On the Social Cost of Fiscal Dumping, Lower and Upper Bound Estimates : How Much Race to the Bottom Hurts People at the Bottom

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Abstract. I set a simple theoretical model up to show how in an two-type agents economy, the "Race to the Bottom" design of governments' objective affects the social welfare. I derive optimal linear tax schedules for redistributive government that accounts for tax avoidance behavior of a representative multinational enterprise. I differentiate welfare effects between consumers and capitalists. Calibrations relate on semi-elasticity of reported profits estimated by the literature. On average, from a purely utilitarian point of view, the downward trend in corporate tax rates leads to a reduction in the utility of the bottom 50% (or equivalent social transfers) of 48%. If there are 10% of capitalists in the economy who equally share ownership of the company, they will face a 5% reduction in utility. The additional source of consumption never compensates for the shortfall in governments' revenues, even if I consider only the utility of the capitalists themselves.

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To my dear brother and dear parents who have always believed in me, given me their full trust and their unconditional love.

To my grand-father, Jean Sixdenier.

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Acronyms

AF Apportionment Formula. 33, 37

ALP Arm's Length Principle. 10

BEPS Base Erosion and Profit Shifting. 9, 10, 12, 31, 41

CbCR Country-by-Country Report. 8, 9, 13, 18, 32, 33, 37, 41, 49

CIT Corporate Income Tax. 7, 9, 11, 13, 15, 18, 19, 24, 27–29, 38–40, 53–55, 60, 62

ETR Effective Tax Rates. 10, 30, 32, 33, 35, 56

GDP Gross Domestic Product. 9, 14, 49, 54

GMT Global Minimum Tax. 16, 19

GSMWW Generalized Social Marginal Welfare Weights. 21–24, 28, 29, 59

HTJ High-Tax Jurisdiction. 10, 18–20, 25, 27, 33–35, 37, 39, 40, 57, 63–68

MNE Multinational Enterprise. 8–29, 31–37, 39–43, 49, 51, 52, 57, 60, 62–68

OECD Organisation for Economic Co-operation and Development. 8, 9, 12, 13, 18, 20, 31–33, 41, 43

PIT Personal Income Tax. 15–18, 29

PS Profit Shifting. 9, 11, 13, 14, 20–22, 25–28, 30, 34–37, 39, 40, 42, 43, 62

SWF Social Welfare Function. 11, 21–24, 31

TH Tax Haven. 8–10, 12, 18–20, 24, 25, 28, 29, 32, 34–36, 39, 40, 53, 58, 60

TJN Tax Justice Network. 7, 13, 14, 33

1 Introduction

Motivation In their last report within the Tax Justice Network (TJN) advocacy group[1], Cobham et al. (2021) have highlighted the urge to put a stop to the Base Erosion and Profit Shifting. The authors are interested in behaviors and strategies set by agents -both individuals and firms- not to face their fiscal duties. Individuals may evade if they cheat on their fiscal residence and if they do not declare some of their income and wealth (see Kleven et al. (2020) for a study on mecanisms and behavioral responses, and Alstadsæter et al. (2019) for the size and distributional impact of tax evasion on personal income). Firms, for their part, optimize: they use discrepancies in laws and the absence of international tax coordination to shift profits towards low-tax jurisdictions and benefit from tax rate differentials. It means that they aim at reducing their effective taxation rate (i.e., the overall tax liability divided by their overall profits before taxation). The former behavior set by individuals is usually called *tax evasion* and the latter set by firms is usually called *tax avoidance*. Both concepts are really close and there is no clear distinction between them. Individuals as well as firms may practice both kind of procedures. I give definitions below and decide to stick myself to *avoidance* for the rest of this work. This is more in line with the core of my analysis, which is the abuse of the Corporate Income Tax (CIT) and its impact on the state budget and public welfare,

> "***Tax evasion*** *generally comprises illegal arrangements where tax liability is hidden or ignored, i.e. the taxpayer pays less tax than he/she is supposed to pay under the law by hiding income or information from the tax authorities*." ;
>
> "***Tax avoidance*** *is defined as acting within the law, sometimes at the edge of legality, to minimise or eliminate tax that would otherwise be legally owed. It often involves exploiting the strict letter of the law, loopholes and mismatches to obtain a tax advantage that was not originally intended by the legislation*."
>
> Commission (2012)

[1] Since 2002, the TJN gathers a number of economists and researchers sharing concern around tax evasion, tax avoidance and tax havens. They make it a point of honour to disseminate the results of their work in the media. They wrote the first version of "The State of Tax Justice" in 2020 to highlight the magnitude of BEPS on both individual income evasion and Multinational Enterprises' profits evasion.

The term avoidance does not make the phenomenon less serious. Indeed, governments face large shortfalls in fiscal revenues due to aggressive tax planning from other countries. Those countries, described as Tax Haven (TH) have been subject to extensive analysis. To understand which countries try to attract capitals, for decades, institutions studied and defined those havens depending on more or less restrictive characteristics. To understand what is at stake I give a more restrictive definition which integrates notions as tax rates, exchange of information, transparency, regulations and economic activity pre-requisites but I will rely on a larger definition widely accepted. It states that countries which set low or no corporate income tax rates with the purpose to attract capital can be considered as such,

> *Restrictive definition: a **Tax Haven** is described by (i) zero or low nominal tax rates provided ; (ii) no effective information exchange with other countries ; (iii) a lack of or inadequate transparency with regard to disclosure requirements ; (iv) basic regulations and their implementation are not clearly defined and regulated, and (v) economic activity is not a necessary precondition. This results in the conclusion that investments or transactions are carried out purely for taxation reasons* ;
>
> OECD (1998)

> *Larger definition: a **Tax Haven** is described by zero or low nominal tax rates provided (under capital attraction purposes).*
>
> Gravelle (2009)

There are three rationales about why study this topic. Firstly, the size and distribution of tax evasion is a source of sustained interest and controversy among the public. Recent outrages as the "Pandora Papers" -i.e., a 12 million documents leak incriminating hundreds of global politicians and wealthy elite for tax avoidance and corruption- were widely covered by the media. It is only the reflect of a larger phenomenon that has been embedded in the tax system for decades. Thanks to the Country-by-Country Report (CbCR) data provided by the Organisation for Economic Co-operation and Development (OECD), I can give insights about the activity reported by Multinational Enterprise (MNE) across the world. Table 3 shows that, overall MNEs do report 34% of their profits abroad (in an other country than their ultimate parent jurisdiction, i.e., the country the firm is headquartered in). Among those $2.7 trillions, 1 trillion is reported into THs

(40% of foreign reported profits, 15% of global profit). In comparison, these havens accounts for less 3% of the total number of employees and 7% of the tangible assets worldwide. It gives insight about the existence of Base Erosion and Profit Shifting (BEPS) phenomenon. On top of this according to the OECD using brand new CbCR data, the revenues per employee tend to be higher where statutory CIT rates are zero than in other jurisdictions. The former have a median revenues per employee equal to $2.6 million. This number stands at $320 000 for jurisdiction with higher than 20% CIT rate. Respectively in high, middle and low income economies those numbers are $443 000, $190 000 and $171 000. It worths digging into those statistics to assess how Profit Shifting (PS) activity affects economic agents.

Secondly, between 1980 and 2020, the global average statutory corporate tax rate fell by about half, from about 50% to 24%. This downward trends has been largely driven by country defined as TH (see figure 1). Low income countries still exhibit the higher average CIT rate among income groups. MNEs headquartered there might have even more incentives to shift profits abroad due to larger tax rate differentials. This is another argument in favor of the existence of BEPS.

Thirdly, for most countries, CIT revenues represent a larger share of their Gross Domestic Product (GDP) in 2018 (world average equals 3.4%) than in the nineties (world average equals 2.2%). No matter this represents a bigger share of GDP for upper-middle income countries (about 4% in 2018) than low-income countries (2.2%), the global trend is increasing and the amount of money involve are significant. Figure 2 documents the argument. Moreover, in terms of percentage of global fiscal revenues -including personal tax revenues, VAT and other taxes on capital gains-, the trend is also increasing. This time, the trend is driven by Non-OECD countries, especially lower-middle income countries. This might give insight about the size of the distributional impact of PS as countries rely more and more on this source of revenues. Figure 3 documents the argument.

International tax system Before going to my contribution, I must quickly describe how the international tax system works and how it leaves room for optimization by MNEs. Current tax systems treat MNEs as a set of separate legal entities, each of them using separate accounting. Because foreign subsidiaries are treated separately from their parent companies, their profits are accounted for on a country-by-country basis. Yet, intra-group transactions affect where the MNE's profits are reported and its taxes paid. The multinational may therefore adjust the prices of transactions between its subsidiaries (so-called "transfer prices") to shift profits from high-tax to low-tax countries.

The Arm's Length Principle (ALP) aims to prevent multinationals from engaging in this type of transfer: the ALP states that prices for intra-group transactions should be identical to those that would have been charged for similar transactions between independent parties. On top of transfer prices manipulation, there exists a wide range of tax planning channels, in accordance with the scope of BEPS: the most striking ones are strategic location of intangibles and manipulation of the location of debt.

Based on old principles, the tax system is today highly prone to tax avoidance and fiscal base erosion. This has led to a "*Race to the Bottom*" in the statutory corporate tax rate over the past decades because governments want to keep and attract capitals declared at home rather than see them fleeing abroad. Still under the statutory rates perspective, some countries considered as haven may exhibit higher rates than some High-Tax Jurisdiction (HTJ). For instance, as underlined by Tørsløv et al. (2018), Belgium is a borderline case: considered as a TH, its legal rate stands at 33%. However, when considering Effective Tax Rates (ETR) firms really face, it falls down to 19% (i.e., lower than most of HTJs). Plus, to see how profit shifting affects the multinational's worldwide tax liability, we generally have to take into account the tax rates of the countries involved as well as the rules used by the parent country to alleviate the potential double taxation of foreign-source income. A multinational's foreign-source income is generally taxed in the foreign country as well as in the parent country. MNE's subsidiaries profits are tax in the country they operate. Then, when profits are repatriated, the parent country may or may not tax income generated abroad: this is how dividends are affected by double taxation. Two cases exist. In case the parent country operates a territorial or source-based tax system, it effectively exempts foreign-source income from taxation. This way, the statutory rates equals the effective one. In the other case, the parent country may treat income on a worldwide or residence-based tax system. Foreign income is subject to domestic taxation, but it generally is the case that foreign credit tax exist to reduce the extent of double taxation.

Thus for consistency with the international tax system and with prediction of Devereux et al. (2008)[2], I consider countries to compete over ETR. This way I reduce the international tax system to a simpler and more comprehensible format. I can account for bilateral treaties existing between two countries, exemption rules and foreign income tax treatment. ETR follow the same decreasing trend as legal rates (see figure 4).

[2]Under the assumption of mobile firms, the authors show that countries are more likely to compete over statutory rates or effective average rates rather than effective marginal rates. My model account for migration location choice of MNEs, so I can stick to competition ETR.

Contribution Extensive literature exists on direct costs of PS. It has been largely discussed and assessed. Fewer reported profits where they actually belong mechanically leads to a consequent shortfall in fiscal revenues. Although it has been acknowledged by researchers, there is for now few evidence about indirect costs of such practice. In the most recent works, researchers begin to account for dynamic effects. Still, to my knowledge, no one performed a consequently welfare analysis. Munoz (2019) paved the way with her work applied to the extent of individual income tax evasion due to fiscal competition within a free mobility union. One way to go now is to translate such analysis to the strategic location of profits by MNE, i.e., the firm that have the ability to shift profit because on paper their activity takes place in several countries. This led me to contribute in several ways.

