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Luis ESTÉVEZ BAULUZ

Trois Essais sur l'accumulation de la richesse à long terme

Directeur de thèse : M. Thomas PIKETTY

Co-directeur de thèse: M. Facundo ALVAREDO

Composition du jury :

<i>Rapporteurs :</i>	Moritz SCHULARICK	Université de Bonn
	Gabriel ZUCMAN	UC Berkeley
<i>Directeur :</i>	Thomas PIKETTY	EHESS - PSE
<i>Examineurs :</i>	Facundo ALVAREDO	EHESS - PSE
	Éric MONNET	Banque de France - PSE
	Leandro PRADOS DE LA ESCOSURA	Université Carlos III de Madrid

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Luis ESTÉVEZ BAULUZ

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Thesis Advisor: M. Thomas PIKETTY

Thesis Co-advisor: M. Facundo ALVAREDO

Jury:

<i>Reviewers:</i>	Moritz SCHULARICK	Bonn University
	Gabriel ZUCMAN	UC Berkeley
<i>Advisor:</i>	Thomas PIKETTY	EHESS - PSE
<i>Examinators:</i>	Facundo ALVAREDO	EHESS - PSE
	Éric MONNET	Banque de France - PSE
	Leandro PRADOS DE LA ESCOSURA	Carlos III University of Madrid

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In memory of José Luis

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Main Introduction

Until recent years, national wealth was displaced from the center of macroeconomic analysis. Instead, the main focus of the profession was on real income growth and its fluctuations. It can be argued that two factors influenced this emphasis: i) The macroeconomics discipline itself developed during the decades following the World War II – years that were characterized by an intense growth in incomes per capita and the decline of the rentier society in Western countries; ii) Some limited evidence suggested the constancy of wealth-income ratios over the path of development ([Kaldor \(1961\)](#)). As a result, not only the economics profession but also national statistical agencies and the international system of national accounts (SNA), did not develop tools to measure countries' wealth in a systematic manner until recently (SNA-93; SNA-2008).

Yet, wealth is gaining an increasing attention from both the academic community and the public opinion. Wild swings in asset prices, the significance of cross border positions and the global increase in inequalities –to name just three recent significant economic trends– point to the importance of studying wealth aggregates. Thus, constructing and strengthening national wealth statistics based on sectoral balance sheets has being the object of an increasing concern from various institutions (([Financial Stability Board and International Monetary Fund, 2009](#), pg. 8)). Moreover, [Piketty and Zucman \(2014a\)](#) work has attracted renewed attention on the importance of understanding the evolution of wealth. Using long-run data for a number of rich countries, they show that the relation between wealth and income is not constant over time. On the contrary, wealth-to-income ratios followed a strong U-shaped evolution over the twentieth century, most prominently in Europe¹. Furthermore, the decomposition of national

1. [Piketty and Zucman \(2014a\)](#)'s work can be viewed as the continuation of a rich literature measuring

wealth into different assets (financial assets, natural resources, physical capital) and owners (private, public, foreigners) reveals a profound transformation of productive systems and of the institutions involved in countries' development.

These results have had a strong impact on how we understand the economic transformation of advanced countries and have incentivized a fast-growing literature on the long-term dynamics of national wealth, essentially along two areas. On the one hand, new research has emerged to analyze the historical evolution of wealth in countries different to those analyzed by [Piketty and Zucman \(2014a\)](#): [Waldenström \(2017\)](#) tracks the evolution of wealth since 1810 in Sweden, [Orthofer \(2015\)](#) analyzes South African wealth since 1975, [Charalampidis \(2016\)](#) the national wealth in Greece, [Piketty, Yang, and Zucman \(2017\)](#) study China's wealth, [Novokmet \(2017\)](#) wealth in the Czeck Lands, [Novokmet, Piketty, and Zucman \(2018\)](#) track the evolution of wealth in Russia, and ? studies national wealth in India. On the other hand, a number of studies focuses on the drivers of the upsurge of wealth-income ratios over the last decades. In particular, a single asset, namely housing, seems responsible for a large part of the recent rise of wealth-income ratios (([Piketty and Zucman, 2014a](#), table II); [Bonnet, Bono, Chapelle, Wasmer, et al. \(2014\)](#); [Rognlie \(2014\)](#)), thus requiring specific attention ([Borri and Reichlin \(2018\)](#); [Grossman and Steger \(2017\)](#); [Knoll, Schularick, and Steger \(2017\)](#)).

This dissertation builds on this literature and presents three empirical investigations to shed light on the previous issues: chapter 1 investigates the long-run evolution of wealth in Spain, chapter 2 connects the upsurge in housing wealth with the transformation of the productive system, and chapter 3 revises and extends the empirical work of [Piketty and Zucman \(2014a\)](#) in light of the most recent accounting standards.

The first chapter is a joint work with Miguel Artola Blanco and Clara Martínez-Toledano, and tracks for the first time the historical evolution of Spanish national wealth since the beginning of the twentieth century. The aim is to analyze and document the long-term

national wealth in the richest European countries and USA during the 18th, 19th and early 20th centuries. Although the central decades were characterized by a lack of these types of studies, there were some notable efforts to asses the evolution of wealth. Among these stands the research pioneered by Raymond W. Goldsmith, who carefully reconstructed the national wealth of the USA ([Goldsmith \(1955\)](#); [Goldsmith, Lipsey, and Mendelson \(1963\)](#)) and also presented estimates for more than twenty countries ([Goldsmith \(1985\)](#)).

dynamics of wealth, with a particular focus on the evolution and determinants of the recent housing boom and bust. We present two long-run series. The first, based on a market value approach, provides the net wealth for the personal and government sector following a census method. We construct a complete and detailed balance sheet including non-financial, financial and offshore assets. The second consists in a book value approach, in which national wealth is derived by calculating the value of domestic produced assets through the perpetual inventory method, non-produced assets through a census-like method, plus the net foreign position. One of the advantages of this last approach is that it allows to decompose housing wealth into buildings and underlying land, which is key to understand the forces driving up the value of dwellings in the last decades. Furthermore, we decompose the accumulation of national wealth into a volume effect (through savings) and a price effect (capital gains/losses), but we go beyond previous studies and differentiate between accumulation in housing and non-housing assets. To our knowledge, this is the first study comparing the evolution of both measures of national wealth for a period covering more than a century.

The key result is that Spain has followed a J-shaped evolution in its national wealth-to-income ratio during the twentieth century that differs from the U-shaped trends observed in other developed countries ([Piketty and Zucman \(2014a\)](#), [Waldenström \(2017\)](#)). Both the market and book value national wealth to income ratios of Spain stood for most of its history in a relatively close range (between 400 and 600%) until the housing boom of the early 2000s led to an unprecedented rise to almost 800% in 2007. In this manner, Spain's national wealth to income ratio was the highest of all countries with available records in the early twenty-first century. What makes Spain different?

First, we document that the shift from high agricultural land value to high urban value, which happened in other advanced countries, was particularly fast in Spain. Agricultural land constituted the most important wealth component in the early twentieth century, and urban land value became so in the early twenty-first century. Second, Spain was heavily dependent on foreign finance since the late nineties. In fact, its net foreign asset deterioration was the largest among developed countries, even surpassing the US levels. Third, we also present

evidence that in Spain, contrary to other rich countries, capital gains based on a sustained increase in the relative price of assets were fundamental for wealth accumulation during the very long term, especially since the 1950s. Our results point to housing as the most important driver, accounting for 83% of total capital gains over the 1950-2010 period. Finally, we explore the role played by immigration in explaining the sharp rise in the value of urban land during the 2000s using our new series of housing wealth decomposed between land and structure. Our results show that immigration explains 46% of the increase in urban land over the period 2001-2012 and approximately one half of capital gains.

The second chapter investigates the upsurge in housing wealth-to-income ratios by focusing on a different channel to those previously investigated by the academic literature: the change in the productive system experienced by rich countries, from manufacturing-oriented economies towards service-intensive ones. I hypothesize that rising housing values are the result of combining two factors. First, structural change may have led to higher regional concentration of economic activity over few places, due to the trend for services to locate together and for manufacturing to disperse ([Desmet and Rossi-Hansberg \(2009\)](#); [Desmet and Rossi-Hansberg \(2014\)](#)). Second, I observe that structural change accelerates when manufacturing-specialized regions are exposed to international competition ([Coricelli and Ravasan \(2017\)](#); [Świącki \(2017\)](#)). With service-cities depending more on location than on traditional capital for their productive activities ([Baldwin \(2017\)](#)), when manufacturing regions decline this may lead to a fast appreciation of house prices in service-successful ones. While these two factors are not necessarily exclusive, both focus on different aspects: the first one on the national concentration of economic activity, the second one on the decline of manufacturing regions and the emergence of service ones (irrespective of how aggregate concentration is). Therefore, I investigate the two separately. By contrast with previous research, I bring in new data, in addition to using theory, to explore the structural change hypothesis.

This second chapter is structured in three parts. In the first part, I investigate the link between the evolution of housing wealth and the concentration of economic activity in seven rich and regionally large economies: France, Italy, Germany, UK, Spain, USA and Japan. I do

this by establishing a new set of stylized facts, which I then connect between them. I start by asking whether the rise of housing wealth is driven by higher urban land values or larger quantity of dwellings. While this is a relevant question to any theory dealing with the rising value of housing, no previous research has shown this decomposition from a cross-country perspective. I find that, indeed, the observed increase in housing wealth since 1970 is largely the result of higher land values. This is consistent with [Knoll, Schularick, and Steger \(2017\)](#), where they focus on house prices (and not on the combination of prices and quantities) and find that the appreciation of these prices over the last decades was largely the result of more expensive urban land.

As a second stylized fact, I compare the regional concentration of economic activity across these seven countries, using definitions of urban areas that are comparable across them. I find that, in most countries, regional concentration of economic activity increased over the last decades, and that this was, to a large extent, because market-oriented services concentrated more, with manufacturing showing the opposite pattern. Yet, this evolution was not homogeneous across countries. In particular, those countries with a more monocentric structure (i.e. France, UK or Spain) saw larger increases in regional concentration than those with a more polycentric one (i.e. Germany or the USA). Interestingly, those countries that concentrated more also increased their housing-income ratios by more. This result is fully consistent with the theoretical argument (higher regional concentration leading to higher demand for housing over few places, hence raising housing values) and is statistically supported by a set of cross-country fixed-effects regressions.

The second part of the project is a theoretical exercise to shed light on the two factors investigated. To do this, I adapt [Moretti \(2011\)](#)'s spatial equilibrium model of the labor and the housing markets to account for two stylized facts: i) The decline of manufacturing regions and the emergence of service ones; ii) The rise of housing prices (or rents) at a faster pace than incomes. Once I adapt Moretti's model to have cities specialized in services and manufacturing, a negative shock to the manufacturing region produces an increase in local housing rents-to-wages (a proxy for housing-income ratios) that is substantially stronger in

my model when compared to a similar shock in the original version of Moretti. I also discuss how to interpret the model to account for the main finding in part I: that those countries that concentrated more also increased their house-income ratios by more.

The third part of the project explores, empirically, the second factor: the decline of manufacturing regions and its impact on local house-income ratios (both in manufacturing and service cities). To do this I use a panel of 62 urban areas in England and Wales with annual data between 1995 and 2015. To the best of my knowledge, this is the first study exploring how macro trends in house-to-income ratios emerge from the local level. I find that the national increase in the house-to-income ratio over this period was characterized by an important upswing in the dispersion of house prices across cities (with the variation of incomes per capita rising much more moderately). Using a descriptive approach, I find that the best predictor of how house prices grew across cities is the local specialization of urban areas, with manufacturing cities showing lower increases in house prices. I then test the prediction of the model and analyze how the aggregate decline in manufacturing value added had a differential impact on local house prices, comparing manufacturing regions with service ones. I estimate that around one quarter of the dispersion in house price growth between these regions is explained by structural change.

The third chapter has a methodological focus. In light of the latest accounting standards, I update the wealth and income macro series used in [Piketty and Zucman \(2014a\)](#), which correspond with eight countries: Australia, Canada, France, Germany, Italy, Japan, UK and USA. All series in [Piketty and Zucman \(2014\)](#) ended in 2010 and followed the 1993 international accounting guidelines². However, since the publication of their paper most countries have adapted the latest system of national accounts (SNA-2008), which incorporates conceptual corrections to the treatment of some assets. Notably, Research and Development –an important component in today’s knowledge economies– was not previously considered as an asset but this has changed in the latest accounts. Furthermore, since the writing of [Piketty and Zucman \(2014a\)](#)’s paper, the World Inequality Database (WID.world) has evolved in

2. The only exception is Australia, which has already adapted to the latest SNA-2008 standards by the time in which [Piketty and Zucman \(2014a\)](#) wrote their paper.

a unified framework to compute macro wealth accounts across countries. Besides adopting the latest SNA guidelines, WID.world presents two main novelties: the inclusion of natural capital (i.e. forestry land, mineral and energy resources) within the concept of national wealth and the differentiation of housing owned by other sectors than households, in an attempt to measure national housing wealth in addition to privately-owned one.

I show that adopting the new SNA does not change in a significant way previous estimates of national wealth. However, when looking at incomes, I find suggestive evidence pointing to an increase in gross capital income due to R&D being recognised as capital investment. Yet, given the high rates of depreciation of R&D assets, net capital investment and net capital incomes do not seem affected by this change in a significant manner. Natural resources, however, do affect significantly the values of national wealth given the large volume of these assets in certain countries (i.e. Australia or Canada). I highlight the uneven progress made by official statistics to estimate in a consistent manner the value of natural capital, with this being an area that requires further attention, both from academics and official statisticians. As for national housing wealth, series show the limited importance of other sectors than the private, but this weight varies across countries and over time. In particular, up to 20% of national housing is not privately-owned in countries like France or Germany, with the non-private involvement in housing markets declining in recent decades. This evolution is in line with some common policies followed by public sectors of advanced economies since the eighties (i.e. the trend for privatizing publicly-fostered dwellings).

All in all, this thesis highlights the fundamental role of wealth to understand the long-term transformation of countries. It underlines the complex nature of the wealth accumulation process, characterized by various forces (different types of investment, swings in asset prices, policies shaping asset markets, etc.), and the need for a better measurement of national wealth aggregates, still an area where national accounts can make important progress.

Chapter 1

Wealth in Spain, 1900-2017: A

Country of Two Lands¹

1. This chapter is based on a joint work with Miguel Artola Blanco and Clara Martínez-Toledano. We thank Facundo Alvaredo, Carlos Barciela, Eva Benages, Thomas Blanchet, Olympia Bover, Juan Carmona, Francisco Comín, Vicent Cucarella, Stefan Houpt, Elena Martínez, Jorge Martínez, Enrique Martínez-García, Pedro Pablo Ortúñez, Leandro Prados de la Escosura, Thomas Piketty, Daniel Waldenström, and Gabriel Zucman for their helpful comments, as well as participants at the 7th meeting of the Spanish Economic History Association and seminars at Paris School of Economics, London School of Economics, European University Institute, 16th Trento Summer School, University of Zaragoza, Macrohistory Lab Bonn and IVIE. We acknowledge financial support from INET, ESRC-DFID (grant ES/I033114/1), and the European Research Council (grant 340831). Luis Estévez Bauluz acknowledges financial support from Fundación Ramón Areces and Clara Martínez-Toledano acknowledges financial support from Fundación Ramón Areces and Bank of Spain at different stages of the project.

Abstract

This study reconstructs Spain's national wealth from 1900 to 2017. Combining new sources with existing accounts, we estimate the wealth of both private and government sectors and use a new asset-specific decomposition of the long-run accumulation of wealth. We find that the national wealth to income ratio stood during the 20th century in a relatively close range -between 400 and 600%- until the housing boom of the early 2000s led to an unprecedented rise to 800% in 2007. Our results highlight the importance of land, housing capital gains and international capital flows as key elements in the accumulation of wealth.

JEL codes: D3, E2, F3

Keywords: Wealth-income ratios; Historical balance sheets; Housing; Net foreign assets; Economic development.

Introduction

Wealth is gaining increasing attention from both the academic community and public opinion. Wild swings in asset prices, the significance of cross-border positions within the Euro area and the global increase in inequalities—to name just three recent significant economic trends—point to the importance of studying wealth aggregates. Thus, constructing and strengthening national wealth statistics based on sectoral balance sheets has been the object of increasing attention from various institutions ([Financial Stability Board and International Monetary Fund \(2009\)](#), p8). In this sense, Spain is a country that clearly deserves internationally scholarly attention. Since entering the Eurozone in the late 1990s, the Spanish economy underwent a large housing bubble followed by an equally huge bust. The country also experienced a sharp deterioration in its net foreign asset position and a more recent rise in public indebtedness. Although academics and the media have been quick to analyze this process, the truth is that many studies are limited by the lack of a complete set of national balance sheets. Additionally, the absence of long-run series makes it more difficult to determine the historical significance of recent developments.

This study tracks for the first time the historical evolution of Spanish national wealth since the beginning of the twentieth century. The aim is to analyse and document the long-term dynamics of wealth, with a particular focus on the evolution and determinants of the recent housing boom and bust. We present two long-run series. The first, based on a market value approach, provides the net wealth for the personal and government sector following a census method. Following this approach, we construct a complete and detailed balance sheet including non-financial, financial and offshore assets. The second consists in a book value approach, in which national wealth is derived by calculating the value of domestic produced assets through the perpetual inventory method, non-produced assets through a census-like method, plus the net foreign position. One of the advantages of this last approach is that it allows to decompose housing wealth into buildings and underlying land, which is key to understand the forces driving up the value of dwellings in the last decades. To our knowledge, this is the first study

comparing the evolution of both measures of national wealth for a period covering more than a century. Furthermore, we decompose the accumulation of national wealth into a volume effect (through savings) and a price effect (capital gains/losses), but we go beyond previous studies and differentiate between accumulation in housing and non-housing assets.

Our main finding is that Spain has followed a J-shaped evolution in its national wealth-to-income ratio during the twentieth century that differs from the U-shaped trends observed in other developed countries (Piketty and Zucman (2014a), Waldenström (2017)). Both the market and book value national wealth to income ratios of Spain stood for most of its history in a relatively close range -between 400 and 600%- until the housing boom of the early 2000s led to an unprecedented rise to almost 800% in 2007. In this manner, Spain's national wealth to income ratio was the highest of all countries with available records in the early twenty-first century. The singular evolution of wealth in Spain is explained by different peculiarities.

First, we document that the shift from high agricultural land value to high urban value, which happened in other advanced countries, was particularly fast in Spain. Agricultural land constituted the most important wealth component in the early twentieth century, and urban land value became so in the early twenty-first century. Second, we also present evidence that in Spain, contrary to other rich countries, capital gains based on a sustained increase in the relative price of assets were fundamental for wealth accumulation during the very long term, especially since the 1950s. Our results point to housing as the most important driver, accounting for 83% and 86% of total capital gains over the 1950-2017 and 1980-2017 period, respectively. Third, Spain was heavily dependent on foreign finance since the late nineties, namely, its increase in net foreign liabilities was the largest among developed countries. We present new empirical evidence that illustrates how the private sector contributed to the large fall in net foreign assets, most importantly through the issuance of debt securities by Spanish monetary institutions. This process in turn fostered an increase in household indebtedness and an unprecedented housing boom. We carry an empirical analysis that supports the hypothesis that international capital flows were significantly related to house prices in Spain during the 2000s even when controlling for financial conditions, most importantly falling interest

rates and a relaxation of credit standards. Hence, together with changing demographics and monetary policy, access to international credit by Spanish credit institutions seems to have played a significant role on the evolution of the real estate market in Spain.

The rest of the paper proceeds as follows. Section II discusses previous research on other countries and Spain. In Section III, we briefly introduce the key concepts, methods, and sources employed. Section IV presents the most important long-term trends in the evolution of wealth aggregates and puts the Spanish case in an international perspective. In Section V we carry a quantitative analysis that relates foreign capital flows with the growth in household credit and the evolution of the real estate market. Finally, Section VII concludes. Appendix A and B provide all figures and tables, respectively. The paper has a companion methodological appendix ("Spain Wealth Appendix") and the complete set of results is provided in an Excel file ("Spain Wealth Database").

1.1 Literature Review

1.1.1 Long-run evolution of national wealth

The study of wealth based on the national accounts framework is a relatively new phenomenon. The 1993 U.N. System of National Accounts (SNA) first introduced an international set of guidelines to compute national wealth through an estimation of sectoral balance sheets, which include all assets and liabilities². Since then, statistical offices in most advanced economies and a few developing countries have produced comprehensive wealth estimates. Progress is still uneven, with some countries providing a very complete and long set of national balance sheets, while others offering only partial results.

This slow development occurred despite research on wealth gaining an increasing interest among scholars and the public. One major stimulus has come through the study of the

2. The SNA-1993 ([Commission of the European Communities and Inter-Secretariat Working Group on National Accounts \(1993\)](#)), was subsequently revised in the SNA-2008 (United Nations et al. 2009). The European Union adapted these accounting standards by creating ESA-1995 ([European Union \(1996\)](#)) and ESA-2010 ([European Union \(2013\)](#)).

evolution, composition, and distributional patterns of household wealth. [Davies, Sandström, Shorrocks, and Wolff \(2011\)](#) estimated household wealth for 39 economies for 2000, using sectoral balance sheets and survey data, which was extended to 2000-2016 using the Global Wealth Report series edited by [Shorrocks, Davies, and Lluberas \(2015\)](#). The other major impetus in wealth research has come through the work [Piketty \(2014\)](#) and [Piketty and Zucman \(2014a\)](#). [Piketty and Zucman \(2014a\)](#) presented a new study on the long-term dynamics of the wealth-to-income ratios for a set of advanced countries adopting the modern SNA guidelines with previous contemporary estimates. Their key finding is that the relationship between wealth and income has not been stable over time. On the contrary, wealth-to-income ratios followed a strong U-shaped evolution over the twentieth century, most prominently in Europe.

Together, these results have had a strong impact on how we understand the economic transformation of advanced countries, and incentivized researchers to reconstruct the dynamics of national wealth in other countries taking a long-term perspective. We are aware of the reconstruction of the Swedish national wealth since 1810 ([Waldenström \(2017\)](#)), an analysis of South Africa since 1975 ([Orthofer \(2015\)](#)), a study on the national wealth of Greece ([Charalampidis \(2016\)](#)), a study of China's wealth ([Piketty, Yang, and Zucman \(2017\)](#)) and another study on the national wealth in India ([Kumar \(2018\)](#)).

International scholars analyzing wealth normally point to Spain as a missing case ([Goldsmith \(1985\)](#), [Piketty and Zucman \(2014a\)](#)), although in truth, there are some existing relevant studies. First, some tentative estimates were made at the beginning of the twentieth century (for example, [Barthe \(1917\)](#), [Banco Urquijo \(1924\)](#), [Vandellós \(1925\)](#)), although as [Velarde Fuertes \(1968\)](#) already pointed out, these results are plagued by important inaccuracies and generally lacked methodological rigor. Second, when Spain started to develop its national accounts, a group of researchers at the [Universidad de Deusto \(1968\)](#) conducted an impressive wealth census for 1965 that covered all non-financial assets (agricultural land, livestock, housing, business assets, consumer durables, etc.) in great depth. Each asset class was studied by a group of scholars, who used various calculation procedures, such as the perpetual inventory method, multiplying wealth quantities by market prices or updating

production costs by considering capital depreciation and changes in asset prices. [Goldsmith \(1970\)](#) argued that it would have been preferable to use a more precise and uniform method, although all researchers have since agreed that the University of Deusto's estimates are broadly reliable ([Carreras, Prados de la Escosura, and Rosés, 2005](#), p1317)).

Since the 1980s, the literature on Spain has grown impressively. On the one hand, a set of academics have developed new series for the capital stock based on the modern procedures of the perpetual inventory method. The first studies following a long-term approach were conducted by [Myró \(1983\)](#) and [Cubel Montesinos and Palafox \(1997\)](#), which have been recently complemented by a more precise analysis by [Prados de la Escosura and Rosés \(2010\)](#). Similarly, researchers of the Ministry of Finance and the IVIE made a very detailed estimation of the capital stock since 1964 ([Dabán Sánchez, Escribá Pérez, Murgui García, and Díaz \(2002\)](#), [Mas Ivars, Perez García, and Uriel Jiménez \(2015\)](#)), while [Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo \(2015\)](#)'s study of public capital starts in 1900. Although these works provide an invaluable point of reference, none actually refers to the wealth of the country, as non-produced assets (i.e., land and subsoil assets) are excluded by definition. Additionally, these studies do not consider foreign wealth.

The other major development occurred in the mid-1980s after the Bank of Spain started to develop a modern system of financial accounts that records all financial assets and liabilities. This set of results later incentivized the development of some complementary sources on wealth aggregates, such as various estimates of the value of residential buildings and the creation of the Survey of Household Finances in 2002. Using these records, [Naredo, Carpintero, and Marcos \(2008\)](#) built the first comprehensive balance sheet for the different institutional sectors in Spain from 1995 to 2007. However, as we detail in the following section, some assets—most importantly, dwellings—are substantially overvalued. Our study aims to provide more precise estimates and to extend the series to the beginning of the twentieth century.

1.1.2 Determinants of the increase in housing prices since the late nineties

The recent rise in wealth-income ratios has been mostly related to the increase in housing assets ((Piketty and Zucman, 2014a, Table II)), thereby deserving specific attention (Rognlie (2014), Bonnet, Bono, Chapelle, Wasmer, et al. (2014), Grossman and Steger (2017)). This literature connects with the scholars' increasing interest on rising house prices (Mankiw and Weil (1989), Favara and Imbs (2015), Saiz (2010), Glaeser, Gyourko, and Saks (2005), Gyourko, Mayer, and Sinai (2013)). Academics have also started to analyse the long-term evolution of housing markets, an area which had been neglected for long. Davis and Heathcote (2007) carried a pioneering study that tracked the long-run value of dwellings in the US by decomposing it into land and structure. More recently, Knoll, Schularick, and Steger (2017) have documented the long-term evolution of house prices in 14 countries, showing that land prices are the key factor to understand these dynamics.

Still, the main debate concerns explaining the most recent rise in housing prices. Scholars have pointed to different mechanism, and many seem to apply to the Spanish housing bubble of the 1999-2007 years. A first strand of the literature has focused on the positive impact of population increases on housing prices (Mankiw and Weil (1989), Combes, Duranton, and Gobillon (2018)). In Spain, the increase of the foreign-born population (from 2% of the working-age population in 2000 to 14% in 2008) seems as one of the principal causes behind the increase in housing prices. Gonzalez and Ortega (2013) and Sanchis-Guarner (2017) quantify this effect and find that between one third and one half of the increase in house prices during the 2000s is explained by foreigners arriving to Spain.

A second set of scholars have related changes in the credit market -through loose monetary conditions and soft lending standards- with the housing bubble. For example, Jordà, Schularick, and Taylor (2015) show the causal relationship between loose monetary conditions and the rise in housing prices through the expansion in mortgage credit. The authors argue that Spain during the 2000s is a good case study to analyse, given the significant difference between the

Taylor rule policy rate and the actual interest rate set by the ECB. [Jiménez, Ongena, Peydró, and Saurina \(2012\)](#) and [Akin, Montalvo, Villar, Peydró, and Raya \(2014\)](#) also present evidence of too soft lending standards and excessive risk-taking by financial institutions during the Spanish housing bubble.

Following a different perspective, other scholars have emphasized the importance of foreign capital flows and housing booms ([Sá, Towbin, and Wieladek \(2014\)](#)). Research has been especially prominent in the USA ([Bernanke \(2005\)](#), [Himmelberg, Mayer, and Sinai \(2005\)](#), [Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh \(2012\)](#), [Ferrero \(2015\)](#)), but more limited in European countries. Most analysis for the eurozone point to current account imbalances ([Belke and Dreger \(2011\)](#)), and the relationship between debt inflows and domestic credit growth ([Hale and Obstfeld \(2016\)](#), [Lane and McQuade \(2014\)](#)). However, the literature for Europe fails to analyze the impact on housing prices. In Spain, [Fernández-Villaverde, Garicano, and Santos \(2013\)](#) point that, as the country adopted the euro, it received large flows of capital that prompted a credit bubble and delayed the implementation of necessary economic reforms. In a similar manner, [Jimeno and Santos \(2014\)](#) argue that inflows of foreign capital made the Spanish economy more dependent upon non-tradable activities (construction, low-skill services, etc.), small-firms with low productivity potential, and a banking system that, due to its relative large size, was increasing the speculative cycle in real estate. Nonetheless, these studies only briefly document the importance of capital flows without carrying a detailed analysis of the channel nor quantifying its importance. In section V we build upon the work carried by this last group of scholars and carry a descriptive and quantitative analysis that relates foreign capital flows with the growth in household credit and the evolution of the real estate market.

1.2 Concepts, methodology, and empirical estimate

In this study, we use the concepts of national income and wealth from the international system accounts (SNA 2008, ESA 2010). Wealth is calculated by providing, for a particular

point in time, a balance sheet that records the value of assets economically owned and liabilities owed by an institutional unit or group of units at prevailing market prices. At the country level, national wealth can be defined by two related but different measures. The first follows what [Piketty and Zucman \(2014a\)](#) call the "market value of wealth", which sums personal and government net wealth. In this definition, corporate capital is mostly captured by the market value of equity holdings owned by households and the government. This approach differs from SNA standards, referred to by Piketty and Zucman as the "book value of wealth", which is the sum of the non-financial assets of all domestic sectors and all resident sectors plus net foreign wealth. Given that net foreign wealth is the sum of financial assets net of the liabilities of the three resident sectors, then the difference between both definitions can be traced to the corporate sector. The distinction between the two definitions is corporate wealth (or residual corporate wealth), which is the difference between corporations' book value of equity and its market value.. Hence, both definitions converge when corporate wealth is zero, or, similarly, when Tobin's Q equals one.

Wealth stocks and its subcomponents can be measured using different approaches. Generally, SNA advises computing wealth based on observed quantities and market prices (a census-like method), and to use alternative approaches when this method is not viable. In this study, we stick to this guideline and compute most wealth aggregates on this basis. All our estimates for financial assets and liabilities, as well as for agricultural land and housing wealth, follow the census approach. Alternatively, we apply the perpetual inventory method and the capitalization technique to measure the remaining wealth aggregates.

This study reconstructs national wealth in the most complete and comprehensive manner by using three different perspectives. First, we compute national wealth at market value for 1900-2017 by calculating household and government net worth position. For both sectors, we estimate financial wealth—financial claims net of liabilities—to which we add non-financial assets. Households' non-financial assets are decomposed into three categories: housing (which includes the value of both the structure and the underlying land), agricultural land, and unincorporated business assets different from agricultural land. Similarly, for the government

sector, we decompose non-financial assets into produced assets (buildings, buildings and constructions, machinery and equipment), land underlying public buildings, and forestland owned by local authorities.

Secondly, we compute the book value of national wealth for 1900-2017 by aggregating all types of non-financial assets in the Spanish economy, to which we add the net foreign wealth. The estimate is done regardless of the sector owning them, and we decompose these assets into the following groups: Housing, non-residential buildings, buildings and constructions, machinery and equipment, transport equipment, inventories, and natural resources (agricultural land and sub-soil assets). For both residential and non-residential buildings, we differentiate between the value of the building and the underlying land. Finally, from 1995 onwards, we also calculate the book value of national wealth using a second definition that computes the balance sheet of corporations, both financial and non-financial entities, and adding their net wealth to the market value definition of national wealth.

As a general rule, our estimation procedure starts by accounting for the total value of a given asset in Spain (i.e., equity), which we then distribute into the different sectors owning it. For the most recent period of 1970 onwards, this approach is simple because most of the information employed already follows this decomposition. For the historical period, however, we need to determine the sector owning a particular asset, something that would be easier for those assets predominantly owned by a single sector (i.e., household-owned dwellings).

Finally, in addition to building sectoral balance sheets and different measures of national wealth, we also present a decomposition of the accumulation of national wealth into a volume effect (through saving) and a relative price effect (through capital gains or losses) in both multiplicative and additive forms. We do this by following the methodology proposed by [Piketty and Zucman \(2014a\)](#) in the appendix of their paper, which relates the accumulation of national saving to the evolution of national wealth and finds the capital gains component as a residual.

On the one hand, the multiplicative decomposition between two given years (t and $t + 1$)

can be specified as follows:

$$W_{t+1} = (W_t + S_t)(1 + q_t), \quad (1.1)$$

where W_t and W_{t+1} are national wealth at times t and $t + 1$, respectively; S_t is the net-of-depreciation national saving over year t ; and $(1 + q_t)$ is the residual component that captures increases in the relative price of wealth with respect to consumption goods. To track the evolution of the wealth-to-income ratio (β), we then divide the previous equation by Y_{t+1} and obtain:

$$\beta_{t+1} = \beta_t \frac{(1 + q_t)(1 + g_{wt})}{1 + g_t}, \quad (1.2)$$

where $1 + g_t = \frac{Y_{t+1}}{Y_t}$, $1 + g_{wt} = 1 + \frac{s_t}{\beta_t}$ and s_t stands for the net-of-depreciation saving rate of Y_t in year t .

In addition, we go one step beyond, and conduct this decomposition for housing and non-housing wealth. To do this, we start from the definition of national wealth as the sum of domestic non-financial assets plus net foreign wealth: $W_N = A^{NF} + NFW$, which we further decompose into housing and non-housing wealth: $W_N = W^H + W^{NH}$. In this expression, housing wealth is the market value of dwellings, while non-housing wealth is the sum of other types of capital and net foreign wealth. Similarly, we decompose national savings into domestic investment (net of depreciation) and foreign savings: $S_N = I + S_F$, which then we decompose into housing investment and non-housing national savings: $S_N = I^H + S^{NH}$. Consequently, each component of national savings is mapped to its corresponding component in national wealth. We run equation (1.3) separately for each of these two components of national wealth:

$$\beta_{i,t+1} = \beta_{i,t} \frac{(1 + q_{i,t})(1 + g_{wi,t})}{1 + g_{i,t}}, \quad (1.3)$$

where i stands for housing or non-housing national wealth.³

3. Ideally, we would have liked to further decompose non-housing wealth into other types of capital and net foreign wealth. However, the multiplicative decomposition of wealth accumulation is based on the geometric averages of growth rates, which are only meaningful when wealth stocks take positive values. This is not the

On the other hand, the additive decomposition between two given years (t and $t + 1$), can be specified as follows:

$$W_{t+1} = W_t + S_{t,t+1} + KG_{t,t+1}, \quad (1.4)$$

where W_t and W_{t+1} are national wealth at times t and $t + 1$, respectively; $S_{t,t+1}$ is the total savings flow between years t and $t + 1$; and $KG_{t,t+1}$ is the total capital gains or losses between years t and $t + 1$. To track the evolution of the wealth-to-income ratio (β), we then divide the previous equation by Y_{t+1} and obtain:

$$\beta_{t+1} = \beta_{ini} + \beta_{sav} + \beta_{kg} \quad (1.5)$$

where $\beta_{ini} = \frac{W_t}{Y_{t+1}}$ is the component coming from initial wealth, and $\beta_{sav} = \frac{S_{t,t+1}}{Y_{t+1}}$ and $\beta_{kg} = \frac{KG_{t,t+1}}{Y_{t+1}}$ are the components coming from savings flows and capital gains or losses, respectively.

Furthermore, in line with the multiplicative form, we go one step beyond and carry this decomposition for housing, other types of capital, and foreign wealth.⁴ The additive decomposition has the advantage of allowing us to disentangle the fraction of savings and capital gains that each component represents in the total, which is very relevant in explaining the accumulation of national wealth in Spain over time. Thus, we run equation (1.6) separately for each of these three components of national wealth:

$$\beta_{i,t+1} = \beta_{i,ini} + \beta_{i,sav} + \beta_{i,kg} \quad (1.6)$$

where i stands for housing, other types of capital, or foreign wealth.

While the results from this study use the market value definition of national wealth, in the methodological appendix (Tables 1-4), we present the same analysis under the book value definition and the results are quite similar.

case for net foreign wealth in Spain.

4. Note that in this case, we do not have the limitations mentioned for the multiplicative decomposition and can split non-housing wealth between other types of capital and foreign wealth.

1.2.1 Non-financial assets

When computing non-financial assets, we follow a different approach for produced assets (buildings, machinery, and equipment) from that for non-produced assets (land and other natural resources). Agricultural land and housing, which clearly constitute the two most important asset components in the long run, are estimated through the census method, which multiplies the observed quantities (land areas or housing stock) by representative unit prices. For each period, we gathered the most refined data on prices to consider variations due to regional differences and diversity of uses (for example, differentiating by crop types in agriculture, or between price-regulated houses versus non-regulated ones). In this basic procedure, both wealth aggregates include the value of the underlying land and produced assets (cultivated crops and dwellings, respectively). Instead of using the housing wealth series from the Bank of Spain, we combine and adjust the different available sources on housing prices (Bank of Spain, IVIE, and the Ministry of Public Works) to produce a more precise estimate. Our housing wealth series is somewhat lower than that obtained by the Bank of Spain (Indicadores del Mercado de la Vivienda), [Pérez and Uriel Jiménez \(2012\)](#) and [Naredo, Carpintero, and Marcos \(2008\)](#), but the trend is the same.

In a second step, and following ESA standards ([European Union \(2013\)](#), p76), we estimate the stock of all produced assets in Spain based on the perpetual inventory method. This method requires an initial value for the stock of an asset, the service life of this asset type, together with investment flows and investment prices. In practice, we implement the perpetual inventory method for 1850-2017 using data on investment flows and investment prices for five groups of assets: dwellings, other constructions, machinery and equipment, transport equipment, and inventories. However, we only provide results from 1901 onwards, the period for which we can also estimate non-produced assets.

We are not the first to use this type of approach to reconstruct produced assets in Spain, and we benefited greatly from previous analyses. Most notably, [Prados de la Escosura and Rosés \(2010\)](#) estimate the stock of produced assets for four fixed-assets for 1850-2000, while [Mas Ivars, Perez García, and Uriel Jiménez \(2000\)](#) and the group of researchers at the IVIE

institute (Mas, Pérez García, and Uriel (2005), Cucarella and Mas Ivars (2009), Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo (2015)) decompose this stock into 17 categories from 1964 onwards. However, we compute our own estimate for two reasons: first, to incorporate the latest recommendations from the OECD (2009) on the use of geometric patterns of depreciation (which differ from Roses and Prados de la Escosura's approach), and second, to include the most recent data on Spain's historical national accounts from Prados de la Escosura (2017), which revised its previous series (Prados de la Escosura (2003)) with a new interpolation method. As a robustness check, we present the series of produced assets using the same depreciation pattern as Prados de la Escosura and Rosés (2010) in the methodological appendix. Overall, both approaches follow a similar trend, but the levels are about 25% lower in our benchmark series. Nonetheless, when computing the total book value of national wealth, both approaches show very close levels⁵.

The only assets that cannot be calculated by either the census-like estimate or the perpetual inventory method are mineral reserves. Historically, their importance for the Spanish case has been very limited compared to other countries, as the value-added from extractive industries has always been below 2% of GDP. Unfortunately, no data exists on the volume of subsoil assets for the present or the past, and so we calculate their value through a net price method, as proposed by Statistics Canada (2006). In this approach, the annual resource rent of extractive industries is capitalized by the depletion ratio. The resource rent has been obtained by deducting from gross value added the value of labour inputs, depreciation of produced assets and the imputed return on the capital stock. This procedure is a second-best estimate, although given the low levels of natural resources in Spain any inaccuracy should have a negligible effect on the top-line estimates on national wealth.

The third step is to estimate (or disentangle) the value of the land underlying buildings. Following OECD and Eurostat (2015) recommendations, we start by decomposing our census-

5. In the methodological appendix we present a set of robustness checks comparing our depreciation pattern with the alternative pattern used in Prados de la Escosura and Rosés (2010). We also compare our series of depreciation with those of the official national accounts. Overall, our series are very close to the official national accounts, with those using the alternative pattern showing lower levels. This reassures us on the convenience of using our depreciation pattern in the book-value national wealth series of the paper.

like estimate of housing using the residual approach. This is the same procedure followed by [Davis and Heathcote \(2007\)](#) to decompose the value of housing in the US for 1930-2000. Through this method, we calculate the value of land by deducting dwellings from the total value of the housing stock. Next, we compute the value of land underlying non-residential buildings, for which we count using an estimate of its structure obtained from the perpetual inventory method. We do this based on recent cadastral records of the total value of residential and non-residential buildings, which allows us to impute the relative weight of land in non-residential buildings with respect to residential ones.

In a fourth step, we determine the ownership by different institutional sectors on the stock of non-financial assets. We start by imputing households' share over the two most important assets of agricultural land and housing directly based on administrative records. We then calculate the unincorporated business assets owned by the household sector, taking as a starting point the results of the Survey of Household Finances (Bank of Spain 2002-2014), and then upgrading the declared values to account for undervaluation and top-coding. We extend the results until the early 1980s by assuming a similar evolution as the assets of non-financial corporations (Bank of Spain 1982-2014). For the public sector, we use [Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo \(2015\)](#)'s series on government produced assets, and add the value of the underlying land and forests. In principle, all other non-financial assets are attributed to the corporate sector as a residual. Nonetheless, as noted previously, after 1995, we can also reconstruct the market value of non-financial assets owned by Spanish corporations using data from the Central Balance Sheet Data Office of the Bank of Spain.

1.2.2 Financial assets

Providing consistent series on the net financial wealth for the public, personal, and foreign sectors since the early twentieth century was done using different sources. For all three sectors, reconstructing financial assets and liabilities from 1970 to the present is mostly a straightforward exercise based on the reported figures in the Financial Accounts of the Bank of Spain. Our main adjustment, as we detail below, is by providing the first complete estimate

of offshore wealth.

Reconstructing the financial position for the rest of the twentieth century is a far more complex process given the lack of consistent estimates. Our calculations for the personal sector are based on a two-fold operation. First, we calculate the aggregate market value of each asset type, something that is simpler for claims (currency, deposits, loans, etc.) assessed at their nominal value than for other assets (bonds and shares) that are valued at the prevailing market prices. The second step involves computing households' share by deducting the holdings of other institutional sectors (mostly corporations or the public sector) using a wide variety of auxiliary accounts (financial yearbooks, balance sheets of banking and insurance companies, government accounts, etc.).

To derive offshore wealth, we mainly use data from [Zucman \(2013, 2014\)](#) for 1999-2014 and the unique information recorded since 2012 by tax authorities on the assets held abroad by Spanish residents, classified by asset type (real estate, stocks, investment funds, deposits, etc.) and country of location. We then extrapolate the series backwards in time using the total value of offshore wealth, which flourished during the 1991 tax amnesty, and also by including the estimates on financial assets held in offshore havens provided by [Zucman \(2015\)](#). Nonetheless, due to the uncertainties related to these calculations, we do not include offshore assets in our benchmark series and only present them when decomposing total financial assets and the net foreign asset position.

Overall, our results on households' financial position benefited greatly from the immense research by previous scholars and to the relative high quality of some Spanish historical sources. For example, two outstanding examples of very detailed sources that are normally unavailable in other countries are the statistics on corporate capital and the aggregate balance sheet of the banking sector published since the early 1920s. Additionally, Spain's relative underdevelopment, and the fact that the country became increasingly detached from the world economy since the First World War made our calculations simpler. In many ways, it is easier to estimate household financial wealth in the past than in the present since the ownership structure is simpler, with less financial intermediation and cross-border positions.

Nonetheless, some problems remain in place. While the volume levels for each financial asset are generally well-covered, the depth and representativeness of market prices are below the desired level in some cases. One of the clearest cases occurs with equity holdings, which include shares traded through stock markets and those that are not. Quoted shares can be valued at their prevailing market prices in the Madrid Stock Exchange, but for non-listed firms, the standard procedure is to apply a valuation ratio observed in the stock market (for example, the dividend yield) to non-listed companies, and then apply a discount factor to consider illiquidity and risk premia. Due to the absence of observations on this last component, we have applied a standard 20% discount as an upper side estimate based on recent comparative studies ([Amihud and Mendelson \(1986\)](#); [Amihud, Hameed, Kang, and Zhang \(2015\)](#)). In the future, more research could be done in this area.

Estimates for the government sector before 1970 are much easier to produce. We proxy public net financial wealth by computing in the asset side of all state-owned equity holdings (e.g., the public railway company RENFE) and deducting as liabilities the market value of public debt. Computing Spain's net foreign wealth prior to 1970 cannot be done through the census-like method given the scarcity of sources, and so we accumulate the current account balance and add the variation in foreign exchange reserves. This is a relatively widespread procedure since a surplus in the current account makes a country a net creditor to the rest of the world (and vice versa). The main drawback of this method is that it does not capture the relative change in assets prices owned by both residents and non-residents. Besides, it is always challenging to establish a starting point for the net foreign asset position. In this paper, we have computed directly the net foreign asset position in 1900, and used the census-like estimate provided by the Bank of Spain on the net foreign assets for 1932 to 1934. For the years in between, we use the data on the current account provided by [Prados de la Escosura \(2010\)](#) and make a final adjustment to match the results with the net foreign asset position reported for 1970.

1.3 Results

This section starts documenting the most important long-term trends in the evolution of personal (Section 1.3.1) and public wealth (Section 1.3.2) and continues presenting the key findings on the evolution of national wealth taking an international perspective (Section 1.3.3). In line with previous literature, we report most results as a share of national income. In this way, stocks are more easily interpretable in real terms and relative to the total income of Spanish residents.

1.3.1 Personal wealth

Figure 1.1 presents the ratio between personal wealth to national income since 1900. The results indicate that, for most of the sample period, the wealth of Spanish households usually stood between four and five times national income, although the recent economic boom led this ratio to record levels of nearly 700%. The main turning points of this uneven process of wealth growth and decline are easy to spot. The personal wealth-to-income ratio stood at a relatively high level (around 6 times the national income) in the period before 1914, but economic growth fuelled by Spanish neutrality during the First World War, combined with a short period of high inflation, led to a significant decline in the relative importance of wealth. From 1920 to 1935, the oscillations in net worth largely reflected the general evolution of the economy and the performance of asset prices. Wealth grew significantly during the twenties, but households suffered a significant shock in their balance sheets during the tumultuous 1930s. Then, the ratio between personal wealth to national income increased sharply after the Civil War. This paradox occurs because from 1935 to 1940, Spanish real national income fell precipitously (c. 16%), but wealth remained almost constant, as destruction was compensated for by the rise in land prices.

However, in a short time, the personal wealth to income ratio declined steadily and remained at their lowest levels in the late 1950s and 1960s. Thus, in a period of rapid industrialization, income and wealth grew mostly at the same pace, and it was only in the late

1960s and early 1970s, when there was a short upswing in asset prices, that rapidly reverted with the economic crisis of the late 1970s. Finally, from the mid-1980s, and especially during the housing boom after the turn of the century, personal wealth started to grow dramatically until it reached an unprecedented level (740%) in 2007. In 2017, the most recent year with available data, the personal wealth to national income ratio stood at 619%, a level similar to that in 2004 (635%). After suffering the most severe economic crisis in more than seventy years, the wealth of Spanish households remains at relative high levels.

The analysis of the personal wealth composition provides several key factors to explain this evolution (Figure 1.2). Overall, one of the most surprising facts is that non-financial assets, in particular, agricultural and housing land, have always represented the bulk of households' assets. In aggregate, real assets constituted 76% of gross assets in 1900 and 69% in 2017. Behind this seeming continuity there is a profound transformation. In the first decades of the century, the composition of Spanish personal wealth followed the conditions of an underdeveloped economy, as agricultural land and farm capital (livestock and machinery) were the main assets that individuals owned. Until the 1950s, the most important changes in the ratio of wealth to national income occurred as a by-product of the change in the relative share of agriculture in the economy and due to the evolution of land prices. However, the irreversible decline of agriculture that finally occurred in Spain from the mid-1950s onwards was matched, in a very short time, by successive real estate boom cycles that made housing the main component of private wealth. As Figure 1.2 shows, it is not the replacement cost of dwellings but the land underlying them that mostly determined the evolution of housing in the post-war decades. From this perspective, the evolution of Spanish household wealth over the twentieth century can be described as the transition from agricultural to residential land.

The significant weight of real assets should not conceal the equally remarkable transformation in the composition of households' financial assets (Figure 1.3). Until the Civil War, debt securities were the most important claim, with a share that fluctuated around 40 to 60% of gross financial assets. This fact attests not only to the prominence of public debt and railway debentures in relation to equity shares in capital markets ([Hoyo Aparicio](#)

(2007)), but also implicitly to the investment preferences of wealthy families. Considering that wealth (particularly financial assets) was heavily concentrated (Alvaredo and Artola Blanco (2017)), and given that the banking system was largely underdeveloped and lacked any form of deposit insurance, it seemed normal for rich households to lend directly to the government or corporations. Unsurprisingly, the high inflation since 1936 constituted a major wealth shock, as the value of most fixed income securities was rapidly wiped out.

From the 1960s onwards, the composition of personal financial assets in Spain started to resemble the conditions of a developed country. Banking deposits became the most widespread tool for channeling households' savings and stock market fluctuations started to have a sizable impact on the net worth of families. In fact, three noticeable trends are worth pointing out. First, after the end of Franco's regime in 1978, Spain experienced a process of Financialization, which led to an increasing comovement between financial and non-financial assets. The interrelationship across housing and stocks has already been documented at a global scale (Jorda, Knoll, Kuvshinov, Schularick, and Taylor (2017)). Second, the process of Financialization also led an exponential rise in offshore assets. In 2012, offshore assets amounted to 195 billion Euros, that is, 23% of both national income and net personal financial wealth. Interestingly, this estimate is higher than the 8% obtained by Zucman (2013) for all world countries. Hence, offshore assets constitute a non-negligible part of the portfolio of households in Spain and must be considered when analyzing the long-run evolution of wealth. This rise in offshore assets, together with the increase in the value of dwellings, have contributed to keep nearly the same levels of wealth concentration in the 1980s in the 2000s (Martínez-Toledano (2017)). Third, in Spain, pension assets have had an almost residual weight until the present day. The rise of an unfunded social security system since late Francoism, combined with an everlasting housing boom, has undoubtedly influenced how households accumulated and invested wealth.

Figure 1.4 shows the share of household liabilities as a percentage of national income. By any standard, private indebtedness stood at very low levels during the first half of the twentieth century (i.e., below 20% of national income), something that seems at odds with

the fact that household balance sheets were relatively strong, and therefore individuals could have increased their leverage for investment purposes. However, as many contemporaries and historians already pointed out ([Carmona and Simpson \(2003\)](#)), the main private asset at that time (agricultural land) was scarcely used as collateral to obtain a loan, given the associated high transaction costs. After the 1950s there was a radical shift in this situation. The development of household credit has been closely connected with the real estate cycle, as each boom (the mid-1960s, late 80s, and 1999-2007) has fostered the growth of household debt to increasingly higher levels.

1.3.2 Public wealth

As it is well known, state finances are different from those of private agents as the government can rapidly increase its debt and have a negative net worth position for a long period of time. [Figure 1.5](#) presents the liabilities and net worth of the Spanish government as a percentage of national income. Both measures tend to follow similar trends, indicating that changes in the debt stock were the main driving force behind the evolution of government wealth. At the start of the twentieth century, public debt stood at very high levels due to the dire state of Treasury finances, and, in particular, to chronic deficits, the loss of the last remnants of the colonial empire (Cuba and the Philippines became independent in 1898), and creditors' demands for high interest rates following various default events ([Comín \(2012\)](#)). Public liabilities gradually decreased thereafter, favored by a reduction in the debt burden through tax increases and inflation during the First World War. Later, during Franco's dictatorship (1939-1975), the government balance sheet improved sharply, mostly driven by the irresistible decline in the debt burden caused by financial repression and inflation ([Comín \(2015\)](#)). The last decades were marked by a two-fold increase in public debt, first during the 1980s and early 1990s, and second after the recent economic crisis. Public liabilities in relation to national income (164% in 2017) currently stand at their highest point since the late nineteenth century.

[Figure 1.6](#) shows the evolution of government assets by differentiating between non-

produced (land) and produced assets (infrastructure, buildings, etc.), plus financial claims (equity, loans, cash, etc.). For a long-term analysis, it seems convenient to analyze each category separately. Agricultural and forestland may now seem purely anecdotal for public finances, but they truly constituted one of the most important assets during the first half of the twentieth century. The subsequent fall in the share of publicly owned land has largely reflected the relative decline of the primary sector, although it is worth remembering that even now the government owns approximately one quarter of all agricultural land in Spain.

Public capital has clearly been the most important government asset in the long term. As [Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo \(2015\)](#) explain, public investment stayed at low levels during the first half of the twentieth century, and, if one excludes the immediate post-war years, the public capital stock relative to national income experienced a slight decline during this period. Afterwards, the growth in infrastructure spending and the rise of the welfare state since the 1970s propelled a sustained rise in the ratio of public capital to national income. State-owned financial assets were negligible before the Civil War, but equity holdings started to grow rapidly from 1940 onwards, driven by Franco's decision to nationalize some key industries (railways and telecommunications) and promote new industrial enterprises ([Carreras, Tafunell, and Torres \(2000\)](#)). Privatization of government-owned companies in the 1990s paved the way for a retreat from economic intervention, but even now, the state owns equity holdings in some very profitable industries.

1.3.3 National wealth

To the best of our knowledge, this is the first study presenting results on national wealth from both book value and market value perspectives, and covering a period of over a century. Overall, all three series show a very close evolution over this long period (Figure 1.7)⁶. The national wealth to income ratio followed a similar trend to the personal wealth to income ratio we described in Section 4.1 and stood in a relatively close range during the twentieth century,

6. Given the resemblances among the three series, we will only focus on the market-value series and abstract from the book-value series in what follows.

between 400 and 600%, until the real estate boom of the early 2000s led to an unprecedented rise to almost 800% in 2007.

One of the most striking results from [Piketty and Zucman \(2014a\)](#) is that European economies followed a marked U-shaped evolution in their wealth-to-income ratios over the twentieth century. In "New world" countries (Canada and the US), on the contrary, the trend is much smoother (fluctuating around 3 to 5 times the national income), but still shows a similar U-shaped pattern. As [Figure 1.8](#) shows, Spain follows a unique path. It started from lower values than core European countries (6 times the national income as opposed to almost 7 times), and then followed a significant, but smaller, decrease during the World War I years. Thereafter, and contrary to other countries, Spain's national wealth fluctuated for the rest of the century at relatively high values, between 4 and 5 times the national income; only from the late 1990s did wealth-to-income ratios start a fast-growing trend, which concluded in a striking increase during the 2000s. From this perspective, a J-shaped curve may represent better the broad evolution of Spain since 1900 than a U-shaped figure. Three peculiarities mark the long-run accumulation of wealth in Spain.

First, the specific asset composition of the Spanish national wealth contributes to explain this different evolution. In Spain, the long-term dynamics of national wealth were mostly dictated by the evolution of two real assets, agricultural land and housing, which represented an almost constant 60 to 70% of the total non-financial assets ([Figure 1.9](#)). On the contrary, in other countries, the influence of "pure" productive assets (i.e., machinery, buildings and construction, and equipment) played a larger role.

[Figures 1.10](#) and [1.11](#) depict the evolution of agricultural land and housing as a percentage of national income, respectively. The first shows how the share of agricultural land in Spain ultimately followed a similar long-term decline as in other European economies, but with some delay, which was exacerbated by the partial re-ruralization in the 1940s. This evolution is consistent with the latecomer dimension of Spain, with agriculture playing a large role well into the twentieth century. The second figure shows that housing wealth had a relatively similar weight as in other economies during the first half of the century, but rose much faster

since the 1960s, attaining at the peak of the housing boom the highest share among countries with available data. Indeed, the evolution of these two assets determined the high values of Spain in the central decades of the twentieth century, a period in which these ratios reached their lowest levels in other advanced economies. Overall, these results indicate that land has played a much stronger role in the evolution of wealth in Spain compared to other advanced countries, since both agricultural and housing wealth are largely driven by this non-produced element.

Second, Spain was heavily dependent on foreign finance since the late nineties. In fact, its net foreign assets' decline was one of the largest among developed countries (Figure 1.12, upper panel). Whereas for most developed countries the net foreign asset position has not deteriorated by more than 50% of national income in the last three decades, in Spain it has surpassed more than 100% of national income in the 2000s. As Figure 1.12 (upper panel) shows, Greece and Portugal have experienced a similar decline in its net foreign assets relative to its national income. However, as we document in Section VI the factors driving this decline are very different in Spain than in Greece and Portugal. Furthermore, as Figure 1.12 (bottom panel) shows, our calculations for households' assets in tax havens can have a significant impact on Spain's international position reducing it by one quarter.

Third, Spain also shows some striking differences when decomposing the long-term accumulation of national wealth between new savings (volume effect) and changes in relative prices (capital gains effect). Table 1.1 compares the decomposition of national wealth accumulation between the volume and capital gains effect during three periods (1900-2010, 1900-1950, and 1950-2010) and for countries with available data (France, the UK, Germany, Sweden, and the US). In the longest period (1900-2010), volume effects were the dominant force in total wealth accumulation for all countries. Spain's case is very different, because capital gains explain 49% of the total accumulation of wealth in real terms over this period.

However, it seems preferable to take 1950 as a cut-off point given that most wealth-to-income ratios approached their lowest levels in this year. During the first half of the twentieth century, national wealth-to-income ratios were dominated by a price effect in core-European

countries, as capital losses accounted for almost all of the decrease in the wealth-to-income ratios. On the contrary, savings explained a large part in the evolution of national wealth in the US because this country did not suffer an external shock. The trend in Spain during these years is similar to that in the US, as capital gains did not have a negative impact on wealth accumulation, with most of the evolution in wealth-income ratios being explained by savings.

From 1950 to 2010, Spain shows the most remarkable differences. Savings explain a large part of wealth accumulation in France, Germany, Sweden, and the US, while capital gains are only a key driver of the accumulation of national wealth in the UK. Spain stands out at this respect because capital gains account for 56% of the total accumulation of national wealth. Some concerns can be raised when choosing 2010 as the end of the analysis, given that the housing bubble was in the first stages of a severe correction. An alternative decomposition for 1950-2017, which captures the fall in housing prices since the 2007 peak, yields very similar trends for Spain. The capital gains component is 52% of wealth accumulation. In both methods, the results confirm that capital gains had an important role in wealth accumulation in Spain during 1950-2017, with increasing asset prices having a much larger role than in other countries. As we argued, this is due to the extraordinary evolution of housing wealth in Spain with respect to other countries over the last decades.

Table 1.2 shows a more detailed decomposition specific to the Spanish case⁷. From 1900 to 2017, the annual growth of national wealth was 2.8%. In turn, we can decompose this trend into a volume effect of 1.4% and a capital gains effect (net of war destruction) of 1.2%. In other words, the fact that 54% of the total growth in national wealth in the very long-term comes through savings confirms the conventional wisdom on the matter. However, that capital gains accounted for the remaining 46% is a factor that has not been sufficiently studied.

When dividing this era into two main sub-periods (1900-1950 and 1950-2017), it seems evident that capital gains played a very different role. From 1900 to 1950, national wealth grew very modestly in real terms (0.9%), resulting in a slight decrease in the wealth to-income

7. We present this analysis for the market value national wealth series, the results of which are practically identical to those of the book value results given their close resemblance over the long run (See "Spanish Wealth Appendix").

ratio from 568% to 556%. The savings-induced effect accounted for 87% of the real wealth accumulation, while capital gains accounted for 13%. On the contrary, the 1950-2017 years were characterized by a strong increase in the wealth-to-income ratios boosted by capital gains. National income grew at a remarkable rate (3.8%) during this period, but was outpaced by an even stronger growth in national wealth (4.0%). As opposed to previous decades, capital gains played a very significant role in national wealth accumulation in these years, accounting for 52% of the growth.

To provide a more in-depth analysis, we divide national wealth between housing and non-housing national wealth, and then calculate the savings rate and capital gains for both sub-sectors (Table 1.3). As previously noted, the most outstanding fact relates to the important role of capital gains, which in turn can be largely explained by changes in housing prices. In contrast to the first decades of the 20th century, from 1950 to 2017 Spain experienced a period of rapid growth and industrialization, which came together with high rates of saving and, consequently, a new wave of investment. However, in this new context, asset price variations in the housing market played a fundamental role in the rising value of national wealth, to the point that rising housing prices explain 70% of the capital gains observed between 1950-1980 and 86% between 1980-2017. No matter which metric is chosen, housing has become the most important driver of Spain's balance sheet.

1.4 International capital flows, credit standards, and housing prices

In the previous section we have shown that in the 2000s wealth increased in Spain much faster than income and that this increase was mainly driven by higher urban land values. This trend was unique relative to its history and to the evolution of wealth-income ratios in other developed countries. As already documented in the literature review, explaining this unique path is particularly challenging since there are many potential mechanisms which could have led to this rise. In this section, we build upon the work carried by [Bernanke \(2005\)](#),

Himmelberg, Mayer, and Sinai (2005), Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh (2012) and Ferrero (2015) for the US and analyze the relationship between foreign capital flows, the growth in household credit and the evolution of the real estate market. We believe this channel to be of particular interest given that the unprecedented growth of Spain's wealth-to-income ratio in the 2000s due to rising urban land values happened at the same time that the country became heavily dependent on foreign finance. We first carry a descriptive analysis, which we then complement with an empirical analysis following Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh (2012).

When it comes to analyzing international capital flows, Spain is in a unique position if we compare it to other European countries. Within the EU, together with Greece and Portugal it has experienced the largest deterioration in its net foreign asset position in the years preceding the crisis. However, the factors driving the growth of Spain's foreign liabilities are clearly distinctive. According to the IMF's data on the International Investment Position, in Greece and Portugal the growth of public debt explains the increase in the negative foreign asset position, while in Spain it was mostly driven by the increase in private debt.

Table 1.4 (upper panel) points that from the late 1990s until 2007, Spanish monetary institutions (mostly commercial banks) were the main actors increasing foreign funding. The increase in foreign liabilities of Spanish monetary institutions mainly happened through the issuance of banks' debt securities, and not through other sources of funding (deposits, loans or equity) (Table 1.4 (bottom panel)). After the housing bubble burst, private banks suffered a sharp reduction in their net foreign liabilities, as some of their traditional funding channels became closed, and had to resort to funding provided through the Bank of Spain and the ECB's TARGET system (Whelan (2014)). Since then, private deleveraging and the growth in public debt have made the government sector the main contributor to Spain's negative foreign position.

During the 2000s two important and deeply interrelated changes took place in the Spanish mortgage market. On one side, banks started to use new sources of funding to fuel credit activity. Traditionally, they had relied solely upon deposits to fund mortgages, but from

the start of the 2000s they increasingly resorted to the issuance of bonds secured by their mortgage portfolio. Importantly, this process was different from the rise of asset backed securities occurred at the same time in the US mortgage market, as Spanish banks mostly issued covered bonds, a debt type which is guaranteed both by a special pool of mortgages and by the issuer. Figure 1.13 (upper panel) summarizes this fundamental change by relating the value of mortgage securities (covered bonds and other debt assets) with the outstanding volume of mortgages held by financial institutions. Securitization rose from almost negligible levels in 1996 (3%) to very high ones in 2012 (60%), considering that over-collateralization requirements would imply a maximum at 80% (European Central Bank (2008)).

The other major change occurred as Spanish monetary institutions became more integrated in international capital markets after the country entered the eurozone. Foreign investors became the main buyers of this unprecedented issuance of Spanish financial debt securities, as this channel seemed to perfectly suit the interests of all parties involved. Spanish banks obtained funding for longer time horizons, and foreigners could invest in a safe asset, with no currency risk, for an attractive yield. This last fact is shown in Figure 1.13 (bottom panel), which compares the spreads of Spanish public debt and covered bonds versus the equivalent German assets. Although both trends show in the long-term a very similar evolution, this should not conceal with the fact that Spanish covered bonds offered an extra 0.5% return versus German equivalent bonds during the 2002-2007 years.

Figure 1.14 summarizes these changes by looking upon the balance sheet of Spanish monetary institutions. On the asset side, the share of households' loans (mainly, mortgages) as a share of total assets rose steadily from 16% to 28%, while on the liabilities side, debt securities issued by Spanish banks and owned by foreign investors as a share of total liabilities increased from 0% to almost 10%. The striking resemblance in the magnitude of these two trends serves as a starting point to measure the impact of foreign capital flows on housing prices.

We test the statistical significance of the previous descriptive analysis following a similar empirical analysis to Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh (2012). In their

paper, they follow a two-step approach. First, they investigate the pure correlations between credit standards, capital flows, and interest rates with housing prices in the US over the recent boom-bust cycle. These regressions could be biased since the movements they find might be endogenous to the state of the economy (i.e. changes in credit demand) or to expectations about future economic conditions (i.e. changes in real interest rates). In a second step, they address this concern. They do this by regressing their measures of credit standards on credit demand, from which they obtain a residual. They then regress house prices on this residual, thus using the variation in credit conditions that is unrelated to shifts in credit demand. They find that changes in international capital flows played, at most, a small role in driving house price movements in this episode in the US and that, instead, the key causal factor were changes in credit standards. They interpret the changing pattern in credit conditions as the consequence of financial market liberalization and its subsequent reversal.

In our empirical analysis we closely follow the methodology used by [Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh \(2012\)](#) and investigate the link between international capital flows, real interest rates and credit standards with housing prices. We use as our main measure of international capital flows the growth in net foreign holdings of debt securities issued by Spanish monetary institutions measured as a share of GDP ($\Delta ND/GDP$). As previously shown, debt securities issued by monetary institutions were the most important asset through which Spanish banks obtained new funding from abroad. Nonetheless, we also carry the correlations using two other more common measures of capital flows from the Bank of Spain statistics: the current account ($\Delta CA_{def}/GDP$) and the net foreign asset position ($\Delta NFAP/GDP$) as a share of GDP.

For credit standards (CS), we use the loan margin reported by Spanish banks in the Bank Lending Survey (BLS) compiled by the Bank of Spain. This margin is specific to loans granted to households for the purchase of dwellings, and should be understood as the spread over a relevant market reference rate (e.g. EURIBOR, LIBOR or the interest rate swap of a corresponding maturity for fixed rate loans), depending on the characteristics of the loan. The survey tracks the net percentage of banks which report having increased their margins in the

previous quarter. A positive value for this variable therefore indicates a tightening of credit conditions, while a negative value indicates an easing. We standardize the credit standards variable by dividing by the standard deviation and subtracting its mean based on data for the full sample. For real interest rates we use the nominal ten-year rate of the Spanish public debt, from the Bank of Spain statistics, minus the expected inflation rate reported by a panel of experts from FUNCAS (rr10yr). Finally, nominal housing prices are based on property appraisals and the series is the same as the one used to construct our housing wealth series. We convert the series into constant prices using the inflation rate from the Spanish National Institute of Statistics. Observations are available on a quarterly basis, and range from the last quarter of 2002 up to the last quarter of 2017.

Table 1.5 presents the results from the regressions of the growth of housing prices on the growth in our three measures of capital flows and housing prices. As expected, net foreign debt securities explain more of the variation in housing prices, namely 20%, than the net foreign asset position which explains 8.5% and the current account that explains 6.2% and it is not even significant. These findings confirm [Obstfeld \(2012\)](#) and [Lane and McQuade \(2014\)](#) observation that the current account is not the best indicator of capital flows because it does not take into account changes in values, and hence, it is more relevant to consider other metrics (i.e. net debt inflows excluding equity investment, net foreign assets, etc.) to explain domestic credit growth.

Table 1.6 (columns 1-4) reports the results from the regressions of real house price growth on credit standards, real interest rates and the growth in net foreign holdings of debt securities. Notice that rr10yr is itself a forward looking variable since it equals the nominal ten-year T-bond rate minus the expected inflation rate. Columns 1-3 show that all three variables play a role in explaining housing price growth. Real interest rates are the most important driver explaining almost 40% of total housing price variation, followed by net foreign holdings of debt securities which account for 20% of total variation and credit standards with 12%. What is important for our analysis is that international capital flows are in all regressions significant, even after controlling for credit standards and/or real interest rates (column 4). These results

are in contrast with those of [Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh \(2012\)](#) for the US, where international capital flows do not seem to affect home prices.

However, these regressions could be biased since the movements we find might be endogenous to the state of the economy (i.e. changes in credit demand) or to expectations about future economic conditions (i.e. changes in real interest rates). Therefore, in a second set of regressions (Table 1.6 (columns 5-6)), we address this endogeneity concern following [Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh \(2012\)](#)'s approach. In these specifications our main explanatory variable of interest is the residual of a regression of international capital flows on credit demand (Res. CD).⁸ As additional explanatory variables, we continue to use our measure of credit standards, CS, and the real ten-year public debt yield, rr10yr. Note that isolating credit demand from the capital flow effect is quite relevant in the Spanish context during the 2000s as a large part of the rise in house prices was driven by demand factors. In particular, [Gonzalez and Ortega \(2013\)](#) and [Sanchis-Guarner \(2017\)](#) find that the boom in foreign born population which happened in Spain during the 2000s explains up to one half of the rise in house prices over the period.

Table 1.6 (columns 5-6) shows that the residual capital flow measure (Res. CD) remains significant and explains by itself almost the same amount of variation in house price growth, approximately 15% (column 5), as does the raw series of the growth in net foreign holdings of debt securities (20%, column 3). Results also remain significant after including all other variables as additional regressors (column 6).

All in all, the evidence presented supports the hypothesis that international capital flows were significantly related to house prices in Spain during the 2000s. Hence, together with changing demographics and monetary policy, the access to international credit by Spanish credit institutions seems to have played a significant role on the evolution of the real estate market in Spain.

8. The CD variable we use is the one included in the Bank Lending Survey (BLS) compiled by the Bank of Spain. The measure is specific to changes in demand of loans granted to households for the purchase of dwellings. The survey tracks the net percentage of banks which report having experienced an increase in the demand for loans in the previous quarter. A positive value for this variable therefore indicates an increase in demand, while a negative value indicates a decrease. We standardize the credit demand variable by dividing by the standard deviation and subtracting its mean based on data for the full sample.

1.5 Conclusion

This study reconstructs Spain's national balance sheet since the beginning of the twentieth century to the present, under both the market value and book value definitions. We also present a new asset-specific decomposition of long-run movements in the value of wealth, housing and other assets into a volume effect (through saving) and a price effect (capital gains or losses). Furthermore, we provide a new long-run series of Spain's net foreign asset position that considers the growing importance of offshore assets.

Overall, the national wealth to income ratio followed a J-shaped curve during the twentieth century, which differs from the U-shaped evolution that characterizes core-European economies. Another peculiarity of Spain is that agricultural land and housing have always represented the most important components of national and personal sector balance sheets. Contrary to other developed economies, price variations in these two assets played a significant role in shaping wealth accumulation, and can thus explain why capital gains constituted a fundamental driver in wealth accumulation in Spain in the very long term. The rise in asset prices became more important during 1950-2017, especially due to housing wealth, which accounts for 83% of total capital gains. We also present new descriptive and empirical evidence supporting the hypothesis that international capital flows were significantly related to the housing boom and bust of the early 2000s.

Our analysis points to three areas in which research on wealth can be developed in the future. First, we argue for the decisive importance of housing and agricultural land as the key drivers of Spanish national wealth, a fact that probably extends to other southern European economies and to most developing countries. Further research is needed to understand the role of capital gains in the rise of national wealth of Spain (i.e., an annual growth rate of 2.8%) for 1900-2017, while this same factor played a negligible role in most other countries (with rates close to zero). In this paper we document that international capital flows are an important driver of the growth in housing prices but there are other potential explanations which might explain the rise in the value of land which have not been deeply analyzed so far such as

agglomeration effects, a high taste for home-ownership, large subsidies to owner-occupied housing, etc.

Second, from the methodological point of view, housing is a complex asset to measure since it combines a produced element (dwellings) with a non-produced one (land) and it seems highly advisable to collect more specific information (statistics on prices, developable land, surveys, etc.) on a regular basis. Moreover, the relatively similar results from the book and market value definitions of Spanish national wealth should not conceal that important methodological problems remain. More efforts and conceptual clarification are needed to determine whether discrepancies between these approaches can be traced to the estimate of fixed assets through the perpetual inventory method, or truly to the existence of a mismatch between corporate assets at market and book value.

Finally, as we have shown, offshore assets can change the foreign asset position of a country significantly. The information available up to now is quite poor and scholars have to make strong assumptions to provide consistent estimates. Hence, further cooperation between national central banks, statistical offices, and tax agencies could provide the basis for a substantial improvement in the available data.

Figures



FIGURE 1.1 – PERSONAL WEALTH. SPAIN, 1900-2017

Notes: This figure depicts personal wealth as a fraction of national income for 1900-2017 in Spain. Personal wealth is the sum of non-financial and financial assets minus financial liabilities for households and the NPISH sector. Computations were done using National Accounts and other sources. Due to lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Table 1 in the data appendix.

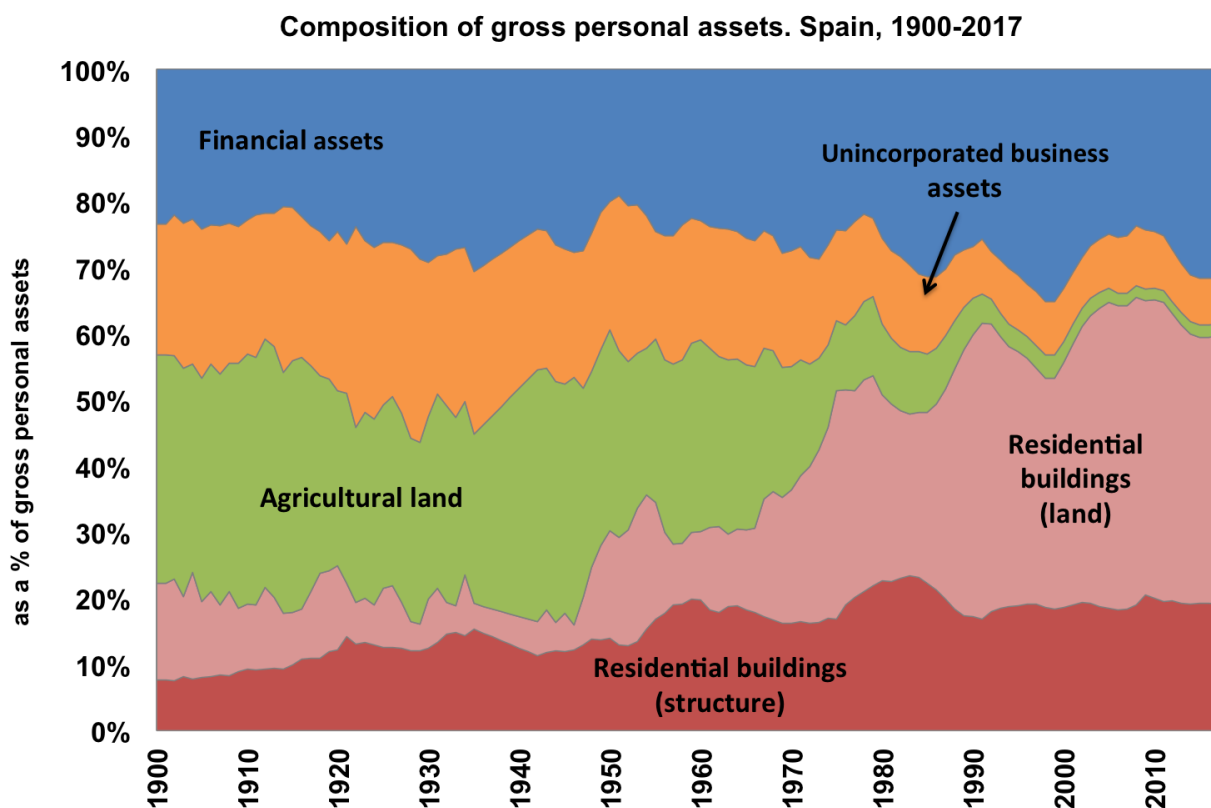


FIGURE 1.2 – COMPOSITION OF GROSS PERSONAL ASSETS. SPAIN, 1900-2017

Notes: This figure displays the composition of gross personal assets as a fraction of total gross personal assets for 1900-2017 in Spain. Gross personal assets are decomposed into residential buildings (replacement cost of the structure), land underlying residential buildings, agricultural land, unincorporated business assets, and financial assets. Computations were done using National Accounts and other sources. Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See table 3.f. in the data appendix.

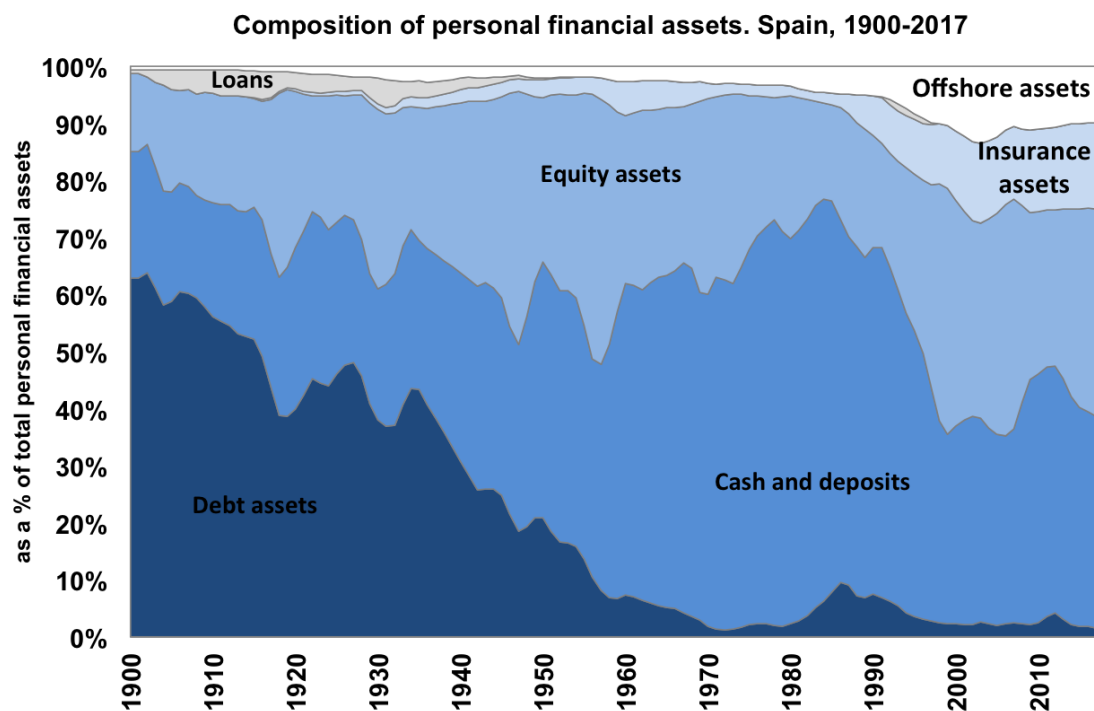


FIGURE 1.3 – COMPOSITION OF PERSONAL FINANCIAL ASSETS. SPAIN, 1900-2017

Notes: This figure displays the composition of personal financial assets as a fraction of total personal financial assets for 1900-2017 in Spain. Personal financial assets are composed of debt securities, cash and deposits, equity shares, insurance claims, loans, and offshore assets. Note that the asset category "other" is excluded in this graph since we have only the series from the 1970s onwards. Computations were done using National Accounts and other sources. Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Table 3.g. in the data appendix.

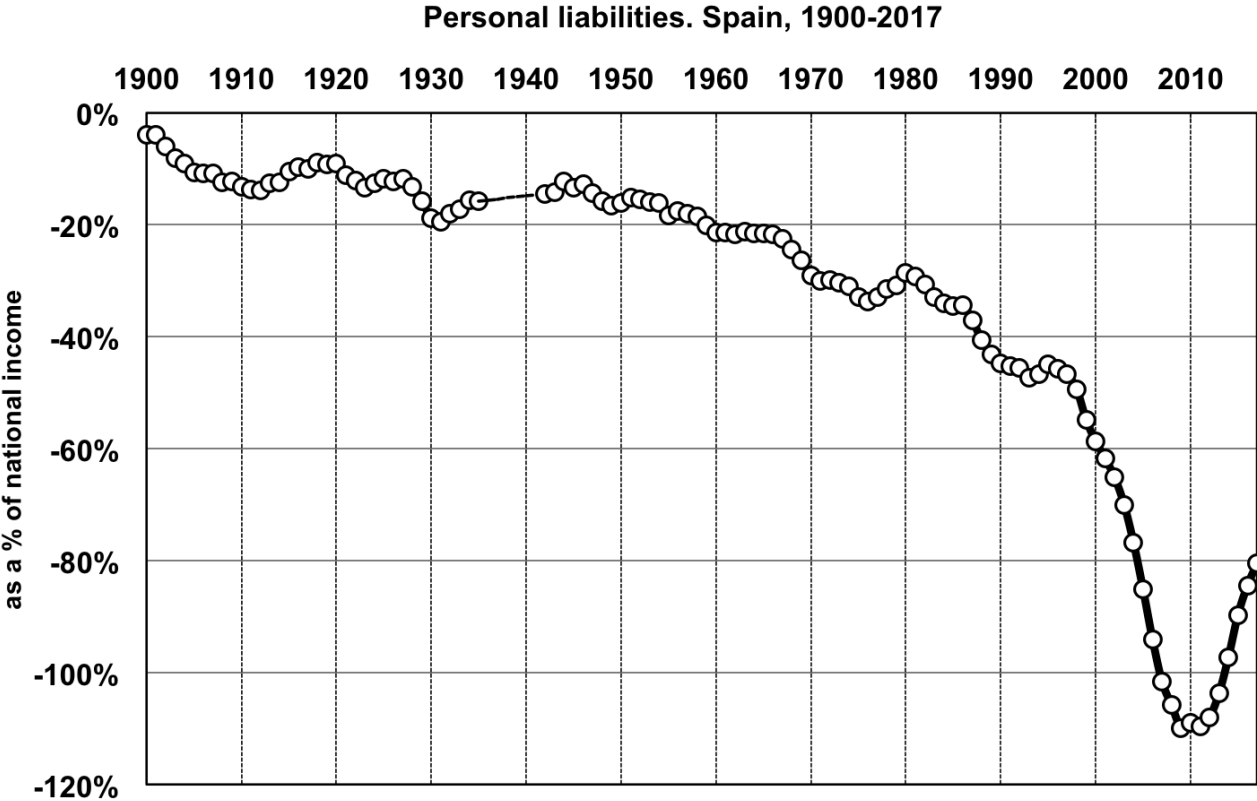


FIGURE 1.4 – PERSONAL LIABILITIES. SPAIN, 1900-2017

Notes: This figure depicts personal financial liabilities as a fraction of national income for 1900-2017 in Spain. Computations were done using National Accounts and other sources. Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Table 3.a. in the data appendix.

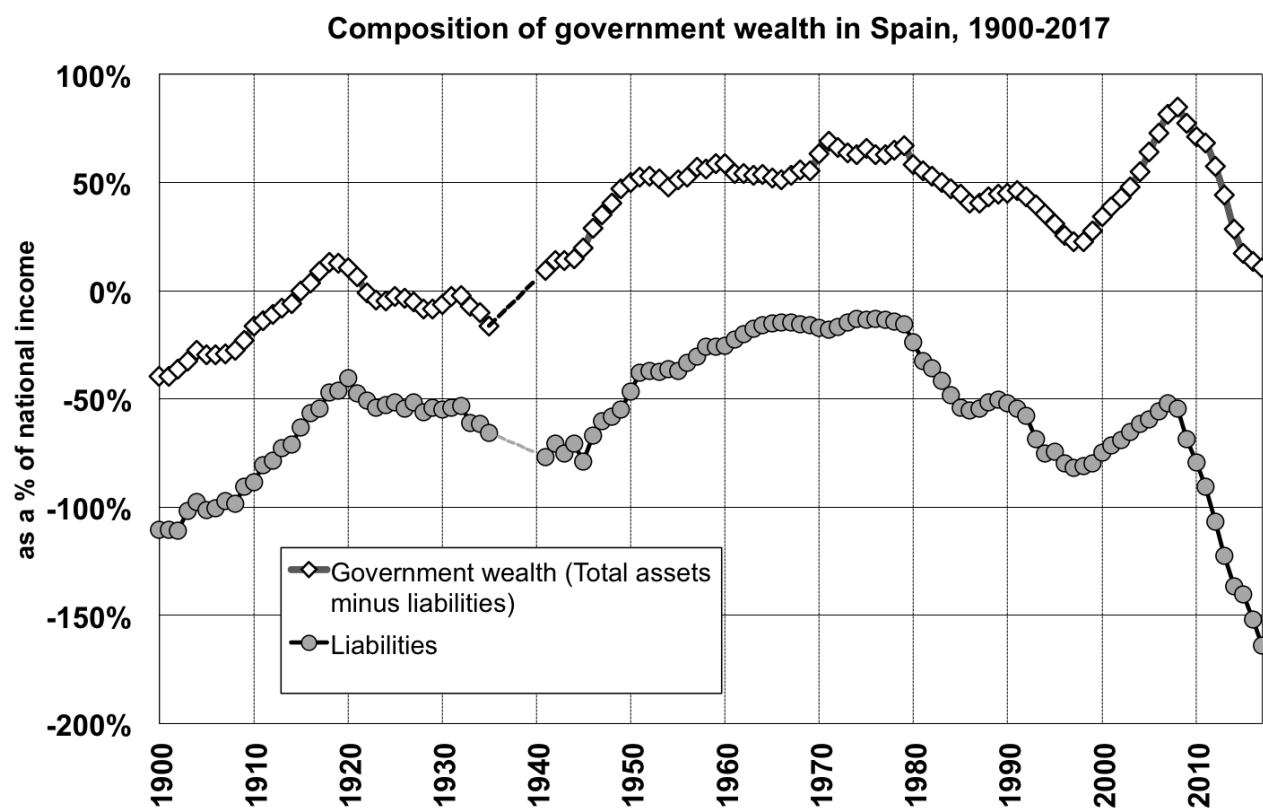


FIGURE 1.5 – COMPOSITION OF GOVERNMENT WEALTH. SPAIN, 1900-2017

Notes: This figure displays government wealth (total assets minus liabilities) and total government liabilities as a fraction of national income for 1900-2017 in Spain. Computations were done using National Accounts and other sources. Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Table 3.a. in the data appendix.