In a similar fashion as hers, I will try to estimate how PS behavior does affect welfare among agent types (consumers versus. capitalists). Doing so, within a theoretical framework, I will consider a simple world economy in which countries compete over effective tax rates.

I will first try to reveal how profit location choice arises through tax rate differentials through the profit maximization program of a representative MNE. Secondly, depending on social preferences[3], I will try to identify what are the welfare costs of fiscal competition. My contribution differs from that of Muñoz since she assesses the effect of tax competition (going from federal to competition) in various scenarios of social objectives and elasticities of migration. In here, compared to the actual situation in which governments compete over effective tax rates, to what extent welfare of consumers and capitalists evolve if the rates are determined to maximize social welfare.

Two channels determine the level of optimal rates. On one side, due to the reduction of the CIT base in high-tax countries, the distributional capacity of governments is dampened. If one considers a lump-sum transfer over every resident, high-tax governments will not be able to redistribute in the competition case as much as they will do if their social objective is different from maximizing the reported profits. On the other side, in a property-based economy, dividends and intra-companies payments capitalists get increase thanks to aggressive tax schedules set by havens (since overall profits of MNEs are pushed up compared to the case in which neither PS incentives, nor opportunities exist). It is positively evaluated by the social planner since some people might benefit from extra-return.

The aim of this thesis is thus to acknowledge once again the distributional impact of the PS

[3]Governments might follow various theories of social justice from the Rawlsian case which favors the poorest to the usual utilitarian case which gives the same weight to each individual in the Social Welfare Function (SWF).

activity, this time under some welfare effect analysis. If so, how much are world citizens losing? Are the effects heterogeneous across countries and agent types? Would they be better-off if countries around the world try not to play the "race to the bottom" game? I will try to answer those questions based on a list of countries defined as tax havens -see table (2) - to assess the distributional impact of the BEPS phenomenon as depicted by the OECD -which tries to eradicate it, see OCDE (2013).

To sum up, the contribution is twofold: (1) document the mechanisms in an world open economy including THs that may lead to various optimal rates under different social objective ; (2) quantify the welfare effects of tax competition on agent depending on their types. Namely, how simple consumers are affected by the optimization process of large MNEs? How vary the utility of capitalists sharing equally those firms?

Results Based on recent empirical estimates of the migration responses from MNEs to differential tax rates, this work assesses the welfare effects of fiscal competition on the particular dimension of corporate profits treatment. These effects vary depending on MNE's true earnings. Each representative MNE's true earnings are assimilated to countries' real production in my framework. Still, it does not allow me to draw conclusions on heterogeneous welfare effects depending on countries' relative development. My model shows that welfare effect are mostly driven by tax rates differentials and not the total amount of production. On top of that, I assumed the firm to be held by locals to some extent allowing me to dress results depending on agent types. Doing so, two counteracting forces appear when it comes to determine optimal tax rates: the government wants to maximize its fiscal revenues to redistribute to the consumers. Higher rate means domestic profits taxed at a higher share. At the same time, accounting for behavioral response prevents the government to set too high rates: it leads to lower reported profits at home. To some extent, tax planning by capitalists allow them to get extra-return. Capitalists' consumption linked to optimization increases while consumers do not have access to this extra-consumption because they do not hold the MNE.

Although this consumption surplus is accounted for in the social welfare function, results show that tax competition does hurt global welfare at country scale. On average, social welfare under Utilitarian (resp. Rawlsian) preferences drops by 24% (resp. 48%). The loss incurred by consumers is never compensated by the welfare gains of capitalists. In fact for capitalists, extra-consumption derived thanks to tax avoidance never out-weights loss incurred following the shortfall in social transfers in their own utility. Consumers' loss between 50% and 70% of

their utility due to fiscal competition depending on social preferences for redistribution in my preferred scenario. Capitalists slightly loose overall from tax competition: their utility drop by 5% to 18%. The greater the governments' redistributive tastes, the higher the overall welfare loss.

Plan announcement This work will present an overview of avoidance costs linked to firms' behavior (escaping CIT) in section 2: I will review existing results and relate my contribution to various strands of the literature. I then only focus on avoidance costs due to firms' optimization plan since section 3 will be dedicated to the extension of the individual location choice model recently set by Mathilde Muñoz to the profit location choice by MNEs in the context of international tax competition. I will quickly recall her initial framework and results. Section 4 explains how I proceed in order to calibrate my simple model and which data I used before going to results in section 5. The last section (6) opens a discussion surrounding the entire body work on evasion and avoidance costs in which I try to bring a global perspective of the phenomenon and ways of improvements for future research.

2 An Overview of Avoidance and Evasion Social Costs

2.1 Existing Results

Entering in such topic, one must acknowledge that results come from sparse data bases and methodologies. For instance, Tørsløv et al. (2018) used three different databases and their work relies on national accounts, Foreign Affiliate Statistics (FATS) data and bilateral balance of payments. The empirical strategy is based on profitability ratios computation. More recently, the work done by economists who relate to the TJN advocacy group uses brand new CbCR data provided by the OECD. This database approaches the concept of the FATS data since a whole set of economic statistics must be provided by each country member on the activity of headquartered MNEs and all their subsidiaries. Rather than looking at how the profitability of foreign-controlled companies differs from domestic companies, they assess the extent of PS thanks to the division of reported profits between true earnings and shifted profits. By the estimation and redistribution of true earnings, they can tell to what extent illicit financial flows go from high-tax jurisdictions towards tax havens. I will return to the selected advantages of CbCR data over other data types in the subsection 4.1 without forgetting to mention the inherent flaws.

Despite those differences, results remain quite consistent with one another. Conclusions drawn

always go into the same direction: tax evasion and tax optimization come at some price. Government revenues are deeply affected and there is no evidence assessing the well-done potential of such practices at country scale. This price is significant and has been largely studied through the shortfall in fiscal revenues. I assess here that potential benefits for capitalists from PS activity never outweigh the damage caused.

Magnitude of the phenomenon First things first, the scale of tax avoidance by MNEs is in billions of dollars. A voluminous literature has scrutinized the magnitude of this phenomenon and resulting shortfall in governments fiscal revenues throughout the world: among others, Clausing (2016), Crivelli et al. (2016), Tørsløv et al. (2018), Cobham et al. (2020), Cobham et al. (2021), Garcia-Bernardo and Janskỳ (2022). Few numbers can resume the current state of affairs: each year the extent of PS is comprise between $400 billions in the most conservative estimation by Janskỳ and Palanskỳ (2019) and more than $1 000 billions in the most recent estimations of the TJN's authors. Depending on rates used for application, it goes from $90 billions up to $312 billions, for the upper bound estimate lost, in the states' coffers. In their widely studied paper, Tørsløv et al. (2018) have shown that about 40% of profits declared in havens by MNEs, were simply transferred and not realized there.

Secondly, the distributional impact is heterogeneous depending on countries' relative development. Crivelli et al. (2016) is one of the first paper to shed light on the PS treatment and consequences on developing countries: the impact might be larger for developing countries in percentage of their GDP compared to effect on developed countries. They however draw attention to the fact that data for developing countries remain scarce and results must be interpreted with cautious. This conclusion is reinforced by the Garcia-Bernardo et al. (2022) study. Plus, accounting for indirect and long-term costs effects, developing countries are those that suffer the most from PS. While analyzing secondary (capital gains and dividend taxes on corporate investors) and tertiary (interest rate differential when borrowing) effects, the authors' Figure 7 show how costs are exacerbated for these countries (+36% of cost linked to PS activity on average) and how the costs curve might be inverted for developed countries (-44% of cost linked to PS activity on average). The ownership structure is the core mechanism in here. MNE are largely headquartered in developed countries and belong to people living in developed countries : direct costs are even almost completely offset for the United States and China (the two largest players in avoidance/evasion).

2.2 Related Literature

My work is part of two other strands of the economics literature to understand tax optimization more precisely. Firstly, the study of tax competition through theoretical models highlighting the main problems. Secondly, tools used in welfare analysis to state the inequalities that result from avoidance.

Fiscal Competition I rely on theoretical work done about fiscal competition. In the first place thanks to their workhorse models (applicable to a broad range of topic), Zodrow and Mieszkowski (1986) and Wilson (1986) -well known as ZMW model- have shown inherent mechanisms of tax competition and how incentives to shift build agents' behavior. On this rock, Kanbur and Keen (1993) developed a model applied to the treatment of MNEs' profits. They show how the "true" earnings of these MNEs might be split between report to local authorities and shift towards others jurisdiction depending on tax rate differential. Rates in each jurisdiction are assumed to maximize fiscal revenues from corporate income treatment. In my framework, I adopt a slightly different point of view and define the fiscal competition as the will to maximize the CIT base rather than revenues. I will show how optimal rate under fiscal competition are affected by two channels: the number of havens and their tax rates (assuming they only differ in term of tax rates) and how it leads to a "race to the bottom". For more extensive contents on theoretical point of view about tax competition, see Keen et al. (2012) for a review. After what, I compare this fiscal rate to optimal rates obtained under other social objectives and social preferences.

Welfare analysis and inequalities I will talk about welfare effect of tax competition which is part of indirect costs analysis. I want to shed light on how the shortfall in fiscal revenues could affect agents depending on their type. I do not pretend to describe the big picture on indirect costs, especially the dynamic part and how countries may or may not recover from avoidance behaviors. I refer to the paper cited in the previous paragraph for dynamic effects (second and third order).

Tax competition implies distortions in all agents' optimization programs: individuals can respond to tax changes through migration as in Munoz (2019). These migrations flows are allowed by globalization. Labor is somehow mobile and people face various migration costs depending on their location in the income distribution: drawing optimal tax rates, the utility differential between the competition economy and a federal economy[4] is much more negative for people at the

[4] In her model, the competition reflects a world economy in which countries compete over Personal Income Tax (PIT)

bottom of the distribution. Bottom 50% earners looses up to 20% of welfare from tax competition, whereas the last decile faces a positive welfare differential. Inequalities are exacerbated within European countries according to her. I review more extensively her paper in section 3.1 since my work is largely based on hers.

To my knowledge the only work done on welfare analysis in this area concerns the effect of a Global Minimum Tax (GMT) implementation: Johannesen (2022) studies how the GMT shapes national tax policies and welfare in a formal model of international tax competition. Changes in international tax system threat firms' behavior as emphasized through past empirical analysis but also national tax policies that are endogenous. Thus welfare analysis is relevant.

Piketty and Saez (2013) extensively summarized (based on previous work done by Piketty (1997), Saez (2001)) the "sufficient statistics" approach in order to describe and grasp what is at stake for optimal income tax formulas in a simple format. Optimal formulas has been shown to be expressed in terms of sufficient statistics including behavioral elasticities capturing the efficiency costs of taxation, social marginal welfare weights capturing society's value for redistribution or even parameters of the earnings distribution. The same way, I apply such insights to optimal corporate tax formulas. They rely on behavioral costs captured by elasticities: how do MNEs react in terms of profits shifted (thus reported profits) whenever the net-of-tax rate change?

Overall, depending on tax-driven mobility intensity and opportunities to shift, social welfare could increase by moving from a situation of tax competition to one objective of social redistribution.

3 Welfare Effects of Corporate Tax Competition

3.1 Initial Model

Munoz (2019)[5] uses the sufficient statistics approach in a simple open economy model in which two countries with various PIT rates compete with one another in order to attract mobile workers. Indeed, the model frames a free mobility union among perfectly symmetrical countries and workers incur a migration cost when flying out the country due of tax competition.

Depending on the strength of mobility response to taxation and government redistributive tastes, she concludes that the bottom 50% lose up to -20% in welfare following the introduction

rates. The federal economy refers to a situation in which a unique PIT rates is set over countries.

[5]She develops a model in which PIT schedules are linear before jumping into non-linear schedules which fit more with the actual situation in the framework of individual income. For my part, I will stick to translating the model with linear tax rates, as it captures the essence of business taxation.

of competition. The results of this work therefore emphasize the efficiency costs of taxation in the absence of tax coordination. It especially affects people at the bottom of the income distribution. Even when the migration elasticity is small the welfare costs of tax competition can be sizeable for poorest workers.

For instance, for a given labor supply elasticity, consider a great elasticity of migration for each individual's type in absolute value[6]. The bottom 50% under Rawlsian preferences would face a 5.2% decrease in the utility. As this government favors only the poorest, the negative effect is mitigated since the optimal rate does not decrease much. However, if the government exhibits moderately redistribution tastes, steeping from the bilateral setting to the unilateral decision means a -18% in the bottom 50%'s utility. In other words, the greater the redistributive tastes, the lower the effect of tax competition since the government's tax policy is poorly affected by the extent of migration since it is design such it favors poor people.

So I want to frame the choices of the MNE and its impact on consumer behavior. This will help me measure the indirect costs of PS, which come in addition to the damage to tax revenues (as widely demonstrated by the literature). I depart from this initial framework translating the welfare analysis to profit shifted in two ways. Firstly, she stresses welfare variation for given redistribution tastes. Since there are two various elasticities at stake in her model (namely the labor supply and the migration responses), she could state for a given redistributive objective what are the effects of tax competition. In other words, steping from bilateral decisions over statutory PIT rates to unilateral rate setting leads to a utility reduction for the poorest[7]. I do not assess welfare variation at given redistribution preferences but rather I do observe the change in social welfare following a shift in government's objective. My benchmark setting corresponds to the actual situation, i.e., the "race to the bottom", described by the social objective to maximize the fiscal base. Hence, a social planner who moves from a Rawlsian or an Utilitarian objective for instance towards the "race to the bottom" situation would change social welfare. I can thus conclude on how the misconception of the social objective does hurt the economies and contributes to the rise of inequalities. This is what I would call here the welfare effect of tax competition. I do this because there is a lack of evidence about the fact that firm's profits vary in another way than avoidance following a tax reform (i.e., there is no equivalent for labor supply response in

[6] Below some threshold, low-income people will migrate within the high-tax country while high-income people will fly away. For those agent types, the elasticity shows converse sign.

[7] For instance, the unilateral setting process, or competition situation, leads to the existence of a migration elasticity called ε. Under Rawlsian preferences, the optimal rate does include this ε (on top of the labor supply elasticity called e) compared to the bilateral setting, or federal situation (federal rate: $\tau^R = 1/(1+e)$ and competition rate: $\tau^R = 1/(1+e+\varepsilon)$). Hence through optimal rates differences, the welfare variation can be assessed.

my framework). The only evidence which exists is about shifting response (i.e., the equivalent of migration response).

Secondly, as we shall see the optimal rates formulas rely on more parameters and appear to be heavier than the ones usually drawn in PIT rates treatment. Usual models that use the sufficient statistics approach capture solely a difference in revenue levels through the amount of effort provided by the workers. In my framework, the difference of consumption levels comes from an additional source of revenue that relies on CIT for capitalists compared to consumers. This way, things could not simplify as easily as in usual sufficient statistics approach. I trade-off formulas simplicity to make other parameters appear in these formulas.

Lastly, note that my work relies on semi elasticities rather than elasticities usually used in the sufficient statistics approach. It is only because of the need to rely on estimates from the literature.

3.2 Application to the Profit Shifting Analysis

Let us come to the adaptation of Muñoz's model of household migration choice to the profit location choices of MNEs according to the "race to the bottom" tax competition among governments around the world. My contribution to the literature is a partial equilibrium model assuming that PIT rate τ and CIT rate T (and thus revenues) within countries are independent from one another[8]: $\tau \perp T$.

Countries may be classified as TH or HTJ[9]. Governments set their tax rates according to the prevailing tax competition and firms then decide to maximize their after-tax profits, which implies a trade-off between reporting profits in the considered country and/or transferring all or part of the profits to a TH to avoid taxation. These choices of profit location will affect the states' distributive capacity, which will be forced to reduce transfers. In addition, it will have a different impact on agents depending on their type (capitalists or consumers). I conjecture that the consumers will suffer more from the loss of tax revenue than the capitalists will (the latter do not need these transfers to consume and get intra-companies dividends and payments as royalties thanks to shifting possibilities). I therefore hope to derive variations in well-being looking at the difference between the utility of agents in a situation where the governments plays the "race to the bottom" game and where it changes its conception about the determination of tax rates and

[8] In fact, these rates could be correlated to some extent: governments could compensate for a loss of total tax revenue due to a reform that reduces PIT rates by increasing the CIT rate. However, this assumption seems quite plausible.

[9] This is a simplification that allows me to consider a world economy with two countries (or two country-types) and their relative weight -i.e., the number of TH will matter to pin down optimal tax under competition as we shall see. Note that, in the CbCR data provided by the OECD, there are several countries considered as TH who report statistics so I do not exclude the possibility for MNEs headquartered there to avoid tax if there exist another haven with lower rate.

the rate is welfare maximizing. Note that I study welfare variation for HTJs side only. I consider welfare variation in THs side negligible for my analysis at world scale. I come back to this limit in the discussion below (section 6).

3.2.1 Global Framework

I will consider a simple theoretical model which frames an open worldwide economy to stress out how the fiscal competition affects tax rates in HTJs (giving rationales for the existence of tax competition is beyond the scope of my analysis[10]), how MNEs react to variation in statutory tax rate differential and finally how it affects welfare. There are three dimensions to account for within a country:

i) Government side: on top of the effect of tax avoidance, by revising its objective (from the "race to the bottom"), the government can account for other dimensions which will affect optimal rates. I will only focus on tax rates within high-tax economies taking tax haven CIT rates as given to see the influence of their number and their corporate tax policy on high-tax economies. The government can be Rawlsian: the poorest people, i.e., consumers here, will be exclusively targeted. Conversely, a standard utilitarian social planner aims at maximizing the sum of utilities over the population valuing each agent the same way. From a more general perspective, the government could value and weight agents differently depending on their type. Such a government might value consumers more than capitalists, up to a certain scalar value under redistributive perspectives (justification of higher weight for consumers rather than capitalists);

ii) Firm side: on the other hand, MNEs that are headquartered in high-tax economies use transfer pricing methods, relocation of internal debt and strategic location of intangibles to escape national taxation. Some profits realized in high-tax jurisdictions are falsely reported within tax havens. This behavior comes at some price for the firm. It may induce fixed costs such as the creation of fake establishments on site allowing the MNEs' subsidiaries to get fiscal residence in those low-tax jurisdictions or variable costs such as the probability to get caught and pay a fine. It seems realistic that fines may increase with the amount of profit shifted. The probability to get caught may increase too with the magnitude of avoidance

[10] It might be the case that THs gain from the downward trend in statutory tax rate to some extent since it might attract a lot of capital but I here only consider the utility within HTJs as mentioned above. See Johannesen (2022) for insights about welfare variation within havens following the introduction of a GMT.

making the overall costs more significant[11] ;

iii) Social utility: both together fiscal competition and strategic location choice will have drawbacks on the consumption set individuals face. By definition of social welfare maximizing rate, social utility will overall increase but who will benefit from this change in rates pin down process? Are effect differentiated? These are undetermined. The government may loose distributive capacity when playing at the "race to the bottom" if the extra share of profits taxed at home outweighs the loss in CIT base due to a higher rate and more evasion according to the elasticity of profit shifted abroad. In this case it will dampen consumers' utility. The MNE belongs to domestic capitalists: the maximization of after-tax profits benefits to them allowing for extra dividends and additional intra-companies payments coming from fake subsidiaries in havens. Thus, under higher domestic taxation, MNEs will shift more so get higher extra dividends from abroad but the remaining part is more heavily taxed at home. Two counteracting effects are at play here. I will quantify the consequences of the interaction between the government side and the firm side of the economy in terms of social utility.

The world economy is described by two sets of countries (or equivalently two country-types): THs and HTJs. There are I governments related to HTJs. There are H THs in the world. Any additional country considered as a haven is an additional *opportunity* for PS. Havens exhibit lower tax rates than HTJs by definition: $\forall\, i, h,\ T_i > T_h$. This creates *incentives* for PS. MNEs are all headquartered in a HTJ. Let's consider a representative MNE[12] in each jurisdiction i whose reported profits in its parent country equal the sum of true earnings and some part transferred towards a low-tax jurisdiction in order to maximise its after-tax profits. A concealment cost is incurred and might be considered deductible or not. It will only re-weight the optimal solution. Note that there is no other opportunity to conceal realized profits than PS. Under reporting profit activity such as sheltering income from informal businesses using only cash transactions or consumption inside informal businesses are beyond the scope of this analysis.

For each theory of social justice, the steps are the following. I derive the welfare function with respect to tax rate to get the optimal social condition. Then I derive the optimal amount of profit shifted (and thus of reported profits) within the firm side. The firm maximizes its global net-of-

[11] See Landier and Plantin (2017) for rationales on the increasing convex cost curve.

[12] See Appendix - D.1 page 57 for rationale about representative MNE. I can not relax the assumption of "identical" MNEs within countries to see how it affects the tax base, optimal tax rates and welfare because data provided by the OECD are aggregated at country level. There is no way to disentangle effects with heterogeneous MNEs within countries.

tax profits with respect to the extent of PS. Finally I combine the social optimal condition and the private one to pin down tax rates functions at the equilibrium. In this subsection I thus compute equilibria for each theory of social justice. Then, I quickly show how formal predictions of the "race to the bottom" Nash equilibrium fit quite well with actual rates in the next subsection (3.3). I close this theoretical section with the formal way to see welfare variations in subsection 3.4.

3.2.2 Government Preferences

In this framework the world economy is symmetric. The remaining differences between countries are their tax rates and the size of their fixed population N_i (no population migration arise consequently to change in tax rates differential and change in profit maximization program of the firm)[13]. Governments choose their tax rates in order to maximize the total welfare in the economy. The aggregation of the total welfare in the economy depends on the preferences of the government, which are chosen as arbitrary parameters. These preferences are loaded in the SWF accordingly to the method of *Generalized Social Marginal Welfare Weights (GSMWW)*, a concept initially set by Saez and Stantcheva (2016). Each individual, depending on some characteristics[14], will be assigned a non-negative weight summarized by a multiplicative constant. Taking social preferences as given[15], country i is represented by a government trying to maximize the following SWF,

$$W = \sum_k g_k u_k$$

where $k \in K$ is the set of individual types and g_k is the social weight assigned to corresponding individuals' type. To get things straightforward, I assume two different types of individuals: on one hand there are simple consumers. People do not have any income apart from transfers received by the government and only derive utility from it. On the other hand, there are capitalists who derive utility from government's transfers but also from the domestic MNE they hold.