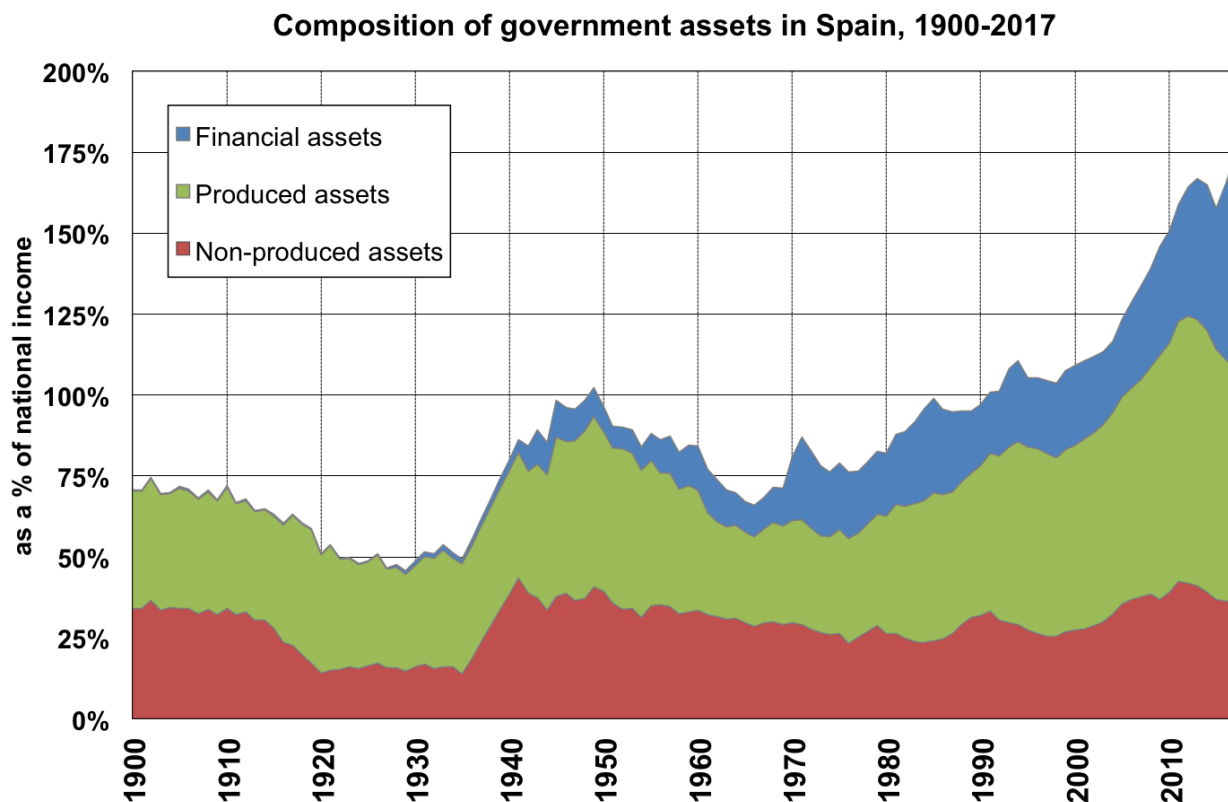


FIGURE 1.6 – COMPOSITION OF GOVERNMENT ASSETS. SPAIN, 1900-2017

Notes: This figure depicts the composition of government assets as a fraction of national income for 1900-2017 in Spain. Government assets are decomposed into produced, non-produced (land underlying buildings and forests) non-financial assets, and financial assets. Computations were done using National Accounts and other sources. For 1900-1970, government non-financial assets include government-produced assets, land underlying buildings, and forests, and financial assets are proxied by computing all state-owned equity holdings on the asset side. Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Table 3.a. in the data appendix.

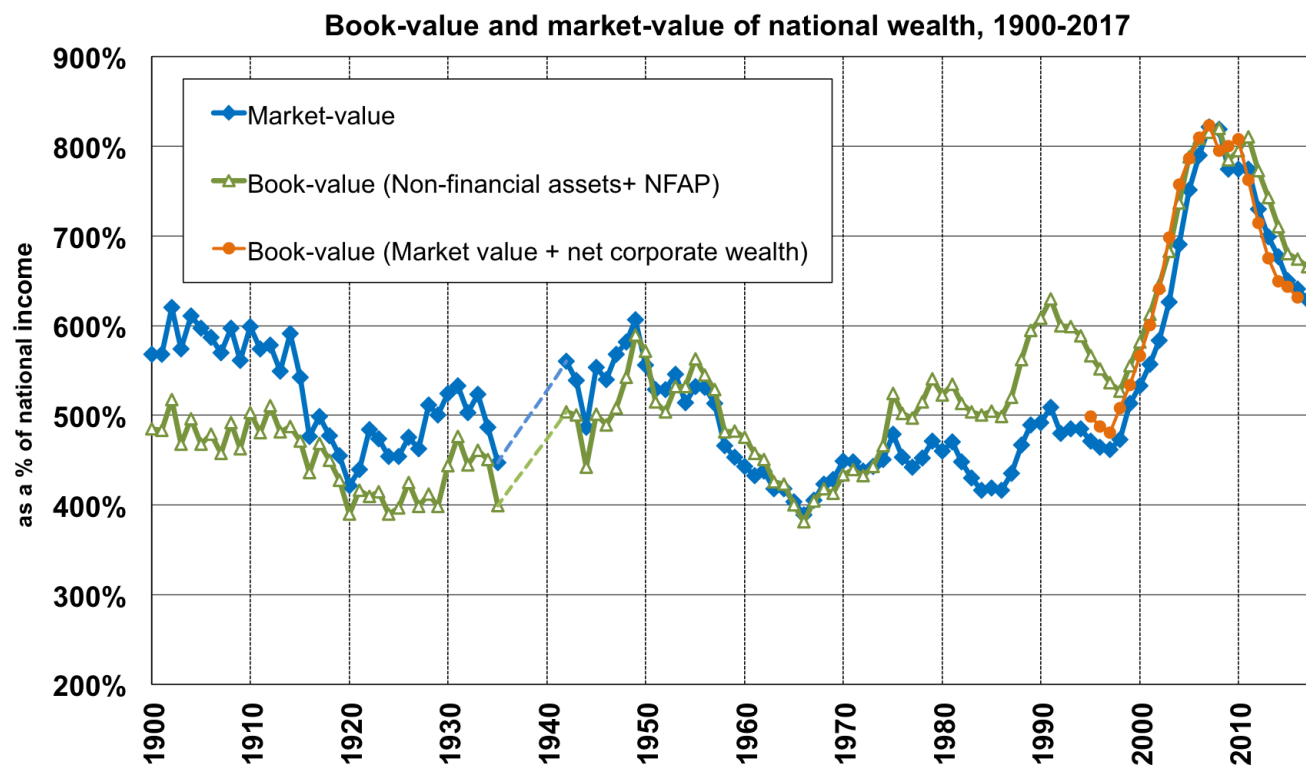


FIGURE 1.7 – BOOK VALUE AND MARKET VALUE OF NATIONAL WEALTH, 1900-2017

Notes: This figure compares national wealth at market and book value as a fraction of national income for 1900-2017 in Spain. National wealth at market value (blue line) is the sum of personal and government net worth. In contrast, national wealth at book value (green line) is the sum of the non-financial assets of all domestic sectors plus net foreign wealth. The difference between both definitions can be traced to the corporate sector, in particular to the mismatch (or residual wealth) that exists between the corporate book value of equities and the market value. Specifically, adding corporate wealth to the market value of national wealth (orange line) equals the book value definition. Both definitions converge when corporate wealth is zero or, similarly, when Tobin Q equals one. Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Tables 3.a. and 3.c. in the data appendix.

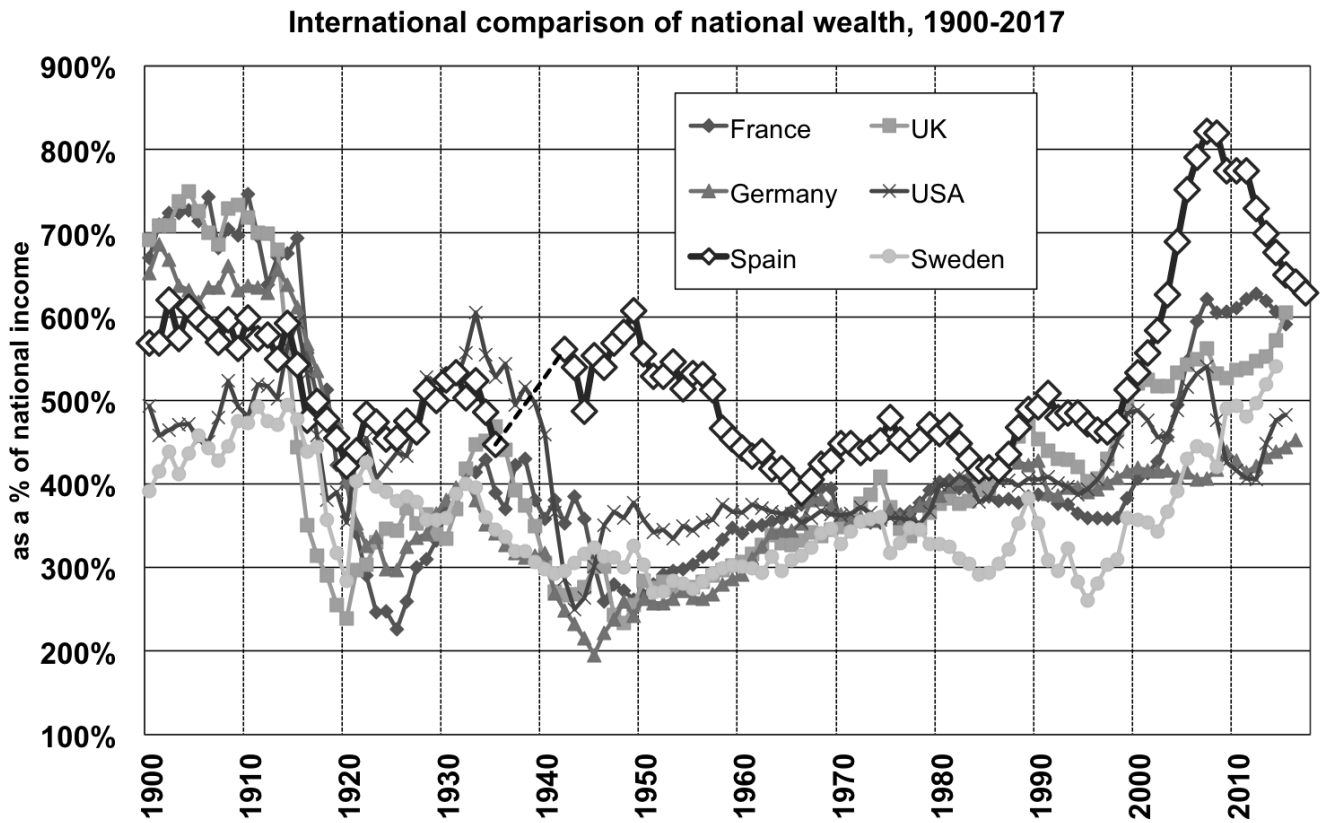


FIGURE 1.8 – INTERNATIONAL COMPARISON OF NATIONAL WEALTH, 1900-2017

Notes: This figure depicts national wealth as a fraction of national income for 1900-2017 in Spain, France, Germany, Sweden, the UK, and the US. The series for France, Germany, Sweden, United Kingdom and United States are taken from the World Inequality Database. See Table 5.b. in data appendix.

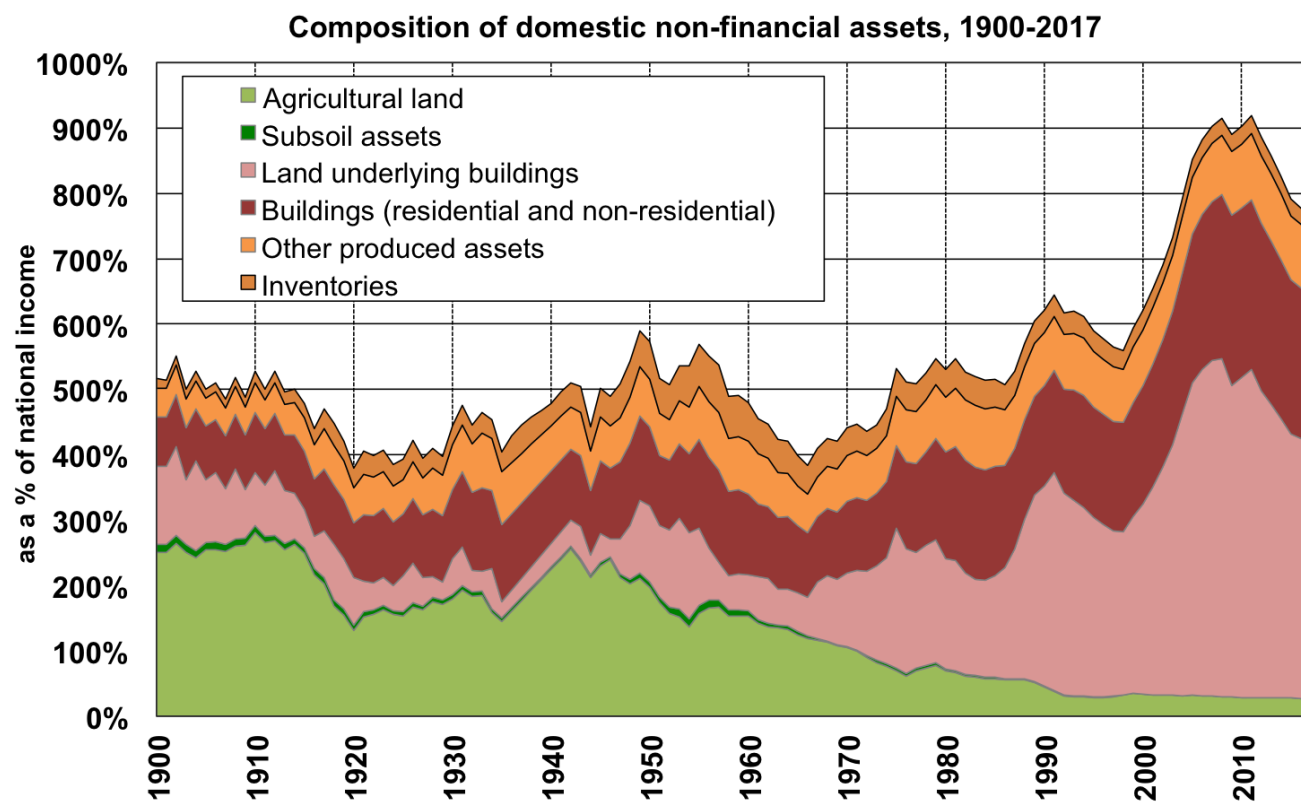


FIGURE 1.9 – COMPOSITION OF DOMESTIC NON-FINANCIAL ASSETS, 1900-2017

Notes: This figure depicts the composition of domestic non-financial assets as a fraction of national income for 1900-2017 in Spain. Domestic non-financial assets are decomposed into buildings (replacement cost of the structure), land underlying buildings, natural resources (agricultural land and subsoil assets), and other produced assets (buildings and constructions, machinery and equipment, and transport equipment). Due to the lack of data for the Civil War period, 1936-1941 are linearly interpolated. See Table 3.c. in the data appendix.

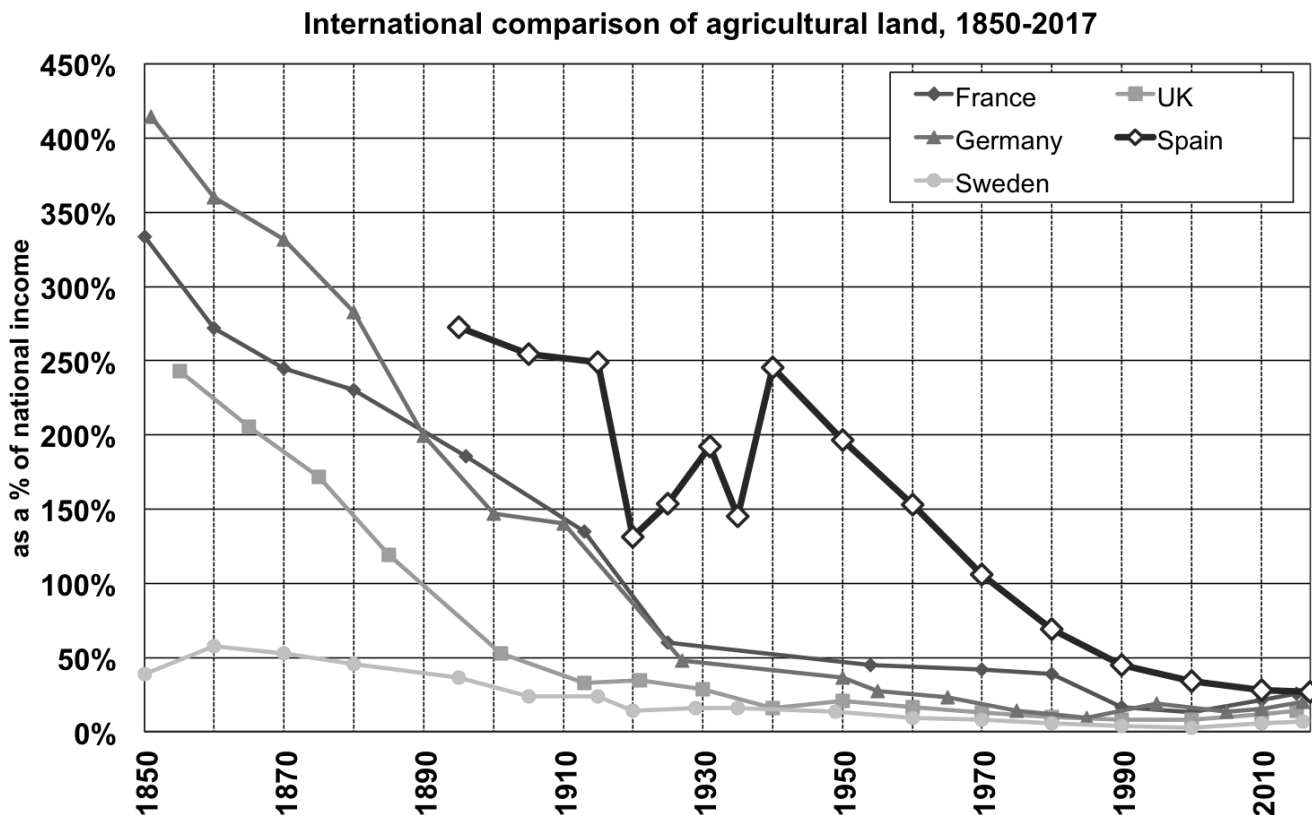


FIGURE 1.10 – INTERNATIONAL COMPARISON OF AGRICULTURAL LAND, 1850-2017

Notes: This figure depicts agricultural land as a fraction of national income for 1850-2017 in Spain (data only available since 1986), France, Germany, Sweden, and the UK. The series for France, Germany, and the UK are taken from [Piketty and Zucman \(2014a\)](#) and are linked with the latest updates of these data in the World Inequality Database. Data for Sweden come from [Waldenström \(2017\)](#) and are linked to the latest updates made by the author at the World Inequality Database. See Table 5.e. in the data appendix.

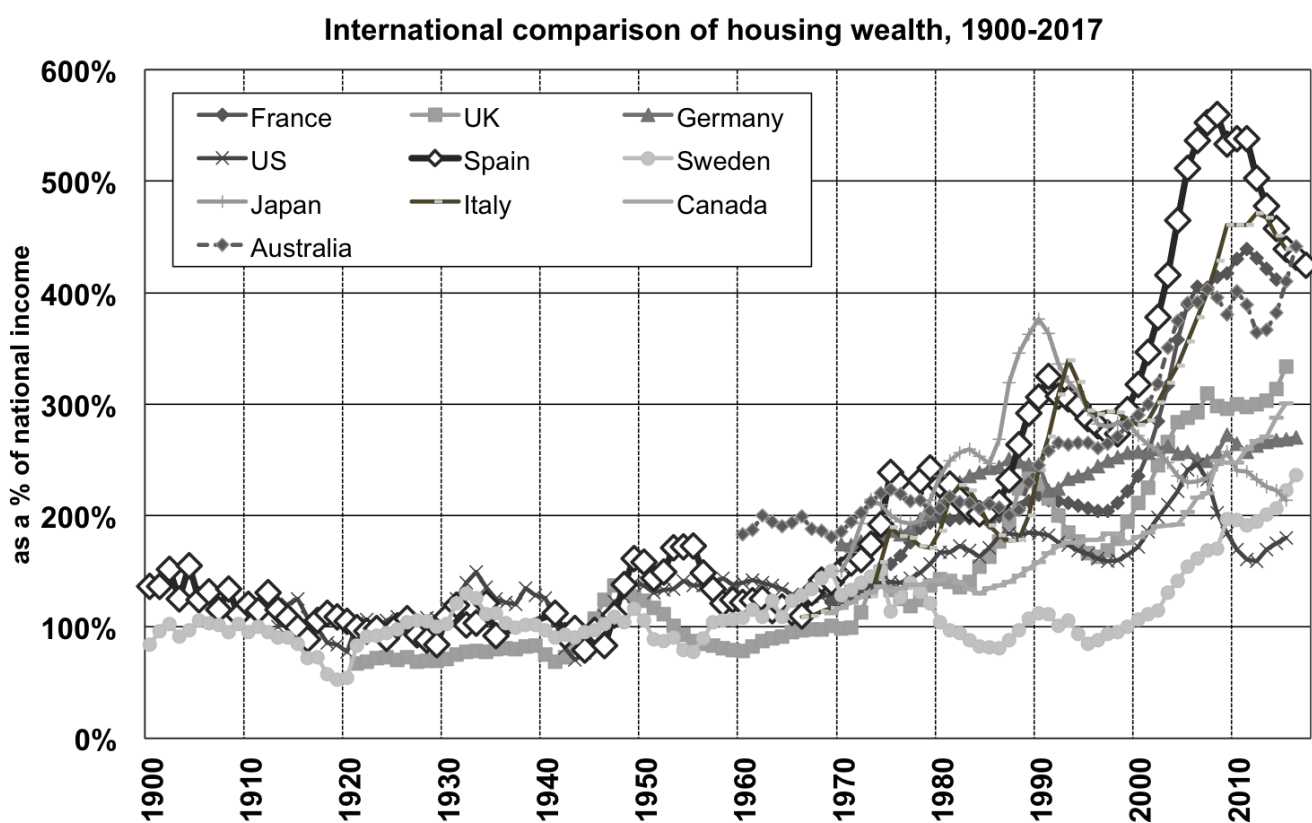
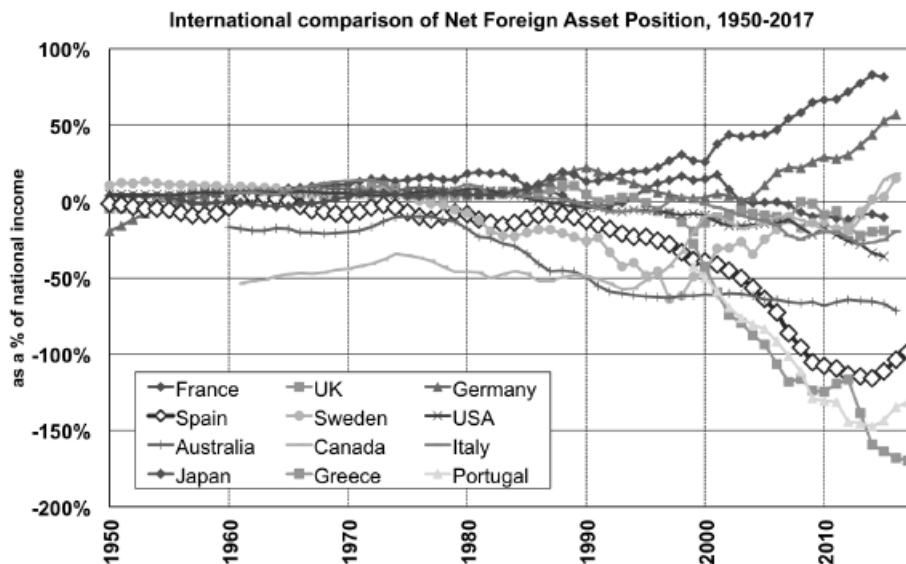
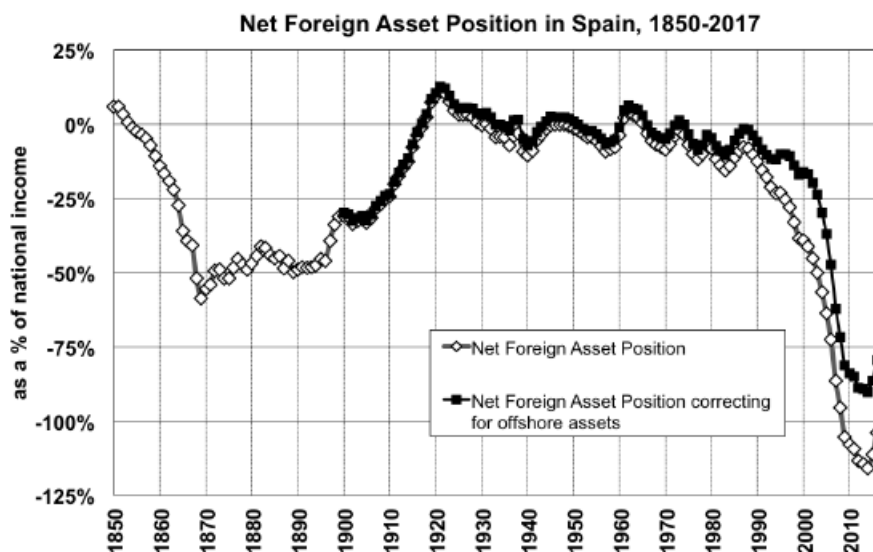


FIGURE 1.11 – INTERNATIONAL COMPARISON OF HOUSING WEALTH, 1900-2017

Notes: This figure depicts housing wealth as a fraction of national income for 1900-2017 in Spain, Australia, Canada, France, Germany, Italy, Japan, Sweden, the UK, and the US. All series are taken from the World Inequality Database except for Spain which comes from our own calculations. All series incorporate the value of the edification and the value of the land underlying the edification. See Table 5.f. in data appendix.



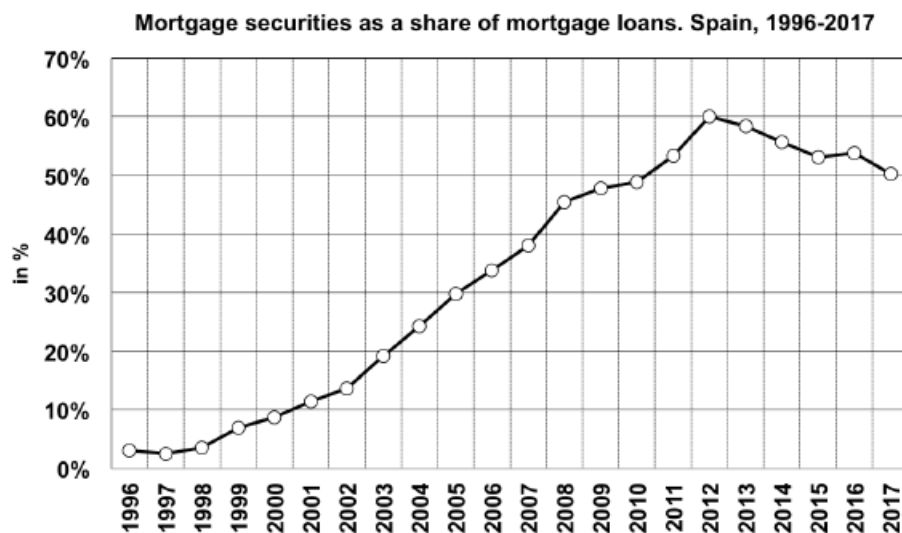
(a) International comparison of net foreign asset positions, 1950-2017



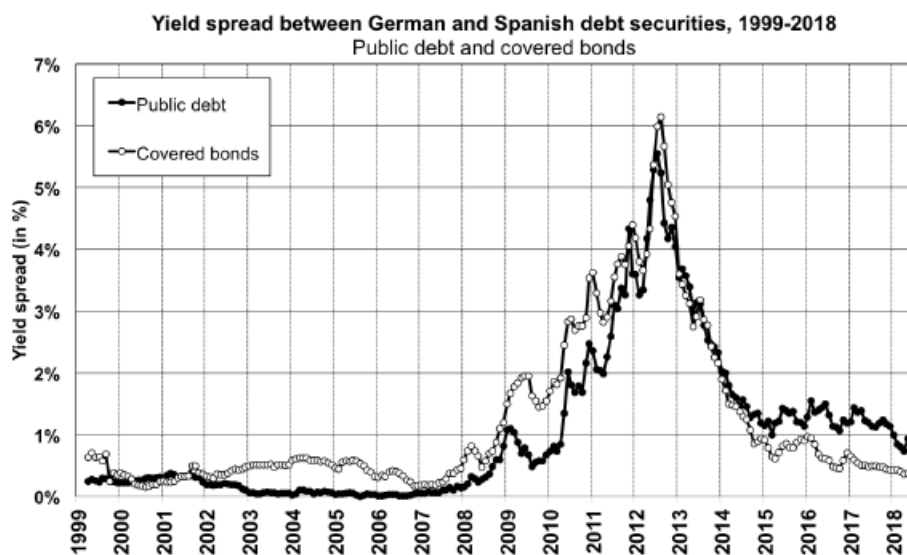
(b) Net foreign asset position in Spain, 1850-2017

FIGURE 1.12 – LONG-TERM EVOLUTION OF NET FOREIGN ASSET POSITIONS

Notes: The top figure (panel a) depicts the net foreign asset position as a fraction of national income over the period 1950-2017 for Spain, Australia, Canada, France, Germany, Greece, Italy, Japan, Portugal, Sweden, UK and USA. Data has been taken from the World Inequality Database, except for Greece and Portugal, which come from Eurostat. See Table 5.d. in data appendix. The bottom figure (panel b) displays the net foreign asset position in Spain for 1850-2017, together with the net foreign asset position correcting for offshore assets for the sub-period 1900-2017. The net foreign asset position was calculated from 1970 onwards using the Financial Accounts of the Bank of Spain, and for the historical period by revising Prados de la Escosura (2010)'s data on the current account balance. Offshore assets are derived using mainly Zucman (2013, 2014, 2015)'s data and statistics gathered since 2012 by tax authorities on the assets held abroad by Spanish residents. See Table 3.b. in the data appendix.



(a) Mortgage securities as a share of mortgage loans. Spain, 1996-2017



(b) Yield spread between German and Spanish debt securities, 1999-2018

FIGURE 1.13 – THE MARKET OF DEBT SECURITIES IN SPAIN

Notes: The top figure (panel a) depicts the value of mortgage securities (covered bonds and other assets) issued by Spanish banks as a percentage of the total volume of mortgages held by these financial institutions. The bottom figure (panel b) displays the yield spread between Spanish and German debt securities over the period 1999-2018. The black line traces the spread between the 10-year bonds of both governments. The grey line shows the spread between covered bonds issued by monetary institutions of these two countries. Information on government yields has been taken from the respective central banks, while those on covered bond yields are derived from Markit iBoxx Indices.

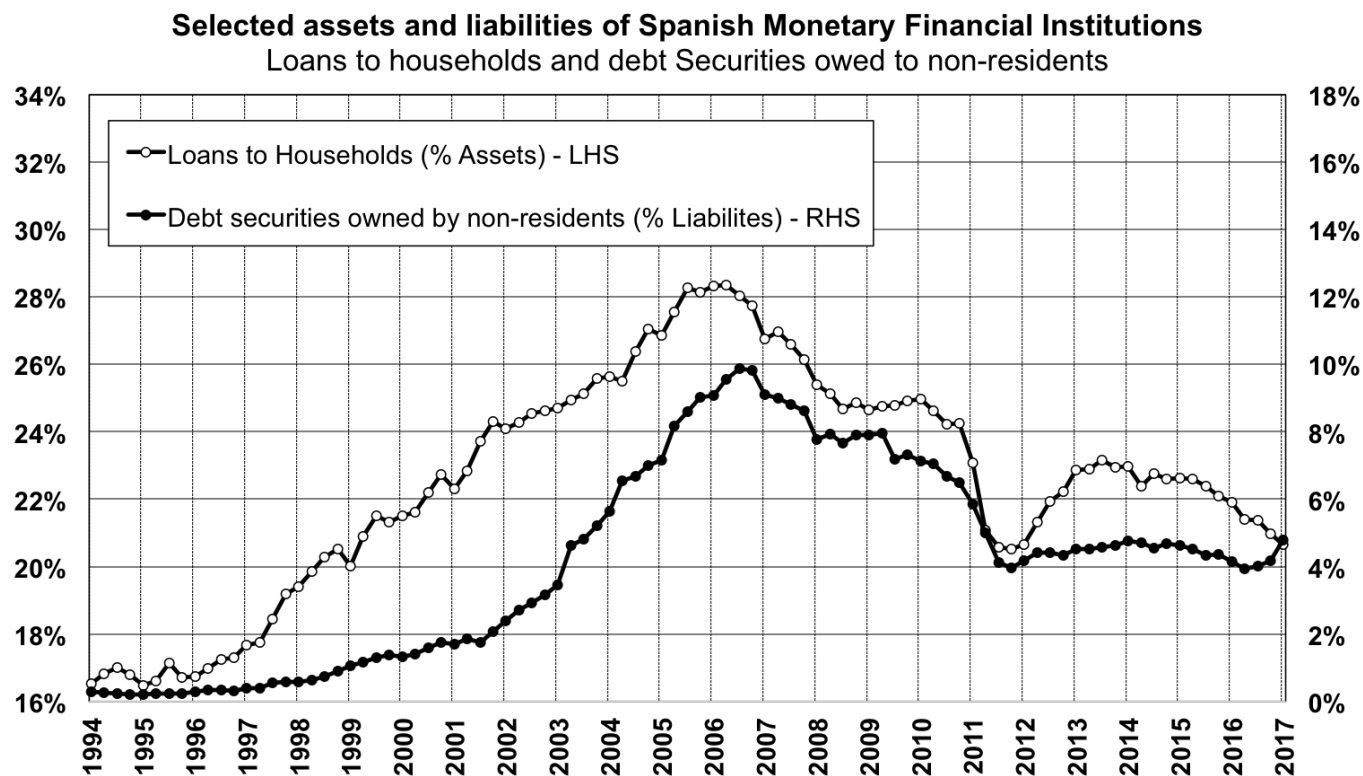


FIGURE 1.14 – SELECTED ASSETS AND LIABILITIES OF SPANISH MONETARY FINANCIAL INSTITUTIONS

Notes: This figure displays two key components of the balance sheet of Spanish Monetary Financial Institutions. First, the share of loans granted to households as a percentage of total assets (LHS). Second, the share of debt securities issued by Spanish Monetary Financial Institutions and owned by non-residents, as a percentage of total liabilities (RHS). All data is derived from the Bank of Spain's Financial Accounts.

Tables

TABLE 1.1 – ACCUMULATION OF NATIONAL WEALTH IN SPAIN, THE US, THE UK, GERMANY, FRANCE, AND SWEDEN, 1900-2010

Accumulation of national wealth in									
Spain, the US, the UK, Germany, France, and Sweden, 1900-2010									
	1900-2010			1900-1950			1950-2010		
	Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate
	g_w	$\frac{g_{ws}}{s/\beta} =$	q	g_w	$\frac{g_{ws}}{s/\beta} =$	q	g_w	$\frac{g_{ws}}{s/\beta} =$	q
Spain	3.1%	1.5%	1.5%	0.9%	0.7%	0.1%	4.7%	2.1%	2.6%
		51	49		87	13		44	56
United States	3.5%	2.7%	0.7%	3.7%	2.9%	0.7%	3.3%	2.6%	0.7%
		79	21		81	19		79	21
United Kingdom	1.6%	1.4%	0.2%	-0.8%	0.7%	-1.5%	3.7%	2%	1.7%
		88	13		-88	188		54	46
Germany	2.0%	2.8%	-0.7%	-0.8%	0.5%	-1.3%	4.4%	4.7%	-0.3%
		133	-33		-63	163		106	-6
France	2.1%	2%	0.2%	-0.8%	0.3%	-1%	4.6%	3.4%	1.2%
		91	9		-43	143		75	25
Sweden	3.1%	3.1%	-0.1%	4.2%	1.8%	0.6%	3.6%	4.3%	-0.6%
		102	-2		74	26		117	-17

Notes: This table presents the accumulation of national wealth in Spain, the US, the UK, Germany, France, and Sweden for 1900-2010. Computations were done using national accounts and other sources. The results for the US, the UK, Germany, and France come from [Piketty and Zucman \(2014a\)](#), and for Sweden, from [Waldenström \(2017\)](#). The small numbers below the savings and capital gains growth rates are the fraction of each in the total growth rate.

TABLE 1.2 – ACCUMULATION OF NATIONAL WEALTH IN SPAIN, 1900-2017 (MULTIPLICATIVE DECOMPOSITION)

Accumulation of national wealth in Spain, 1900-2017 (Multiplicative decomposition)											
Market-value national wealth income ratios (%)		Decomposition of national wealth growth rate (%)			Decomposition of housing wealth growth rate (%)			Decomposition of non-housing wealth growth rate (%)			
β_t	β_{t+n}	Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	
		g_w	$\frac{g_{ws}}{s/\beta}$	q	g_w	$\frac{g_{ws}}{s/\beta}$	q	g_w	$\frac{g_{ws}}{s/\beta}$	q	
1900-2017	568%	629%	2.8%	1.4%	1.2%	3.7%	1.8%	1.9%	2.0%	1.4%	0.6%
			54	46		49	51		68	32	
1900-1950	568%	556%	0.9%	0.7%	0.1%	1.2%	1.0%	0.2%	0.8%	0.6%	0.2%
			87	13		82	18		73	27	
1950-2017	556%	629%	4.0%	1.9%	2.1%	5.4%	2.2%	3.1%	2.8%	1.9%	0.9%
			48	52		41	59		67	33	
1950-1980	556%	460%	5.0%	2.5%	2.4%	6.9%	3.3%	3.5%	3.7%	2.2%	1.5%
			50	50		48	52		59	41	
1980-2017	460%	629%	3.3%	1.5%	1.8%	4.2%	1.3%	2.8%	2.1%	1.6%	0.4%
			46	54		32	68		80	20	

Notes: This table presents the accumulation of national wealth in Spain for 1900-2017 using the multiplicative decomposition. Computations were done using national accounts and other sources. The Table reads as follows: The annual real growth rate of national wealth in Spain was 2.8% over 1900-2017. This can be decomposed into 1.4% and 1.2% savings-induced and capital gains-induced wealth growth rates, respectively. The table also presents the accumulation of housing and non-housing national wealth (other types of capital and foreign wealth) separately. The small numbers below the savings and capital gains growth rates are the fraction of each in the total growth rate.

TABLE 1.3 – ACCUMULATION OF NATIONAL WEALTH IN SPAIN, 1900-2017 (ADDITIVE DECOMPOSITION)

	Accumulation of national wealth in Spain, 1900-2017 (Additive decomposition)					
	Savings (% total cumulated net savings)			Capital gains (% total capital gains)		
	Housing	Other types of capital	Foreign	Housing	Other types of capital	Foreign
1900-1950	34%	64%	2%	49%	8%	43%
1950-2017	57%	79%	-36%	83%	17%	0%
1950-1980	42%	93%	-35%	70%	-2%	31%
1980-2017	63%	73%	-36%	86%	24%	-10%

Notes: This table presents the accumulation of national wealth in Spain for 1900-2017 using the additive decomposition. National wealth is decomposed into housing, other types of capital, and foreign wealth. The Table reads as follows: Housing accounts for 34% of total cumulated net savings over 1900-1950.

TABLE 1.4 – NET FOREIGN ASSET POSITION OF THE SPANISH ECONOMY (AS A % OF NATIONAL INCOME), 1997-2017

Net foreign asset position of the Spanish economy by institutional sector								
	National Economy	Non-financial corporations	Financial institutions	<i>incl. Central Bank</i>	<i>incl. Other monetary financial institutions (OMFIs)</i>	<i>incl. Other financial institutions</i>	General government	Households and NPISHs
1997	-31%	-26%	7%	12%	-9%	4%	-18%	6%
2002	-43%	-28%	4%	6%	-23%	21%	-28%	8%
2007	-92%	-42%	-39%	7%	-47%	1%	-19%	9%
2012	-115%	-36%	-60%	-35%	-20%	-4%	-26%	7%
2017	-103%	-41%	-23%	-23%	-14%	14%	-52%	13%

(a) Net foreign asset position of the Spanish economy by institutional sector

Net foreign asset position of the Spanish economy by type of asset							
	National Economy	Currency and deposits	Debt securities	Loans	Equity and investment funds	Insurance, pension and standardised guarantee schemes	Other accounts
1997	-31%	-2%	-2%	-5%	-25%	0%	0%
2002	-43%	-20%	0%	-13%	-11%	0%	1%
2007	-92%	-15%	-50%	-18%	-7%	0%	-1%
2012	-115%	-62%	-38%	-23%	4%	0%	4%
2017	-103%	-47%	-41%	-19%	3%	0%	1%

(b) Net foreign asset position of the Spanish economy by type of asset

Notes: This table decomposes Spain's net foreign asset position in five benchmark years. Panel a presents the net foreign assets of the four main institutional sectors, and further decomposes the financial sector in three subsectors. Panel b presents the net foreign position according to the net positions held by Spanish residents in six asset classes. Data is derived from the Financial Accounts compiled by the Bank of Spain.

TABLE 1.5 – REGRESSION OF REAL HOUSE PRICE GROWTH ON INTERNATIONAL CAPITAL FLOWS GROWTH, 2002-2017

	(1)	(2)	(3)
$\Delta\text{CAdef}/\text{GDP}$	0.129 (1.518)		
$\Delta\text{NFAP}/\text{GDP}$		0.069** (2.401)	
$\Delta\text{ND}/\text{GDP}$			0.182*** (2.931)
Constant	-0.004 (-0.813)	-0.003 (-0.637)	-0.001 (-0.329)
R-squared	0.062	0.085	0.200

Notes: This table presents the results from the correlations of the growth in three measures of capital flows (current account ($\Delta\text{CAdef}/\text{GDP}$), net foreign asset position ($\Delta\text{NFAP}/\text{GDP}$) and net foreign holdings of debt securities issued by monetary institutions as a share of GDP ($\Delta\text{ND}/\text{GDP}$)) and the growth in real housing prices. All series are published in the Bank of Spain statistics. Observations are available on a quarterly basis, and range from the last quarter of 2002 up to the last quarter of 2017. Hence, all regressions have 61 observations in total. Newey-West standard errors using four lags are reported in parenthesis.

TABLE 1.6 – ACCUMULATION OF NATIONAL WEALTH IN SPAIN, 1900-2017 (MULTIPLICATIVE DECOMPOSITION)

	(1)	(2)	(3)	(4)	(5)	(6)
CS (Margin)	0.008** (2.623)			0.002 (0.735)		0.002 (0.919)
rr10yr		-0.010*** (-4.778)		-0.008*** (-3.837)		-0.009*** (-3.735)
Δ ND/GDP			0.182*** (2.931)	0.113** (2.298)		
Res. CD					0.159** (2.495)	0.103** (2.093)
Constant	0.000 (0.049)	0.019*** (2.695)	-0.001 (-0.329)	0.014** (2.073)	0.000 (0.023)	0.016** (2.185)
R-squared	0.124	0.398	0.200	0.472	0.145	0.460

Notes: This table presents the results of quarterly regressions of real house price growth on credit standards, real interest rates and the growth in net foreign holdings of debt securities. As a measure of international capital flows, we use the growth in net foreign holdings of debt securities issued by Spanish monetary institutions, excluding the Bank of Spain, measured as a share of GDP (Δ ND/GDP). For credit standards (CS), we use the loan margin reported by Spanish banks in the Bank Lending Survey (BLS) compiled by the Bank of Spain. This margin is specific to loans granted to households for the purchase of dwellings, and should be understood as the spread over a relevant market reference rate (e.g. EURIBOR, LIBOR or the interest rate swap of a corresponding maturity for fixed rate loans), depending on the characteristics of the loan. The survey reports the net percentage of banks that state having higher margins. A positive value for this variable therefore indicates a tightening of credit conditions, while a negative value indicates an easing. We standardize the credit standards variable by dividing by the standard deviation and subtracting its mean based on data for the full sample. For real interest rates we use the nominal ten-year rate of the Spanish public debt, from the Bank of Spain statistics, minus the expected inflation rate reported by a panel of experts from FUNCAS (rr10yr). Nominal housing prices are based on property appraisals and the series is included in the Housing Market Indicators from the Bank of Spain. We convert the series into constant prices using the inflation rate from the Spanish National Institute of Statistics. The CD variable we use is the one included in the Bank Lending Survey (BLS) compiled by the Bank of Spain. The measure is specific to changes in demand of loans granted to households for the purchase of dwellings. The survey tracks the net percentage of banks which report having experienced an increase in the demand for loans in the previous quarter. A positive value for this variable therefore indicates an increase in demand, while a negative value indicates a decrease. We standardize the credit demand variable by dividing by the standard deviation and subtracting its mean based on data for the full sample. Res. CD is thus the residual variable of a regression of our measure of international capital flows (Δ ND/GDP) on our measure of credit demand (CD). Observations are available on a quarterly basis, and range from the last quarter of 2002 up to the last quarter of 2017. Hence, all regressions have 61 observations in total. Newey-West standard errors using four lags are reported in parenthesis.

Appendix

A Introduction

The main challenge of this research has been to build a consistent wealth series for Spain that will cover the lack of an official national balance sheet for the present and the past. This appendix is dedicated to present the key concepts, methods and sources employed.

A.1 Concepts

National income and wealth are two concepts extensively developed in the international accounting systems (SNA-2008 and ESA-2010). Wealth is calculated by providing, for a particular point in time, a balance sheet that records the value of assets economically owned and liabilities owed by an institutional unit or group of units. To carry this analysis, the system of national accounts divides the economy into five resident sectors —households, non-profit institutions serving households (NPISH), financial corporations, non-financial corporations and the general government—, and a sixth sector which corresponds to the rest of the world. For a given resident sector (i.e., personal, corporate, or government sectors), wealth (or net worth) is the sum of non-financial assets plus financial assets, less liabilities: $W_i = A_i^{NF} + A_i^F - L_i$.

At the country level, we follow the two definitions of national wealth used by [Piketty](#)

and Zucman (2014a). The first one, called the "book value of wealth", basically follows the SNA standards by computing, for each resident sector i , their non-financial assets (A_i^{NF}), and adding the net foreign wealth (NFW)⁹. Grouping households and non-profit institutions into the 'personal sector' and financial and non-financial corporations into the 'corporate sector', book-value of national wealth (W_N^B) can be expressed as follows:

$$W_N^B = A_P^{NF} + A_C^{NF} + A_G^{NF} + NFW$$

The other definition of national wealth, named "market value of wealth" (W_N^M), is the sum of personal wealth (W_P) and public sector wealth (W_G):

$$W_N^M = W_P + W_G$$

The link between these two definitions can be traced to the corporate sector. To see this, start with a closed economy, where financial assets cancel out with liabilities, and national wealth equals the national stock of non-financial assets. Given that in an open economy net foreign wealth equals the sum of financial assets A_i^F minus liabilities L_i of resident sectors: $NFW = A_P^F - L_P + A_C^F - L_C + A_G^F - L_G$, then the "book-value of national wealth" equals the market-value definition plus the wealth of the corporate sector:

$$W_N^B = W_N^M + W_C$$

Hence, both definitions of national wealth are equal when the residual wealth of the corporate sector (W_C) is zero or, equivalently, when the famous Tobin's q (Tobin (1969)) formula equals 1.

In this paper, we develop national wealth series based on these two definitions, and provide also an estimate of the residual corporate wealth for the most recent period.

9. In the SNA, the rest of the world sector only holds financial positions, with non-financial assets holdings being accounted as financial. In ESA-2010, non-financial assets of non-residents are classified in AF.519: "Other equity".

A.2 Asset classification

The other major recommendation of the SNA/ESA involves creating a balance sheet that separates between non-financial assets, financial assets and liabilities. In this paper, we have followed the proposed guidelines, although, given the lack of detailed sources, some necessary adjustments have been made. At a country level, we separate between produced and non-produced assets. In the first, we include dwellings, other buildings, infrastructures, machinery, and transport equipment. In the second, we separate between agricultural land, land underlying buildings, and mineral reserves. Valuables (art, antiques, jewelry, etc.) are excluded due to insufficient data. Also, neither human capital nor consumer durables are part of the wealth definition used in this paper. By doing so, we follow SNA/ESA guidelines which do not consider human capital an economic asset, and classify investment in durables as current consumption. Overall, the book value definition of national wealth is based on the sum of these non-financial assets plus the net foreign asset position.

Wealth of the major institutional sectors has also been detailed into separate balance sheets by distinguish between non-financial assets, financial assets and liabilities. In the personal sector, we group households and non-profit institutions serving households¹⁰. Household non-financial assets are presented following a simplified structure around three categories (housing, agricultural land and unincorporated business capital), while financial assets and liabilities are classified by strictly sticking to SNA/ESA principles.

In the general government (or simply, the public sector) we include the central government, the state government ("Autonomous communities" in Spain), the local government as well as social security funds. Public non-financial assets have been divided between produced ones (i.e. the capital stock of buildings, infrastructure, etc.) and non-produced one (basically, forest land and land underlying buildings). Then, for the historical period, we proxy financial assets by the value of state-owned equity holdings (for example, the public railway company RENFE) plus financial assets owned by social security funds. Finally, the liabilities include

10. For the sake of brevity, in what follows, we refer to households in a broad sense that includes non-profit institutions serving households.

the market-value of public debt and the technical reserves of the funded pension system.

The other institutional sectors cannot be analysed in such detail. The available data makes possible to calculate Spain's net foreign wealth, although it is only feasible to differentiate between assets and liabilities from 1971 onwards . Information on selected corporate assets and liabilities are used as an auxiliary source in this paper, but presenting a complete balance sheet for both non-financial and financial institutions is only possible for the most recent period.

A.3 Time coverage

This paper reconstructs the balance sheet for the Spanish national economy and for the selected institutional sectors (personal, government and foreign sectors) since 1900. Our results start at beginning of the twentieth century, since it is only at this period when it is possible to obtain the basic sources to compute wealth aggregates. Some very conjectural estimates could be made for the preceding century, but we have preferred to provide only results based on homogeneous series. It is also worth pointing that we do not provide any figures for the Civil War and the immediate following year (1936-1940), given that most statistics do not include references for this period. Besides, the whole concept of wealth seems difficult to assess at that time. On the one hand, most of household assets (land, dwellings and financial securities) lacked any organized markets, as the stock market was closed and very few real estate transactions were carried, and so imputing representative prices seems almost impossible. Besides, with two competing forces fighting over Spain, each with different government structures, debts and currencies, establishing the size of the public sector is not as straightforward as in other periods of history.

Another important point that should be kept in mind refers to the period of observation of our wealth variables. Generally-speaking, non-financial assets are measured as mid-year averages in the original sources, while financial claims are valued at the end of the year. To provide a convergence between both, we make a mid-year average of financial assets and liabilities by making a simple mean between the values of year t and $t - 1$.

B Domestic assets

B.1 Produced assets

Our estimate of produced assets covers the ESA-2010 category of fixed assets (AN.11), which includes dwellings, other buildings and structures, machinery and equipment, weapons systems, cultivated biological resources, and intellectual property products. Inventories (AN.12) and valuables (AN.13) are excluded from this category, and thereby not considered in our book-value estimate of national wealth. This omission is not a major problem, as data from other countries show that both assets represent a relative small share of national wealth ¹¹.

Ideally, fixed assets should be measured through the 'census-like' approach, which multiplies the observed quantities of each asset type by their corresponding market prices. In practice, however, direct observation of some fixed assets may be difficult, especially for the corporate and the general government sectors. Due to this reason, the SNA-2008 recommends its measurement using the "perpetual inventory method" (PIM). The basic principle of this method is that asset values can be estimated by cumulating historical flows of investment, corrected for depreciation, and adjusted at current market prices. More concretely, to obtain the capital stock in year $t + 1$ (C_{t+1}) from an initial value of the capital stock in year t (C_t), the PIM adds the investment flow in year $t + 1$ (I_{t+1}) and detracts the depreciation of existing capital in year $t + 1$. If we name δ the depreciation rate of existing capital, the accumulation method can be expressed in the following form:

$$C_{t+1} = C_t + I_{t+1} - \delta \frac{C_t + I_{t+1}}{2}$$

Hence, for implementing this method, three elements are crucial: an initial estimate of the value of an asset type, high-quality series of investment flows and prices, plus depreciation rates over time.

11. For example, in France valuables and inventories have, respectively, fluctuated around 21-26% and 4-14% of national income. Since 2002, the Survey of Household Finances of the Bank of Spain covers valuables owned by individuals. Results point to a very low share (c. 1%) in total household wealth.

Unfortunately, the SNA-2008 does not provide strict guidance to national statisticians on which specific procedure to follow when implementing the PIM, something which may obstruct the international comparison of produced assets. Depreciation rates depend on the age efficiency and the retirement profiles of assets, and different assumptions about them will imply different depreciation patterns. Nevertheless, the SNA-2008 refers to the [OECD \(2009\)](#) manual, which explores in greater detail the practical implementation of the PIM, and gives some particular recommendations. Importantly, the OCDE advises to use geometrical patterns of depreciation "because they tend to be empirically supported, conceptually correct and easy to implement" ([OECD, 2009](#), p. 12). Given that the use of initial levels of produced assets and the quality of investment series are an empirical matter (and not a conceptual one), the advice to use "geometric patterns" indeed points towards homogenizing the international implementation of the PIM.

In this paper, we implement the perpetual inventory method for the period 1850-2017 using data on investment flows and investment prices from [Prados de la Escosura \(2016a\)](#) and [Prados de la Escosura \(2017\)](#) for four groups of fixed assets: dwellings, other constructions, machinery and equipment, and transport equipment¹². However, we only provide results from 1900 onwards for two reasons: first, it is since 1900 when we can also estimate the stock of non-produced assets; and second, any mismeasurement of the initial stock of produced assets at 1850 will have a negligible impact on the PIM estimates from 1900 onwards.

We are not the first study using this type of approach to reconstruct produced assets in Spain and we have benefited greatly from previous analyses. Most notably, [Prados de la Escosura and Rosés \(2010\)](#) estimate the stock of produced assets for the same four asset categories for the period 1850-2000, while [Mas Ivars, Perez García, and Uriel Jiménez \(2000\)](#) and the group of researchers at the IVIE institute ([Mas, Pérez García, and Uriel \(2005\)](#), [Mas Ivars, Perez Garcia, and Uriel Jimenez \(2011\)](#), [Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo \(2015\)](#)) decompose this stock into 17 different categories from 1964 onwards. However, we decide to compute our own estimate to incorporate the

12. Machinery and equipment is a broad concept that includes "agriculture" and "other" assets, plus intellectual property since 1995.

latest recommendations from [OECD \(2009\)](#) on the use of geometric patterns of depreciation, and, also, to include the recently available data on Spain's historical national accounts from [Prados de la Escosura \(2017\)](#).

Regarding the geometric pattern of depreciation, we stick to the "double-declining balance method" ([OECD, 2009](#), p. 52), where the depreciation rate of an asset i takes the following form: $\delta_i = \frac{2}{T_i}$, with T_i being the average service life of asset type i . This depreciation pattern coincides with the one adopted by the IVIE institute since 2011, but differs from [Prados de la Escosura and Rosés \(2010\)](#) approach, who use the "modified" geometric pattern as an in-between approach of the arithmetic and the geometric patterns.

To choose the service life (T_i) for each of the four groups of assets, we take the values from [Prados de la Escosura and Rosés \(2010\)](#) in Table 1 of their paper. In line with them, we also divide the asset lives into three broad periods (1850-1919, 1920-1959 and 1960-2000), to capture the diverse evolution of assets lives over time (i.e. certain asset types depreciate much faster nowadays than in the 19th century). However, we make a further correction. For the three asset types which service lives change over time (only "Dwellings" have a constant service life of 70 years over the period 1850-2000), we do not assume that service lives are constant over the mentioned periods and, then, suddenly change from one period to the next one. Doing this would affect the estimate of produced assets by the PIM, as in the years when a new period is introduced there is a sudden increase in the amount of capital depreciated as a result of lower service lives in the most recent periods. Instead, we set the average service live of an asset type at the middle of the mentioned periods, and link the three periods using linear interpolation, therefore smoothing the evolution of service lives over time. Given that the middle year of the period 1960-2000 is 1979, we add an extra benchmark year in 2007. For this year, we use the service lives profile for "Machinery and equipment" and "Transport equipment" used by Denmark in its national accounts ([Görzig, 2007](#), table 6)), and keep constant the service life profile of "Other constructions". We use the Danish service life profile as it is in line with the one used in this study. In the robustness checks section we compare the evolution of produced assets using constant versus varying service lives.

One important difference in this paper with respect to [Mas Ivars, Perez García, and Uriel Jiménez \(2015\)](#) relates to the use of the historical series of investment flows to implement the PIM. In this study, we employ the reconstruction of Spain's national accounts from [Prados de la Escosura \(2017\)](#) for the period 1850-2017, who revises and updates his previous series of GDP (1850-2000) with a new interpolation method to splice historical national accounts. This method is designed to overcome the problems of the conventional 'retropolation' approach, which overstates the level of investment and of other components of GDP in the past, and underestimates their growth over time ([Prados de la Escosura \(2016b\)](#)), especially when official national accounts started to produce estimates for countries that had not completed their structural transformation towards modern, service-oriented economies. Applying the perpetual inventory method with retropolated investment series—as it is the case in the IVIE institute—, inflates artificially the initial stocks of fixed assets, and shows lower growth rates (i.e. a flatter posterior development).

We use the same values than [Prados de la Escosura and Rosés \(2010\)](#) for the initial value of the stock of produced assets in 1850, with a stock of fixed asset equivalent to 86% of national income. In their paper, Prados de la Escosura and Rosés choose this value by applying a 'steady state' formula, where fixed assets equal the value of investment over the sum of capital depreciation rates and GDP growth rates around 1850 which, then, they multiply by two. This value may contain an important degree of uncertainty. However, this choice has little incidence on the performance of the PIM after some decades, as ([Prados de la Escosura and Rosés, 2010](#), figure 1) show: by 1890, any assumption about the initial stock of fixed assets in 1850 has almost no impact on the PIM estimate. Hence, by presenting our results from 1900, we avoid any mismeasurement in our PIM series derived from the choice of an initial stock of fixed assets.

A final adjustment has to be made on our PIM series to account for war destructions during the Civil War period (1936-1939). We take the percentage of capital destroyed from ([Prados de la Escosura and Rosés, 2010](#), pg. 144): Transport equipment (40%), machinery and equipment (13%), buildings (4%) and infrastructures (6%). Given that we do not distinguish

between buildings and infrastructures but between dwellings and other buildings, we assume 4% destruction for dwellings and 5% for other buildings (average of 4 and 6%).

B.1.1 Housing. In this paper, we estimate the value of housing from two perspectives. First, we estimate the total market value of the housing stock using the 'census approach', which captures both the value of the structure (produced element) and the land underlying (non-produced element). Second, we estimate the value of the structure by estimating the value of dwellings following the PIM previously discussed. As an specific consideration to the housing sector, we assume that the asset life of dwellings is 70 years (as in [Prados de la Escosura and Rosés \(2010\)](#)), and that, following the "double-declining balance method", the annual depreciation rate is 2.9% (i.e. two divided by seventy). One additional element has to be considered when applying the PIM to housing investment data, as these data include commissions from existing home sales. In the United States ([Davis and Heathcote \(2007\)](#)), the Bureau of Economic Analysis quantifies the impact from including commissions in the value of the replacement cost of dwellings in 8.5 per cent. In Spain, we are not able to quantify the value of these commissions so we do not correct our series. As a result, our estimate of dwellings using the PIM may be somewhat overestimated.

Our initial point is to estimate the total market value of the housing stock, including both the structure and the land underlying. Although this asset is probably the most important component to study wealth in Spain from long-term perspective, unfortunately, the quality of sources and the methods employed vary notably during the 20th century, and clearly more research is needed for the past and the present. Housing wealth during the period of 1900 to 1954 is calculated by multiplying, at a provincial level, the number of dwellings by the average prices recorded by property registrars. The number of houses can be obtained from the decennial censuses and interpolating for the years in between. From 1900 to 1930, figures are derived from the oldest and simplest survey, the Nomenclator, which recorded the total number of buildings at a local level, differentiating both between dwellings and other

types of constructions¹³. After the Civil War, the information is of higher quality, as the government started in 1950 to carry a modern housing censuses on decennial intervals¹⁴. The only adjustment relates to the destructions caused by the Civil War. We assume that from 1931 to 1935 the building activity continued at the same rate as in the preceding decade, and afterwards 5% of the housing stock was destroyed between 1936 and 1939. The resulting trend is very similar to the 250.000 housing units that contemporaries estimated that were destroyed during the Civil War ((Tafunell, 2005, pg. 463)).

From 1900 to 1954 housing prices have been derived from the Registrars' Yearbook (Ministerio de Gracia y Justicia (1910)). This source has already been used by Carmona, Lampe, and Rosés (2014) to construct a hedonic index of housing prices. Our computations are slightly different in two aspects. First, in this paper we are only interested in market prices, and so we exclude post-mortem transmissions and other special transactions. Secondly, given that there is hardly any difference between the evolution of their hedonic price index and real prices, we simply opt to compute housing prices by making a simple average in each province. Nonetheless, it should be noted that the original source is plagued by small typographical errors that most times do not alter results. The only exception occurs in 1910 and 1927, when results seem highly implausible and thus we opt to interpolate linearly with the nearest two years. Finally, housing wealth has been calculated by multiplying the number of units by the average price at a provincial level.

Although property registrars' have continued to publish the same statistics until the present, the legal changes that occurred in Spain from 1950s onwards makes highly advisable to use alternative sources. Until that moment the real estate market had been dominated by a system of vertical property (i.e. the building and the underlying land could only have one owner), but since the 1950s there was a transition to a system of horizontal property and ownership became gradually extended. Unfortunately, property registrars did not change their data format, and therefore it is not possible to distinguish buildings and single apartments in

13. [Direccion General de Estadistica \(1924\)](#); [Direccion General del Instituto Geografico, Catastral y de Estadistica \(1933\)](#)

14. [INE \(2011\)](#); [INE \(2001\)](#); [INE \(1995\)](#); [INE \(1986\)](#); [INE \(1976\)](#); [INE \(1962\)](#); [INE \(1953\)](#)

transactions.

As an alternative, we have assumed that since 1954 and until 1975 the change in housing wealth (i.e. dwellings multiplied by nominal prices) followed the same trends than the housing rents recorded in the national accounts (IEF (1969); INE (1971); Instituto Nacional de Estadística and Ministerio de Economía y Comercio (1982)). We have compared our estimate with the one provided by the Universidad de Deusto (1968) for 1965, and the results are broadly in range. However, we do hope to improve the results for this period in future versions.

For the most recent era (1975-2015), we provide a more accurate estimate of housing wealth using new statistics. Presently, there are two main sources on the market value of housing: the *Indicadores del Mercado de Vivienda* of the Bank of Spain (1987-2015) and the BBVA Foundation report of Pérez and Uriel Jiménez (2012). Both sources follow a similar methodology by multiplying the total constructed area by the average price. These two metrics are expressed in square meters. Surface area is computed in both studies using the census of dwellings, and both obtain almost identical results¹⁵. For constructing our series of housing wealth, we use the Bank of Spain's series, since it covers a longer period (1987-2015) than the work of Pérez and Uriel Jiménez (2012)¹⁶.

For calculating the average price per square meter, both studies use the series of average prices elaborated by the Ministry of Public Works based on property appraisals. However, whereas the Bank of Spain uses the average price of free housing, Pérez and Uriel Jiménez (2012) use both the average price of free and social housing. As this latter method is more accurate, we use the data provided by Pérez and Uriel Jiménez (2012) for constructing our series of housing wealth. However, the shortcoming of using this latest one is that it does not cover the period after 2010. Thus, for the period 2011-2015, we directly use the series of average price of free housing of the Ministry of Public Works, and adjust for social housing by multiplying prices by the price ratio between free and social housing over the average free

15. In order to know the exact methodology followed to construct this series see the definitions' appendix of *Indicadores del Mercado de Vivienda* and Uriel Jiménez (2009) for the series included in the 2012 report of *Fundacion BBVA*.

16. We thank Jorge Martinez Pages for sharing the series on the total constructed area, since it is not directly available in *Indicadores del Mercado de la Vivienda*.

housing price in 2010.

Until now we have explained how we construct our series of housing stock for the period 1990-2015. We complete the series backwards to 1975 using the nominal house price index (1975-2015) used in [Mack and Martínez-García \(2011\)](#). These authors provide two versions of a housing price index. From 1986 to 1994 they use the price series produced by the Ministry of Housing (1986-1994) on the average price on all dwellings types (new and existing), and from 1995 onwards the already mentioned series of the Ministry of Public Works. For the period 1986-2015, the two series are virtually identical, but for from 1975 to 1986 they show considerable differences. The first annual house price series was the one produced by Tecnigrama, which measures average prices for all dwelling types located in Madrid. The second series is the one constructed by [Taltavull de La Paz and Juárez Tárraga \(2015\)](#), based on mortgage loan data from the National Statistics Institute (INE). Although in theory this latter one should be more accurate, the truth is that it shows an implausible fall of more than 50% in housing prices in the early 1980s. For this reason, we use the data series derived from Tecnigrama, since we believe that it better captures the trend in Spanish housing prices between 1975 and 1985.

One final adjustment needs to be done to link the 1975-1986 series with the 1986-2015 data. First, we divide the housing wealth series that has already been obtained by the stock of dwellings in 1990, the reference year of the census. Secondly, we extend the results backwards in time based on the growth rate in the volume of dwellings, according to other census data (1970 and 1980). Finally, we obtain the value of the housing stock by multiplying the estimated volume of dwellings by the nominal house price index in each year.

B.1.2 Other produced assets. Besides dwellings, we estimate three other components of fixed assets using the PIM: other constructions, machinery and equipment, and transport equipment. The correspondence between these categories and the ESA-2010's decomposition of fixed assets (AN.11) is as follows: "Other constructions" is equivalent to "Other buildings and structures" (AN.112); "Machinery and equipment" incorporates the equally named category

in ESA-2010 (AN.113) as well as "Weapons systems" (AN.114) and "Cultivated biological resources" (AN.115). In addition, from 1995, "Machinery and equipment" includes "Intellectual property products" (AN.117). Finally, as a separate category, we present estimates of "Transport equipment", which correspond to the equally named group of assets (AN.1131) in ESA-2010.

To implement the PIM on these three asset categories we follow the procedure explained before, using the asset lives of ([Prados de la Escosura and Rosés, 2010](#), pg. 145)) and applying the "double-declining balance method" of depreciation. Furthermore, we decompose the category "Other constructions" into non-residential buildings and structures. To do this, we use information on non-residential buildings from the latest IVIE study of Spain's produced assets ([Mas Ivars, Perez García, and Uriel Jiménez \(2015\)](#)), where "Other constructions" (category 1.2) are decomposed between economic structures (categories 1.2.1 to 1.2.6) and other types of constructions (category 1.2.7), the latter capturing non-residential buildings. During the years for which the IVIE carries this analysis (1964-2013), the share of non-residential buildings on "Other constructions" was relatively stable, ranging from 66% in 1964 to 71% in 2013. For this period, we use IVIE's share of non-residential buildings and we apply it to our estimate of "other constructions". Then, to extend this decomposition backwards to 1900, we assume that the share of non-residential buildings was constant at 65%. For the years 2014-2017, we assume that this share was equal to the last year in IVIE's data: 2013. Although this is the best approximation we could come up with to decompose "Other constructions" between structures and non-residential buildings, these values should be viewed as a rough approximation, particularly during the period 1900-1963. If better data become available in the future, our figures would be revised accordingly.

B.2 Non-produced assets

Non-produced assets, as defined by ESA-2010, can be divided into three broad categories: Natural resources (AN.21), Contracts, leases and licences (AN.22) and Purchases less sales of goodwill and marketing assets (AN.23). In this study, we estimate the value of all natural resources (AN.21) but, due to lack of information, we do not cover the latter two categories:

AN.22 and AN.23. Nevertheless, the value of these two categories in other countries is very small (i.e. in France, they represent between 4% and 6% of the total value of non-produced assets over the period 1978-2014). Hence, by assessing the value of natural resources, we are already capturing almost all non-produced assets.

B.2.1 Agricultural, pastoral and forest land. The valuation of agricultural land involves the use of various sources of diverse quality. For the first period, that starts at the beginning of the 20th century and lasts until the outbreak of the Civil War, we start by gathering estimates on the surface of arable, pastoral and forest land by crop type (Gallego Martínez, Roca Cobo, Sanz Fernández, Zambrana Pineda, and Zapata Blanco (1983)). The original series only provides surfaces in hectares for some specific benchmark years (1900, 1910, 1922 and 1931), from which we construct an annual estimate by making a linear interpolation for the years in between. The challenge then lies in linking these data with a reliable series of land prices, a fact that has always been problematic in Spanish history given the late development of its fiscal cadastre. As an alternative, we use the land prices per hectare and crop published by Bringas Gutiérrez (2000), who carried an extensive survey on property auctions for a period ranging from the early 19th century until 1935 using also benchmark years (1905, 1915, 1920, 1925, 1931 and 1935). From his data, we thus construct an approximate land price index by interpolating the values in between. Thereafter, we relate both magnitudes (arable land by crop and average price per hectare and crop) to estimate the total value of agricultural land.

After the Civil War the quality of statistics declines substantially. High inflation, the development of a black market of foodstuffs and the lack of any rigorous fiscal control makes more difficult the assessment of agricultural land prices. Later, the situation improves, and by 1963 the research team of the University of Deusto made a detailed estimate of Spain's land prices using the first results provided by the agrarian census carried by the government the year before¹⁷. This impressive work was later replicated by the Ministry of Agriculture in

17. Although the wealth estimate of Universidad de Deusto was referred to 1965, their series on agricultural wealth was done for the year 1963 ((Universidad de Deusto, 1968, pg. 190)). When upgrading their estimates,

1970, 1972, 1974 and 1976 ([Ministerio de Agricultura, Pesca y Alimentacion \(1975\)](#)). As for the most recent period, the available data are far less problematic. The Ministry of Agriculture published a first preliminary survey on land prices for years 1979-1983 ([Sánchez and Igueu \(1986\)](#)), which thereafter has been upgraded and made permanent ([Ministerio de Agricultura, Pesca y Alimentacion \(1984\)](#)). Our calculations for the 1960s and 1970s take these estimates and interpolate for the years in between. Since the 1979 till the present day we multiply the weighted average price per hectare by the utilized agricultural area.

Linking the 1935 and 1963 estimates is more problematic. As a solution we considered that land surface stayed unchanged and that the evolution of prices per hectare followed the patterns of the indemnity paid by the public National Institute of Colonization to private landowners through this period ([Gomez Manzanares \(1979\)](#)). Some caution should be taken when using this land price index. While historians ([Mangas Navas and Barciela \(1990\)](#)) agree that public indemnities were generous (i.e. near market conditions), it is also true that the available data do not take into account differences between regions or crop types. Besides, the land price index shows some very questionable results in its first two years (1942 and 1943), pointing to decline in nominal prices in a context of high inflation. Given that these figures are very difficult to justify, we have opted to make our last direct estimate in 1944, when agricultural land amounts to 212% of national income, and extrapolated this ratio for the preceding three years (1941-1943).

B.2.2 Mineral and energy reserves. Historically, the importance of subsoil assets in Spain has been very limited when compared to other countries. Oil and natural gas reserves have been almost inexistent ([Tortella, Ballestero, and Díaz Fernández \(2003\)](#), [Diaz Fernandez 2014](#)) and only mining and quarry have had some minor contribution to Spain's total production. Unfortunately, we do not count with data on the amount of these reserves so we multiply the value added from these industries by a factor of six, as already explained. This procedure is highly conjectural, but given that the value added from these industries has

the authors assumed that land prices remained constant in value, something implausible at a time of relative high inflation (c. 10% per annum). For this reason, we use their data as referring to 1963.

been below 2% of Spain's total GDP, any inaccuracy should have an almost negligible effect on our national wealth series.

B.2.3 Land underlying buildings. Finally, we need to account for the value of land underlying buildings. This part of the analysis is of special importance given the increasing role of land under constructions in advanced economies, as recently shown for the housing sector by [Knoll, Schularick, and Steger \(2017\)](#). For dwellings, this procedure is simple, we apply the residual approach suggested by the OECD and Eurostat ([\(OECD and Eurostat, 2015, pgs. 78-80\)](#)), which consists of detracting the perpetual inventory method estimate of the value of dwellings from our census-like estimate of housing. In this manner, we obtain a decomposition of housing between land and structure for the period 1901-2017. We are the first study which decomposes housing wealth in Spain into land and structure using the 'residual approach' for a period over a century, but we have benefited from the study of [Uriel Jiménez \(2009\)](#) and [Pérez and Uriel Jiménez \(2012\)](#), who apply this same method for the period 1990-2010.

Incorporating the value of land underlying non-residential buildings is a more complex exercise given the absence of census-like estimates for these assets. We start by dividing our estimate of "Other constructions" between economic structures (i.e. roads, ports, bridges, etc.) and buildings, using the decomposition of this same category in [Mas Ivars, Perez García, and Uriel Jiménez \(2015\)](#) for the period 1964-2014. Over these years, this decomposition is relatively stable (around 65-70% of the total being economic structures), so that we assume a constant share over the previous period too. To account for land underlying non-residential buildings, we use the valuation of residential and non-residential buildings in the most recent years from the Spanish cadastre (2006-2014), which already subsumes the value of both land underlying buildings and its structure. Interestingly, over these years the relative value of non-residential buildings on total buildings was relatively constant at around 45%. As in other countries, cadastral sources do not capture accurately the market valuation of buildings but we use it to compare the relative value of housing versus non-residential buildings. By doing

so, we account for the share of land in residential buildings with respect to non-residential ones. To extend this relation backwards we use as a reference the evolution of land in the case of housing. Overall, the most conflicting estimates of non-financial assets are subsoil assets and land underlying non-residential buildings, which together represent between 4% and 16% of the total value of non-financial assets over the period 1901-2017. In our opinion, the general trend of these two assets is correctly captured by our estimates while any imprecision in their level is not having a decisive effect in our total estimate of non-financial assets. Nevertheless, we admit that this procedure is subject to improvement and if better data become available we will update our series.

C Personal wealth

C.1 Non-financial assets

The modern SNA distinguishes a broad range of non-financial assets. However, given the lack of homogeneous sources, we group household assets into three main categories: housing, agricultural land and unincorporated business capital.

C.1.1 Housing. To be consistent with the sectoral division of the SNA/ESA, we adjust housing wealth by excluding dwellings that do not belong to the personal sector. Given the lack of data on housing ownership trends, it has been assumed that during the period of 1900-1975 all houses were held by individuals. This fact is in accordance with the anecdotal evidence that exists for some cities ([Chumillas \(2002\)](#)), and also with the results of the 1970 census, which pointed out that 95% of dwellings were owned by households.

After, we use the census of dwellings to measure household ownership on a decennial basis and interpolate for the years in between. Holdings by corporations and the general government are stated in these statistics. Unfortunately, information on houses owned by non-residents is scarcer, although the anecdotal evidences points that they might have a significant part in coastal and touristic areas. As a first approach, we use the statistics on housing transactions of the Ministry of Public Works for the period of 2006-2015. This data

set reports the transactions in which non-residents were involved (c. 1% of the total), from which we compute a three-year moving average. This share is directly deducted from the housing wealth for the latest decade, and for the years prior to 2006 we apply the average ratio of the period 2006-2015.

Also, it must be emphasized that even though in this paper personal wealth includes both households and non-profit institutions, our series of housing wealth only report in a consistent manner the dwellings owned by households. The reason has mostly to do with the lack of information, as the 1991 census was the only that reported separately the dwellings owned by non-profit institutions. Since in that year the share owned by this sector amounted to only 0.1% of the total housing stock, we believe that it makes very little difference between including or excluding dwellings owned by non-profit institutions.

C.1.2 Agricultural land Using the value of agricultural land, we calculate the ownership of different institutional sectors through history. Households have been the main owners of agricultural land in Spain, although the government and corporations have owned an increasing share. For the period prior to the Civil War, there are some estimates on the area covered by public forests (Gallego Martínez, Roca Cobo, Sanz Fernández, Zambrana Pineda, and Zapata Blanco (1983)), from which we prefer to use a constant value of 6.5 million of hectares (around 14% of total land), which is then multiplied by the average price of forest land (Bringas Gutiérrez (2000)). As we explain later, during Francoism there was a sustained increase in the land in the hands of public institutions, until it reached 25% of the total in the 1972 census. Public ownership of agricultural land has remained almost unchanged until now.

Data on corporate ownership of agricultural land is far scarcer. Before the Civil War there is no systematic information on ownership patterns, so we rely on the results of the special survey carried in 1932 by the Second Republic (*Registro de la Propiedad Expropiable*) to carry the agrarian reform. Results gathered by researchers show different regional patterns, but overall it is safe to say that around 1% of total land was in the hands of corporations¹⁸. We

18. (Mata, Albert, Amaro, Cottureau, and Ferrera (1985); Muñoz, Serrano, and Roldán López (1980); Romero González (1982))

apply this same ratio for the years from 1905 to 1941, which then gradually increases up to 4% in 1972 and then, following the results of the most recent agrarian census, up to 8% by the turn of the century.

C.1.3 Unincorporated business capital The unincorporated sector includes all productive assets held directly by individuals (i.e. farmers, merchants, industrialists, entrepreneurs, etc.), as sole proprietorships and partnerships. For practical reasons, during the period of 1905 to 1980 assets employed in the agricultural sector with respect to the rest of the economy are calculated separately.

C.1.3.1 Farm capital In the modern system of national accounts, farm capital basically includes livestock (animal resources yielding repeat products), other buildings, machinery and equipment. Prior to 1964 the first asset class has been calculated drawing on the census compiled and reviewed by the [Gallego Martínez, Roca Cobo, Sanz Fernández, Zambrana Pineda, and Zapata Blanco \(1983\)](#) that classifies livestock species (horses, cattle, sheep, etc.). Each kind are then related to the average price reported in two benchmark years (1910 and 1919) by [Cascón \(1934\)](#) and [Ceballos Teresi \(1921\)](#), and later with the estimate for 1963 of the Universidad de Deusto. Given that we have still not found more systematic price series of livestock for other periods, we have opted to make a provisional estimate that relates the value of livestock to agricultural land (i.e. 10% in 1919) and extend the results for the missing years.

The estimate on farm fixed assets follows a similar reasoning, except that data is of inferior quality. [Cascón \(1934\)](#) provides a full balance sheet for various farms in 1910, which points that farm machinery amounted to 27 pesetas per hectare on average (or 1.7% the value of agricultural land). For the early 1930s, [Carrion \(1932\)](#) gives a more rough estimate of 50 pesetas per hectare (c. 2% the value of agricultural land), while the researchers of the Universidad de Deusto provide for 1963 a detailed assessment of Spanish farm capital that amounts to 2.5% of agricultural land. These three estimates are in accordance with the prevailing idea that Spanish agricultural became increasingly mechanized.

Reconstructing farm capital (including both livestock and machinery) from 1964 until 1980 is easier, given that [Mas Ivars, Perez García, and Uriel Jiménez \(2015\)](#) provide a detailed estimate of the capital stock that quantifies the value of non-financial produced assets in the primary sector. Interestingly, their results are very similar to the ones provided by the Universidad de Deusto and the Ministry of Agriculture on some particular years (1965, 1967, 1969, 1970, 1972 and 1976).

Farm capital is then divided by institutional sectors. The basic assumption is that ownership trends follow the same evolution as with agricultural land, with households initially holding 85 per cent of farm capital in 1905 and then progressively been reduced up to 50 per cent in the present day.

C.1.3.2 Non-farm capital To estimate non-farm business assets it is not feasible to conduct a similar approach, given the lack of the most basic accounting information until the recent period. As an alternative, non-farm asset is calculated from 1900 to 1980 by first drawing the mixed income of sole proprietorships and partnerships, then separating labour and capital returns and finally capitalizing this last series by the corresponding rate of return. Estimates for the later period (1981-2015) are more straightforward the series has been computed by extending the results from the Survey of Household Finances.

During the period of 1900 to 1980 the mixed income of non-farm entrepreneurs has been estimated differently in two sub-periods. From 1900 to 1954, the basic data source is provided by the industrial tax [*Contribucion industrial, de comercio y profesiones*]. This tax consisted on a fixed rate that was levied on non-farm economic activities according to some basic indicators (type of industry, location, number of employees, etc.). The tax was imposed to all partnerships and individual entrepreneurs, but corporations were exempted and thereby assigned to a new tax [*Contribucion de Utilidades*]. Thus, although the evaluation of the industrial tax was somehow crude and simple, it has been used by historians to analyse the industrialization process and regional inequality in Spain ([Betrán Pérez \(1999\)](#); [Rosés, Martínez-Galarraga, and Tirado \(2010\)](#)).

These statistics include the number of taxpayers and the tax paid, classified both by region and economic sector ([Direccion general de Contribuciones \(1900\)](#); [Direccion General de Contribuciones y Regimen de Empresas \(1956\)](#); [IEF \(1990\)](#)). Thus, to calculate actual income it has been assumed that the tax amounted, on average, to a rate that fluctuated between 3 to 7 per cent of earnings during this period. The imputed rate has been set at a slightly lower bound than the one imposed to the smallest joint-stock corporations and in accordance with changes in tax legislation¹⁹.

Income for non-farm entrepreneurs for the period of 1954 to 1980 have been derived from Spanish national accounts ([IEF \(1969\)](#); [INE \(1971\)](#); [INE and Ministerio de Economia y Comercio \(1982\)](#))

As it was mentioned before, the resulting series corresponds to the mixed income earned by entrepreneurs. Therefore, a standard separation between labour and capital income has been carried according to the factor shares provided by [Prados de la Escosura and Rosés \(2009\)](#) on the Spanish economy. Finally, capital income has been capitalized by the return on equity of non-financial companies, as stated by [Tafunell \(2000\)](#), to arrive to the value of unincorporated business assets.

From 1981 to 2015 two basic sources have been used to calculate unincorporated business assets: the Survey of Household Finances (SHF) ([de2004encuesta](#) for 2002-2014) and Central Balance Sheet Data Office of non-financial corporations ([Banco de España \(1990\)](#) for 1982-2016). For years 2002 to 2014 information on household wealth is clearly more abundant and of higher quality due to the availability of SHF micro-data. The SHF reports the value of unincorporated business assets declared by households for some specific benchmark years (2002, 2005, 2008, 2011 and 2014) . However, since household surveys tend to underestimate the market value of virtually all asset classes (financial claims, housing, etc.) due to under-coverage of the wealthiest sectors or misreporting ([Hurst, Li, and Pugsley \(2014\)](#); [Vermeulen \(2016\)](#)), the declared values on unincorporated business have been upgraded. Basically, the share of

19. The imputed tax rate varies across time. It stands at 5% from 1900 to 1919, rises to 6% with the fiscal reform of 1920 and then to 7% with the second reform of 1932. After the Civil War, the imputed tax rate is of 6%, which thereafter decreases to 4% in 1946 and 3% by 1950. The details to make such assumptions have been derived from ([Direccion General de Contribuciones y Regimen de Empresas, 1956](#), pgs. 2-3).

unincorporated business assets (excluding agricultural land) over housing, as computed from SHF micro-data, has been multiplied by the aggregate value of dwellings held by households, as calculated by other sources (see next section). The rationale behind this process is that the bulk of unincorporated assets are invested in commercial property (office buildings, businesses premises, undeveloped land, etc.) and, thus, the degree of underreporting should be similar as with dwellings. Overall, the resulting figures are on average 23% higher than the raw data reported in SHF micro-data. The ratios provided in the SHF surveys have been interpolated for the years in between (i.e. 2003-2004; 2006-2007, etc.) and multiplied by the value of household dwellings.

The major challenge involves extrapolating these results backwards for years 1981-2001. The basic assumption taken is that unincorporated business assets followed the same trends as non-financial assets of non-financial companies, the latter being reported by the Central Balance Sheet Data Office of the Bank of Spain (more information in the section on corporate wealth in this appendix).

C.2 Financial assets

Sources on financial assets and liabilities are in general much more detailed. Since December 1980 until the present we use the Financial Accounts of the Spanish Economy published by the Bank of Spain. Basically, there are two set of statistics: one based on ESA-95 (1980-1994), and another constructed with ESA-2010 (1995-2017). From 1970 to 1979 data is quite similar, albeit of inferior quality ([Banco de España \(1986\)](#)). The main difference lies in the fact that the statistics published at the time were only a first estimate that, to our knowledge, have never been updated or revised. The most important drawback is that the balance sheet for non-financial corporations and households were consolidated into one group, but also it seems evident that the equity holdings of the public sector were being considerably underestimated. For these reasons, we have adjusted this dataset with the available data.

In contrast, for the period 1900 to 1969 we had to construct new estimates. This process basically involves taking the aggregate volume of each asset type, and then computing

households' share by deducting the holdings of other institutional sectors (mostly corporations or the public sector). Besides using previous research carried by historians, our main sources are financial yearbooks and the published balance sheets of banking and insurance companies.

C.2.1 Currency and deposits. Our basic reference is [Martín Aceña \(1985\)](#) and [Martín Aceña \(1988\)](#), who presents Spanish money aggregates differentiating between currency, bank accounts, bank deposits and savings banks deposits for the period between 1900-1962. Later, for 1963 to 1969 we use the official data published by the Bank of Spain to extend his series. Both datasets have been elaborated by including only money held by the public (including households, non-financial corporations and the public sector, but excluding financial institutions). The financial accounts of the 1970s present similar data, but bring together households and non-financial institutions, while those elaborated after 1980 differentiate between both sectors.

Using these results, we calculate for the historical period the share held by households on total money aggregates. For currency, this process is straightforward. Financial accounts presently show that almost all bank notes and coins (around 96%) held outside financial institutions correspond to households, so we extend backwards this ratio considering that it has been constant over time. With bank accounts and bank deposits we follow a similar procedure, using different ratios (50% and 80%). Finally, regarding savings banks' deposits we simply opted to assign all to households, given that these financial institutions were mostly designed to serve low and middle-income families at that time.

C.2.2 Debt securities. The stock of debt securities corresponds to the aggregate value of bonds issued by the public sector and corporations. Due to practical reasons, both set of securities are assessed separately.

During the period of 1900-1969, we start with [Fernández Acha \(1976\)](#) series on public debt, who details the debt profile of the central government in terms of maturity (perpetual, non-perpetual), currency (national or foreign) and the issuer (central government, the Treasury or subsidiary institutions). These data are supplemented by our own calculations on the small

volume of bonds issued by regional and local governments. For the period of 1901 to 1919, [Núñez Romero-Balmas and Castellano Montes \(1998\)](#) present an estimate on this debt stock using tax statistics. Afterwards, the *AFSAE* Yearbook and the *Anuario Financiero de Bilbao* extend the series from 1920 to 1944. From this date and until 1964, [García Añoveros et al. \(1969\)](#), provides a more comprehensive estimate on the total liabilities of local authorities, which includes not only securities issued, but also loans provided by the Bank for Local Government Funding [*Banco de Crédito Local*]. Since the debt of this last institution is already computed by [Fernández Acha \(1976\)](#) in his estimate of central government debt, we exclude it to avoid double counting. Finally, for the last years we interpolate the figures with the relevant figures of the Financial Accounts of the Bank of Spain.