For all that follows, I assume that utility comes only from consumption in a linear fashion: $u(c) = c$ for all individual types. I denote by $\underline{c}$ consumers' consumption and by $\bar{c}$ capitalists' consumption. Let's consider a lump-sum transfer from the government: each individual will

[13] N_i will only be used to dress population weighted average effect over countries worldwide. The rest of the analysis is the result of a within-country change in welfare. I assume no population migration to arise, i.e., there is no in-and-out population flows between countries depending on their tax rates. Individuals do not choose their location depending on countries' rate.

[14] The authors extensively discuss how some characteristics are kept and others excluded of the weight function: some enter solely the utility function (i.e., not fair to compensate for), some enter solely the weight function through social criteria and others do fit with both the individual preferences and the social criteria. All in all the weight function uses those characteristics and sums up each marginal value of an individual by a scalar in the SWF.

[15] The aim is not to show how it results from any political process.

receive the same amount of money, that is the linear tax rate multiplied by the fiscal base (since population is fixed) $T_0 = T \times B$. The government transfers consumption from some individuals to others. Shareholding are distributed the following way: $\underline{\alpha} = 0$ for consumers and $\sum \overline{\alpha} = 1$ meaning that capitalists do share the firm equally. They represent a share β of the population so each shareholding for one capitalist is $\overline{\alpha} = 1/\beta$ of global MNE's profits Π. Consumption is given by,

$$\underline{c} = T_0 \qquad ; \qquad \overline{c} = \frac{\Pi}{\beta} + T_0$$

Any government must take into account the fiscal base -i.e., reported profits within the country- which is simply the reported profit of the representative MNE headquartered in it. More generally, this fiscal base B relies on the domestic tax rates as well as the set of havens' rates through domestic reported profits. In the model, reported profits are endogenous since the MNE chooses the extent of PS accordingly to the differential tax rates: I can stress a fiscal reaction function [16] such that $B \equiv B\left(T; \boldsymbol{T_h}\right)$. This way I account for behavioral responses induced by fiscal competition: the semi-elasticity of fiscal base with respect to the net-of-tax rate will matter in here: $\Gamma \equiv \partial B/\partial(1-T) \times 1/B$. Since I assumed each country to have a representative MNE, the fiscal base is simply the reported profit (π) of this MNE: $B = \pi$ and $\Gamma = \partial\pi/\partial(1-T) \times 1/\pi$. This parameter will be positive as the differential tax rate decreases when the domestic net-of-tax increases (or equivalently the domestic tax rate decreases). In the same vein, I define the semi-elasticity of shifted profit (s_h) in haven h to the net-of-tax: $\gamma_h = \partial s_h/\partial(1-T) \times 1/s_h$. Let's consider three different governments which respond to various theories of social justice: one which aims at maximizing the utility of the poorest. This is the so-called Rawlsian objective. Another country values each individual the same way. This is the standard utilitarian objective. The last one may weight differently people within its SWF and respond to various redistributive tastes. I will rely on the recent GSMWW method. Note that a large range of redistributive tastes might be described within this weights (including Rawlsian and Utilitarian objectives).

Rawlsian principle Under the principle of the veil of ignorance, the government tries to maximize the utility of the least favored people. Within my two-type set of individuals it is straightforward that consumers have the lowest utility. Capitalists can retire direct consumption from the

[16] See Brueckner (2003) and the review on spillover and resource-flow models which are strategic-interaction models.

MNE after-tax profits paid as dividends, consumers can not. The maximization program writes,

$$\max_{T} \left\{ (1-\beta)\, \underline{c} \right\}$$

Consumers only get transfers, as the proportion $1-\beta$ is fixed, the maximization program is equivalent to maximizing the fiscal revenues (equals the fiscal transfers since population is fixed). Hence the derivative with respect to the domestic tax rate gives,

$$\pi(1-T) - T\,\Gamma\,\pi = 0 \tag{1}$$

Standard Utilitarian solution The standard utilitarian SWF is given by the sum of utilities over consumers and capitalists. The social planner account for the fiscal base and the equally between public resources and expenses. The maximization program thus writes,

$$\max_{T} \left\{ (1-\beta)\, \underline{c} + \beta\, \overline{c} \right\}$$

The optimal domestic tax rates simply sums to zero the marginal effect on the lump-sum and the marginal effect on the overall MNE's profits. The expression in terms of firms' behavioral responses follows: marginal response on profits reported at home equals the sum of marginal response on profits reported in the whole set of havens,

$$\frac{dT_0}{dT} + \frac{d\Pi}{dT} = 0 \quad \Leftrightarrow \quad \Gamma\pi - \sum_{h} (1-T_h)\gamma_h s_h = 0 \tag{2}$$

Moderately and highly redistributive government Following again Munoz (2019), I will now consider the case in which the government does not value the same way each individuals. According to the weight functions described above in the context of GSMWW, the g_k will re-weight each individual relative utility compared to others in the society. Doing so, the social planner can give more importance to consumers than to capitalists in the social welfare function. To depart from the utilitarian standard case in which I can consider $g_k = 1$ for every individual, now I may assign $\overline{g}$ to consumers and $\underline{g}$ to capitalists, with $\underline{g} < \overline{g}$; $\{\underline{g}; \overline{g}\} \in \mathbb{R}^2_+$. The maximization program thus generally re-writes,

$$\max_{T} \left\{ (1-\beta)\, \overline{g}\, \underline{c} + \beta\, \underline{g}\, \overline{c} \right\}$$

The optimal domestic tax rates now sums to zero the marginal effect on the lump-sum for the overall population weighted by the scalar $(1-\beta)\overline{g}+\beta\underline{g}$ and the marginal effect on the overall MNE's profits for the fraction β of capitalists weighted by government's taste $\underline{g}$. The government also accounts for additional dividends repaid to all domestic shareholders,

$$\Big((1-\beta)\,\overline{g}+\beta\underline{g}\Big)\frac{dT_0}{dT}+\beta\underline{g}\frac{d\Pi}{dT}=0$$

It can be rewritten as a the effect of transfers plus the effect of additional profits maximized by the MNE, each term weighted by a function of $g\in\{\overline{g};\underline{g}\}$,

$$(1-\beta)\,(\overline{g}-\underline{g})\Big[\pi(1-T)-T\,\Gamma\pi\Big]-\underline{g}\Big[\Gamma\pi-\sum_h(1-T_h)\gamma_h s_h\Big)\Big]=0 \tag{3}$$

In equation (3) it is clear that if one puts $\{\overline{g};\underline{g}\}=\{1;0\}$, the Rawlsian optimal condition is recovered. If one puts $\{\overline{g};\underline{g}\}=\{1;1\}$, the Standard Utilitarian optimal condition is recovered. That is why the GSMWW method encompasses those redistributive tastes.

Equilibrium tax rates Equations (2) & (3) respectively allow to define the optimal tax rates under fiscal competition for a government with an utilitarian objective and a government with more or less redistributive taste loaded in the SWF. Indeed, the government will take the MNE maximization program as given and reported profits as well as shifted profit will be function of domestic tax rate: $\pi(T;\boldsymbol{T_h})$, $s_h(T;\boldsymbol{T_h})$.

3.2.3 Multinational Enterprise Side

I follow the pioneer Hines Jr and Rice (1994)'s work and notations on this kind of model, with shifted profits being a function of tax rate differentials. I assume true earnings to be fully independent of corporate tax rates[17] ($p\perp T$). In a perfect competition on labor and capital market, it seems quite realistic since the CIT rate will not influence any of the factor productivity, neither labor output, nor capital output. This way each MNE located in jurisdiction i will maximize its after-tax profits Π, being the sum of net-of-tax reported profits in the parent country and net-of-tax reported profits abroad -i.e., in THs.

I consider each MNE to be composed by its headquarter in the parent country and having one

[17]Under this assumption, my work sticks at given inputs of capital and labor. The firm will not adapt these inputs depending on tax policy. I do so because my tax policy functions relates on profits shifting elasticities estimated under the same assumption.

representative subsidiary in at least one TH. It might be the case that profits are shifted towards several THs in which case their number might affect the total amount shifted -simply because each time a low-tax jurisdiction appears, there is an additional opportunity to conceal profits-,

$$\Pi = \underbrace{(1-T)\pi}_{\text{Domestic part}} + \underbrace{\sum_{h\in H}(1-T_h)\pi_h}_{\text{Foreign part}} \tag{4}$$

The domestic part sums true earnings, shifted profits and subtracts shifting costs. Regarding the foreign part of profits, in each haven profits reported is the sum of true earnings and profits shifted from the parent companies located in HTJ. $\forall\, i,\ S = \sum_h s_h$: among THs profits shifted in from the MNE sums to the profits shifted out the HTJ. PS arise only between the headquartered firm (or all establishments of the enterprise within HTJ) and subsidiaries in THs. On this point, I depart from the analytical solutions drawn in Huizinga and Laeven (2008) since they allow for PS arising from international tax differences between affiliates everywhere in the world. I assume true earnings from the MNE's subsidiaries in havens are not correlated to the extent of PS in those havens: $\forall\, h,\ p_h \perp s_h$. This creates an lower bound in the estimate for PS since for instance a US MNE may benefit from the existence of an affiliate in Luxembourg in order to facilitate PS afterwards. This is not a requirement in my model. In order to fill equation (4) I have for all MNE located in i,

$$\begin{cases} \pi &= p + S - c(S) \\ \pi_h &= p_h - s_h \quad \forall\, h \end{cases} \tag{5}$$

As I argued above, shifting costs curve can be increasing and convex in profits shifted: $c'(.) > 0\ ;\ c''(.) > 0$. Plus, the avoidance technology never allows for value creation. In other words, each enterprise worldwide can not increase its total income thanks to PS. This can be seen in equation (5). It allows me to account for the fact it internationally sums to zero[18]. Since I focus on two country-types characterized by $T_i > T_h$ for all i and h, I always get $s_h < 0$ or equivalently $\pi_h > 0$. This seems logical since profits will be transferred out of HTJs towards THs. Usually, in a more general framework authors restrict the flows from low-tax jurisdiction to higher-tax jurisdiction to correct for observations such as Bermudian companies in resource-rich countries[19]. Outliers like that do not fit with opportunities and incentives given by tax rate differential.

MNEs maximize (4) choosing the optimal amount of profit shifted in each haven h given (5).

[18] Usual Lagrange condition: over n countries, $\sum_n s_n \leq 0$.
[19] Example drawn from Cobham et al. (2020), Cobham et al. (2021), Garcia-Bernardo and Janský (2022).