Secondly, we adjust the nominal value of debt to its market price using the average annual prices quoted in the Madrid Stock Exchange. This reassessment has some importance in the years prior to the Civil War, when most public debt securities traded with a significant discount over par value (usually around 70-80%), but has almost no incidence during Franco's era. Treasury debt [*Deuda del Tesoro*] -which includes both short-term securities and non-marketable debt- is priced at its nominal value.

Lastly, to compute households' share we deduct the holdings of the following groups:

1. Central Bank. The balance sheet of the Bank of Spain included within its assets some special kinds of Treasury debt and a small portfolio of marketable public debt. Overall, central bank holdings had some importance at the beginning of the 20th Century and especially in the aftermath of the Civil War.
2. Private Banks. [Martín Aceña \(1985\)](#) and [Martín Aceña \(1988\)](#) present the securities portfolio of Spanish private banks from 1900 to 1962 using the official statistics published by the Spanish Banking Council [*Consejo Superior Bancario*]. Within these reports, public debt was stated as a separate item of the securities portfolio. However, for the years prior to 1920 this last information is not available, so we use the estimates provided by [Martínez Méndez \(2005\)](#), who basically extends a constant share. For the period from 1963 to 1969 we use the same statistics of the Spanish Banking Council.

3. Saving Banks. [Titos Martínez and Piñar Santos \(1993\)](#) present the public debt portfolio of Spanish savings banks from 1941 to 1969. For the years before the Civil War we also use the estimates provided by [Martínez Méndez \(2005\)](#). Furthermore, we include the public debt holdings of the Postal Savings Bank [*Caja Postal de Ahorros*] and the small portfolio of securities held by the public banking sector [*Credito Oficial*] using the information available on the annual reports of both institutions.
4. Insurance companies. In the early 1910s the Spanish Ministry of Finance imposed a severe control on the investments of the technical reserves by private insurance companies. The annual reports of the General Directorate of Insurance ([Direccion General de Seguros y Ahorro \(1955\)](#) for 1955-1970) include a detailed analysis of the sector's balance sheet, from which it is possible to obtain the figures corresponding to public debt securities. Separately, the reports of the Spanish public insurance institutions (the INP and later the Social Security) recorded the volume of public debt held against its technical reserves ([Instituto Nacional de Prevision \(1931\)](#) for 1931-1945; [Ministerio de Trabajo \(1953\)](#); [Ministerio de Trabajo y Seguridad Social \(1985\)](#)).
5. Rest of the World. Since 1898, only non-residents that had provided an *affidavit* could own the external perpetual debt payable in gold currencies. Therefore, for the 20th century this kind of securities and foreign loans are by definition in the hands of non-residents. Their share is important until 1916 and afterwards in the late 1960s, but in the years in between Spain had almost no public foreign debt.

Corporate debt has been computed relying on two different sources. From 1902 to 1919 the official tax statistic states the debentures issued by joint-stock corporations ([Direccion general de Contribuciones \(1900\)](#) for 1901-1934). This series is far from perfect, as researchers ([Tafunell \(2005\)](#)) have already pointed that tax authorities did not update with sufficient diligence the volume of corporate securities, so that numbers should be taken as a rough estimate. Since 1921 and until 1969 data has been obtained from financial yearbook calculate([AFSAE \(1916\)](#) for 1916-1970). The advantage of this publication is that, despite not being an official register, it has been regarded as a far more reliable source by historians studying corporate profits and

the business cycle in the long term ([Carreras and Tafunell \(1993\)](#); [Tafunell \(1998\)](#); [Tafunell \(2000\)](#))).

This latest source is also of great value as it details the debt issued by different corporate sectors (railways, electricity, banking, etc.), and makes possible to make some minor deductions to avoid double counting errors. In this sense, we deducted the covered bonds [*cedulas hipotecarias*] issued by the official public financial sector, which have already been computed as a special kind of public debt.

Overall, debt was an important source of corporate finance until the Civil War, but afterwards its role declined sharply. This trend is in accordance with the fact that during the first decades of the 20th century more than half of the corporate debt was issued by railway companies, so that the nationalization of this sector in 1941 had a profound impact in the overall volume. The difference between railroad and other corporations issuing debt (mostly utilities) is also of great importance for converting the nominal value of corporate debt into market prices. The railroad sector was more leveraged and its revenues were severely impacted by the First World War, so that its bonds normally traded with an important discount over par (around 70-80%, but at times even at 50%). In contrast, the creditworthiness of other corporations was far higher and their bonds traded nearer to their nominal values. To take into account this difference, from 1905 to 1936 we compute separately the market value of railway and other corporations bonds with the series published by [Hoyo Aparicio \(2007\)](#). Since the Civil War onwards there is no systematic information on corporate bond prices, but to make them resemble the general trends of the public debt market, we compute them at their nominal value.

Finally, as with public debt, we deduct the holdings of the following groups to obtain household's wealth:

1. Private Banks. As pointed previously, the official statistics published by the Spanish Banking Council present the portfolio of private banks, including as a joint item all corporate securities [Otros valores]. The main problem is thus to differentiate between debt and shares. For the period prior to the Civil War we rely on the detailed composition

of the securities portfolio of some banks (Banco Vizcaya, Santander, Aragon, Lopez Quesada) that was published in the 1924 edition of *AFSAE*. Per this source, within the corporate securities portfolio there was a separation between debt and stocks around 70/30 per cent. Thereafter we do not have any further direct sources, but to make our series consistent with the evolution of the aggregate volume of corporate debt and the holdings of other financial institutions (as detailed bellow), we make that the share corresponding to corporate debt in banking balance sheets gradually decreases from 70 to 20 per cent.

2. Saving Banks. The series presented by [Titos Martínez and Piñar Santos \(1993\)](#) for years 1941 to 1969 is very similar, except that it does detail the separation between corporate bonds and shares from 1959 onwards, pointing that, on average, private debt securities amount to 80% of the total. Prior to this year we extend backwards this share until 1941. Finally, for the period of 1905-1935 we extrapolate the same results as obtained by [Martínez Méndez \(2005\)](#).
3. Insurance companies. The annual reports of the General Directorate of Insurance also include the corporate debt portfolio held by these companies since 1915 until 1969.
4. Rest of the World. At the beginning of the 20th century an important part of the Spanish railway debt was listed in foreign stock markets (mostly Paris). However, after the First World War the government promoted the repatriation of funds, so that by the time Franco nationalized these companies, foreign debt holdings had almost disappeared. To take into account the changes of these three decades, we rely on the approximate ownership ratios provided by historians ([Cuéllar \(2015\)](#); [López-Morell \(2005\)](#); [Tedde de Lorca \(1994\)](#)) and the yearbook of the Madrid Stock Exchange ([Colegio de Agentes de Cambio y Bolsa \(1919\)](#) for 1919-1942) on the three most important companies (*Norte*, *MZA* and *Andaluces*). Since these corporations accounted for c. 75 per cent of the bonds issued by railways, we extrapolate their overall trends to the remaining companies.

From 1970 to 1979 the Financial Accounts of the Bank of Spain present a consolidated statement of household's and non-financial corporations debt holdings, that is, including

securities issued by the public sector and financial corporations, but not of non-financial corporations. To recalculate our series, we start from 1980, the first year in which household debt holdings are separately computed and then extend backwards the missing information assuming that it followed a similar path as the consolidated statement.

C.2.3 Loans. The economic literature has highlighted that households in developing countries frequently tap informal credit markets to finance their investments. Although scholars have not made a detailed research on the matter, the scarce evidence found for Spain during the first half of the 20th Century points that informal lending provided by rich individuals [*prestamistas o usureros*] also played a significant role (Carmona and Simpson (2003)). The only systematic sources of information that can be found for this period refer to mortgage loans. Since 1900 the Ministry of Finance levied a specific tax on the interests of mortgage loans. Commercial and savings banks were exempted, while the Mortgage Bank [*Banco Hipotecario de Espana*] only had to pay the tax on its covered bonds [*cedulas hipotecarias*].

For the first three decades of the 20th century, from the total amount of interests paid on mortgage loans, as reported by tax authorities (Direccion general de Contribuciones (1900) for 1901-1936), it is possible to deduct the amount corresponding to covered bonds, as reported in the annual statement of the Mortgage Bank and in Lacomba and Ruiz (1990). The resulting series corresponds to the interests paid on loans granted by households to other individuals. Then, it is necessary to capitalize this series to obtain the volume of outstanding loans. The literature points that in Spain during this period interests on informal credits usually stood around 6 to 9% ((Carmona and Simpson, 2003, p. 280)). As such, we take as a reference the interest on covered bonds (that normally was 5%) and add 2% more to reflect the higher risks and lack of liquidity associated with these investments.

Data is absent for the period after the Civil War, although it is reasonable to assume that informal lending was progressively displaced by the rise of banking institutions. Thus for 1941 we take the volume of outstanding loans that existed in 1935 and draw a process of a gradual

disappearance until 1954.

C.2.4 Equity and investment fund shares Equity shares correspond to the aggregate value of stocks issued by corporations and other limited liability companies. Mutual and investment funds are an important part of financial markets nowadays, but they did not exist in Spain until the mid-1960s and can be omitted in the construction of historical estimates.

As [Hannah \(2015\)](#) has recently pointed out, calculating the volume of these assets is especially problematic for various reasons. First, joint-stock companies that provide separate legal personhood and limited responsibility can exist in different forms. Secondly, it is very rare to have an official census on the number and capital of each set of companies, so it is necessary to use unofficial records. Thirdly, the available historical sources normally refer to the aggregate paid-up capital of corporations, that is, the funds originally provided by shareholders. These set of figures then need to be converted to market values. The easiest cases occur with those corporations that are listed in the stock market, given that equity holdings can be recorded at the prevailing prices at one particular time. Unfortunately -both presently and in the past- most companies are not listed in exchanges, and thus it is necessary to provide some assumptions on the book value reported on corporate balance sheets to estimate market values.

When dealing with this problem, the Bank of Spain had traditionally opted as most historians have done: applying to non-listed firms the same ratio that exists between the book and market value of companies quoted in the stock market. However, recently it has started to follow a different approach by which the annual profits of non-listed firms in a particular economic sector (i.e. utilities, manufacturing, etc.) are capitalized at a the rate as similar companies listed in exchanges (Bank of Spain, 2005). Although this approach provides better results, there are no sufficient historical sources to carry it. Instead, in this paper the traditional approach of applying a ratio between the paid-up capital and the equity market value is carried.

As a starting point, the same sources used for corporate bonds have been drawn to compute

the equity value of Spanish corporations [*sociedades anonimas*]. For the period of 1905 to 1918 the paid-up value of corporations is derived according to the official tax statistic ([Direccion general de Contribuciones \(1900\)](#) for 1901-1920), and from 1924 to 1969 from the *AFSAE* yearbook, as published by [Tafunell \(2005\)](#). Data for the years in between (1919-1923) has been interpolated due to the inconsistency of both sources. Then, to convert this series into market prices we use the quoted ratio between market prices to paid-up capital of the Spanish stock exchanges. For the period of 1900-1936 [Houpt and Rojo Cagigal \(2010\)](#) have kindly provided this data for the Bilbao Stock Exchange, while for years 1941-1969 it can be derived from the official index of the Madrid bourse ([Servicio de Estudios de la Bolsa de Madrid \(1992\)](#))²⁰.

Limited liability companies [*sociedades limitadas*] have also been included, but unlimited partnerships [*sociedades colectivas* and *sociedades comanditarias*], a form of business association widely used at the beginning of the century, are excluded as they did not issue shares and therefore computed within the unincorporated sector. Limited liability companies started to exist in 1920 and have had a growing importance in business activities since. However, unlike with corporations, data is of inferior quality as there is only two complete census of these set of companies referring to 1944 and 1949 ([Direccion General de Contribucion sobre la Renta \(1944\)](#); [INE \(1951\)](#)). As a complementary source, [Tafunell \(2005\)](#) provides a revised version of the official statistic of the Mercantile Register on the annual number of charterings and paid-up capital for the whole period. This series is completed from 1950 onwards with data on the number and value of capital increases, reductions and corporate dissolutions.

With these different sources a new series on the paid-up capital of limited liability companies is constructed. First, it is assumed that before 1950 net changes in the equity of existing companies (increases, reductions and dissolutions) in relation to newly incorporated companies amounted to the average observed from 1950 to 1969 (34 per cent). Secondly, the flow of new corporate charters and net changes in equity is accumulated from 1920 until 1936. Thirdly, this series is then matched with the 1949 census estimate and accumulate backwards

20. In future versions we intend to replace the first series with one built with data of the Madrid Stock Exchange. Stefan Houpt and Stefano Battilossi are currently working on a project to reconstruct a market capitalization index.

and forwards in time with the more complete data of the Mercantile Register. Finally, given the lack of sources, it is important to point that these set of estimates are not converted into market prices, although the difference should be as large as with corporations, as limited liabilities companies normally held fewer reserves.

From the aggregate volume of equity holdings, it is then necessary to deduct holdings of the following institutional sectors to compute household's share:

1. Private Banks. As discussed above, the aggregate balance sheet of the banking sector provides figures on the holdings of corporate securities, from which is necessary to make an assumption on the distribution between bonds and shares. The weight of stocks starts at 30 per cent before the Civil War and rises gradually up to 80 per cent by 1969.
2. Savings Banks. In the same manner, the available data presents the evolution of stocks held in the balance sheet of savings banks.
3. Insurance companies. The annual reports of the General Directorate of Insurance include the shareholdings of these companies since 1915 till 1969.
4. Non-financial corporations. Beyond some anecdotal evidence on utilities and industrial companies ([Aubanell-Jubany \(1994\)](#)), there is very little systematic data on inter-corporate stockholdings. The only noticeable exception than could be found comes from the 1955 estimate made by [Banco de Bilbao \(1957\)](#) on the Spanish national income, which included as an appendix a detailed survey on the balance sheet of a sample of circa 100 non-financial corporations. From these data it is possible to estimate that around 20 per cent of shareholdings were held by corporations. Later, in 1970, the Financial Accounts of the Bank of Spain point to a share around 30 per cent. To construct a time series, these two points are interpolated and then extended backwards in time assuming a level of 5 per cent in 1930 and 1 per cent in 1914.
5. Public sector equity holdings. As discuss in the section below, the public sector started to build an important number of shareholdings in industrial and service companies from the 1940s onwards. These stakes could be valued either at book value or market value,

and so are deducted separately from the overall volume of corporate shares.

6. Rest of the World. As [Broder \(1976\)](#) and [Prados de la Escosura \(2010\)](#) have pointed, at the beginning of the 20th century foreigners were heavily involved in two economic sectors: railways and mining. Investment in the first kind of business was made through Spanish companies. Information provided by [Vidal Olivares and Ortunez \(2002\)](#), [Tedde de Lorca \(1994\)](#) and [Cuéllar \(2015\)](#) for the three major railway companies during this period enables to construct the precise share accruing to foreigners, and then assumed a similar weighting for the other railroad companies. Foreign investment in the mining sector was different as it was mostly channelled through foreign-based companies (i.e. Rio Tinto Company, Compagnie Royale Asturienne des Mines, Societe Miniere et Metallurgique de Penarroya, etc.). The census developed by tax authorities ([Direccion general de Contribuciones \(1900\)](#) for 1901-1919) points that in the 1910s the above mentioned companies usually represented around 20 per cent of the paid-up capital in the mining sector. Thereby this ratio is applied for the whole period of 1900 to 1935. Later, for the 1940s and 50s it is assumed that foreigners were completely absent, as Franco forced the last foreign investors to sell their stakes ([Carreras \(2003\)](#)). Later, as other historians have pointed, the liberalisation of Spanish economy from 1959 onwards enabled a growing flow of foreign investments. It is thus assumed that their share gradually grew from 1 per cent in 1960 to the level pointed in the Financial Accounts of the Bank of Spain in 1970 (4 per cent).

For the period of 1970-1979 the Financial Accounts of the Bank of Spain present a consolidated statement of the equity holdings belonging to households and non-financial corporations, which include securities issued by financial and foreign corporations, but not by non-financial corporations. To recalculate our series, we start from 1980, the first year in which household equity holdings are separately and completely computed, and then extend backwards in time assuming an evolution similar to the market capitalization of the Madrid Stock Exchange ([Servicio de Estudios de la Bolsa de Madrid, 1992](#)).

C.2.5 Insurance, pension and standardized guarantee schemes Insurance and pension assets correspond to the value of accumulated reserves against outstanding claims made by households. In practice, these assets are not held directly by households, but rather as technical reserves by private and mutual insurance companies.

For practical reasons, the technical reserves of private companies and public institutions are calculated separately for the period of 1905 to 1969. Data on private sector insurance schemes start in 1915, when the Spanish Ministry of Finance imposed a control on the investments made by insurance companies. Thereafter, official reports state the amount and composition of technical reserves ([Direccion General de Seguros y Ahorro \(1955\)](#) for 1955-1970). Although insurance schemes had already been present in Spain for a long time ([Tortella Casares, Caruana de las Cagigas, Garcia Ruiz, Manzano Martos, and Pons Pons \(2014\)](#)), the value of reserves in 1905 is so low (42 million pesetas, or 0.3 per cent of the Spanish national income) that it is feasible to dismiss its importance prior to then. For the first two decades figures are only available in five year intervals (1915, 1920, 1925, 1930 and 1935) and thus have been interpolated for the years in between. From 1941 to 1969, the reports appear on a yearly basis. In principle, most technical reserves are constituted to cover life insurance contracts, but some can also refer to the liabilities incurred with households and non-financial companies for other reasons (for example, fire or vehicle insurances). Since no information is available on the ownership trends by institutional sector, households' share in 1980 (84 per cent of all technical reserves) has been extrapolated backwards in time.

The development of public insurance schemes has undergone through two different phases in history that need to be briefly explained. In 1908 the government created the INP [*Instituto Nacional de Prevision*] as a system that grouped various schemes that covered workers' risks (disability, sickness, old age, etc.) based on the contributions of employees and employers ([Comin \(2010\)](#)). The most important economic right (pensions) were provided based on accumulated savings and investment returns. Later, in 1962, the government created the modern Social Security as an unfunded, defined-benefit system that included the previous existing schemes of the INP.

Unfortunately, data sources on public technical reserves are quite scarce. During the period of the INP, the government published a complete balance sheet on irregular intervals (1913, 1918, 1923, 1928, 1933-1935, 1940, 1945-1947, 1949-1952) and thus figures have been linearly interpolated for the years in between²¹. Later, during the years of transition to the new Social Security system there is a complete lack of consistent sources. From 1962 onwards, the most comprehensive accounting data was published in [Ministerio de Trabajo y Seguridad Social \(1985\)](#).

From 1970 to 1979 technical reserves are directly derived from the Financial Accounts of the Bank of Spain.

C.2.6 Other accounts The Financial Accounts of the Bank of Spain group in this category some miscellaneous assets: financial derivatives, short-term commercial credit and all other accounts pending payment. As readers may imagine, there are virtually no sources to compute them in a consistent way for the historical period. Nonetheless, their magnitude is relatively small and their share has been declining since 1980.

C.2.7 Offshore wealth The Spanish financial institutions automatically report to the Spanish Tax Agency the income (dividends, interest, and capital gains) and wealth (deposits, stocks, investment funds, life insurance, and pension funds) held by their clients. To compile the Financial Accounts, the Bank of Spain uses very similar sources to record households' assets and liabilities ([Banco de España \(2011\)](#)). Thus, implicitly, these two official statistics do not include assets held by individuals in foreign countries²².

Zucman (2013) estimates that around 8% of households' financial wealth is held through tax havens, three-quarters of which goes unrecorded. Moreover, he also provides evidence that the share of offshore wealth has increased considerably since the 1970s. This fraction is even larger for Spain. According to [Zucman \(2015\)](#), wealth held by Spanish residents in tax havens

21. The first two reports appeared in the official *Gazeta de Madrid*. Information from 1923 onwards has been derived from [Instituto Nacional de Prevision \(1931\)](#) for 1931-1945, and [Ministerio de Trabajo \(1953\)](#).

22. See [Zucman \(2013\)](#) for a general explanation on the problems related to recording offshore wealth in Financial Accounts. The only exception occurs with bank accounts held abroad, because the Bank for International Settlements collects data on those assets.

in 2012 amounted to 80 billion euros, which accounts to 9.4% of household's net financial wealth. [Peramo \(2016\)](#) has also made a very rough estimate on Spanish offshore assets that arrives to a similar figure. Hence, offshore wealth is not a negligible part of the portfolio of households and must be taken into account when analyzing the long-run evolution of wealth.

In order to construct our series of offshore wealth we rely on two main data sources: Zucman's ([Zucman \(2013\)](#); [Zucman \(2014\)](#)) data, which come mainly from the Swiss National Bank (SNB) statistics, and the unique information provided by the 720 tax-form. Since 2012, Spanish residents holding more than 50.000 euros abroad are obliged to file this form specifying the type of asset (real estate, stocks, investment funds, deposits, etc.), value, and country of location. This new form aims to reduce evasion by imposing large fines in case taxpayers are caught not reporting or misreporting their wealth. In an attempt to increase future revenue and reduce further evasion, the Tax Agency also introduced a tax amnesty in 2012.

When constructing our series of offshore wealth, we calculate separately reported assets, that is, claims held abroad by Spanish residents and declared to the Spanish tax authorities, from unreported offshore wealth. For the latter, we mainly use Zucman's ([Zucman \(2013\)](#); [Zucman \(2014\)](#)) statistics on offshore portfolios held in Swiss banks, which have been published for more than two decades by the Swiss National Bank (SNB). Given the outsized role that Switzerland plays in the wealth management industry, we believe that this is the best available source we can use. Nonetheless, we then extrapolate these results for tax havens in the rest of the world.

Our starting point for the reported offshore wealth is the 720 tax-form for years 2012 to 2014. Then, we compare the magnitude of assets declared in Switzerland with our estimate on the total wealth held in this country (both declared and undeclared). The SNB provides on the one hand information on the total amount of fiduciary deposits held in Switzerland by non-residents by country of origin and, on the other hand, the total amount of portfolio assets held by non-residents in Switzerland. We follow the methodology of Zucman ([Zucman](#)

(2014); Zucman (2015)) to calculate the total amount of offshore wealth held by Spaniards in Switzerland. Zucman provides the ratio of offshore wealth held by Europeans in Switzerland. With this fraction and the SNB statistics on fiduciary deposits, we can then obtain the share corresponding to Spanish residents.

Secondly, we compare total wealth held in Switzerland by Spanish residents with assets declared in this country in the 720 tax-form. In 2012, the comparison shows that 23% of offshore wealth was reported to tax authorities. This figure is consistent with Zucman's (Zucman (2013)) estimate that around three quarters of offshore wealth held abroad goes unrecorded. We then extrapolate this series to obtain total reported offshore wealth in other countries (Luxembourg, the Panama, etc.) using the fraction of reported wealth not held in Switzerland from the 2012 720 tax-form, which is 76%.

Total unreported financial offshore wealth can be then derived by first applying to the latter series the fraction of financial wealth declared in tax havens in order to have an estimate of total reported financial offshore wealth held by Spaniards in tax havens²³. Finally, using the fraction of unreported financial wealth held by Spaniards in Switzerland we can derive the total amount of unreported offshore wealth²⁴.

By adding up the estimations of unreported financial offshore wealth with the reported one, we obtain the final aggregated series. Our results range between 1999 and 2014, since the statistics on total offshore held in Switzerland are only available for this period of time.

As a last step, we extrapolate the series backwards using the total amount of offshore wealth that flourished in the 1991 Spanish tax amnesty (10,367 million euros as reported by the newspaper *ABC*) and make a linear interpolation for the years in between. We assume that this corresponds to the declared assets, and then add the total amount of offshore non-declared wealth using the average ratio of unreported versus reported offshore wealth from years 1999 until 2014. Finally, we extrapolate the series backwards up to 1900 by using

23. This fraction is calculated based on the information provided in the 720 tax-form and the classification of tax havens by Zucman (2013).

24. This fraction is calculated based on the reported financial wealth held in Switzerland in the 720 tax reform and the series of total offshore wealth held by Spaniards in Switzerland using SNB data and the methodology in Zucman (2013) and Zucman (2014).

the proportion of European financial wealth held in offshore havens estimated by [Zucman \(2014\)](#). His data is based on decennial averages, and so we linearly interpolate for the years in between. We believe that our historical series from 1902 until 1991 is quite robust given that our 1991 estimate using the declared wealth from the tax amnesty perfectly matches with the historical series from 1900 until 1990 with this different methodology.

Using the 720 tax-form we also provide a decomposition of our series of offshore wealth by asset type. Offshore wealth appears disaggregated into financial and non-financial wealth and financial wealth further more disaggregated into deposits, stocks, investment funds and life and other insurance.

2012 offshore declared assets amounted to 194,586 million euros, which represents around 23% of both national income and net personal financial wealth. Our estimate is larger than Zucman's ([Zucman \(2013\)](#)) 8% estimate for the whole world. This discrepancy can be explained as we do include non-financial assets in our estimates (i.e. dwellings in foreign countries), whereas Zucman only considers financial claims. However, in any case, the difference is large enough to claim that offshore wealth is relatively larger in Spain than the world average²⁵.

Even though our estimates are a step forward the measure of offshore wealth because of the unique information from the 720 tax-form, the available data sources are still quite poor. The Bank of Spain and the European Central Bank could start measuring offshore wealth by using fiscal information, such as the 720 tax-form in the case of Spain, as well as increasing the cross-border flow of information. Further research and data are needed to better understand the levels and trends in offshore wealth across countries and over time.

C.3 Liabilities

Households' liabilities are constituted by all credits and loans provided to finance investment and consumption. Their magnitude has been reconstructed from the perspective of institutional

25. We are not the first at claiming that offshore wealth is larger in Spain than the world average. As it was mentioned in the beginning, [Zucman \(2015\)](#) estimates that Spanish financial wealth in offshore havens amounted to 80 thousands million euros 2012, which represents more than 9% of total net financial wealth.

lenders (i.e. banks), and added the informal lending provided by other household.

Using the statistics of financial institutions to reconstruct households' liabilities is not without problems. The main issue is that virtually no institution stated in its balance sheet whether credits were provided to households or companies, so that it is necessary to follow a case by case approach:

1. The Bank of Spain. Although the main function of the central bank was to act as the lender of last resort, the Bank also operated as a private firm that granted loans to private individuals [*cuentas de crédito con garantía personal*], mostly entrepreneurs (i.e. merchants, industrialists and tradesmen). [Martínez Méndez \(2005\)](#) reconstructs their volume for the period of 1900 to 1935. After the Civil War, the balance sheet of the Bank of Spain includes these loans as a separate category, but from 1945 onwards it differentiates between loans granted directly to households, from those that had been given through the public sector. Given that these last ones were separately recorded in other official banks (see next section), we exclude them from this category. Results show that personal loans granted by the Bank of Spain had some significance until the First World War.
2. Official banking sector. Since the 19th century, the government promoted the creation of official banks to provide loans for some specific sectors. The first and most important was the Spanish Mortgage Bank [*Banco Hipotecario de España*], but in the following years others were also developed, such as the Industrial Bank [*Banco de Crédito Industrial*], the Bank for Local Government Funding [*Banco de Crédito Local*], the Agrarian Bank [*Banco de Crédito Agrícola*], Bank for Maritime and Fishing Activities [*Crédito Marítimo y Pesquero*] and the Construction Bank [*Banco de Crédito a la Construcción*]. After the Civil War, these firms were grouped into a single holding [*Crédito Oficial*], although they continued to publish separate balance sheets.

As the reader can imagine, not all of these banks provided loans to the household sector. In the absence of detailed statistics, only the credits provided by the Mortgage, Construction, Agrarian, Maritime and Fishing Banks have been computed. These banks

have been selected under the assumption that until the late 1960s the activity in the primary and real estate sectors were dominated by households. Also, it can be argued that public lending would have been carried out to benefit mostly individuals (and not corporations). Besides, the scarce evidence presented by Casares (1985) on the most important official bank (the Mortgage Bank) confirms that almost of all its debtors were individuals.

3. Private banks. Martín Aceña (1985) and Martín Aceña (1988) uses the statistics of the Spanish Banking Council to reconstruct the balance sheet of the private banking sector from 1900 to 1962. From 1962 to 1969 we extend his series using the same source. The original statistics recorded as a single item all loans provided to the private sector. However, from 1942 onwards, in the AFSAE yearbook, the Spanish Banking Council provided a summary that differentiated between loans provided against collateral [*créditos con garantía*] from personal ones [*créditos personales*]. Results show that during the period covered (1942-1969), the share of personal loans was rather stable, averaging around 82%, so we extend the same weighting to the previous years.
4. Savings banks. As pointed previously, for the period before the Civil War Martín Aceña (1985) makes an estimate on the accounts and deposits held by savings banks. Also, by using the data of Martínez Méndez (2005), it is possible to estimate the securities portfolio of these institutions. Thus, it can be assumed that the difference between both magnitudes amounted to the loans provided to the private sector. From 1941 onwards the data is of higher quality, as Titos Martínez and Piñar Santos (1993) provide their consolidated balance sheet using official statistics. Finally, to this set of data small number of loans provided the official Postal Savings Banks has been added. Given that for much of their history, savings banks only served middle and low-income individuals, all loans have been classified as liabilities of the household sector.
5. Insurance companies. Besides owning a large portfolio of financial securities, insurance companies could also grant mortgage loans. Their magnitude has been traced since 1915 using the official reports of the Spanish Ministry of Finance ((Dirección General de

[Seguros y Ahorro, 1955](#), years 1955-1970)). As we have already assumed that mortgages granted by the official banking sector were held by private individuals, we have also computed these loans as a liability of the household sector.

6. Informal lending. Loans granted by households have already been estimated as a financial asset of the personal sector from 1900 to 1954. Since these credits constitute a liability of other individuals, they must be included in this study.

Data on liabilities form 1970-1979 are provided in the Financial Accounts. As with other items of the balance sheet, the information refers to the aggregated loan volume of non-financial corporations and households. Thereby, the both are disentangled by applying the same ratio (38%) that existed in December 1980 according to the later revisions.

D General Government wealth

D.1 Non-financial produced assets: public capital

The produced non-financial assets include the public capital stock (infrastructure, public buildings, etc.). The excellent work of [Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo \(2015\)](#) provides an annual estimate of the public capital stock during the period 1900-2013 that has been established through the perpetual inventory method. The authors present two series: one of public investment and another on the capital stock provided by private agents but with a strong public service bias (i.e., railways). In this study, we only include the first, given that the second series can be better calculated as part of the financial wealth of the general government.

D.2 Non-financial non-produced assets: agricultural land and land underlying buildings

Non-produced assets of the general government have never been systematically studied, but for a long-term study it is necessary to have at least some rough estimates on both public-owned agricultural land and land underlying public buildings.

During the first decades of the twentieth century, around 6.5 million hectares of forest (11-13% of the agricultural area) were owned by public institutions, mostly municipalities. Moreover, since the end of the Civil War, the Francoist regime started a systematic policy of agricultural colonization which involved buying land plots that were afterwards rented to peasants. Nowadays, the agrarian census points that c. 25% percent of agricultural land is owned by the general government.

Our calculations public agricultural land are done in the following way. For the first three decades of the twentieth century, we use the various available estimates on public forest area ([Gallego Martínez, Roca Cobo, Sanz Fernández, Zambrana Pineda, and Zapata Blanco \(1983\)](#)) to fix a standard surface of 6.5 million hectares. These figures are then multiplied by the average price of forest land of [Bringas Gutiérrez \(2000\)](#). After the Civil War and until the 1972 agrarian census, we use two sources to compute the agrarian surface owned by government institutions. First, the official statistics on forest land point to a sustained growth in public forest, reaching around 9 million hectares by the late 1960s. To this figure, we accumulate the surface of arable land that was purchased by the Institute of National Colonization during this period, according to [Maurel \(1984\)](#). The value of land is then calculated following the same method that has been explained in the first section.

Finally, the modern agrarian census provides information on the ownership of the general government ([INE \(1973\)](#); [INE \(1984\)](#); [INE \(1991\)](#); [INE \(2002\)](#)). This surface is then multiplied by the average land prices, as published by the Ministry of Agriculture ([\(Ministerio de Agricultura, Pesca y Alimentacion, 1984, years 1984-2014\)](#))).

In addition, we estimate the value of land underlying public buildings based on our own estimate of land underlying non-residential buildings and on IVIE's study of Spain's stock of produced assets ([Mas Ivars, Pérez García, Uriel Jiménez, Benages Candau, and Cucarella Tormo \(2015\)](#)). One advantage of IVIE's study is the decomposition of the "Other constructions" category into economic structures and non-residential buildings, which they further decompose into public and non-public ones. Hence, we use the share of public non-residential buildings in the "other constructions" category present in IVIE over the period

1964-2013, and we apply this share to our own estimate of "Other constructions". Over this period, this share in IVIE's data is relatively constant, fluctuating in values between 5% and 8%. To extend backwards the value of land underlying non-residential public buildings for the period 1900-1963, we assume that this share was 5% over this period, in line with the values observed in the initial years of IVIE's study.

D.3 Financial assets

Until 1970 we approximate the value of financial assets owned by the public sector by computing state-owned equity holdings. Their study must be done following the same caveats as the ones pointed with regard to households' shareholdings. In practical terms, this means that although historians have already analysed the development of state-owned enterprises and written numerous case studies ([Carreras, Tafunell, and Torres \(2000\)](#); [Martín Aceña and Comín \(1991\)](#)), there is still not a comprehensive census on the number and value of the corporations in which the state held total or partial ownership. This lack of comparable series is by no means an accident, as it simply reflects the fact that, for most part of history, the initiatives of the different Spanish ministries (most importantly, Finance and Industry) were not coordinated, and, in consequence, the state did not have a complete balance sheet of public equity holdings. This situation did not change until the mid-1970s ([Dirección General del Patrimonio del Estado, 1977](#), years 1977-1981), but truly it was not until the development of the modern financial accounts when it is possible to have a complete picture.

Secondly, defining state-owned enterprises is more challenging than for the private sector. In principle, all joint-stock companies in which the state has total or partial ownership must be counted, but also all quasi-corporations that may not have a separate legal personality, but that do perform market-orientated activities. As we will later show, much of the previous research has neglected these last kind of entities, even though they may be as relevant as the traditional state-owned companies.

Thirdly, valuation of state-owned enterprises can also be a tricky issue, and thus we follow a case-by-case approach. In some situations, it is reasonable to assume that public-owned firms

operated as private companies, and thus turning from book to market values can be done by using metrics similar to the ones observed in other economic sectors. However, in other important cases, the persistent unprofitability of state-owned enterprises makes it reasonable to assume that the book values reported in balance sheets are the most appropriate measure²⁶.

Finally, it should be noted that, unlike with households' investment position, the Financial Accounts of the Bank of Spain for the 1970s are not an accurate source to study the equity holdings of the public sector, as they systematically underestimate the assets of the public sector. For this reason, our historical estimates have been extended until 1979 in a way that can be later matched with the new and revised Financial Accounts of the 1980s.

In this appendix, we start by analysing the classic public state-owned corporations in a way that takes into account the different economic sectors and the assessment at book or market values. Afterwards, we analyse in a specific manner some particular cases of special enterprises.

The major milestone in the development of state-owned enterprises occurred in 1940, when Franco's government created the National Institute of Industry [*Instituto Nacional de Industria*] as a special company that grouped all public holdings into industrial corporations. The detailed study of [Martín Aceña and Comín \(1991\)](#) presents the basic accounts of the Institute, including a consolidated profit and loss statement and the balance sheet. Given that the Institute was hardly profitable throughout its history, it seems reasonable to compute public equity holdings as the sum of the paid-up capital and reserves. In 1941 another major change occurred, when the government nationalized the railroad companies and unified their business by creating a new public enterprise (*RENFE*) ([Comín, Martín Aceña, Muñoz, and Vidal \(1998\)](#)). The annual reports of this corporation also show that it was never profitable, so it is indeed preferable to record the equity (capital and reserves) as stated in its balance sheet.

Besides these two gigantic companies, the Ministry of Finance also kept an independent control over important shareholdings in service sector corporations. The most important,

26. Interestingly, the Bank of Spain currently employs the same method when analyzing companies that are unprofitable on a sustained basis. (([Banco de España, 2005](#), pg. 23))

with their respective dates of creation or nationalization, were *CAMPESA* (1927), *Ferrocarriles del Oeste de España* (1928), *Tabacalera* (1945), *Telefónica* (1945), *Petroliber* (1961) and *Trasmediterránea* (1977). Virtually all were only partly state-owned, and their shares continued to be quoted in the stock market. To compute public holdings, we start by making an approximation to the stake held by the state in each enterprise according to different sources. Afterwards, we adjust to market prices using the stock prices of the Madrid Stock Exchange at the end of each year.

Public-owned corporations that operated in the mining and financial sectors need to be analysed in a specific manner. With respect to the first, in Spain, a few mining sites (*Almadén*, *Arrayanes* and *Torre Vieja*) have been under public-ownership during the late modern era. In the twentieth century these mines were usually exploited directly by the state, although they normally lacked the legal status of a modern corporation and therefore did not publish regular accounts. Also, in some particular years, the government opted to make a lease with a private agent in exchange for royalties. To estimate their value, we start by taking the annual dividends and royalties, as reported in the state budget [Cuentas generales del Estado] (IEF (1979); IEF (1982); IEF (1989); IEF (1990)), and multiply its decennial averages by the return on equity of the private mining companies (Tafunell 2000). This figure represents the "core value" or "capital" of this publicly owned-business, to which we add the corresponding annual profit to estimate the government's equity. Overall, results show that these mining firms were an important asset of the public sector in some periods.

The Spanish state has also played an important role in the development of the financial sector. Since the nineteenth century the government granted a privileged status to some banking firms, such as the monopoly of issue acquired by the Bank of Spain or the right to issue covered bonds of the Spanish Mortgage Bank. Originally, these enterprises were fully owned by private investors and the government only imposed a special tax on profits. However, in 1962 these set of companies were nationalized. The Bank of Spain retained its special status as a separate corporation, but the others were grouped into a new entity called *Crédito Oficial*. The analysis of this latter group is not particularly difficult, as their equity (capital

plus reserves) is stated in the annual reports (([Instituto de Crédito a Medio y Larzo Plazo, 1963](#), years 1963-1979)).

However, the valuation of the public stake in the Bank of Spain is a more difficult task. As ([Piketty and Zucman, 2014a](#), pg. 14) point in their appendix, the ways in which central banks value their assets changes significantly between countries, as some opt to record them at book value, while others reflect variations in market prices. Also, earnings based on seigniorage income can change notably throughout time. In Spain, the modern Financial Accounts compute as part of the Bank of Spain's equity not only the paid-up capital and ordinary reserves, but also the accounting provisions for valuation adjustments. This makes that presently the equity holding in the Bank of Spain is one of the most important shareholdings of the public sector²⁷.

For the period of 1962 to 1979, it seems very difficult to apply these same criteria. As an alternative, we have opted to take the annual profits (which were fully paid as dividends to the state) (([Ministerio de Hacienda, 1962](#), years 1962-1979)) and capitalize them at the return of equity of the private banking sector, as stated by [Tafunell \(2000\)](#). Although this method makes the series a bit volatile, the results provide similar valuation figures to the ones used in present day accounting standards.

D.4 Liabilities

The last step for estimating the net wealth of the general government is to deduct its liabilities. For the period of 1905 to 1969, we have already stated in the section dedicated to household fixed income securities the sources used to calculate the debt of the general government. We have also explained the necessary adjustments to convert nominal values into market prices.

However, to follow the SNA and ESA methodology, we have also made one final adjustment to deduct the debt that is not issued by the general government, but has an explicit (or implicit) state guaranteed. The rules of the European Union are very clear in this sense.

27. For example, in 2014 state-owned equity holdings amounted to 148 billion euros, of which 21% (31 billion euros) corresponded to the value of the Bank of Spain.

Although state-guaranteed debt can be included when calculating the public debt stock following the Maastricht criteria, "guaranteed debt is recorded solely as the borrowing of the borrower" but "for the government, it is contingent liability which is not recorded in ESA balance-sheet (but may be shown as memorandum item or a footnote)" (([European Union, 2016](#), pg. 392)).

Fortunately, the original source ([Fernández Acha \(1976\)](#)) is sufficiently detailed to make the necessary changes. As a rule, we compute all debt issued by the government and the Treasury, but we exclude the securities of the Mortgage Bank [*Banco Hipotecario de España*], railway companies [*RENFE* and *Ferrocarril de Tánger a Fez*], the National Institute of Industry [*Instituto Nacional de Industria*] and other minor entities [*Administración del Norte de Marruecos* and *Asociación de la Prensa de Madrid*]. Also, regarding foreign loans guaranteed by the government, we have excluded those in which borrowers were companies [*Empresas y organismos con garantías del Estado*] or individuals [*particulares*].

From 1970 onwards we include all general government liabilities as stated in the Financial Accounts of the Bank of Spain.

These particularities of the SNA rules ought to be considered when comparing these new series with other estimates. For the period of 1905 to 1969 our results are slightly inferior than the public debt stock estimated by [Comín and Díaz \(2005\)](#) and [Comín \(2012\)](#), due to the reasons above mentioned. Thereafter, government liabilities tend to follow the same trend than public debt, as computed by other sources. However, it should be noted that differences between both magnitudes get bigger throughout time²⁸.

E Corporate wealth

In this paper, we approximate corporate wealth from two perspectives. First, for the period 1900-2017, we find corporate wealth indirectly by detracting the "market-value" measure of national wealth from the "book-value" definition. Second, for the 1996-2016 years, we compute

28. As a point of reference, at the end of 2015, total government liabilities amounted to 139% of GDP, but public debt according to the EU criteria stood at c. 100 per cent.

it directly from market-value records of the balance sheet of corporations. In this section, we explain how we dealt with the direct measurement of corporate wealth from balance-sheet data, including a brief discussion of the Tobin's Q concept.

E.1 Non-financial assets of non-financial corporations

Since 1982, the Central Balance Sheet Data Office of the Bank of Spain has built a comprehensive sample on the accounting information provided by Spanish non-financial corporations. Measured in terms of gross value added, the sample originally covered around 20-25% of the Spanish corporate sector, but since the mid-1990s it has gradually risen to 45%. From this dataset, the Bank of Spain publishes two different set of results. From 1982 until the present, the Bank summarizes the main balance sheet variables of its sample of corporations. Alternatively, since 1995 onwards the Bank also extrapolates the previous series to reflect the complete universe of Spanish non-financial companies.

Both datasets have been reclassified by changing the traditional accounting classification to SNA/ESA standards. This process implies not only changes in nomenclature, but also revaluating some specific assets (i.e. real estate) from book to market values. Furthermore, from the late 1990s onwards, the Bank of Spain also decomposes non-financial assets between non-produced and produced assets. However, the resulting series is highly questionable as the values for non-produced assets are very low, probably because the division between buildings and the land underlying has not been properly calculated. For this reason, only the basic series on corporate non-financial assets has been used in this paper.

One last observation must be done regarding the data provided by the Bank of Spain. Since the dataset of the Central Balance Sheet Data Office is revised in various time intervals, as a rule we took the latest version (normally published up to 6 years later from year t) as the reference value. This means that the series for the most recent years (2009-2016) can be subject to small revisions in the future. Also, it should be noted that the values for financial assets and liabilities are slightly different to the ones published in the Financial Accounts of the Bank of Spain. To keep all series consistent, the Financial Accounts figures have been

taken as the definitive ones.

E.2 Non-financial assets of financial institutions

Spain does not have a complete set of statistical set on the non-financial assets of financial institutions. The Central Balance Sheet Data Office does not include this sector in their surveys and the Financial Accounts of the Bank of Spain does not cover these assets in their definitions. Alternatively, their magnitude can be calculated by drawing on the statistics of monetary institutions (i.e. the Bank of Spain, deposit-taking corporations and money markets funds), insurance companies and pension funds. Implicitly, it has been assumed that other non-monetary financial institutions (such as financial intermediaries, asset managers, etc.) do not own non-financial assets.

Information on these three institutional groups is provided by the Bank of Spain. The aggregated balance sheet of monetary institutions includes as a separate item the value of non-financial assets (buildings, office equipment, etc.) since 1962. The statistics for insurance companies and pensions funds is slightly different, as it presents in one single item all other assets different from financial investments, loans and cash. By taking this classification, non-financial asset might be slightly overstated, although its overall magnitude relative to other institutional sectors is relatively small. Another problem of the insurance and pensions funds statistics is that they only cover up to 2009, so alternatively it has been assumed that non-financial assets from then onwards follow the trends reported by private insurance companies.

E.3 Financial assets and liabilities

Financial assets and liabilities of both non-financial and financial institutions are reported in the Financial Accounts of the Bank of Spain. No further adjustment has been made in this paper.

E.4 Tobin Q

As a final step, the Tobin's Q of the Spanish corporate sector (including both non-financial and financial institutions) has been calculated in the following way:

$$Q = \frac{\textit{Market value of equity}}{\textit{Corporate net worth}} \quad (1.7)$$

The market value of equity is directly stated in the Financial Accounts of the Bank of Spain, and is available from 1981 onwards. The corporate net worth is a broader concept that sums corporate assets minus non-equity liabilities, both measured at market prices following ESA guidelines. Hence, for the period 1995-2016, we can compute corporations' Tobin's Q based on the aggregate balance sheet of the corporate sector. Alternatively, we also compute the Tobin's Q using the indirect measure of corporate wealth obtained from detracting the market-value definition of national wealth from the book-value approach. In this case, we define 'corporate net worth' as the sum of corporations' wealth plus their market-value of equity, and we compute Tobin's Q for a longer period: 1981-2016. For the period in which both measures overlap results show a similar value.

F Foreign wealth

Net Foreign Assets are the assets held by Spanish residents in foreign countries minus the value of assets held by non-residents in Spain. Our estimate covers the full 1850-2017 period and is expressed at market value. To calculate the Net Foreign Assets of Spain we rely on a variety of sources and methods.

For the period 1850-1913 we take the data on Spain's international indebtedness from [Prados de la Escosura \(2010\)](#)²⁹. His approach is easy to understand. He assumes that Spain's international indebtedness in 1850 amounted to the foreign liabilities of the public sector, and then accumulates the current account plus the variation in foreign exchange reserves. This method is based on the accounting identity according to which the aggregate of the

29. International indebtedness is an equivalent to Net Foreign Assets, just expressed with an opposite sign.

current account, the financial account plus the variation in reserves equals to zero. The main drawback of this method, however, is that it does not capture changes in the relative price of assets in different countries that could be happening over time. However, as we do not count with specific information on the assets held abroad by country and by type of asset, this seems the best possible method to apply.

Later, for the years 1932 to 1934 the Bank of Spain estimated the level of international indebtedness of Spain and we use estimates without further correction (([Banco de España, 1932](#), years 1932-1935)). However, we discard a previous estimate made by the Bank of Spain for the year 1931, as this calculation has a lower quality than those of the period 1932-1934. To match the 1932-1934 estimates from the Bank of Spain with the series of Prados de la Escosura ending in 1913, we extend Prados de la Escosura's data following the same methodology: we start by accumulating the current account since 1914 correcting for the variation in reserves up to 1931³⁰. This procedure leads to an estimate of the net foreign asset position of Spain in 1931 that is -18% the value of the national income of Spain in the same year, versus an estimate of the Bank of Spain for the year 1932 of -4% the national income of Spain in 1932.

This difference could be the result of different factors. First, it could be because of lack of information in the Bank of Spain's estimate for the years 1932-1934 or it could be due to a wrong approximation to Spain's foreign assets in 1850. Most likely, this could be largely the consequence of not being able to account for the variation in the relative price of assets held abroad by Spanish residents and those assets owned by foreigners in Spain. Given that the quality of current account information is slightly better for the period 1850-1913 than for the period 1914-1931, we decided to correct our extension of Prados de la Escosura's series of international indebtedness with a constant capital gain to match the 1913 estimate with that of 1932. The annual capital gain needed to match the 1913 estimate with that of 1932 is an annual revaluation of the net foreign asset position of 0.75% as a proportion of annual national income.

The next period in which net foreign assets have been estimated go from 1935 to 1970.

30. Data on the current account balance has been kindly provided by [Prados de la Escosura \(2016a\)](#). Information on gold reserves is stated in [Martín Aceña \(1985\)](#)

Thereafter, the Financial Accounts of the Bank of Spain enable to calculate directly the net foreign assets of the country. Thus, to match the 1934 estimate with that of 1970, we follow the same procedure of accumulating the current account and correcting by the variation of foreign exchange reserves. Data on the current account balance is provided by [Prados de la Escosura \(2017\)](#). Information on the foreign exchange reserves from 1935 to 1948 is presented by [Martínez Ruiz \(2006\)](#) and for the later period from the annual reports of the Bank of Spain and the Statistical Yearbook of Spain ([Direccion General del Instituto Geografico y Estadistico \(0000\)](#)). The resulting series is corrected in the period 1958-1970, assuming some given capital gains of 1.9% per annum.

Finally, for the period of 1970 to 2017, Spain's net foreign assets are derived by netting the gross foreign assets and gross foreign liabilities from the Financial Accounts.

G Income and savings

In this paper, we reconstruct both the stock of wealth and the income flows of the Spanish economy. On the flows side, we are mostly interested in three measures: net national income, net national savings and the current account.

Net national income (or simply national income) seems the best measure to measure the resources produced at disposition of a country's population for either consumption or saving. From this metric, we derive net national savings (or just national savings) to evaluate whether the evolution of wealth is driven by a volume effect (through savings) or by a capital-gains effect (through prices). Finally, we reconstruct the current account to estimate the evolution of the Foreign Assets Position in certain periods.

To obtain these estimates we use the Spanish historical national accounts of Leandro Prados de la Escosura, who reconstructs the GDP and national income of Spain for the period 1850 to 2017 ([Prados de la Escosura \(2003\)](#); [Prados de la Escosura \(2017\)](#)), and the international position from 1850 to 1913 ([Prados de la Escosura \(2010\)](#)).

G.1 National income

National income is equivalent to GDP, plus the net primary income with the rest of the world, and minus the consumption of fixed capital. We are interested in this measure as it reflects the income of a country after discounting the income dedicated to 'repair' the depreciation of the existing capital stock, and after accounting for the rents sent abroad and received from abroad.

For the period of 1850-2017 we use the data on GDP at market value from [Prados de la Escosura \(2017\)](#) most recent update of the Spanish historical accounts, in which he extends his previous work on the Spanish GDP for the period 1850-2000 ([Prados de la Escosura \(2003\)](#)). In addition, these new estimates revise the splicing procedure of the different GDP series produced by the Spanish statistical office since 1958. Consequently, the new series for the 1958-2000 period show some differences relative to the figures for the same period published in his 2003 book footnote. For a detailed methodological discussion of this splicing revision, see [Prados de la Escosura \(2016b\)](#).

In addition to GDP, we need data on the net primary income from the rest of the world, which can be decomposed between net foreign labor and capital income, plus the net foreign production taxes (net of subsidies). We use the series on net primary income with the rest of the world from [Prados de la Escosura \(2017\)](#) for the period 1850-2016 and we only correct these data for the Civil War period (1936-1939) when Prados de la Escosura's estimates (which are still work in progress) seem implausibly low. We correct these data using the estimates from [Martínez Ruiz \(2006\)](#), which analyzes the foreign sector of Spain during the Civil War. In particular, Martínez-Ruiz's work collects two important flows of income from Spain to foreign countries over this period: the maintenance cost of foreign troops fighting in Spain (around 277.3 million of current dollars) and the payments made by the Spanish authorities to pay down acquired loans (around 78.5 million dollars)³¹. Given that her estimates cover a period of four years, we provide a simple annual average and apply the exchange rate with the

31. The maintenance cost of foreign troops is taken from table 4.3 in [Martínez Ruiz \(2006\)](#). The amount of debt payments is taken from table 4.10 (payments to Italy), table 4.11 (payments to Germany) and from the text in the case of payments to Portugal (which amounted to 5.84 million of dollars).

US dollar prevailing in each of these four different years. Following this procedure, our annual estimate of net foreign primary income is about -2.9% of Spain's national income, which is of a much larger magnitude than Prados de la Escosura's provisional estimate of about -0.2% .

For the Consumption of Fixed Capital (CFC), we decide not to use the values of [Prados de la Escosura \(2017\)](#), for two reasons. First, to keep consistency between our estimates of produced assets and the decomposition of national wealth accumulation between savings and capital gains. Importantly, this decomposition relies on using net investment rates by asset type, hence discounting CFC from gross investment. Second, Prados de la Escosura adopts the official data on CFC from INE (Spanish National Statistics Institute) since 1999 onwards, coinciding with the latest official national accounts series. Although this approach seems reasonable to assure convergence between the historical accounts and the most recent official data, it also implies discarding the pattern of depreciation adopted for the period 1850-1998. For these reasons, we prefer to use our series of CFC throughout all sections of this study. As we show in the robustness checks section, our benchmark values of CFC are consistent both with the existing national accounts and with the historical series of [Prados de la Escosura \(2017\)](#). Therefore, this choice does not affect significantly our results in this study.

G.2 National savings and the current account balance

Net national saving is equal to net domestic saving (gross capital formation minus the consumption of fixed capital) plus net foreign investment. Foreign investment is equivalent to the current external balance (i.e. the net balance with the rest of the world of exports, primary income, current transfers and capital transfers). The current external balance diverges from the most extended definition of the current account balance in that the former includes net capital transfers from the rest of the world. As briefly introduced at the beginning of this section, the main goal for calculating net national saving is to decompose wealth growth between a savings effect and changes in asset prices. From this perspective, it is more accurate to include in the definition of net savings the current external balance instead of the current account balance because net capital transfers directly affect the property of assets across

countries, something we would like to capture³².

To compute gross capital formation (domestic investment) and net exports (exports minus imports) we need to decompose GDP into its demand side components (private consumption, investment, government spending and net exports). All metrics are derived for the 1850-2016 period from [Prados de la Escosura \(2017\)](#).

Net current transfers with the rest of the world are also taken directly from [Prados de la Escosura \(2017\)](#) for the 1850-2016 period. Net capital transfers with the rest of the world, on the contrary, are only available for the period 1972-2017 from OECD National Accounts Statistics. Although it would be good to count with data covering a longer period, we do not think this should have a relevant effect on the current external balance as capital transfers only became significant after Spain entered the European Union in 1986. Given that the GDP levels in [Prados de la Escosura \(2016a\)](#) and OECD show some discrepancies for the reasons discussed above, we rescale the net capital transfers in OECD to match the GDP values of Prados de la Escosura. For example, in 1989 the GDP level per OECD statistics stood at 102.7% the level of [Prados de la Escosura \(2017\)](#). Consequently, we simply make that net capital transfers (as per OECD data) are matched at the same percentage (for example, 0.3% in 1989), but using Prados de la Escosura's GDP series.

H Decomposition of wealth accumulation

In addition to building sectoral balance sheets, we also present a decomposition of the accumulation of wealth between a volume effect (through saving) and a relative price effect (through capital gain/losses). To do this, we follow both the "multiplicative" and the "additive" decomposition of wealth accumulation as proposed by [Piketty and Zucman \(2014a\)](#) in the appendix to their paper. These methods relate the accumulation of national saving to the evolution of national wealth, and finds the capital gain component as a residual.

The multiplicative approach argues that the wealth stock in year $t + 1$ depends on three

32. Capital transfers (ESA 2010, 4.145, 4.146) are defined as transfers of ownership of an asset (other than inventories and cash), or the cancellation of a liability by a creditor, without any counterpart being received in return (([European Union, 2013](#), pg. 119))

factors: the volume of wealth in t , new accumulated wealth from t to $t + 1$ (net of depreciation) and the evolution of the relative price of wealth with respect to income. This can be thought as a two goods model were the price of wealth varies with regard to the price of consumption goods. Leaving aside the capital gains component, the accumulation of wealth can be expressed through the following equation:

$$W_{t+1} = W_t + s_t Y_t \tag{1.8}$$

where W_{t+1} represents the value of wealth in year $t + 1$, W_t represents de value of wealth in year t , and $s_t Y_t$ represents the net-of-depreciation saving flow between years t and $t + 1$, that results from the net-of-depreciation saving rate in year t from Y_t , the net national income in year t . Then, to track the evolution of the wealth-to-income ratio (β) we divide the previous equation by Y_{t+1} and we obtain:

$$\beta_{t+1} = \beta_t \frac{(1 + g_{wt})}{(1 + g_t)} \tag{1.9}$$

where $1 + g_{wt} = 1 + \frac{s_t}{\beta_t}$ and $1 + g_t = \frac{Y_{t+1}}{Y_t}$. Hence, in this model movements in the wealth-to-income ratio are positively determined by the volume of saving and negatively determined by the growth rate of income.

Using the result in equation 1.9, we introduce the relative price effect component ($1 + q_t$) as follows:

$$\beta_{t+1} = \beta_t (1 + q_t) \frac{(1 + g_{wt})}{(1 + g_t)} \tag{1.10}$$

Next, we cumulate this equation over n years to get the following multiplicative decomposition of wealth accumulation:

$$\beta_{t+n} = \beta_t (1 + q_t)^n \frac{(1 + g_{ws})^n}{(1 + g)^n} \tag{1.11}$$

where $(1 + g_{ws})^n = (1 + g_{wt}) \times \dots \times (1 + g_{wt+n-1})$ equals the cumulated saving-induced

wealth growth rate;

$(1 + q)^n = (1 + q_t) \times \dots \times (1 + q_{t+n-1})$ is the cumulated capital-gains-induced wealth growth rate, and

$(1 + g)^n = (1 + g_t) \times \dots \times (1 + g_{t+n-1})$ is the cumulated growth rate of national income.

From equation 1.11, we can decompose the evolution of the wealth-to-income ratios into the previous three components or, alternatively, we could just decompose the accumulation of wealth into a volume effect and a capital gains effect. Given that we count with all the data in equation 1.11 except the "cumulated capital-gains-induced" component, we solve for this component as a residual of this equation.

In addition, we carry this decomposition of wealth accumulation for two subcomponents of national wealth: Housing and non-housing wealth. To do this, we start from the definition of national wealth as the sum of domestic non-financial assets plus net foreign wealth: $W_N = A^{NF} + NFW$, which we further decompose into housing and non-housing wealth: $W_N = W^H + W^{NH}$. Housing wealth is the market value of dwellings, while non-housing wealth is the sum of non-housing non-financial assets and net foreign wealth. Similarly, we decompose national saving into domestic investment (net of depreciation) and foreign saving: $S_N = I + S_F$, which then we decompose into housing investment and non-housing national saving: $S_N = I^H + S^{NH}$. As a result, each component of national saving is mapped to its corresponding component in national wealth. We run equation 1.10 separately for each of these two components of national wealth:

$$\beta_{i,t+1} = \beta_{i,t}(1 + q_{i,t}) \frac{(1 + g_{wi,t})}{(1 + g_{i,t})} \quad (1.12)$$

where i stands for housing or non-housing national wealth. Ideally, we would have liked to further decompose non-housing wealth into non-housing non-financial assets and net foreign wealth. However, the multiplicative decomposition of wealth accumulation is based on geometric averages of growth rates, which are only meaningful when wealth stocks take positive values. This is not the case for net foreign wealth in Spain.

On the other hand, the additive decomposition between two given years (t and $t + 1$) can be specified as follows:

$$W_{t+1} = W_t + S_{t,t+1} + KG_{t,t+1} \quad (1.13)$$

where W_t and W_{t+1} are national wealth at time t and $t + 1$, $S_{t,t+1}$ is the total saving flow between year t and $t + 1$, and $KG_{t,t+1}$ are the total capital gains or losses between year t and $t + 1$. To track the evolution of the wealth-to-income ratio (β) we then divide the previous equation by Y_{t+1} and obtain:

$$\beta_{t+1} = \beta_{ini} + \beta_{sav} + \beta_{kg} \quad (1.14)$$

where $\beta_{ini} = \frac{W_t}{Y_{t+1}}$ is the component coming from initial wealth and $\beta_{sav} = \frac{S_{t,t+1}}{Y_{t+1}}$ and $\beta_{kg} = \frac{KG_{t,t+1}}{Y_{t+1}}$ the components coming from saving flows and capital gains or losses, respectively.

Furthermore, in line with the multiplicative form, we go one step beyond and carry this decomposition for housing, other types of capital and foreign wealth³³. We run equation 1.14 separately for each of these three components of national wealth:

$$\beta_{i,t+1} = \beta_{i,ini} + \beta_{i,sav} + \beta_{i,kg} \quad (1.15)$$

where i stands for housing, other types of capital or foreign wealth.

The additive decomposition has the advantage of allowing us to disentangle the fraction of savings and capital gains that each component represents in the total, which is very relevant for explaining the accumulation of national wealth in Spain over time.

The decomposition of wealth accumulation (in both the multiplicative and the additive forms) can be calculated directly with the available series on national wealth, income and savings, except for the Civil War period (1936-1939) and the two subsequent years (1940 and 1941), when we lack complete information to compute the wealth stock. To provide an estimate

33. Note that in this case we do not have the limitations mentioned for the multiplicative decomposition and we are able to split non-housing wealth between other types of capital and foreign.

of national wealth in these years, we follow the approach of [Piketty and Zucman \(2014a\)](#) when they estimate the value of wealth in periods with missing data by running equation 1.9. In addition, they add a fixed capital gain $(1 + q)$ over the whole period, as in equation 1.10, which serves to match the initial estimate of the wealth-to-income ratio with the ratio at the end of the given period. From 1935 to 1942 we follow this same approach with two corrections. First, we correct for the destruction of wealth during the Civil war period (1936-1939) based on [Prados de la Escosura and Rosés \(2010\)](#), using the same proportions of assets destroyed that we use for the PIM estimates of produced assets. Second, we adjust equation 1.12 with a fixed annual capital gain, which serves to match the 1935 estimate of wealth-to-income ratios for each subcomponent of national wealth with that of 1942. Specifically, we run accumulation equations separately for housing and non-housing wealth (we do count with foreign wealth data for the period 1935-1942). We then assume a fixed capital gain for each of this two subcomponents. Finally, we obtain the evolution of national wealth for the period 1935-1942 by aggregating the three subcomponents (housing, non-housing and foreign wealth).

A second aspect where our data show some limitations has to do with the estimate of housing and non-housing investment. By definition, gross national saving equals gross investment plus net foreign saving (current external balance), where gross investment is the sum of gross fixed capital formation and changes in inventories. While we count with data for gross fixed capital formation for housing and non-housing assets, changes in inventories is not decomposed into different assets. Hence, we assume that the proportion of housing and non-housing assets in changes in inventories is proportional to the one observed in gross fixed capital formation. Although we would like to count with more precise estimates of inventories, we do not believe that this assumption has a practical effect on our accumulation equations, as changes in inventories are a small proportion of total gross investment.

I Robustness checks

In this paper we compare the long-run evolution of national wealth at market-value and at book-value and, in addition, we decompose the accumulation of national wealth

between capital gains and savings using the market-value definition of national wealth. In this section, we check the robustness of our results to different specifications. First, we estimate an alternative measure of book-value national wealth using three different patterns of depreciation for produced assets. Second, we test the validity of each estimate of produced assets by comparing the implied values for the Consumption of Fixed Capital. Thirdly, we compare the decomposition of national wealth accumulation using the market-value approach, as presented in the paper, with the same decomposition using the book-value definition. Fourthly, we compare our housing wealth series with estimates produced by other researchers or institutions and analyse if the average evolution of housing prices varied with city size and geography during the housing bubble. Finally, we compare our capital gains estimates on national wealth and the increases in real terms of the three most important assets (housing, equities and agricultural land). Overall, our results are very robust to these different specifications.

I.1 Alternative measurement of book-value national wealth

The book-value approach to national wealth sums the stock of non-financial assets (produced and non-produced) and the net foreign wealth. Ideally, the measurement of all types of assets should be based on a census-like approach where prices and quantities are observed at a given point in time, for which a value of assets is reconstructed. While we measure the two most important non-financial assets in Spain (agricultural land and housing) through the census approach, our book-value definition of wealth calculates produced assets with the PIM³⁴. This method is sensitive to three aspects: the initial stock of produced assets from which investment flows are added, the depreciation pattern of assets and the quality of the underlying data on flows of investment.

The last of these three elements is difficult to test. However, we rely on Prados de la Escosura's reconstruction of Spain's historical national accounts ([Prados de la Escosura](#)

34. We also measure subsoil assets using a capitalization approach, which is different to the census-like method. However, given the historically low weight of subsoil industries in total GDP in Spain, any mismeasurement of the stock of subsoil assets should have an almost negligible impact on the total value of national wealth (for more details, see "mineral and energy reserves" section in this appendix).

(2017)), which is regarded as one of the most serious and consistent historical reconstructions in advanced economies. As for the initial value of the stock of produced assets, we calculate our series of produced assets since 1850, but we only present results since 1900 onwards. This way, we avoid any mismeasurement coming from the choice of an initial value. This is shown by [Prados de la Escosura and Rosés \(2010\)](#), where they compare different choices for the initial stock of produced assets in Spain for the year 1850 and the posterior evolution of PIM estimates. The authors demonstrate that after a period of 40 years (i.e. by 1890), differences in the value of produced assets basically vanish.

The choice of a depreciation pattern is a more delicate aspect. At this respect, the release of the [OECD \(2009\)](#)'s manual supposed an improvement for the practical implementation of the PIM, as it recommends the use of geometric patterns of depreciation, which we use in this study. This type of pattern is characterized by fast rates of depreciation in the initial years of an asset life, which reduces the accumulation of investment and the resulting stock of produced assets when compared to other patterns. Therefore, we decide to compare our results with those using a more conservative approach. For this purpose, we take the depreciation rates used in [Prados de la Escosura and Rosés \(2010\)](#), which correspond to a "modified" geometric pattern, and which are especially conservative regarding the speed at which assets depreciate. As expected, using the "modified" geometric depreciation raises the annual stock of produced asset.

As figure 1.15 shows, our benchmark value for produced assets is around 70-80 per cent of the alternative stock of produced assets over the period 1900-2017. In both cases, we have smoothed the evolution of service lives across the three different periods (1850-1919, 1920-1959 and 1960-200) for which [Prados de la Escosura and Rosés \(2010\)](#) calculate different service lives (see discussion in the "produced assets" part of this appendix). We do this to avoid sharp breaks in the years in which there exist a change of 'service-lives' period (i.e. between 1959 and 1960), which would imply a sudden and artificial increase in the depreciation of produced assets in these years. Figure 1.16, on the contrary, compares our benchmark estimate of produced assets with that of a "modified" geometric depreciation with non-smoothed service

lives while Figure 1.17 presents the comparison of our benchmark series with those using the same depreciation pattern (geometric) but with non-smoothed service lives. Overall, results for the value of produced assets are very similar when comparing the same depreciation pattern with smoothed and non-smoothed service live. However, there exists a significant difference in the level of produced assets when computed with a geometric depreciation pattern or a "modified" geometric depreciation approach (i.e. geometric pattern is around 70-80 percent of the "modified" pattern, confirming the results of Figure 1.15).

To shed light on which series of produced assets are better to use, we compare the Consumption of Fixed Capital (CFC) obtained with each of the previous approaches. Figure 1.18 compares our benchmark series of CFC with those obtained using the "modified" geometric pattern, as a percentage of GDP. In both specifications, the service lives of assets are smoothed. As expected, our benchmark series using the "double-declining" geometric approach shows higher levels of depreciation. Figure 1.19 compares our benchmark series with those using a "modified" geometric pattern with non-smoothed services lives while figure 1.20 compares our benchmark series with those using the same depreciation approach but with non-smoothed service lives. Results from figure 1.19 present very similar values to those in figure 1.18, confirming that the main difference when estimating produced assets stems from the depreciation patterns, and not from the smoothing of service lives. However, as shown in figure 1.20, when using non-smoothed series, a spike in CFC appears in 1960, coinciding with the year in which there is a change in the profile of service lives. From this perspective, using smoothed lives seems preferable.

In figure 1.21 we compare the geometric and the "modified" geometric results for CFC with those from the Spanish national accounts, since 1970, when the OECD splices the official series from the Spanish National Statistics Institute. In this comparison, the denominator (GDP) is different: the geometric and "modified" geometric series uses the GDP from Prados de la Escosura (2017) while the OECD series uses their own GDP obtained when splicing official accounts. This way, all results for CFC are comparable. This figure shows that our benchmark estimates of CFC are very close to those of national accounts, while those obtained

using the "modified" approach are significantly below (between 3 and 4 points of GDP). From this perspective, our benchmark series of produced assets are closer and more compatible with official national accounts than those using the significantly more conservative pattern of depreciation, as it is the case for the "modified" depreciation one.

As explained in the "produced assets" section, in this study we prefer not to use the data on CFC in [Prados de la Escosura \(2017\)](#). The main reason for doing this is that, since 1999, Prados de la Escosura uses directly the data from the last official Spanish national accounts, which start in 1999. While doing this allows Prados de la Escosura full convergence of CFC between his series and those in the official national accounts for the period 1999-2016, it also implies a break with the depreciation pattern followed during the historical period. In [figure 1.22](#) we compare our benchmark values for CFC with those of [Prados de la Escosura \(2017\)](#)) and those of OECD (which, since 1999, correspond with the official national accounts). Overall, the evolution of the three series is very similar, with our series being slightly above the official ones in the most recent years. Yet, it is worth noting that official data during the 1999-2017 period is based on a linear pattern of depreciation, as opposed to the geometric pattern used in this study and advised by [OECD \(2009\)](#).

Overall, this analysis of the different levels of depreciation shows that the real difference when computing CFC stems from the use of different depreciation patterns. In particular, when using our benchmark depreciation pattern, our series are very close to both the values in [Prados de la Escosura \(2017\)](#)'s Historical National Accounts and the official Spanish accounts. As shown in the first three figures of this appendix, the pattern of depreciation is what determines the level of the PIM series of produced assets. Hence, from this perspective, using our pattern of depreciation to compute PIM estimates is more adequate when compared with alternative patterns. Nevertheless, in what follows we compute the book-value national wealth, the stock of non-financial assets and the Tobin's Q under the different patterns of depreciation used to estimate produced assets.

Figures [1.23](#), [1.24](#) and [1.25](#) compare our benchmark series of book-value national wealth with the same three alternative scenarios to calculate produced assets: "modified" geometric

depreciation with smoothed service lives, "modified" geometric depreciation with non-smoothed service lives and geometric depreciation with non-smoothed services lives. In all three cases, the results are very similar to our benchmark series. This seemingly paradox is the result of land underlying buildings, which is obtained as a residual from detracting the replacement cost of dwellings from the total value of housing. Thereafter, the share of land underlying non-residential buildings is imputed from the relation found in the housing sector. Thus, when using the most conservative depreciation pattern, we obtain a higher value of produced assets, which is compensated by lower land underlying buildings (both residential and non-residential)³⁵. This is shown in figures 1.26, 1.27 and 1.28 in the appendix, which present the decomposition of non-financial assets obtained under these different specifications as compared to our benchmark series. Although the share of produced assets and land underlying buildings varies between the two figures, the dynamics are broadly similar.

Finally, in figures 1.29, 1.30 and 1.31 in the appendix we present the Tobin's Q obtained using these different approaches to the book-value national wealth and compare them with the Tobin's Q calculated from corporations' balance sheet. As the alternative measures of national wealth based on the PIM show similar levels over the long run, the Tobin's Q estimates under the different specifications offer similar results too.

Overall, this sensitivity analysis confirms the robustness of our book-value measure of national wealth. In addition, these results highlight the importance of computing dwellings at market value (i.e. including land underlying), as this asset not only determines the long-run dynamics of national wealth but also the role played by land underlying buildings in our calculations. Nevertheless, these results also confirm the need to count with better assessments of both produced assets and land underlying buildings. This element has not been sufficiently explored by statistical institutes and researchers, both in the past and in the present.

35. When using the "modified" geometric depreciation, we find slightly negative values for land underlying dwellings in the years 1930s and 1940s. This could be the result of dwellings being overestimated by the PIM when using the "modified" geometric depreciation but also some degree of underestimation in our series of housing wealth over these years. Historically, rent control can also explain the low values of the market-value of housing as compared to the replacement cost of dwellings during this period.

I.2 The decomposition of national wealth accumulation with the book-value approach

A second aspect which deserves attention has to do with the decomposition of national wealth accumulation shown in the paper. This decomposition is carried with market-value national wealth series and not with the book-value ones. Therefore, we compute the same decomposition using our benchmark series of book-value national wealth. In addition, we show this decomposition for the alternative book-value definition of national wealth, where we use the modified-geometric pattern of depreciation, which we have shown produces too low values of depreciation (hence, high values of net national saving). In table 1.7 and 1.8 of the appendix we reproduce tables 1.2 and 1.3 of the paper, using our benchmark book-value national wealth series. Not surprisingly, given the close resemblance between the two measures of national wealth, results obtained with the two measures are almost identical. In addition, table 1.9 compares the decomposition of national wealth into a savings and a capital gains component using the alternative book-value national wealth definition in addition to our benchmark market-value and book-value national wealth series, for the period 1950-2017. In the two benchmark series (market value and book value), the capital gains component explains between 52 and 54% of the accumulation of national wealth. In the alternative series, capital gains explain a lower share: around 46%. Given the too high net national saving produced by the alternative book-value national wealth series, the share computed with these alternative series should be seen as a lower bound. Overall, these results confirm the important role of capital gains in explaining the accumulation of wealth in Spain since the 1950s, no matter which metric is used in the calculation.

Finally, table 1.10 of the appendix compares the decomposition of market-value national wealth with the decomposition of the private wealth component. As figures 1.1 and 1.5 of the paper depict, the evolution of national wealth in Spain is mostly shaped by the private component. This table shows the similarity of the decomposition of national wealth and private wealth, confirming the predominate role of private wealth in driving the evolution of Spain's national wealth, both at the aggregate level, and when decomposing the accumulation

of wealth into a saving and a capital gains component. This should not be surprising given the predominant role of housing (almost fully owned by households) in driving the dynamics of national wealth in Spain.

I.3 Sensitivity of housing wealth series

For the most recent period (i.e. since 1980-1990) other researchers and institutions have estimated the market-value of the housing stock in Spain. In figure 1.32 of the appendix we compare our series to these alternative estimates. Overall, our series show similar trends to the ones calculated by [Naredo, Carpintero, and Marcos \(2008\)](#), [Pérez and Uriel Jiménez \(2012\)](#) and the Bank of Spain, although our levels are generally lower as we make a more precise use of the available prices on real estate transactions. Clearly, our estimate is the most conservative on the Spanish housing stock.

Focusing on the years around the Spanish housing bubble, one natural question is whether the aggregate dynamics that we find are the consequence of certain regions or cities behaving markedly different from the rest of the country. In figures 1.33 and 1.34 of the appendix we use data from the IVIE institute on the evolution of housing prices by municipality size (figure appendix 19) and by type of geographical region (coastal vs non-coastal regions). The existing evidence shows that the rise in housing prices during the boom happened across the board and was slightly stronger in big cities than in smaller cities and in coastal cities than in the non-coastal cities

I.4 Capital gains and asset price changes

Table 1.11 compares our capital gains estimates on national wealth and the increases in real terms of the three most important assets (housing, equities and agricultural land). This comparison is carried for the whole period 1900-2017, and for different subsets (1900-1950, 1950-2017, etc). Data on housing and equities was kindly provided by [Jorda, Knoll, Kuvshinov, Schularick, and Taylor \(2017\)](#).

Results show interesting trends that go in line with our results. Overall, housing real prices

and capital gains show very similar trends, especially for the 1950-2014 period. In the first half of the 20th century, it is agricultural land prices that mostly resembles the evolution of capital gains. Stock returns are weakly correlated with our capital gains measure, but this fact can be explained due to the underdevelopment of the Spanish stock market. Nonetheless, some caution should be taken when making these comparisons, as [Jorda, Knoll, Kuvshinov, Schularick, and Taylor \(2017\)](#)'s data on housing prices is based on relatively low-quality sources (i.e. house advertisements on the Barcelona-based newspaper *La Vanguardia*).

J Appendix figures and tables

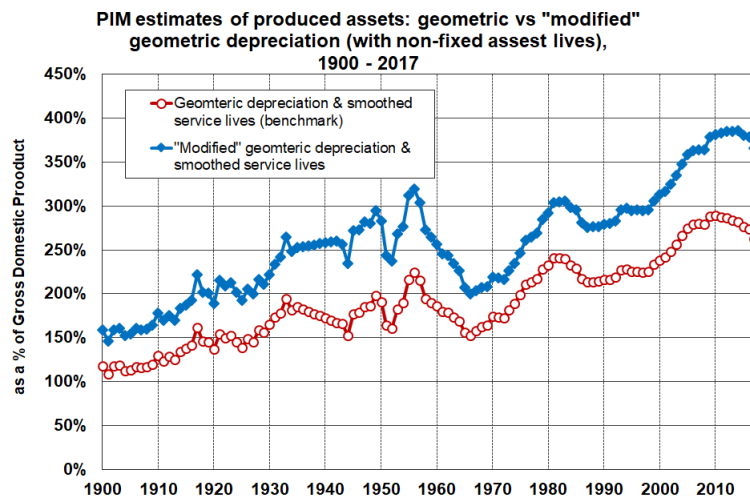


FIGURE 1.15 – PIM ESTIMATES OF PRODUCED ASSETS: GEOMETRIC VS "MODIFIED" GEOMETRIC DEPRECIATION (WITH NON-FIXED ASSEST LIVES), 1900-2017

Notes: This figure compares the stock of produced assets obtained using the Perpetual Inventory Method with smoothed service lives of assets under two different patterns of depreciation: a) Using a geometric pattern of depreciation (benchmark series in the paper), and b) Using a "modified" geometric pattern of depreciation. Data are expressed as a percentage of Gross Domestic Product.

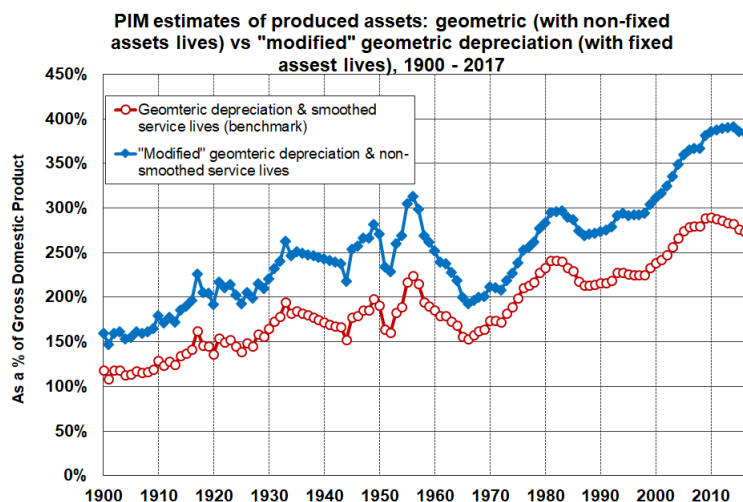


FIGURE 1.16 – PIM ESTIMATES OF PRODUCED ASSETS: GEOMETRIC (WITH NON-FIXED ASSETS LIVES) VS "MODIFIED" GEOMETRIC DEPRECIATION (WITH FIXED ASSEST LIVES), 1900-2017

Notes: This figure compares the stock of produced assets obtained using the Perpetual Inventory Method under two different scenarios: a) Using a geometric pattern of depreciation together with smooth service lives of assets (benchmark series in the paper), and b) Using a "modified" geometric pattern of depreciation with non-smoothed service lives of assets. Data are expressed as a percentage of Gross Domestic Product.

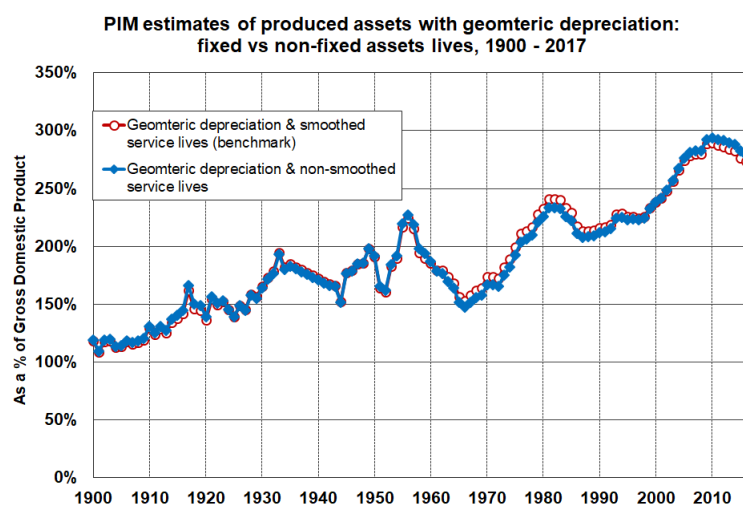


FIGURE 1.17 – PIM ESTIMATES OF PRODUCED ASSETS WITH GEOMTERIC DEPRECIATION: FIXED VS NON-FIXED ASSETS LIVES, 1900-2017

Notes: This figure compares the stock of produced assets obtained using the Perpetual Inventory Method with a geometric pattern of depreciation under two different specifications for the service lives of assets: a) Using smoothed service lives (benchmark series in the paper), and b) Using non-smoothed service lives. Data are expressed as a percentage of Gross Domestic Product.

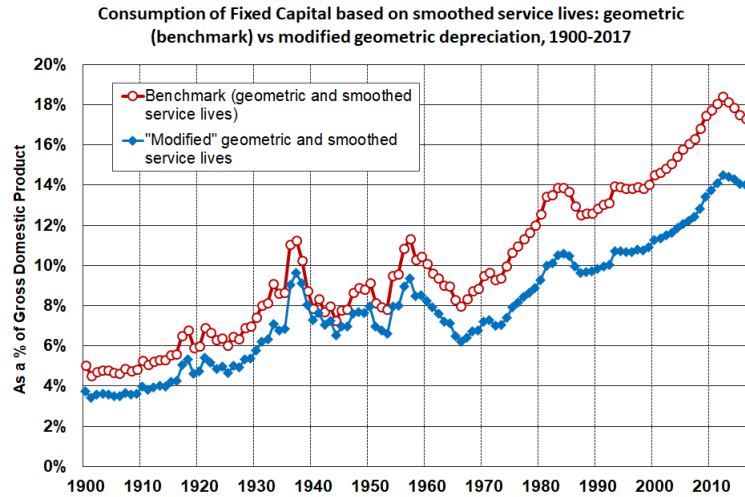


FIGURE 1.18 – CONSUMPTION OF FIXED CAPITAL BASED ON SMOOTHED SERVICE LIVES: GEOMETRIC (BENCHMARK) VS MODIFIED GEOMETRIC DEPRECIATION, 1900-2017

Notes: This figure compares capital depreciation obtained from estimating the stock of produced assets using the Perpetual Inventory Method with smoothed service lives of assets but under two different patterns of depreciation: a) Using a geometric pattern of depreciation (benchmark series in the paper), and b) Using a "modified" geometric pattern of depreciation. Data are expressed as a percentage of Gross Domestic Product.

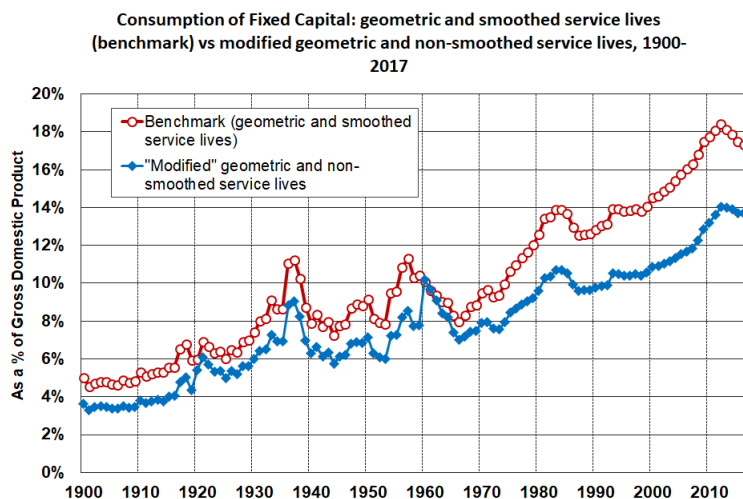


FIGURE 1.19 – CONSUMPTION OF FIXED CAPITAL: GEOMETRIC AND SMOOTHED SERVICE LIVES (BENCHMARK) VS MODIFIED GEOMETRIC AND NON-SMOOTHED SERVICE LIVES, 1900-2017

Notes: This figure compares capital depreciation obtained from estimating the stock of produced assets using the Perpetual Inventory Method under two different scenarios: a) Using a geometric pattern of depreciation with smoothed service lives of assets (benchmark series in the paper), and b) Using a "modified" geometric pattern of depreciation with non-smoothed service lives of assets. Data are expressed as a percentage of Gross Domestic Product.

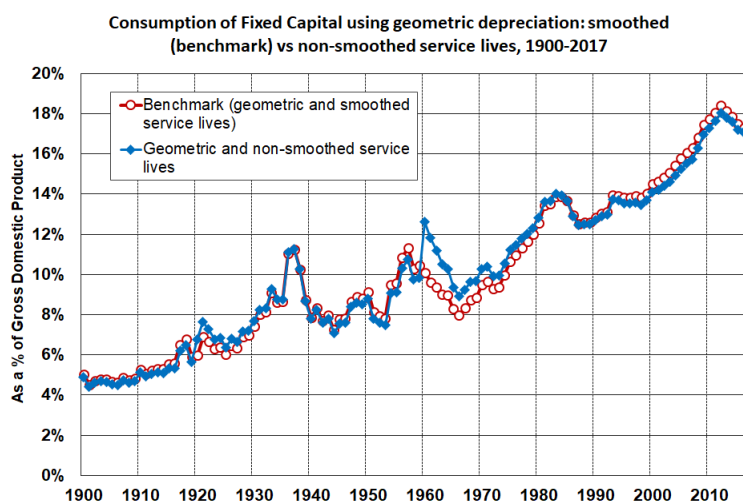


FIGURE 1.20 – CONSUMPTION OF FIXED CAPITAL USING GEOMETRIC DEPRECIATION: SMOOTHED (BENCHMARK) VS NON-SMOOTHED SERVICE LIVES, 1900-2017

Notes: This figure compares capital depreciation obtained from estimating the stock of produced assets using the Perpetual Inventory Method with a geometric pattern of depreciation under two different specifications for the service lives of assets: a) Using smoothed service lives (benchmark series in the paper), and b) Using non-smoothed service lives. Data are expressed as a percentage of Gross Domestic Product.