At the optimum one MNE decides to shift until its marginal cost of doing so equals the marginal benefits it can extract thanks to the tax rate differential. Since shifting costs are tax-deductible, the extent of PS does not solely depend on absolute tax rate differential but also on a scaling parameter $1/(1-T)$. If shifting costs were considered not tax-deductible in either of the two concerned countries, the marginal cost would solely depend on $\Delta T_{hi} \equiv T_h - T$,

$$c'(s_h) = \frac{\Delta T_{hi}}{1-T} \qquad\qquad h = 1, \ldots, H \tag{6}$$

From now on, I will use the following functional form for shifting costs assuming that the overall cost of PS is simply the sum of PS in each low-tax jurisdiction: $c(S) = a \sum_h s_h^2/2p = \sum_h c(s_h)$. Costs are increasing with some positive factor of proportionality $a > 0$ and decreasing with true earnings (assumed to be non negative): a large MNE can shift profit at lower cost. For instance, their staff may already be composed by a lot of jurists and lawyers to deal with administrative matters. A smaller MNE may have a smaller administrative team. Here, I also depart from existing literature and modelisation since the cost is usually quadratically increasing in the overall amount of PS. My motivation is that tax authorities will be focused on the activity between the MNE and a considered haven as the amount of suspicious flows increases rather than looking at the global MNE activity and overall transactions throughout the world. Although an administrative team is already hired it costs a bit each time an establishment needs to be created within a considered haven. This might be better captured by the sum of squared PS by haven rather than the squared sum of PS. This choice also allows me to get an estimate of the amount shifted in each haven, which is by the way an upper bound estimate since for all $\{s_h\}$, $c(S) = a(\sum_h s_h)^2/2p < c(s_h) = a \sum_h (s_h)^2/2p$. All other things being equal, lower costs lead to higher PS activity. Optimal amount of PS in any h by MNE belonging to i and gross reported profit $\pi^r = p + S$[20] in any country becomes,

$$s_h = \frac{p}{a} \frac{\Delta T_{hi}}{(1-T)} \qquad\qquad \forall\, h = 1, \ldots, H \tag{7}$$

[20]The equation is just an accounting identity. It only says: reported profits equal actual profits plus inward profit shifting. Both profit measures here are interpreted to be gross of the cost of profit shifting. If I were to interpret them net of these costs, then they would have to be deducted from both sides of the equation, which gives back the stated equation.

$$\begin{cases} \pi^r = p\Big[1 - \dfrac{1}{a}\sum_h \dfrac{\Delta T_{ih}}{(1-T)}\Big] \\ \\ \pi_h^r = p_h + \dfrac{p}{a}\dfrac{\Delta T_{hi}}{(1-T)} \end{cases} \tag{8}$$

Intuitive results are here confirmed: (1) larger MNEs shift more ; (2) a larger factor of proportionality reduces the extent of PS (increases costs) ; (3) a larger tax rate differential between a haven and the HTJ increases the extent of PS ; (4) a greater number of HTJ reduces the extent of domestic reported profits. It is reassuring to see that $p > \pi^r$: profits are lower in HTJs compared to their true level. $\forall\, i,\ p_h < \pi_h \quad \Rightarrow \quad \forall\, h,\ p_h = \sum p_h < \pi_h = \sum \pi_h$ meaning false operations are reported there.

Once I get estimates for s_h, I can derive expressions for sufficient statistics in order to link the government side to solutions drawn by the firm side. Welfare variations will be computed thanks to a functional utility form for the government social welfare function associated to a social theory of justice loaded in it thanks to weights the planner gives to consumers and capitalists respectively.

3.2.4 Equilibrium

At the equilibrium, the government takes into account the MNE's maximization program to set its optimal tax policy. Doing so, behavioral responses are internalized within the policy function: with the knowledge of evasion incentives and opportunities, optimal tax rates will be lower compared to an hypothetic situation in which no behavioral response exists.

Rawlsian equilibrium As no component of the equation (1) relies on a function of T, the equilibrium is unchanged and described by this equation. The effect of PS incentives, opportunities and linked costs are already loaded in Γ. The greater the semi elasticity of domestic reported profits to the net-of-tax rate, the lower the domestic rate. In other words, a Rawlsian government will be careful to strong behavioral response because fiscal revenues are sensitive to such response. In case behavioral response is not strong enough, $\Gamma < 1$, (and since I consider any other form of concealment beyond the scope of my analysis) I get back to the first-best solution: profits are entirely taxed, $T^R = 1$. Note that this result relies on the previously stated assumption of independence between true earnings and the CIT policy function. In practice, of course, inputs are affected by tax policy, especially at higher rates, and thus revenue maximizing tax rate is likely to be lower

than the one describe by this function,

$$T^R = \frac{1}{\Gamma} \tag{9}$$

Standard utilitarian equilibrium The government combines its tax policy function drawn in equation (2) and reported profits at the optimum for the MNE parent plant and its affiliates given by equations (7) & (8) to reach the optimal tax rate level. I denote by T^U this rate for an utilitarian government which always lies between 0 and 1, i.e., the MNE shifts less as the domestic rate decreases, and the numerator always stands below the denominator (sums two components both greater than the two components of the numerator). It also exhibits expected properties. The domestic tax rate (1) increases with the cost proportionality factor: as PS activity is more costly, the government has more room to increase its rate without triggering a great behavioral response ; (2) decreases with TH's rates as predicted by fiscal dumping: this is the *incentive part* for PS activity ; (3) decreases with the number of TH in the world: this is the *opportunity part* in PS activity. See formal computations in Appendix D.2 page 58 . Note that once all PS opportunities are erased, i.e., $H = 0$ or equivalently no TH exist, I come back to the first-best solution which is to fully tax profits: $T^U = 1$.

$$T^U = \frac{\Gamma(a + \sum_h T_h) - \sum_h T_h(1 - T_h)\gamma_h}{\Gamma(a + H) - \sum_h (1 - T_h)\gamma_h} \tag{10}$$

For what comes next, I study the condition for T^U to lie between 0 and 1 (assuming the government do not subsidize production and can not tax profits more than a hundred percent) in the calibration part. See subsection 4. Thanks to that I will set a range of potential values for γ as a function of Γ because the later is the only semi-elasticity estimated by previous research.

General case equilibrium Relying on the GSMWW method, once again I can combine equation (3) and equations for reported and shifted profits at the optimum (resp. 7 & 8) to reach the optimal value for the domestic CIT rate. Such computations lead to a quadratic formula in T with complicated expressions for the scalars behind the unknown. This is why I do not get explicit analytic formula in this case. I provide the statistical software `.RStudio` this following quadratic equation to solve for optimal T^G once I have entered the value of the parameters. Formal computation steps are in Appendix - D.3 page 59 . Nevertheless with the first order condition above, lessons drawn for the standard utilitarian case still hold (regarding a, H, Γ and $\forall h$, T_h and γ_h). Plus, whenever I put specific values for g's to fit Rawlsian and pure Utilitarian case, I recover pre-

viously drawn solutions. The GSMWW formula actually encompasses those redistributive tastes as expected. Setting $G = (1-\beta)(\overline{g}-\underline{g})$, T^G is characterized by the following,

$$\begin{aligned} T^2\Big[G\Gamma(a+H)\Big] \\ +T\Big[\underline{g}\Big(\Gamma(a+H)-\textstyle\sum_h(1-T_h)\gamma_h\Big)-G\Big(\Gamma(a+\textstyle\sum_h T_h)+a+H\Big)\Big] \\ +\Big[G(a+\textstyle\sum_h T_h)+\underline{g}\Big(\textstyle\sum_h(1-T_h)T_h\gamma_h-\Gamma(a+\textstyle\sum_h T_h)\Big)\Big]=0 \end{aligned} \tag{11}$$

3.3 Actual Rates Prediction: the "Race to the Bottom" Nash Equilibrium

In this subsection, I want to give a rationale about why we can interpret the set of actual rates and their trend as conditioned by the "race to the bottom" game.

Under fiscal competition, the government fiscal base B is related to all tax rates of the economy: its own and those of havens since shifting profit arise solely between domestic headquartered MNE and its affiliate in havens within my model. As the own rate relies on the value of havens' rates and the country characteristics X, I have $T = f(\boldsymbol{T_h}; X)$ and thus $B \equiv B(T; \boldsymbol{T_h}; X)$. I argue that the $f(.)$ function is decreasing with any havens' rate T_h.

I want to show in here that fiscal competition actually arise following the opportunities and incentives given by THs to MNEs. The government aims at maximizing its CIT base (no matter there is a representative MNE or several differentiated MNEs within the country[21]). Under the assumption that wages paid are invariant to any CIT rate change (see Alstadsæter et al. (2022), there are few indirect effects on wage premium following the optimization of the after-tax profits, especially for the bottom 50% wage earners -i.e., $dw/d(1-T) \times (1-T)/w \simeq 0$) a government who plays the "race to the bottom" game aim at maximizing the fiscal base. I still assume that PIT rates and CIT rates are independent.

For a representative MNE, the fiscal base is simply the reported profit of the single MNE. Using the same functional form for costs as from the beginning and the chain rule formula, the reaction function on CIT rates is given by,

$$\frac{\partial B}{\partial T}\Big(\equiv \frac{\partial \pi}{\partial T}\Big)=0 \quad \Leftrightarrow \quad -\frac{\partial S}{\partial(1-T)}-\frac{\partial S}{\partial(1-T)}c'(S)=0 \quad \Leftrightarrow \quad c'(S)=1$$

Recall that $s_h = S - \sum_{h'} s_{h'}$ so the derivative of the chosen cost function with respect to the global

[21] The following result holds for J independent MNEs in a country. The optimal rate formula of the government remains the same. I show the formal computations in Appendix - D.4 page 60.

amount of profits shifted S gives,

$$c'(S) = \frac{a}{2p} \times 2 \sum_h \left(S - \sum_{h', h' \neq h} s_{h'} \right) = \frac{a}{p} \Big(HS - (H-1)S \Big) = \frac{a}{p} S$$

together with the optimal formula for shifted profits (with reversed sign because costs are positive), i.e., equation (7), gives

$$\sum_h \frac{p}{a} \frac{\Delta T_h}{(1-T)} = \frac{p}{a} \quad \Leftrightarrow \quad \sum_h (T - T_h) = 1 - T \quad \Leftrightarrow \quad T^{FC} = \frac{1 + \sum_h T_h}{H+1} \tag{12}$$

Playing a simultaneous uncoordinated game with a set of havens, the HTJ will decrease its rate as the number of TH increases and their rates decrease as predict by the Nash equilibrium. In theory, if the government solely focuses on maximizing the fiscal base, rates will continue to be pushed down as the formal solution predict. Thanks to the data, this predicted rate approximate quite well the average CIT rate for non-havens countries: the actual 2017 average statutory rate for non-havens stands at 24.98% according to the OECD's CbCR data. Although the predicted rate by the non-cooperative game is lower than the actual average legal rate of non-havens, I found that the 18.39% optimal tax competition rate approximate even more the average ETR of non-havens. Indeed, using Tørsløv et al. (2018)'s data release and the effective rates they correct from legal ones[22], I found an average ETR equal to 18.31%. In any case, I may assume that actual rates are determined the "race to the bottom" game. This name comes from the downdraft effect havens apply to HTJs by setting zero or low rates. I argue that countries tend to play this game and as the evolution of CIT rates over time shows, even if some countries still have higher than expected rate, they will eventually reach it if the decreasing trend pursues.

3.4 Welfare Variation Depending on True Earnings, Capitalism and Theories of Social Justice

My strategy is to rely on optimal formulas drawn above to get the indirect social utility in each country. This indirect social utility is heterogeneous in the sense that PS affects differently countries depending on their theoretical profits. These are the results of some production function (which I do not pretend to describe in here) and reflect their relative income. According to these theoretical profits and the income group classification given by the World Bank I want to stress heterogeneous effects. More precisely, I am interested in the the welfare variations: I quantify the

[22] They used the forward looking effective tax rate estimated by Spengel et al. (2019).

percentage of change in SWF's steping from the maximizing rate of one theory of social justice that the government defends to the well-known "race to the bottom" situation, where rates are pushed downwards in order to attract more capitals. The question is: what is the cost of this attempt to attract profits?

For each country group, I want to compare, the indirect utility within the benchmark situation of fiscal competition: $W(T^{FC})$, to any other indirect utility given by theories of justice $J \in \{R; U; G\}$ the government may follow: $W(T^J)$. The magnitude of welfare effects will rely on parameters such as the factor of proportionality in costs, the proportion of capitalists, the number of havens. The sign of variations will depend on effects each agent-type faces and discussed above in sub-subsection 3.2.1 paragraph *iii) Social utility*. Formally I quantify for each country group i,

$$\begin{cases} \Delta R = W(T^{FC}) - W(T^R) \\ \Delta U = W(T^{FC}) - W(T^U) \\ \Delta G = W(T^{FC}) - W(T^G) \end{cases}$$

considering T^{FC} to be the actual tax rates countries exhibit. With the formulas for optimal rates at hand, and reported/shifted profits functions, it is possible to perform a welfare analysis.

4 Data and Calibration

All the data used in this work are quickly introduced in table 1 page 48.

4.1 Country-by-Country Report Statistics (OECD)

My analysis is mainly based on the new data set provided by the OECD. As mentioned above, in order to countervail BEPS phenomenon, the OECD has set an Action Plan with a dozen of actions to be undertaken (15 of them to be precise). The 11th one "*Establish methodologies to collect and analyse data on BEPS and the actions to address it*" stresses limitations of available data to analyse BEPS: other available data are often not comprehensive across jurisdiction and companies (no international standards) and taxes paid are generally not included. This is why Action 11's final report recommends the publication of a range of data and statistics relevant to the economic analysis of BEPS in an internationally consistent format[23].

[23] This action especially emphasizes the need to provide transparent statistics on tax planning and transactions made by MNEs.

The provision of CbCR data is a response to such need underlined. The rules developed include a requirement that MNEs[24] provide all relevant governments with needed information on their global allocation of the income, economic activity and taxes paid among countries according to a common template. Each country data gathers essential statistics about headquartered there MNEs' financial and economic activity. Among others, the number of MNEs headquartered is disclosed, as well as aggregated profits made, people employed, stated capital and value of assets other than cash in each partner country -i.e., where the parent company has subsidiaries. Since data is aggregated and anonymised at country level, I framed my work into the lens of representative MNE because their is no way to know to what extent each headquartered MNE is responsible of the total production. Although this initiative taken by the OECD allow to analyze data of unprecedented quality, there are a certain number of limitations that must be addressed.

Data of unprecedented quality According to Cobham and Janskỳ (2020)'s work, there are three reasons why this dataset is valuable. Firstly, the country coverage is wider than any other data actually available. In 2017, the Action 13 has led over 5000 MNE groups with fiscal year ending between 01.01.2017 and 12.31.2017 to report statistics within 38 headquarter jurisdictions[25]. These firms and their subsidiaries report activities in more than 200 jurisdictions overall. As an example, the leading country being Japan with 200 jurisdictions covered through activity of Japan MNEs. They report activity within 40 out of the 46 THs included in the list I based my analysis on. Concretely it means that large Japan MNEs and their subsidiaries located all around the world file CbCRs with Japanese tax authorities because Japan is the ultimate parent jurisdiction. According to Japan confidentiality standards, a single dataset is provided to the OECD gathering economic information about those MNEs and their activity. I described the data availability in table 4 .

Secondly, profits and tax liabilities are consistent with the concept of corporate profits because it has been explicitely asked to MNEs to disclose such information. For instance, data provided by the Bureau of Economic Analysis do not insure this level of quality. There, profits are imputed by a combination of net profits, intra-group dividends, interest paid, and other variables. Here, the computation of profits and taxes also excludes double-counting issues. It is another explicit rule MNEs must fulfill to provide CbCR statistics on revenues and profits. Double-counting is problematic since it bias the ETRs. According to the authors, CbCR data offer the opportunity to

[24]MNEs with yearly revenues higher than $750 millions must fill their duty accordingly to the template and rules provided by OCDE (2015).

[25]Despite the fact that the Inclusive Framework counts 135 country member, only 38 of them have judged to receive enough CbCRs to ensure taxpayer confidentiality according to their standards.

conduct the best cross-country analysis among the range of available data.

Thirdly, data sets are provided in separate files. One for all MNEs and the other for MNEs that have positive profits only (so not losses). It helps to compute the ETRs more accurately[26].

Inherent limitations and way to address them There exist several general limitations inherent to the way CbCR rules and templates are constructed. Among which one can find limited information, fiscal years coverage or aggregation issues for instance. See the OECD's disclaimer on this topic available at: *"Important disclaimer regarding the limitations of the Country-by-Country report statistics"*. Inherent limitations are being scrutinized by the relevant authorities and corrections should be incorporated soon (I come back to this in section 6).

On top of these limitations, note that if double-counting has been removed from revenue by explicit request of the OECD, it should also been removed from profits but may remain sometimes. This limitation relies on the discretion each jurisdiction has to impose data collection to headquartered MNE. It is linked both to intra-company dividends and stateless entities. Since stateless income (reported in data) might be another source of double-counting, I drop such observations as it has been done in previous work by the authors of the TJN. Some governments[27] have investigated the issue themselves and did provide instructions to correct double-counting. Other papers apply correction to other countries as well[28]. I follow the same path in order to reduce this limit as much as possible.

4.2 Apportionment Formula

Using the reported profits by each HTJ's MNE in a wide range of country[29], I use the widely known Apportionment Formula (AF)[30] method to pin down theoretical profits to calibrate my model on this basis. I proceed according to the following steps to set AFs:

1. For each HTJ i, I sum the domestic reported profits π and foreign reported profits π_h for all $h \in H$. It represents the consolidated financial statements of the representative MNE in i ;

2. I compute the domestic share of several indicators embedded in the AF. For instance, look-

[26] ETRs are indeed upward biased with the full data set since profits are understated (losses included). Anyway, I used ETR computed by Tørsløv et al. (2018) since their computations do not suffer from such bias

[27] Italy, Netherlands, Sweden and the United Kingdom where respectively 35%, 16%, 51% and 52% of profits are double-counted.

[28] Garcia-Bernardo et al. (2021a) correct 44% of profits in the USA and 10% of profits in all havens. Cobham et al. (2021) correct 50% in Belgium, Singapore, and Isle of Man and 35% in all other countries except for Mexico and Slovenia.

[29] See table 4 for the number of jurisdiction in which there are reports available per country.

[30] The FMI in its report largely described the functioning of such formula: Keen et al. (2019). It has been used in the pure misaligned profit method in Cobham et al. (2020), Cobham et al. (2021), Garcia-Bernardo and Janský (2022)

ing at employment in the production process of the MNE, I compute the domestic share of employees as the domestic number of employees over the total number of employees in this firm all over the world: $e = emp/(emp + \sum_h emp_h)$. Similarly for every TH in which the firm reports activity I compute $e_h = emp_h/(emp + \sum_h emp_h)$. I repeat the operation for all considered indicators[31] ;

3. Then I redistribute consolidated profits according to the formula. Following the example with employees I will get,

$$\pi + \sum_h \pi_h = \underbrace{e \times \left(\pi + \sum_h \pi_h\right)}_{p} + \underbrace{\sum_h e_h \times \left(\pi + \sum_h \pi_h\right)}_{\sum_h p_h}$$

with $e + \sum_h e_h = 1$.

4.3 Calibration

The departure from theoretical Huizinga and Laeven (2008)'s framework allowed me to get even simpler expression to asses the magnitude of PS which only relies on theoretical profits in each country, statutory differential tax rates and a shifting cost parameter a which I assume uniformly distributed across HTJs, i.e., no matter the country in which a MNE is headquartered, the avoidance technology is the same. Only the true earnings and tax rate differential will pin down the optimal amount of profit shifted.

Parameters Several parameters in the optimal rate functions and social welfare functions must be taken into account for calibration: the cost proportionality parameter, the number of havens the government face, a partition between capitalists and consumers and finally government's redistributive tastes. Note that the functional form for utility is linear in consumption. I used it earlier in the work to draw optimal rates.

➢ *The factor of proportionality (a)* of marginal cost link to PS activity: MNE's accounts should be relatively undistorted to accommodate PS if true earnings are large according to Huizinga and Laeven (2008). I assume here that the avoidance technology is identical in each country, meaning that a is uniformly distributed. I will set a = 1 for simplicity. One way to go further and do comparative statics would be to set a $\in \{1; 10\}$ to see how the less or greater

[31] Depending on specifications I will consider employment, total payroll or stated capital.

ease to shift affect optimal rates and shifted amounts (I let this for further investigation). Intuitively, if PS activity is more costly, the government should increase its rate since the behavioral response is shrunken ;

➢ *The number of havens (H)*: starting from the TH list usually studied and initially set in Hines Jr and Rice (1994) gathering 41 countries, I add 5 of them on top of this list as done by Tørsløv et al. (2018). The full list is available in table (2) page 50. H = 46 as counted in the TH list below. For practice manners, since I considered in my theoretical framework havens to be differentiated uniquely by their ETR, if several of them have the same rate, I sum reported statistics among those and I assign later on shifted profits to this unique aggregated entity. Overall, an underlying assumption is that each and every HTJ can access in theory each and every TH for PS purposes ;

➢ *The share of capitalists (β)*: in the framework, the size of each country might be different, thus global agent-type effect may vary over countries, still I assume the share of capitalists to be uniformly distributed over HTJs. Doing so, I can stress analysis for a certain percentage of the population depending on individuals' type. For instance, putting $\beta = 0.5$ meaning that 50% of the population own at equal share the domestic MNE allows me to state about the other half of population that are consumers (i.e., the bottom 50% here) and their welfare variation. I will set $\beta \in \{0.1; 0.5\}$;

➢ *The social welfare weights (g's)*: In the general case equilibrium I consider a moderately and a highly redistributive government (on top of the particular Rawlsian and Utilitarian studied above) in the same fashion as Munoz (2019) did. In the moderately redistributive case the government values two times more consumers compared to capitalists: $\overline{g} = 2\underline{g}$. In the highly redistributive case, the government values five times more consumers compared to capitalists: $\overline{g} = 5\underline{g}$;

➢ *Tax haven effective tax rates (T_h's)*: I have shown how competition over ETR approximate more fiscal dumping. I calibrate my simulations based on TH's ETR given by Tørsløv et al. (2018). Preferential rates for foreign firms might exist in various havens as well as bilateral treaties between countries. ETR do integrate more realistically than statutory rates the complexity and nesting of the international tax system, as described in section 1.