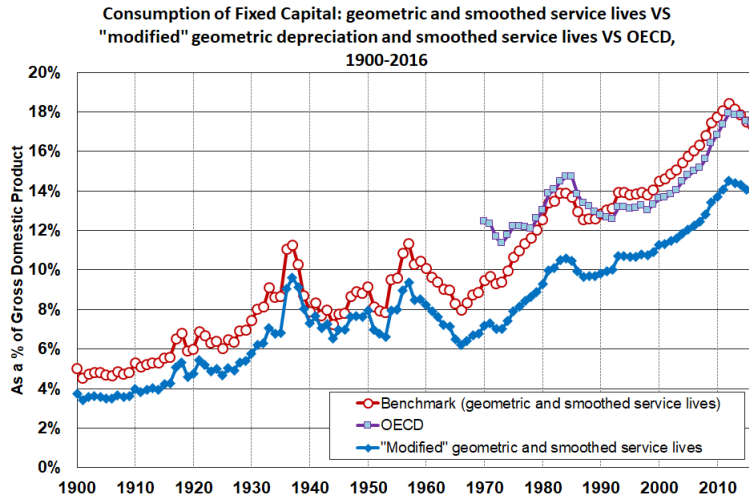


FIGURE 1.21 – CONSUMPTION OF FIXED CAPITAL: GEOMETRIC AND SMOOTHED SERVICE LIVES VS
"MODIFIED" GEOMETRIC DEPRECIATION AND SMOOTHED SERVICE LIVES VS OECD, 1970-2016

Notes: This figure compares our benchmark series of capital depreciation (geometric pattern of depreciation with smoothed service lives) with those obtained with a "modified" geometric pattern of depreciation and those calculated by the OECD National Accounts Statistics. Data are expressed as a percentage of Gross Domestic Product. To be consistent, OECD's capital depreciation is expressed as a percentage of OECD's GDP (our benchmark series of GDP slightly differ from those at OECD).

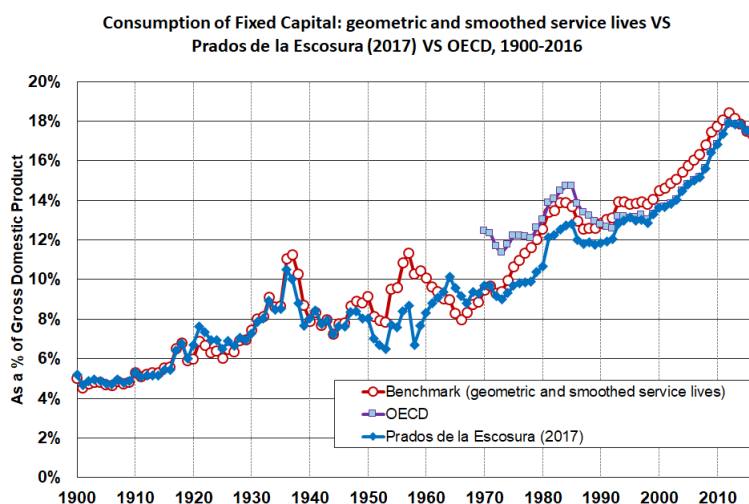


FIGURE 1.22 – CONSUMPTION OF FIXED CAPITAL: BENCHMARK SERIES VS PRADOS DE LA ESCOSURA (2017) VS OECD, 1900-2016

Notes: This figure compares our benchmark series of capital depreciation with those of Prados de la Escosura (2017) and those of OECD. Data are expressed as a percentage of Gross Domestic Product.

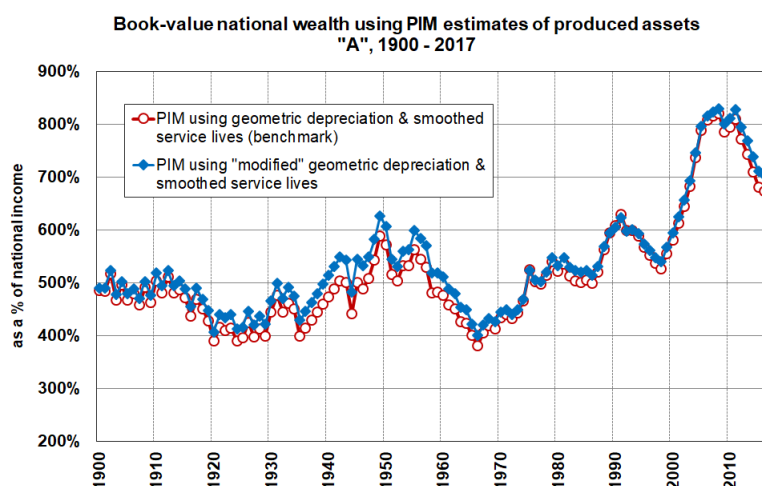


FIGURE 1.23 – BOOK-VALUE NATIONAL WEALTH USING PIM ESTIMATES OF PRODUCED ASSETS "A", 1900-2017

Notes: This figure compares our benchmark series of book-value national wealth with those obtained estimating produced assets under an alternative pattern of depreciation. Our benchmark series uses a geometric pattern while the alternative series uses a "modified" geometric pattern. Data are expressed as a percentage of Gross Domestic Product.

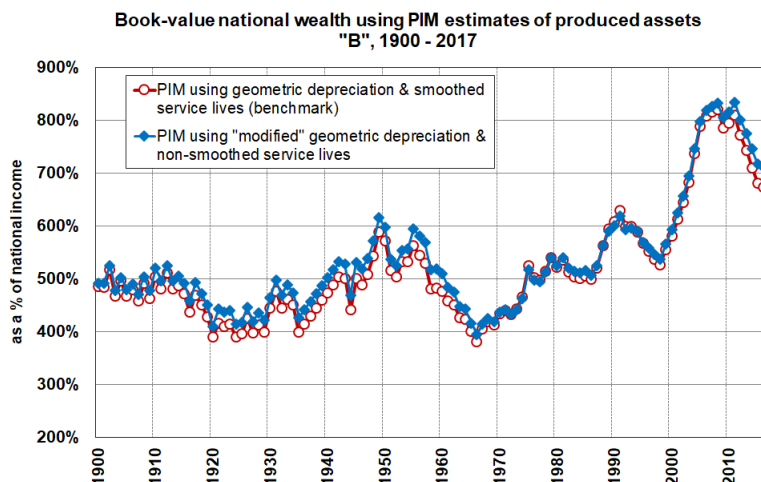


FIGURE 1.24 – BOOK-VALUE NATIONAL WEALTH USING PIM ESTIMATES OF PRODUCED ASSETS "B", 1900-2017

Notes: This figure compares our benchmark series of book-value national wealth with those obtained estimating produced assets under an alternative pattern of depreciation and a different specification for the service lives of assets. Our benchmark series uses a geometric pattern together with smoothed service lives of assets while the alternative series uses a "modified" geometric pattern with non-smoothed service lives of assets. Data are expressed as a percentage of Gross Domestic Product.

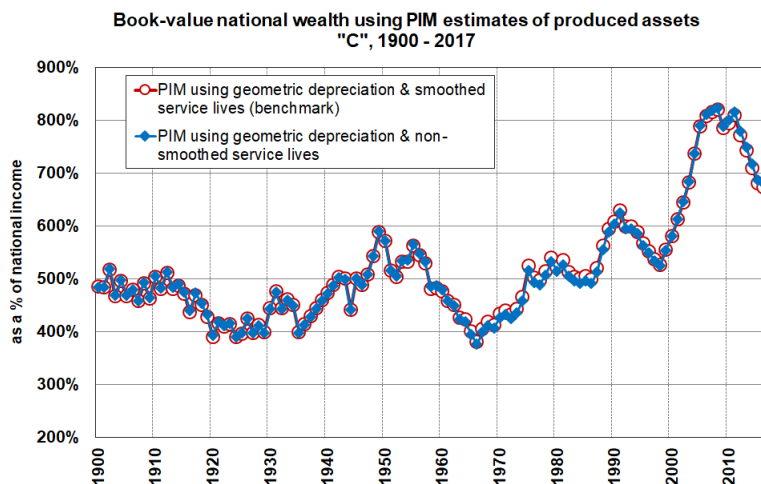


FIGURE 1.25 – BOOK-VALUE NATIONAL WEALTH USING PIM ESTIMATES OF PRODUCED ASSETS "C", 1900-2017

Notes: This figure compares our benchmark series of book-value national wealth with those obtained estimating produced assets with a different specification for the service lives of assets. Our benchmark series uses smoothed service lives of assets while the alternative series uses non-smoothed service lives of assets. Data are expressed as a percentage of Gross Domestic Product.

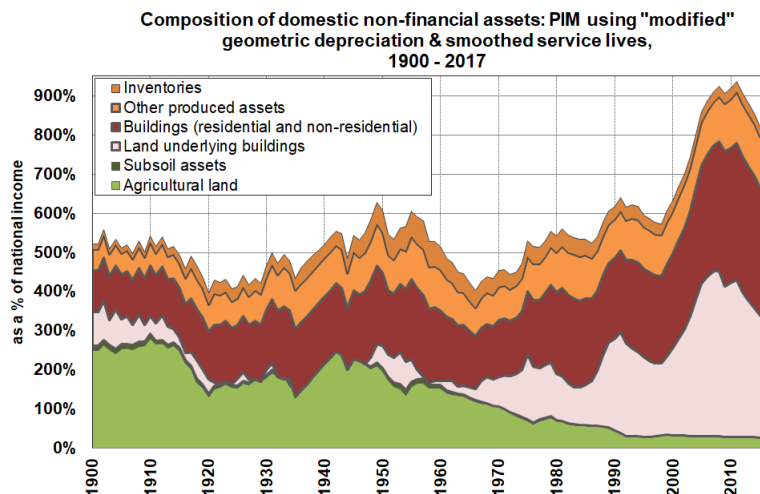


FIGURE 1.26 – COMPOSITION OF DOMESTIC NON-FINANCIAL ASSETS: PIM USING "MODIFIED" GEOMETRIC DEPRECIATION AND SMOOTHED SERVICE LIVES, 1900-2017

Notes: This figure shows the composition of domestic non-financial assets which results from estimating produced assets with an alternative specification to the one used in the paper. In this alternative case, produced assets are obtained using a "modified" pattern of depreciation while the benchmark series in the paper uses a geometric pattern. Data are expressed as a percentage of National income.

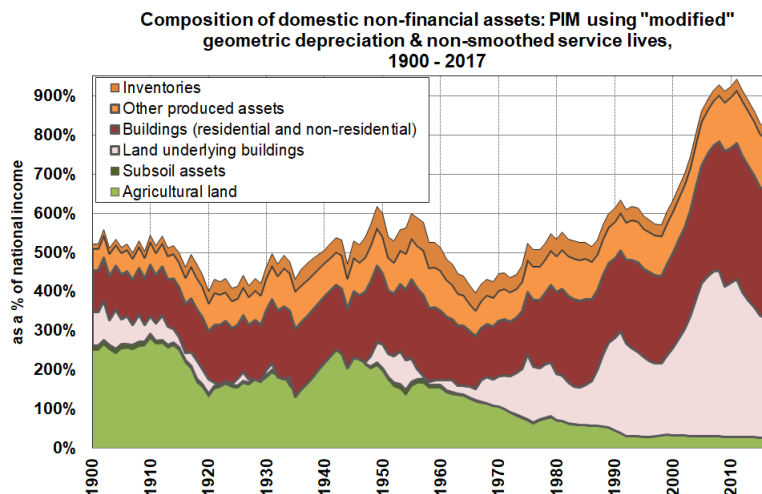


FIGURE 1.27 – COMPOSITION OF DOMESTIC NON-FINANCIAL ASSETS: PIM USING "MODIFIED" GEOMETRIC DEPRECIATION AND NON-SMOOTHED SERVICE LIVES, 1900-2017

Notes: This figure shows the composition of domestic non-financial assets which result from estimating produced assets with an alternative specification to the one used in the paper. In this alternative case, produced assets are obtained using a "modified" pattern of depreciation and non-smoothed service lives of assets. The benchmark series in the paper uses a geometric pattern with smoothed service lives of assets. Data are expressed as a percentage of National income.

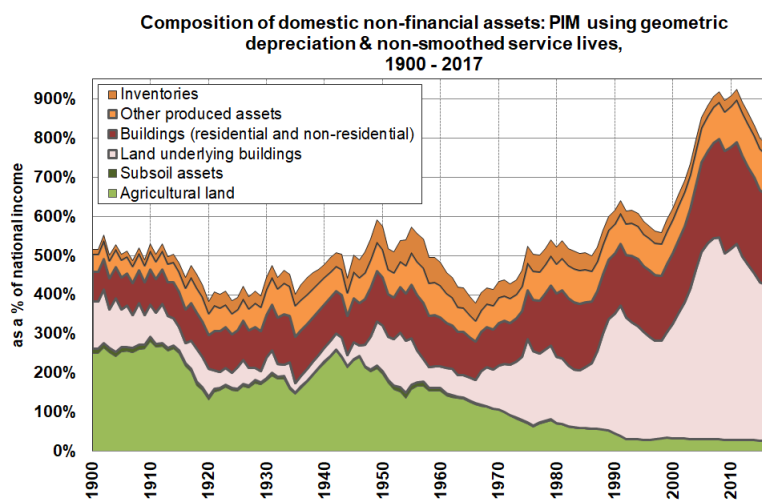


FIGURE 1.28 – COMPOSITION OF DOMESTIC NON-FINANCIAL ASSETS: PIM USING GEOMETRIC DEPRECIATION AND NON-SMOOTHED SERVICE LIVES, 1900-2017

Notes: This figure shows the composition of domestic non-financial assets which results from estimating produced assets with an alternative specification to the one used in the paper. In this alternative case, produced assets are obtained using non-smoothed service lives of assets. The benchmark series in the paper uses smoothed service lives of assets. Data are expressed as a percentage of National income.

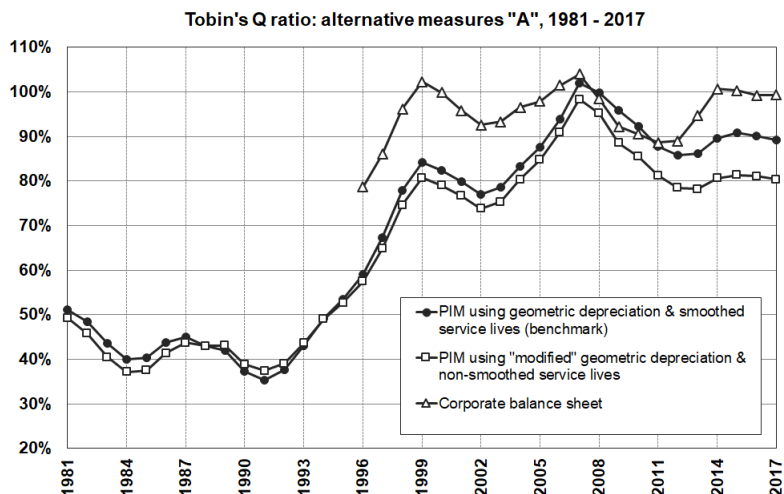


FIGURE 1.29 – TOBIN'S Q RATIO: ALTERNATIVE MEASURES "A", 1981-2017

Notes: This figure compares our benchmark series of Tobin's Q and the census-like estimate from the Bank of Spain with an alternative series of Tobin's Q obtained estimating produced assets using a "modified" pattern of depreciation and non-smoothed service lives of assets.

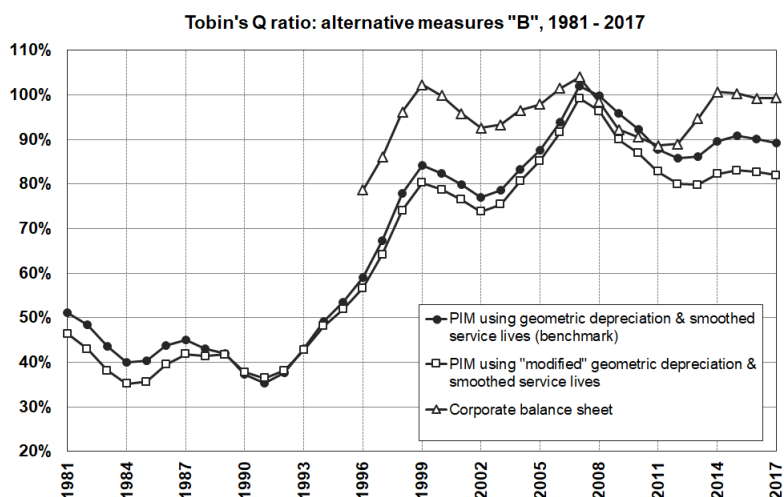


FIGURE 1.30 – TOBIN'S Q RATIO: ALTERNATIVE MEASURES "B", 1981-2017

Notes: This figure compares our benchmark series of Tobin's Q and the census-like estimate from the Bank of Spain with an alternative series of Tobin's Q obtained estimating produced assets using a "modified" pattern of depreciation.

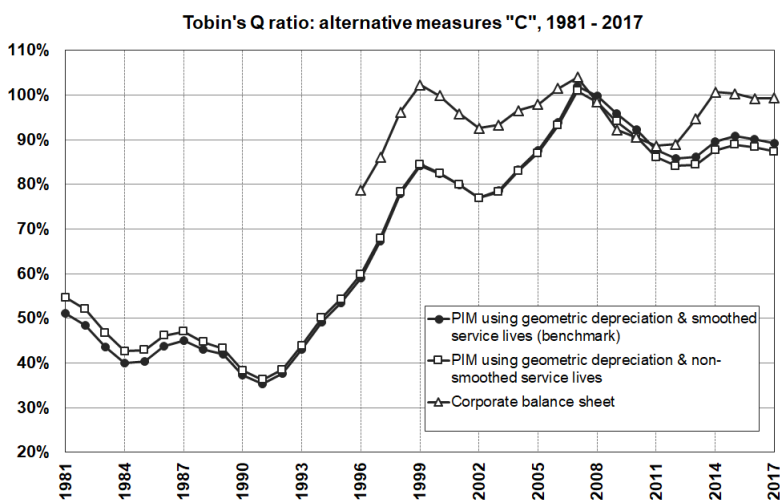


FIGURE 1.31 – TOBIN’S Q RATIO: ALTERNATIVE MEASURES "C", 1981-2017

Notes: This figure compares our benchmark series of Tobin’s Q and the census-like estimate from the Bank of Spain with an alternative series of Tobin’s Q obtained estimating produced assets using non-smoothed service lives of assets.

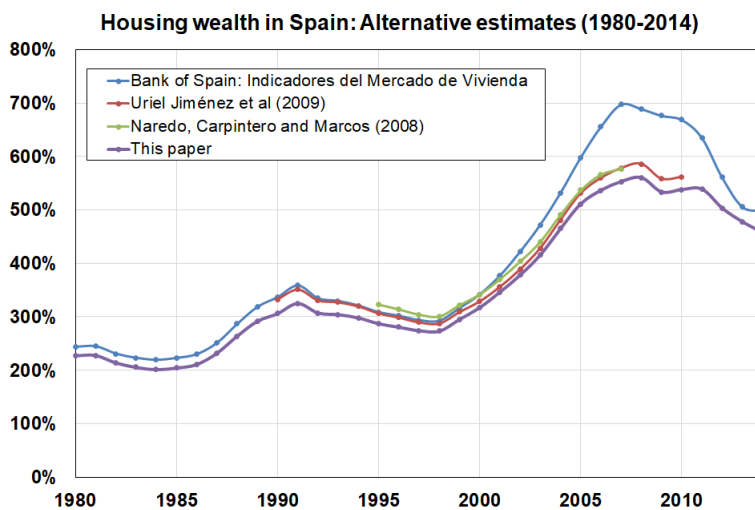


FIGURE 1.32 – ALTERNATIVE ESTIMATES OF HOUSING WEALTH IN SPAIN, 1980-2014

Notes: This figure compares our benchmark series of housing wealth with alternative estimates made by other researchers and institutions.

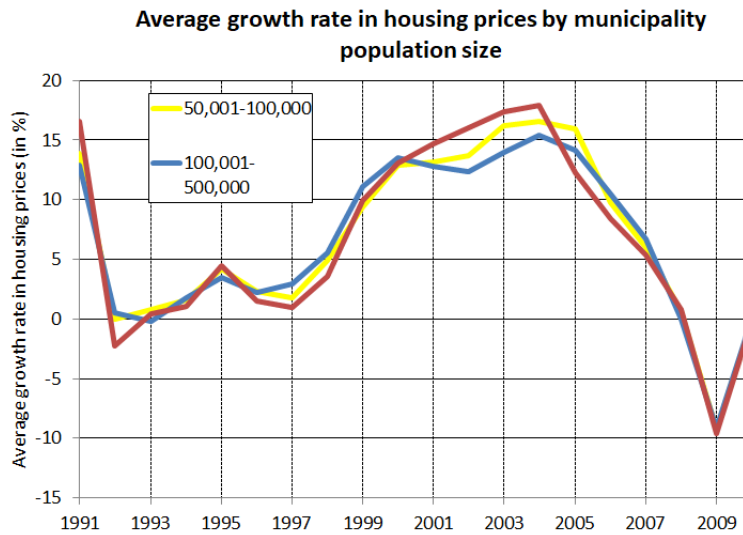


FIGURE 1.33 – AVERAGE GROWTH RATE IN HOUSING PRICES BY MUNICIPALITY POPULATION SIZE, 1991-2010

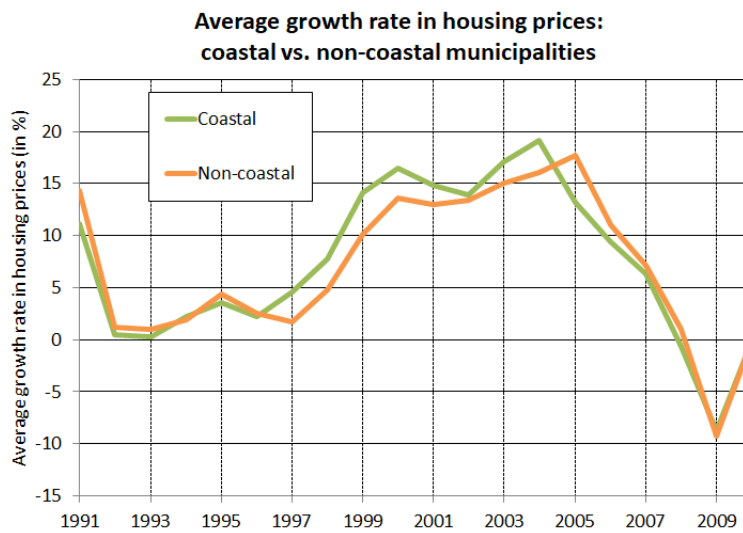


FIGURE 1.34 – AVERAGE GROWTH RATE IN HOUSING PRICES: COASTAL VS. NON-COASTAL MUNICIPALITIES, 1991-2010

TABLE 1.7 – ACCUMULATION OF BOOK-VALUE NATIONAL WEALTH IN SPAIN, 1900-2017 (MULTIPLICATIVE DECOMPOSITION)

Accumulation of benchmark book-value national wealth in Spain, 1900-2017 (Multiplicative decomposition)

	Book-value national wealth-income ratios (%)		Decomposition of national wealth growth rate (%)			Decomposition of housing wealth growth rate (%)			Decomposition of non-housing wealth growth rate (%)		
			Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	Real growth rate of housing wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate	Real growth rate of non-housing wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate
			βt	$\beta t+n$	gw	gws=s/ β	q	gw	gws=s/ β	q	gw
1900-2017	484%	666%	3,0%	1,4%	1,4%	3,7%	1,8%	1,9%	2,4%	1,3%	1,1%
				50	50		49	51		54	46
1900-1950	484%	572%	1,2%	0,8%	0,3%	1,2%	1,0%	0,2%	1,2%	0,7%	0,5%
				72	28		82	18		58	42
1950-2017	572%	666%	4,1%	1,8%	2,2%	5,4%	2,2%	3,1%	3,0%	1,6%	1,4%
				44	56		41	59		52	48
1950-1980	572%	522%	5,3%	2,4%	2,8%	6,9%	3,3%	3,5%	4,4%	2,1%	2,3%
				46	54		48	52		47	53
1980-2017	522%	666%	3,1%	1,3%	1,8%	4,2%	1,3%	2,8%	1,9%	1,2%	0,7%
				42	58		32	68		63	37

Notes: This table presents the accumulation of book-value national wealth in Spain for 1900-2010 using the multiplicative decomposition. Results for the market-value definition of national wealth are presented in Table 1.1 in the paper. This table reads as follows: The annual real growth rate of national wealth in Spain was 3% over 1900-2017. This can be decomposed into 1.4% and 1.4% savings-induced and capital gains-induced wealth growth rates, respectively. The table also presents the accumulation of housing and non-housing national wealth (other types of capital and foreign wealth) separately. The small numbers below the savings and capital gains growth rates are the fraction of each in the total growth rate.

TABLE 1.8 – ACCUMULATION OF BOOK-VALUE NATIONAL WEALTH IN SPAIN, 1900-2017 (ADDITIVE DECOMPOSITION)

Accumulation of book-value national wealth in Spain, 1900-2017 (Additive decomposition)						
	Savings (% of total cumulated net savings)			Capital gains (% of total capital gains)		
	Housing	Other types of capital	Foreign	Housing	Other types of capital	Foreign
1900-1950	33%	65%	2%	17%	69%	15%
1950-2017	57%	79%	-36%	75%	25%	0%
1950-1980	42%	93%	-35%	52%	24%	23%
1980-2017	63%	73%	-36%	82%	27%	-9%

Notes: This table presents the accumulation of book-value national wealth in Spain for 1900-2017 using the additive decomposition. Results for the market-value definition of national wealth are presented in Table 1.3 in the paper. National wealth is decomposed into housing, other types of capital, and foreign wealth. The Table reads as follows: Housing accounts for 33% of total cumulated net savings over 1900-1950.

TABLE 1.9 – ACCUMULATION OF NATIONAL WEALTH: COMPARISON OF NATIONAL WEALTH MEASURES
(MULTIPLICATIVE DECOMPOSITION): 1950-2017

Accumulation of national wealth: comparison of national wealth measures (Multiplicative decomposition): 1950-2017					
	National wealth-income ratios (%)		Decomposition of national wealth growth rate (%)		
			Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate
	β_t	β_{t+n}	gw	gws=s/β	q
Benchmark market value	556%	629%	4,0%	1,9% 48	2,1% 52
Benchmark book value	572%	666%	4,1%	1,9% 46	2,2% 54
Alternative book value	606%	696%	4,1%	2,2% 54	1,8% 46

Notes: This Table presents the accumulation of national wealth in Spain for 1950-2017, for three alternative measures. Computations have been done using national accounts. The Table reads as follows: the real growth rate of market-value national wealth in Spain has been 4% a year on average over 1950-2017. This can be decomposed into a 1.9% savings-induced wealth growth rate and a 2.1% capital gains-induced wealth growth rate.

TABLE 1.10 – ACCUMULATION OF MARKET-VALUE NATIONAL AND PRIVATE WEALTH IN SPAIN, WITH TWO ENDING YEARS: 2010 AND 2017
(MULTIPLICATIVE DECOMPOSITION)

**Accumulation of market-value national and private wealth in Spain, with two ending years: 2010 and 2017
(Multiplicative decomposition)**

	Market-value <u>national</u> wealth-income ratios (%)		Decomposition of <u>national</u> wealth growth rate (%)			Market-value <u>private</u> wealth-income ratios (%)		Decomposition of <u>private</u> wealth growth rate (%)		
			Real growth rate of national wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate			Real growth rate of private wealth	Savings-induced wealth growth rate	Capital gains-induced wealth growth rate
			βt	$\beta t+n$	gw			$gws=s/\beta$	q	βt
1950-2010	556%	774%	4,7%	2,1%	2,6%	506%	703%	4,7%	2,2%	2,5%
				44	56				47	53
1950-2017	556%	629%	4,0%	1,9%	2,1%	506%	619%	4,1%	2,1%	2,0%
				48	52				52	48
1980-2010	460%	774%	4,5%	1,7%	2,8%	402%	703%	4,7%	1,9%	2,7%
				38	62				41	59
1980-2017	460%	629%	3,3%	1,5%	1,8%	402%	619%	3,6%	1,8%	1,7%
				46	54				52	48

Notes: This Table presents the accumulation of market-value national wealth in Spain for 1900-2017, for the total economy and the private sectors. Computations have been done using national accounts. The Table reads as follows: the real growth rate of market-value national wealth in Spain has been 4.7% a year on average over 1950-2010. This can be decomposed into a 2.1% savings-induced wealth growth rate and a 2.6% capital gains-induced wealth growth rate.

TABLE 1.11 – TABLE APPENDIX 5: A COMPARISON BETWEEN ESTIMATED AND OBSERVED REAL CAPITAL GAINS. SPAIN, 1900-2017 (CAPITAL GAINS IN REAL TERMS, ANNUAL GROWTH RATE)

**Table appendix 5: A comparison between estimated and observed real capital gains.
Spain, 1900-2017
(Capital gains in real terms, annual growth rate)**

	Wealth accumulation model (This paper)			Historical Asset prices		
	Total wealth	Housing wealth	Non-housing wealth	Housing	Stocks	Agricultural land
	Capital gains induced wealth growth rate	Capital gains induced wealth growth rate	Capital gains induced wealth growth rate			
1900-2017	1,2%	1,9%	0,6%	0,66%	-0,67%	0,87%
1900-1950	0,1%	0,2%	0,2%	-1,56%	-1,48%	0,55%
1950-2017	2,1%	3,1%	0,9%	2,43%	-0,01%	1,11%
1950-1980	2,4%	3,5%	1,5%	2,97%	-3,93%	3,03%
1980-2017	1,8%	2,8%	0,4%	1,91%	3,35%	-0,50%

Notes: This table compares the real capital gains on national wealth, as computed in this paper (table 1.2), with real price gains on specific data. Historical data on housing and stocks is derived from Jorda et al. (2018), while for agriculture it is derived from the same sources used in this paper

Chapter 2

From Manufacturing to Services: The impact of Structural Change on the value of Housing¹

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Abstract

This paper connects the striking rise of national housing-to-national income ratios experienced by rich countries over the last decades decades with the transformation of the productive system: from manufacturing to services. It explores two factors: the increase in countries' spatial concentration of economic activity and the negative shocks to manufacturing-specialized regions. To explore the first factor, I present new series of housing wealth and of spatial concentration of economic activity in seven developed economies: France, Germany, Italy, Japan, Spain, UK and USA. Results show that rising housing wealth is the consequence of higher urban land values, with this increase being tightly connected with larger concentration of market-oriented services. The second factor is investigated using urban-level data in England and Wales, thus analyzing how macro trends in house-income ratios emerge from the local level. I find that rising national values are largely the result of higher dispersion of local house prices, but not of incomes per capita. The best predictor of how house prices changed is the city-level specialization of the productive system. I estimate that one quarter of the dispersion in local house prices is explained by manufacturing output declining at the national level. A simple theoretical model is used to rationalize these two factors.

JEL codes: L16, R11, R12, R3.

Keywords: Wealth-income ratios; Spatial inequality; House prices; Structural change.

Introduction

National wealth-to-national income ratios in rich countries have doubled over the last decades (Piketty and Zucman (2014a)), from values of 3 in 1970 to almost 6 in 2015 (Bauluz (2017)). Out of the total increase, most of it corresponds to a single asset: Housing (Bonnet, Bono, Chapelle, Wasmer, et al. (2014); (Alvaredo, Chancel, Piketty, Saez, and Zucman, 2018, table 3.2.1.)). And within housing, it is likely the result of higher urban land values (Knoll, Schularick, and Steger (2017); Artola Blanco, Bauluz, and Martinez-Toledano (2018)). Yet, the reasons for this increase are unclear, with only a few papers investigating specific channels: income and population growth (Grossman and Steger (2017)); low productivity in the construction sector (Borri and Reichlin (2018)); or the decline in gains from the transport technology (Miles and Sefton (2017)). Although these are interesting analyses, all three are theory-based, making difficult to determine the actual relevance of the proposed factors.

In this project I focus on a different channel which I believe powerful enough to partly explain such a drastic increase: the change in the productive system experienced by rich countries, from manufacturing-oriented economies towards service-intensive ones (Herrendorf, Rogerson, and Valentinyi (2014)). I hypothesize that rising housing values are the result of combining two factors. First, structural change may have led to higher regional concentration of economic activity over few places, due to the trend for services to locate together and for manufacturing to disperse (Desmet and Rossi-Hansberg (2009)). Second, I observe that structural change accelerates when manufacturing-specialized regions are exposed to international competition (Coricelli and Ravasan (2017); Świącki (2017)). With service-cities depending more on location than on traditional capital for their productive activities (Baldwin (2017)), when manufacturing regions decline this may lead to a fast appreciation of house prices in service-successful ones. While these two factors are not necessarily exclusive both focus on different aspects: the first one on the national concentration of economic activity, the second one on the decline of manufacturing regions and the emergence of service ones (irrespective of how aggregate concentration is). Therefore, I investigate the two separately. By contrast with

previous research, I bring in new data, in addition to using theory, to explore the structural change hypothesis².

This project is structured in three parts. In the first part, I investigate the link between the evolution of housing wealth and the concentration of economic activity in seven rich and regionally large economies: France, Italy, Germany, UK, Spain, USA and Japan. I do this by establishing a new set of stylized facts, which I then connect between them. I start by asking whether the rise of housing wealth is driven by higher urban land values or larger quantity of dwellings. While this is a relevant question to any theory dealing with the rising value of housing, no previous research has shown this decomposition from a cross-country perspective³. I find that, indeed, the observed increase in housing wealth since 1970 is largely the result of higher land values. This is consistent with [Knoll, Schularick, and Steger \(2017\)](#), where they focus on house prices (and not on the combination of prices and quantities) and find that the appreciation of these prices over the last decades was largely the result of more expensive urban land.

As a second stylized fact, I compare the regional concentration of economic activity across these seven countries, using definitions of urban areas that are comparable across them. The latter element is important as previous research has mostly compared the evolution of regional inequality based on administratively-defined boundaries⁴ – the problem being that these administrative regions do not reflect economically-delimited areas (i.e. urban areas). I find that, in most countries, regional concentration of economic activity increased over the last decades, and that this was, to a large extent, because market-oriented services

2. In a parallel work, [Venables \(2018\)](#) explores how globalization impacts negatively non-competitive tradable regions and how an equilibrium exists where the share of urban land-rents rises in national income, because of land rents increasing in non-declining tradable regions. Venables's paper is based on a theoretical model and does not look at manufacturing and services separately, by contrast with this paper.

3. [Davis and Heathcote \(2007\)](#) decompose USA's housing wealth into these two components, since 1930; [Artola Blanco, Bauluz, and Martínez-Toledano \(2018\)](#) do the same decomposition for Spain since 1900.

4. A large literature on regional inequality has used administratively-delimited regions. Examples of this are the use of states within the USA ([Barro and Sala-i Martín \(1991\)](#)); regions in Italy ([Felice \(2017\)](#)); provinces in Spain ([Martínez-Galarraga, Rosés, and Tirado \(2015\)](#)); regions in UK ([Geary and Stark \(2015\)](#)); *départements* in France ([Combes, Lafourcade, Thisse, and Toutain \(2011\)](#)); regions in Portugal ([Badía-Miró, Guilera, and Lains \(2012\)](#)). Recently, [Rosés and Wolf \(2018\)](#) have analyzed the long-term evolution of regional inequality in 16 European countries based on GDP estimates at the NUTS-2 area level (NUTS are regional areas defined by Eurostat, and usually follow countries' interior administrative sub-division).

concentrated more, with manufacturing showing the opposite pattern. Yet, this evolution was not homogeneous across countries. In particular, those countries with a more monocentric structure (i.e. France, UK or Spain) saw larger increases in regional concentration than those with a more polycentric one (i.e. Germany or the USA). Interestingly, those countries that concentrated more also increased their housing-income ratios by more. This result is fully consistent with the theoretical argument (higher regional concentration leading to higher demand for housing over few places, hence raising housing values) and is statistically supported by a set of cross-country fixed-effects regressions.

The second part of the project is a theoretical exercise to shed light on the two factors investigated. To do this, I adapt [Moretti \(2011\)](#)'s spatial equilibrium model of the labor and the housing markets to account for two stylized facts: i) The decline of manufacturing regions and the emergence of service ones; ii) The rise of housing prices (or rents) at a faster pace than incomes. Once I adapt Moretti's model to have cities specialized in services and manufacturing, a negative shock to the manufacturing region produces an increase in local ratios of housing rents-to-wages (a proxy for housing-income ratios) that is substantially stronger in my model when compared to a similar shock in the original version of Moretti. I also discuss how to interpret the model to account for the main finding in part I: that those countries that concentrated more also increased their house-income ratios by more.

The third part of the project explores, empirically, the second factor: the decline of manufacturing regions and its impact on local house-income ratios (both in manufacturing and service cities). I do so by using a panel of 62 urban areas in England and Wales with annual data between 1995 and 2015. To the best of my knowledge, this is the first study exploring how macro trends in house-to-income ratios emerge from the local level. I find that the national increase in the house-to-income ratio over this period was characterized by an important upswing in the dispersion of house prices across cities (with the variation of incomes per capita rising much more moderately). Using a descriptive approach, I detect that the best predictor of how house prices grew across cities is the local specialization of urban areas, with manufacturing cities showing lower increases in house prices. I then test the

prediction of the model and analyze how the aggregate decline in manufacturing value added had a differential impact on local house prices, comparing manufacturing regions with service ones. I estimate that around one quarter of the dispersion in house price growth between these regions is explained by structural change.

The article is organized as follows. Section 2.1 presents new series of housing wealth and spatial concentration of economic activity, connecting the two phenomena. In section 2.2, I introduce the theoretical model. In section 2.3, I use microdata from England and Wales to analyze the decline of manufacturing regions and the reaction of local house-income ratios. Section 2.4 concludes.

2.1 New stylized facts

Over the last five decades, rich countries have gone through a profound transformation of their productive systems, from manufacturing-intense economies towards service-oriented ones (Herrendorf, Rogerson, and Valentinyi (2014)). According to Desmet and Rossi-Hansberg (2009), over the 1970-2000 period, employment in services increased its regional concentration in the US and Europe, with the opposite trend happening in manufacturing. While they connect these trends with the dispersion in land rents in the USA (Desmet and Rossi-Hansberg (2014)) they do not examine how aggregate concentration of economic activity is after structural change happens nor they look at how this is connected to the national value of housing when compared to incomes.

In this section, I explore this link (structural change, aggregate concentration of economic activity and national house-income ratios). To do so I present the necessary stylized facts to connect these phenomena by using data for seven rich economies: France, Germany, Japan, Italy, Spain, UK and USA. Selecting these countries has a clear reason: these are sufficiently large countries in terms of interior regions to analyze the regional concentration of economic activity. First, I quantify the contribution of different economic activities (i.e. manufacturing, construction, services) to gross value added and analyze patterns of regional concentration of

economic activity. Second, I show the evolution of national housing wealth decomposed into a land and a structure component. Finally, I present a correlation analysis of both phenomena by means of both visual correlations and statistical tests.

2.1.1 Structural change and spatial concentration

Historically, economic development has followed structural change patterns: poor-agricultural economies transit towards richer-manufacturing countries, which in the latest stages of development specialize into service activities ([Herrendorf, Rogerson, and Valentinyi \(2014\)](#)). Today's rich countries were largely industrialized around the World War II years and started to deindustrialize between the 1960s and 1980s, with this process accelerating during the 2000s⁵. According to [Świącki \(2017\)](#), two are the fundamental mechanisms explaining the transition from manufacturing to services over the last decades: sector-biased technological change (based on [Baumol \(1967\)](#)'s cost disease theory) and international trade. Recent research by [Coricelli and Ravasan \(2017\)](#) points to the first mechanism as the main driver before the 2000s with the second being fundamental to explain the 2000s, coinciding with the emergence of China as a world-leading exporter.

While these country-level patterns of structural change are well known, how the spatial distribution of economic activity evolves within countries throughout this process has received limited attention. To the best of my knowledge, only [Desmet and Rossi-Hansberg \(2009\)](#) have analyzed the geographical distribution of employment for the US and Europe, in connection to structural change⁶. They find a trend for manufacturing employment to disperse and service employment to concentrate over the period 1970-2000, which they rationalize with a theoretical argument: in the last decades, the service sector can be characterized as a "young industry" benefitting from agglomeration economies, hence tending to locate together; on

5. [Rodrik \(2016\)](#) documents that the date at which developing countries start to deindustrialize (relative to their level of income per capita) comes much sooner than for developed economies, with the exception of many Asian countries.

6. [Michaels, Rauch, and Redding \(2012\)](#) is another exception, but their analysis investigates the geographical distribution of population in the US (and not employment or value added). In addition, the paper focuses on the transition from agriculture to manufacturing rather than from manufacturing to services.

the contrary, the manufacturing sector is an "old industry", that has already benefitted from agglomeration economies in the past, and for which it is optimal to locate in smaller regions where land values are cheap. This interpretation goes in line with [Combes, Lafourcade, Thisse, and Toutain \(2011\)](#)'s analysis of France, where they find that agglomeration economies in services almost tripled between 1930 and 2000, while no change is observed in manufacturing.

From an empirical perspective, however, there are three limits to Desmet and Rossi-Hansberg's analysis. First, their geographical unit of observation may not be the correct one, as they use county-level data for the US and Eurostat's NUTS regions for Europe – the problem being that these geographical units are based on administrative boundaries that may not coincide with economically meaningful areas (as, for example, urban regions or travel-to-work areas). Second, their analysis does not cover the aggregate consequences of these trends, for instance, whether total employment is becoming more concentrated nationally. Finally, the analysis is restricted to employment. Whether similar trends are also found in value added, and not only in employment, remains an open question ⁷, but a relevant one when dealing with the evolution of housing wealth when compared national income or value added.

To overcome these limits, I decompose total gross value added in these seven countries into five sub-sectors: agriculture, manufacturing, construction, market services and non-market services ⁸. The goal is to show the evolution of each type of economic activity in overall value added. I then investigate if economic activity has increased its spatial concentration within countries using definitions of urban areas that are comparable across them. The analysis spans the period 1980-2014, due to availability of data sources. Focusing on this period is, nonetheless, certainly convenient. This is because rich countries had already reached very high levels of urbanization by 1980 (Figure 2.1) whereas the previous three decades (1950-1980)

7. Under Baumol's hypothesis, structural change happens because the leading technological sector – i.e. manufacturing – loses employment; hence, it is theoretically possible a dispersion of manufacturing employment but not of its value added, if manufacturing employment is sufficiently more productive in denser areas.

8. Results do not include the agriculture sector (which includes agriculture, forestry and fishing activities), given its declining importance in total output (below 5% of total GVA in most countries). Manufacturing includes the following three sectors: "Mining and quarrying", "manufacturing activities" and utilities (i.e. electricity, gas and water supply).

were characterized by strong rural-urban migrations. This implies that indexes of aggregate spatial concentration of economic activity before 1980 will reflect, to a large extent, migrations from rural to urban regions. After 1980, however, these indexes will capture, mostly, the relocation of economic activity and population across different urban regions. The latter phenomenon is the one of interest in the present analysis.

Data for Europe come from the European Regional Database of Cambridge Econometrics; for the USA, from the Regional Accounts of the Bureau of Economic Analysis; for Japan, from the Cabinet Office, Prefectural economic accounts. All details and links to raw sources are explained in the Data Appendix. All three sources provide data on population and value added at the regional level⁹: NUTS-3 regions in Europe, Metropolitan Statistical Areas (MSA) in the USA and prefectures in Japan. In Europe and Japan, NUTS-3 areas and prefectures are generally smaller than urban areas. I then approximate urban areas by combining NUTS-3 and prefectures regions. In Europe, I do this following Eurostat's definition of "metropolitan regions" (which are already-defined combinations of NUTS-3 areas adding up to agglomerations of more than 250.000 inhabitants) and of Functional Urban Areas (FUAs)¹⁰. For example, in France, the agglomeration of Paris is formed out of eight NUTS-3 regions; in the UK, the agglomeration of Manchester is based on five NUTS-3 regions; in Germany, the agglomeration of Berlin is based on eight NUTS-3 regions. In Japan, I add prefectural data (there are 47 prefectures in Japan) to 14 metropolitan areas, as defined by Statistics Bureau of Japan. The largest metropolitan area is Kanto (which is the metro region of Tokyo) and is based on the addition of eight prefectures. In the USA there is no need to adjust the definition of the geographical units, as MSAs are 382 urban areas already defined in an economic sense. A final note is needed. While in Japan and Europe, the combination of NUTS-3 areas and prefectures does not perfectly match the boundaries of economically defined urban areas, the definitions that I use seem to be good approximations.

9. The exception is the US, where no data on value added at the MSA level is available. I use income by earnings industry instead.

10. FUAs include all urban areas, thus also those with less than 250.000 inhabitants. Given that Eurostat does not have already-defined combinations of NUTS-3 regions when urban areas are below 250.000 inhabitants, I carry my own approximation (see details in the Data Appendix).

Figures 2.2 and 2.3 show the evolution of aggregate value added in these seven countries decomposed into different types of economic activity. The most important fact from these figures (and one that has been shown in previous studies) is the rising share of services and the declining importance of manufacturing within total GVA during the last decades. Within services, it is worth noting that those rising their share are market-oriented ones, with non-market-oriented services showing non-clear trends¹¹. Finally, construction activities display non-clear trends either – if anything, fluctuations resemble those of national business cycles, for example, increasing their share in the years before 2008, reducing them afterwards.

I then investigate whether economic activity has increased its spatial concentration within countries employing definitions of urban areas that are comparable across countries and a widespread index of concentration: the Herfindahl-Hirschman index (HHI). The HHI is a popular measure of market concentration, used intensely in the industrial organization literature but also in other fields (i.e. Azar, Marinescu, and Steinbaum (2017)). In the context of a country composed of different urban areas, the formula of the HHI is:

$$HHI_{c,t} = \sum_{j=1}^J s_{j,c,t}^2$$

where $s_{j,c}$ is the market share of urban area j in country c . The higher the value of the index the higher the concentration is. In our context, higher values of the HHI imply a larger proportion of a country's production being concentrated in fewer regions.

By definition, an index of spatial concentration is not directly comparable across countries, at least in levels, as countries differ in their size and number of interior regions. It is possible to compare, however, changes in concentration once the index is normalized to take the same value for a given year in all countries. I do this in figures 2.4, 2.5 and 2.6, where I plot the evolution of aggregate concentration of economic activity in all countries taking the value of 1 in 2014 (the last year of the sample). I find that, indeed, regional economic concentration

11. Market services include: Financial and business services; Wholesale, retail, transport, accommodation and food services; Information and telecommunication. Non-market services are mostly public sector activities (public administration, human health, education, defense and social work) and some types of arts and recreation services, together with some activities of households.

has augmented in most countries during 1980-2014, although with significant differences across them. In particular, France, Italy, Spain, the UK and Japan show rising levels of concentration while in Germany and the USA the opposite happens. Interestingly, rising levels of concentration are largely the result of market services becoming more concentrated, with manufacturing following the opposite trend. This result is fully consistent with the analysis by [Desmet and Rossi-Hansberg \(2009\)](#), where they focus on employment rather than on value added activities.

2.1.2 Housing: land vs structure decomposition

Housing wealth-to-national income ratios have doubled in rich countries over the last decades, from values around 1.5 in 1970 to values around 3 in recent years. Consequently, this rise has been the object of increasing attention ([Rognlie \(2014\)](#); [Bonnet, Bono, Chapelle, Wasmer, et al. \(2014\)](#); [Stiglitz \(2016\)](#)); [Grossman and Steger \(2017\)](#); [Borri and Reichlin \(2018\)](#)). In a recent study, [Knoll, Schularick, and Steger \(2017\)](#) show that real house prices experienced a striking increase over the last decades in a sample of 14 advanced economies, with about 80% of this increase due to higher urban land prices (the remaining 20% would be explained by construction costs). However, housing wealth is the combination of both prices and quantities, and no systematic evidence exist on the evolution of national housing values decomposed into a land and a structure component. Therefore, theories that attempt to explain the rise in housing stock values are currently limited by the lack of this empirical evidence.

In figures [2.7](#) and [2.8](#), I present the first cross-country comparison of national housing wealth decomposed into these two components, between years 1970 and 2015, for the sample of 7 countries used in this section: France, Germany, Italy, Japan, Spain, UK and USA. Data come from the World Inequality Database (see [Bauluz \(2017\)](#) for details on the raw sources), except for the UK and Italy¹². In all countries but Germany this decomposition is based

12. Data on the UK has been kindly shared by James Gleeson, and are publicly shown in the following blog post: <https://jamesjgleeson.wordpress.com/2017/04/03/historical-housing-and-land-values-in-the-uk/>. Data for Italy are my own calculations following the residual approach – see appendix for details.

on the residual approach (OECD and Eurostat (2015)), first implemented in the academic literature by Davis and Heathcote (2007) for the case of the USA, and recently applied by Artola Blanco, Bauluz, and Martinez-Toledano (2018) for Spain. This method obtains the value of land by estimating, in the first place, the total value of the housing stock (housing prices times number of dwellings) and deducting, in a second step, an estimate of the value of housing structures obtained by means of the Perpetual Inventory Method. This is an indirect method to measuring urban land but one widely used by national statisticians due to the scarcity of direct sources on urban land prices¹³. In Germany, however, the Federal Statistics Office counts with relatively rich data on prices for urban land plots, which they use to compute the total value of urban land nationally. Hence, a word of caution is needed when comparing Germany with the rest of the countries.

Results from figures 2.7 and 2.8 show that the rise of housing wealth values in this set of countries is, to a large extent, the consequence of higher urban land values, as opposed to dwelling structures. This is coherent with the findings of Knoll, Schularick, and Steger (2017) and is supportive of theories explaining rising housing wealth due to some form of pressure over certain urban locations.

2.1.3 Housing wealth and spatial concentration

The last part of this section is devoted to comparing the spatial concentration of economic activity and the evolution of private housing wealth¹⁴. In figures 2.9 and 2.10, I plot these two series in every country and find a relatively strong correlation between the two. To shed light on whether countries that concentrated more their economic activity experienced larger increases in housing-income ratios, I plot the change in the HHI (normalized to 1 in 2014) and the change in housing-income ratios, between 1982 and 2012 (1982 is the 5-years average of

13. This scarcity is the consequence of the functioning of most housing markets: Dwellings' sales are the main data source used to track house prices and these sales are generally made for the total value of a house, with no decomposition into the value of the building and that of the underlying land.

14. I use private housing (i.e. housing owned by households and non-profit institutions serving households) instead of national housing (which includes corporate and public housing), as this may better reflect the market valuation of dwellings. Given that most of the national housing stock is private (between 80-99%), results are virtually unchanged when using national values rather than private ones.

1980-1984; 2012 is the 5-years average of 2010-2014). As figure 2.11 displays, those countries that concentrated the most over the last decades were also those that experienced larger increases in their housing-income ratios (the exception being Japan). This also shows that those countries that had a more monocentric structure by 1980 (i.e. France, UK or Spain), increased further both their regional concentration and their housing values relative to those that had a more polycentric one (i.e. Germany or USA). I will comment on this aspect in section 2.2.

To investigate whether this visual correlation is statistically significant, I estimate cross-country fixed-effects regressions. For this, I use a balanced panel of 7 countries (those analyzed in this section) with annual data from 1980 to 2014. My econometric specification is similar to the one used in Monnet and Wolf (2017). In their analysis they use as dependent variable housing investment as percentage of GDP. Instead, my dependent variable is the value of private housing as percentage of net national income. They use the following set of regressors: population growth of group 20-49 (their variable of interest)¹⁵, real disposable income, real house prices, real-long term interest rates, variation in unemployment rate and real private credit. In my analysis, the main regressor of interest is the concentration of GVA (measured with the HHI), which I normalize to take value 1 in all countries in 2014. Then, as controls I use all regressors in Monnet and Wolff (2017), except real house prices (as this variable is a component of my dependent variable)¹⁶. In addition to their controls, I add an index of urbanization rate. All data sources are explained in the Data Appendix.

To correct for cross-sectional dependence and serial correlation, I apply Driscoll and Kraay (1998) standard errors – I use Stata’s user-written program "xtscc" (Hoechle (2007)). Concretely, I estimate the following equation:

15. They also include the growth of population aged 1-19 and aged 50 plus, finding no influence of these groups on housing investment (consistent with their theory by which residential investment is primarily determined by the age-group accessing the housing market – i.e. those between 20 and 50 years old).

16. Note, also, that Monnet and Wolf (2017) use credit to the private non-financial private sector (i.e. households and non-profit institutions serving households, non-financial corporations) in their main regressions. Then, for a subset of countries where they can isolate credit to households, they find that results are almost alike. In my case, I use credit to households and NPISH directly (i.e. excluding credit to private non-financial corporations).

$$\frac{\textit{Private housing}_{c,t}}{\textit{National income}_{c,t}} = \beta(\textit{HHI GVA}_{c,t}) + \gamma X_{c,t} + \theta_c + \lambda_t + \varepsilon_{c,t}$$

where $\frac{\textit{Private housing}_{c,t}}{\textit{National income}_{c,t}}$ is the ratio of private housing-to-national income in country c at time t , and $\textit{HHI GVA}_{c,t}$ is the HHI index for GVA (taking value 1 in 2014 in all countries). $X_{c,t}$ includes several time-varying controls, as described above. θ_c and λ_t are country and year fixed effects, and $\varepsilon_{c,t}$ is a disturbance term. In addition to this regression, I estimate three alternative specifications to investigate two aspects: i) whether the visual correlations merely reflect population changes (and not shifts in the location of economic activity); ii) the specific components of value added that may influence the relation between housing values and aggregate concentration of economic activity.

Regression results are shown in table 2.1. Column 1 corresponds to the main specification and uses the HHI for GVA as the main regressor. In columns 2 and 3, I investigate the role of population concentration when compared to that of value added: column 2 drops the HHI for GVA and uses the same HHI but for population instead of GVA; column 3 introduces the HHI for both GVA and population, together. Finally, in column 4 I drop these two variables and use HHIs for different types of economic activity: manufacturing, construction, market services and non-market services.

The output from this table confirms the significant relation between concentration of economic activity and housing values. The point estimate for HHI of GVA in column 1 is statistically significant and, also, economically large: a back-of-the-envelope calculation implies that rising concentration in GVA explains 49% of the average increase in housing-income ratios over 1980-2014¹⁷. Interestingly, the concentration of population is only significant when regressions do not include the concentration of GVA (column 2), but once both are added together, population becomes non-significant (column 3). Also, note that the R^2 from column 1 and 3 are equal (0.74), while that of column 2 is lower (0.66). This indicates that, once

17. Over 1980-2014, the average increase in the HHI for GVA and in the private housing-income ratios were 0.08 and 1.10, respectively. Using the point estimate from column 1 (7.01), one gets that rising concentration accounts for 0.54 points increase in housing-income ratios (7.01 times 0.08). This is 49% of the total increase observed over these years (0.54 over 1.10).

regressions include the concentration of economic activity, population itself becomes irrelevant. Finally, column 4 confirms the seemingly predominant role of market services in determining the overall concentration of economic activity shown in figures 2.5 and 2.6. Results from this latter regression find market services as the most relevant component accounting for housing wealth values, both in terms of the magnitude of the coefficient and the statistical significance. Concentration in manufacturing is also positively associated with housing values but, given the trend for manufacturing activities to deconcentrate, this means that manufacturing tended to relax the upswing in housing-income ratios.

While the previous statistical analysis cannot claim causality, I consider these results (together with all other findings in this section) as indicative of a relevant connection between structural change, the regional distribution of economic activity and the evolution of housing values. In particular, results are consistent with the hypothesis that higher levels of economic concentration, due to the trend for market services to concentrate more, are leading to higher housing demand over fewer locations and, consequently, to higher urban land values.

2.2 Model

In this section, I slightly adapt [Moretti \(2011\)](#) spatial equilibrium model of the labor and the housing markets to account for two stylized facts: i) The decline of manufacturing regions and the emergence of service ones; ii) The rise of housing prices (or rents) at a faster pace than incomes. Moretti's model is based on two cities (enough to have general equilibrium feedbacks) and allows analyzing how local changes in productivity, amenities or housing supply elasticity affect labor supply, wages and housing rents in the city where changes occur, but also indirect effects in other cities. While the model does not deal directly with how local changes affect aggregate concentration of economic activity (i.e. whether the rise of one city and the decline of the other implies more concentration globally), I also discuss how this can be captured by means of the housing supply elasticity parameters of the model.

I depart from Moretti in one essential aspect. Instead of assuming that both cities have

the same production function (Cobb-Douglas using labor and capital as inputs), I make it ‘city-specific’ by changing the factors of production: the manufacturing city depends on labor and capital but the service one uses labor and housing. This way the economy has two different productive sectors, which are region-specific, with the service city incorporating the idea that location, rather than traditional capital (i.e. machinery), is a key input for service firms . Next, I model the decline of the manufacturing region and focus on its impact on wages and rents, both in the manufacturing city and in the service one (I use wages and housing rents as a proxy for incomes and house prices). To do this, I interpret the technology parameter of the manufacturing region as being relative to international competition. For example, if the manufacturing city becomes less competitive (relative to foreign manufacturing), the productivity parameter will decrease. This idea coincides with [Coricelli and Ravasan \(2017\)](#), where they argue that structural change from manufacturing to services, in rich and open economies, depends critically on the relative productivity growth of domestic manufacturing vs foreign manufacturing. They claim that Baumol’s mechanism (structural change happening because the high productivity growth sector loses activity in favor of the low productivity sector) explains the fall in manufacturing labor shares but not of value added shares. On the contrary, the trade channel would explain the fall of both manufacturing employment and manufacturing value added shares.

I then assume a negative labor demand shock to the manufacturing city (by lowering the productivity parameter) and observe the adjustment in wages and housing rents in the two cities. Under these conditions, the ratio of rents relative to wages increases in the two cities. This result also happens in Moretti’s original model whenever one of the two cities (which in his model have identical production functions) suffers a negative productivity shock. However, once I characterize one city as the service region (with housing, and not capital, in its production function), a negative labor demand shock to the manufacturing city leads to an increase in rents relative to wages that is significantly stronger than in Moretti’s model. Interestingly, this stronger reaction of rents relative to wages is concentrated in the service city and not in the manufacturing one. One difference in my model with respect to Moretti’s

is, however, that it has no analytical solution. To contrast the two models, I solve them numerically and compare their behavior when affected by a similar shock.

In what follows I explain Moretti's original model together with my modified version. The goal is to compare the reaction of both models to a negative labor demand shock in one city.

2.2.1 Setup

This model is a simplified and linearized version of [Roback \(1982\)](#)'s paper but is characterized by imperfect mobility. There are two cities, a and b , and N individuals (workers). Each individual consumes one unit of housing and has indirect utility in city c (where c stands for city a or city b) of the form:

$$U_{i,c} = w_c - r_c + A_c + e_{ic}$$

Where w_c is the log of wages in city c , r_c the log of housing rents in city c , A_c are consumption amenities in city c and e_{ic} idiosyncratic preferences for city c .

Workers are homogeneous except for their taste for residing in city a relative to city b , which follows a uniform distribution:

$$e_{ia} - e_{ib} \sim U[-s, s]$$

where s measures the degree of workers heterogeneity.

Individual i locates in city b whenever:

$$w_b - r_b + A_b + e_{ib} > w_a - r_a + A_a + e_{ia}$$

With the marginal worker being indifferent between the two cities:

$$e_{ib} - e_{ia} = (w_a - r_a) - (w_b - r_b) + (A_a - A_b)$$

Hence, city size is determined by the marginal worker, with the following proportion of

the population residing in city b :

$$\begin{aligned}\frac{N_b}{N} &= p(e_{ib} - e_{ia} > (w_a - r_a) - (w_b - r_b) + (A_a - A_b)) \\ \frac{N_b}{N} &= \frac{1}{2s}(s + w_b - w_a - r_b + r_a + A_b - A_a)\end{aligned}$$

Using $\frac{N_b}{N}$ and $\frac{N_a}{N}$, we obtain the (real) inverse labor supply curve:

$$w_b - r_b = w_a - r_a + A_a - A_b + \frac{s}{N}(N_b - N_a) \quad (2.1)$$

For given total population N and characteristics of city a (w_a , r_a and A_a), this equation provides us with the labor supply in city b , N_b , as an increasing function of net wage in city b , $w_b - r_b$. Note that if idiosyncratic preferences for location, s , are large, population does not react much to differences in real wages and amenities across cities.

In Moretti, each city c has a Cobb-Douglas production function with constant returns to scale, which uses labor and capital as inputs:

$$Y_c = \ln X_c + d \ln N_c + (1 - d) \ln K_c$$

where X_c is a city-specific productivity parameter, K_c is capital and d is the proportion of labor in production. Under perfect competition, workers are paid their marginal product. The log price of capital (ρ) is exogenous and set internationally (i.e. because capital is infinitely supplied at a given price i , with $i = e^\rho$). Then, equalization of marginal products to factor prices leads to:

$$w_c = \ln X_c - (1 - d) \ln N_c + (1 - d) \ln K_c + \ln d \quad (2.2)$$

$$\rho = \ln X_c + d \ln N_c - d \ln K_c + \ln(1 - d) \quad (2.3)$$

By contrast with Moretti, I characterize the city a as the manufacturing city and city b as the service one. City a keeps the same production function than Moretti, using labor and

capital as inputs. City b produces with a similar Cobb-Douglas function but, in addition to using labor, it uses housing (and not capital) as input:

$$Y_b = \ln X_b + d \ln N_b + (1 - d) \ln H_b$$

with H_b the amount of housing used by service firms in city b . Workers are paid their marginal product; similarly, housing rents (r_b) equal their marginal product too:

$$w_b = \ln X_b - (1 - d) \ln N_b + (1 - d) \ln H_b + \ln d$$

$$r_b = \ln X_b + d \ln N_b - d \ln H_b + \ln(1 - d) \tag{2.4}$$

In both Moretti's and my model, each worker is assumed to consume one unit of housing. Hence, workers' inverse demand for housing in each city is a rearrangement of equation 2.1:

$$r_b = (w_b - w_a) + r_a + (A_b - A_a) - s \frac{(N_b - N_a)}{N} \tag{2.5}$$

To close the model, housing supply in each city is supposed to have an increasing marginal cost (in line with the monocentric-city model). In Moretti's, housing supply in both cities is of the form:

$$r_c = z + k_c N_c \tag{2.6}$$

where $k_c \in [0, \infty)$ and characterizes the elasticity of housing supply (i.e. housing supply is perfectly elastic when k_c equals 0). N_c captures the number of houses in city c which, in Moretti, is the number of workers. In my model, the number of houses demanded in manufacturing city a still equals the number of workers in this city, but the number of houses in the service city b is now equal to the number of workers, N_b , plus the number of houses demanded by service firms, H_b . Hence, the supply of housing in city b is:

$$r_b = z + k_b(N_b + H_b)$$

2.2.2 Equilibrium

The mechanics to solve for the equilibrium in both models are similar. The problem being that my modification of Moretti's model cannot be solved analytically. Hence, in what follows, I present how Moretti's model is solved and show the equation that limits the analytical solution to the modified version of the model.

The model is solved for N_a , N_b , r_a , r_b , w_a and w_b using:

- $N_a + N_b = N$
- The labor mobility equation (eq. 2.1)
- The equalization of marginal productivity to wage in each city (eq. 2.2)
- The equalization of marginal product of capital to capital costs in the two cities (eq. 2.3)
- The equalization of housing demand (eq. 2.5) to housing supply (eq. 2.6) for the two cities

In Moretti, this leads to the following equilibrium equations:

$$w_c = \frac{1}{d} \ln X_c + \frac{(1-d)}{d} \left[\ln(1-d) - \rho \right] + \ln d$$

$$N_b = \frac{N}{(k_b + k_a)N + 2s} \left[\frac{1}{d} \ln \frac{X_b}{X_a} + k_a N + (A_b - A_a) + s \right]$$

$$r_b = z + \frac{k_b N}{(k_b + k_a)N + 2s} \left[\frac{1}{d} \ln \frac{X_b}{X_a} + k_a N + (A_b - A_a) + s \right]$$

In the modified version of the model, the housing supply equation in the service city b equals the total demand for housing, which is the sum of the demand from workers and from firms. Workers' demand for housing is N_b , while firms' demand for housing is obtained from equation 2.4, solving for H_b (note: I show the non-linearized version of eq. 2.4 as it is easier

to grasp):

$$H_b = \left[\frac{(1-d)}{e^{r_b}} X_b \right]^{\frac{1}{\alpha}} N_b$$

Hence, total demand for housing in city b (H_b plus N_b), is:

$$H_b + N_b = \left[\frac{(1-d)}{e^{r_b}} X_b \right]^{\frac{1}{\alpha}} N_b + N_b \quad (2.7)$$

Introducing equation 2.7 in the supply of housing equation, $r_b = z + k_b(N_b + H_b)$, we get:

$$r_b = z + k_b \left[1 + \left(\frac{(1-d)}{e^{r_b}} X_b \right)^{\frac{1}{\alpha}} \right] N_b \quad (2.8)$$

The latter equation has two unknown variables (r_b and N_b) but it has no analytical solution. Nonetheless, I can compare comparative statics in the two models using numerical simulations.

2.2.3 Comparative statics: negative labor demand shock in city a

I now compare the evolution of housing rents, relative to wages, in city a and city b when city a experiences a negative labor demand shock. This shock is modeled by lowering city- a 's productivity shifter (X_a) in period 2 with respect to period 1. Concretely, $X_{a2} = X_{a1} + \Delta_0$, with $\Delta_0 < 0$. In what follows I show the dynamics of Moretti's model when a productivity shock happens in city a . Then I explain the reaction of my model, when compared to Moretti's, in the face of a similar shock, by using numerical simulations.

In Moretti, wages in city a increase proportionally to the productivity shock:

$$w_{a2} - w_{a1} = \frac{1}{d} \ln(X_{b1} + \Delta_0) - \frac{1}{d} \ln X_{b1} = \frac{1}{d} \ln \left(1 + \frac{\Delta_0}{X_{b1}} \right) \approx \frac{1}{d} \frac{\Delta_0}{X_{b1}} = \Delta$$

City- b 's productivity does not change, so neither do wages. Because of lower wages in city a , some workers would prefer to move from city a to reside in city b . This happens until a new equilibrium is reached where the marginal worker is indifferent between the two cities.

Population changes in the two cities in the following way:

$$N_{a2} - N_{a1} = \frac{N}{(k_b + k_a)N + 2s} \Delta \leq 0$$

$$N_{b2} - N_{b1} = -\frac{N}{(k_a + k_b)N + 2s} \Delta \geq 0$$

Given that some workers abandon city a and arrive to city b , housing demand changes in the two cities as well, and so do housing rents:

$$r_{a2} - r_{a1} = \frac{Nk_a}{N(k_b + k_a) + 2s} \Delta = k_a(N_{a2} - N_{a1}) \leq 0$$

$$r_{b2} - r_{b1} = -\frac{Nk_b}{N(k_b - k_a) + 2s} \Delta = k_b(N_{b2} - N_{b1}) \geq 0$$

Intuitively, in city a rents decrease because there is less demand for housing (less workers live now in this city); similarly, rents increase in city b because more workers demand a house. Note that rent changes depend on the housing supply elasticities, being larger when housing supply elasticity is low (larger k_c), as supply would not be very reactive to changes in the number of workers living in each city.

Question is: how do real wages (i.e. the change in nominal wages net of housing rents) evolve in the two cities? The answer is that real wages decrease in both cities when one of them is affected by a negative labor demand shock¹⁸. This happens because in city a nominal wages fall by more than housing rents do. In city b , on the contrary, wages do not change, but the arrival of new workers push upwards housing rents. Analytically:

$$(w_{a2} - w_{a1}) - (r_{a2} - r_{a1}) = \frac{Nk_b + 2s}{N(k_b + k_a) + 2s} \Delta \leq 0 \quad (2.9)$$

18. The exception is when there is no workers mobility after a productivity shock (for example, because workers' preference for location, s , is extremely large). In this case, rents do not decrease in city a (i.e. real wages fall by the same amount than nominal wages do), while wages and rents stay equal in city b (real wages in b do not change).

$$(w_{b2} - w_{b1}) - (r_{b2} - r_{b1}) = \frac{Nk_b}{N(k_b + k_a) + 2s} \Delta \leq 0 \quad (2.10)$$

In city a , the fall in real wages would be larger, the higher the elasticity of housing supply in city a is (lower k_a), because rents will not decrease much when workers leave the city. On the contrary, the decrease in real wages would be larger in city b the lower the elasticity of housing supply is (because rents are very sensitive to the increasing number of workers).

So far, we have analyzed the reaction of real wages in Moretti's original model to a negative labor demand shock in one of the two cities. However, analyzing this type of shock makes more sense in the context of one city explicitly modeled as the manufacturing region, with the other city being the service one. Then, assuming a negative labor demand shock to the manufacturing city due to the fall in its international competitiveness (in line with patterns of structural changes observed in advanced economies) is data motivated. Thus, I now compare the evolution of real wages in the two cities, when the manufacturing region (city a) suffers a negative productivity shock in the context of two different productive systems, as described above. Given the impossibility to solve the model analytically, I observe the reaction of real wages in the two cities numerically.

The basic result of this simulation, for a given value of the parameters, is that reducing the productivity shifter of the manufacturing city leads to a reduction in real wages in the two cities. This also happens in Moretti's original model whenever one of the two cities experiences a negative labor demand shock. However, the main distinction is that this fall is more intense in the modified version of the model, mostly because now housing rents rise substantially faster in the service city than before. In both models, a negative labor demand shock to the manufacturing city makes wages to decrease in the manufacturing city, while they remain equal in the service one. Now, however, rents are more sensitive in the service city to increases in population given the additional demand for housing that the service city has from firms.

Figure 2.12 compares the evolution of real wages in city a in the two models, when productivity in this city changes. The positive slope means that both models react in the same direction, with the modified-version having a stronger reaction. Similarly, figure 2.13 compares

the evolution of real wages in service city b , when productivity changes in manufacturing city a . Again, the reaction of the two models goes in the same direction, with the modified version reacting faster. Importantly, the slope in figure 2.13 is substantially larger than in figure 2.12 (see the different scale of the y-axes in the two figures), meaning that the reaction of the modified version of the model, relative to Moretti's original, is much stronger in the case of the service city than in the manufacturing one.

Hence, in the context of the real experience of countries, the model points to the following prediction: At the national level, a negative labor demand shock to one of the two cities produces an increase in housing rents in the 'other city' which is much stronger in the case where the 'other city' is explicitly modelled as the service region. This is because housing prices are now significantly more sensitive in the service city to increases in population (with wages behaving similarly in the two models).

2.2.4 The role of aggregate concentration

The model does not deal directly with the evolution of the aggregate concentration of economic activity when structural change happens and its connection to real wages. But we have seen in section 2.1 that those countries with a more monocentric structure (i.e. France, UK or Spain), relative to those with a more polycentric one (i.e. USA or Germany), increased by more both their overall concentration of economic activity and their housing-to-income ratios when structural change happened. Can this model help rationalize these patterns? Indirectly, yes.

The idea is to understand what the housing supply elasticity parameters could be in countries initially more monocentric relative to those countries initially more polycentric. For this, I use a recent empirical finding from the urban economics literature: that the elasticity for new housing constructions is lower the larger the size of a city is (Chapelle and Eyméoud (2017); Combes, Duranton, and Gobillon (2018)). In other words, in big cities changes in housing demand will have a larger impact on housing prices than in small cities. Now, let's suppose that all rich countries were affected by structural change with similar intensity, but

that the difference between them is the initial configuration of their urban areas: with some countries being more monocentric and others being more polycentric. And let's suppose that after the structural change shock, those countries more monocentric tend to concentrate their economic activity even more in its central cities (i.e. Paris, London, Madrid / Barcelona, Rome / Milano) whereas the more polycentric countries tended to relocate their activity within various cities (i.e. San Jose, Seattle, Boston, Houston in the USA). In the present model, this would be captured by the initial housing supply elasticity parameters of the two cities, with more monocentric countries exhibiting lower housing supply elasticities in the service city (higher k_b). Hence, other things equal, the shock to the manufacturing city would produce larger increases in the evolution of housing rents relative to wages in more monocentric countries (see equation 2.10).

2.3 Local house-income ratios in England and Wales

In recent years, a significant number of studies have focused on the evolution of national housing-income ratios. While national values are necessarily the result of local dynamics in both incomes and house prices, none of the previous papers has investigated how country-level trends emerge from the local level. Yet, understanding how macro trends arise from the local level is certainly critical. I do this in this section, employing England and Wales as country study. By using a micro approach, I connect the analysis of national housing-to-national income ratios with a large literature in the field of urban economics. Furthermore, I investigate the role of structural change in the upswing of housing-income ratios, linking the theoretical predictions of my modified-version of Moretti's model with actual trends in the data. To the best of my knowledge, this mechanism has not been empirically investigated yet.

Choosing to investigate England and Wales (E&W) has two reasons: one practical and one conceptual. On the practical side, these are the only countries where I have found rich micro data on house prices, at the very local level, and at annual frequency. On the conceptual side, the UK seems representative of the average evolution of national housing-income ratios

when compared to other advanced economies¹⁹. In the UK, national housing-to-income ratios have tripled since 1970 and doubled since 1995, in line with the trends observed in other rich countries like France, Italy, Spain, Australia and Canada (see figures 2.7 and 2.8 and Bauluz (2017))²⁰.

In E&W, the whole universe of housing transactions is publicly available from 1995 until today (HM Land Registry: Price Paid Data)²¹. Based on these data, the Office for National Statistics (ONS) constructs average house prices at the district level (UK House Price Index), using geometric means to avoid biases from outliers. I use these district-level average house prices and combine them to 62 urban areas. To combine data to the urban area level, I use as weights the number of housing transactions, by district, in the previous year, similarly to what ONS does at the district level. The definitions of urban areas follow those introduced in section 2.1 and are constructed as the combination of NUTS-3 regions (for example, the urban area of London results from combining 21 NUTS-3 regions). For these types of regions (NUTS-3), I count with annual data (1980-2015) on value added by type of activity and on population from the European Regional Database of Cambridge Econometrics. Thus, by using these two data sources, I end up with an annual panel of 62 urban areas, covering the period 1995-2015, with information on: i) average house price; ii) value added by five types of economics activity (agriculture, manufacturing, construction, market services and non-market services); iii) population. These urban areas cover, in E&W, around 89% of total gross value added and 87% of total population, with these proportions being stable over the 1995-2015 period.

In figure 2.14 I plot, for the 62 urban areas, the ‘average house price-to-average GVA per capita’, between 1995 and 2015. During these years, the average household size in E&W

19. Note, however, that my analysis focuses on E&W, and not on all the UK. Nonetheless, given that over 87% of UK’s population reside in E&W, focusing on these two countries is interesting in itself.

20. While a lot of previous academic research on the evolution of housing markets has focused on the US experience, this country seems to be the exception, rather than the rule, when compared to other advanced economies: for example, US’s housing-income ratios show no rising trend during the last decades and has the lowest ratio among rich countries (figures 2.7 and 2.8). Given the focus of this paper on the evolution of housing-income ratios, investigating the UK seems preferable.

21. Similar data are available in Scotland since 2004. I decide not to include Scotland in the analysis to cover a longer period: since 1995 and not only since 2004.

remained constant (ONS (2014) and Eurostat (2018)); hence, this measure should be a good proxy for the local evolution of house-income ratios. To ease the exposition, in what follows I will use the concept of income when dealing with local gross value added even if, in truth, the two are not exactly equal²².

Figure 2.14 shows that, over the 1995-2015 years, urban areas in E&W experienced a generalized upswing in their house-income ratios. Interestingly, this increase is far from being homogeneous: while by 1995 house-income ratios had a lower dispersion than income per capita (where dispersion is measured with the coefficient of variation), the opposite was true in 2015 (figure 2.15). This is the consequence of a sharp increase in the dispersion of local house prices. Importantly, there is a remarkably strong correlation between the increase in house-to-income ratios and the increase in local house prices over the period 1995-2015 (figure 2.16). I then focus the rest of the analysis on the determinants of rising housing prices.

Is the rising dispersion of housing prices a new phenomenon? This question is not easy to answer, at least in E&W, since I do not have data prior to 1995. However, given that the aggregate housing-to-income ratio in the UK increased with such intensity after 1995, coinciding with the upsurge in house prices in some specific regions, it is worth reflecting on the determinants of this dispersion. Previous economic research has identified a similar phenomenon in the US pointing to three possible explanations: the increase in the number of rich households nationally (Gyourko, Mayer, and Sinai (2013)); the endogenous development of better amenities in places benefitting from higher-than-average economic growth (Diamond (2016)); and the impact of local productivity shocks (within manufacturing firms) in attracting population and, hence, pressuring up housing prices where productivity increases (Hornbeck and Moretti (2018))²³. These three explanations are not necessarily substitutes but have two limits in common. First, all three studies use data for the US (decennial censuses covering up to 2000), but the US seems to follow significantly different dynamics in its house prices

22. I do this to employ the same concepts than those used in the macro trends (i.e. for the evolution of national housing-to-national income ratios). Note, however, that the macro trends could be described in terms of GVA, and not of income, without any significant change in both the interpretation and the data trends.

23. Van Nieuwerburgh and Weill (2010) make a close argument and explain the increase in house price dispersion in the US as the consequence of rising cross-sectional productivity differences.

when compared to other rich countries. Second, these three papers do not investigate whether structural change is at the root of the decline and emergence of urban regions and of the changing productive system within cities. Yet, the three studies are compatible with structural change being the ultimate driver of their results.

2.3.1 Descriptive analysis

The first step of the present analysis is to document the best predictors of the growth in house prices over 1995-2015, based on 1995 city-level characteristics. I document that the best predictor is the sectoral composition of economic activity at the beginning of the period, with those cities more manufacturing-oriented experiencing lower increases in house prices afterwards (figure 2.17). Sectoral composition, in turn, is correlated with both income per capita and the level of house prices in 1995, with regions that were more specialized in manufacturing showing lower levels of house prices and incomes per capita. Yet, these two variables, alone, have smaller predictive power than the sectoral composition itself (figures 2.18 and 2.19). Finally, it is worth noting that city size (measured by total population) does not predict posterior growth in housing prices (figure 2.20). This lack of predictive power might be explained by the fact that, in E&W, an important number of mid-to-large cities were historically specialized in manufacturing activities (i.e. the three largest cities in E&W after London: Birmingham, Manchester and Liverpool).

In a second step, I analyze changes in house prices simultaneously with changes in income per capita and population. I find that house prices increased faster in those places where population growth was stronger (figure 2.21) but no correlation is observed when growth in house prices is compared to growth in incomes per capita (figure 2.22). Importantly, as result of all previous dynamics, we observe a remarkable increase in the correlation between sectoral composition of economic activity and house-income ratios between 1995 and 2015 (figure 2.23): while local house-income ratios were only weakly correlated with the density of manufacturing activities at the city level in 1995, by 2015 this correlation is significantly stronger (R^2 goes from 0.08 to 0.35).

These results suggest the following mechanism. Manufacturing-oriented cities had initially lower incomes per capita and house prices than service-specialized cities. Then, over the period 1995-2015, service regions increased their importance in total output, with manufacturing regions deteriorating their weight (consistent with structural change affecting differently service and manufacturing cities). Incomes per capita, however, did not change much between manufacturing and services regions over these years, likely because population increments in service-successful regions outweighed the increase in output. Yet, house prices experienced a striking increase in service-successful regions receiving new inflows of population, leading to an impressive upsurge in the house-income ratios of these locations. These findings are coherent with the narrative of my modified-version of Moretti's model where structural change will impact negatively manufacturing-specialized cities leading to a sizeable upswing in house prices in service-successful ones.

2.3.2 Regression analysis

To deepen into the previous analysis, I now take my modified-version of Moretti's model to the data and test the prediction from section 2.2.

Proposition: Are service-oriented cities differently affected when structural change occurs (i.e. when the aggregate share of manufacturing value-added declines)?

At the national level, the model implies that a negative labor demand shock to one of the two cities produces an increase in housing rents in the 'other city'. This increase would be substantially stronger in the case where the 'other city' is explicitly modelled as the service region and the city affected by the shock as the manufacturing one. Empirical work has shown that, over the last decades, manufacturing regions in rich countries are hit negatively when exposed to international competition from developing countries, in particular from China (Autor, Dorn, and Hanson (2013) analyze the US; Malgouyres (2017) the case of France; Balsvik, Jensen, and Salvanes (2015) analyze Norway; Donoso, Martín, and Minondo (2015) Spain²⁴). This coincides with the setting of my model where the decline of the manufacturing

24. In Spain, the decline of manufacturing employment due to import competition has been compensated

city is the consequence of its loss of international competitiveness. At the national level, [Coricelli and Ravasan \(2017\)](#) argue that the decline of manufacturing value added shares in advanced economies is the consequence of this trade channel. Hence, I test empirically if a decrease in aggregate manufacturing value added share has a differential impact on house prices in service cities relative to manufacturing ones.

To do this, I follow a similar econometric specification to [Gyourko, Mayer, and Sinai \(2013\)](#), where they analyze the impact of a country-level phenomenon (in their case, the rising number of rich households nationally) on a subset of metropolitan regions (in their paper, those considered *superstar cities*), relative to the other subset of regions (the *non-superstar cities*). In the present paper, the aggregate phenomenon of interest is structural change (captured by the shrinking share of manufacturing) and the subset of regions are those initially specialized in services relative to those specialized in manufacturing. Thus, by splitting urban areas into two groups, I approximate the ‘2-cities’ setting of the model to actual trends in the data.

To define the two subsets of regions, I establish a simple cutoff and divide the sample of 62 urban areas into two equal groups according to the 1995-density of manufacturing value added: 31 urban areas with above-median share of local manufacturing on local output (the ‘service regions’) and 31 urban areas below this cutoff (the ‘manufacturing regions’). Specifically, the regression equation takes the following form:

$$\log(\text{house price}_{it}) = \beta \text{service city}_i \times \log(\text{share manu}_t) + \gamma_i + \delta_t + \varepsilon_{it}$$

The dependent variable is the log of mean house price at the end of year t in urban area i . The first regressor interacts the time-invariant service-city indicator with the log of the share of manufacturing in national output. The service-city indicator varies across urban areas and the share of national manufacturing value added varies over time. Hence the interaction varies over time within an urban area. Thus, the coefficient for the interaction measures how changes in the national share of manufacturing value added affect differently service cities relative to manufacturing ones. The urban area fixed effects control for urban area level unobserved

by rising employment in other sectors.

heterogeneity while year dummies absorb influences that vary only over time, such as aggregate macroeconomic factors.

Results are shown in table 2.2. Columns 1 to 3 estimate the main equation using data with different time frequency: column 1 uses annual data (1995-2015), column 2 employs every-5-years data (1995, 2000, 2005, 2010 and 2015) and column 3 uses every-10-years data (1995, 2005 and 2015). In all regressions the coefficient of interest is negative and statistically significant at the 1% level. This supports the model's prediction and indicates that house prices rise significantly more in service-oriented cities when the aggregate share of manufacturing value added falls. Yet, some concerns may arise regarding two aspects: i) the specific influence of London in the previous results; ii) the fact the urban areas are not weighted by their city size in the main regression. Hence, in table 2.3 I repeat these regressions dropping the urban area of London (columns 1 to 3) and weighting urban areas by their 1995-population size (columns 4 to 6). Results are virtually identical.

Interestingly, the value of the coefficient in table 2.2 (similarly, in table 2.3) increases with the time-intervals used to estimate the equation: being lower when using annual data and highest when every-10-years observations are used. The coefficients are statistically different across the three regressions²⁵. These results are consistent with the analysis of Blanchard and Katz (1992), where they estimate that regional adjustments to local economic shocks take between 5 and 10 years, in the context of US's states. Therefore, to interpret the results of this paper, I focus on those capturing long-run adjustments – i.e. those using data at a 10-years interval in column 3. This is the same time interval used in the empirical work of Gyourko, Mayer, and Sinai (2013), Hornbeck and Moretti (2018) and Diamond (2016).

The economic significance of the coefficient is the following. The aggregate share of manufacturing value added fell by 43 percent between 1995 and 2015. Over the same years, average house prices in service cities grew by 65 percentage points more than in manufacturing cities. Hence, the decline in aggregate manufacturing value added share accounts for 24% of

25. Coefficients in columns 1 and 3 are statistically different at the 1% level. Differences between coefficients in columns 1 and 2 and between columns 2 and 3 are statistically significant at the 5% level. These differences and their significance apply to both tables 2.2 and 2.3.

the excess growth in house prices in service cities²⁶.

Overall, these regressions are fully consistent with the narrative of structural change being a key determinant of the observed increase in housing-income ratios in E&W. Yet, they have three limits. First, they only capture the influence of structural change on the relative growth of house prices in service regions relative to manufacturing ones. While rising dispersion in house prices is a key feature of UK's housing-income ratios over 1995-2015, it is also true that there was a general increase in local house-income ratios across all types of locations. Hence, whether this general rise is partly explained by structural change (i.e. through the aggregate concentration channel discussed in section 2.1), is not captured by this specification. Second, these regressions cannot shed light on the specific mechanism by which more service-intense cities experience higher house price increases. One possibility is the one pointed in the theoretical model, where service-oriented businesses are more dependent on location as an input of production than on traditional capital. Besides, and based on the descriptive analysis of this section showing growth in house prices highly correlated with growth in population but not in incomes per capita, it is also likely that within-city's inequalities have increased and probably contributed to the rise of local house prices: with service-oriented regions becoming prosperous and traditional manufacturing areas entering in decline, low-skilled workers may accept the cost of higher house prices to the extent that working conditions have a higher expected return in successful areas. Yet, this dataset is not detailed enough in terms of types of activities or population characteristics to shed further light on what types of services or population sorting explain better the evolution of local house prices. Finally, while regression results are consistent with the theoretical model, the very nature of analyzing the impact of an aggregate phenomenon (structural change) on local house prices, makes not feasible to use an optimal identification strategy (for example, to isolate aggregate structural change by means of an IV).

Nevertheless, I consider these regressions, together with the descriptive analysis, as suggestive of a strong connection between structural change, local economic activity and the

26. $-43 \times -0.363 = 15.6$, which is 24.1 percent of 65.

evolution of house-income ratios.

2.4 Conclusion

This paper connects two salient phenomena happened in rich countries over the last decades: the growth of national housing wealth-to-national income ratios and the structural transformation of the productive system, from manufacturing to services. I present new data, in addition to a theoretical framework, to explore two possible drivers of both phenomena: i) The trend for higher spatial concentration of economic activity within countries, due to market-services concentrating more; ii) Negative shocks to manufacturing regions, with indirect consequences on house prices in service-successful cities.

To explore the first factor, I present new stylized facts on the evolution of housing wealth and the concentration of economic activity, in seven rich and regionally large countries: France, Germany, Italy, Japan, Spain, UK and USA. I show that the rise of national housing wealth was mostly the result of higher urban land values. Thus, this finding supports theories explaining higher housing wealth due to some form of pressure over certain urban locations. Next, I analyze the evolution of spatial concentration of value added within countries, using urban areas as units of observation. I find that most countries increased their concentration of economic activity and that this was due to larger concentration within market-oriented services, with the opposite trend happening in manufacturing. I then compare how national housing wealth evolved together with the concentration of economic activity and find a strong connection between the two, with those countries concentrating more also experiencing higher increases in their national housing wealth-to-national income ratios. These results are further supported by a set of cross-country fixed effects regressions.

The second factor is investigated by using micro data for urban areas in England and Wales. This way I explore how macro trends in housing-income ratios emerge from the local level. I show that the rise of national housing-income ratios was largely the consequence of an increase in the dispersion of house prices across urban areas, and not of incomes per capita.

I also find that the best predictor of how house prices evolved is the initial composition of economic activity at the urban area level, with those cities initially specialized in services experiencing larger increases in their house values afterwards. I then investigate the role of the national decline in manufacturing in the observed dispersion in house prices and estimate that one quarter of the overall dispersion can be accounted by this channel.

To rationalize the empirical findings of the paper, I present a 2-cities general equilibrium model where I characterize one city as specialized in manufacturing and the other in services. I then show that a negative labor demand shock to the manufacturing region produces an increase in local housing rents relative to local wages, which is particularly strong when the successful city is characterized as specialized in services. I also discuss how the model can account for the connection between increases in the concentration of economic activity and the rise in national housing wealth.

Overall, this paper brings in strong evidence for a direct link between structural change and the rising value of housing. However, further research is needed to understand the two factors investigated. On the one hand, a better knowledge of the links between higher spatial inequalities and national house-income ratios is needed, beyond the simple intuition of stronger demand over certain urban locations. On the other hand, better and more detailed data is required to clarify the specific types of services and population sorting driving the dispersion in local house-income ratios when structural change happens.

Figures

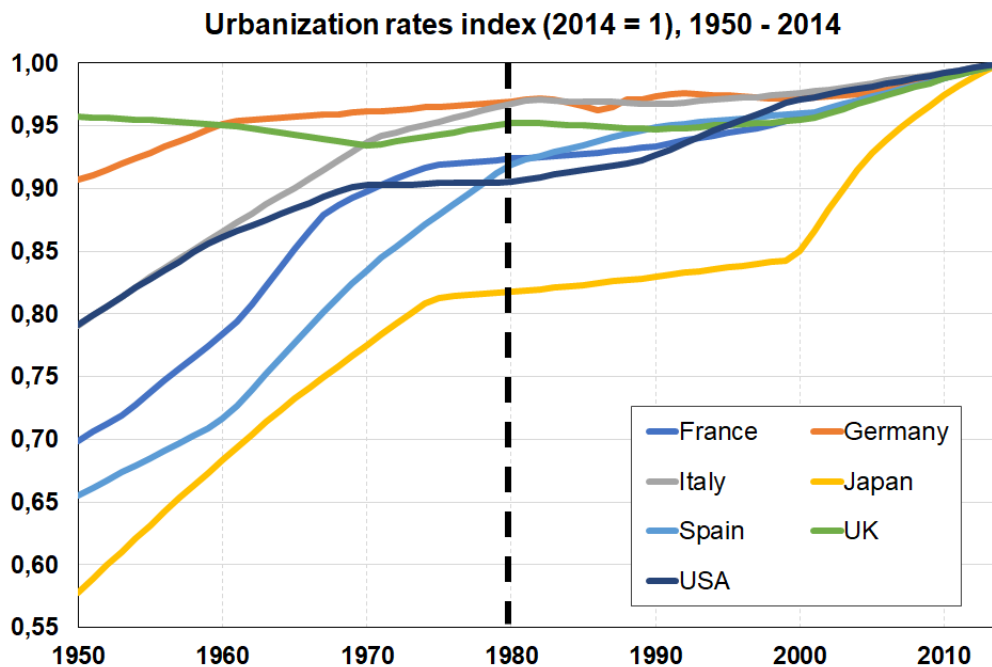


FIGURE 2.1 – URBANIZATION RATES INDEX (2014 = 1), 1950-2014

Notes: This figure displays the evolution of urbanization rates in France, Germany, Italy, Japan, Spain, UK and USA for 1950-2014. Data are end-of-year values and are normalized in all countries to take value of 1 in 2014. Data source is United Nations, World Urbanization Prospects 2018. See appendix for details.

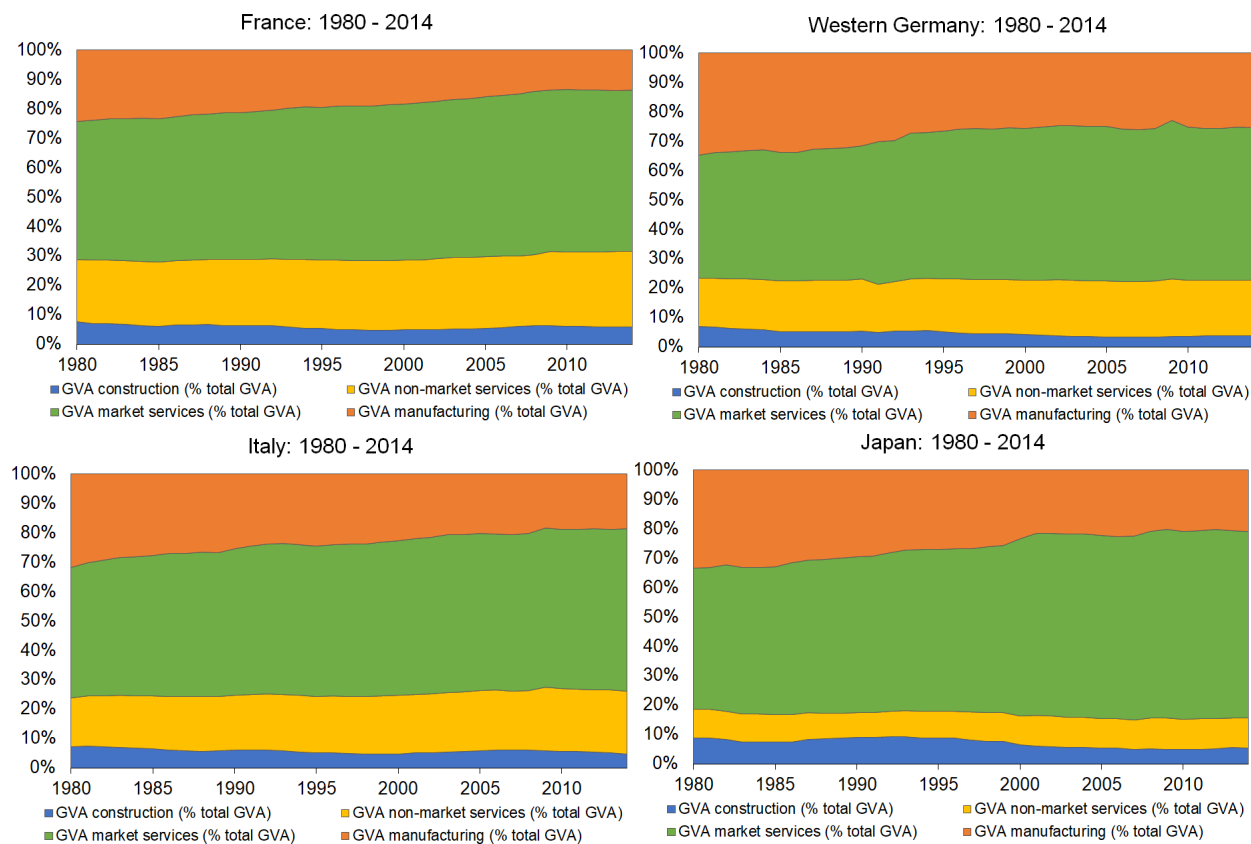


FIGURE 2.2 – GROSS VALUE ADDED DECOMPOSED INTO SECTORS OF ACTIVITY: FRANCE, WESTERN GERMANY, ITALY AND JAPAN. 1980-2014

Notes: These figures decompose total Gross Value Added (GVA) into the shares of four types of productive sectors: Construction, Manufacturing, Market-services and Non-market services (the agricultural sector is excluded from the analysis given its reduced weight on total GVA). Data cover the period 1980-2014 for four countries: France, Western Germany, Italy and Japan. See appendix for details on the construction of the series.

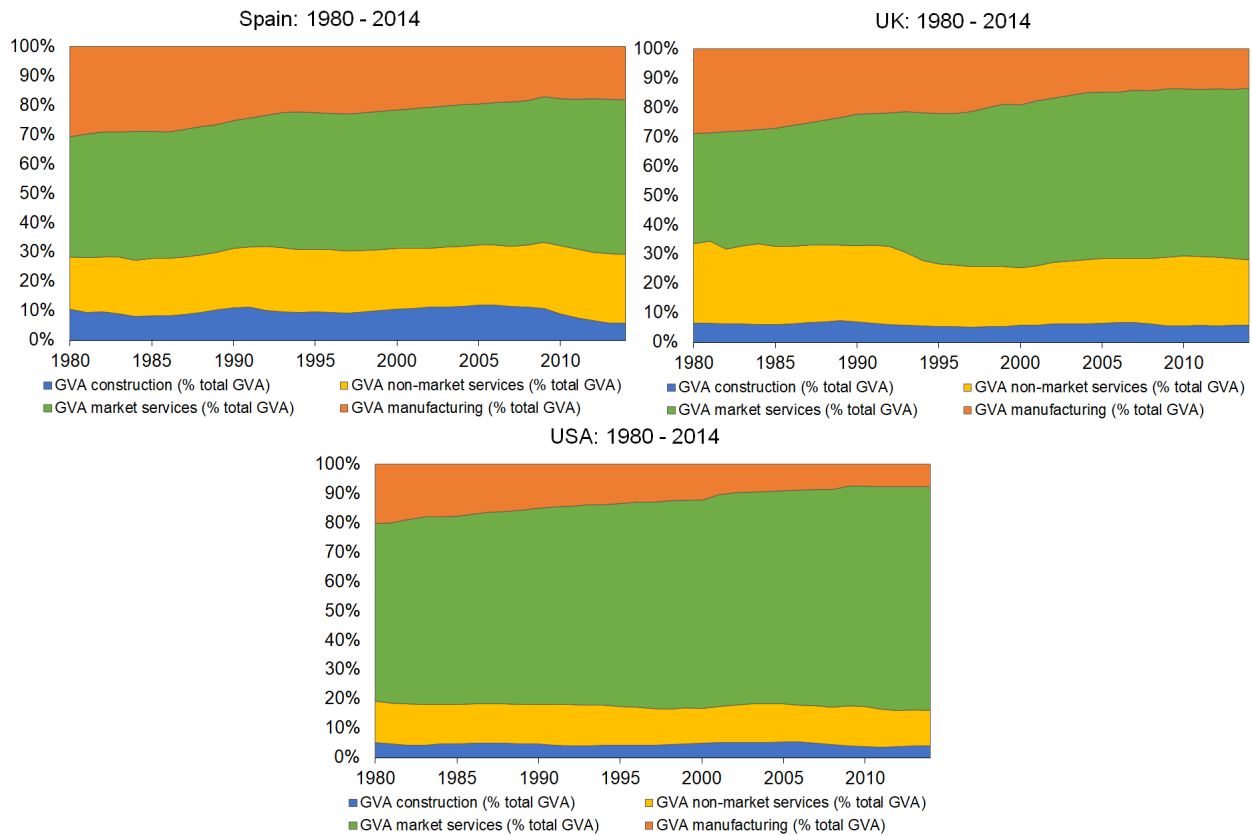


FIGURE 2.3 – GROSS VALUE ADDED DECOMPOSED INTO SECTORS OF ACTIVITY: SPAIN, UK AND USA. 1980-2014

Notes: These figures decompose total Gross Value Added (GVA) into the shares of four types of productive sectors: Construction, Manufacturing, Market-services and Non-market services (the agricultural sector is excluded from the analysis given its reduced weight on total GVA). Data cover the period 1980-2014 for three countries: Spain, UK and USA. See appendix for details on the construction of the series.

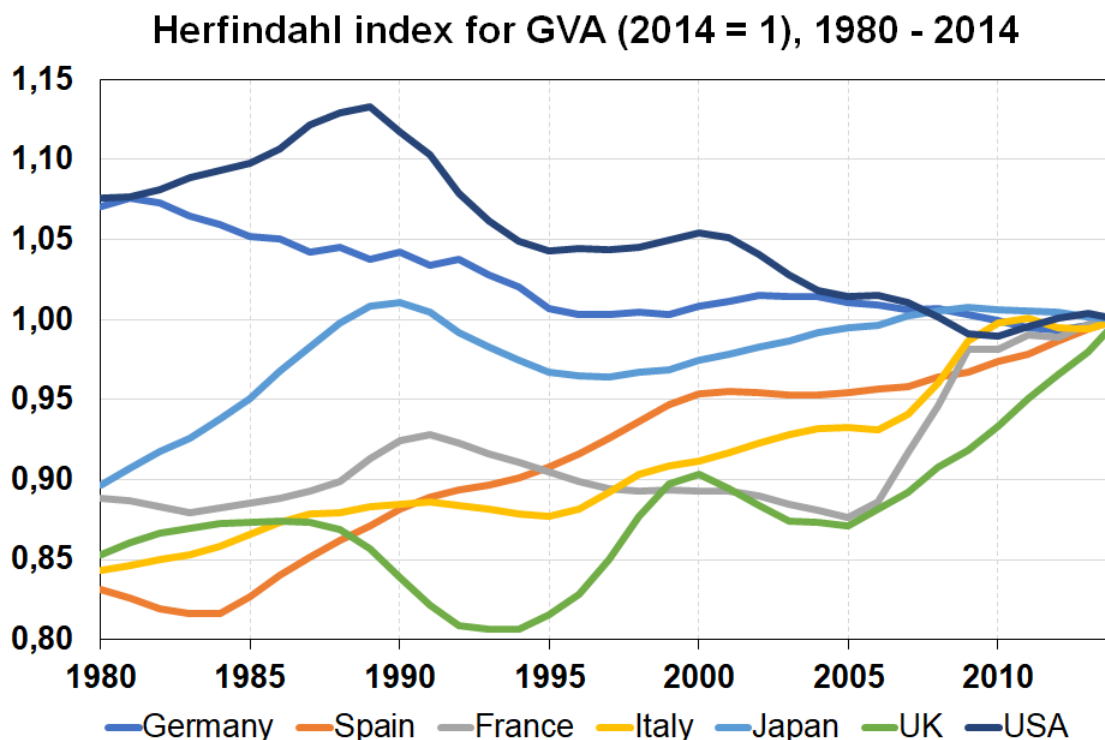


FIGURE 2.4 – HERFINDAHL INDEX FOR GVA (2014 = 1), 1980-2014

Notes: This figure depicts the evolution of the Herfindahl-Hirschman index (HHI) of concentration in France, Germany, Italy, Japan, Spain, UK and USA for 1980-2014. In each country, the HHI is computed using observations of GVA at the urban-area level and is normalized to take value of 1 in 2014. See appendix for details on the construction of the series.

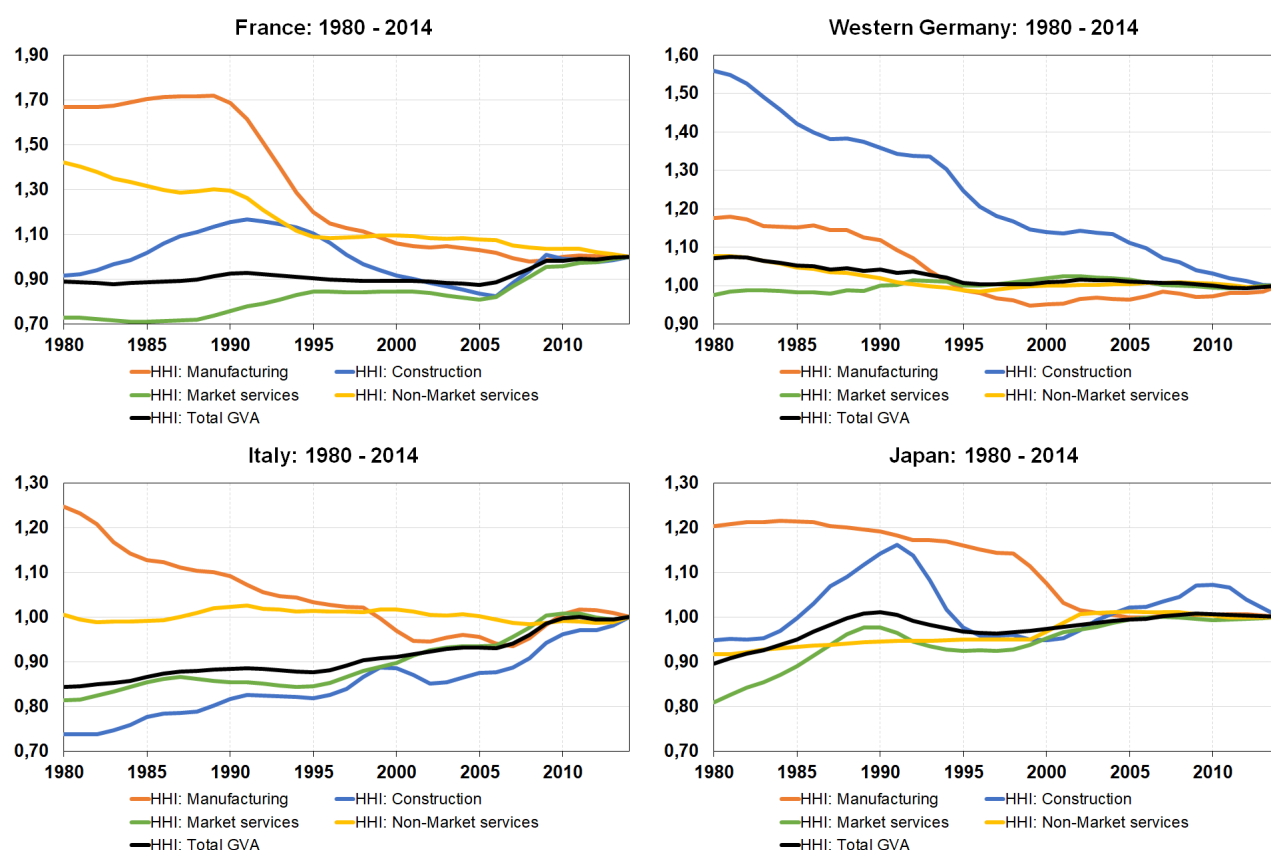


FIGURE 2.5 – THE CONCENTRATION OF ECONOMIC ACTIVITY WITHIN COUNTRIES AND ACROSS PRODUCTIVE SECTORS: FRANCE, WESTERN GERMANY, ITALY AND JAPAN. 1980-2014

Notes: These figures display the evolution of the Herfindahl-Hirschman index (HHI) of concentration in France, Western Germany, Italy and Japan for 1980-2014. It calculates, separately, the HHI for 4 types of economic activity: Construction, Manufacturing, Market services and Non-market services (the agricultural sector is excluded given its reduced weight in total Gross Value Added). It also calculates the HHI for total Gross Value Added. In each country, the HHI is computed using observations at the urban-area level and is normalized to take value of 1 in 2014. See appendix for details on the construction of the series.

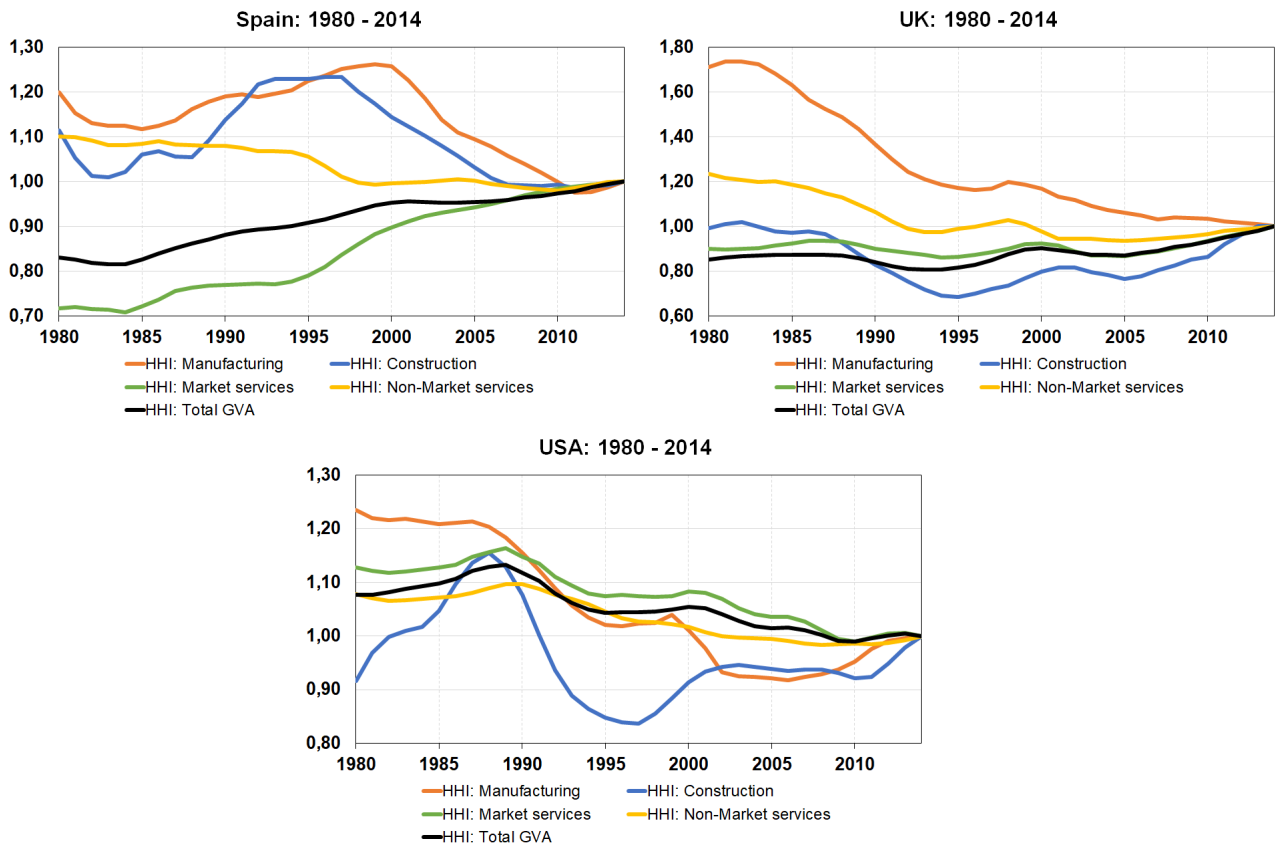


FIGURE 2.6 – THE CONCENTRATION OF ECONOMIC ACTIVITY WITHIN COUNTRIES AND ACROSS PRODUCTIVE SECTORS: SPAIN, UK AND USA. 1980-2014

Notes: These figures display the evolution of the Herfindahl-Hirschman index (HHI) of concentration in Spain, UK and USA for 1980-2014. It calculates, separately, the HHI for 4 types of economic activity: Construction, Manufacturing, Market services and Non-market services (the agricultural sector is excluded given its reduced weight in total Gross Value Added). It also calculates the HHI for total Gross Value Added. In each country, the HHI is computed using observations at the urban-area level and is normalized to take value of 1 in 2014. See appendix for details on the construction of the series.

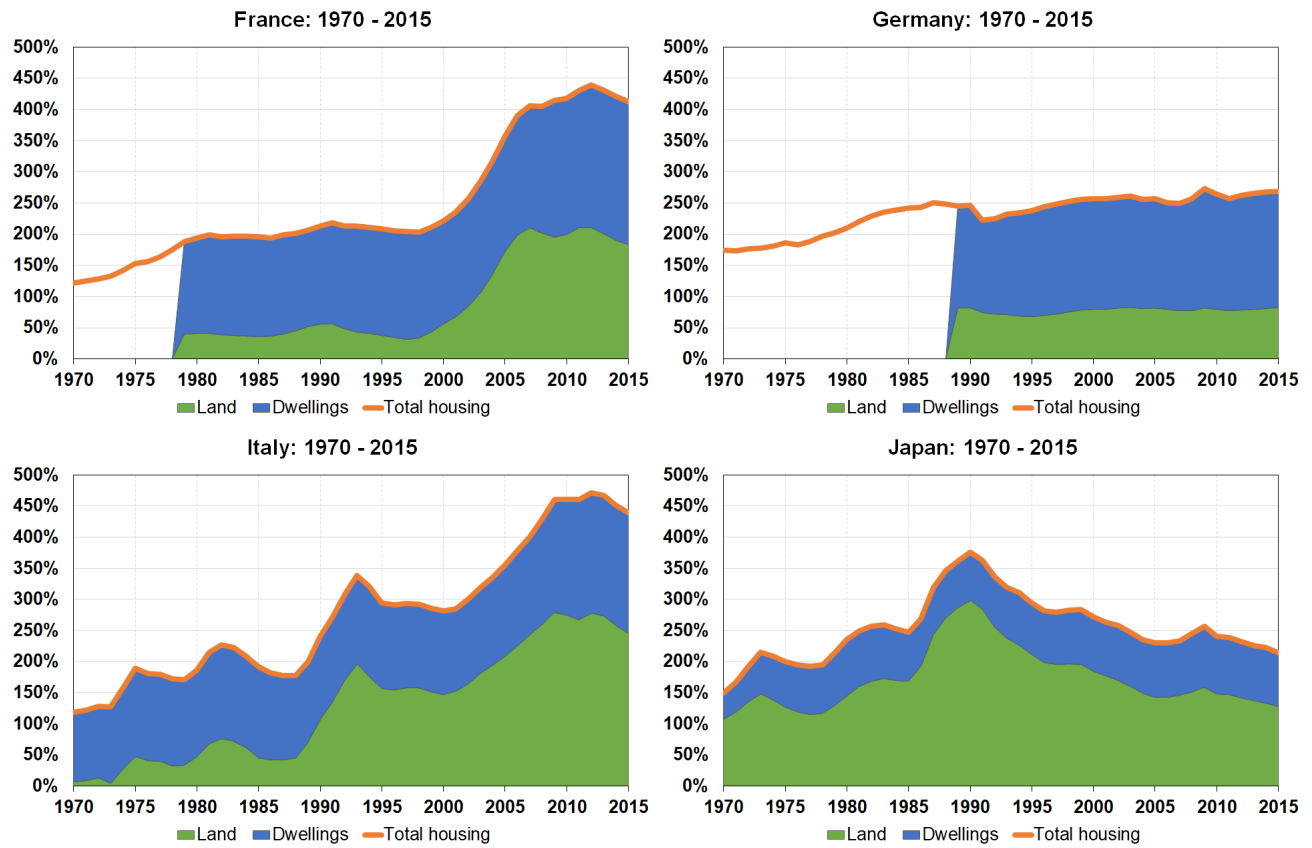


FIGURE 2.7 – LAND VS STRUCTURE DECOMPOSITION OF NATIONAL HOUSING WEALTH IN FRANCE, GERMANY, ITALY AND JAPAN. 1970-2014

Notes: These figures decompose the market-value of national housing (as % of national income) into two elements: structure and land underlying. Data are displayed for four countries: France, Western Germany, Italy and Japan. The period covered is 1970-2014. In Germany and France, the ratio of national housing-to-national income is shown since 1970, but the decomposition into the two elements starts in 1990 and in 1980, respectively. See appendix for details on the construction of the series.

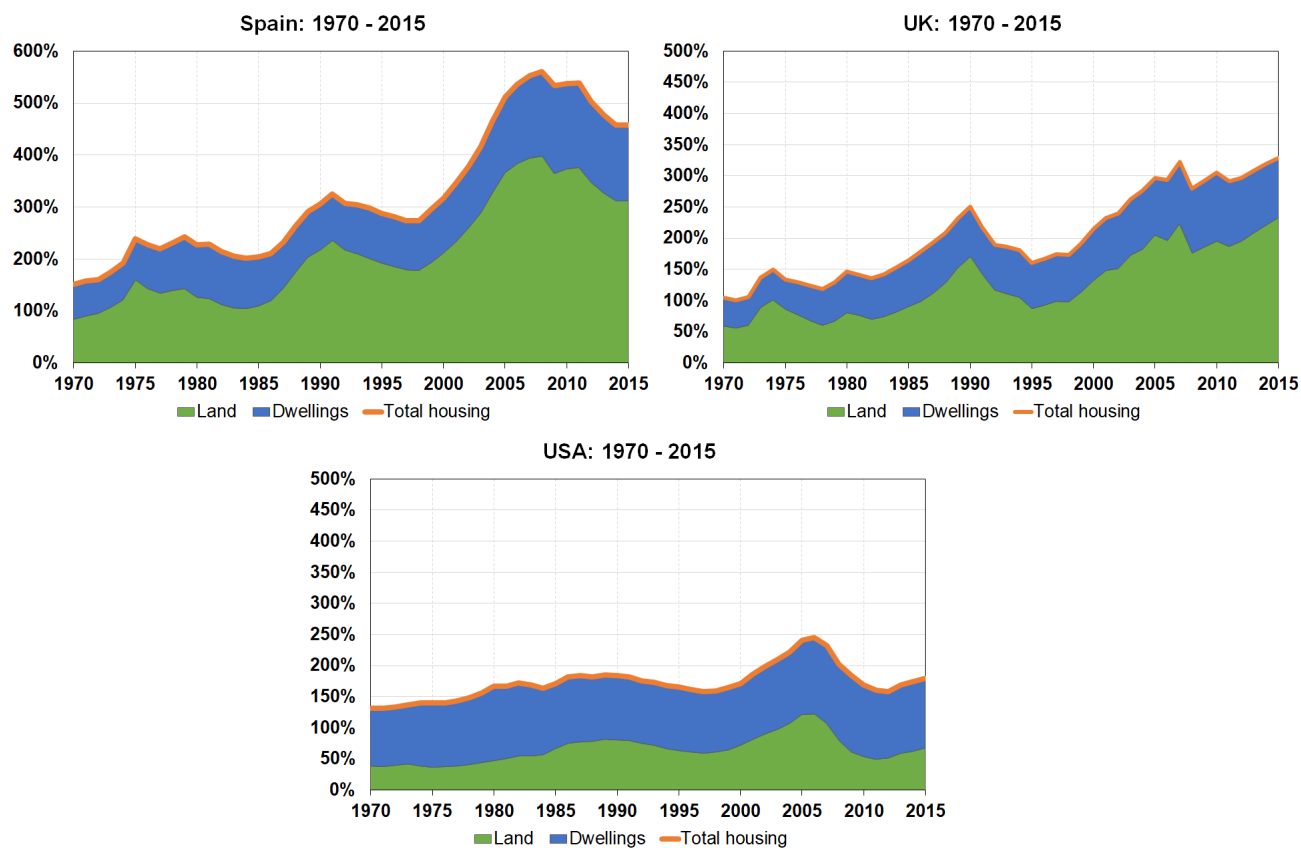


FIGURE 2.8 – LAND VS STRUCTURE DECOMPOSITION OF NATIONAL HOUSING WEALTH IN SPAIN, UK AND USA. 1970-2014

Notes: These figures decompose the market-value of national housing (as % of national income) into two elements: structure and land underlying. Data are displayed for three countries: Spain, UK and USA. The period covered is 1970-2014. See appendix for details on the construction of the series.

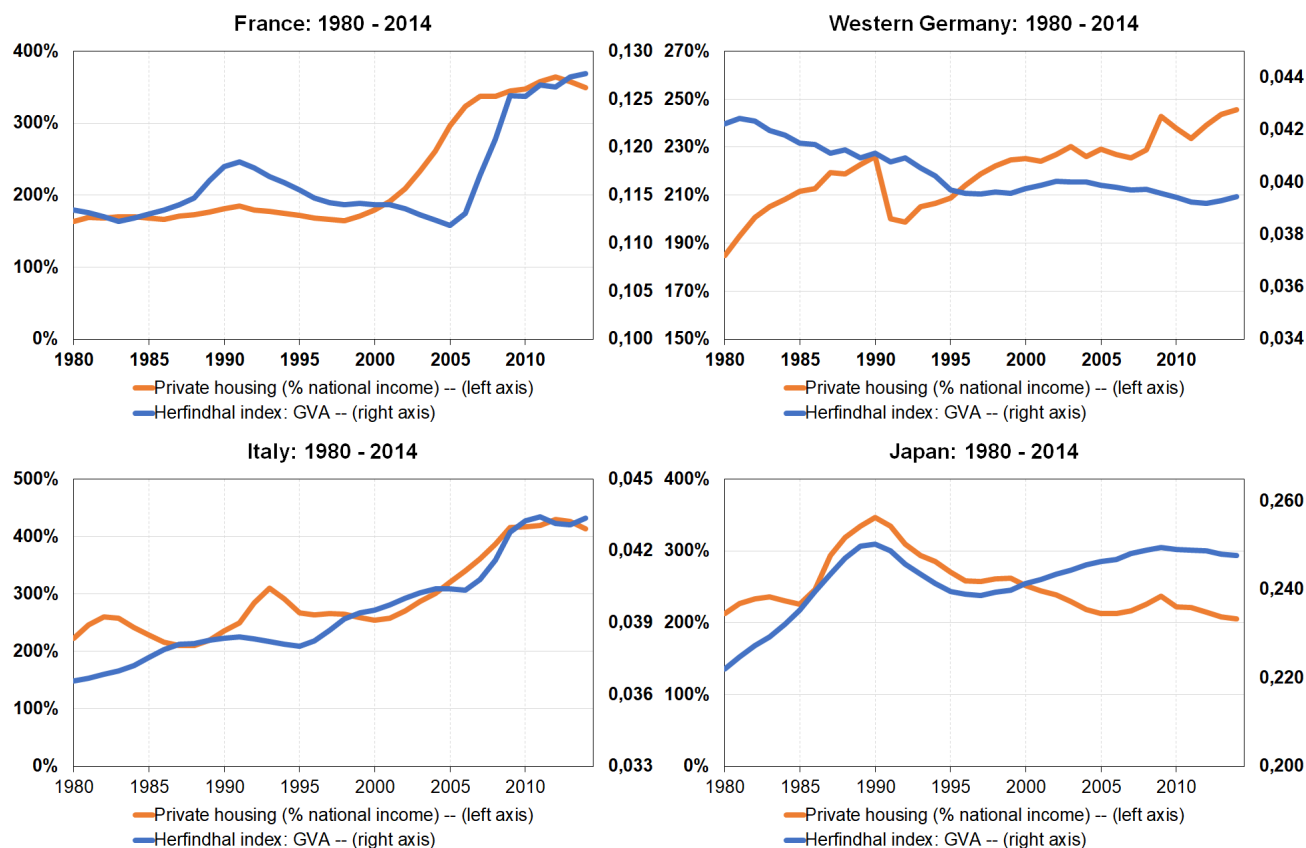


FIGURE 2.9 – PRIVATE HOUSING-TO-NATIONAL INCOME RATIOS AND THE CONCENTRATION OF ECONOMIC ACTIVITY: FRANCE, WESTERN GERMANY, ITALY AND JAPAN. 1980-2014

Notes: These figures depict the evolution of the private housing-to-national income ratios (left axis) and the within-country's spatial concentration of economic activity (right axis) for four countries: France, Western Germany, Italy and Japan. The spatial concentration of economic activity is measured, in each country, with the Herfindahl-Hirschman index (HHI) of concentration using observations of Gross Value Added at the urban-area level. The period covered is 1980-2014. See appendix for details on the construction of the series.

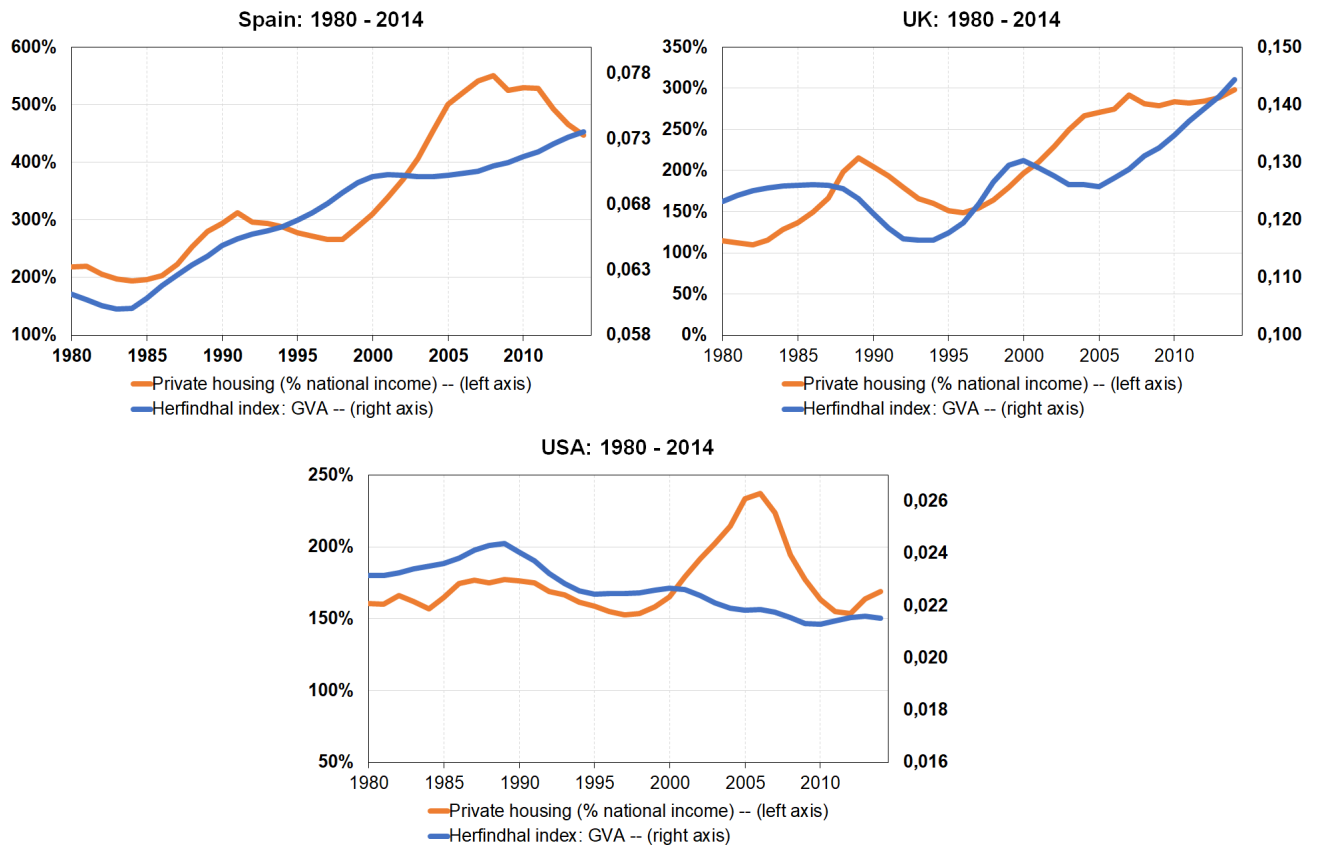


FIGURE 2.10 – PRIVATE HOUSING-TO-NATIONAL INCOME RATIOS AND THE CONCENTRATION OF ECONOMIC ACTIVITY: SPAIN, UK AND USA. 1980-2014

Notes: These figures depict the evolution of the private housing-to-national income ratios (left axis) and the within-country's spatial concentration of economic activity (right axis) for four countries: Spain, UK and USA. In each country, the spatial concentration of economic activity is measured with the Herfindahl-Hirschman index of concentration using observations of Gross Value Added at the urban-area level. The period covered is 1980-2014. See appendix for details on the construction of the series.

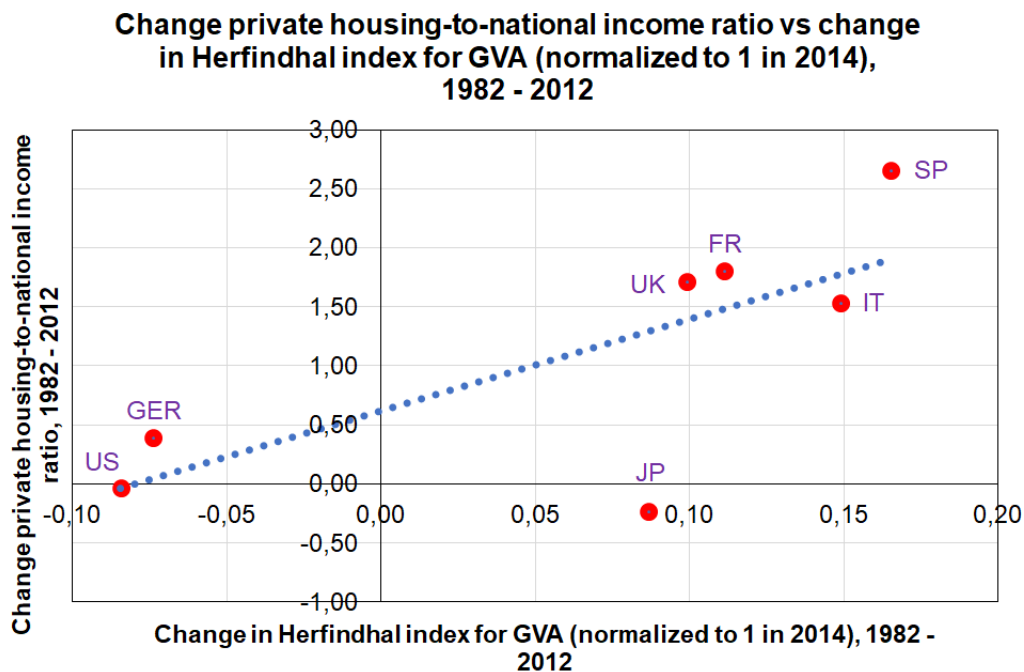


FIGURE 2.11 – CHANGE PRIVATE HOUSING-TO-NATIONAL INCOME RATIO VS CHANGE IN HHI FOR GVA (NORMALIZED TO 1 IN 2014), 1982 - 2012

Notes: This figure displays the change between 1982 and 2012 in the private housing-to-national income ratio (left axis) and the change in the Herfindahl-Hirschman index for GVA normalized to 1 in 2014 (right axis) in France, Germany, Italy, Japan, Spain, UK and USA. In each country, the Herfindahl-Hirschman index of concentration is calculated using observations of Gross Value Added at the urban-area level. Year 1982 is the 5-years average of 1980-1984 while year 2012 is the 5-years average of 2010-2014. See appendix for details on the construction of the series.

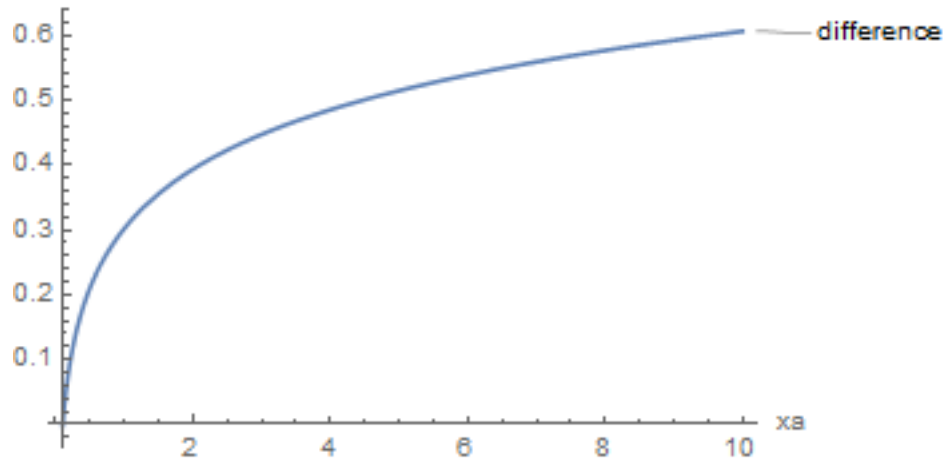


FIGURE 2.12 – REAL WAGE REACTION IN CITY-A TO A NEGATIVE PRODUCTIVITY SHOCK IN CITY-A:
DIFFERENCE BETWEEN MODIFIED VERSION AND MORETTI’S MODEL

Notes: This figure displays the reaction of real wages in city-a to a productivity shock in city-a (eq. 2.9) in the "modified version" of the model relative to the original version. Both models are calibrated with the same set of parameters and are exposed to the same productivity shock. A positive slope means that "modified version" of the model reacts in the same direction than the original version, but more intensely. The parameters used to calibrate the models are the following: $z = 0.1$, $d = 0.7$, $K_a = 0.1$, $N = 0.1$, $s = 0.1$, $K_b = 0.1$, $A_a = 0.1$, $A_b = 0.1$, $\rho = 0.1$, $X_a = 1$ and $X_b = 1$. Models react in the same direction when using alternative values for the parameters as long as parameters are strictly higher than 0 (otherwise parameters would not make economic sense).

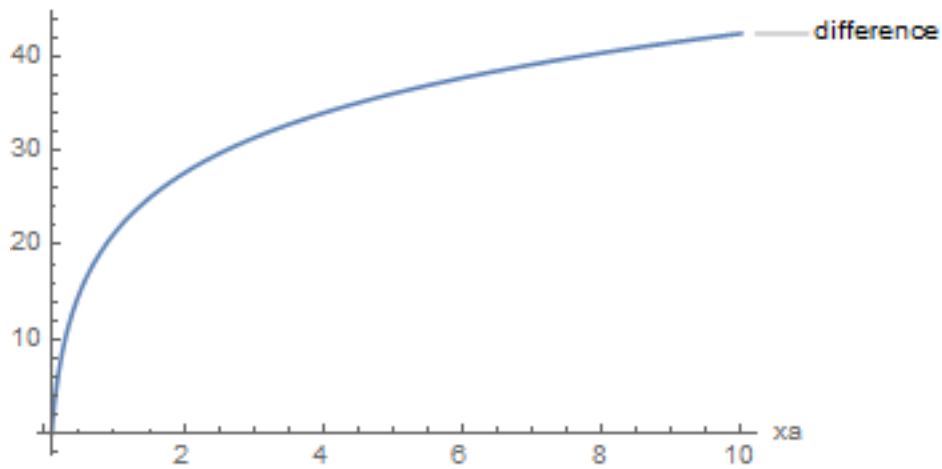


FIGURE 2.13 – REAL WAGE REACTION IN CITY-B TO A NEGATIVE PRODUCTIVITY SHOCK IN CITY-A:
DIFFERENCE BETWEEN MODIFIED VERSION AND MORETTI'S MODEL

Notes: This figure displays the reaction of real wages in city-b to a productivity shock in city-a (eq. 2.10) in the "modified version" of the model relative to the original version. Both models are calibrated with the same set of parameters and are exposed to the same productivity shock. A positive slope means that the "modified version" of the model reacts in the same direction than the original version, but more intensely. The parameters used to calibrate the models are the following: $z = 0.1$, $d = 0.7$, $K_a = 0.1$, $N = 0.1$, $s = 0.1$, $K_b = 0.1$, $A_a = 0.1$, $A_b = 0.1$, $\rho = 0.1$, $X_a = 1$ and $X_b = 1$. Models react in the same direction when using alternative values for the parameters as long as parameters are strictly higher than 0 (otherwise parameters would not make economic sense).

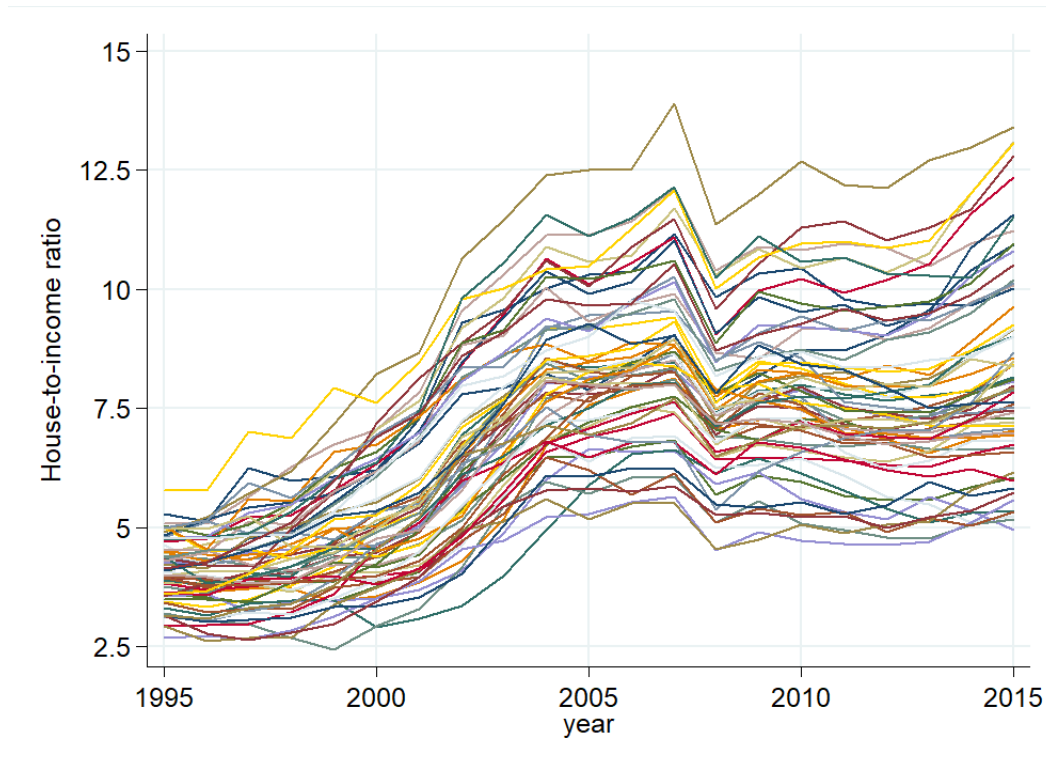


FIGURE 2.14 – AVERAGE HOUSE-TO-AVERAGE INCOME RATIOS, 62 URBAN AREAS, 1995-2015

Notes: This figure displays the evolution of the ratio "average house price-to-Gross Value Added per capita" in 62 urban areas of England and Wales, for 1995-2015. Gross Value Added is used to proxy for income. Average prices are calculated using geometric means. Sources: own calculations (see appendix for details).

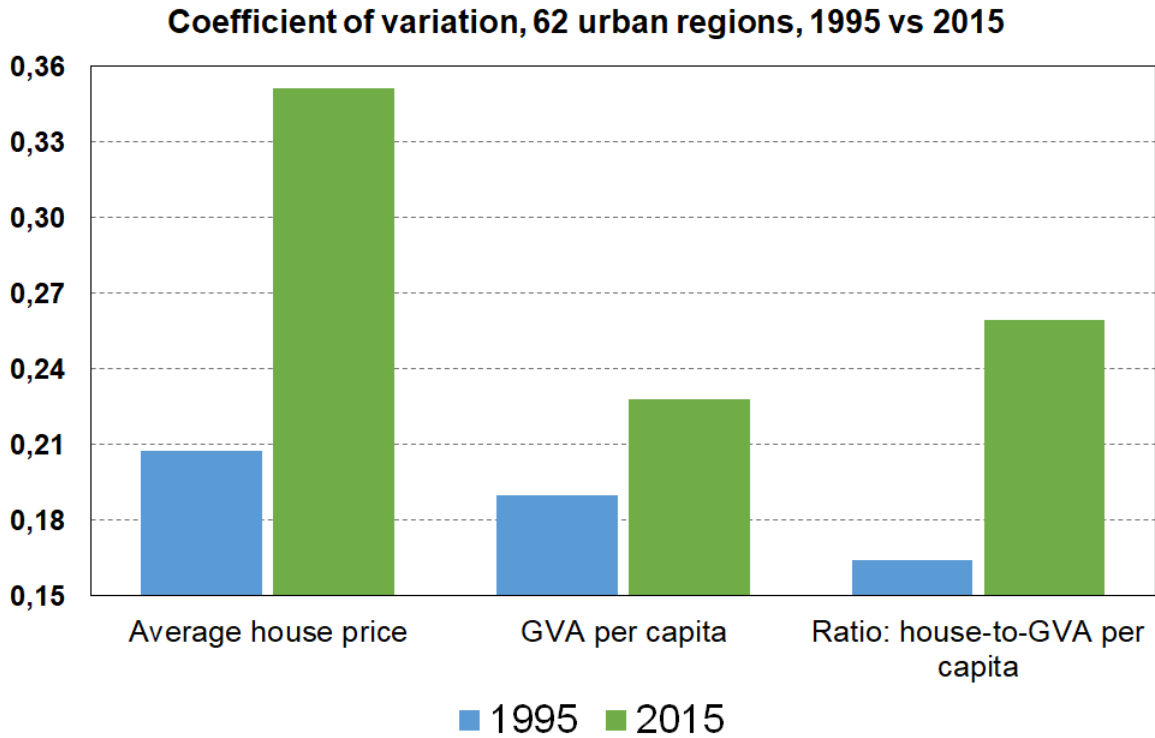


FIGURE 2.15 – COEFFICIENT OF VARIATION, 62 URBAN AREAS, 1995-2015

Notes: This figure displays the coefficient of variation across 62 urban areas in England and Wales for 1995-2015, for three measures: Average house price, Gross Value Added per capita, ratio of 'average house price-to-Gross Value Added per capita'.

Sources: own calculations (see appendix for details).

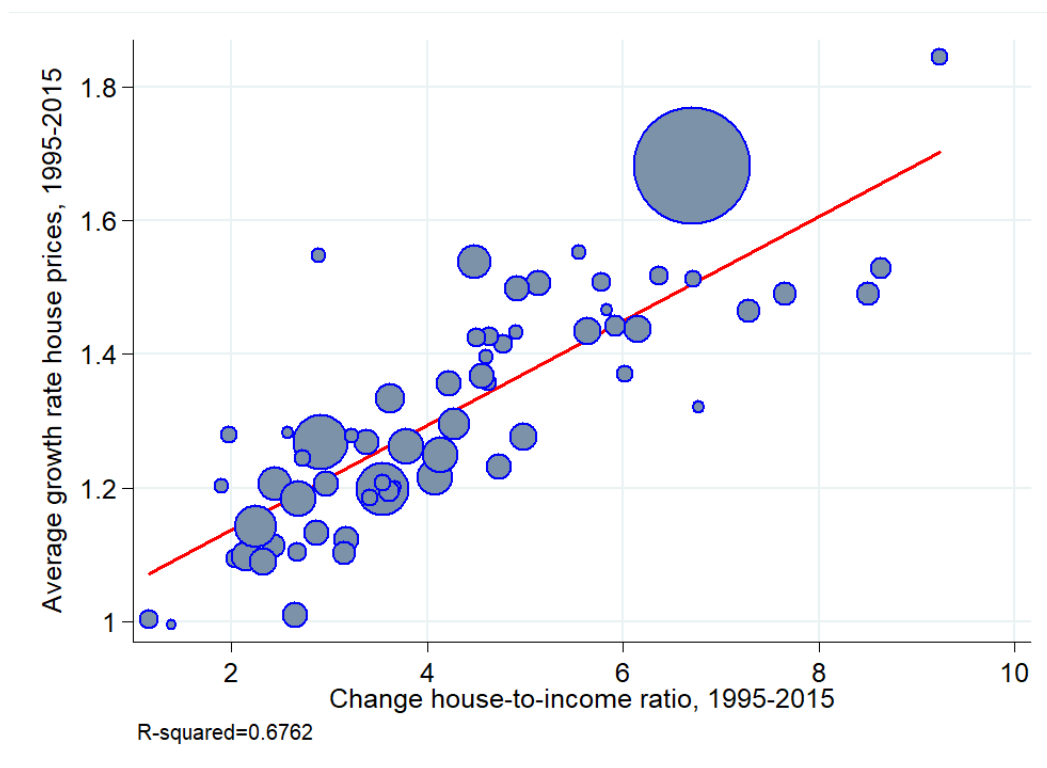


FIGURE 2.16 – AVERAGE GROWTH RATE IN HOUSE PRICES VS CHANGE IN HOUSE-TO-INCOME RATIOS, 62 URBAN AREAS, 1995-2015

Notes: This figure displays the average growth rate of house prices (left axis) and the change in the ratio of 'average house price-to-GVA per capita' (right axis), across 62 urban areas in England and Wales between 1995 and 2015. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.68. Sources: own calculations (see appendix for details).

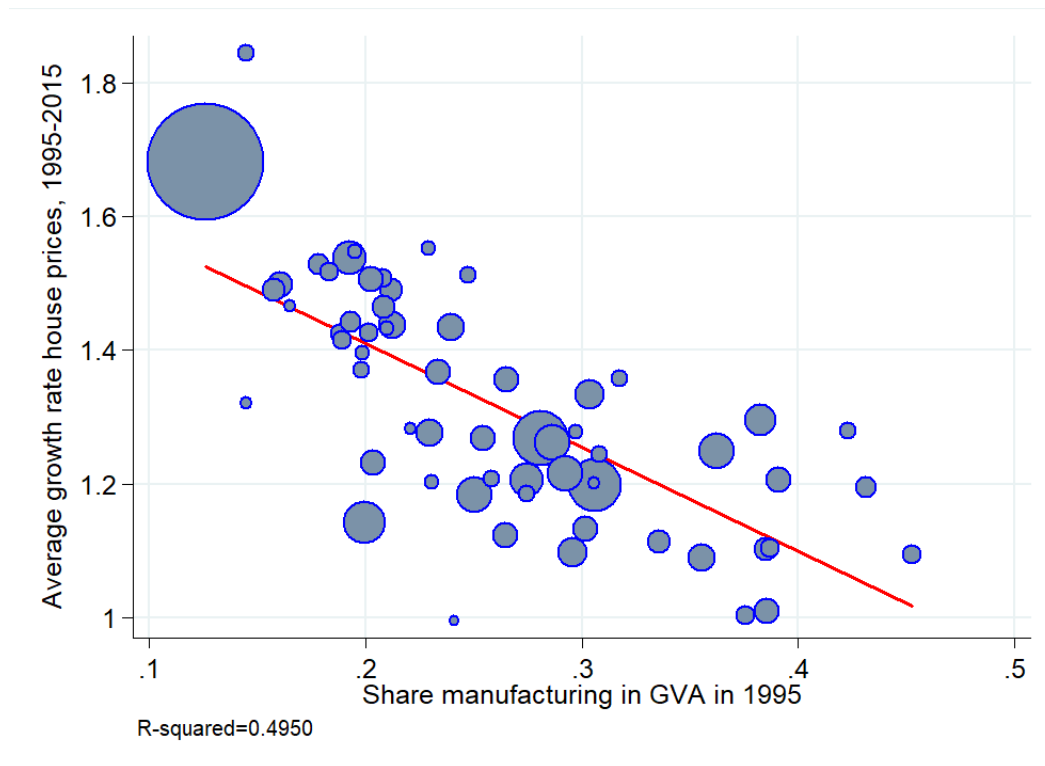


FIGURE 2.17 – AVERAGE GROWTH RATE IN HOUSE PRICES BETWEEN 1995-2015 VS % MANUFACTURING IN GVA IN 1995, 62 URBAN AREAS

Notes: This figure displays the average growth rate of house prices between 1995 and 2015 (left axis) and the share of manufacturing value added in total urban area's value added in 1995 (right axis). Observations correspond to 62 urban areas in England and Wales. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.49.

Sources: own calculations (see appendix for details).

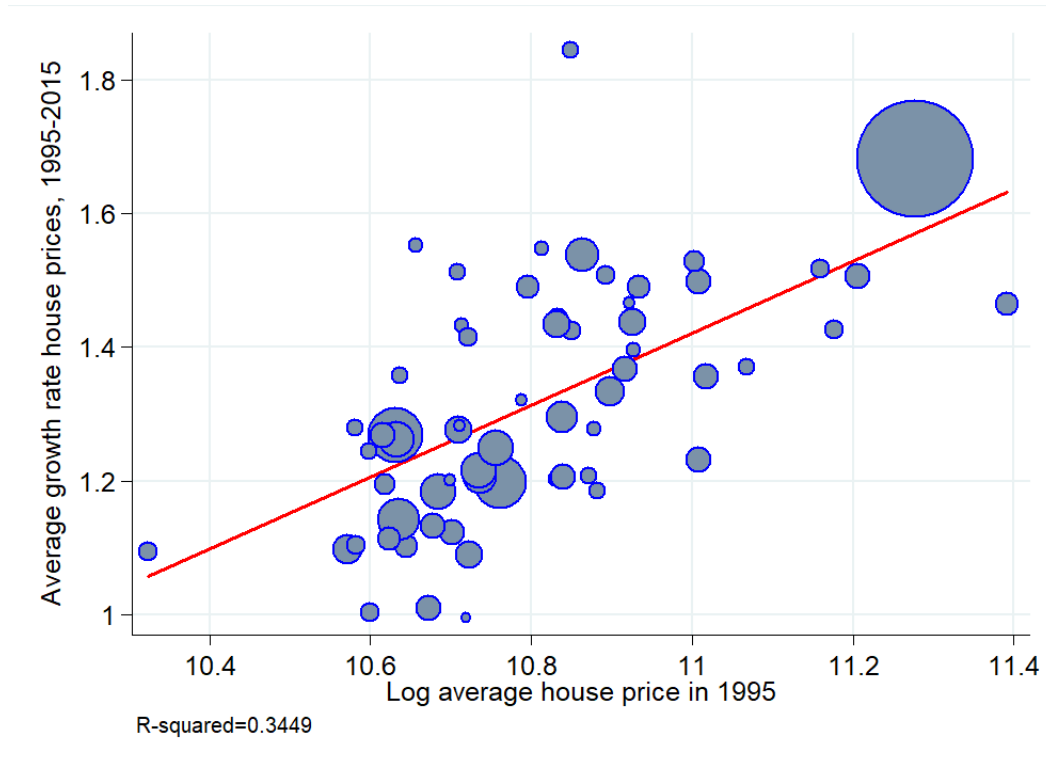


FIGURE 2.18 – AVERAGE GROWTH RATE IN HOUSE PRICES BETWEEN 1995-2015 VS LOG HOUSE PRICES IN 1995, 62 URBAN AREAS

Notes: This figure displays the average growth rate of house prices between 1995 and 2015 (left axis) and the log of house prices in 1995 (right axis). Observations correspond to 62 urban areas in England and Wales. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.35. Sources: own calculations (see appendix for details).

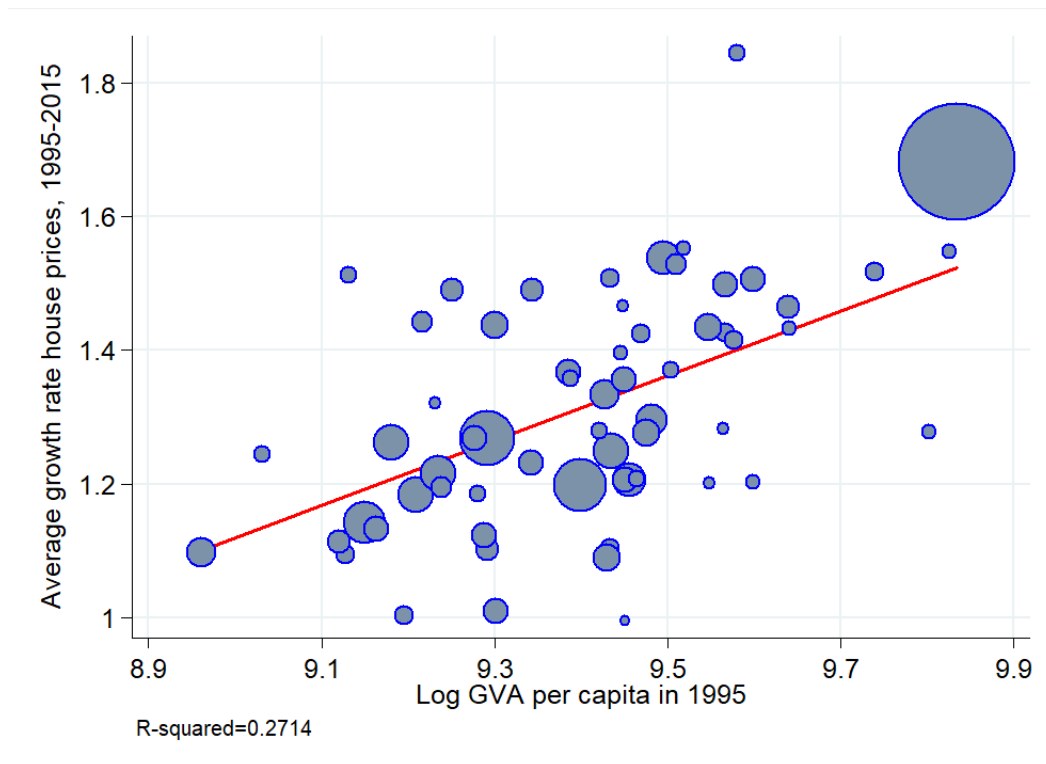


FIGURE 2.19 – AVERAGE GROWTH RATE IN HOUSE PRICES BETWEEN 1995-2015 VS LOG GVA PER CAPITA IN 1995, 62 URBAN AREAS

Notes: This figure displays the average growth rate of house prices between 1995 and 2015 (left axis) and the log of Gross Value Added per capita in 1995 (right axis). Observations correspond to 62 urban areas in England and Wales. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.27. Sources: own calculations (see appendix for details).



FIGURE 2.20 – AVERAGE GROWTH RATE IN HOUSE PRICES BETWEEN 1995-2015 VS LOG OF POPULATION IN 1995, 62 URBAN AREAS

Notes: This figure displays the average growth rate of house prices between 1995 and 2015 (left axis) and the log of population in 1995 (right axis). Observations correspond to 62 urban areas in England and Wales. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.00.
 Sources: own calculations (see appendix for details).

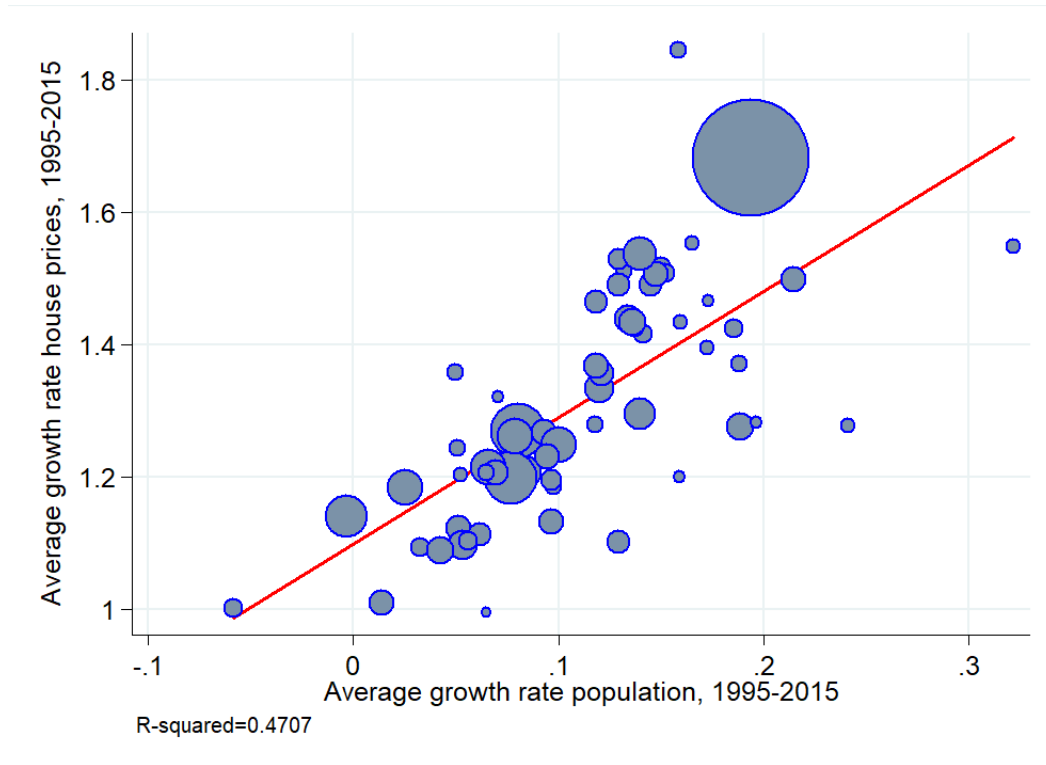


FIGURE 2.21 – AVERAGE GROWTH RATE OF HOUSE PRICES VS AVERAGE GROWTH RATE OF POPULATION, 62 URBAN AREAS, 1995-2015

Notes: This figure displays the average growth rate of house prices (left axis) and the average growth rate of population (right axis), between 1995 and 2015. Observations correspond to 62 urban areas in England and Wales. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.47.

Sources: own calculations (see appendix for details).

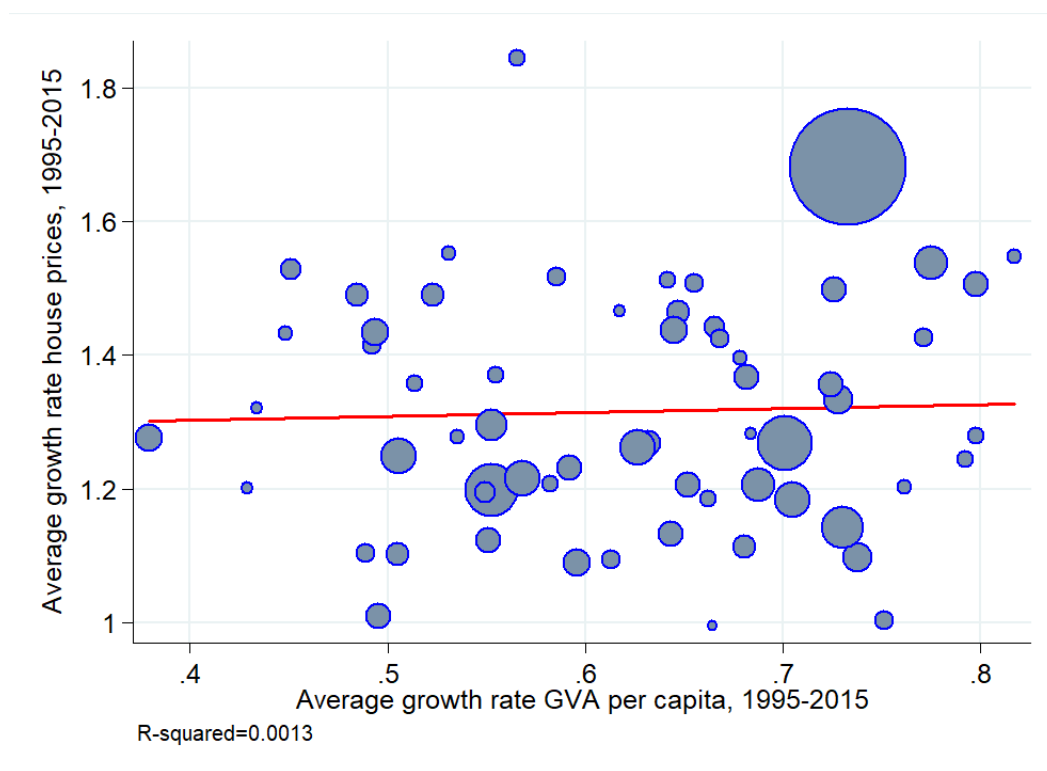


FIGURE 2.22 – AVERAGE GROWTH RATE OF HOUSE PRICES VS AVERAGE GROWTH RATE OF GVA PER CAPITA, 62 URBAN AREAS, 1995-2015

Notes: This figure displays the average growth rate of house prices (left axis) and the average growth rate of Gross Value Added per capita (right axis), between 1995 and 2015 . Observations correspond to 62 urban areas in England and Wales. The fitted straight line is the outcome of an OLS regression. R-squared equals 0.00.

Sources: own calculations (see appendix for details).

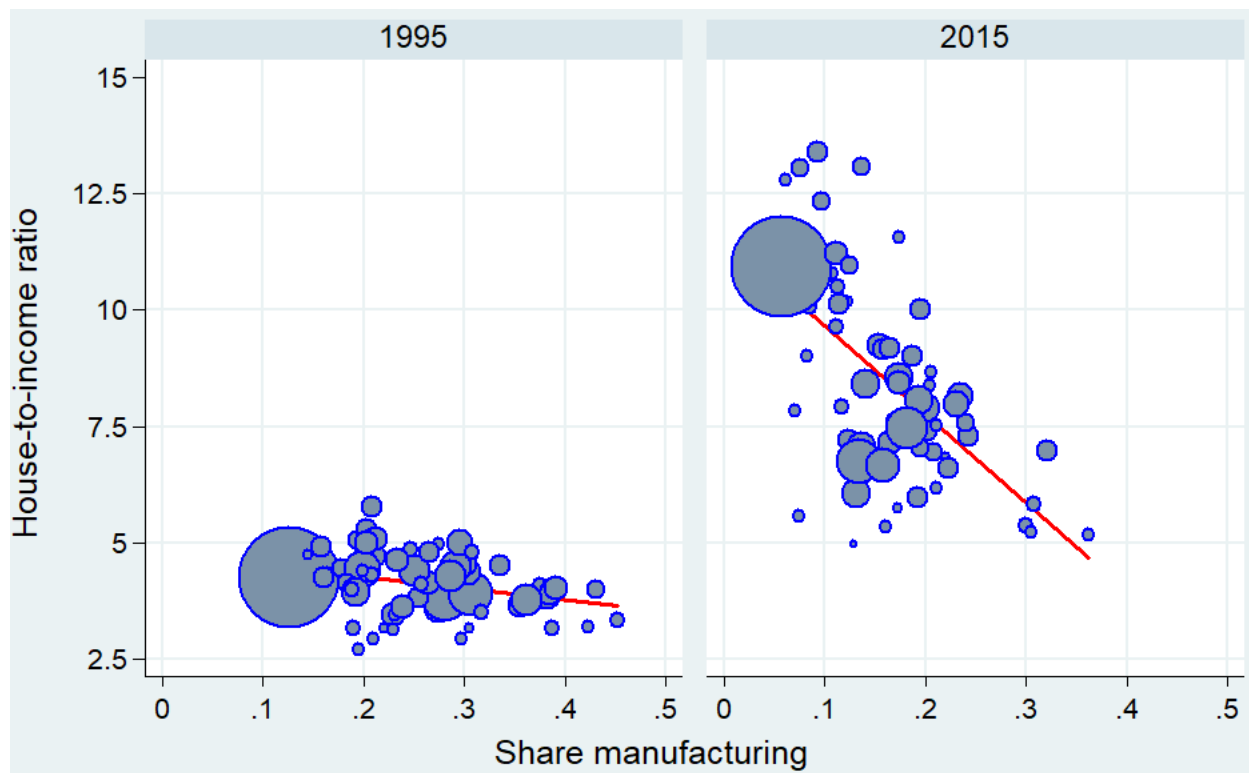


FIGURE 2.23 – HOUSE-INCOME RATIOS VS % MANUFACTURING IN VALUE ADDED IN 1995 AND 2015, 62 URBAN AREAS

Notes: This figure displays the ratio of 'average house price-to-Gross Value Added per capita' (left axis) and the % of manufacturing in Gross Value Added (right axis), in two different years: 1995 and 2015. Observations correspond to 62 urban areas in England and Wales. The fitted straight lines are the outcome of OLS regressions. R-squared equals 0.08 in 1995 and 0.35 in 2015.

Sources: own calculations (see appendix for details).

Tables

TABLE 2.1 – CROSS-COUNTRY FIXED EFFECTS REGRESSIONS: PRIVATE HOUSING-TO-NATIONAL INCOME RATIOS AND SPATIAL CONCENTRATION OF ECONOMIC ACTIVITY

VARIABLES	(1) Private housing (% national income)	(2) Private housing (% national income)	(3) Private housing (% national income)	(4) Private housing (% national income)
HHI: total GVA (2014=1)	7.011*** (0.921)		7.523*** (1.404)	
HHI: population (2014=1)		6.426*** (1.312)	-1.025 (1.680)	
HHI: Manufacturing (2014=1)				0.960** (0.465)
HHI: Market services (2014=1)				4.715*** (0.572)
HHI: Non-market services				-3.578** (1.406)
HHI: Construction (2014=1)				-0.192 (0.504)
Observations	245	245	245	245
R-squared	0.74	0.66	0.74	0.78
Number of groups	7	7	7	7
Controls	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is the market-value of private housing as a percentage of net national income. Herfindahl indexes for population, total GVA and different sectors within GVA take value 1 in 2014 and are based on similarly defined urban areas. Controls include: urbanization rate, growth in real households' credit, real long-term interest rate, growth population group between 20 and 49 years old, growth real personal disposable income and change in unemployment rate. All regressions include country and year fixed effects, and use [Driscoll and Kraay \(1998\)](#) standard errors to correct for serial correlation and cross-sectional dependence (estimates obtained with Stata user-written command 'xtscc' ([Hoechle \(2007\)](#))).

TABLE 2.2 – HOW CHANGES IN AGGREGATE MANUFACTURING AFFECT DIFFERENTLY MANUFACTURING AND SERVICE CITIES – MAIN SPECIFICATION

	Annual (1)	Every 5 years (2)	Every 10 years (3)
VARIABLES	Log house price	Log house price	Log house price
Service_i x log share_manuf_t	-0.0896*** (0.0234)	-0.212*** (0.0457)	-0.363*** (0.0498)
Observations	1,240	310	186
R-squared	0.980	0.981	0.988
Number of urban areas	62	62	62

Standard errors clustered at the urban area level in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is the log of average house price. The main regressor is an indicator for an urban area being specialized in services interacted with the log of the national share of manufacturing value added. Column 1 uses annual data between 1995 and 2015. Column 2 uses every-5-years data (1995, 200, 2005, 2010 and 2015). Column 3 uses every-10-years observations (1995, 2005 and 2015). All regressions include urban area and year fixed effects. Standard errors clustered at the urban area level are between brackets. All reported R^2 are within time.

TABLE 2.3 – HOW CHANGES IN AGGREGATE MANUFACTURING AFFECT DIFFERENTLY MANUFACTURING AND SERVICE CITIES – ALTERNATIVE SPECIFICATIONS

	Excluding London			1995 population weights		
	Annual (4)	Every 5 years (5)	Every 10 years (6)	Annual (7)	Every 5 years (8)	Every 10 years (9)
VARIABLES	Log house price	Log house price	Log house price	Log house price	Log house price	Log house price
Service_i x log share_manuf_t	-0.0863*** (0.0233)	-0.204*** (0.0449)	-0.351*** (0.0482)	-0.0922** (0.0365)	-0.218*** (0.0407)	-0.373*** (0.0560)
Observations	1,220	305	183	1,240	310	186
R-squared	0.981	0.982	0.989	0.980	0.981	0.988
Number of urban areas	61	61	61	62	62	62

Standard errors clustered at the urban area level in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is the log of average house price. The main regressor is an indicator for an urban area being specialized in services interacted with the log of the national share of manufacturing value added. Columns 1 to 3 use 61 urban areas and exclude London. Columns 4 to 6 use 62 urban areas and are weighted by the 1995 urban area's population size. Column 1 and 4 use annual data between 1995 and 2015. Column 2 and 5 use every-5-years data (1995, 200, 2005, 2010 and 2015). Column 3 and 6 use every-10-years observations (1995, 2005 and 2015). All regressions include urban area and year fixed effects. Standard errors clustered at the urban area level are between brackets. All reported R^2 are within time.

Appendix

A Introduction

This appendix is divided into five parts, the first four referring to section 2.1 and the last one to section 2.3: i) Value added and population data; ii) Urban areas definitions; iii) Housing wealth decomposition: land vs structure; iv) Data used in cross-country fixed effects regressions; v) Data used in England and Wales's country study.

B Value added and population data

B.1 Europe: France, Germany, Italy, Spain and UK

European data on value added and population come from the European Regional Database of Cambridge Econometrics²⁷. These are regional economic and population accounts, covering the period 1980-2015, with annual frequency. The primary source used by Cambridge Econometrics is Eurostat's REGIO database. However, REGIO is only publicly available at the NUTS-3 level since 2000. Hence, for the purpose of covering a longer period of time, I acquired the European Regional Database (ERD).

In this project, I use the subset of the ERD dataset that contains population and gross value added by type of activity, at the NUTS-3 level of disaggregation (the dataset contains also data for employment at the NUTS-3 level, as well as all the previous variables together with hours worked, compensation of employees and investment at the NUTS-2 level). The six sectors in which gross value added is decomposed are:

- Agriculture, Forestry and Fishing
- Industry (excluding construction)
- Construction

27. <https://www.camecon.com/european-regional-data/>

- Wholesale, Retail, Transport, Accommodation and Food Services, Information and Communication
- Financial and Business Services
- Non-Market Services

This decomposition follows Eurostat's NACE rev.2, which are the latest European standards on the classification of economic activities by sector of production²⁸. In this paper, I group all types of markets services together and use the following terminology to refer to the previous sector classification:

- Agriculture → Agriculture, Forestry and Fishing
- Manufacturing → Industry (excluding construction)
- Construction → Construction
- Market services → Wholesale, Retail, Transport, Accommodation and Food Services, Information and Communication; Financial and Business Services
- Non-market services → Non-market services

It is important to note that the sector "Industry (excluding construction)", which in the paper I name simply as "manufacturing", includes the following three sub-sectors: mining and quarrying; manufacturing; energy utilities (electricity, gas, steam and air-conditioning supply; Water supply, sewerage, waste management and remediation).

While ERD's data are prepared in constant prices of 2005, I asked Cambridge Econometrics for the original nominal values (i.e. without being deflated). These are the ones I use in this project. In order to comply with Cambridge Econometrics' confidentiality conditions, in the data appendix of the project I do not include the original figures from ERD but the processed values.

A final note is needed. The period analyzed in the present paper covers the years 1980-2014. In the case of Germany, until 1989, the country was divided in two parts: West Germany (Federal Republic of Germany) and East Germany (German Democratic Republic). Then, in 1990, the country was reunified. By 1991, West Germany was substantially richer than

28. <http://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF>

East Germany, with the latter representing less than 8% of total reunified Germany's GDP (and less than 12% in 2016²⁹). Hence, given the weight of West Germany in total Germany, I decide to analyze only the evolution of economic activity and spatial concentration within the states of West Germany throughout the whole period 1980-2014. This way, I avoid having a break in the series in 1990 due to the enlargement of the country. In addition, ERD data does not cover the Berlin area before 1991, even if a part of Berlin belonged to West Germany. Hence, I also exclude Berlin from the analysis throughout the whole 1980-2014 period. In the robustness checks I show how the evolution of West Germany and Reunified Germany follow similar dynamics for the period in which the two coincide.

B.2 Japan

In Japan, regional data on population and gross value added by type of activity are available at the prefecture level (there are 47 prefectures in Japan).

Data on gross value added by type of activity come from the Prefectural Accounts of the Cabinet Office, Government of Japan. There exist different series for different subperiods, following two different System of National Accounts (SNA 93 and SNA 68). These are the periods covered by the different regional series, including the base year and the SNA followed:

- Accounts for the period 2001-2014. Base year is 2005 and follows SNA-93³⁰.
- Accounts for the period 1996-2009. Base year is 2000 and follows SNA-93³¹.
- Accounts for the period 1990-2003. Base year is 1995 and follows SNA-93³².
- Accounts for the period 1975-1999. Base year is 1990 and follows SNA-68³³.
- Accounts for the period 1955-1974: Base year is 1955 and follows SNA-68³⁴.

The Japanese definitions of economic activities by type of productive industry are stable

29. See Germany's state level GVA statistics in the following link: <https://www.statistik-bw.de/VGRdL/tbls/?lang=en-GB>

30. http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/contents/main_h26.html

31. http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/contents/main_h21.html

32. http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/contents/main_h15.html

33. http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/contents/main_68sna_s50.html

34. http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/contents/main_68sna_s30.html

over time across the different vintages of national accounts. I then use the following regional accounts for each of the next subperiods: 2001-2014 (series with 2005 base year); 2000 (series with 2000 base year); 1975-1999 (series with 1990 base year); 1955-74 (series with 1955 base year). To have a consistent series of total Japan's GDP for the whole period 1955-2014, I use data on total GDP from the World Inequality Database (WID.world). I then adjust each component of value added in the raw data series using the discrepancy between total GDP in WID.world and total GDP calculated from the specific prefecture accounts. For example, WID.world's total GDP in 1980 is 99% of total GDP in the raw prefectural accounts. I then take WID.world's total GDP for 1980 and adjust all components of prefectures' value added by this discrepancy (i.e. multiplying value added in construction in the 1980 prefectural accounts by 0.99; the same for all other components of value added).

Data on total population by prefecture come from e-Stat (Japanese Government Statistics), for two subperiods: 1920-2000 and 2000-2015³⁵. These data correspond to population estimates as of October 1st of each year.

B.3 USA

Data in the USA is less comparable to those in other countries. First, there are no data on gross value added by type of activity at the urban area level or below, at an annual frequency. The lowest level for which these data are available is the state level, but states in the USA usually include various urban areas. Sometimes, urban areas even belong to more than one single state – for example, the metropolitan region of New York is part of three states: New York, New Jersey and Pennsylvania³⁶. Given the final focus of the paper on tracking the economic activity at the urban area level, I do not use these state-level observations. However, the Regional Accounts of the Bureau of Economic Analysis (BEA) has data on income (and not value added) generated by sector of activity at the urban area level:

35. <https://www.e-stat.go.jp/en/stat-search/files?page=1&layout=datalist&toukei=00200524&tstat=00000090001&cycle=0&tclass1=00000090004&tclass2=00000090005>; <https://www.e-stat.go.jp/en/stat-search/files?page=1&layout=datalist&toukei=00200524&tstat=00000090001&cycle=0&tclass1=00000090004&tclass2=000001051180>

36. This definition corresponds with the Metropolitan Statistical Area of New York-Newark-Jersey City.

Metropolitan Statistical Areas (MSA) as defined by the BEA (there are 382 MSAs in the USA). Given that the focus of my analysis is on the spatial distribution of economic activity (and not in the levels of gross value added in an individual urban area), I use these data as a proxy for the distribution of actual gross value added across MSAs.

The next difficulty that I face in the case of the USA has to do with the shift in the classification of economic activities used in the USA before and after 2000. Before 2000, data on income at the MSA level by type of activity followed the SIC classification system, and covered the period 1969-2000. Since 2001, data follows the newest classification system introduced in the USA: the NAICS; covering the years 2001-2016. The problem is that some of the concepts used in the SIC's classification do not have a direct correspondence in the new system. Then, I need to make some adjustments. In what follows I explain how I constructed the US series, using the 5 subcomponents of value added that I have used in Europe and Japan: agriculture, manufacturing, construction, market services and non-market services.

- Agriculture → SIC (1969-2000): Farm earnings; Agricultural services, forestry and fishing – NAICS (2001-2016): Farm earnings; Forestry, fishing and related activities.
- Manufacturing → SIC (1969-2000): Mining; Manufacturing – NAICS (2001-2016): Mining, quarrying and oil and gas extraction; Manufacturing.
- Construction → SIC (1969-2000): Construction – NAICS (2001-2016): Construction.
- Market services → Throughout the whole period 1969-2016, I calculate market services as the residual of total income minus the other four components (agriculture, manufacturing, construction and non-market services).
- Non-market services → SIC (1969-2000): Government and government enterprises – NAICS (2001-2016): Government and government enterprises.

Hence, there are some inconsistencies between the definitions used in the USA and those used in Europe and Japan. In particular, non-market services in Europe and Japan include households' non-profit production of services. In the USA, however, these data are subsumed within other types of services, so I cannot isolate them. In addition, in the USA there is no consistent definition of utilities over time, with parts of the utilities' production being

classified together with transportation activities (a service-type activity) in the SIC accounts. I therefore decide not to include utilities within my definition of "manufacturing", contrary to what I do in Europe and Japan. Thus, utilities are included within the market services category as a residual.

To summarize, in the USA, utilities' production and households' non-profit production of services are included within market services, as a residual. By contrast, in Europe and Japan the former is included within the manufacturing category, the latter within the non-market services category. This paper focuses on having series of economic activity by type of sector at the urban area level to track changes in the concentration of economic activity within a country, but not to compare the specific levels. Thus, if these two sectors do not have a large impact on the other categories, then this classification should not affect the comparability of results. Nevertheless, this could be improved in future versions of the paper. Yet, to take an idea of the magnitude of utilities' production and households' non-profit production of services, in Japan they represented 2.1 and 2.4% of total gross value added in 2014, respectively.