Semi-elasticities The calibration exercise also requires an empirical estimate for the reported profits and shifted profits semi elasticities to the net-of-tax. The key thing is to know how firms would react to a change in differential tax rates. A great number of papers have been working on the estimation of this behavioral response. In a meta-analysis, Heckemeyer and Overesch (2017) have gathered 203 estimations from 27 empirical studies and compared their magnitude accounting for data and methodologies differences. Correcting for confounding factor in meta-regressions, their preferred predicted value for the semi elasticity of reported profits to domestic tax rate stands at 0.8. It means that following a 1 percentage point increase in the domestic tax rate, firms would decrease their reported profits by 0.8%. The estimate lies in the following confidence interval $[0.546; 1.026]$. To see the influence of this semi-elasticity on welfare, I also draw conclusions using the Huizinga and Laeven (2008)'s estimations coming from an analysis on European MNEs. Their framework is the closest to mine I could found. Their preferred estimate is 1.43 and lies between 0.97 and 2.21. This way, following a 1 percentage point increase in the domestic tax rate, firms would decrease their reported profits by 1.43%. Within my framework it corresponds to the Γ parameter.

I still need to pin down the γ_h parameter. Intuitively the two semi-elasticities are linked: consequently to a change in the domestic rate, if reported profits decrease to some proportion, it must be the case that shifted profits increase in a certain proportion too. In order to simplify things I will consider that semi-elasticities of shifted profits towards each haven h are equal to each other In order to simplify estimations and because I do not have the data to estimate such parameter per TH, I will assume it to be equals among havens: $\forall h,\ \gamma_h = \gamma$. Simple computations led me to link Γ and γ. The first derivative of gross reported profits with respect to the net-of-tax gives me, $\gamma \equiv f(\Gamma) = \pi/S \times \Gamma$: the extent of PS compared to reported profits at home matters. However, this $f(.)$ function relies on the optimal rate T if a replace $\pi(T)$ and $S(T)$ in it.

Regarding equation (10), two sets of condition appears for this optimal rate to be valid. It needs to lie between 0 and 1. Now, I can draw conditions on the relationship between the two semi-elasticities only relying on parameters value. The utilitarian rate will be greater than zero as

long as,

$$\left\{\gamma < \frac{a+\sum_h T_h}{\sum_h T_h(1-T_h)}\Gamma \quad \text{AND} \quad \gamma < \frac{a+H}{\sum_h (1-T_h)}\Gamma\right\} \tag{C0}$$

OR

$$\left\{\gamma > \frac{a+\sum_h T_h}{\sum_h T_h(1-T_h)}\Gamma \quad \text{AND} \quad \gamma > \frac{a+H}{\sum_h (1-T_h)}\Gamma\right\} \tag{$\overline{C0}$}$$

and the utilitarian rate will be lower than 1 under equation (C0) or under equation ($\overline{C0}$) as long as,

$$\gamma \leq \frac{H-\sum_h T_h}{\sum_h (1-T_h) - \sum_h T_h(1-T_h)}\Gamma \tag{C1}$$

$$\gamma \geq \frac{H-\sum_h T_h}{\sum_h (1-T_h) - \sum_h T_h(1-T_h)}\Gamma \tag{$\overline{C1}$}$$

To chose the relevant pair of condition (either {C0 ; C1} or {$\overline{C0}$; $\overline{C1}$}), I will help myself with the condition on T^U to increase with cost proportionality factor: as PS become more costly for firms, the government may tax more domestic profits. I show in Appendix - D.2 page 58 . This condition is the same as equation (C1). Hence I stick to the pair {C0 ; C1}.

5 Results

Among the 38 countries available in the data, I provide result for 20 countries which report activity within the CbCR data. I excluded 8 havens that report activity in this framework through their MNE to avoid bias in my estimation: the overall welfare effect in those countries are a mixture between the attraction of the fiscal bases belonging to other countries and the loss of their own fiscal base to some extent. 10 HTJs did not provide any statistics about activity within havens. The entire set of results are presented on Appendix E - Welfare effects page 61. I firstly show in table 5 how I calibrated γ, then optimal rates follow in table (6) and finally the welfare effects under several specifications are available in tables (7 - 12) from page 63 to page 68. I used four redistribution tastes in governments preferences. From least to more redistributive: Utilitarian, moderately redistributive, highly redistributive, Rawlsian. I used three different AFs respectively based on the number of employees, the capital stated by MNEs and the wage bill. Welfare effects appear to be robust to the AFs.

Optimal schedules The main scenario takes the Huizinga and Laeven (2008)'s preferred estimate (1.43) for Γ as input. If the behavioral response is too small, every government type will fully tax profits. I thus choose to pick a high enough response (above 1) to see differentiated settings in rates among governments' types. The more redistribution matters for the government, the higher the CIT rate. Optimal schedules are quite concentrated since even the utilitarian planner pushes up its rate to reach 52.3% if she tries to maximize social welfare rather than CIT base. A rawlsian planner will push the rate up to 70%. The difference between the two is significant for such amount of money considered in the fiscal base. Other planners lie between those two, which is consistent with the theoretical prediction. Another consistent feature is the decreasing trend with the share of capitalist: the higher the share of capitalist, the lower the optimal rate.

One interesting feature is the reversal of optimal rates whenever the semi-elasticity of reported profits is very high (the behavioral response is very strong). Now, the rawlsian planner will set the lower rate compared to the utilitarian planner who will set the highest. The lower the will of the planner to redistribute, the higher the rate. Plus, under such consideration, the latter interpretation about share of capitalist is reversed: the higher the share of capitalist, the lower the optimal rate.

Welfare effects conclusions follow. Note that in both cases for Γ, effects under an utilitarian perspective remains since the optimal rate is 52.3% no matter what.

Welfare effects One striking fact is the following: within this simplified economy, no ones benefit from tax competition, even shareholders. If an Utilitarian planner decides to shift from the "race to the bottom" game to the maximization of the social welfare, capitalists loose about 5% of their utility. The extra-consumption they may retire from aggressive tax planning set by havens does not compensate for the loss in redistributive capacity of the government. Nevertheless, consumers are much more affected by this misconception of optimal rate setting. Due to tax competition and the "race to the bottom" game, consumers, who solely rely on social transfers loose about 50% of their utility if the government follows an utilitarian theory of social justice. Overall social welfare drops by 24%.

This negative effect is higher for government whose purpose is to redistribute more. When I weight by population size, on average a Rawlsian social welfare drops about half (48%), the effect being largely driven by the bottom 50% of consumers who loose 72.3% of their utility (or equivalent consumption linked to transfers). Governments weighting more consumers than capitalists range themselves in between an Utilitarian and a Rawlsian government in my preferred estima-

tion. The planner who gives two (resp. five) times more weight to consumers than capitalists will face a 40% decrease in social welfare (resp. 46%).

Lastly, I expected results to be driven by relative development -e.g., the more truly productive an MNE is, the more PS appears and thus, the larger the social welfare effect. Still, this is not the case. I can not conclude on an link between true earnings and the size of the welfare effect. The correlation coefficient between true earnings (p) of the MNE and the social welfare effect is about 0.08. The main driver of the overall effect is the initial CIT rate set by the HTJ under the conception of the "Race to the Bottom" game. The correlation coefficient between the parent CIT rate and welfare effects is about 0.98. One potential explanation for this non-result, not in line with Crivelli et al. (2016)'s result for instance, is the static feature of my model. I do not include dynamics to derive long-run effects as they do to estimate the scale of PS.

Comparison with Muñoz's results In my preferred estimation the way how results do range themselves is opposite to hers. The change in how effects rank between each other is simply due to the definition of tax competition she gave and I give. In her model, accounting for migration responses (on top of labor supply response) affect more governments whose will to redistribution is moderate. A Rawlsian government is less affected since its social preference for the poorest acts as a strong barrier to reduction in rates following competition existence. In my view, the more affected government will be the one who weight the more consumers. Indeed, the gap between playing at the "race to the bottom" and following its social preferences to determine rates is wider. Going further on estimation and running additional robustness tests would be to use calibration for the pair $\{\Gamma;\gamma\}$ such that schedules in optimal rates are reversed depending on social preferences the government exhibit. I had unfortunately no time to present these results for now. All in all, conclusions are the same: poor people are quite hurt by this kind of optimization process!

6 Discussion and Conclusion

Limits One striking limit of my work for now is that it do not consider any link between real activity within THs and the extent of PS making the estimation an lower bound: $\forall\, i, h,\ p_h \perp s_h$. It seems more realistic that some MNEs headquartered in the USA, France or Germany for instance may have a real location and activity in countries like Luxembourg or Switzerland. They may benefit from the real activity there to hide more easily profits and mislead tax authorities. It may also partially explain why in practice MNEs in various HTJs do not report activity in the whole

set of THs: it seems easier to avoid tax autorithies when real activity happen in havens. My estimate does not captures any potential effect of real activity within the extent of PS. I am aware of this flaw in my modelisation. The welfare variation would certainly be higher in absolute value correcting for it.

Another limit is that welfare effects at international scale is not fully pictured: I voluntarily (in order to simplify the framework) put aside any welfare consideration regarding THs. I did not consider the MNEs potentially headquartered in those countries. Welfare variation within havens is undetermined. Indeed, by the will to attract capitals from HTJs, their governments are constantly decreasing statutory CIT rate. Doing so they lose potential revenues from MNEs headquartered in their country that could have been taxed at higher rate because they hope getting revenues from subsidiaries of MNEs headquartered in HTJs. Within my simple model and its restrictive assumptions the welfare effect of tax competition in those countries only depends on the government revenues channel. There is no effect on capitalists since local MNEs in havens do not shift abroad. In other words, it might be the case that additional source of revenues (thanks to low rates) outweighs the loss in fiscal revenues (due to low rates fixation essentially). Depending on the harshness of tax competition (to what extent do tax rate decrease), allowing for PS opportunities worldwide might increase governments revenues if the tax competition is not too hard and thus mitigate the overall international welfare variation. Weighting equally THs and HTJs in a global perspective by population for instance, since havens do represent a low share of global population, I thus considered their mitigated effect negligible. Note that social dumping might be detrimental to havens too if tax competition is too harsh: governments could lose revenues in net with the fake hope to attract enough capitals in order to outweigh the revenues losses on local MNEs.

Another limit appears when I considered elasticity of reported profits to the net-of-tax rate and elasticities of profits shifted to the net-of-tax rate. This limit is twofold. Firstly one must acknowledge that the empirical estimate I used for Γ is not a structural parameter. It is in fact affected by many environmental factors, such as current differences in tax rates, levels of cooperation. The values of this elasticity may be varying over time, and across countries. Secondly, and related, I assumed $\gamma_h = \gamma$ for all TH which is a solid simplification. This elasticity also could vary over time and over countries (here among HTJ and over TH such that we have γ_{ih}). Even if I calibrate this parameter using Heckemeyer and Overesch (2017) meta-analysis, I do not account for country and time differences. At least in the short-run, according to my conclusion, consumers from

low-income countries do not suffer more than consumers located in high-income countries. Still, with the differentiated ability of governments to recover from BEPS (low-income governments may have less tools to recover than high-income governments -e.g., less margin of indebtedness. I come back to this in the avenues for future research paragraph), it might be the case.

One limit exist when I relate my model to the data. As shown in section 4, the CbCR data are not flawless. When filling the OECD's requirements, MNEs have a large discretion in order to manipulate their statistics. There is no information to link the statistics to the actual name of the multinational and its ownership structure. Governments also have a great discretion regarding disclosure statement to protect more or less information MNEs are submitted to. This and all of the above limitations are being addressed by the data collection authorities in connection with the release of information by member governments who signed the BEPS Action Plan. Nevertheless, for now, it prevents me to apply a more granular analysis allowing firms to differ by their productivity and level of profits. I needed to stick to the case in which firms are identical. It could have been interesting to see how sufficient statistics as the semi-elasticity of reported profits to net-of-tax would have evolved according to the distribution of firm productivity. The analysis could include for each country i, $\Gamma_j = \sum_j \pi_j/(1-T)$. This way the behavioral response depends on the distribution of true earnings (p_j) within countries as firms may be more or less productive. However, only true earnings by country p are approachable with those kind of data.