Population data at the MSA level come from the same data source (BEA, Regional Accounts) and are available for the same two sub-periods: 1969-2000 and 2001-2016. Population is not affected by the change in definitions from SIC to NAICS, so series are consistent throughout the whole period 1969-2016.

C Definitions of urban areas

C.1 Europe: France, Germany, Italy, Spain and UK

Eurostat provides two measures of urban agglomerations: i) Functional Urban Areas; ii) Metropolitan Regions. Functional Urban Areas (FUAs) are defined at the micro level and capture cities and their commuting zone. The boundaries of these areas are defined in an economic way, hence being independent of existing administrative or political boundaries. Metropolitan regions (MRs), on the contrary, are NUTS-3 level approximations of the FUAs (city and commuting zones) of more than 250.000 inhabitants. Each metro region consists of

one or more NUTS-3 areas.

For Europe, I use value added and population data at the NUTS-3 level (from ERD, Cambridge Econometrics). For this reason, I approximate urban areas by using the second definition of Eurostat: Metropolitan regions. However, to cover the universe of FUAs (and not only those over 250.000 inhabitants), I follow a similar procedure to Eurostat's when defining Metropolitan Regions and approximate FUAs of less than 250.000 inhabitants as the combination of NUTS-3 areas. To do so, I use an online file from Eurostat matching each NUTS-3 areas to the main FUA within its territory³⁷. This file is based on the 2010 definition of NUTS areas. Since then, Eurostat has updated and made some changes to these definitions: in 2013 and in 2016. Given that ERD data uses the definitions of 2013³⁸, I adapt the NUTS 2010 classification of regions to that of 2013. Spain and Italy did not experience any change between 2010 and 2013. In France, changes only affected to the codes of overseas territories, but not the boundaries. In UK, the 2013 classification subdivided some 2010 NUTS-3 areas into smaller sub-areas. Hence, being possible to easily merge the new sub-areas to the 2010 definition. For example, the 2010 NUTS-3 area of "Greater Manchester South", with code UKD31, was divided into three new NUTS-3 areas in 2013: Manchester (UKD33), Greater Manchester South West (UKD34) and Greater Manchester South East (UKD35). Out of the five European countries that I analyze, the only one that that experienced changes to some of the boundaries of its NUTS-3 areas from the definitions of 2010 to those of 2013, is Germany. All affected areas correspond to the state of Mecklenburg-Vorpommern, which is a formerly East Germany state (i.e. part of the former Democratic Republic of Germany). The new NUTS-3 regions have the following codes: DE803, DE804, DE80J, DE80N, DE80K, DE80L, DE80M, DE80O. To approximate existing FUAs to these new regions, instead of using the excel file from Eurostat mapping 2010 NUTS-3 areas to FUAs, I use an interactive map from Eurostat tracing 2013 NUTS-3 areas to FUAs³⁹. Note, however, that in the benchmark series

37. See link to excel file "Regional typologies and local information corresponding to NUTS 3" in the following address: <http://ec.europa.eu/eurostat/web/nuts/background>

38. Since the 2013 edition, there exist a new one: the 2016. However, as ERD data follow the 2013 boundaries, I do not use the latest one.

39. <http://ec.europa.eu/eurostat/statistical-atlas/gis/viewer/?ch=TRC&mids=BKGCNT,NUTS-2013-3->

of economic concentration in Germany I exclude former East Germany's states, in order to have a consistent series over the whole 1980-2014 period. Therefore, I do not use data from the state of Mecklenburg-Vorpommern in my benchmark analysis.

In some cases, I face a last challenge: some NUTS-3 regions may include more than one FUA. For example, the NUTS-3 area of Morbihan in France includes two FUAs within its limits: Loirent and Vannes. In these cases, I attach the whole NUTS-3 area to a single FUA, choosing the largest FUA, which in the case of Morbihan is Loirent. Therefore, I am assuming that there is a single FUA, represented by the NUTS-3 area, instead of two separate ones (this is the same that Eurostat does for when dealing with the same issue in the Metropolitan Region definition).

Overall, I consider that this approximation of urban areas offers a satisfactory level of accuracy for the purpose of the present paper: measuring the relative concentration of economic activity across the territory. This approximation is not perfect yet, but it overcomes some of the limits of an abundant literature in Europe analyzing inequality trends both within and across European countries using NUTS areas as their unit of observation (i.e. [Ciccone \(2002\)](#); [Combes, Lafourcade, Thisse, and Toutain \(2011\)](#); [Rosés and Wolf \(2018\)](#); [Desmet and Rossi-Hansberg \(2009\)](#); [Tabellini \(2010\)](#), to cite just a few).

A final note is needed. In the case of France, I exclude the overseas regions, as they follow very different economic trends relative to those of metropolitan France. The same applies to the autonomous cities of Ceuta and Melilla in the case of Spain.

C.2 Japan

In Japan, there are 47 prefectures for which I count with data on population and gross value added by sector of activity. I combine prefectures to 14 urban areas, following the definitions of Major Metropolitan Area and Metropolitan Area from Statistics Bureau of Japan⁴⁰ (based on the 2015 Population census).

40. <https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00200521&tstat=000001080615&cycle=0&tclass1=000001110216&second=1&second2=1&>

C.3 USA

Data from the USA, both for population and economic activity, are obtained at the level of Metropolitan Statistical Area (MSA). These are already-defined urban areas (based on an economic criteria and not on existing administrative boundaries) from the Bureau of Economic Analysis, so no further adjustment of these definitions is needed. There are 382 MSAs in the USA.

D National housing wealth decomposition: land vs structure

The total value of a single house can be decomposed into two components: the value of the structure and the value of land underlying the building. At the country level, this same decomposition applies. According to the System of National Accounts of 2008, national balance sheets should incorporate this decomposition, and most advanced economies have recently started to do so. There are a range of methodological guidelines on how to measure the value of the structure and that of underlying land ([OECD and Eurostat \(2015\)](#)). The problem is that there are limited sources of information on the exact value of the two. This is because sales and acquisitions of dwellings are generally made for the combination of the two components, and do not differentiate between them. And given that most housing price statistics are based on housing transactions, statisticians generally face a limitation to measuring these two components of the market value of a dwelling. Hence, in most countries, statistical institutes follow an indirect procedure to carry this valuation: the residual approach ([\(OECD and Eurostat, 2015, pgs. 78-80\)](#)). This method starts from the total value of national housing and detracts an estimate of the value of the structure. The residual between the two is supposed to capture the value of land underlying dwellings.

Generally, the value of the structure is obtained by using the Perpetual Inventory Method. This method consists in accumulating flows of residential investment, to which a depreciation pattern is applied to reflect the deterioration and maintenance of existing dwellings. To value the accumulated flow of investment in a given year, construction-costs prices are used, so as

to capture the value of the structure excluding the value of the underlying land.

Data in figures 2.7 and 2.8 of the paper present the decomposition of total national housing-to-national income ratios into a land and a structure component, for seven countries: France, Germany, Japan, Italy, Spain, UK and USA. In all countries but Germany, this decomposition into land and structure follows the residual approach. In Germany, however, Destatis (the Federal Statistical Office of Germany) computes the value of land underlying dwellings by using direct observations on land prices for already-built land. Data for all countries except UK and Italy are directly taken from the World Inequality Database. Details on the raw sources and calculations for this set of countries are explained in Bauluz (2017) except for Spain, which is explained in Artola Blanco, Bauluz, and Martinez-Toledano (2018). Data for the UK has been kindly shared by James Gleeson⁴¹. Total national housing in Gleeson is taken from ONS balance sheets (Blue Book accounts). This is the same source used in the World Inequality Database to calculate national housing. Hence, the total values of the two series are almost equal. The decomposition into a land and a structure component has been carried by James Gleeson using the residual approach.

Finally, data on Italy are my own calculations following the residual approach too. The value of national housing is taken from the World Inequality Database (Bauluz (2017)). The value of the structure is calculated using the Perpetual Inventory Method with the same geometric depreciation profile than the one used by Artola Blanco, Bauluz, and Martinez-Toledano (2018) to estimate Spain's dwellings stock. Housing investment flows and deflators for the period 1860-2011 are taken from Baffigi (2011). I estimate the stock of dwelling since 1860 by accumulating residential investment, applying the geometric depreciation profile and deflating series with the construction cost deflator in Baffigi (2011). As explained in Prados de la Escosura and Rosés (2010) and Artola Blanco, Bauluz, and Martinez-Toledano (2018), the choice of an initial value for the dwellings stock well before the series are shown (i.e. 40 years before) makes the specific value given in the initial year irrelevant (because most of it would have been already depreciated after 40 years). Given that I compute the capital series

41. These data are shown in James Gleeson's blog: <https://jamesjgleeson.wordpress.com/2017/04/03/historical-housing-and-land-values-in-the-uk/>

for dwellings since 1860, but I only show its values since 1970, the choice of an initial value on 1860 has no incidence in the series used in the paper.

By 2012, national housing in Italy was worth 4.61 times the national income. Dwellings (the value of the structure), calculated with the PIM, is equal to 1.93 times national income. Hence, the residual equals 2.67 national income (4.61 minus 1.93). Residential investment data in [Baffigi \(2011\)](#) end in 2011, but total national housing series cover up to 2015. Hence, I decide to use an assumption for the value of dwellings over the period 2012-2015, so I can extend the series. Concretely, I assume that dwellings kept equal to its 2011 value (1.93 national income). Hence, the decreasing value of total national housing over this period, from 4.61 to 4.39 times the national income is assumed to be a land valuation effect. This trend is consistent with the experience of other countries during this same period, where national housing reduced its value mostly because of its land component. Nonetheless, in future versions of the paper I will update the housing investment data and the dwellings stock series calculated with the PIM so no assumption is made on the most recent years.

E Cross-country fixed-effects regressions

Cross-country fixed effects regressions in section 2.1 use as dependent variable the private value of housing as percentage of net national income. As regressor of interest, they use the HHI of gross value added and population. Both data sources have been explained above. As controls, I use the regressors in [Monnet and Wolf \(2017\)](#) together with an index of urbanization.

Urbanization index

Urbanization data are taken from United Nations, World Urbanization Prospects 2018. I use the variable: Annual Percentage of Population at Mid-Year Residing in Urban Areas⁴². Given that data are as of mid-year, I compute end-of year values by taking the average of year $t + 1$ with year t . Given that urbanization rates may have been calculated with different

42. <https://esa.un.org/unpd/wup/DataQuery/>

definitions of urban-areas size in each country, I normalize all countries to take value 1 in 2014, similarly to what I do with the concentration indexes.

Population group aged 20-49

Data on population by country and age group are taken from United Nations, World Population Prospects 2017. I use the variable: Annual Population by Age Groups – Both Sexes. These are annual population estimates by Five-Year Age Groups. Population estimates are as of 1st July of the year indicated, classified by five-year age groups (0-4, 5-9, 10-14, ..., 95-99, 100+). Data are presented in thousands. I calculate data as of end of year t by taking the average of year $t + 1$ and year t . I then add together all five-year groups between 20 years and 49 years (20-24, 25-29, 30-34, 35-39, 40-44 and 45-49).

Real personal disposable income per capita (working-age population)

Data are taken from the Federal Reserve Bank of Dallas. These were constructed by [Mack and Martínez-García \(2011\)](#) and are normalized in all countries to have value 100 in 2005. Data are quarterly values. Given that the panel frequency used in the regressions of the present paper has annual frequency, I compute annual figures of personal disposable income using the arithmetic average of all four quarters in year t .

Real credit per adult

I use annual credit to the sector 'households and non-profit institutions serving households' from the World Inequality Database (WID.world). Concretely, I use the WID.world's variable: private debt, within Net private wealth. These data are mid-year values. I then calculate end-of-year values by taking the arithmetic average of year $t + 1$ and year t . To calculate credit series in real terms, I deflate these series with the OECD Consumer Price Index. I normalize all countries to take value of 100 in 2010. Finally, I put series in per adult values. To do this, I download data on the number of adults per country and year from the World Inequality Database and divide countries' real credit series by the number of adults. Data for Germany up to 1990 correspond to West Germany; from 1991 onwards to reunified Germany (similarly

to what happens with Germany's national income and national housing wealth series).

Unemployment rates

I use data from AMECO database, which is the annual macroeconomic database of the European Commission. I use variable unemployment rates as percentage of the active population. In the case of Germany, up to 1990 I use series for West Germany. From 1991 onwards, series for "Germany" (which is reunified Germany).

Real long-term interest rates

Nominal annual long-term interest rates for the period 1980-2013 are taken from the Jorda-Schularick-Taylor Macrohistory Database⁴³. Then, I extend these data for the year 2014, using the growth rates in variable "long-term interest rate on government bonds" from OECD Economic Outlook No 102, November 2017⁴⁴. To calculate the real long-term interest rate (r), I follow Monnet and Wolf (2017) and use the Fisher equation: $1 + r = \frac{(1+i)}{1+\pi}$, where i is the nominal interest rate and π is the inflation rate (inflation rate is calculated from OECD's Consumer Price Index).

F Local house prices in England and Wales

In what follows I explain the construction of the house price series at the urban area level in England and Wales used in section 2.3 of the paper. Population and value added data at the urban area level have been explained in previous parts of this appendix.

My source of house prices data is the UK House Price Index (UK HPI)⁴⁵. These are local house price indexes available since 1995 for England and Wales and since 2004 for Northern Ireland and Scotland. The organization in charge of producing this index is the Office for National Statistics (ONS). The primary source of house price data used by ONS is the Price Paid Data from HM Land Registry. This registry captures the whole universe of housing

43. <http://www.macrophistory.net/data/>

44. I extend the extra year with the growth rates, and not plugging directly the OECD's data, because levels in the two series (JST / OECD) may not perfectly match.

45. A detailed explanation of the UK House Price Index can be found in the following link: <https://www.gov.uk/government/publications/about-the-uk-house-price-index/about-the-uk-house-price-index>

transaction in England and Wales (E&W) and is publicly available online⁴⁶. Given the goal of the present paper in having the longest series possible, I focus on data for E&W only – note that E&W represent between 87-90% of total UK's population and GVA.

The UK HPI calculates geometric mean house prices at different regional levels, all levels following the official regional division of E&W⁴⁷. However, NUTS-3 regions are not part of the interior administrative division of E&W (NUTS-3 are regional units used by Eurostat). However, they are perfect combinations of E&W's districts. Given that the UK HPI has data at the district level, I use these data and map them to NUTS-3 regions. I use the 2013 definitions of NUTS-3 areas (these are the same definitions followed by gross value added and population data from the ERD database). To do this mapping, I use ONS data linking district levels to local authority units to NUTS-3 areas⁴⁸. These latter data correspond to the 2016 definitions of NUTS-3 areas (and not to the 2013 that I use). However, there were no changes in the definition of NUTS-3 areas in E&W between the 2013 classification and that of 2016.

The next step involves weighting the district-level mean house prices from the UK HPI to the NUTS-3 areas. And from NUTS-3 areas to urban areas (which are combination of NUTS-3 regions). I follow the same weighting scheme used by the UK HPI. This consists in using the number of transactions of the lower-levels units from the year before (in my case the number of transactions per district). As NUTS-3 areas are the combination of districts, I calculate the number of housing transactions per district and year. To do this, I use the HM Land Registry Price Paid Data, which has the whole universe of housing transactions in E&W since 1995, as explained above. In particular, the HM Land Registry Data has postcodes identifier that I can match to the district level. Given that transaction data do not exist before the first year of the sample (1995), for this initial year I use the transactions of 1995 and not of the year before.

46. <https://www.gov.uk/government/collections/price-paid-data>

47. As explained by the ONS in their explanation to the HPI (see link above): "the geometric mean reduces the weighting given to high value properties when compared to the arithmetic mean and is typically lower, usually closer to that of the median".

48. http://geoportal.statistics.gov.uk/datasets/e1e5de6c5fcc40c78adb03d84a2d299d_0

Chapter 3

Revised national income and wealth series: Australia, Canada, France, Germany, Italy, Japan, UK and USA¹

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Abstract

This paper presents updated series of national wealth and capital shares of income for the eight countries covered by [Piketty and Zucman \(2014a\)](#): Australia, Canada, France, Germany, Italy, Japan, the UK and the USA. It discusses the adaptation of the series from the SNA93 to the SNA2008, the inclusion of natural capital (i.e. forestry land, mineral and energy resources) within the concept of national wealth and the division of national housing across households and other sectors. I find that adopting the SNA2008 has no relevant consequences for aggregate macro wealth or for the net-of-depreciation capital share. However, gross-of-depreciation capital shares are higher, likely due to the inclusion of R&D as investment in the new system of accounts. Overall, new series reveal that average private wealth to national income ratios have been steadily increasing in recent years with capital-labor shares remaining relatively constant at their 2010 values.

JEL codes: E01, E3, N5

Keywords: Wealth-income ratios; Capital-labor shares; National accounts; Housing; Natural capital.

Introduction

[Piketty and Zucman \(2014a\)](#) (PZ from now on) presented macro series of national wealth and national income for 8 rich countries (Australia, Canada, France, Germany, Italy, Japan, UK and USA) covering the period 1970-2010. For four of these countries (France, Germany, UK and USA), they were able to cover a much longer time-span, going back to the 19th century or before. These series were supplemented by a methodological appendix ([Piketty and Zucman \(2014b\)](#)), which provides detailed information on the sources and methods followed to construct these data. In this paper, I revise and extend PZ's series in light of the most recent available data and the latest accounting standards².

For the period 1970-2010, PZ's data are largely based on official national accounts. Before 1970, their evidence relies mostly on the work of economic historians and on contemporaneous authors that reconstructed the wealth and income accounts of these countries. At the time of writing their paper, PZ used official national accounts that followed the 1993 System of National Accounts (SNA93)³. Since then, all countries have adapted their balance sheets and income series to the new system of accounts: the 2008 System of National Accounts (SNA2008). Although the main concepts and valuation methods of the SNA93 are still present in the SNA2008, some changes are worth noting and will be discussed in this paper (in particular, the inclusion of Research and Development as an investment good, therefore being part of capital investment and capitalized as a fixed asset).

In addition, since the writing of their paper, the World Inequality Database (WID.world) has evolved to produce a unified framework to compute both macro wealth and income accounts across countries. This framework follows the international accounting guidelines set by the SNA2008 and presents two main difference relative to PZ⁴. Firstly, it includes natural

2. The only exception to these updates are the national income accounts of Canada. Statistics Canada has undergone a deep revision of Canada's national income accounts that requires careful understanding. Hence, national income accounts for this country will be provided in the future, but not in the updates presented in this paper.

3. Australia, by contrast with other countries, had already adapted SNA2008 when Piketty and Zucman wrote their paper.

4. The detailed methods and concepts used at WID.world are explained in the DINA guidelines written by [Alvaredo, Atkinson, Chancel, Piketty, Saez, and Zucman \(2016\)](#).

capital (i.e. forestry land, mineral and energy resources) within the non-financial assets of the different institutional sectors. Secondly, it specifically accounts for housing assets owned by corporations and the government (in PZ housing owned by non-private sectors were included within broader categories of assets - i.e. within total public or corporate non-financial assets).

In this paper, I explain the updated series of these 8 countries, whose data now cover up to years 2015-2017, depending on the country. In section 3.1, I explain the conceptual changes between SNA93 and SNA2008 together with the treatment of natural capital and national housing at WID.world. In section 3.2, I compare the values taken by the new series relative to the old ones, pointing out the main reasons for the observed differences. Finally, in section 3.3, I explain the general procedure followed to splice the updated series with the historical data, including country specific notes on the reconstruction of the series. Specific attention is paid to explaining the following two wealth components: housing and natural capital.

3.1 Conceptual differences between old and new series at WID.world: R&D, natural capital and national housing

3.1.1 Research and development

The international guidelines to produce national accounts were last revised in 2008 (SNA2008), replacing the previous vintage of 1993 (SNA93). The new updated income and wealth macro series for the 8 countries in PZ follow in their totality the SNA2008, whereas in PZ all data but the Australian were based in the SNA93. The structure and classification of financial assets "were virtually unchanged in the new system" ((Alvaredo, Atkinson, Chancel, Piketty, Saez, and Zucman, 2016, pg. 42)) but some changes are worth mentioning in the case of non-financial assets and capital income. In particular, three categories that were previously considered as intermediate consumption are now recognised as capital formation (investment)

and, hence, capitalised as fixed assets⁵:

1. **Research and development (AN.1171)**: Before viewed as expenditure in intermediate non-durable goods, now is part of investment in intangible assets. In France, for example, in 2015 research and development (R&D) represents 2.9% of the stock of produced assets (AN.1).
2. **Databases**: They are part of the new category 'Software and databases' (AN.1173). Before SNA2008, only expenditure on software, and not on databases, was considered as investment. In France, for the year 2015, this category represents 1.8% of total produced assets, with databases representing around 20% of this category.
3. **Weapons systems (AN.114)**: In SNA93, only the acquisition of military structures and equipment that were considered to have a civilian purpose were recorded as capital formation. In SNA2008, military weapons and supporting system with no civilian purpose are considered as capital assets. In France, AN.114 represents 0.4% of produced assets in 2015.

Conceptually, the recognition of the previous three categories as capital goods (and, especially, of R&D) should raise the value of the stock of non-financial assets in the new series. However, the magnitude is relatively small. Taking the example of France in 2015, the inclusion of these assets would represent around 3.5% of total produced assets or 2% of total non-financial assets (the sum of produced and non-produced assets). Of course, the inclusion of these assets would impact differently some institutional sectors, being more intense for corporations and the government and less so for households.

By contrast, the impact on the national income series is more substantial because this inclusion has had a sizeable effect on the total value of GDP, by raising Gross Fixed Capital Formation. [Koh, Santaèulàlia-Llopis, and Zheng \(2018\)](#) provide values for the share of R&D investment in total US investment since the 1950s showing that its importance has increased considerably over time: from values around 10% of total investment in 1950 to values close

5. A detailed analysis of the changes between SNA93 and SNA2008 can be found in [Eurostat \(2014\)](#)'s manual.

25% in recent years⁶. This rise is also present in other rich economies ([European Commission \(2009\)](#)).

Once R&D is included as investment, this also affects the decomposition of output into capital and labor components. In particular, [Koh, Santaaulàlia-Llopis, and Zheng \(2018\)](#) estimate that almost all the observed decline in the labor share of the US since the 1950s is the result of including R&D within investment ([\(Koh, Santaaulàlia-Llopis, and Zheng, 2018, figure 1\)](#)). Yet their paper focuses on the gross capital-labor shares (which include capital depreciation within capital income) and not on the net-of-depreciation capital-labor shares. While understanding the impact of including R&D within gross capital-labor shares is important in itself, from a welfare perspective using net-of-depreciation shares is more meaningful. In sections 3 and 4 I present evidence showing that the impact on the net-of-depreciation capital-labor shares is almost negligible. This is because R&D types of assets present very high depreciation rates (around 20% in recent years in the US) when compared to traditional fixed capital assets such as buildings and infrastructures (with rates around 4%). Indeed, the increase in gross investment observed in the new series is offset by similar increases in the value of depreciation. As a consequence, net capital-labor shares are almost identical before and after adapting to the SNA2008 (i.e. in PZ's series and in the new updates).

3.1.2 Natural capital

There are three big categories of natural resources according to the SNA: Land underlying buildings and structures (AN.2111), Land under cultivation (AN.2112) and Mineral and energy reserves (AN.212)⁷. Furthermore, Land under cultivation may be split into Agricultural

6. In their paper, [Koh, Santaaulàlia-Llopis, and Zheng \(2018\)](#) discuss the evolution of Intellectual Property Products, which includes R&D, software and artistic originals. In the USA, software was first included within investment in the 1999 BEA revision of national accounts, while R&D and artistic originals were included in the BEA revision of 2013 (which adapted the US national accounts to the SNA 2008). [Koh, Santaaulàlia-Llopis, and Zheng \(2018\)](#) show that close to 80% of IPP is R&D, with software and artistic originals, hence, accounting for a small fraction.

7. There exist other types of natural resources in the SNA (i.e. recreational land and associated surface water, other land and associated surface water, etc.) but their magnitude is relatively small within the very few countries that actually report their value. For example, in Germany, they represent 11.6 million of euros in 2011 or 0.4% of total national land ([\(Brede and Schmalwasser, 2015, table 1\)](#)).

land (AN.21121) and Forestry land (AN.21122). The sum of forestry land and mineral and energy resources is what is known as Natural capital in the DINA guidelines and which are implemented in the WID.world database ([Alvaredo, Atkinson, Chancel, Piketty, Saez, and Zucman \(2016\)](#)). Out of these categories, PZ included Land underlying buildings and structures and Agricultural land in their estimates of national wealth but accounted for natural capital as a memo item, excluded from their benchmark series of national wealth. Two important reasons to do so were the complexity to measure natural capital and the fact that only 4 out of the 8 countries in the sample reported estimates of these assets. However, WID.world intends to progressively account for them, in particular, due to the important role that these assets play in some developing countries. Hence, in the updated series of wealth, natural capital is included in the 4 countries that report their value: Australia, Canada, France and Japan (see table [3.1](#)).

The inclusion of natural capital for some countries but not for others may generate a comparability problem if natural capital is a significant part of wealth in those countries not reporting their value⁸. For the 4 countries that do not report their value, I can check an alternative source on natural capital to evaluate the importance from this omission. According to the latest [UNU-IHDP and UNEP \(2014\)](#)'s Inclusive Wealth Report, the market value of non-renewable resources (which correspond to mineral and energy resources) are almost negligible in Italy and the UK. Only in Germany and the USA they take a significant value. For 2010, the latest year for which the UNU-IHDP reports estimates, I can compare the value of these same assets in Canada and Australia (the two countries where official accounts report a sizeable value for natural capital) with the estimates of this report⁹. In both cases, estimates from the official national accounts represent around one third of those in the report. Applying this same proportion to the values of Germany and USA in the UNU-IHDP report, I would get a value of mineral and energy resources equivalent to 16% and 10% of national income, respectively (table [3.1](#), column 3). Although not negligible, these values are far from

8. Note, however, that the value of these assets is indeed captured in all countries within the market value of equity of those sectors exploiting these assets.

9. In 2010, mineral and energy resources represent 99% and 88% of total natural capital in Australia and Canada, respectively.

being problematic, given that national wealth in this year was equal to 411% of national income in Germany and 416% in the USA. Overall, the measurement of natural capital is a complex area that requires further attention by both academics and official statisticians. In WID.world, we expect to progressively extend these estimates in future updates of the database.

3.1.3 National housing

In PZ, housing wealth data referred to dwellings owned by the private sector: households and non-profit institutions. While private housing represents the vast majority of the national housing stock, corporations and the government do also hold positions on housing. These positions were not absent in PZ's series, but were included in broader categories of assets of the corporate and public sectors (i.e. within total non-financial assets). Given the important role of housing in national wealth, in this paper I present the first estimates of national housing, by including series of public and corporate housing in addition to those of the private sector.

Overall, the role of corporations and the government in housing markets is limited but varies across countries and over time: from maximum values of 20% of total national housing in Germany and France, to minimum values of 3% in the USA. In addition, a trend is observed for a progressive decrease in the involvement of non-private sectors in national housing, in line with the privatization of publicly-fostered dwellings in some countries ([Whitehead and Scanlon \(2007\)](#)). In the country specific notes of this paper, I discuss how I estimate housing wealth for non-private sectors. It is fair to recognize that the measurement of corporations and public housing is generally of lower quality than the measurement of the private sector. More progress could be done in this area in the future.

3.2 New results: comparing the old and the new series

In this section, I compare the main results of the updated income and wealth macro series with the equivalent values in PZ. I present the analysis decomposed into two subsections: one for macro wealth; another for capital-labor shares. In both cases, I take the average value of key indicators in the available countries (8 countries in the case of wealth; 7 countries in the case of income, given that updated series for Canada are not provided in this paper) and compare values in PZ with the latest updates. In all cases, the average values of these indicators correspond to an unweighted arithmetic average.

Before commenting on the results, a note of caution is needed. In the previous section, I examined the main conceptual difference between the estimates in PZ and these updates. However, differences between the new and the old series respond to numerous factors that are not only conceptual. In particular, national statisticians revise periodically their historical series: they use new data sources (i.e. on the price of assets), they change the parameters of their models (i.e. modifying the depreciation structure of assets when applying the Perpetual inventory method) or they account for new assets (i.e. new types of natural resources), to name just a few common adjustments. Hence, differences between the new and the old series cannot be uniquely explained by adopting the SNA2008 or by the inclusion of natural capital within non-financial assets.

3.2.1 Macro wealth

Figures 3.1, 3.2, 3.3 and 3.4 compare the values in PZ and in the updated series between 1970 and 2015 in four key indicators: (1) private wealth-national income ratio, (2) public wealth-national income ratio, (3) national wealth-national income ratio and (4) Tobin's 'equity' Q (the latter is compared for the period 1990-2015, when data for all countries except Italy are available). In all cases, the evolution of the new series is very close to the old ones, with some small differences. Overall, the new series tend to converge with the old ones in the initial years (around 1970) and to diverge in the ending years (around 2010).

By 2010, the updated series of private wealth (figure 3.1) are higher than the old series in the equivalent of 18% of national income: the updated series equal 526% of national income vs 508% in PZ. For public wealth (figure 3.2), new series are higher than the old series in 2010 too, in the equivalent of 12% of national income: public wealth represents 21% of national income in the new series vs 9% in the old ones. Consequently, market-value national wealth (the sum of private and public net worth) is higher in the new series, in the equivalent of 30% of national income (figure 3.3): 547% of national income vs 517%. Regarding Tobin's 'equity' Q (figure 3.4), values are displayed for the period 1990-2015, years for which data are available in 7 of the 8 countries¹⁰. A ratio below one means that the market value of corporations is lower than their book value or, equivalently, that book-value national wealth is higher than the market value. Over this period, both series of Tobin's Q move together, with the updated series being slightly closer to unity than the old ones, meaning that market and book value measures are slightly closer in the new update.

3.2.2 National income: capital-labor shares

In this subsection I compare the capital-labor decomposition of national income in the updated series relative to those in PZ for the period 1970-2016 using four indicators: net capital share (figure 3.5), gross capital share (figure 3.6), gross capital formation (figure 3.7) and net capital formation (figure 3.8). I use the definition of capital income that excludes interests paid by the government but includes foreign capital income, as a percentage of factor-price national income (i.e. excluding product taxes from national income)¹¹. Three words of clarification are needed before proceeding with the analysis. First, as commented previously, in this paper I present updates of capital-labor shares for all countries in PZ except for Canada. Second, out of these seven countries, Australia had already adopted the SNA

10. Italy is not included in the average Tobin's 'equity' Q values because corporate wealth series are only available for the period 2006-2015.

11. In addition to this definition, PZ use an alternative definition of capital income where they include interests paid by the government. At WID.world, the two series will be available but I stick to the first definition in this paper as it makes more comparable the different country series (though there are reasons to include some return to government assets, as the second definition does – see (Piketty and Zucman, 2014b, pg. 43)).

2008 by the time when PZ wrote their paper. Hence, to understand the role of adopting this new system of accounts, it is important to exclude Australia from the analysis. Third, the UK has experienced a very significant revision of the gross operating surplus of the housing sector in the most recent updates (see country-specific notes in section 3.3) which is not related to adopting SNA2008 but to using better and more detailed historical data on housing rents. This revision implies much higher values for households' capital income relative to those in PZ. Thus, in figure 3.9, figure 3.10, figure 3.11 and figure 3.12 I present the equivalent results to figures 3.5 to 3.8 but excluding Australia and the UK from the analysis.

Overall, the analysis of these figures shows the following two simple facts: i) the updated net capital shares (figures 3.5 and 3.9) are almost equivalent to those in PZ, ii) gross capital shares are substantially higher in the new updates (figures 3.6 and 3.10), with the difference between the new and the old series rising over time (e.g. being smaller in 1970 than in 2016). The second fact (higher gross capital shares in the updated series) is consistent with the findings of Koh, Santaeulàlia-Llopis, and Zheng (2018) for the case of the US: when gross capital formation includes R&D, this increases both gross capital formation and gross capital shares.

Figures 3.7 and 3.11 show, indeed, the rising value of gross capital formation in the updated series when compared with the old ones (around 2-3 percentage points of national income). Yet, net capital formation (figures 3.8 and 3.12) is almost identical in the new and the old series. This suggests that the similar values in the net capital shares obtained in the new series relative to the old ones is due to depreciation rising in similar proportion to gross investment.

3.3 Splicing procedure and country specific notes

Official national accounts (both for income and wealth) are periodically revised but, frequently, the new versions do not cover the whole period for which official statistics have existed. For example, in Canada, the latest official update of the national wealth accounts covers the period 1990-2016 but not the period 1970-1989, for which data had existed in

previous editions. As a rule, I use the most recent official accounts and then reconstruct the historical series following the proportional evolution of the corresponding series in PZ. Regarding the specific concepts, sources and adjustments made to the data, in all cases I follow the work of PZ, which is explained in the appendix to their paper (Piketty and Zucman (2014b)) and in the corresponding country-specific excel files¹². When an alternative procedure is followed, I point to it in this document.

In the next country-specific notes, I comment on the official statistics used in this update and the procedure to splice the new data with older series. Within every country, I explain separately the estimate of wealth and income. Within wealth, I comment in a different subsection the splicing of the private, public and corporate sectors. Three additional sub-sections cover the estimation of national housing (the sum of private, corporate and public housing), national agricultural land and natural capital.

3.3.1 Australia

3.3.1.1 Overview

Data for Australia in PZ covered the period 1960-2011. I have extended the series to 2016 (wealth) and 2017 (income) and revised the existing series for the period 1960-2011.

3.3.1.2 Explanation: wealth

The official balance sheets used by PZ already followed the SNA2008 and ended in 2011. In this update, I use the latest national accounts from the Australian Bureau of Statistics¹³, that cover the period 1990-2016, and splice these series with those of PZ for the preceding years. An important novelty with respect to PZ is the inclusion of natural capital in the new series. In addition, I estimate the total stock of national housing for the years 1960-1990.

Private wealth (figure 3.13): The private sector in Australia is not decomposed into households and NPISH: official statistics group together the two sectors into what is called the

12. <http://piketty.pse.ens.fr/en/capitalisback>

13. <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02015-16?OpenDocument>

private sector in WID.world database. By 1990, the new series of private wealth are slightly higher than those in PZ: 402% of national income in the new series and 391% in the old ones. This is the result of higher financial wealth (financial assets net of liabilities). I extend the series of non-financial assets, financial assets and liabilities taking the first observation in the new series (1990) and using the growth rates in the equivalent series of PZ, up to 1978. Before 1978, only data on non-financial assets and net wealth are available and I follow the same procedure to extend backwards net wealth and non-financial assets. By 1970, the updated series of net private wealth are slightly higher than the old ones: 340% of national income vs 332% in PZ.

Public wealth (figure 3.14): By 1990, the updated series including natural capital are slightly lower than the equivalent series in PZ (including natural capital too): 103% of national income vs 108%. Before 1990, Piketty and Zucman (2014) do not separate financial wealth into financial assets and liabilities. Instead, they provide data for net financial wealth. Given that by 1990, the new series of financial assets and liabilities are almost equal to the old ones, I extend net financial wealth to 1960 using Piketty and Zucman without modification. For non-financial assets, I extend backwards the new series using the growth rates in PZ. By 1970, the updated series are slightly lower than the old ones: 80% of national income vs 84%.

Corporate wealth (figure 3.15): Corporate balance sheet is available since 1990 in PZ. This is the same year for which the corporate balance sheet is available in national accounts. Hence, I replace the existing series from PZ with the new data, which cover the period 1990-2016. The new Tobin's Q is higher than in PZ. This is mainly the result of the market-value of equity liabilities, which is significantly higher in the new series.

Housing (figure 3.16): In the updated series, I reconstruct national housing, which is the sum of housing owned by the private, corporate and public sectors. For the years 1990-2016, data are directly taken from the official balance sheets¹⁴. Before 1990, PZ provide series of

14. The Australian Bureau of Statistics reports the value of housing structures (dwellings, AN.111) but does not decompose land into different uses (i.e. land underlying dwellings, land underlying non-residential structures, agricultural land, etc.). However, for the private sector, the total value of housing (dwellings plus land underlying) is reported in the Reserve Bank of Australia's balance sheets accounts (<http://www.rba.gov.au/statistics/tables/>), which are fully consistent with ABS's ((Piketty and Zucman, 2014b, pg.139)). Then, for the private sector, the value of land underlying dwellings is obtained as a residual from total housing

housing owned by the private sector (starting on 1960), but not by corporations and the government. To extend private housing, I use the first observation in the new national accounts (year 1990), and extend it backwards using the growth rates in PZ. Given that both series have a similar value in 1990 (231% of national income in the updated series vs 229% in the old ones), they have an almost identical value in the preceding years too. For corporations and the government, I make an assumption. I observe that corporate housing and government housing represent a relatively constant fraction of the value of the domestic stock of over the 1990-2016 period: 5% and 1% respectively. I then assume that this proportion was also constant for the period 1960-1989. Of course, this is approximative and if better data become available, we will correct their value.

Natural capital (figure 3.17): Official series of natural capital, both at the national and institutional sector level, are available for the period 1990-2016. Within natural capital, mineral and energy resource are the vast majority (around 99% of the total), the remaining being timber and spectrum assets. Before 1990, I extend their value using the growth rates in PZ. Natural capital in Australia is almost exclusively owned by the government (around 99.8% of the total stock) and has experienced a dramatic rise since the 2000s. The updated series are very close to the old series during the last years of the sample (2008-2011), but they are significantly lower in the preceding years.

Agricultural land: The ABS national accounts do not differentiate agricultural land from other types of land. Hence, we do not account separately for agricultural land in WID.world series.

3.3.1.3 Explanation: income

The update of the income accounts is simple. I take the new national income accounts from the Australian Bureau of Statistics (which cover the period 1960-2017) and replace the old values with the new ones¹⁵. Figures 3.18, 3.19, 3.20 and 3.21 compare the updated series

in RBA minus dwellings in ABS. For corporations and the government, the same ratio land-dwellings is assumed to obtain the total value of housing.

15. Data can be found in the following link: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02016-17?OpenDocument>

with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure 3.22 compares the difference in nominal value of the series of gross capital formation and consumption of fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). Overall new and old series in Australia are almost identical.

3.3.2 Canada

3.3.2.1 Overview

Data for Canada in PZ covered the period 1970-2011. I have extended the wealth macro series to 2016 and revised the existing series for the period 1970-2011. In this paper I do not updated the national income series (except the main aggregates: GDP, national income, etc.) given that Statistics Canada has carried a deep revision of their national income accounts. These accounts will be included at WID.world in the next months and will be supported by a technical note describing the reorganization of the income accounts in Canada.

3.3.2.2 Explanation: wealth

PZ used the National Balance Sheets statistics from Statistics Canada (Statcan), which covered the period 1970-2011 and followed the SNA93. Since then, Statcan has revised these accounts to match the SNA2008, and now cover the period 1990-2016. One important novelty of the new series is to allocate natural capital across the different institutional sectors (before, natural capital was a satellite variable in the national balance sheet of Canada, but was excluded from the sector accounts). In this update, I replace the series of PZ with the new accounts from Statistics Canada and extend backwards the new series to 1970. I also introduce two adjustments. Firstly, I account for agricultural land at the sector level (in PZ, agricultural land was part of their measure of built-up land, so the latter is slightly overestimated: see 'agricultural land' below). Secondly, I estimate corporate and public housing, so I can compute

national housing (the sum of private, public and corporate housing). Some of the explanations for the differences between the new and the old series are based on the raw balance sheets used by PZ. The interested reader can find these data in PZ's directory for Canada¹⁶.

Personal wealth (figure 3.23): The national accounts used by PZ did not report data for non-profit institutions serving households. Instead, only data for "Persons, and incorporated business" (the equivalent to the households sector in the SNA2008) were available. In the updated national accounts, however, data are reported for both households and NPISH, separately. I use the new data of the personal sector (households) for the years 1990-2016, and extend this sector backwards to 1970 using the growth rates in PZ2014. By 1990, the updated series of personal wealth are slightly below the old ones: 292% of national income and 301%, respectively. In this update, agricultural land is differentiated within non-financial assets (before it was not).

Non-profit institutions: Net wealth of non-profit institutions is a small but growing proportion of national income: from 0.8% in 1990 to 6% in 2016. Given that these data were not reported in PZ, I cannot extend backwards these series using those of PZ214a. Hence, I assume that net worth of non-profit institutions was constant an equal to 0.8% of national income over the preceding years (1970-1989). The goal of doing this extension is to complete the private wealth series, which are the sum of the personal and the non-profit sectors, but not to provide precise estimates of NPISH over the 1970-1990 years. We advise not to use the data of NPISH separately from the private sector before 1990.

Public wealth (figure 3.24): Contrary to balance sheets employed by PZ, the updated national accounts for the government include natural capital within non-financial assets. Surprisingly, by 1991 net public wealth in the new series is below net wealth in PZ (−36% of national income and −28%, respectively), even though public natural capital equals 9% of national income in this year. This difference is largely explained by non-residential structures, which are worth 25% of national income in the updated series and 40% in the old ones. On the contrary, other types of non-financial assets, financial assets and liabilities have very

16. <http://piketty.pse.ens.fr/files/capitalisback/CountryData/Canada/>

similar values in the two sets of national accounts. To extend the updated series of public wealth backwards to 1970 I proceed as follows. For financial assets and liabilities, I follow the standard procedure (take the first observation in the new series and extend it backwards with the growth rates of the equivalents in PZ). For non-financial assets, I follow the same procedure but, in this case, I extend non-financial assets net of natural capital with the growth rates of total non-financial assets in PZ2014 (which do not include natural capital). To obtain total non-financial assets according to the new series' definition, in a second step I add public natural capital (see subsection "natural capital" below).

Corporate wealth (figure 3.25): Like in the case of the public sector, the latest national accounts incorporate natural capital within corporate non-financial assets, while the accounts used by PZ did not. Surprisingly too, by 1991 net corporate wealth (corporate book minus market value) is lower in the new series (58% of national income vs 64%), even with natural capital representing 17% of national income. Like the public sector, the main reason for this is the higher value of non-residential structures and machinery in the old series: 118% of national income in the old accounts and only 81% in the updated ones. This large difference is slightly compensated by higher net financial wealth in the updated series, in which the value of financial assets net of liabilities equals -107% of national income for -117% in the old series. To extend the new series, I follow the same procedure than in the public sector. Financial assets and liabilities are extended with the growth rates of the equivalent series in PZ. For non-financial assets, I extend corporate non-financial assets net of natural capital. Then, I add natural capital to obtain total non-financial assets as defined in the updated series.

Housing (figure 3.26): In the updated series I reconstruct national housing, which is the sum of housing owned by the private, corporate and public sectors. For the years 1990-2016, data for the three sectors are based on the latest official balance sheets. For every sector, I follow the same procedure than PZ for households: (1) decompose built-up land into 'land underlying dwellings' and 'land underlying other buildings and structures'; (2) add land underlying dwellings to dwellings to obtain total housing (land plus structure). Decomposing

land into types is necessary because the Canadian accounts do not decompose the variable 'land' into different uses. However, PZ treated the variable 'land' in the Canadian accounts as 'built-up land', when it also includes agricultural land. Hence, before splitting built-up land, firstly I subtract an estimated value for agricultural land. To calculate housing for the period 1970-1990, I follow the same system: subtract agricultural land, splice built-up land, add land underlying dwellings to dwellings. The data for this period are the sector balance sheets used by PZ, spliced with the new accounts with standard procedure: extending the first observation available in the new series (1991) with the growth rates in the equivalent data in the previous national accounts.

Natural capital (figure 3.27): In the national accounts used by PZ, natural capital (variable "natural resources" in the Canadian nomenclature, which include timber, mineral and energy resources) was not incorporated in the sector accounts, but only in the national balance sheet. Since then, Statcan has incorporated this variable into the non-financial assets of the institutional sectors¹⁷, with series available for the period 1990-2016. Even though natural resources are legally owned by the public sector, Statcan splits them between corporations and the government according to the flow of royalties and profits obtained from the exploitation of these resources (Kazi (2017)). To extend backwards natural resources I follow a twofold approach. Firstly, I extend the total value of natural resources back to 1967. To do so, I use the series of natural resources from Statcan's Natural Resource Asset Account¹⁸. These series are not completely updated, reason why they show some discrepancies with the new series, especially during the 2000s. Still, they are relatively closer to the updated series than those used by PZ. Secondly, I split the total value of natural capital between corporations and the government according to the proportion observed during the period 1990-2016: 25% of natural capital 'owned' by the government, 75% by corporations. This proportion has been relatively stable during the years 1990-2016 (corporations between 70-80% of the total, the

17. Technically, Statcan treats natural resources of institutional sectors as intangible non-financial assets which, at the national level, add up as tangible assets. For a deep discussion of the treatment of natural resources in Statcan, see the following link: <https://www.statcan.gc.ca/pub/13-605-x/2015009/article/14239-eng.htm>

18. <http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1530121&p2=33>

government between 20-30%) but, nonetheless, it should be taken as a rough approximation in the absence of specific data to carry this division.

Agricultural land (figure 3.28): As explained above, sector balance sheets accounts include a variable named 'land', which includes built-up land and agricultural land. Hence, a decomposition between the two types is necessary before splitting built-up land into underlying dwellings and underlying other buildings and constructions. I take the value of national agricultural land from the balance sheet of the agricultural sector¹⁹, which covers the period 1981-2016. Then, I extend the series backwards to 1970 using the growth rate in the equivalent series of PZ. However, these series are not decomposed across sectors. As a rough approximation, I consider that 65% is owned by households and 35% by corporations, in line with the values observed in other advanced countries (see, for example, figures 21 and 27 for France and Germany). Overall, the magnitude of agricultural land is relatively small (between 12% and 24% of national income over the period 1990-2016).

3.3.3 France

3.3.3.1 Overview

Official balance sheet data for France in PZ covered the period 1970-2010 while for income covered the period 1949-2010. In addition, they present annual series of national income, private, public and national wealth since 1870. I have extended the wealth series to 2015 and revised the previous period. For income series, I take directly those of [Garbinti, Goupille-Lebret, and Piketty \(2018\)](#).

3.3.3.2 Explanation: wealth

Current wealth macro data at WID.world comes from [Piketty and Zucman \(2014a\)](#). These data end in 2010 and follow SNA93. [Garbinti, Goupille-Lebret, and Piketty \(2017\)](#) ('GGP2017' from now on) updated these series up to 2014 using more recent data from INSEE, which

19. <http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0020020&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid=>

adopt the latest SNA2008 guidelines. In this update, I follow the latter paper and use the most recent data from INSEE, which covers the period 1978-2015. In this update, I separate natural capital from other natural resources (built-up land and agricultural land).

Private wealth (figure 3.29): Both the raw series used by PZ and the latest updates of the national accounts report data separately for the personal and the NPISH sectors. I reconstruct separately the evolution of the two sectors for the period 1970-2015, and add them to obtain the private sector. INSEE's accounts report data for non-financial assets for the period 1979-2015. For financial assets and liabilities, data cover the years 1996-2015. In both cases, I use the latest INSEE's data for the available years and extend it backwards to 1970 using the series of GGP2017. Given that the series used by GGP2017 coincide with the latest INSEE accounts in the earlier years (1980s-1990s) and only slightly differ in the last years, no splicing procedure is needed. For the period 1870-1969, I take the data directly from GGP2017, which present annual series of net private wealth not differentiated into different subcomponents²⁰.

Corporate wealth (figure 3.30): Data for the balance sheet of corporations in PZ were available for the period 1970-2010. In GGP2017, these are available for the period 1970-2014. I follow the same procedure than for the private sector during the period 1970-2015: use the latest national accounts covering non-financial assets for the period 1979-2015 and financial wealth for the period 1996-2015, and extend them backwards to 1970 using the data in GGP2017.

Public wealth (figure 3.31): For the period 1970-2015, I follow the same procedure as in the private and the corporate sector cases. For the period 1870-1969, I take the data on non-financial assets, financial assets and liabilities from PZ, without further modification (no splicing procedure is needed given that both the updated and the PZ series are equal by 1970).

Housing (figure 3.32): In the updated series, I reconstruct national housing, which is the

20. This is due to the estimation procedure in the original paper by PZ. Data on the balance sheet of households were only available for certain years throughout this period, which are then joint with accumulation equations of private savings and capital gains.

sum of housing owned by the private, corporate and public sectors. For the years 1979-2015, data for the three sectors are based on the latest official balance sheets from INSEE. As in other countries, INSEE reports data on the value of dwellings (AN.111) but does not separate the variable "Land underlying constructions and civil works" (AN.2111) into different types. I follow the approach of PZ for calculating private housing, and decompose AN.2111 in proportion to the corresponding fixed assets: Dwellings (AN.111), Non-residential buildings (AN.1121) and Civil works (AN.1122). For the period 1970-1978, only data on private housing (as the sum of land plus structure) is available, both in PZ and in GGP2017. Unfortunately, data on housing, as a separate component, within corporations and the public sector's non-financial assets are not available. As a proxy of the evolution of housing in these two sectors, I use the percentage of 'social housing' renters within all households in France, from the French Housing Survey²¹. I observe that in the years 1979-2013, the evolution of corporate plus publicly owned housing as a percentage of national housing follows relatively close the evolution of the percentage of households that are social renters. Hence, I assume that public and corporate housing moved proportionally to the percentage of social renters during the 1970-1978 period too (figure 3.33). To split the sum of corporate and public housing into these two sectors, I keep constant the proportions observed in 1979: 93% owned by corporations, 7% owned by the government.

Natural capital: INSEE accounts report the value of mineral and energy reserves (AN.212) within their non-produced assets. In PZ and in GPP2017, these assets are included within their measure of non-financial assets but are not reported as a separate category. In this update, I separate this category for the years in which INSEE reports on their value: 1979-2015. Ideally, we would like to account for forestry land too within natural capital, but the variable land under cultivation (AN.2112) is not split into agricultural and forestry by INSEE. Hence, as in

21. Between 1970 and 2013, there have been 10 editions of the French Housing Survey: 1970, 1973, 1978, 1984, 1988, 1992, 1996, 2002, 2006 and 2013. Between 1970 and 2006, I define social renting as renters of "HLM" dwellings ("*Habitation à loyer modéré*" in French). For the year 2013, the definition changes slightly: renters of "HLM and of other social housing" (but social housing different from HLM is almost negligible in France). For the years between 1970 and 2006, data can be found in the following link: <https://www.data.gouv.fr/fr/datasets/les-menages-et-leur-logement-depuis-1955-et-1970-quelques-resultats-extraits-des-enquetes-logement/> The year 2013 can be found here: <https://www.insee.fr/fr/statistiques/1912703?sommaire=1912749>

other countries, we treat cultivated land as agricultural land at WID.world. Overall, the value of mineral and energy reserves is very small: between 1.1% and 0.1% of national income over the 1979-2015 years. I do not extend this variable backwards from 1979 given the absence of data sources.

Agricultural land (figure 3.34): PZ reported data for households agricultural land for the years 1970-2010, but not for other sectors. GPP2017 already included corporate holdings of agricultural land for the period 1979-2014 (corporations are the only sector, in addition to households, owning agricultural land according to INSEE's balance sheets). I update these series to the year 2015 and extend them backwards to 1970. For the period 1979-2015, I take data for "Land under cultivation" (AN.2112) from the latest national accounts. As in other countries, this variable adds both agricultural and forestry land (see "Natural capital" sub-section above). This is the same procedure followed by PZ and GGP2017. For the period 1970-1978, I extend the series of households agricultural land using the growth rates of the equivalent series in PZ. Given the absence of data for corporations over these years, I extend corporate agricultural land using the same growth rates than in the case of households.

3.3.3.3 Explanation: income

Income data are taken directly from the data appendix A to [Garbinti, Goupille-Lebret, and Piketty \(2018\)](#). The only exception are the three variables needed to compute Gross Capital Formation (Gross Fixed Capital Formation, Change in inventories and Acquisition less disposal of valuable), which are not part of the already mentioned appendix A. I download these data from INSEE: National accounts, institutional sector, national economy, base 2010. This corresponds with the same set of national accounts used by [Garbinti, Goupille-Lebret, and Piketty \(2018\)](#) in their paper, therefore being fully compatible.

Figures 3.35, 3.36, 3.37 and 3.38 compare the updated series with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure 3.39 compares

the difference in nominal value of the series of gross capital formation and consumption of fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). Overall, new series of net-of-depreciation capital income are similar to the old series. As it is the case in other countries, gross-of-depreciation capital shares are higher in the new series, with the difference between the new and the old series rising over time. This is consistent with the higher values of gross capital formation in the updated series and the almost equal values of net capital formation.

3.3.4 Germany

3.3.4.1 Overview

Official balance sheets for Germany in PZ cover the period 1991-2011. In addition, they present annual series of national income and macro wealth since 1870 (and for corporate wealth since 1971). I have extended the to 2016 (wealth) and 2017 (income) and revised the existing series for the previous years.

3.3.4.2 Explanation: wealth

Current wealth macro data at WID.world comes from [Piketty and Zucman \(2014a\)](#). These data end in 2011 and follow SNA93. In this update I use the most recent national accounts from Destatis and the Bundesbank (2017 edition), which follow SNA2008 and cover the period 1999-2016²². I splice these data with the annual series presented in PZ since 1870²³.

22. Destatis (the Federal Statistical Office of Germany) publishes the official balance sheets by institutional sector in Germany. The latest accounts cover the period 1999-2016, while those used in PZ covered the period 1991-2011 (2012 edition). Non-financial assets are direct estimates from Destatis while financial assets and liabilities are based on the Financial Accounts from Bundesbank. One difference with respect to the financial data reported in Bundesbank is that Destatis consolidates financial assets and liabilities at the institutional sector while Bundesbank's data are unconsolidated (([Destatis, 2017](#), pg. 5)). This was also the case with the accounts used by PZ. This is why some discrepancies may arise when comparing gross financial assets and liabilities between the two sources. Data from Destatis and the Bundesbank can be found in the following two links: https://www.destatis.de/EN/Publications/Specialized/Nationalaccounts/BalanceSheetPDF_5816104.html https://www.bundesbank.de/Navigation/EN/Statistics/Time_series_databases/Macroeconomic_accounting_systems/macroecomic_accounting_systems_node.html

23. PZ use estimates of contemporaneous authors, economic historians and older versions of official accounts (both from Destatis and the Bundesbank) to extend their annual series back to 1870. They complement these sources with accumulation equations to splice different available years.

In addition, I estimate national housing (as the sum of private, corporate and public housing) since 1970 and national agricultural land since 1989 (in PZ these two variables were available for the private sector alone, since 1950 and 1989 respectively). Data for natural capital are not available in German national accounts.

Private wealth (figure 3.40): Official balance sheets in Germany group together households and NPISH (sectors S14 and S15) and cover the period 1999-2016 in the latest update. For financial assets and liabilities, I follow PZ and use data directly from the Financial Accounts of Bundesbank, which decompose financial assets and liabilities into more categories than Destatis²⁴. Non-financial assets come directly from the Destatis' accounts. By 1999, the new series of private wealth are significantly higher than those in PZ: private wealth equals 376% of national income in the new series and 347% in the old ones. This is due to the higher value of two categories of non-financial assets: business assets different from housing and built-up land²⁵. Other types of assets and liabilities are almost identical in the new and the old series by 1999. I then splice the new series of assets and liabilities with the equivalent ones in PZ to extend backwards the data to 1991 (which is the first year of official balance sheets in PZ). Private wealth is then calculated as the sum of the different asset subcomponents, net of liabilities. The splicing procedure is the standard: extend the new series with the growth rates of the equivalent series in PZ.

Before 1990, PZ report data for the household sector only (i.e. not including NPISH). Between 1950 and 1989, they use older versions of Bundesbank's Financial Accounts to account for households financial assets and liabilities. For non-financial assets, they rely on the estimates from Baron (1988), which present data for some given years (1953, 1957, 1960, 1963, 1966, 1972, 1974, 1977 and 1988), which PZ interpolate linearly in between. For financial assets and liabilities differences between the new and the old series are negligible. However,

24. For other sectors (corporations and the government) I will use data on financial assets and liabilities from Destatis and not from the Bundesbank. Given that the financial counterpart of households are other institutional sectors, the fact that Bundesbank's data are not consolidated does not generate a problem: unconsolidated and consolidated data within the private sector are identical.

25. PZ explain in their appendix ((Piketty and Zucman, 2014b, pg. 72)) that land underlying buildings and structures may be downward biased due to the absence of a real census-like estimate. This has been improved in the latest editions of the balance sheets (see subsection: Housing). This can explain the higher values of built-up land in the new official balance sheets.

the new series of non-financial assets are higher than the old series for the period 1991-2011. I then upgrade the point estimates of Baron by the observed discrepancy. By 1950, private wealth equals 205% of national income in the new series and 184% in the old version.

For the period 1870-1949, PZ present an annual series of private wealth, which is not decomposed into further categories. This is due to using accumulation equations to splice some year estimates for which they know the balance sheet of households. I use their series of private wealth without further modification for the period 1870-1946, and splice the new series with those in PZ between 1946-1950²⁶. Although this splicing is not totally correct, I prefer not to upgrade the previous historical period. In particular, due to the great uncertainty surrounding the stock and value of assets and liabilities during World War II. Overall, differences between the old and the updated series are small so this decision has no significant effect on the long-run development of the series.

Public wealth (figure 3.41): The procedure to extend and splice public wealth series is the same than in the private sector: use the latest national accounts for 1999-2016²⁷, extend them with the growth rates in PZ's series for the period 1950-1990, splice the updated series with those in PZ for 1946-1950 (so both converge by 1946), and take, without modification, the annual series for the years 1870-1946. The only difference stems from the fact that PZ provide annual series of non-financial assets, financial assets and liabilities for the period 1870-1949, and not only of net wealth (as it is the case in the private sector).

For the period 1950-2011, the new series are slightly higher than the old ones: in 1950, the updated series are 58% of national income vs 43% in the old series; in 1999 (first year available in the new official balance sheets), the new series are 39% of national income vs 22% in the old ones. This is mostly due to higher non-financial assets, which in the new series represent 77% of national income in 1999 and 62% in the same year of PZ. Financial assets and liabilities, on the contrary, are almost equal.

26. I add a fixed capital gain of 4% to the series of PZ between 1946 and 1950, so their series match the updated ones by 1950.

27. For the public sector, financial data are taken from Destatis' balance sheets and not from Bundesbank's Financial Accounts (the former take the data from the latter but present them already consolidated at the sector level).

Corporate wealth (figure 3.42): I take directly the new data on corporate wealth from Destatis national accounts for the years 1999-2016. I then splice these series with those in PZ backwards to 1971 (first year available in PZ). The splicing procedure is the standard: use the new estimates and extend them with the growth rates of the equivalent data in PZ.

The updated series of net corporate wealth (net worth minus market-value of equity) are lower than those reported in PZ. However, those in PZ contained a mistake in one formula: land underlying buildings and structures took the data of households and NPISH and not of corporations. If I compare the new series with the corrected version in PZ, then net wealth of corporations is higher than before. As in the case of the private and the public sectors, this is mostly the result of higher non-financial assets (financial assets are also slightly higher, but they are compensated by higher non-equity liabilities too). Overall, the Tobin's 'equity' Q follows a similar trend in the three series, with some difference in the levels.

Housing (figure 3.43): PZ present series of private housing for the period 1950-2011 but do not separate housing assets within the non-financial assets of corporations and the government. In this update I present data on national housing (the sum of housing owned by private, corporate and public sectors) for the period 1970-2016, in addition to revising the private housing series of PZ for the years 1950-2011. For the period 1990-2011, PZ use the official balance sheets from Destatis, which provide data on the value of dwellings and of land underlying dwellings for the three institutional sectors²⁸. Then they splice the private housing series with the series of housing owned by households from Baron (1988), which provides estimates for certain years within 1950 and 1980.

In this update, I use Destatis' balance sheets for the period 1999-2016, which report the value of housing for the three sectors. One novelty of these national accounts with respect to those used by PZ is the improved treatment of land underlying buildings (including land underlying dwellings). As PZ explain in page 72 of their appendix, estimates of land

28. As it is the case in other countries, the German balance sheets do not decompose land underlying buildings and structures (AN.2111) into land underlying dwellings (AN.2111A) and land underlying other buildings and structures (AN.2111B). Following PZ and DINA guidelines, I split AN.2111 into the two types, in the same proportions than corresponding categories of produced assets: dwellings (AN.111) and other buildings and structures (AN.112).

underlying buildings from Destatis could be biased as the valuation is based on prices of new land for building development. These estimates were produced by the Bundesbank and were incorporated by Destatis into their balance sheets. However, Destatis now produces their own estimates of land underlying dwellings which are based on series of prices for already built land. Overall, both series follow a similar trend with the new ones having a higher value than the old ones (i.e. by 1999, the new series of national land underlying dwellings are worth 78% of national income, while it was 58% in the old ones).

By 1999, the new series of private housing are equal to 218% of national income, while they were equal to 200% in PZ. I extend backwards to 1990, separately, dwellings and of land underlying dwellings, for each sector, using the equivalent variables in PZ. Then, for private housing, I splice the new series with those of Baron (the series of Baron correspond to the total value of households housing, and are not decomposed into land and structure). Similar to what I do with other components of private wealth, I upgrade the series of Baron with the discrepancy observed between the new and the old series in 1990 (first year for which PZ report data on housing from the modern national accounts) (figure 3.44). For corporations and the government, series for dwellings are available in PZ since 1970. I splice these series with the new updated series in 1999 using the standard procedure (extending the updated series with the growth rates in the equivalent ones in PZ). Then I follow PZ and assume that the evolution of land underlying dwellings follows that of dwellings (i.e. the growth rates of the two series over 1970-1999 are equal). This assumption is done to approximate the total value of housing in Germany (as the sum of private, corporate and public housing) and implies fixing the ratio land-structure during the period 1970-1989 taking 1990 as reference. Given the predominant role played by the household sector in housing, the margin of error is limited when looking at the total value of housing in Germany (which is the goal in these estimates). However, if more specific data on the value of land underlying dwellings becomes available, we will correct these numbers.

Agricultural land (figure 3.45): In the 2012 edition of Destatis national accounts used by PZ, only data on land underlying buildings and structures (AN.2111) were reported,

but not on other types of land: cultivated land (AN.2112), recreational land and associated surface water (AN.2113) and other land and associated surface water (AN.2119). Hence, to correct for these missing data, PZ estimated agricultural land by assuming a ratio of land to cultivated assets of 9 (cultivated assets are part of produced assets and are available in the official balance sheets accounts). The latest balance sheets from Destatis, however, do report the value of total land (AN.211) but only reports in a differentiated manner one of the subcomponents: land underlying buildings and structures. This implies that the residual from total land minus land underlying buildings and structures includes cultivated land but also other types. However, in a note from Destatis (([Brede and Schmalwasser, 2015](#), table 1)), land is decomposed into lower categories for two single years: 2011 and 2012. It shows that within land different from built-up land, cultivated land (*Landwirtschafts/Waldfläche*) accounts for the vast part. For example, in 2011, cultivated land equals 379.2 million euros, while other types of land (*Flächen anderer Nutzung*) equals 11.6. In other words, in these two years, the role played by land different from built-up and cultivated is negligible. I then assume that the residual of land net of built-up land only captures cultivated land over the 1999-2016 years. Overall, these new data imply two changes: (1) The government sector owns cultivated land (in PZ public cultivated assets have zero value, therefore public cultivated land too); (2) agricultural land is higher in the new series than in those in PZ.

I extend backwards these series to 1989, using the evolution of cultivated assets in PZ, for each institutional sector. The splicing procedure is the standard: extend the updated series using the growth rates of the series for cultivated assets in PZ. Given that the public sector has no cultivated assets, I assume that they follow the trend of the corporate sector.

Natural capital: According to ([Destatis, 2017](#), pg. 4), natural capital other than land is not estimated.

3.3.4.3 Explanation: income

The national accounts used by PZ covered up to 2011. In this update I use the latest national income accounts from Destatis, which cover the period 1991-2017²⁹. In addition, some selected components of the national accounts are available since 1970³⁰ and I use them too. As a general rule, I splice the new series with the old ones apply the proportional difference of the new series with those in PZ, except in those cases in which it was preferable to use the original data from PZ to avoid inconsistencies across different income component (details are explained in the corresponding excel file for Germany). Given that for some components of national income data are only available since 1980, the new series and the old ones tend to converge around this year and have similar values for the historical period before 1980.

Figures 3.46, 3.47, 3.48 and 3.49 compare the updated series with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure 3.50 compares the difference in nominal value of the series of gross capital formation and consumption of fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). Overall, new series of net-of-depreciation capital income are similar to the old series (with some differences emerging in the 1950-1980 period). As it is the case in other countries, gross-of-depreciation capital shares are higher in the new series, with the difference between the new and the old series rising over time. This is consistent with the higher values of gross capital formation in the updated series and the almost equal values of net capital formation.

29. https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Nationaleinkommen/SectorAccountsAnnualresultsPDF_5812106.html

30. https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Inlandsprodukt/InlandsproduktsberechnungLangeReihenPDF_2180150.pdf?__blob=publicationFile

3.3.5 Italy

3.3.5.1 Overview

PZ presented series of national income for the period 1960-2011. In the case of macro wealth, they presented series of private and public wealth in Italy for the periods 1966-2011 and 1960-2011, respectively. Not for corporations. In this update I extend these series to 2015 (wealth) and to 2017 (income) and revise the existing series of PZ. I also estimate corporations wealth for 2006-2015, using the recently published non-financial accounts of Italy.

3.3.5.2 Explanation: wealth

At the time of the work of PZ, Italy did not publish official non-financial stock accounts for the institutional sectors. The only exception were households, for which the Bank of Italy did publish its full balance sheet for the period 1995-2011. Contrary to non-financial assets, the Bank of Italy had an already long tradition publishing the Financial Accounts of Italy, including a comprehensive decomposition for all institutional sector, and with annual estimates starting in 1950. For the private sector, PZ relied on these data, which they complemented with the estimates of households' non-financial assets for the period 1966-1995 in [Brandolini, Cannari, dAlessio, and Faiella \(2006\)](#)³¹. For the government sector, financial information came from Bank of Italy's Financial Accounts. For non-financial assets, their estimates were based on a paper by [ISTAT \(2017\)](#), which computes government non-financial assets for 2006, 2007 and 2008, and which PZ extrapolated for the preceding years (([Piketty and Zucman, 2014b](#), pgs. 127 and 128)). All data used by PZ followed the SNA93.

In 2015, ISTAT (the Italian National Institute of Statistics) published, for the first time, non-financial accounts for institutional sectors in Italy, which follow SNA2008. These accounts cover the period 2005-2015, except for housing and cultivated land, which series start in 2001. The Italian Financial Accounts continued being published by the Bank of Italy, and

31. Over the period 1966-2011, Bank of Italy's Financial accounts referred to the private sector (households plus NPISH), while the non-financial data did not include NPISH. However, given the low net holdings of NPISH, PZ did not consider necessary to correct this discrepancy (([Piketty and Zucman, 2014b](#), pg. 127))

at the present follow SNA2008 too. These accounts cover the period 1995-2016 in its most recent edition, but historical accounts exist for the 1950-1994 years. I then use these series to compute private, corporate and public wealth over the period 2005-2015. Then I follow PZ to reconstruct private and public wealth for the preceding years (with data starting in 1966 and 1960 respectively). In addition, I present an estimate of national housing and national agricultural land, based on the sum of the holdings of the private, corporate and public sectors. Natural capital is not reported by ISTAT's accounts.

Private wealth (figure 3.51): For the period 2005-2015, I take the data on non-financial assets of the private sector (households plus NPISH) directly from ISTAT's non-financial accounts (March of 2017 edition). Data for financial assets and liabilities come (for the same sector: Households plus NPISH) from the Bank of Italy's Financial Accounts (available for the period 1995-2016). I extend the series of housing, business assets and agricultural land backwards to 1995, using the growth rates of the equivalent series of non-financial assets from the Bank of Italy's Supplements to the Statistical Bulletin of 2014³². Note that these series of non-financial assets of Bank of Italy only include households. But I extend the series of the private sector with the growth rates of households. If I were to obtain NPISH's wealth as a residual from ISTAT's private sector and Bank of Italy's households one, I get that NPISH account for about 6% of total private wealth, or the equivalent to around 27% of national income.

Before 1995, I extend the updated series with the growth rates of the equivalent asset categories in PZ. Recall that PZ's data are based on the Historical Financial Accounts from the Bank of Italy and on the work of Brandolini, Cannari, d'Alessio, and Faiella (2006) (the latter for the case of non-financial assets, the former for financial assets and liabilities). For financial assets I extend three series for which data are available: Equity and fund shares, Pension funds and life insurance, and other financial assets. I then extend liabilities and three types of non-financial assets: housing, business assets and agricultural land. In all cases I follow the standard procedure: extend the updated series with the growth rates of those in

32. <https://www.bancaditalia.it/pubblicazioni/ricchezza-famiglie-italiane/index.html?com.dotmarketing.htmlpage.language=1>

PZ.

Overall, the new private series are slightly higher than those in PZ throughout the 1966-2005, with differences being more significant from 2005 onwards. The main reason are higher non-financial assets in the new series, particularly housing.

Public wealth (figure 3.52): In this update I report series of government wealth for the period 1960-2015. For 2005-2015, non-financial assets are taken directly from ISTAT's non-financial accounts. For the preceding years, official data do not exist. Given the relative stability of the value of public non-financial assets over the period 2005-2015, around 36% of national income, I assume that the value of these assets was equal to this percentage of national income over the 1960-2005 period too. This is below the previous assumption in PZ's: 52% of national income (see subsection 'Explanation'). The stability of the value of non-financial assets may be justified by the evolution of public investment in Italy (([Piketty and Zucman, 2014b](#), pgs. 127 and 128)), but the levels seem a bit low relative to the evolution in similar countries. In the absence of better data, this value should be understood as our best guest and will be revised if new data become available.

Financial assets and liabilities are taken from the official Financial Accounts for the period 1995-2015. I then extend these series backwards to 1960 using the growth rates of the equivalent ones in PZ (which are taken from the Historical Financial Accounts of the Bank of Italy). Overall, the updated series of public wealth are lower than those in PZ (between the equivalent to 10-20% of national income). The main reason are the lower non-financial assets which are slightly compensated by higher financial assets in the updated series.

Corporate wealth (figure 3.53): In PZ, corporate wealth was not covered due to the absence of non-financial assets data. The ISTAT non-financial accounts (which were not published yet at the time that PZ wrote their article), cover all institutional, for the period 2005-2015. In addition, Bank of Italy's Financial Accounts report corporations financial balance sheets for the period 1995-2016. In this update I present corporations wealth series between 2005 and 2015, years in which the two data sources overlap.

Housing (figure 3.54): In this update I present series of national housing (as the sum of

private, corporate and public housing) for the period 1966-2015. For the period 2001-2015, data for all sectors are directly available at ISTAT's balance sheets³³. Before 2005, the extension is as follows. For the private sector, I extend the series of private housing with the growth rates of housing owned by households in the Bank of Italy's Supplement to the Statistical Bulletin (2015) for the years 1995-2005. For the period 1966-1995, I use the series from PZ, which are based on [Brandolini, Cannari, d'Alessio, and Faiella \(2006\)](#).

To account for housing owned by corporations and the government, I need to make a series of approximations. Firstly, I observe their share on national housing for the years for which official ISTAT accounts are available (2001-2015). Over these years, corporate and public housing represented a relatively constant share of national housing: around 8% and 2%, respectively. Then, I observe the evolution of the tenure structure in Italy (figure 3.55), to track if there exist important changes that could alter the proportion of private housing in the total stock of dwellings. The idea is to look at the evolution of owner-occupied and privately rented dwellings relative to other types of tenures: social housing and the category 'others'. According to SNA, privately owned and owner-occupied dwelling are owned by the households sector, while social housing and other types of dwellings are typically owned by corporations and the government.

Data on renting, differentiated into private and social, are only available since 1981. Before, only total renting is reported. Over the 1981-2011 years, owner-occupied and privately rented dwellings represent around 87-89% of total stock of dwellings in Italy. If the proportion of social housing before 1981 remained relatively similar to the proportions observed in the 1980s (around 5% of the total), then private housing will continue representing around 88-89% of the total. In light of this plausible stability of the share of private housing on the total stock of dwellings, I assume that corporate and public housing represented the same proportions into national housing than those observed in the 2001-2015 period: 8% and 2% respectively. Of course, this is a rough estimate. However, note that the idea of this exercise is to approximate national housing and not, specifically, the share owned by corporations and the government

33. ISTAT's accounts do not decompose the total value of housing into dwellings and land underlying dwellings.

individually and we will correct these estimates if better data become available. Nevertheless, changes to national housing should be of minor importance given that the vast majority of this stock should be owned by households, which in principle are correctly captured in our series.

Agricultural land: I report values for national agricultural land (as the sum of the holdings of the private, corporate and public sector) for the period 2002-2015. In addition, for the private sector, series are extended back to 1966, the same year in which data for private agricultural land are reported in PZ. For the period 2002-2015, data are taken directly from ISTAT's non-financial accounts, which includes the variable "cultivated land" for all institutional sectors. Before 2002, the procedure to estimate private agricultural land is the same than for private housing: between 1995 and 2001, use the series of households' non-financial assets from the Bank of Italy (2015) Supplement to the Statistical Bulletin; for the period 1966-1994, use the equivalent series in PZ. The splicing procedure is the standard: extend the updated series with the growth rates of the equivalent ones. Note that, by definition, "cultivated land" in national accounts includes forestry land in addition to agricultural land.

Natural capital: In Italy, natural capital is not covered by the non-financial accounts of ISTAT. However, according to the latest [UNU-IHDP and UNEP \(2014\)](#)'s Inclusive Wealth Report, natural capital has a negligible value in Italy.

3.3.5.3 Explanation: income

PZ presented series of national income covering the period 1960-2011. In this update I use the latest available accounts from ISTAT covering the period 1995-2017. I then splice the new series with those in PZ for the historical period (i.e. 1960-1994).

Figures [3.56](#), [3.57](#), [3.58](#) and [3.59](#) compare the updated series with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure [3.60](#) compares the difference in nominal value of the series of gross capital formation and consumption of

fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). Contrary to other countries, net-of-depreciation series of capital income are significantly higher than those in PZ. As shown in figure 3.61 this is the result of both higher households and corporations net capital income. Gross-of-depreciation capital shares are also higher, but this is not because gross capital formation and capital formation are substantially higher (as it is the case in other countries): these two variables present similar values in the old and the new series (figures 3.58 and 3.59). As figure 3.60 shows, the new nominal values of gross capital formation and capital depreciation are higher in the new series, but the magnitude is small (i.e. below 1% of GDP). Investigating why the adaptation to the SNA2008 has not brought substantially higher values of gross investment and depreciation is a pending issue.

3.3.6 Japan

3.3.6.1 Overview

The latest official national accounts for Japan used by PZ covered the period 2001-2010. They spliced these data with previous editions of national accounts to present annual estimates of national income for the period 1955-2011 and of national wealth since 1970. I have extended their series to 2015 (wealth) and 2016 (income) and revised the existing series for the previous period.

3.3.6.2 Explanation: wealth

PZ used the 2010 edition of Japan's National Accounts from the Cabinet Office, that covered the period 2001-2010 and followed the SNA93 (with 2005 as benchmark year). These national accounts report the balance sheets of institutional sectors (including the separation of the private sector into households and NPISH) and offer a great detail in the decomposition of assets and liabilities³⁴. For the previous years (1970-2000), they used older editions of national

34. The main tables for institutional sectors balance sheets (Stock accounts classified by institutional sector) only decompose non-financial assets into four categories: inventories, fixed assets, land and other non-produced

accounts: the 2000 edition (SNA93) and the 1990 edition (SNA68). In this update I use the 2015 edition of Japan's national accounts (with 2011 as benchmark year), which follows SNA2008 and covers a longer period than those used by PZ: 1994-2015³⁵. One novelty of these accounts with respect to the 2010 edition, is that they systematically report two categories of natural capital for each institutional sector: mineral and energy resources (AN.212) and Non-cultivated biological resources (AN.213)³⁶. For the earlier years (1970-1993), I follow PZ and rely on the previous editions of national accounts. Finally, I include an estimate of national housing and national natural capital for the period 1970-2015, as the sum of the holdings of these assets by the different institutional sectors³⁷.

Private wealth (figure 3.62): The national accounts of Japan already differentiate the households and the NPISH sectors. We report series of wealth for the two sectors separately, which are then added into the private sector³⁸. For the period 1994-2015, I use directly the data from the 2015 National Accounts of Japan. Financial assets and liabilities already offer a great detail in their decomposition, but non-financial assets are only decomposed into 5 categories: inventories, fixed assets, land, mineral and energy resources and non-cultivated biological resources. To compute housing assets, I use data on dwellings from the supporting table "Net Capital Stocks of Fixed Assets classified by Institutional Sectors and Economic Activities (At current price)" and data on land underlying dwellings from the supplementary table "Value of Land by Prefectures (owned by Private Sectors)"³⁹. This supplementary

assets (this latter category are fisheries for households and subsoil assets for non-financial corporations; other institutional sectors only hold non-produced assets in the form of land). However, data offering greater detail in the decomposition of fixed assets and land are available in two supplementary tables to the national accounts: "Net Capital Stocks of Fixed Assets classified by Institutional Sectors and Economic Activities" and "Value of Land by Prefectures (owned by Private Sectors)".

35. http://www.esri.cao.go.jp/en/sna/data/kakuhou/files/2015/29annual_report_e.html

36. In the 2010 edition, only households and non-financial corporations included a non-produced asset different from land: fisheries in the case of households and subsoil assets in the case of non-financial corporations. In the new accounts, the general government also holds non-produced assets different from land (in the form of non-cultivated biological resources). Nevertheless, the value of these holdings, for the three sectors, is very small (see subsection natural capital).

37. PZ report the value of private housing, but do not differentiate housing within the non-financial assets owned by other sectors. Natural capital is a memo item in their benchmark series of national wealth.

38. Net wealth of NPISH is a very small part of private sector, with value closer to 20% of national income according to the latest national accounts (years 1994-2015). Households net wealth, on the contrary, is valued at around 600% of national income in the same period.

39. According to the decomposition of dwellings across sectors from the fixed assets accounts, NPISH do

table decomposes the total value of land into three categories: land underlying buildings and construction (AN.2111), Land underlying cultivation (AN.2112) and Others. I compute land underlying dwellings by using the proportion of dwellings relative to other buildings and construction in the fixed assets accounts (this is the same procedure used by PZ and recommended by DINA guidelines). Note that this table (Land) is not available in the 2015 edition of the national accounts, so I use the data from the 2014 edition⁴⁰. Overall, the new series of private wealth are slightly higher than the older ones during the 2000s, but are almost identical in the initial year of the new series: 1994. The difference between the two is mostly due to higher financial assets in the new series.

For the period 1970-1993, I extend separately the series of households and NPISH. For households I extend the following variables for which data are available: dwellings, land underlying dwellings, business assets⁴¹, equity assets, pension and insurance assets, other financial assets and liabilities. Households net wealth is then obtained as the sum of the previous categories of financial and non-financial assets, net of liabilities. For NPISH I extend non-financial assets, financial assets and liabilities (there is no lower level of decomposition in the original data from PZ). In all cases the splicing procedure between the updated series and the series in PZ is the standard: extend backwards the new series using the growth rates of the equivalent categories in PZ. Over the period 1970-1993, the new series of private wealth are almost identical to those in PZ.

Public wealth (figure 3.63): For the period 1994-2015, data on public assets and liabilities are taken directly from the 2015 national accounts of Japan. These data include natural capital owned by the public sector (in the 2010 edition no category existed for public natural capital). In particular, the new accounts report a positive (although small) value for non-cultivated biological resources of the government. According to the supporting table on fixed assets (see

not own dwellings. Only households do within the private sector.

40. The values of total land owned by households are identical between the two editions over the period 1994-2013, edition and 672,514 in the 2014 one. I then extend the total value of land in the 2014 edition to the year 2015 using the growth rates between these two years in the 2015 accounts. Data for the 2014 edition of the national accounts can be found in the following link: http://www.esri.cao.go.jp/en/sna/data/kakuhou/files/2014/28annual_report_e.html

41. Within business assets, two additional categories are extended: agricultural land and natural capital.

private subsection above), the general government does not own dwellings, therefore, it is not necessary to compute the value of housing for this sector. Unfortunately, one limitation of Japan's national accounts has to do with the presentation of the variable "Land", which in the benchmark balance sheets is not decomposed into different types. For households and corporations this is not an issue given that this decomposition is available in the supplementary table on land, but this is not the case for the government. Hence, it is not possible to separate public agricultural and forestry land from public built-up land.

During the period 1994-2011, the updated series of government wealth are higher than the old ones, by about 20-25% of national income. This is mostly due to higher non-financial assets and, to a lesser extent, to slightly higher financial assets too. By 1994 (first year of data in the new official series), the updated public net wealth equals 125% of national income while it was 104% in PZ. To extend the series backwards to 1970, I splice the latest official series with those in PZ. Before 2000, PZ report data for three variables of the public sector: non-financial assets, financial assets and liabilities. I then extend these three variables in the new data with the growth rates of the equivalent ones in PZ for the period before 1994. In addition, I extend also the public natural capital series (see subsection on natural capital). Given the initial differences in 1994, government wealth is also higher in the revised series during the 1970-1993 years. However, differences tend to decrease backwards in time due to the better financial position (financial assets net of liabilities) of the Japanese government at the beginning of the 1970s, and to the lower importance that non-financial assets had in these initial years.

Corporate wealth (figure 3.64): The procedure to update the corporate wealth series follows that of the private and the public sectors: use the new official national accounts for the period 1994-2016, and extend backwards the new series with the growth rates in those from PZ. The only difference between the new series and those in PZ is that I include an estimate of housing and natural capital owned by corporations (see the subsections housing and natural capital). Overall, the updated series are very close to the old series, with Tobin's Q being slightly higher in the new ones.

Housing (figure 3.65): In this update I provide series of national housing (as the sum of housing owned by the different institutional sectors), in addition to the series of private housing presented by PZ. As explained in the private sector section, to construct the variable housing it is necessary to estimate two of its subcomponents for each sector: dwellings (the value of the structure) and land underlying dwellings. According to the supplementary tables on fixed assets (which in the latest national accounts of 2015 cover the period 1994-2015), only households and corporations own housing in Japan. For these two sectors, it is possible to reconstruct land underlying dwellings using the supplementary table on land, which decomposes the land of these sectors into three different types: land underlying buildings and constructions, land underlying cultivations, and others. During the period 1994-2015, households' share on national housing represented between 85% and 87% of the total, the residual being held by corporations. It is easy to extend the series of private housing backwards to 1970, given that these two variables were already estimated by PZ.

To reconstruct corporate housing over the 1970-1993 period, I need to make some assumptions. This is because data are not available for dwellings or for land owned by this sector over these years as a separate item within the corporate balance sheet. I start by observing that the share of corporate dwellings over total national dwellings is relatively constant over the 1994-2015 years: between 13% and 15% of the total. Then I assume that the share observed in 1994 (15%) is constant for the previous period too. This way I obtain an estimate of corporate dwellings based on the private series. Then I calculate corporate land underlying dwellings. To do this, I assume that the value of corporate land relative to households' land kept the same proportion over the period 1970-1993 than the one observed in 1994, and I apply the ratio of land over dwellings to the previously calculated series. Needless to say, this estimate should be taken as an imperfect approximation in the absence of richer data, with the goal of having national, and not only private, series of housing. Overall, these estimates point to corporate housing representing around 7% to 10% of total national housing over the full period 1970-2015.

Agricultural land: I use the latest national accounts of 2015 to report agricultural land

owned the private and corporate sectors for the years 1994-2015. In both cases, I use the variable "land underlying cultivations" in the supplementary table to the national accounts on land (see private sector subsection). Given that similar data are not available for the government sector, I do not report data for this sector or for the national economy (the latter would be the sum of agricultural land owned by the private, corporate and public sectors). Before 1994, I only extend backwards the series of private agricultural land using the equivalent variable in PZ (which is available since 1970). The splicing procedure is the standard: extend backwards the updated series with the growth rates in PZ.

Natural capital: The latest national accounts already report data on natural capital for every institutional sector, concretely for the following two variables: Mineral and energy resources (AN.212) and non-cultivated biological resources (AN.213). On the contrary, the 2010 edition of the national accounts used by PZ only reported data for two items: fisheries owned by households and subsoil assets owned by corporations. PZ reported these assets as a memo item, not included in their benchmark series of wealth.

For the period 1994-2015, I use the data on natural capital directly from the 2015 national accounts. Overall, the value of these assets is very small (below 3% of national income over the period 1994-2015). For the period before 1994, PZ report the value of total natural capital in Japan. I then extend national natural capital with the growth rates in PZ, and assume that the distribution across sectors follows the same proportions than in 1994. This is a rough approximation. However, given the small dimension of these assets, these assumptions have no significant consequences on the aggregate values of wealth for each institutional sector.

3.3.6.3 Explanation: income

PZ used the Annual Report of National Accounts (benchmark year 2010), which followed SNA93. In this update I use the Annual Report of National Accounts (benchmark year). The latest report provides annual national income accounts for the period 1994-2016 and follows SNA2008. The report used by PZ covered the period 2001-2011. I splice the new series with the old ones using the proportional difference between the new and the old series by 1994.

Figures 3.66, 3.67, 3.68 and 3.69 compare the updated series with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure 3.70 compares the difference in nominal value of the series of gross capital formation and consumption of fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). Overall, new series of net-of-depreciation capital income are slightly higher than the old ones in the initial years (up to the 1990s) but then converge to the old values in the last two decades. Gross-of-depreciation capital shares follow the opposite trajectory: they are almost equal to the old series before the 1990s but then are higher afterwards. The case of Japan, therefore, is somewhat different to that of other countries. In particular, I find higher values of gross capital formation in the new series throughout the whole period, with net capital formation showing similar values in both the updated and the series in PZ. Hence, difference between net-of-depreciation capital share should respond to other elements of capital income that have been revised by Cabinet Office of Japan, and not only to the adoption of the SNA2008 and the inclusion of R&D as gross investment.

3.3.7 United Kingdom

3.3.7.1 Overview

PZ's data for the UK spliced different periods of official national accounts, some of them starting as far as 1948, and ending in all cases in 2010. In addition, they presented annual series of national income and of private, public and national wealth since 1855. I have extended the series to 2015 (wealth) and 2016 (income) and revised the existing series for the period before.

3.3.7.2 Explanation: wealth

For the period 1987-2010, PZ used the 2011 edition of the official national accounts in the UK ('Blue Book'), produced by the Office for National Statistics (ONS). This edition follows the SNA93. Before 1987, they combined official national accounts from previous editions of the Blue Book with the work of economic historians and contemporaneous authors. In this update I use the latest edition of the Blue Book (2016), which already follows SNA2008 and covers the years 1995-2015 for non-financial assets and 1987-2015 for financial assets and liabilities. To cover the period 1987-1995 for non-financial assets, I have used data from the Blue Book of 2012, whose values are almost identical to the 2016 Blue Book during the years in which both editions coincide: 1995-2011. In addition, I splice the new series with the historical ones. A correction is made to the series of private housing for the period 1948-1987, to make them more consistent with the way SNA defines economic assets and classifies them across sectors. I also estimate national housing and agricultural land during the period 1920-2015 (in PZ, the focus was in housing and agricultural land owned by the private sector). It is worth noting that the ONS prepares a substantial revision of their balance sheets in the next edition of the Blue Book (2017), which will affect the measurement of land and its classification across sectors⁴².

Private wealth (figure 3.71): For the period 1987-2010, PZ's data for the UK comes straight from the 2011 edition of the Blue Book, which reports together (not separately) the households and the NPISH sectors. For the years 1948-1986, they relied on the work of [Blake and Orszag \(1999\)](#) ('BO', from now on) while for the period 1920-1948 they used the estimates from [Solomou and Weale \(1997\)](#). For the period 1855-1920, they present annual series of net private wealth based on certain year-specific estimates made by contemporaneous authors,

42. ONS's revision of the Blue Book is a step forward to fully adapting the SNA's guidelines. In this edition, housing and other types of constructions will be separated into the produced element (structure) and the non-produced element (land underlying). It will also report separately the households sector (S.14) and the Non-profit institutions serving households sector (S.15) and will split cultivated assets into agricultural and forestry types. Importantly, there will be a significant reallocation of housing across sectors, reducing the holdings of households and increasing those of public corporations (NPISH will not own housing). This is likely the result of classifying housing associations within the public corporate sector. See: <https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/articles/nationalaccountsarticles/changestothenationalbalancesheetforthebluebook2017>

which they splice using accumulation equations.

In this update, I use the 2016 edition of the Blue Book to cover the period 1987-2015. The only exception are non-financial assets, which are not available in the 2016 edition and are taken from the 2012 edition instead⁴³ (see above). The extension for the period 1920-1987, is a bit complex. For non-financial assets, PZ present two series of assets: housing and other business assets. For housing, I make a conceptual correction (see below: sub-section 'housing'). Other business assets are extended using the standard procedure: take the most recent series, and extend them using the growth rates in the old ones. Between 1948 and 1987, total financial assets are the result of extending, separately, two sub-categories of assets which are available in these years: pension assets and other financial assets. Before 1948, only total financial assets are available. In all cases, the extension of financial assets is based on the standard procedure. Liabilities are extended throughout the period 1920-1987 without a further decomposition and using the same procedure than with other business assets and financial assets. For the period 1855-1920, PZ present annual series of net private wealth but not for different subcomponents. This is because they calculate net private wealth in some specific years, which are then spliced with accumulation equations. Given that the new and the old series of private wealth are almost identical by 1920, I take directly the values in PZ without modification.

Public wealth (figure 3.72): PZ present two series of government wealth, the benchmark series correcting financial assets and the non-corrected series. In this update I use the corrected series. These series upgrade government net wealth during the 1940-2010 years by including within them the net wealth of the public corporate sector. This is due to a significant mismatch between market-value and book-value of equity for public corporations, which artificially lowers government financial assets (see (Piketty and Zucman, 2014b, pg. 105)). Before 1958, Piketty and Zucman use accumulation equations to extend the non-financial assets of the public sector based on existing estimates for certain years (they do have data on net financial assets). Then, they add non-financial assets, net financial assets and the net wealth of public

43. Up to the 2011 edition of the Blue Book, non-financial assets included the category "non-marketable tenancy rights", which are not an asset according to SNA (reason why PZ excluded this variable in their series). Since the 2012 edition, this variable is no longer part of the private sector balance sheet. Hence, I do not need to make any adjustment to the data.

corporations to obtain total government wealth⁴⁴.

I follow the same procedure. For the years 1987-2015, I use the ONS2016 and ONS2012 series of government wealth to which I add the net wealth of public corporations (over these years this variable is very small: between 1-6% of national income). Then I extend backwards the series of non-financial assets, financial assets and liabilities, using the growth rates of the equivalent series in PZ. Non-financial assets are available since 1958 (including two subcomponents: housing and agricultural land), but detailed data on financial assets and liabilities are only available since 1967. Given that by 1967 the new series of government wealth are very close to those in PZ (31% of national income and 29% respectively), I extend the variable government wealth for the period 1855-1967 using the series in PZ without further modification.

Corporate wealth (figure 3.73): In this update I report the corporate balance sheet for the years 1988-2015. For financial assets and liabilities, data come from the 2016 edition of the Blue Book. For non-financial assets, the data corresponding the years 1995-2015 come from the Blue Book of 2016, while data for the period 1988-1995 come from the 2012 edition of the Blue Book (the two vintages of national accounts are spliced with the standard procedure: extending the new series with the growth rates of the older ones). In addition, data for housing and agricultural land are extended backwards to 1967 (these variables are available since this date in the Blue Book of 2012). Overall, the updated Tobin's 'equity' Q is close to the old one, but it is slightly higher. This is mostly the result of higher values for non-equity liabilities in the new series, which reduce the net worth of corporations (denominator in the Q ratio).

Housing (figure 3.74): In this update, I make some conceptual corrections to the measurement of private housing in PZ for the period 1948-1987. Over these years, they use the data from BO, but the measurement of housing in BO is not fully consistent with the current definition and sector classification of economic assets in SNA guidelines. In addition, I account for housing owned by corporations and the government, two concepts that were not previously differentiated within the non-financial assets of corporations and the government in PZ. Note,

44. Net wealth of public corporations is only significant since 1940 onwards.

however, that the actual values of the new series do not differ substantially from the older ones (figure 3.75), but they are better at approximating the changing tenure structure in the UK: the rise of social housing during the 1960s and 1970s, and the reversal after the introduction of the Right to buy Scheme at the beginning of Margaret Thatcher's government⁴⁵.

The backwards extension to 1948 is more complex. Over the 1948-1987 years, PZ used data from BO, which they slightly upgraded to match the ONS's series of private housing from 1987 onwards. However, BO series are not completely compatible with the modern series of housing, for two reasons:

1. BO estimate personal housing, and not private housing. However, housing associations (a type of NPISH) own a non-negligible share of the UK's housing stock: from 2% of the total stock in 1980 to 10% in 2014. Hence, they should be included within housing owned by the private sector.
2. Their measure of personal housing is not compatible with the SNA criteria to classify assets at the sector level. This is because they include "non-marketable tenancy rights" within personal housing. From 1975 onwards, BO use data on personal wealth from historical versions of the UK national accounts. In these series, the ONS estimated an asset category for tenants named "non-marketable tenancy rights". However, this asset category is not recognized as such in the SNA (reason why PZ also deduct their value in the post-1987 period, when they use the 2011 Blue Book series that still included this category). For the period 1948-1975, BO multiply the average market value of dwellings by the number of owner-occupied dwellings. Then, they calculate "non-marketable tenancy rights" for the remaining stock of dwellings (which include, mainly, tenants of

45. The Right to buy scheme is a policy enacted by the Thatcher's government and still active today, which was passed within the Housing Act 1980. It allowed tenants of social housing owned by local authorities, to buy their homes with a discount with respect to their market value (between 33% and 50% discount), and which was complemented with lending facilities to access housing mortgages. Under this scheme, social housing sales peaked during the 1980s, lowering afterwards (for a detailed description, see chapter 5 in [Whitehead and Scanlon \(2007\)](#)). In 2015, the Cameron's government extended the Right to buy scheme to social housing owned by housing associations (the other major provider of social housing in the UK, together with local authorities, and which presence has risen since the 1980s). For data on the evolution of UK's housing tenure structure see: <https://www.gov.uk/government/statistical-data-sets/live-tables-on-dwelling-stock-including-vacants>

both private and social dwellings). They assume that non-owner-occupied dwellings are worth a constant 70% of the market value of owner-occupied dwellings, which is the ratio of tenancy rights relative to owner-occupied dwellings observed in the official ONS data for 1975.

But this is incorrect. To explain the need for a correction, let me explain the tenure structure in the UK and how the sector classification should be according to the SNA. In the UK, there exist 5 types of tenure: (a) Owner-occupied; (b) Rented privately; (c) Rented from local authorities; (d) Rented from housing associations; (e) Other public sector dwellings. From the SNA perspective, (a) and (b) are part of the personal sector; (c) are social dwellings owned by public corporations; (d) are social dwellings owned by NPISH; (e) are dwellings owned by the public sector. Hence, housing of the private sector (personal plus NPISH) should include categories (a), (b) and (d). Category (c) should be part of the corporate sector and (e) of the public sector⁴⁶. However, BO are assuming, implicitly, that the average market value of dwellings is only representative of owner-occupied dwellings and that both social and privately rented dwellings should be part of personal housing with a 30% discount with respect to the average market value. In a historical period (1948-1987) of drastic changes in the tenure composition in the UK (figure 3.76)⁴⁷, this approach is particularly problematic.

I propose an alternative estimate of housing in the UK for the period 1948-1987, which accounts for national housing, and which is decomposed across institutional sectors (private, corporate and public sectors). Firstly, I obtain national housing over the period 1948-1987 by multiplying the average price of dwellings by the number of dwellings in the UK (data

46. General government dwellings are almost negligible during the whole period (i.e. below 1% of national income) given that local authorities, the main public housing provider, own equity on public corporations providing social housing. Therefore, dwellings owned by local authorities are classified within the corporate sector, while the equity held by local authorities on these corporations are classified within the general government financial assets.

47. Sources for this figure are: Department for Communities and Local Government (2012, last update April 2017): <https://www.gov.uk/government/statistical-data-sets/live-tables-on-dwelling-stock-including-vacants> and ONS historical data on England and Wales tenure: <http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/rel/census/2011-census-analysis/a-century-of-home-ownership-and-renting-in-england-and-wales/short-story-on-housing.html>

from table 3 in BO). Then I upgrade the value of these series to match the ONS data since 1987 (ONS series are about 10% higher by 1987). Next, I decompose national housing into the private sector (households plus NPISH) and the non-private sector (corporations plus government). I do this by comparing two indicators for the period 1987-1994 (period of overlap of BO series and the new ONS accounts): (i) the evolution of private tenure as a percentage of total UK households; (ii) the share of national housing owned by the private sector in ONS statistics. I observe that during the period 1987-1994: (i) the average share of private tenure was 77%; (ii) the average share of the private sector on the value of national housing was 90%. I then split total national housing over the period 1948-1987 into private and non-private owners according to the corresponding tenure proportions. Then I upgrade this splitting to account for the higher value of private housing relative to non-private housing using the proportions of private value vs private tenure observed in the 1987-1994 years ($1.16 = 90/77$).

Finally, for the period 1920-1948, I follow PZ and splice the new series of private housing with those of [Solomou and Weale \(1997\)](#) so they converge by 1940. I also make a rough estimate of non-private housing by using the proportion of non-private tenure over the total. By 1919, non-private tenure represents 1% of the total stock of dwellings in the UK, and 10% by 1939. I linearly interpolate in between. These values for non-private housing should be seen as a rough approximation in the absence of more specific data.

Agricultural land: In this update I estimate private, corporate and public agricultural land. For the period 1995-2015, I use the latest Blue Book of 2016, and I take the value of the variable "Cultivated biological resources" at the sector level. Note that this variable includes both the produced element (i.e. crops) and the non-produced element (land). It also groups agricultural and forestry land together. Hence, it overestimates the value of this asset. However, the bulk of this value probably captures agricultural land: forestry land is almost negligible in the UK, according to the UNU-IHDP Inclusive Wealth Report, and produced agricultural asset are typically about 15% of the value of land in other countries. In the forthcoming 2017 edition of the Blue Book, ONS plans to estimate separately agricultural land from the other components.

For the period 1987-1995, I splice the ONS2016 series with the equivalent in ONS2012. By 1995, the ONS2016 are slightly higher than the ONS2012, so I apply the standard splicing procedure: extend the new series with the growth rate of the old ones. The ONS2012 series are identical to the data used by PZ. Hence, I splice the new series with those in PZ for the period 1920-1987. Over the period 1920-1987 I also estimate national agricultural land. I observe that by 1987, private agricultural land represents 87% of national agricultural land. I assume that this value goes up to 100% in 1920, and I linearly interpolate in between. Overall, agricultural land has a limited role in the UK throughout the period 1920-2015, representing 33% of national income in 1920 and 14% in 2015.

Natural capital: Data for natural resources other than forestry land (which is included in the variable cultivated assets: see above) are not available in UK's balance sheets. According to the UNU-IHDP Inclusive Wealth Report, as of 2010 energy and mineral reserves are almost negligible in the UK (around 2% of GDP).

3.3.7.3 Explanation: income

In this update I use the 2017 edition of the UK National Accounts, which follows the SNA2008. PZ, by contrast, used the 2011, which followed the SNA1993. The latest accounts provide data since 1948, but some components are only available since some more recent years. As a general rule, I use the latest accounts and splice them with the historical series in PZ using the proportional difference between the new series and the old ones.

Figures 3.77, 3.78, 3.79 and 3.80 compare the updated series with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure 3.81 compares the difference in nominal value of the series of gross capital formation and consumption of fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). As figure 3.77 shows, the new series of net-of-depreciation capital income are substantially higher than the old ones. Figures 3.82 and 3.83 show the capital income of the

three production sectors: housing, non-corporate businesses and corporations. The comparison the two figures shows that the increase is mostly due to higher housing capital income (operating surplus of households and non-profit institutions). This is due to a large revision undertaken by the ONS in the 2016 edition of the Blue Book⁴⁸. The large revision was due to improvements to data sources and methods in the calculation of owner-occupied imputed rentals. In particular, the deflator used to calculate current price was greatly improved with the introduction and use of administrative data. Figure 3.84 shows the important difference between the gross operating surplus in the 2017 edition of the Blue Book with respect to the 2012 one. Overall, this change has a profound impact on both the net and gross capital shares, much more important than any possible change in the accounting of R&D investment.

3.3.8 United States

3.3.8.1 Overview

PZ present series of US national income and private and public wealth, with annual frequency, for the period 1870-2010 and for corporate wealth for the period 1946-2010. In this update I use the new data on US income and wealth from [Piketty, Saez, and Zucman \(2017\)](#), which revise the existing series of PZ for the years 1913-2010 and extend them for the years 2011-2015. In addition, I splice these new series with those in PZ for the years 1870-1913.

3.3.8.2 Explanation: wealth

PZ covered in great depth the evolution of wealth in the US. They provide annual series of private and public wealth since 1870 and of corporate wealth since 1946. These series end in 2010. In a recent work, [Piketty, Saez, and Zucman \(2017\)](#) ('PSZ' from now on) update these series to 2015, presenting the private and public series since 1913 and the corporate ones since 1946. In this update I use directly these revised data. In addition, for the private and public sectors, I splice the series of PSZ with those of PZ for the years 1870-1913. The

48. [Seethefollowinglinkforathoroughdescriptionofthechanges:https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/articles/changestonationalaccounts/imputedrental](https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/articles/changestonationalaccounts/imputedrental)

splicing procedure is very simple. Public wealth series are equal in the new and updated series in 1913, so I take data from PZ for the previous period without any modification. The new series of private wealth, however, are slightly higher in 1913: they are equal to 469% of national income in the updated series and to 437% in the old version. I then make the two series converge in 1907, and assign a negative annual capital gain of 1.5% to the growth rates of the updated series over the years 1907-1913. Figures 3.85, 3.86 and 3.87 compare the update and the old series of private, public and corporate wealth (Tobin's Q), respectively.

In addition, I include two new series in this update of the WID.world database: national housing for the period 1946-2015 (figure 3.88) and national agricultural land for the period 1913-2015 years. Data are taken directly from the sector-specific wealth series in PSZ. Natural capital other than land is not covered in PZ or PSZ given that these data are not reported in the official balance sheets of the US.

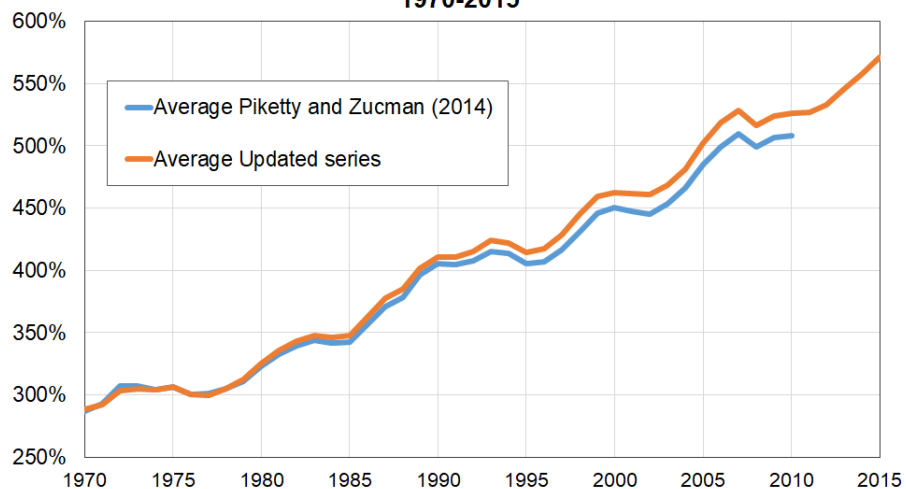
3.3.8.3 Explanation: income

In the case of income, I do not carry any adjustment and take directly all income components from PSZ for the available period (1913-2015), spliced with the series in PZ for the years 1870-1912.

Figures 3.89, 3.90, 3.91 and 3.92 compare the updated series with those in PZ in the following four dimensions: net capital income (% net factor-price national income), gross capital income (% gross factor-price national income), gross capital formation (% national income) and net capital formation (% national income). In addition, figure 3.93 compares the difference in nominal value of the series of gross capital formation and consumption of fixed capital (this difference in nominal values is expressed as a percentage of the updated series of GDP). Overall, new series of net-of-depreciation capital income are similar to the old series with the new series being slightly below the old ones in recent years. Gross-of-depreciation series have slightly higher values in the new series since 1970 but converge to the old series in the latest years. As in other countries, net capital formation in the new and the old series are almost equal with gross capital formation being higher in the new series.

Figures

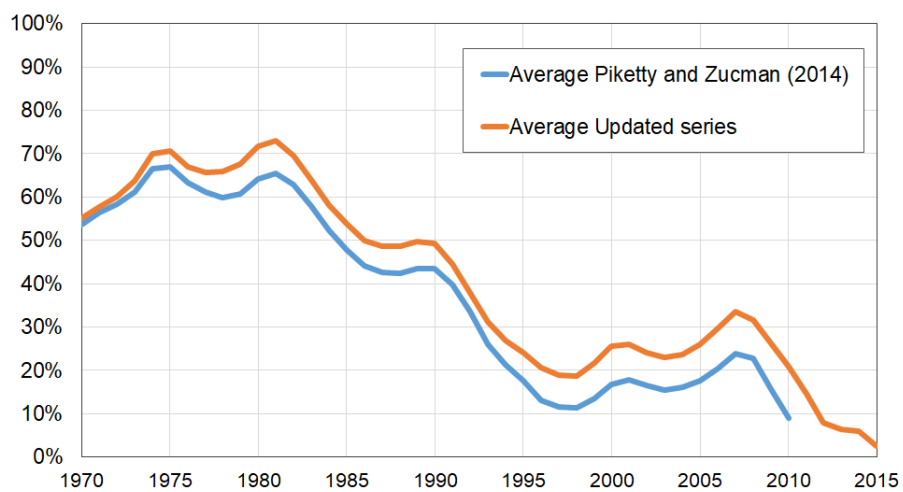
**Figure 1: Average private wealth / national income ratio
1970-2015**



Note: Arithmetic average of countries' private wealth / national income ratios. Source: see country-specific subsections.

FIGURE 3.1 – AVERAGE PRIVATE WEALTH-TO-NATIONAL INCOME RATIOS, 1970-2015

**Figure 2: Average public wealth / national income ratio
1970-2015**



Note: Arithmetic average of countries' public wealth / national income ratios. Source: see country-specific subsections.

FIGURE 3.2 – AVERAGE PUBLIC WEALTH-TO-NATIONAL INCOME RATIOS, 1970-2015

Figure 3: Average market-value national wealth / national income ratio, 1970-2015

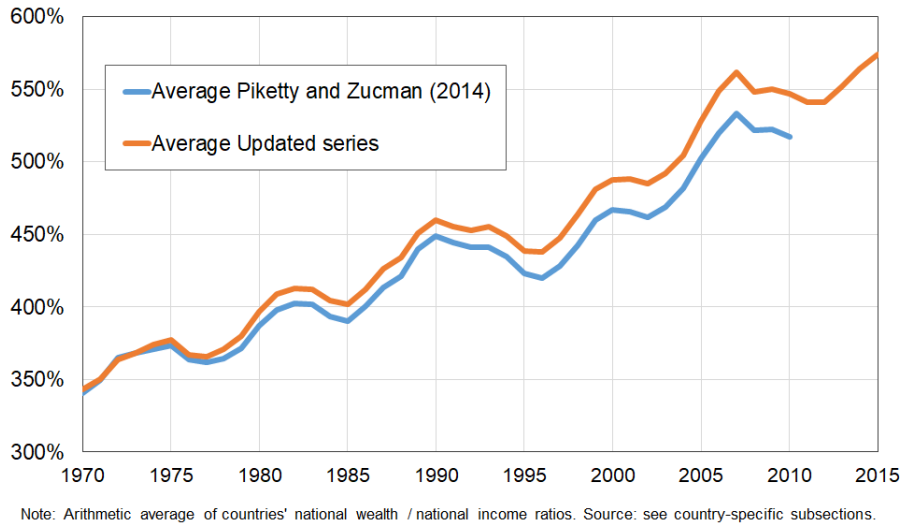


FIGURE 3.3 – AVERAGE MARKET-VALUE NATIONAL WEALTH-TO-NATIONAL INCOME RATIOS, 1970-2015

Figure 4: Average Tobin's Q ratios, 1990-2015

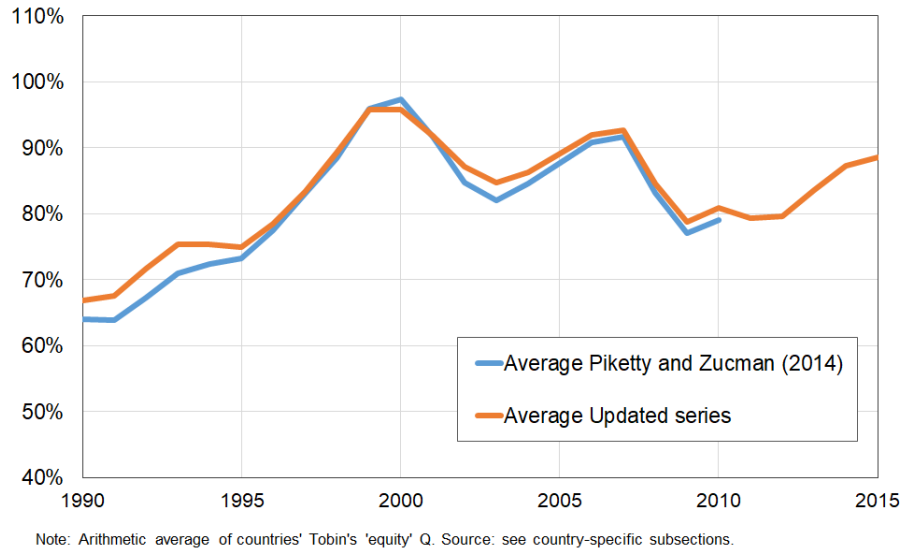


FIGURE 3.4 – AVERAGE TOBIN'S Q RATIOS, 1990-2015

Figure 5. Net capital income (% factor-price national income), 1970 - 2016

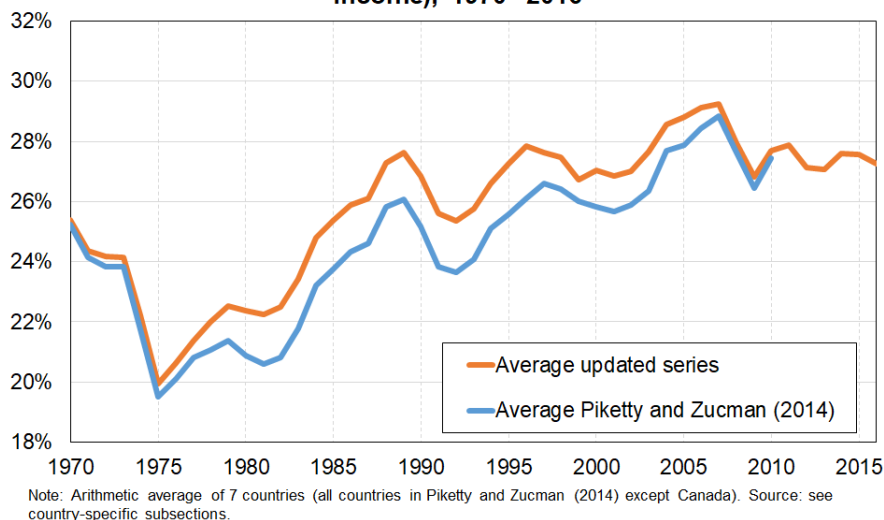


FIGURE 3.5 – AVERAGE NET CAPITAL INCOME (% NET FACTOR-PRICE NATIONAL INCOME), 1970 - 2016

Figure 6. Gross capital income (% factor-price gross national income), 1970 - 2016

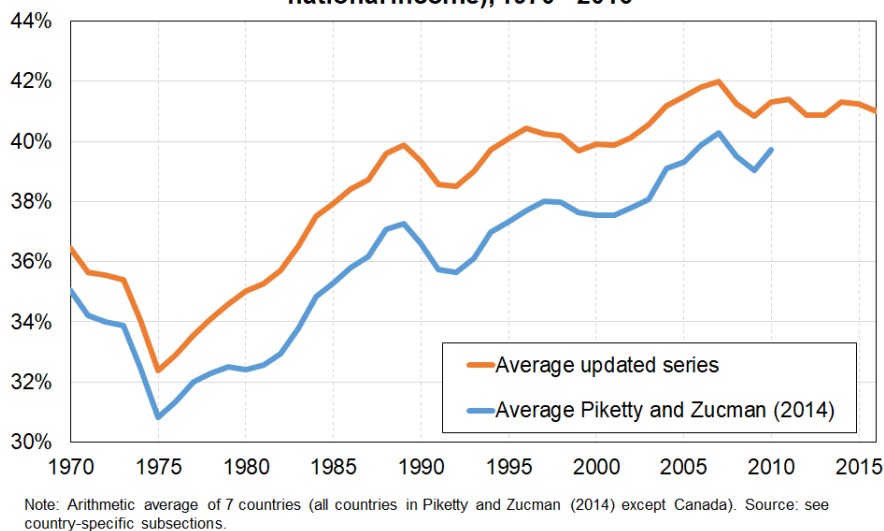


FIGURE 3.6 – AVERAGE GROSS CAPITAL INCOME (% GROSS FACTOR-PRICE NATIONAL INCOME), 1970 - 2016

Figure 7. Gross capital formation (% national income), 1970-2016

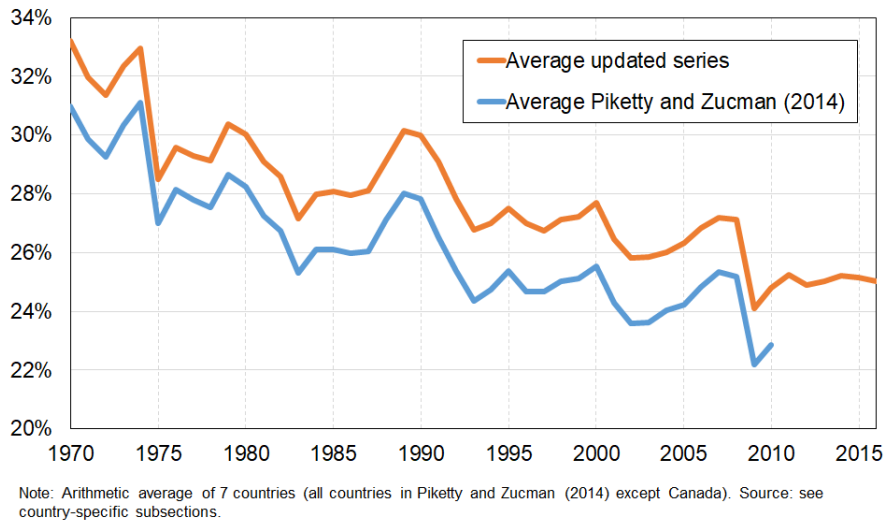


FIGURE 3.7 – AVERAGE GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1970-2016

Figure 8. Net capital formation (% national income), 1970-2016

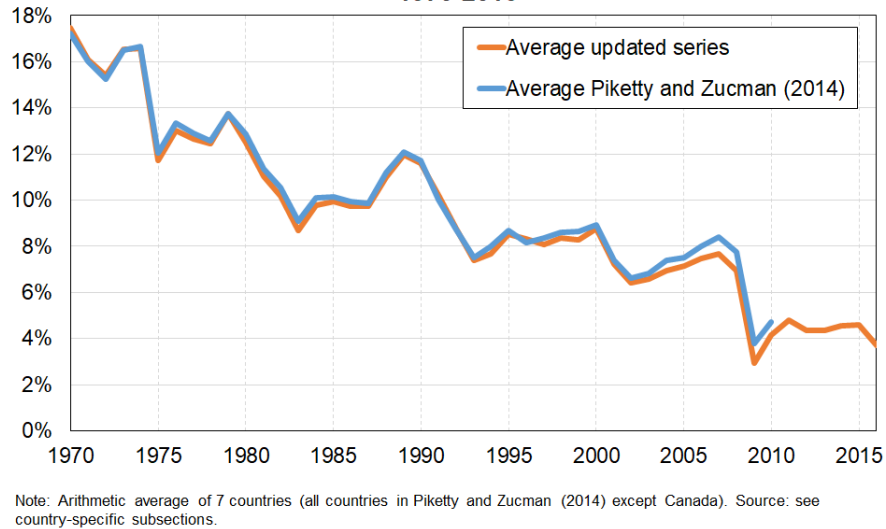
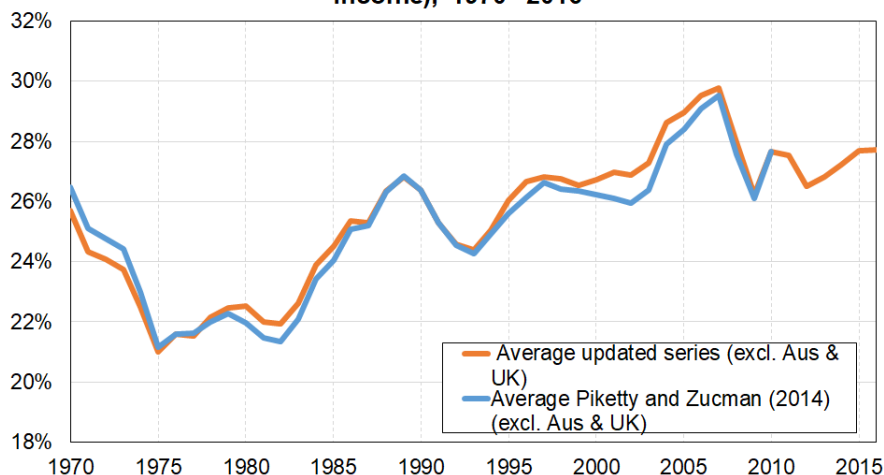


FIGURE 3.8 – AVERAGE NET CAPITAL FORMATION (% NATIONAL INCOME), 1970-2016

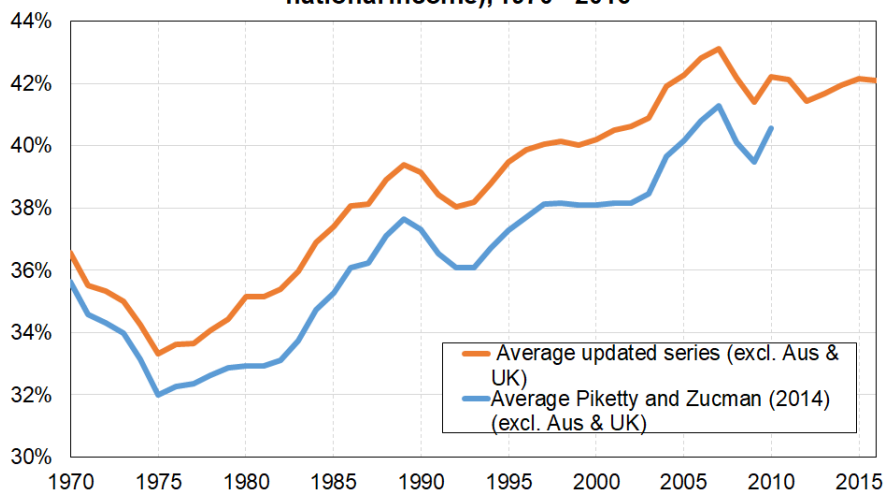
Figure 9. Net capital income (% factor-price national income), 1970 - 2016



Note: Arithmetic average of France, Germany, Italy, Japan and the US. Source: see country-specific subsections.

FIGURE 3.9 – AVERAGE NET CAPITAL INCOME (% NET FACTOR-PRICE NATIONAL INCOME), 1970 - 2016 (EXCLUDING AUSTRALIA AND UK)

Figure 10. Gross capital income (% factor-price gross national income), 1970 - 2016



Note: Arithmetic average of France, Germany, Italy, Japan and the US. Source: see country-specific subsections.

FIGURE 3.10 – AVERAGE GROSS CAPITAL INCOME (% GROSS FACTOR-PRICE NATIONAL INCOME), 1970 - 2016 (EXCLUDING AUSTRALIA AND UK)

Figure 11. Gross capital formation (% national income), 1970-2016

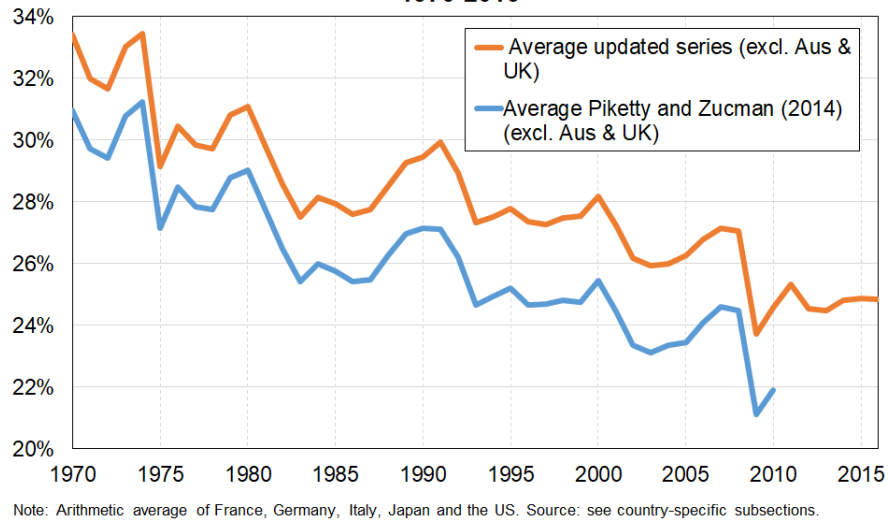


FIGURE 3.11 – AVERAGE GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1970-2016
(EXCLUDING AUSTRALIA AND UK)

Figure 12. Net capital formation (% national income), 1970-2016

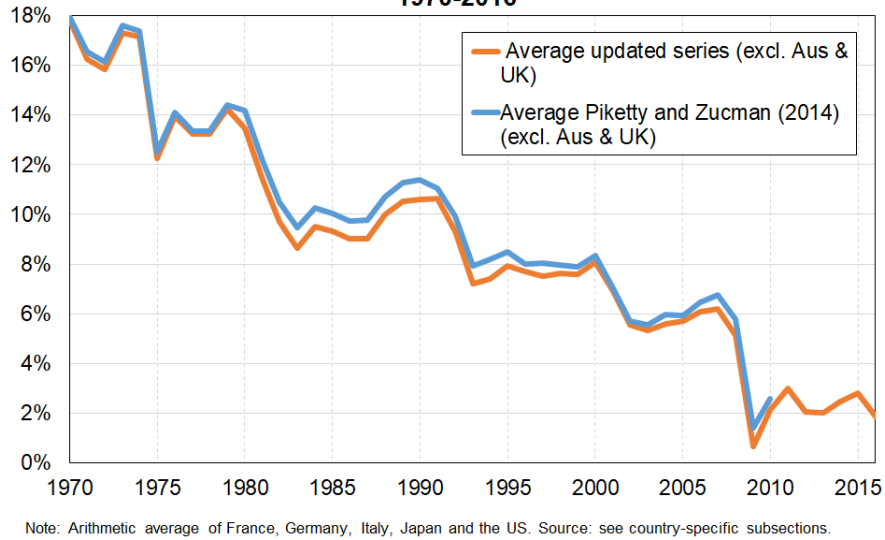


FIGURE 3.12 – AVERAGE NET CAPITAL FORMATION (% NATIONAL INCOME), 1970-2016
(EXCLUDING AUSTRALIA AND UK)

Figure 13. Australia: Net private wealth (% national income), 1970-2016

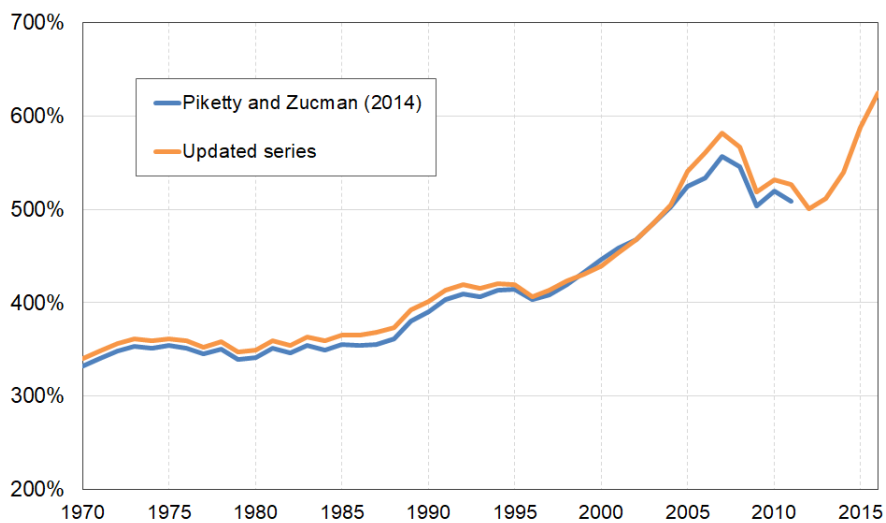


FIGURE 3.13 – AUSTRALIA: NET PRIVATE WEALTH (% NATIONAL INCOME), 1970-2016

Figure 14. Australia: Net public wealth (% national income), 1970-2016

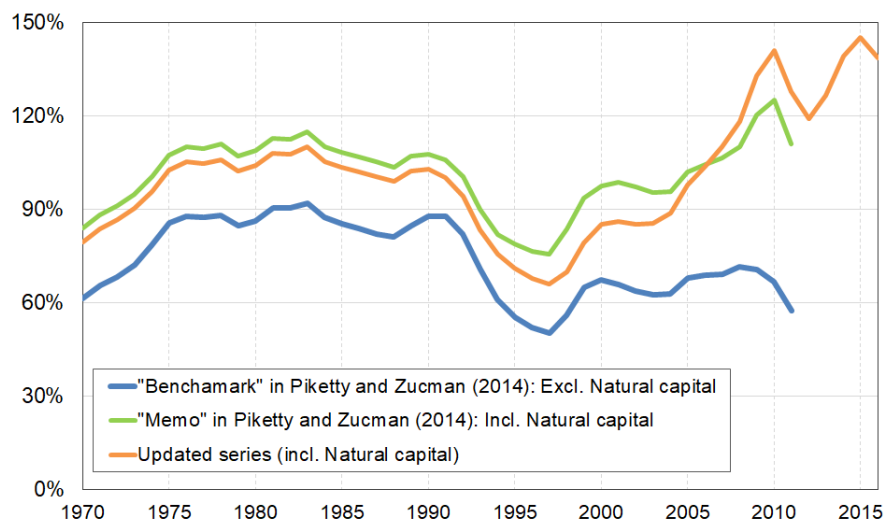


FIGURE 3.14 – AUSTRALIA: NET PUBLIC WEALTH (% NATIONAL INCOME), 1970-2016

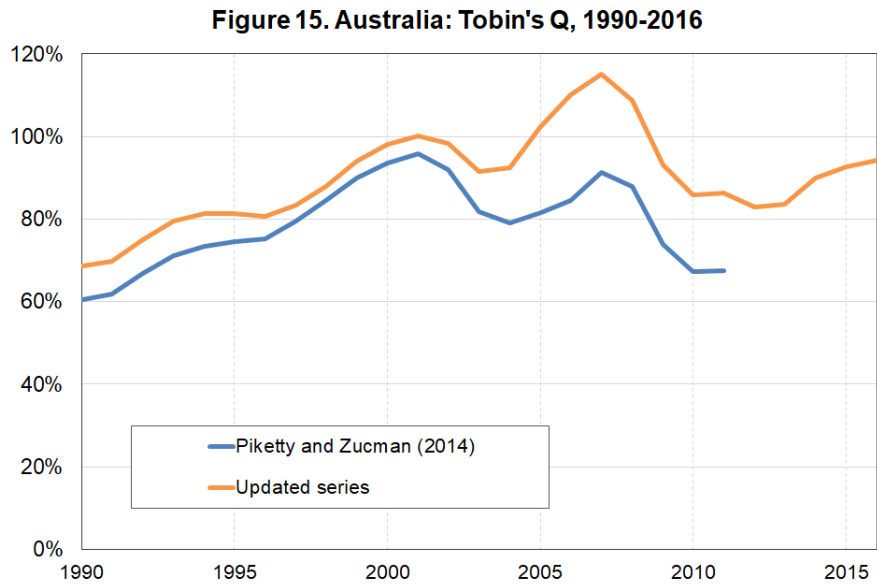


FIGURE 3.15 – AUSTRALIA: TOBINS'Q, 1990-2016

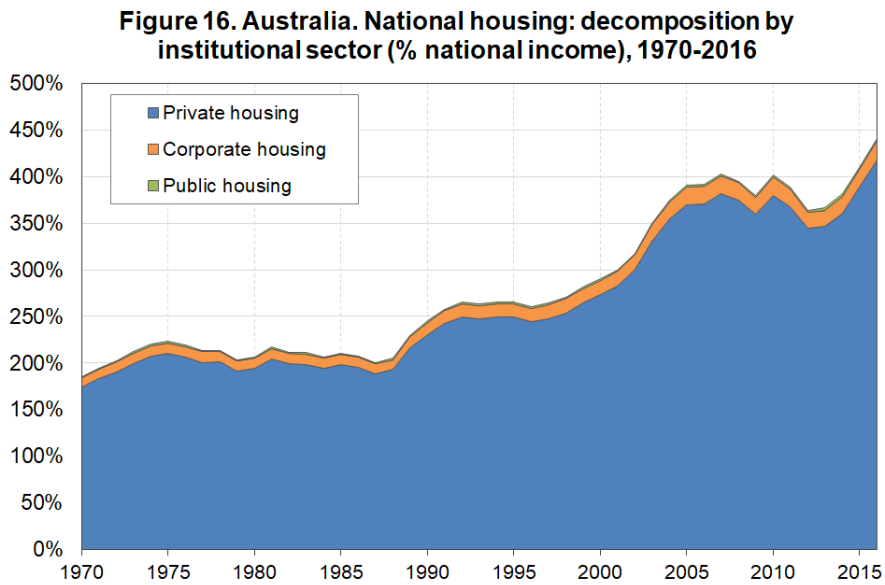


FIGURE 3.16 – AUSTRALIA: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2016

**Figure 17. Australia: National natural capital
(% national income), 1970-2016**

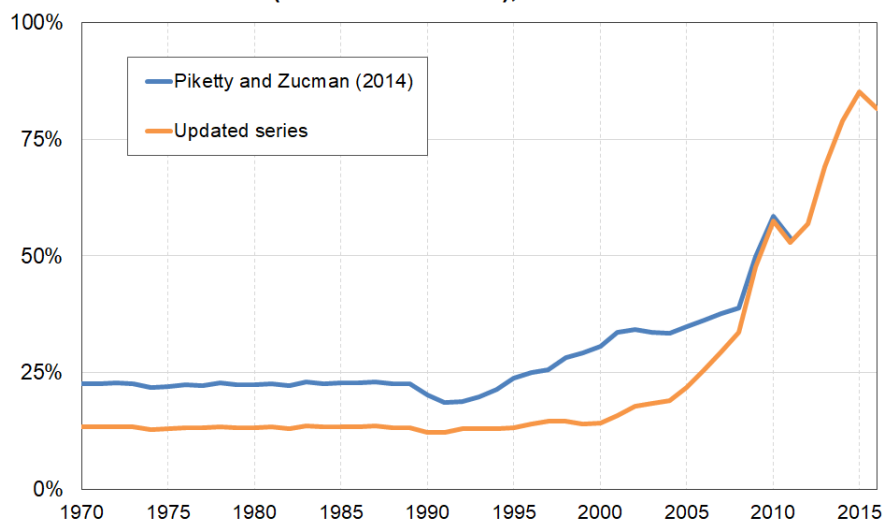


FIGURE 3.17 – AUSTRALIA: NATURAL CAPITAL (% NATIONAL INCOME), 1970-2016

**Figure 18. Australia: Net capital income (% factor-price net
national income), 1960-2017**

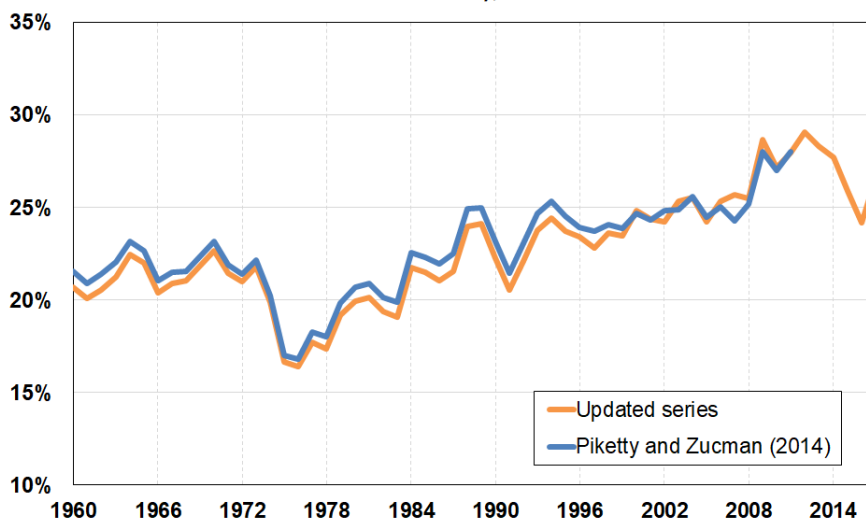


FIGURE 3.18 – AUSTRALIA: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1960-2017

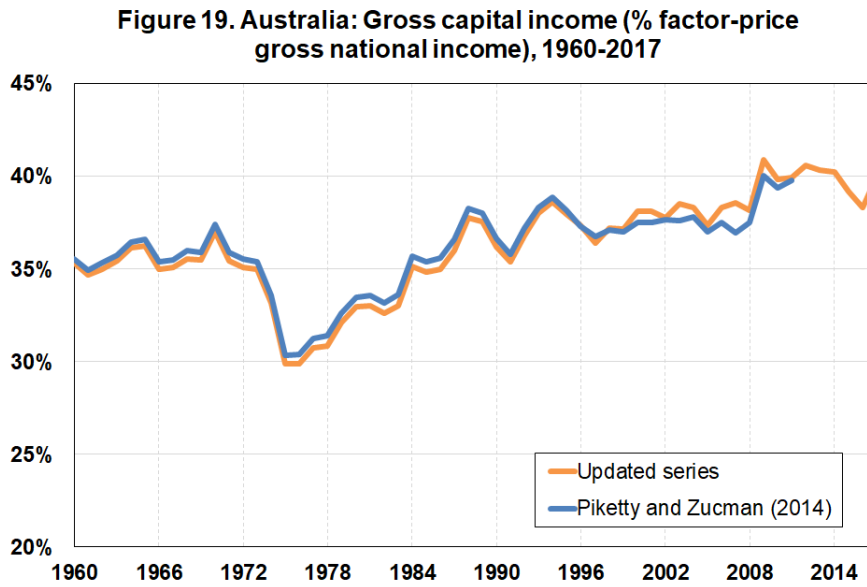


FIGURE 3.19 – AUSTRALIA: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1960-2017

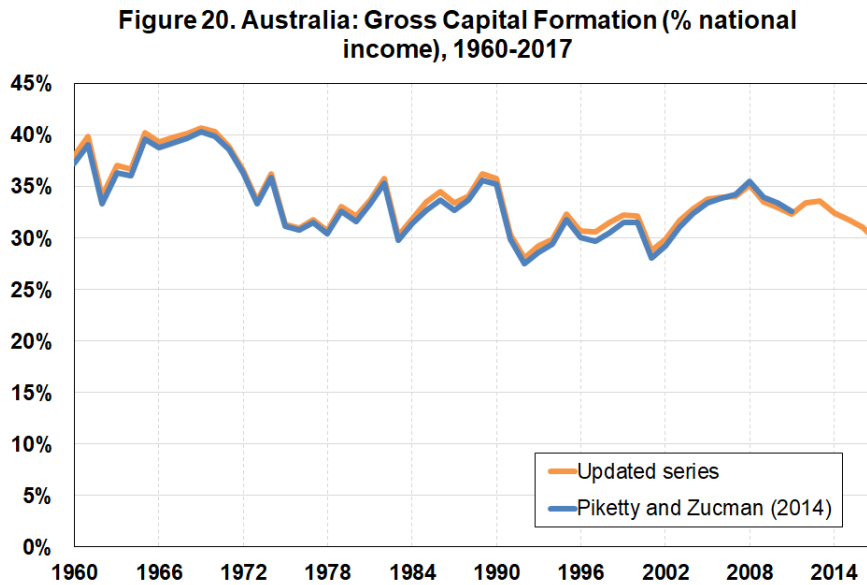


FIGURE 3.20 – AUSTRALIA: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1960-2017

Figure 21. Australia: Net Capital Formation (% national income), 1960-2017

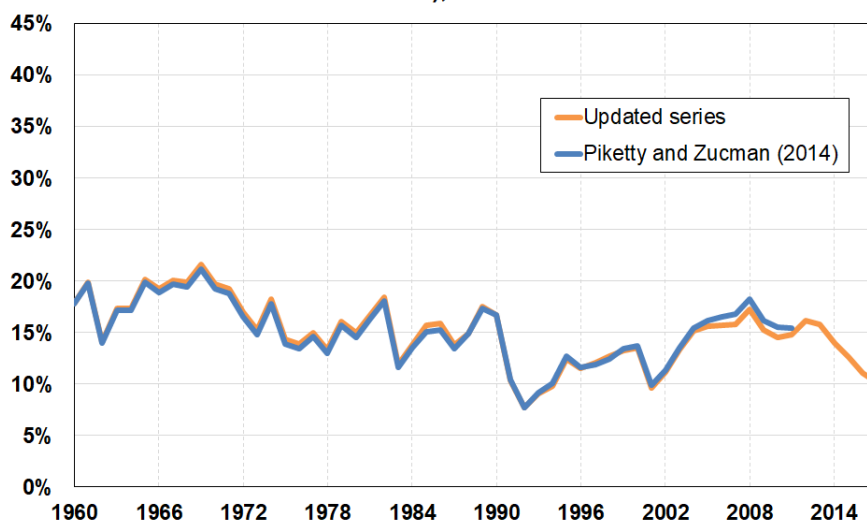


FIGURE 3.21 – AUSTRALIA: NET CAPITAL FORMATION (% NATIONAL INCOME), 1960-2017

Figure 22. Australia: Gross capital formation and capital depreciation, nominal values difference between new and old series (as a % of updated GDP), 1960-2011

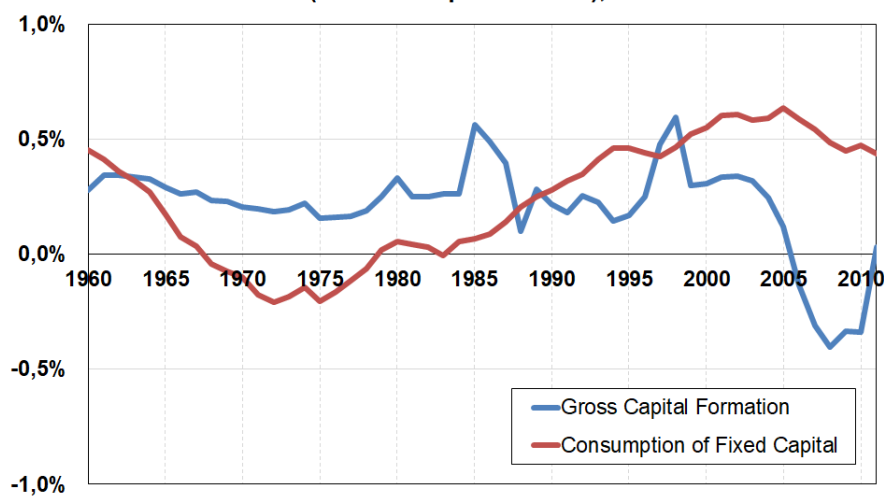


FIGURE 3.22 – AUSTRALIA: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1960-2011

Figure 23. Canada: Net personal wealth (% national income), 1970-2016

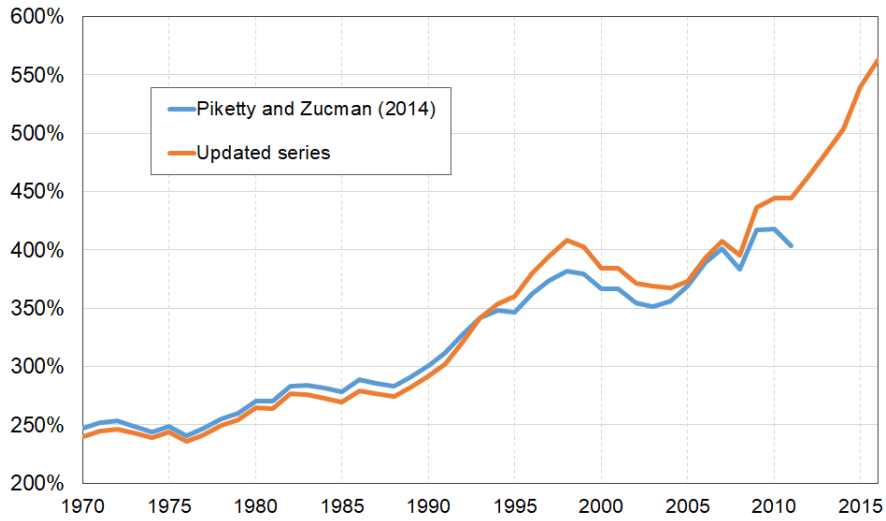


FIGURE 3.23 – CANADA: NET PERSONAL WEALTH (% NATIONAL INCOME), 1970-2016

Figure 24. Canada: Net public wealth (% national income), 1970-2016

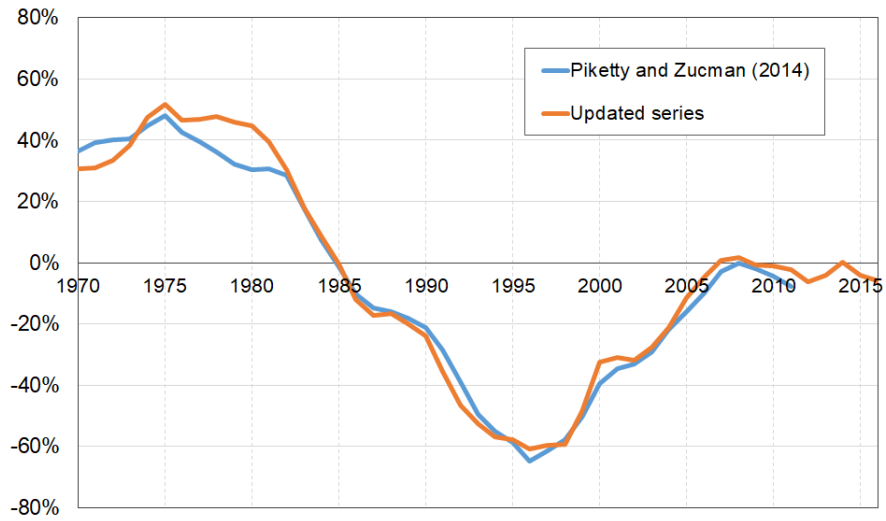


FIGURE 3.24 – CANADA: NET PUBLIC WEALTH (% NATIONAL INCOME), 1970-2016

Figure 25. Canada: Tobin's equity Q (% national income), 1970-2016

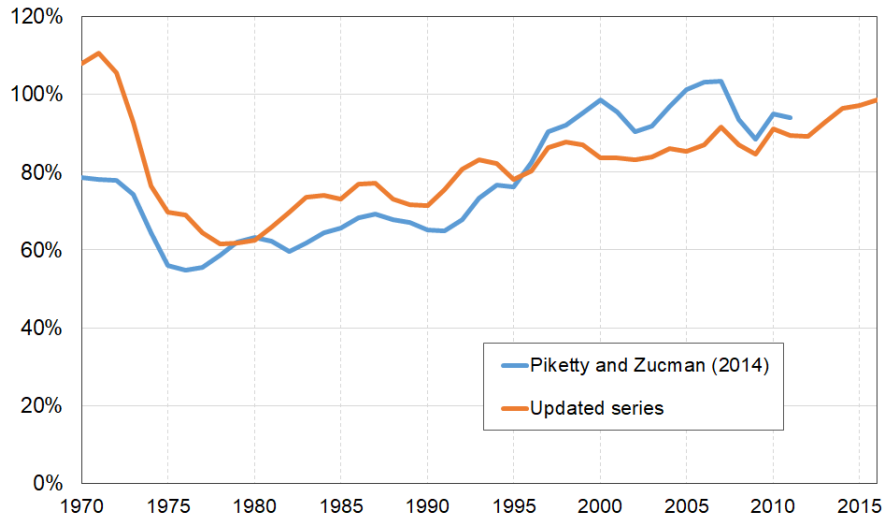


FIGURE 3.25 – CANADA: TOBIN'S EQUITY Q, 1970-2016

Figure 26. Canada. National housing: decomposition by institutional sector (% national income), 1970-2016

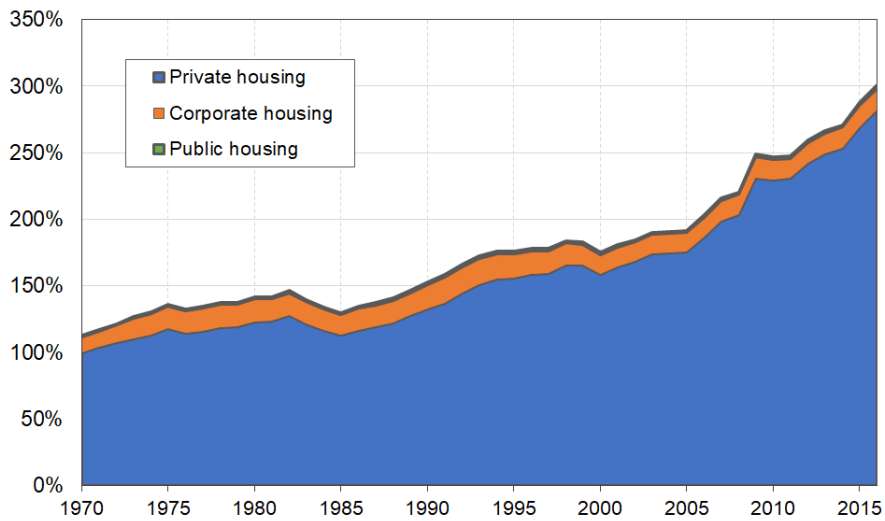


FIGURE 3.26 – CANADA: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2016

Figure 27. Canada. Natural resources: Comparison of series (% national income), 1970-2015

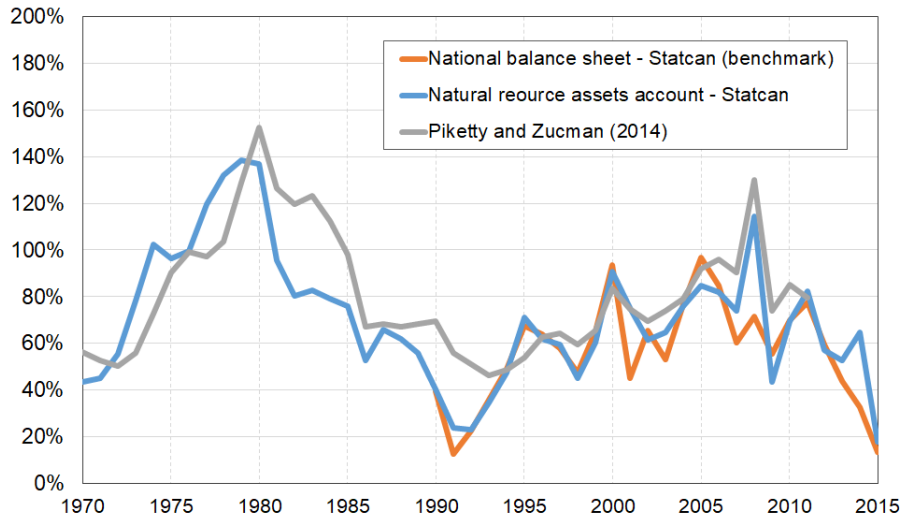


FIGURE 3.27 – CANADA: NATURAL RESOURCES: COMPARISON OF SERIES (% NATIONAL INCOME), 1970-2016

Figure 28. Canada. Agricultural land: decomposition by institutional sector (% national income), 1970-2016

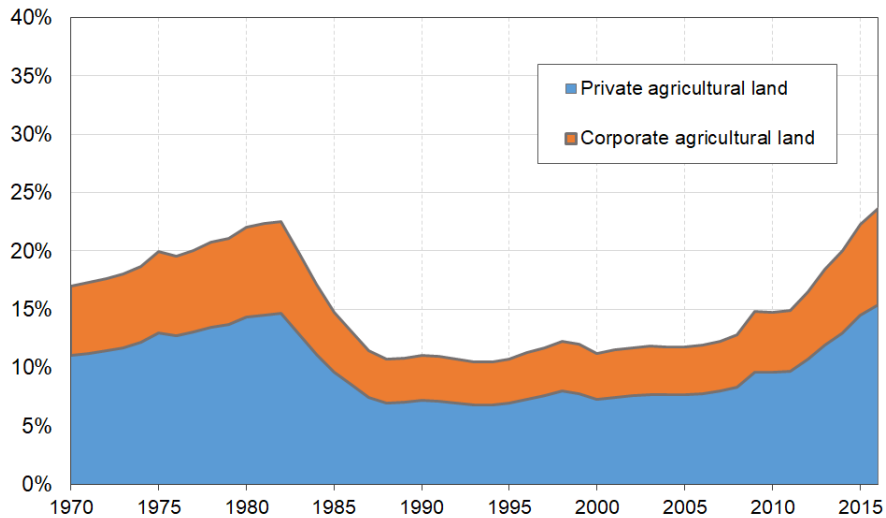


FIGURE 3.28 – CANADA: AGRICULTURAL LAND: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2016

Figure 29. France. Net private wealth (% national income), 1970-2015

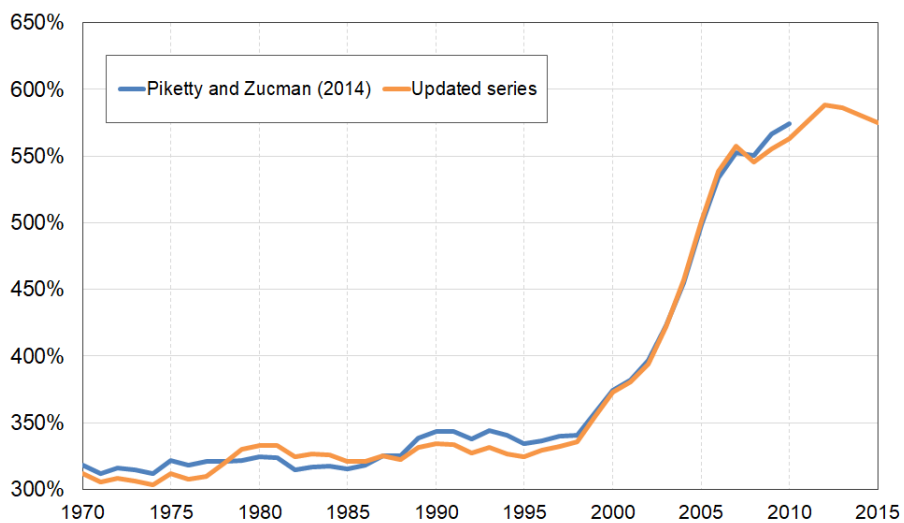


FIGURE 3.29 – FRANCE: NET PRIVATE WEALTH (% NATIONAL INCOME), 1970-2015

Figure 30. France. Tobin's 'equity' Q, 1970-2015

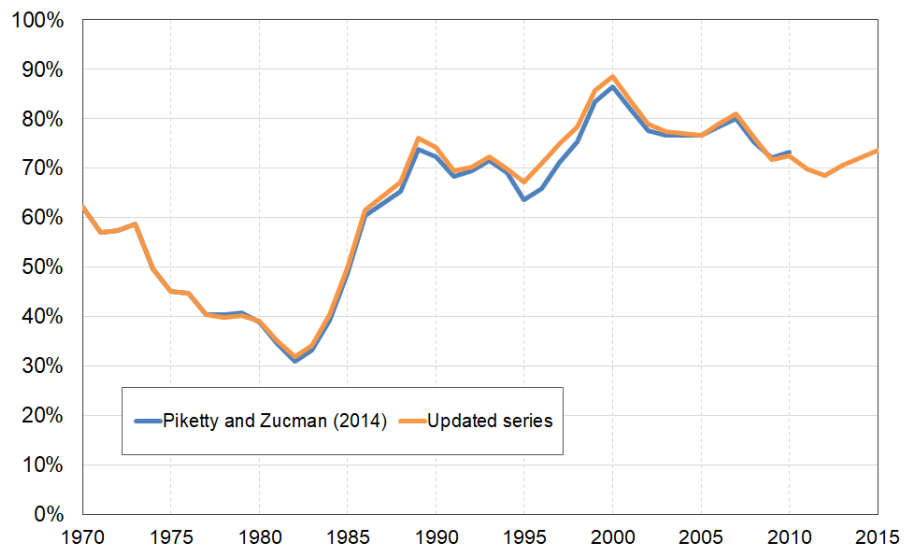


FIGURE 3.30 – FRANCE: TOBIN'S EQUITY Q, 1970-2015

Figure 31. France. Net public wealth (% national income), 1970-2015

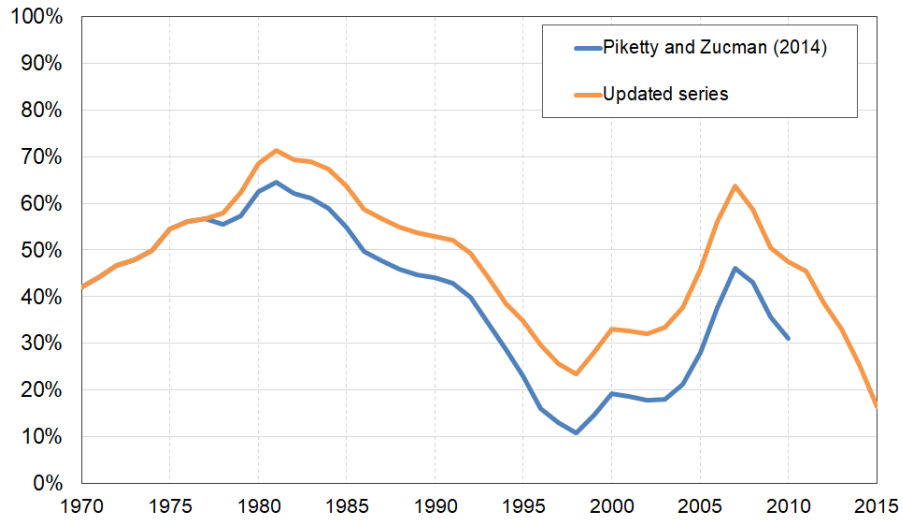


FIGURE 3.31 – FRANCE: NET PUBLIC WEALTH (% NATIONAL INCOME), 1970-2015

Figure 32. France. National housing: decomposition by institutional sector (% national income), 1970-2015

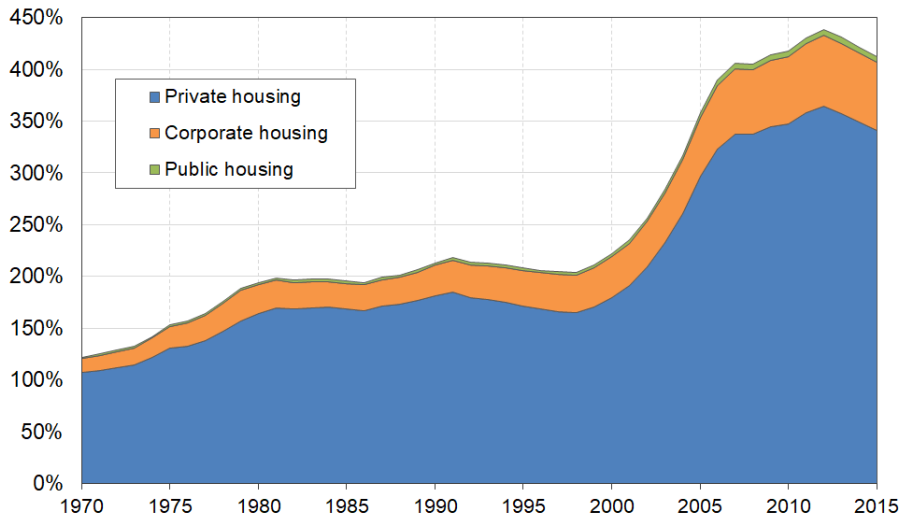


FIGURE 3.32 – FRANCE: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2015

Figure 33. France. Renters of social housing (% total households) and 'Corporate and public housing' (% national housing), 1970-2015

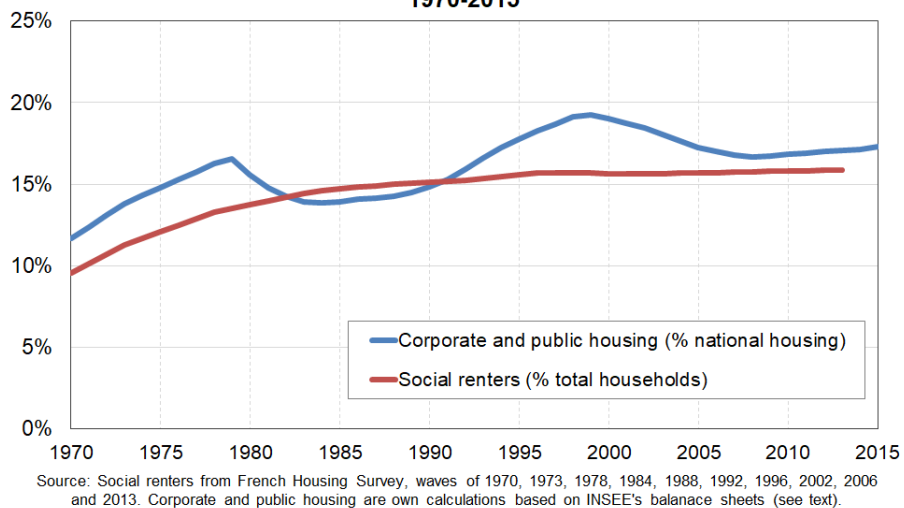


FIGURE 3.33 – FRANCE: RENTERS OF SOCIAL HOUSING (% TOTAL HOUSEHOLDS) AND 'CORPORATE AND PUBLIC' HOUSING (% NATIONAL HOUSING), 1970-2015

Figure 34. France. National agricultural land: decomposition by institutional sector (% national income), 1970-2015

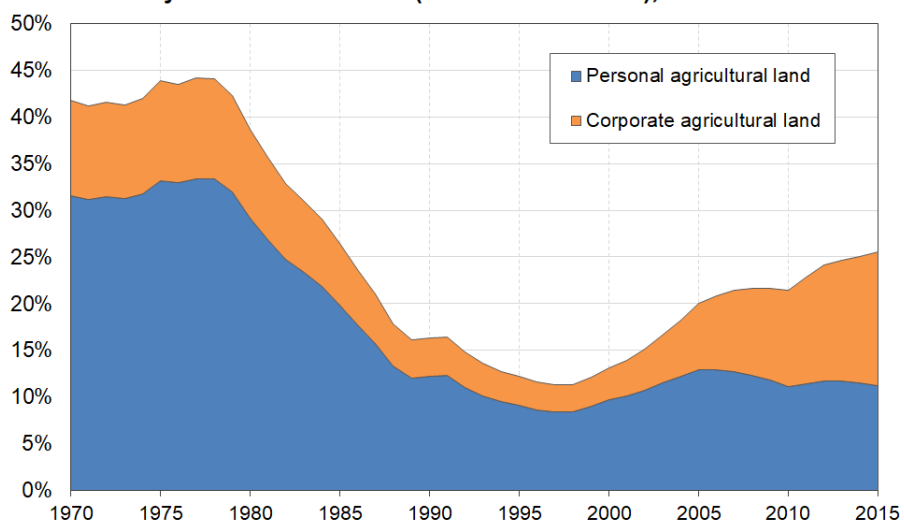


FIGURE 3.34 – FRANCE: NATIONAL AGRICULTURAL LAND: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2015

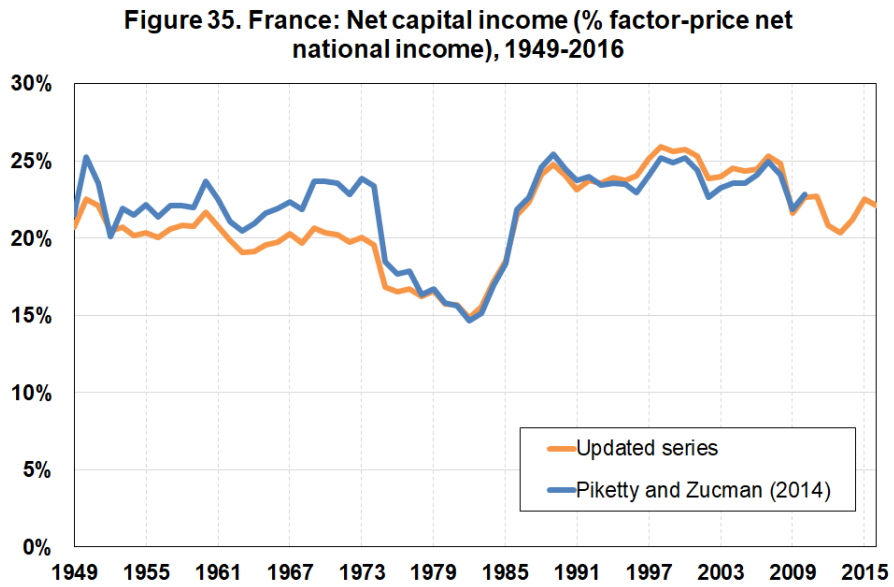


FIGURE 3.35 – FRANCE: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1949-2016

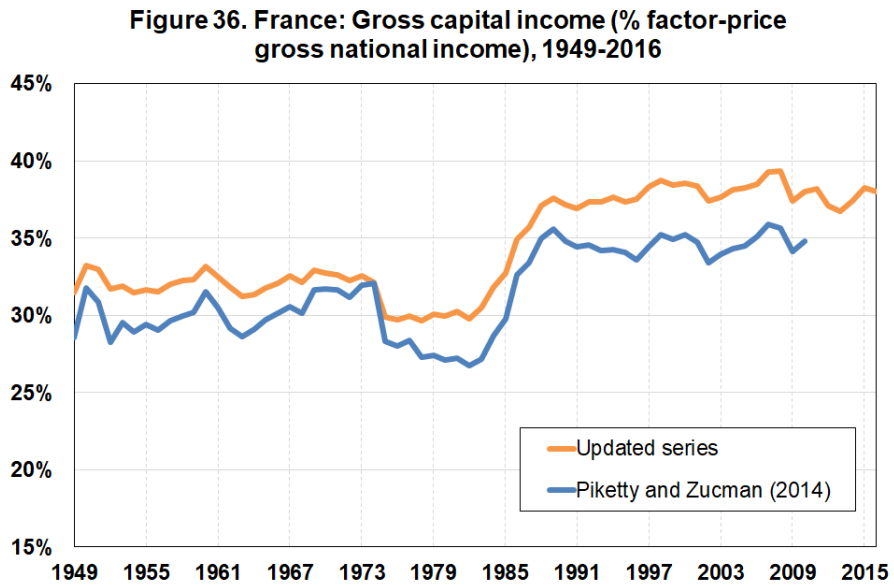


FIGURE 3.36 – FRANCE: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1949-2016

Figure 37. France: Gross Capital Formation (% national income), 1949-2016

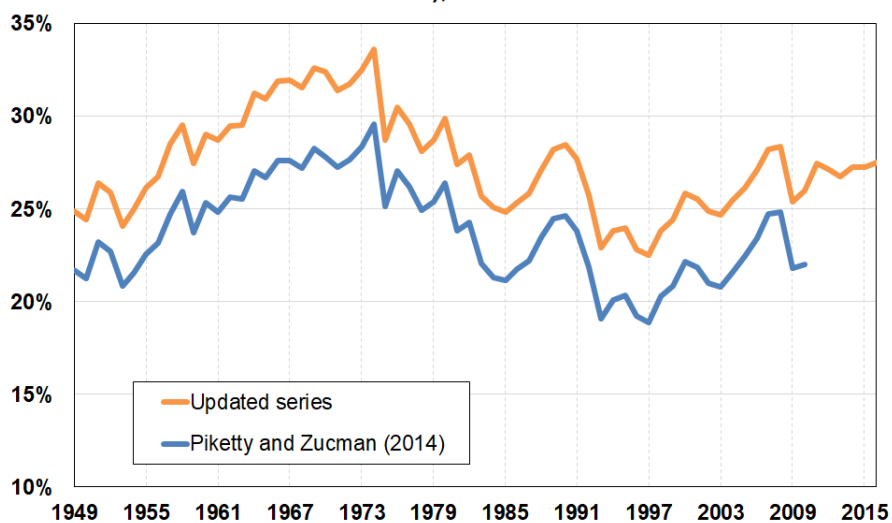


FIGURE 3.37 – FRANCE: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1949-2016

Figure 38. France: Net Capital Formation (% national income), 1949-2016

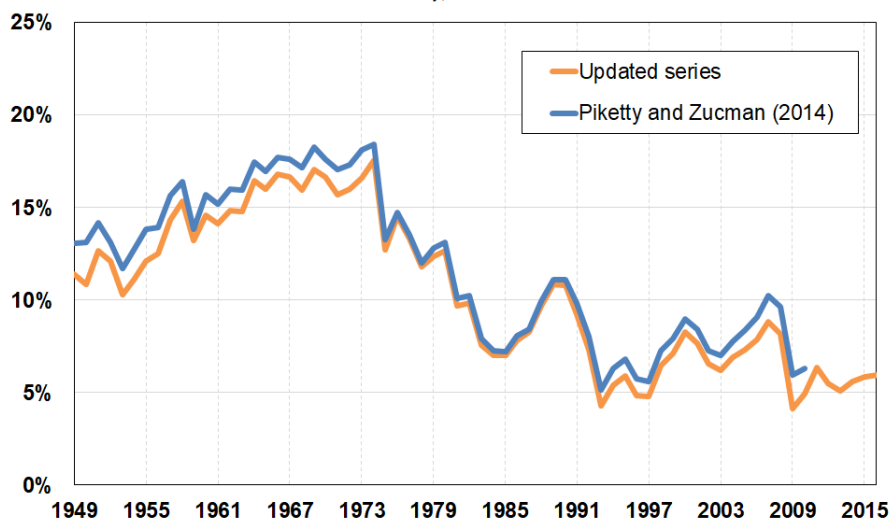


FIGURE 3.38 – FRANCE: NET CAPITAL FORMATION (% NATIONAL INCOME), 1949-2016

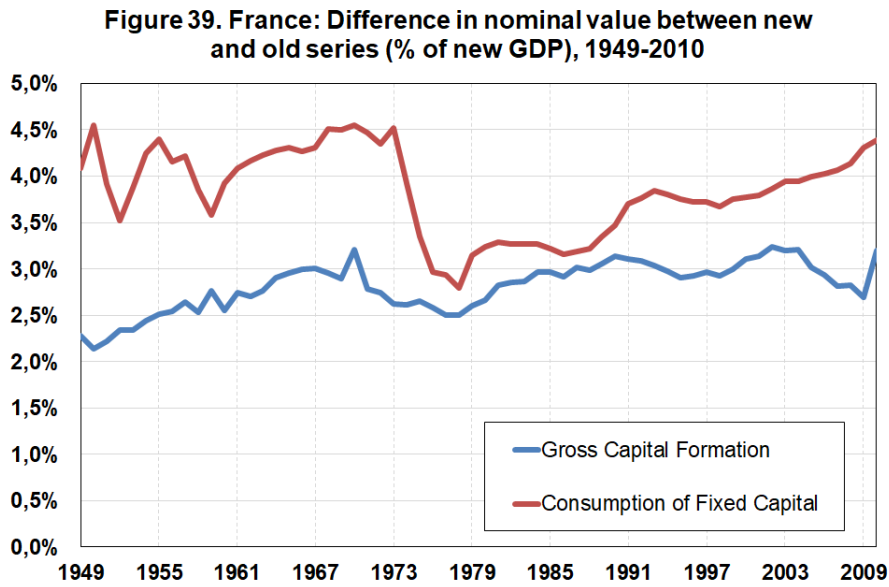


FIGURE 3.39 – FRANCE: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1949-2010

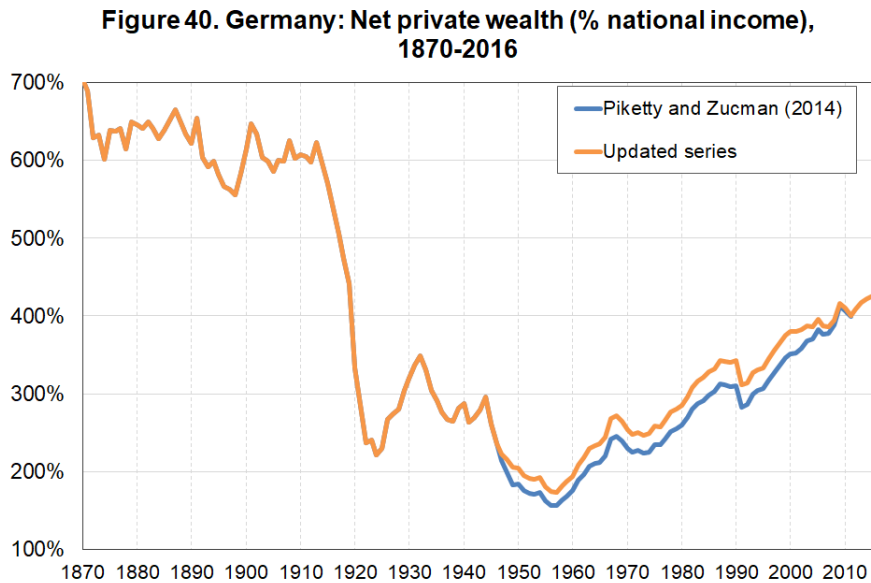


FIGURE 3.40 – GERMANY: NET PRIVATE WEALTH (% NATIONAL INCOME), 1870-2016

Figure 41. Germany: Net public wealth (% national income), 1870-2016

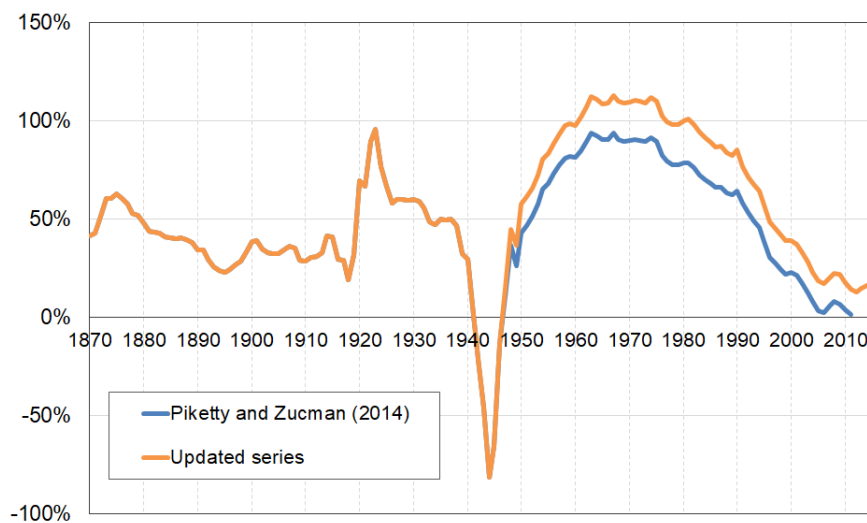


FIGURE 3.41 – GERMANY: NET PUBLIC WEALTH (% NATIONAL INCOME), 1870-2016

Figure 42. Germany: Tobin's equity Q (% national income), 1971-2016

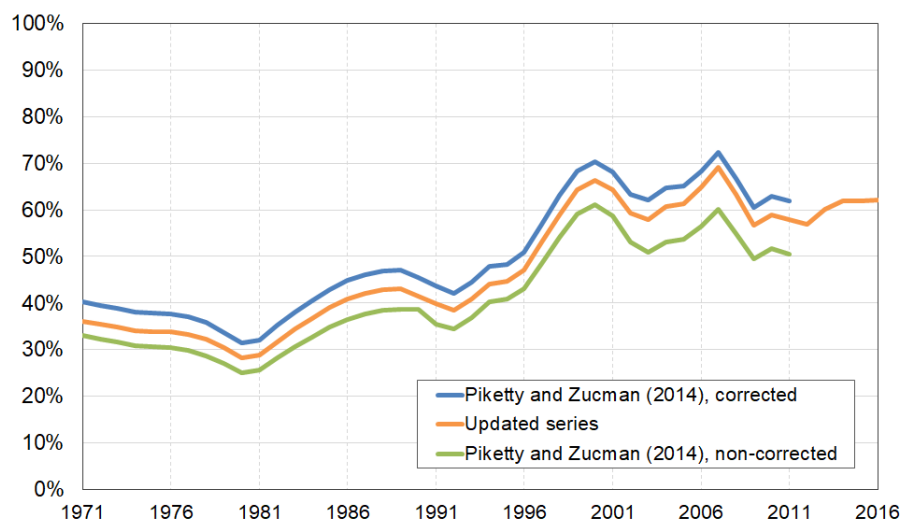


FIGURE 3.42 – GERMANY: TOBIN'S EQUITY Q, 1971-2016

Figure 43. Germany: National housing: decomposition by institutional sector (% national income), 1970-2016

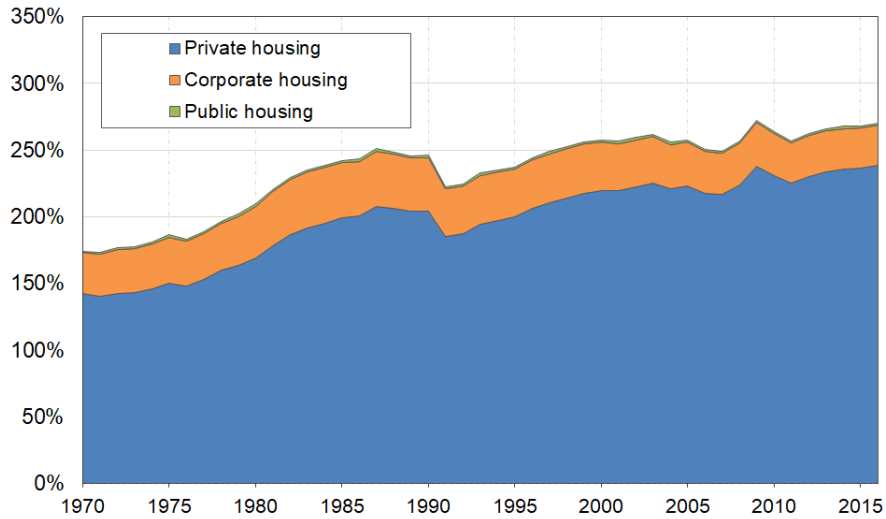


FIGURE 3.43 – GERMANY: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2016

Figure 44. Germany: Private housing (% national income), 1950-2016

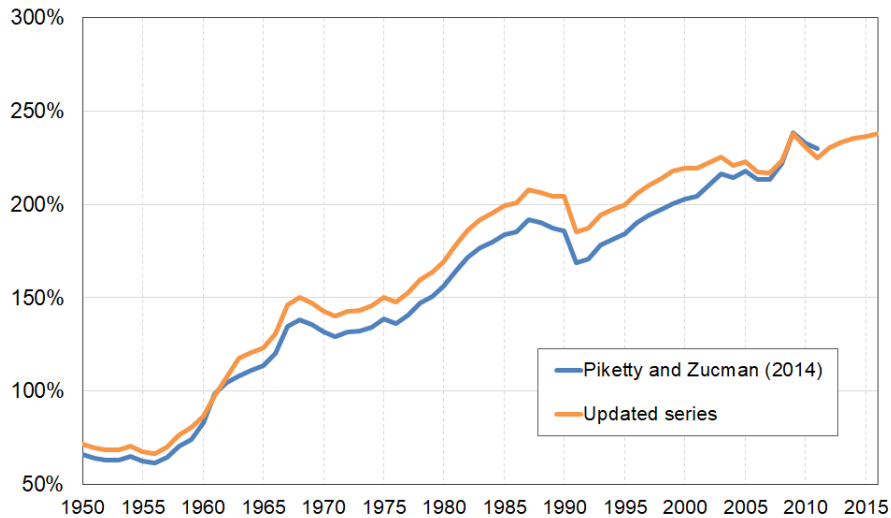


FIGURE 3.44 – GERMANY: PRIVATE HOUSING (% NATIONAL INCOME), 1950-2016

Figure 45. Germany. National agricultural land: decomposition by institutional sector (% national income), 1989-2016

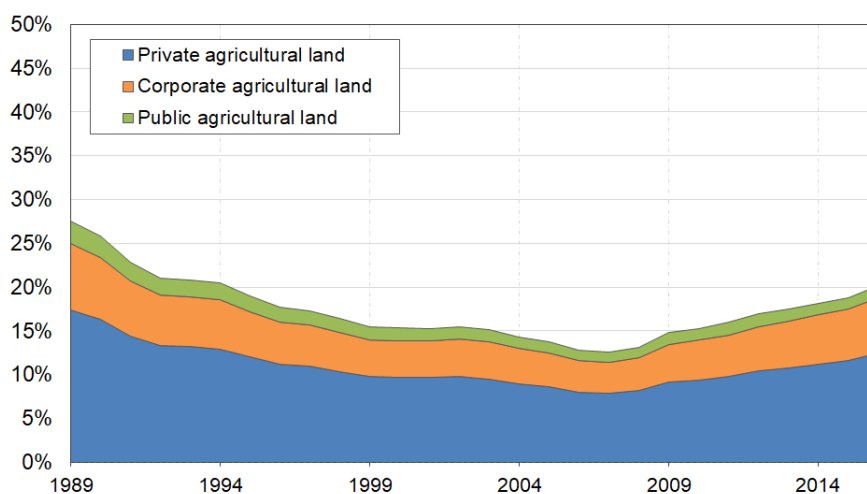


FIGURE 3.45 – GERMANY: NATIONAL AGRICULTURAL LAND: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1989-2016

Figure 46. Germany: Net capital income (% factor-price net national income), 1950-2017

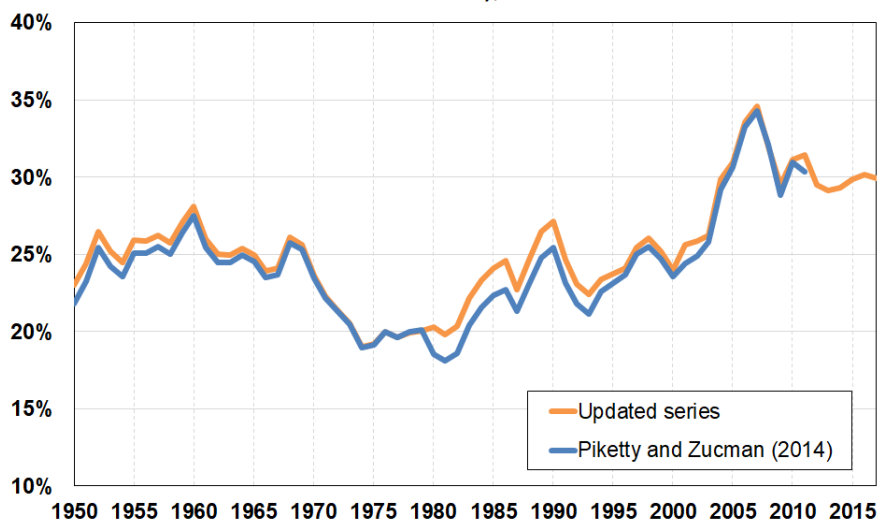


FIGURE 3.46 – GERMANY: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1950-2017

Figure 47. Germany: Gross capital income (% factor-price gross national income), 1950-2017

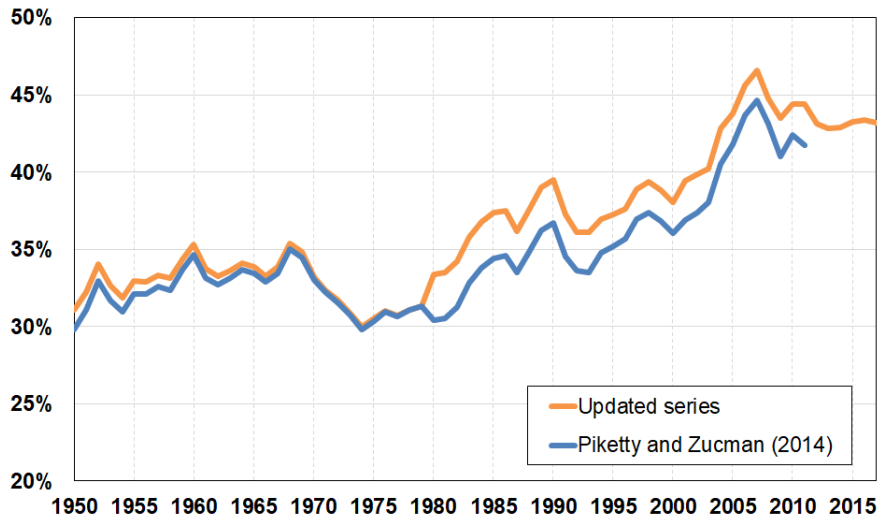


FIGURE 3.47 – GERMANY: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1950-2017

Figure 48. Germany: Gross capital formation (% national income), 1950-2017

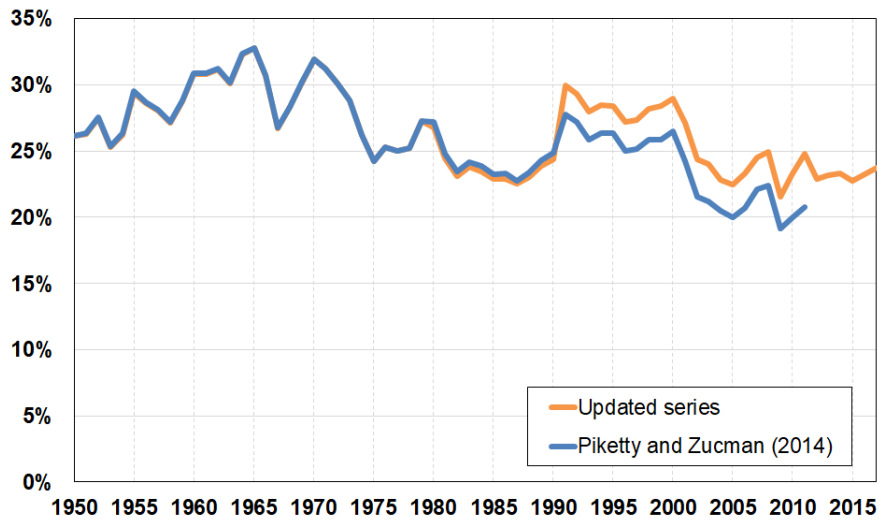


FIGURE 3.48 – GERMANY: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1950-2017

Figure 49. Germany: Net capital formation (% national income), 1950-2017

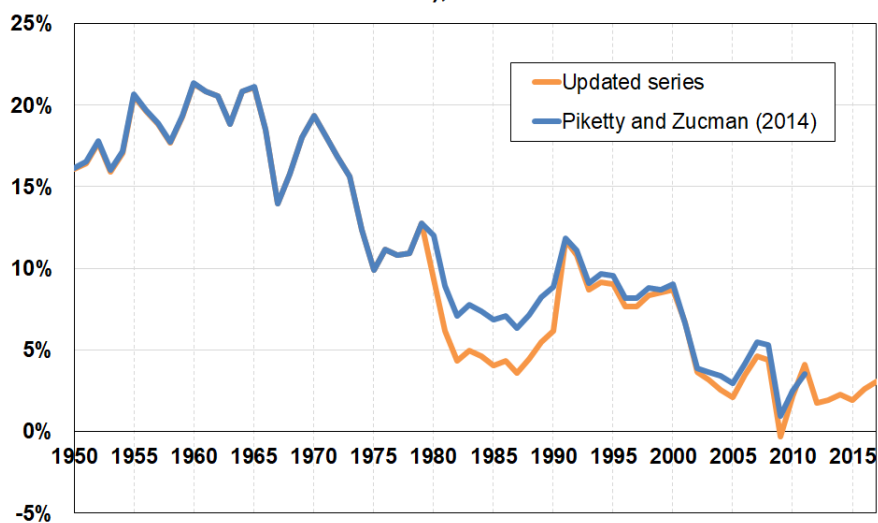


FIGURE 3.49 – GERMANY: NET CAPITAL FORMATION (% NATIONAL INCOME), 1950-2017

Figure 50. Germany: Difference in nominal values between new and old series (% of new GDP), 1990-2011

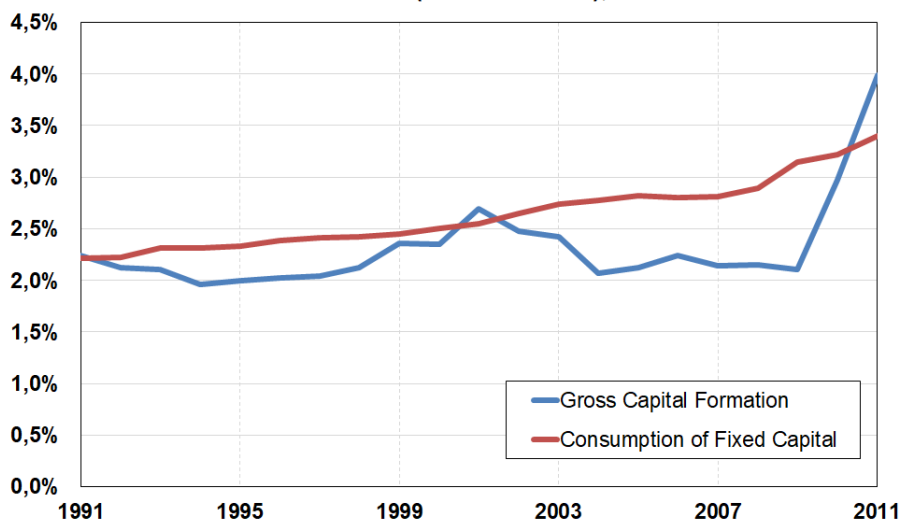


FIGURE 3.50 – GERMANY: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1990-2011

Figure 51. Italy: Net private wealth (% national income), 1970-2015

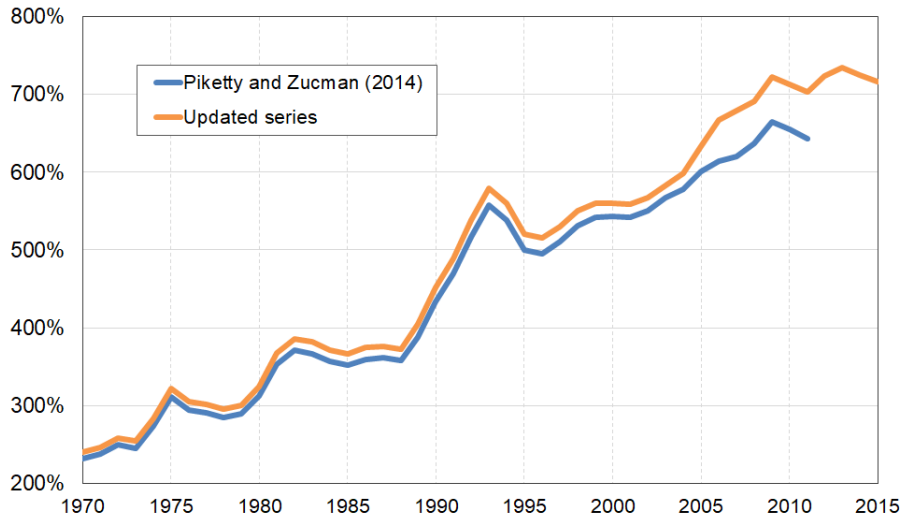


FIGURE 3.51 – ITALY: NET PRIVATE WEALTH (% NATIONAL INCOME), 1970-2015

Figure 52. Italy: Net public wealth (% national income), 1970-2015

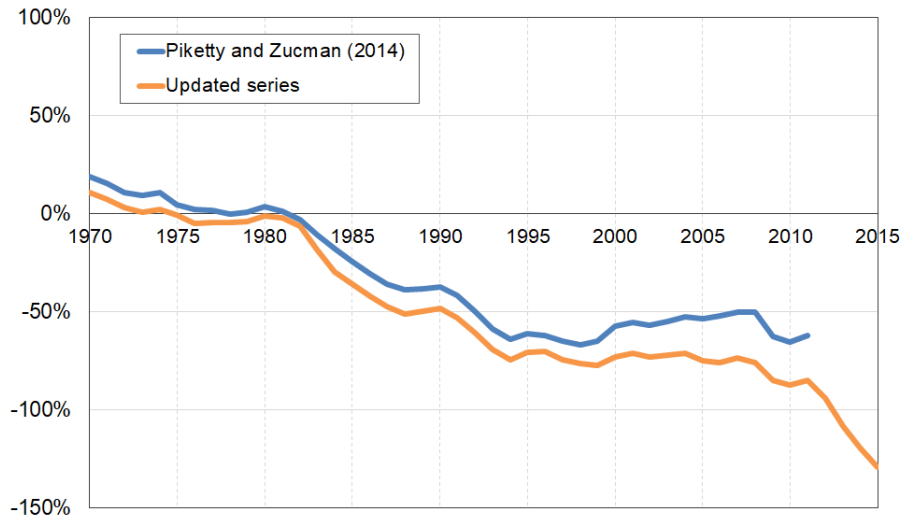


FIGURE 3.52 – ITALY: NET PUBLIC WEALTH (% NATIONAL INCOME), 1970-2015

Figure 53. Italy: Tobin's 'equity' Q, 2006-2015

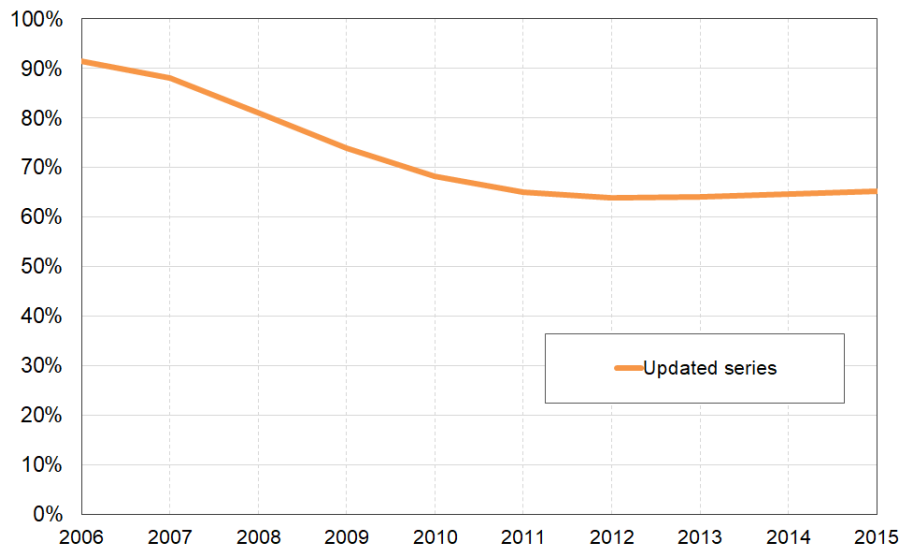


FIGURE 3.53 – ITALY: TOBIN'S EQUITY Q, 2006-2015

Figure 54. Italy. National housing: decomposition by institutional sector (% national income), 1970-2015

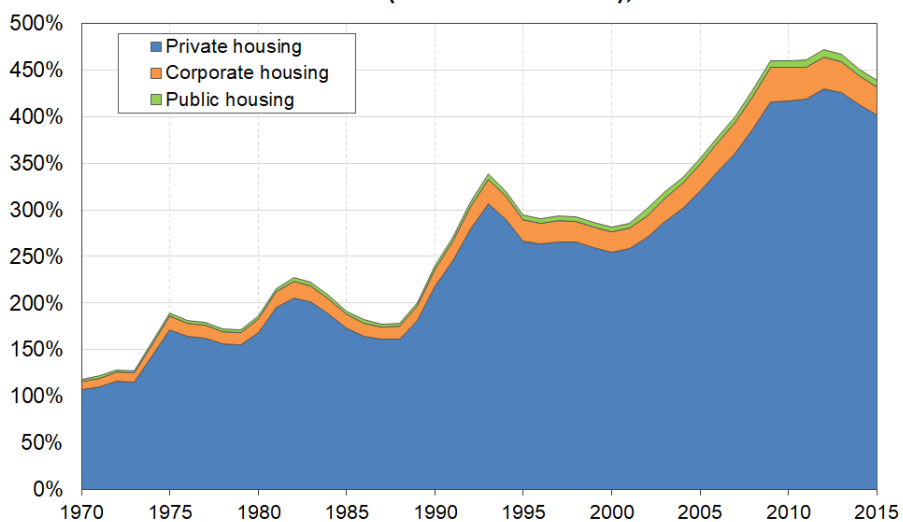


FIGURE 3.54 – ITALY: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2015

**Figure 55. Italy. Principal residences by tenure
(% total principal residences), 1966-2011**

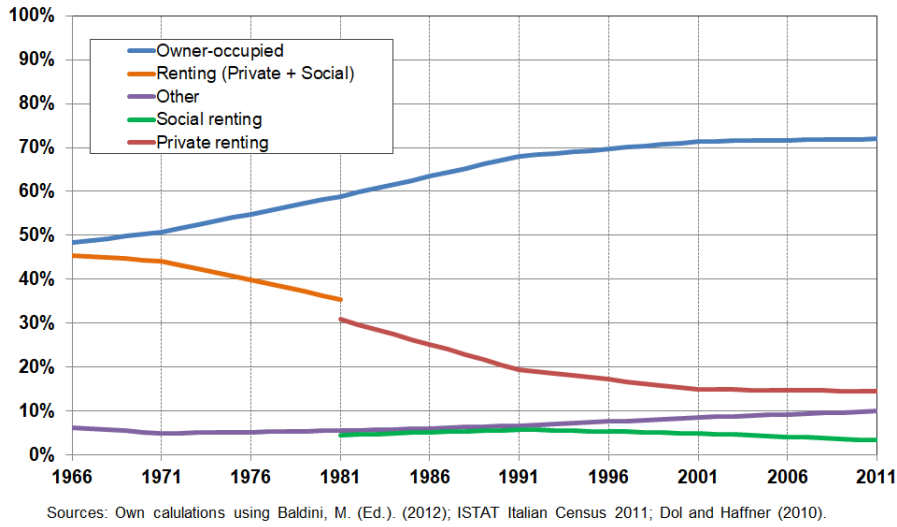


FIGURE 3.55 – ITALY: PRINCIPAL RESIDENCES BY TENURE (% TOTAL PRINCIPAL RESIDENCES), 1966-2011

Sources: Own calculations using Baldini (2012); ISTAT Italian Census 2011; Dol and Haffner (2010).

Figure 56. Italy: Net capital income (% factor-price net national income), 1960-2017

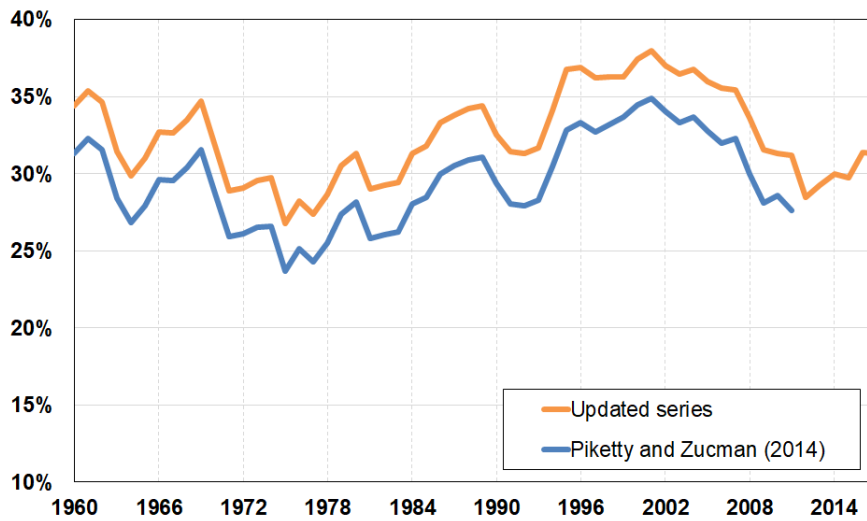


FIGURE 3.56 – ITALY: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1960-2017

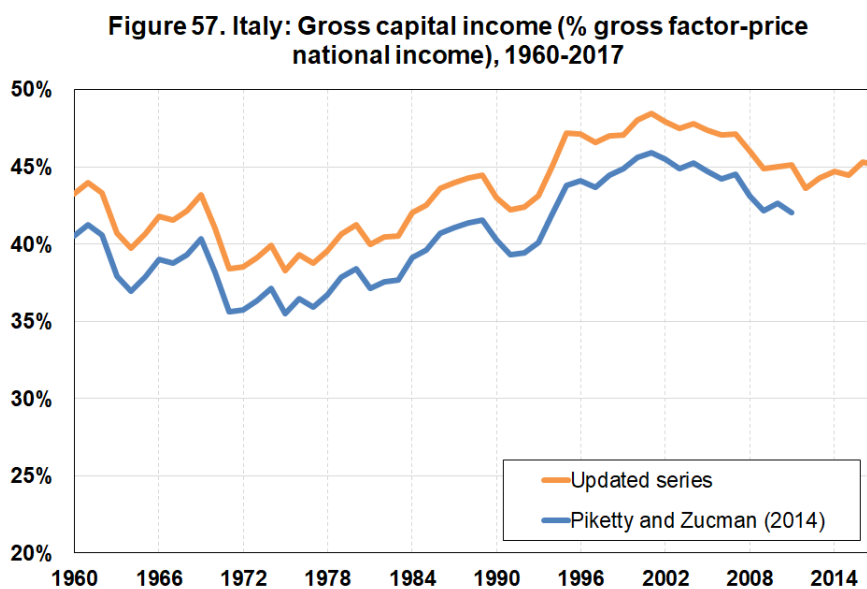


FIGURE 3.57 – ITALY: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1960-2017

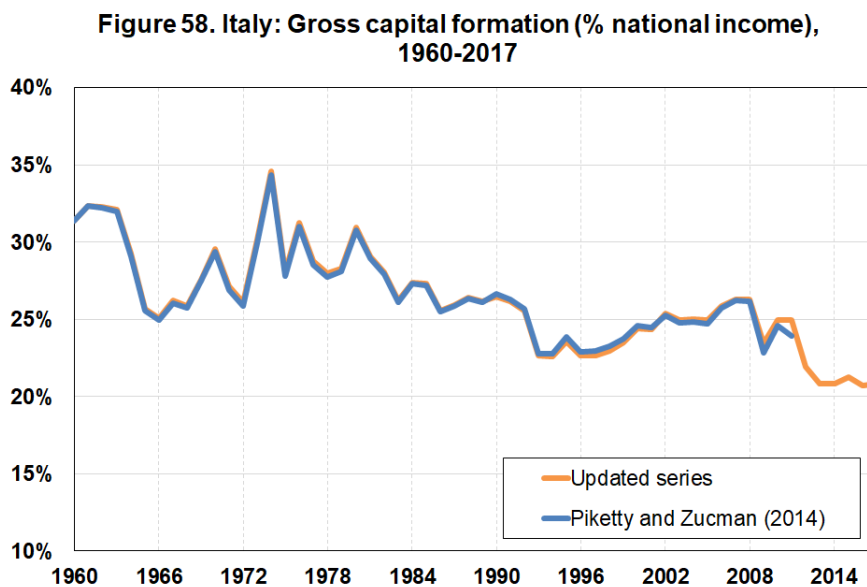


FIGURE 3.58 – ITALY: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1960-2017

Figure 59. Italy: Net capital formation (% national income), 1960-2017

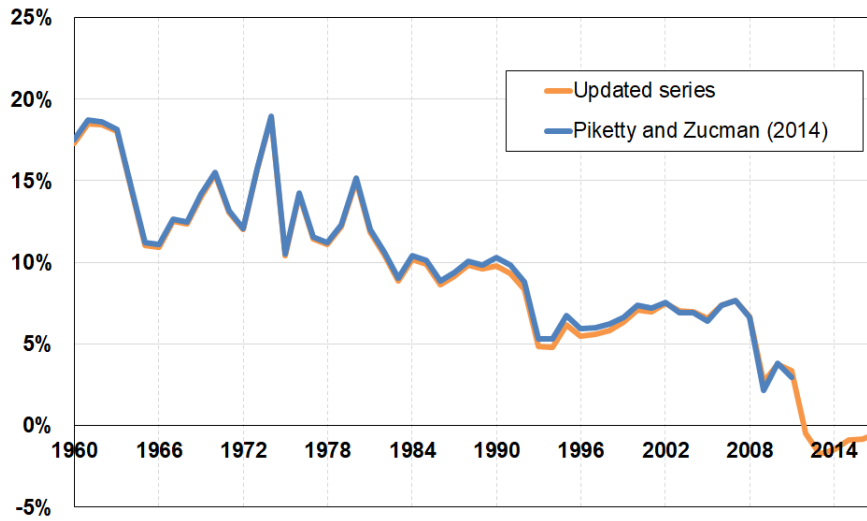


FIGURE 3.59 – ITALY: NET CAPITAL FORMATION (% NATIONAL INCOME), 1960-2017

Figure 60. Italy: Difference in nominal values between new and old series (% of new GDP), 1960-2010

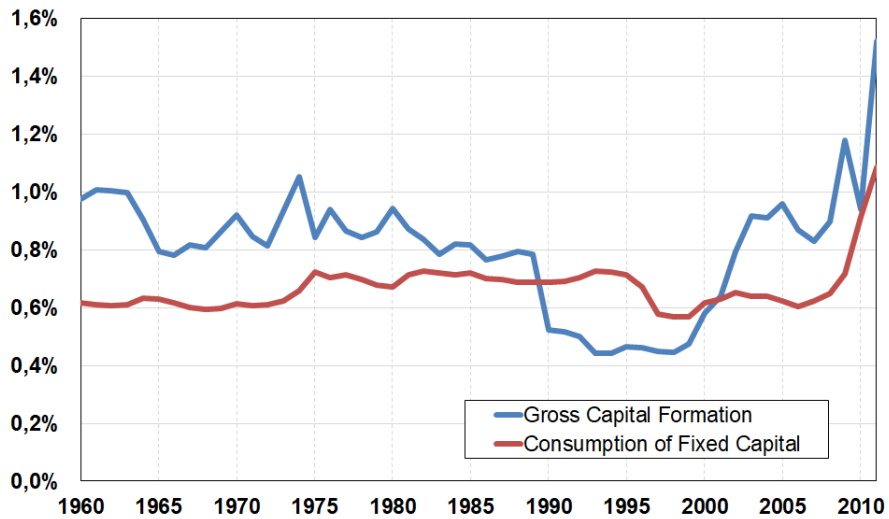


FIGURE 3.60 – ITALY: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1960-2010

Figure 61. Italy: Households and corporations net capital income in updated and old series (% of new GDP in both cases), 1980 - 2017

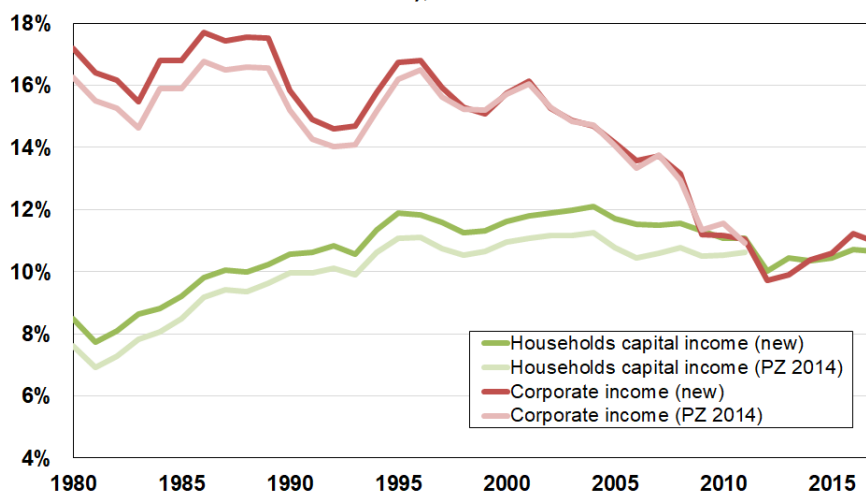


FIGURE 3.61 – ITALY: HOUSEHOLDS AND CORPORATIONS NET CAPITAL INCOME IN UPDATED AND OLD SERIES (% OF NEW GDP IN BOTH CASES), 1980 - 2017

Figure 62. Japan: Net private wealth (% national income), 1970-2015

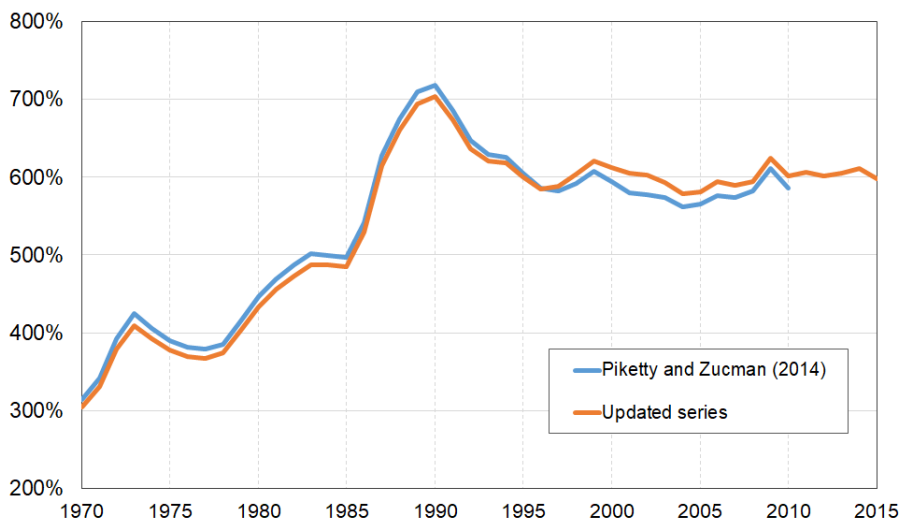


FIGURE 3.62 – JAPAN: NET PRIVATE WEALTH (% NATIONAL INCOME), 1970-2015

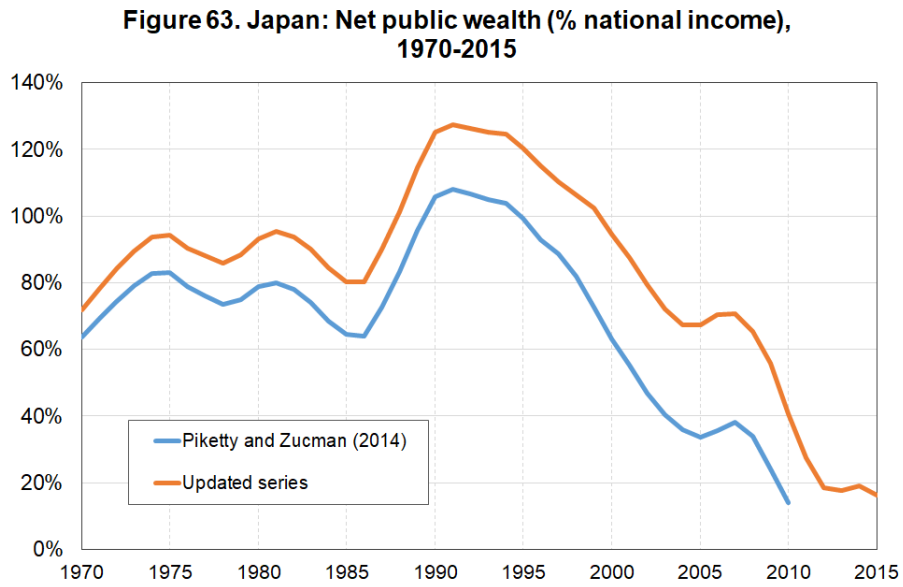


FIGURE 3.63 – JAPAN: NET PUBLIC WEALTH (% NATIONAL INCOME), 1970-2015

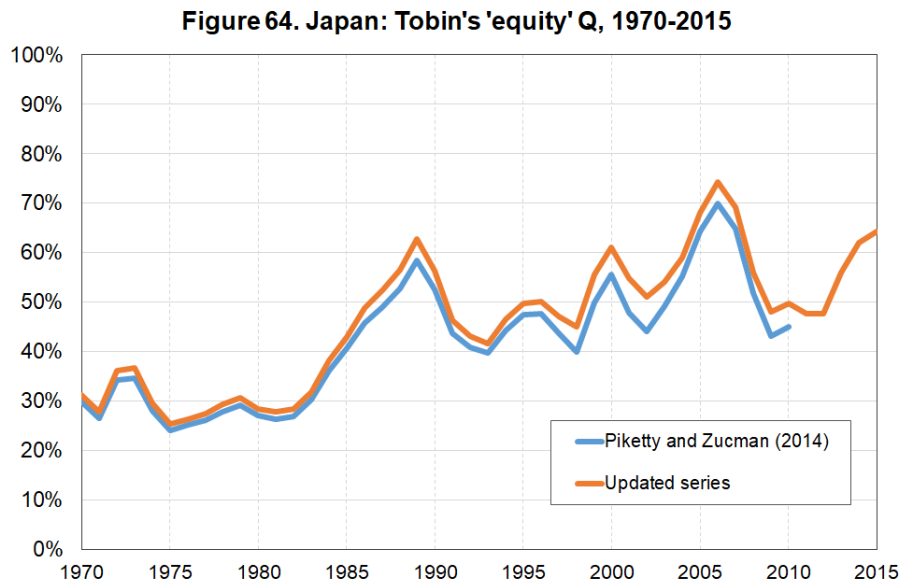


FIGURE 3.64 – JAPAN: TOBIN'S EQUITY Q, 1970-2015

Figure 65. Japan. National housing: decomposition by institutional sector (% national income), 1970-2015

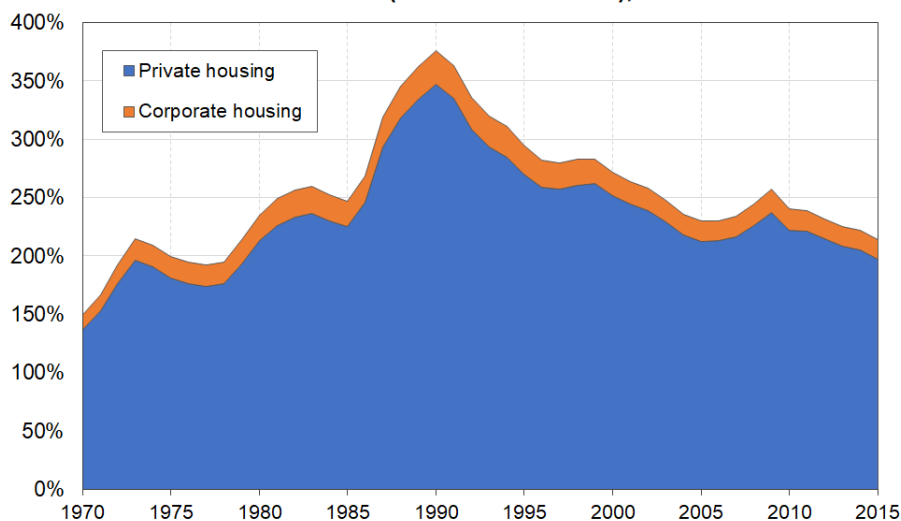


FIGURE 3.65 – JAPAN: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1970-2015

Figure 66. Japan: Net capital income (% factor-price net national income), 1955-2016

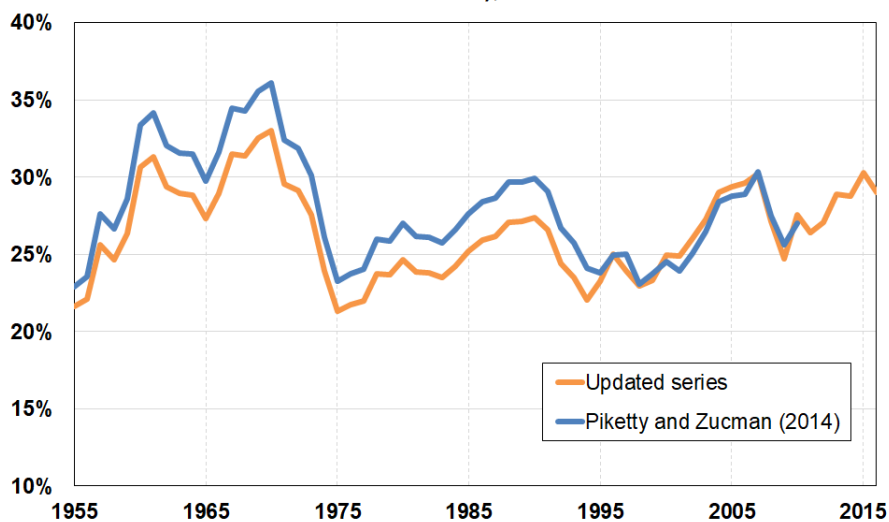


FIGURE 3.66 – JAPAN: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1955-2016

Figure 67. Japan: Gross capital income (% gross factor-price national income), 1955-2016

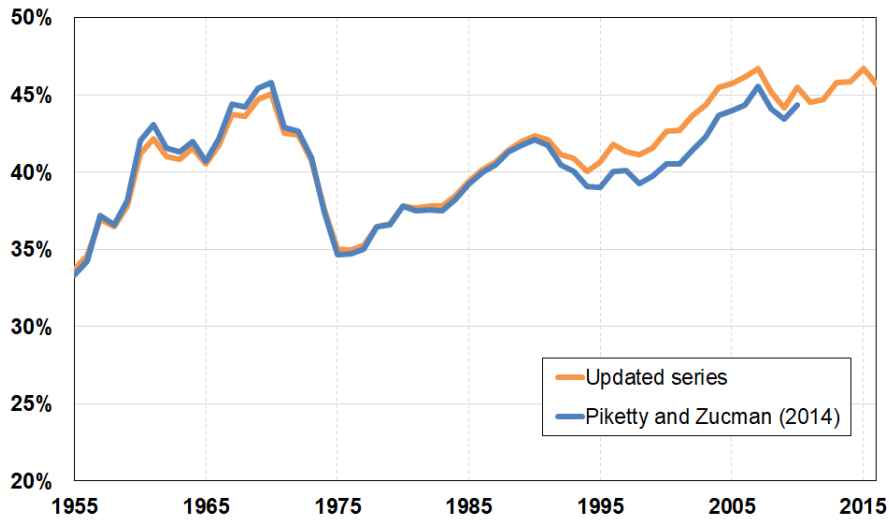


FIGURE 3.67 – JAPAN: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1955-2016

Figure 68. Japan: Gross capital formation (% national income), 1955-2016

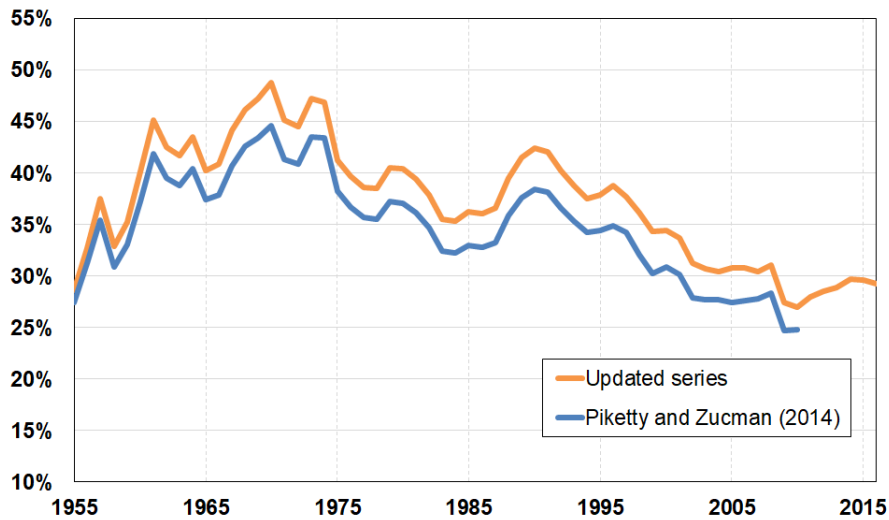


FIGURE 3.68 – JAPAN: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1955-2016

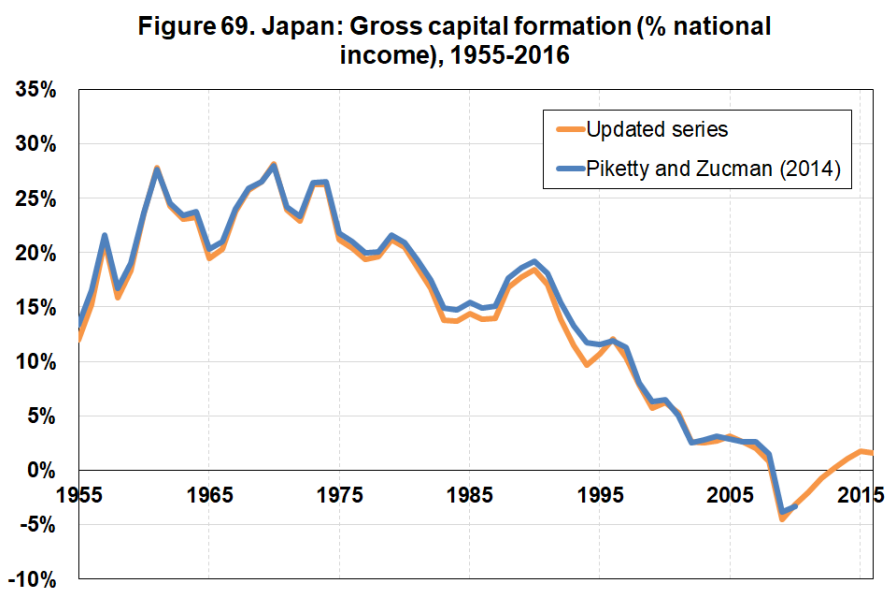


FIGURE 3.69 – JAPAN: NET CAPITAL FORMATION (% NATIONAL INCOME), 1955-2016

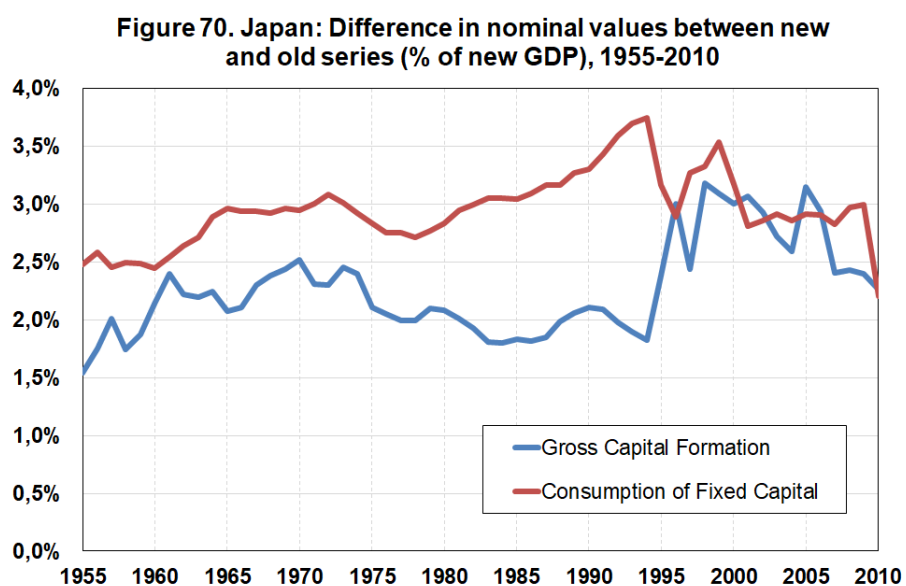


FIGURE 3.70 – JAPAN: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1955-2010

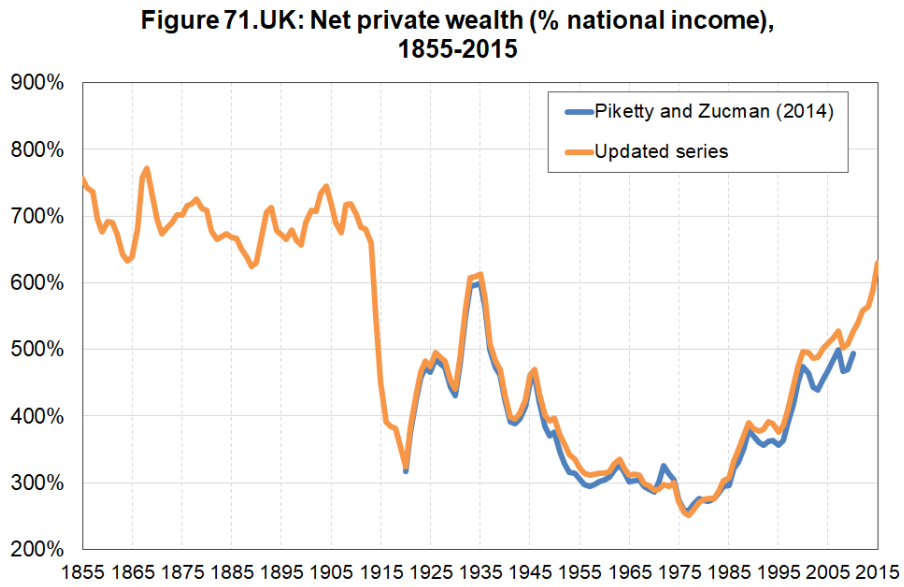


FIGURE 3.71 – UK: NET PRIVATE WEALTH (% NATIONAL INCOME), 1855-2015

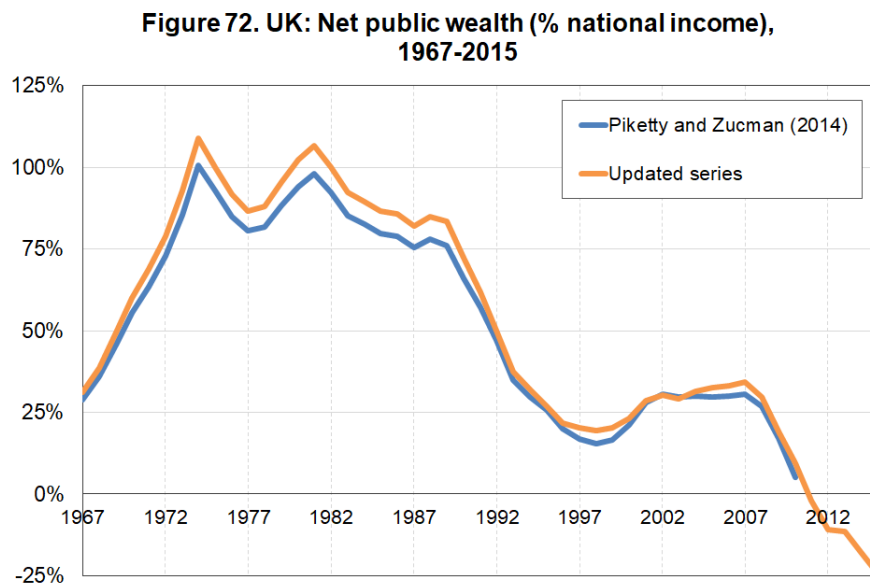


FIGURE 3.72 – UK: NET PUBLIC WEALTH (% NATIONAL INCOME), 1967-2015

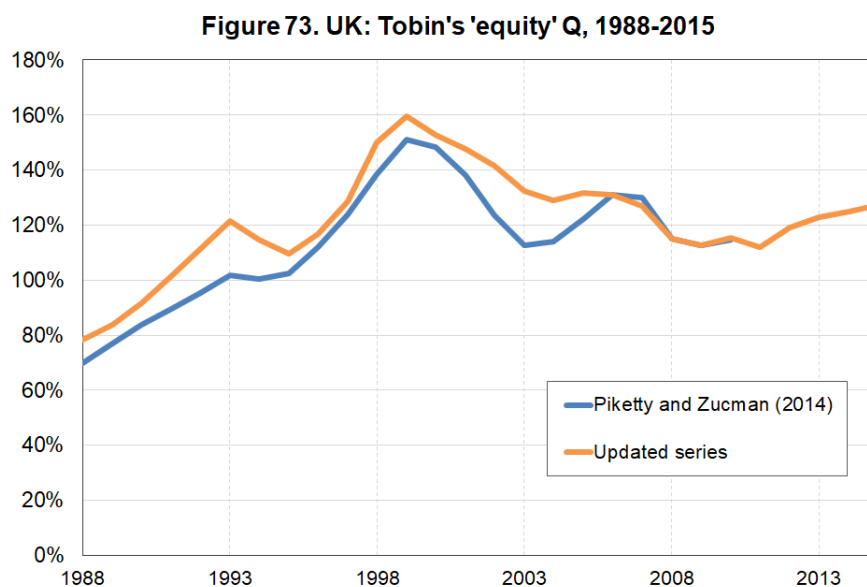


FIGURE 3.73 – UK: TOBIN'S EQUITY Q, 1988-2015

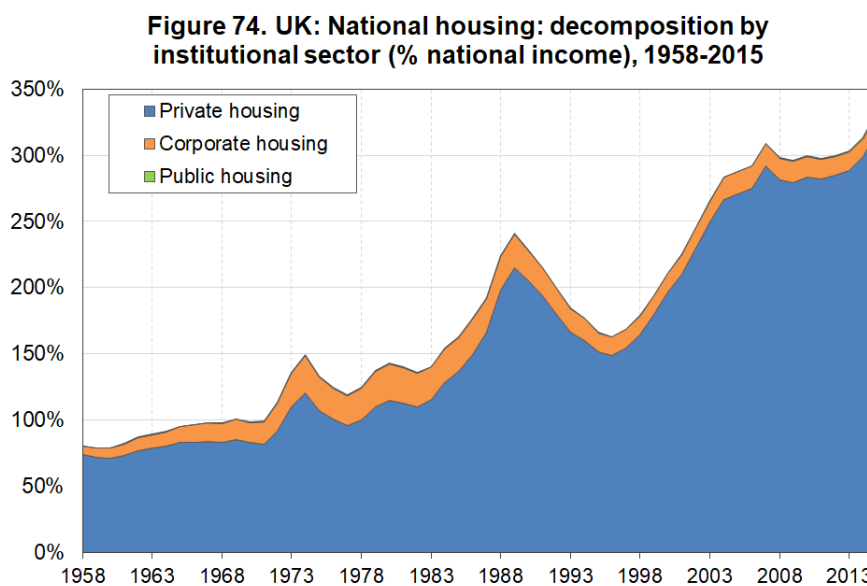


FIGURE 3.74 – UK: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1958-2015

Figure 75. UK: Private housing (% national income), 1920-2015

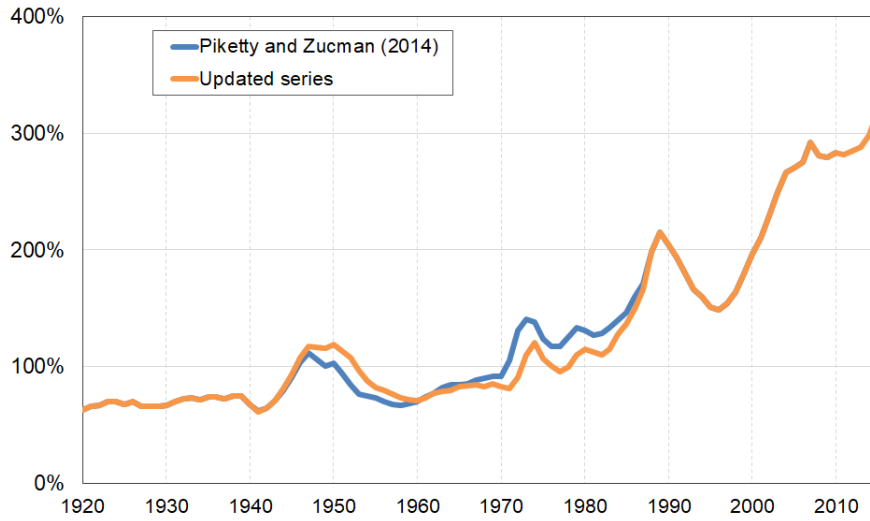


FIGURE 3.75 – UK: PRIVATE HOUSING (% NATIONAL INCOME), 1920-2015

Figure 76. UK. Housing tenure types (% total dwellings), 1948-2014

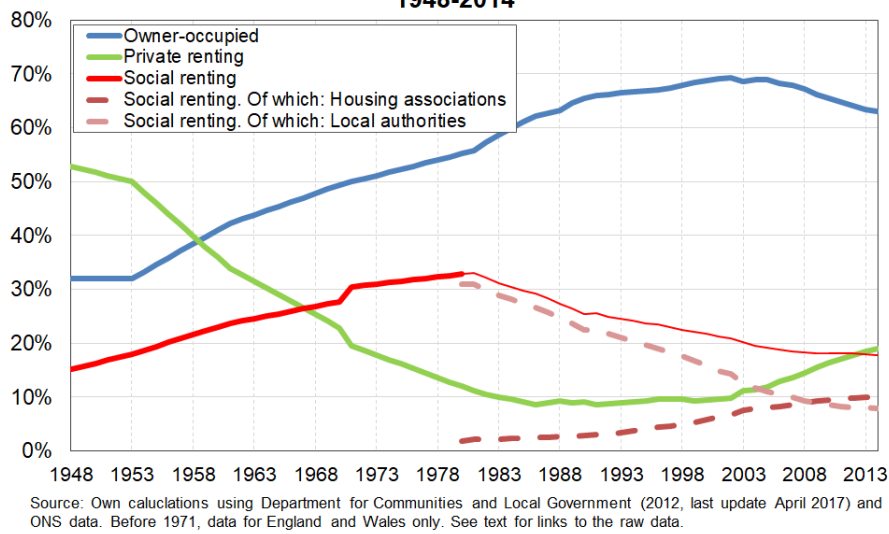


FIGURE 3.76 – UK. HOUSING TENURE TYPES (% TOTAL DWELLINGS), 1948-2014

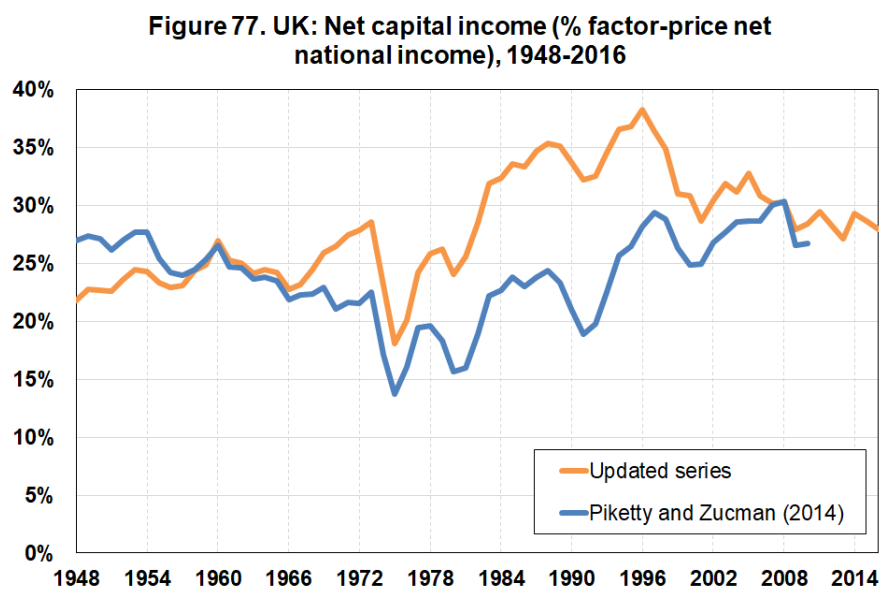


FIGURE 3.77 – UK: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1948-2016

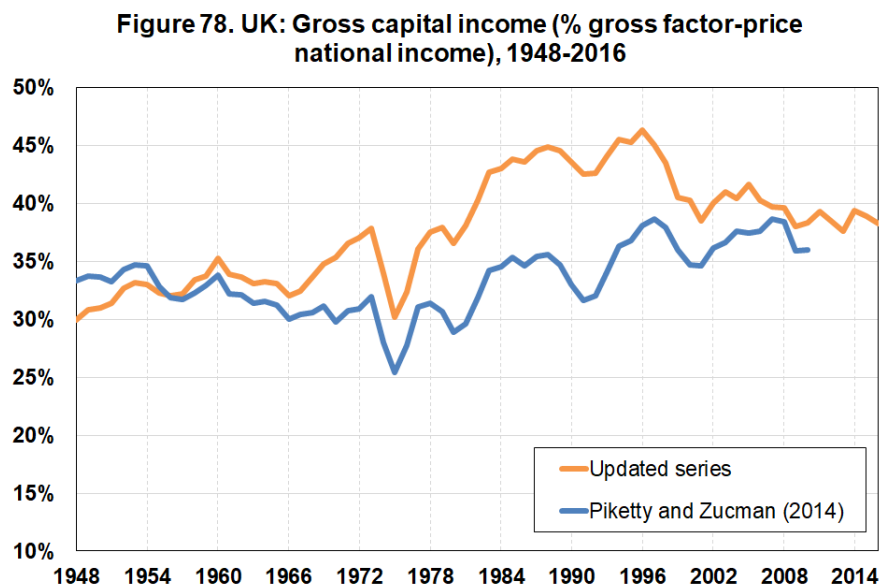


FIGURE 3.78 – UK: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1948-2016

Figure 79. UK: Gross capital formation (% national income), 1948-2016

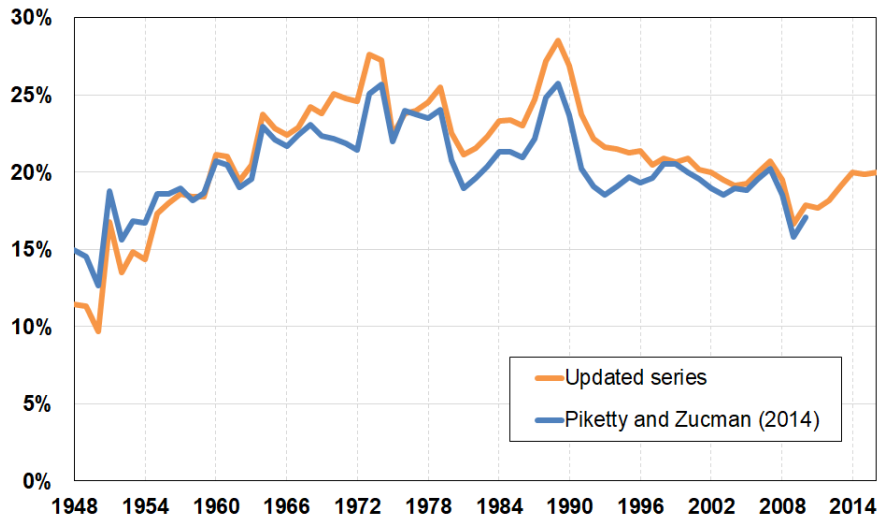


FIGURE 3.79 – UK: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1948-2016

Figure 80. UK: Net capital formation (% national income), 1948-2016

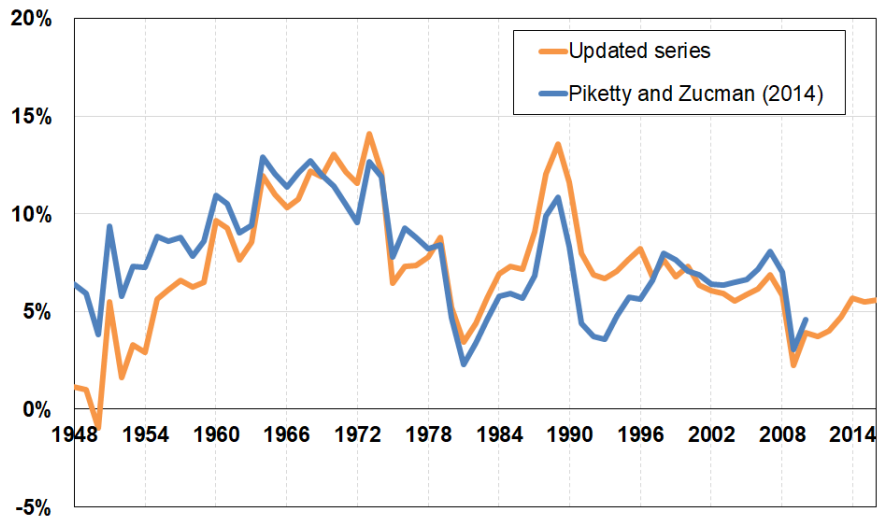


FIGURE 3.80 – UK: NET CAPITAL FORMATION (% NATIONAL INCOME), 1948-2016

Figure 81. UK: Difference in nominal values between new and old series (% of new GDP), 1948-2010

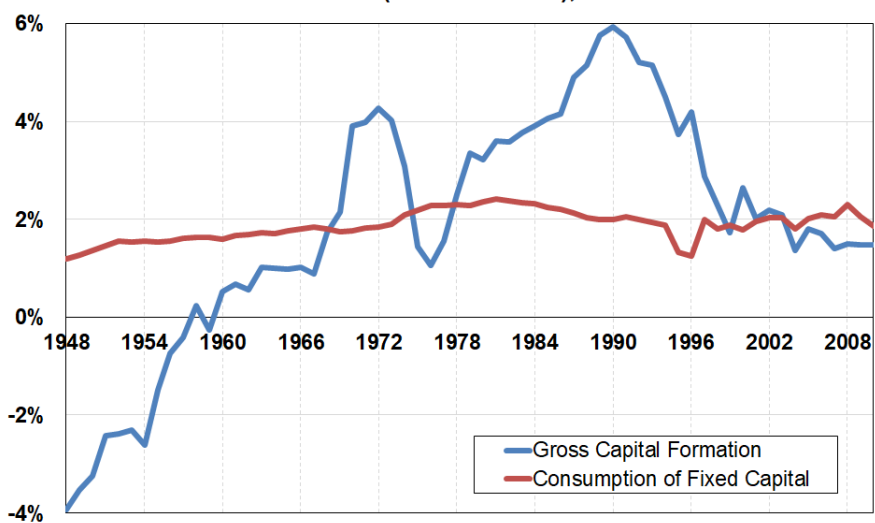


FIGURE 3.81 – UK: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1948-2010

Figure 82. UK: Domestic sectors capital income (% national income), PZ-2014 series, 1948-2010

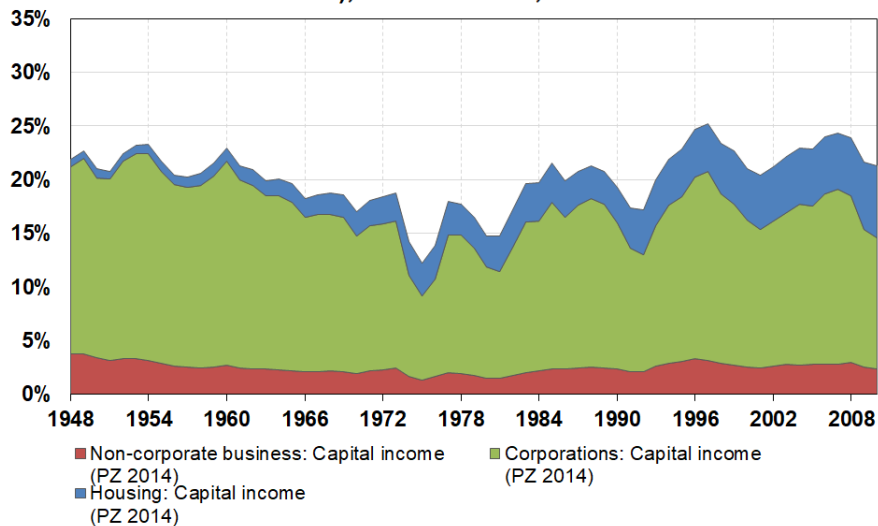


FIGURE 3.82 – UK: DOMESTIC SECTORS CAPITAL INCOME (% NATIONAL INCOME), PZ-2014 SERIES, 1948-2010

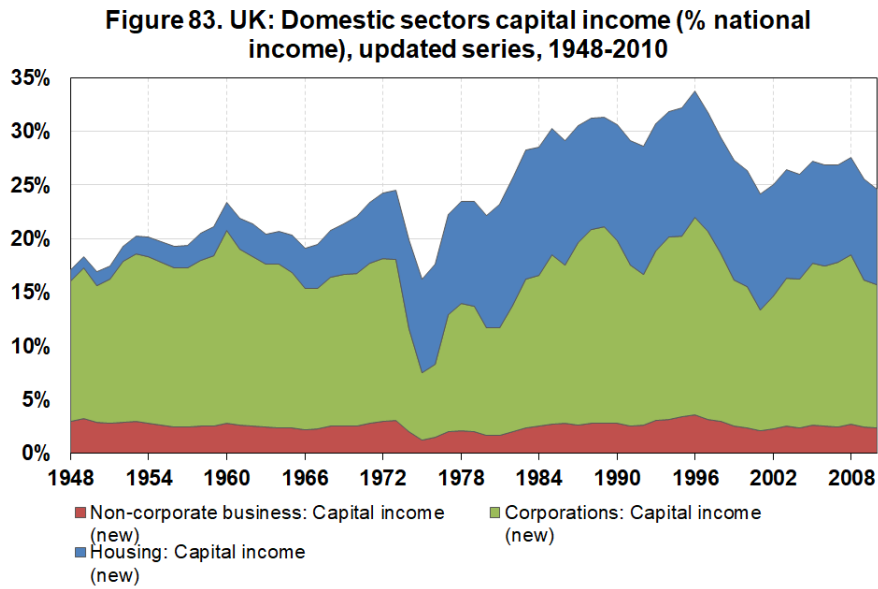


FIGURE 3.83 – UK: DOMESTIC SECTORS CAPITAL INCOME (% NATIONAL INCOME), UPDATED SERIES, 1948-2010

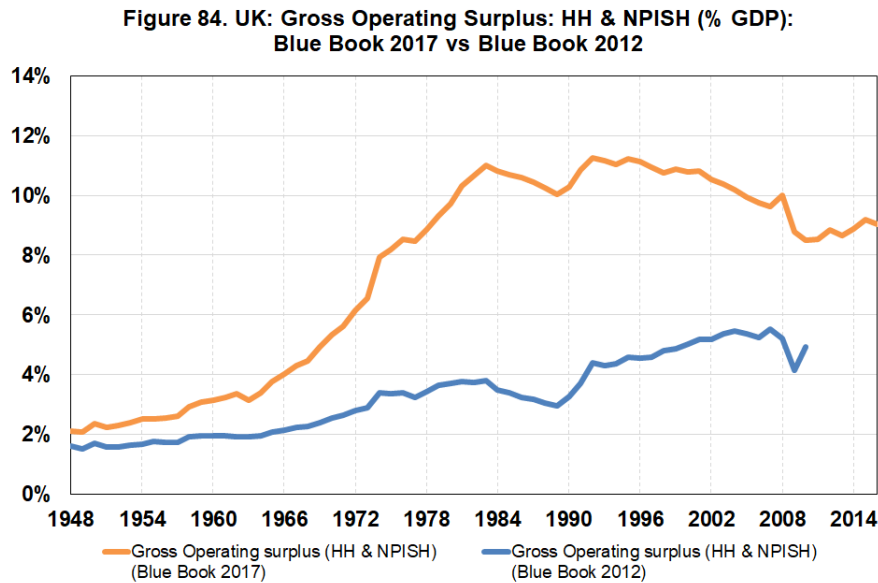


FIGURE 3.84 – FIGURE 84. UK: GROSS OPERATING SURPLUS: HH AND NPISH (% GDP): BLUE BOOK 2017 vs BLUE BOOK 2012

Figure 85. USA: Net private wealth (% national income), 1870-2015

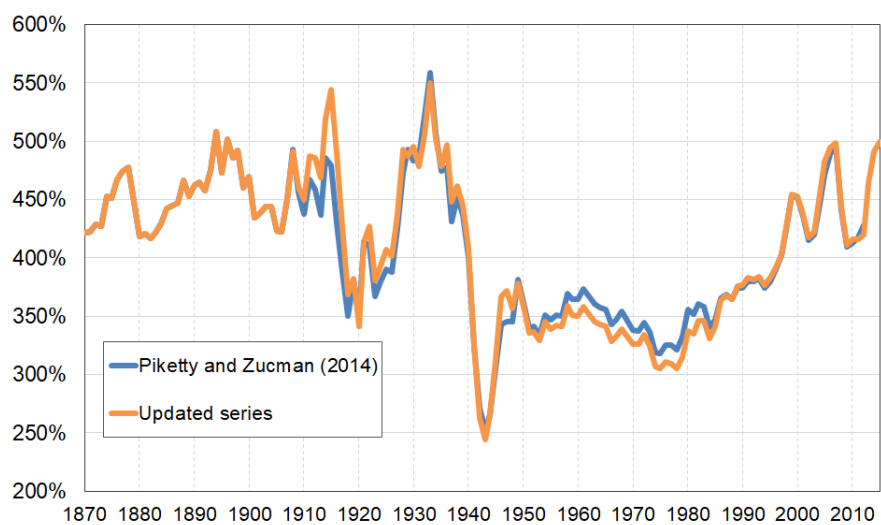


FIGURE 3.85 – USA: NET PRIVATE WEALTH (% NATIONAL INCOME), 1870-2015

Figure 86. USA: Net public wealth (% national income), 1870-2015

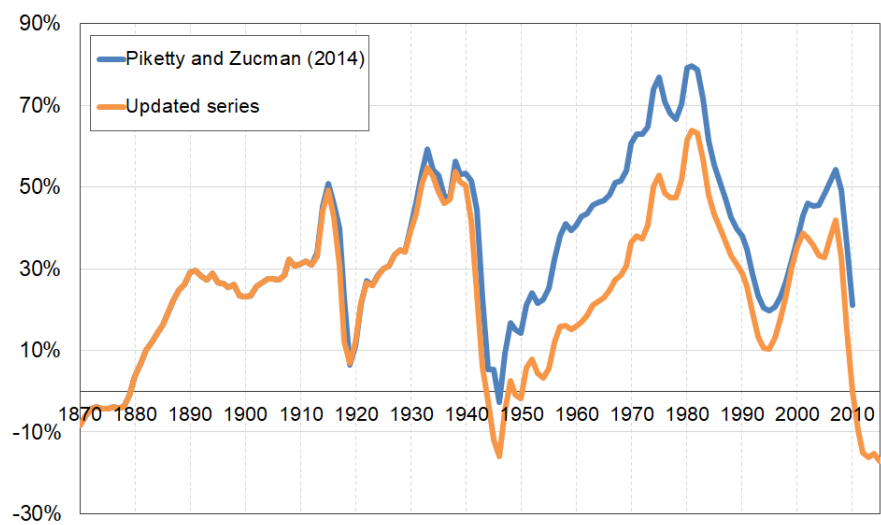


FIGURE 3.86 – USA: NET PUBLIC WEALTH (% NATIONAL INCOME), 1870-2015

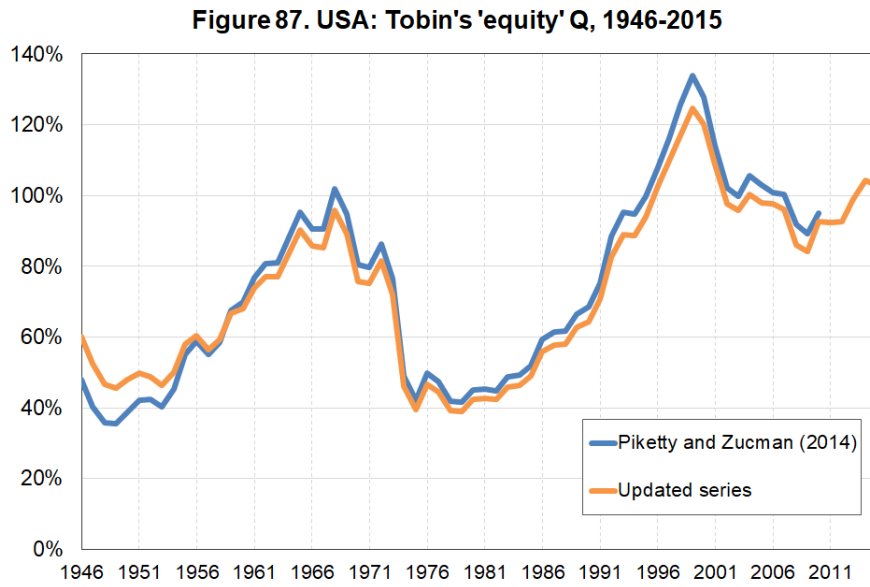


FIGURE 3.87 – USA: TOBIN'S EQUITY Q, 1946-2015

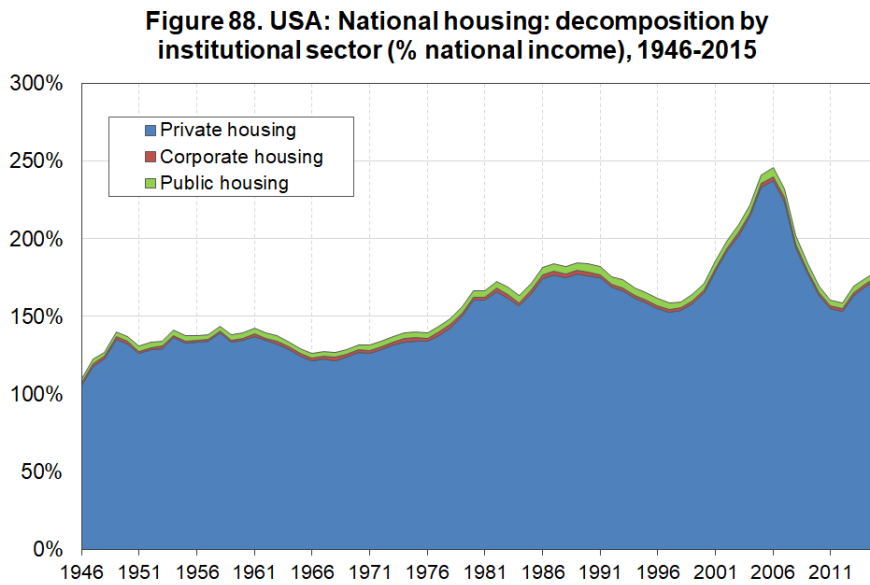


FIGURE 3.88 – USA: NATIONAL HOUSING: DECOMPOSITION BY INSTITUTIONAL SECTOR (% NATIONAL INCOME), 1946-2015

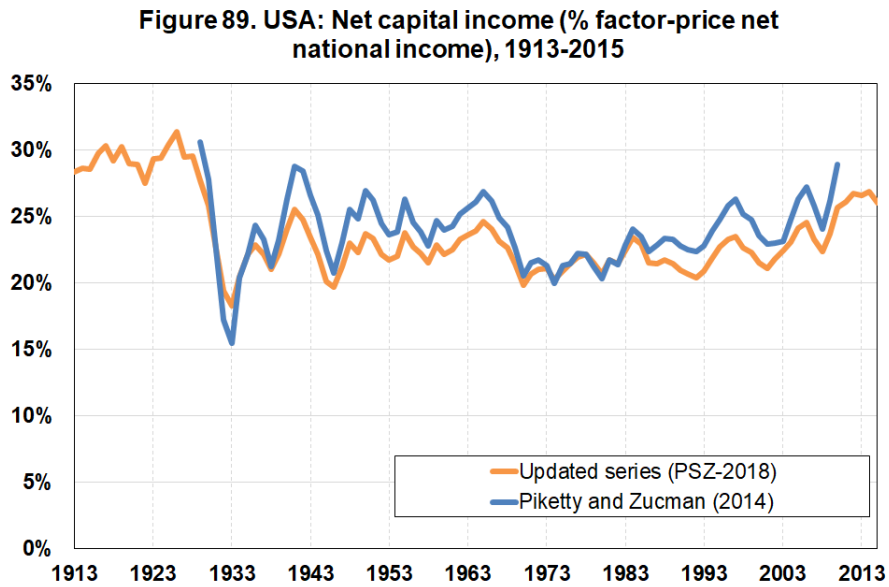


FIGURE 3.89 – USA: NET CAPITAL INCOME (% FACTOR-PRICE NET NATIONAL INCOME), 1913-2015

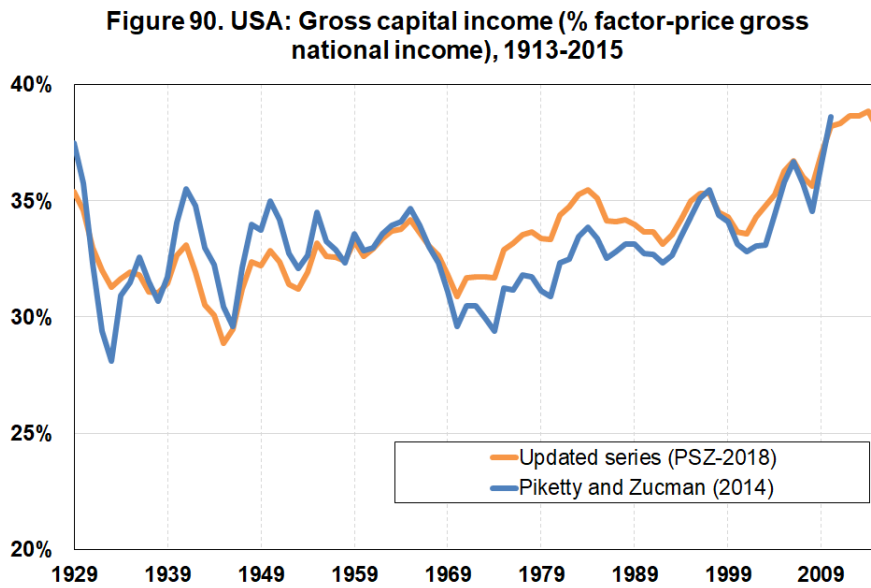


FIGURE 3.90 – USA: GROSS CAPITAL INCOME (% FACTOR-PRICE GROSS NATIONAL INCOME), 1913-2015

Figure 91. USA: Gross capital formation (% national income), 1913-2015

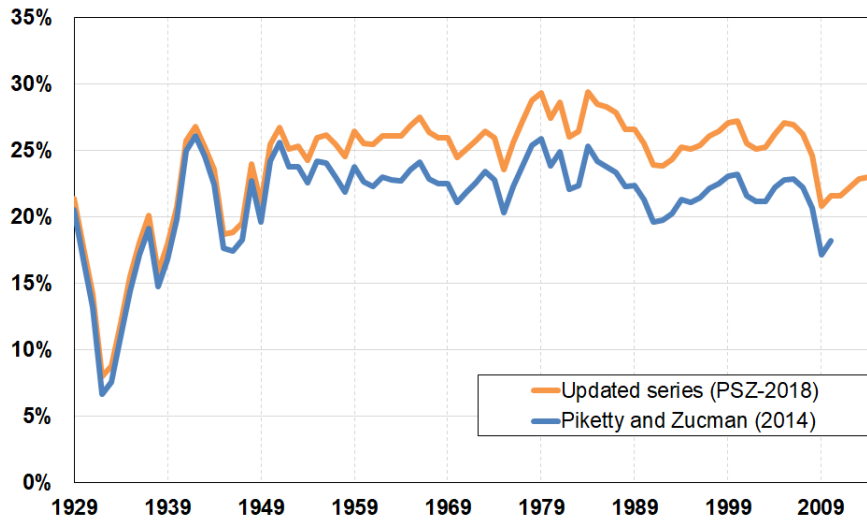


FIGURE 3.91 – USA: GROSS CAPITAL FORMATION (% NATIONAL INCOME), 1913-2015

Figure 92. USA: Net capital formation (% national income), 1913-2015

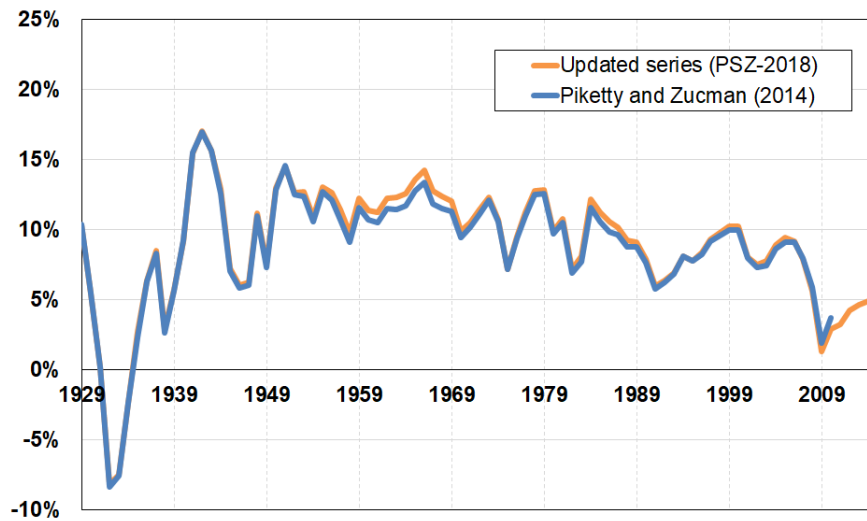


FIGURE 3.92 – USA: NET CAPITAL FORMATION (% NATIONAL INCOME), 1913-2015

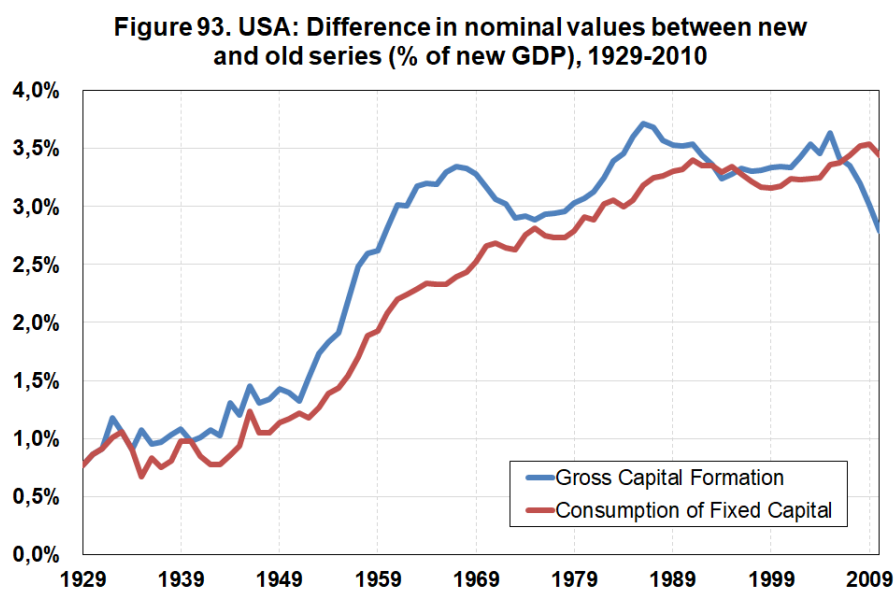


FIGURE 3.93 – USA: DIFFERENCE IN NOMINAL VALUE BETWEEN NEW AND OLD SERIES (% OF NEW GDP), 1929-2010

Tables

TABLE 3.1 – NATURAL CAPITAL IN 2010 (% NATIONAL INCOME)

Table: National natural capital in 2010 (% nat. Income)			
	(1) Piketty and Zucman (2014)	(2) Updated series	(3) Extrapolated from UNU-IHDP (2014)*
Australia	58,6%	57,4%	
Canada	77,1%	60,8%	
France	No data	0,1%	
Germany	No data	No data	16,0%
Italy	No data	No data	0,1%
Japan	0,3%	1,6%	
UK	No data	No data	0,6%
USA	No data	No data	10,3%

* These values correspond to mineral and energy resources, but not to all types of natural capital. In Australia and Canada, mineral and energy resources represent 99% and 88% of natural capital in 2010, respectively.

Notes: This table displays the value of natural capital in 2010 (as % of national income) for the countries for which official estimates exist: Australia, Canada, France and Japan. Column 1 reports the values of these assets in the national accounts used in [Piketty and Zucman \(2014a\)](#). Column 2 reports the values of these same assets in the latest national accounts. Column 3 reports tentative estimates of natural capital based on [UNU-IHDP and UNEP \(2014\)](#)'s Inclusive Wealth Report for those countries for which official data do not exist.

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