The final limit I want to state relates to the assumption that true earnings realised by MNEs are independent to the CIT rate fixed by governments. In other words, there is no equivalent of the labor supply elasticity one can found in Munoz (2019) in mine. If so, I would have use the same definition for welfare effect of tax competition as she did. I had to work around this issue.

Conclusion and policy recommendations For the first time ever in the US, billionaires' average tax rates on income stands below the average tax rate of the bottom 50% (see Saez and Zucman (2019)). Those same billionaires are those who benefit the most from tax avoidance by MNEs since they are likely to hold large share of C-corps. As I have shown, the size of the welfare effect for these individuals is much smaller than for consumers. This contributes to the continued explosion of inequality. Public institutions must be equiped to face it. They need the information and the appropriate tools.

In terms of policies, conclusions of my work can only reinforce the recommendations previously made in the literature, namely Cobham et al. (2020), Cobham et al. (2021) through the "Tax Justice Network". The OECD Action Plan to counteracts BEPS initiated the process with the CbCR

data. To go even further, it should be extended and made mandatory to all countries reporting activity for their MNEs.

On top of what, automatic exchange of information would make the political process of taxation less costly and faster. Reducing the asymmetry of information, the added value is more easily assimilated to a subsidiary and therefore to its location. Tax authorities would access to MNE's consolidated accounts and treat global profits accordingly. The European Commission brought forward in 2021 "BEFIT": it is intended to create a common set of rules for corporate taxation and contribute to the fair allocation of taxation rights among member states.

For now, only legal owners are known by tax authorities. It must be extended to beneficial owners. Because beyond knowing who really benefits from these illicit financial flows, the beneficial ownership registration could allow to dress more precise analysis about the real direct and indirect cost among societies.

Avenues for future research I over-simplified the theoretical framework[32] in order to bring light on analytical solutions including sufficient statistics to the welfare analysis and fit with the data available. In addition to facing to previously mentioned limitations, one avenue for future research will be to account for more complex models and assess their impact from this welfare point of view.

Improving the model by making it more complex involves taking more detailed account of the ownership structure of the MNEs. For instance, it is rather likely the case that not only locals own the firms. Accounting for cross-border ownership structure may give more insight about who may gain and where. It also might be a path to follow in order to stress heterogeneous effect depending on relative development. For instance, if US capitalists hold a large share of US MNEs but also MNEs headquartered in lower income countries, it could be the case that US capitalists gain increases giving showing that USA are losing less than in my estimation. Lower income countries would gain less extra-dividends as I argued in my estimation worsening the losses in terms of social welfare in those countries.

In line with the previous paragraph, it would be interesting to give a more granular insight by refining the ownership structure within countries. In other words, drop the assumption of

[32] I assumed my model to capture all types of PS methods within S whereas granular analysis may refine results. My conclusions stick to transfers and extra-dividends as revenue sources. One reason why the overall effect is negative for capitalists is the weight given to transfers in their utility function. In reality, they might rely quite less on this kind of revenue. Hence, to capture more the positive effect and rationalize why capitalist behave this way, I could refine utility functions in some on going work.

I also left aside preferential tax-treatments for foreign enterprises. I did not refine the analysis to capture more precisely hybrid entities, stateless reported income and so on.

uniform distribution of holding among capitalists. It might be the case that a small group of people hold larger share and a larger group of people hold a smaller share of the MNE. It would refine the heterogeneous analysis in terms of agent-type effects.

Another wider improvement would be to link PS and social utility within the brand new framework drawn in Garcia-Bernardo et al. (2022) in which the authors account for secondary and tertiary effects that mitigate the overall costs of the phenomenon for developed countries and exacerbate it for developing countries. Developed countries recover revenues losses (primary effect) on one hand, thanks to capital gains and dividends taxes on corporate investors (secondary effects) and on the other hand by borrowing in financial markets at very low interest rates (tertiary effects). Those channels are less exploited by developing countries. On short, including dynamic conception of tax avoidance within utility might be interesting to see how consumers might recover or not in the economies.

In this perspective, the data limit those kind of work even if unprecedented improvements have been made. More and more comprehensive and complete data will clarify the way to proceed in the following years. This is path taken by the OECD and other institutions helped by enforcement rules set by governments for multinationals, which must provide clear and complete statistics to provide this kind of data.

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Appendix

A - Data Sets and Variables Used

Table 1: Data sets and variables

Source	Variable	Description
OECD Country-by-Country Reporting	Ultimate Parent Jurisdiction	The ultimate parent jurisdiction is the jurisdiction where the ultimate parent entity is resident for tax purposes.
	Partner Jurisdiction	The partner jurisdiction is the jurisdiction in which constituent entities of the MNE group are resident for tax purposes. A partner jurisdiction is defined as a state as well as a non-state jurisdiction that has fiscal autonomy.
	Total Revenues	Revenues should include revenues from sales of inventory and properties, services, royalties, interest, premiums and any other amounts. Revenues should exclude payments received from other constituent entities that are treated as dividends in the payer's tax jurisdiction. Total revenues should equal the sum of unrelated and related party revenues.
	Profits (Loss) before Income Tax	The sum of the profit (loss) before income tax for all constituent entities resident for tax purposes in the relevant tax jurisdiction. The profit (loss) before income tax should include all extraordinary income and expense items.
	Income Tax Paid	The total amount of income tax actually paid during the relevant fiscal year by all constituent entities resident for tax purposes in the relevant tax jurisdiction. Taxes paid should include cash taxes paid by the constituent entity to the residence tax jurisdiction and to all other tax jurisdictions. Taxes paid should include withholding taxes paid by other entities (associated enterprises and independent enterprises) with respect to payments to the constituent entity. Thus, if Company A resident in Jurisdiction A earns interest in Jurisdiction B, the tax withheld in Jurisdiction B should be reported by Company A.
	Income Tax Accrued	The sum of the accrued current tax expense recorded on taxable profits or losses of the year of reporting of all constituent entities resident for tax purposes in the relevant tax jurisdiction. The current tax expense should reflect only operations in the current year and should not include deferred taxes or provisions for uncertain tax liabilities.
	Stated Capital	The sum of the stated capital of all constituent entities resident for tax purposes in the relevant tax jurisdiction. With regard to permanent establishments, the stated capital should be reported by the legal entity of which it is a permanent establishment unless there is a defined capital requirement in the permanent establishment tax jurisdiction for regulatory purposes.
	Number of Employees	The total number of employees on a full-time equivalent basis of all constituent entities resident for tax purposes in the relevant tax jurisdiction. The number of employees may be reported as of the year-end, on the basis of average employment levels for the year, or on any other basis consistently applied across tax jurisdictions and from year to year. For this purpose, independent contractors participating in the ordinary operating activities of the constituent entity may be reported as employees. Reasonable rounding or approximation of the number of employees is permissible, providing that such rounding or approximation does not materially distort the relative distribution of employees across the various tax jurisdictions. Consistent approaches should be applied from year to year and across entities.

World Bank income group classification	Income group	The World Bank assigns the world's economies to four income groups —low, lower-middle, upper-middle, and high income. The classifications are updated each year on July 1 and are based on the GDP per capita of the previous year.
IMF World Revenue Longitudinal Data (WoRLD)	Corporate Income Tax Revenues	Time series on revenues from corporate income taxation in percent of GDP for 197 countries.
Tax Foundation	Corporate income tax rates	Statutory rates on the time period 1980-2021 for 251 countries.
Tax Justice Network	Effective tax rates	Corresponds to the average effective tax rates (tax liabilities divided by earnings before taxes) faced by MNEs computed on the basis of CbCR data.

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B - Country Classification

Table 2: Income group classification and tax havens.

Tax haven	Cayman Islands (CYM) - Bermuda (BMU) - Vanuatu (VUT) - Guernsey (GGY) - British Virgin Islands (VGB) - Hong Kong, China (HKG) - Panama (PAN) - Malta (MLT) - Cyprus (CYP) - Jersey (JEY) - Mauritius (MUS) - Switzerland (CHE) - Luxembourg (LUX) - Singapore (SGP) - Netherlands (NLD) - Belgium (BEL) - Ireland (IRL) - Curacao (CUW) - Macau, China (MAC) - Bahrain (BHR) - Bahamas (BHS) - Barbados (BRB) - Liberia (LBR) - Liechtenstein (LIE) - Isle of Man (IMN) - Turks and Caicos Islands (TCA) - Puerto Rico (PRI) - Gibraltar (GIB) - Saint Vincent and the Grenadines (VCT) - Marshall Islands (MHL) - Jordan (JOR) - Monaco (MCO) - Lebanon (LBN) - Antigua and Barbuda (ATG) - Andorra (AND) - Aruba (ABW) - Seychelles (SYC) - Samoa (WSM) - Maldives (MDV) - Saint Kitts and Nevis (KNA) - Tonga (TON) - Saint Lucia (LCA) - Belize (BLZ) - Dominica (DMA) - Anguilla (AIA) - Netherlands Antilles (ANT)
Low income	Afghanistan (AFG) - Benin (BEN) - Burkina Faso (BFA) - Burundi (BDI) - Central African Republic (CAF) - Chad (TCD) - Comoros (COM) - Democratic Republic of Congo (COD) - Eritrea (ERI) - Ethiopia (ETH) - Gambia (GMB) - Guinea (GIN) - Guinea-Bissau (GNB) - Haiti (HTI) - Liberia (LBR) - Madagascar (MDG) - Malawi (MWI) - Mali (MLI) - Mozambique (MOZ) - Nepal (NPL) - Niger (NER) - North Korea (PRK) - Rwanda (RWA) - Senegal (SEN) - Sierra Leone (SLE) - Somalia (SOM) - South Sudan (SSD) - Tanzania (TZA) - Togo (TGO) - Uganda (UGA) - Zimbabwe (ZWE)
Lower-middle income	Angola (AGO) - Armenia (ARM) - Bangladesh (BGD) - Bhutan (BTN) - Bolivia (BOL) - Cambodia (KHM) - Cameroon (CMR) - Cape Verde (CPV) - Congo (COG) - Cote d'Ivoire (CIV) - Djibouti (DJI) - Egypt (EGY) - El Salvador (SLV) - Eswatini (SWZ) - Georgia (GEO) - Ghana (GHA) - Guatemala (GTM) - Honduras (HND) - India (IND) - Indonesia (IDN) - Jordan (JOR) - Kenya (KEN) - Kiribati (KIR) - Kosovo (OWID_KOS) - Kyrgyzstan (KGZ) - Laos (LAO) - Lesotho (LSO) - Mauritania (MRT) - Micronesia (NA) - Moldova (MDA) - Mongolia (MNG) - Morocco (MAR) - Myanmar (MMR) - Nicaragua (NIC) - Nigeria (NGA) - Pakistan (PAK) - Palestine (PSE) - Papua New Guinea (PNG) - Philippines (PHL) - Sao Tome and Principe (STP) - Solomon Islands (SLB) - Sri Lanka (LKA) - Sudan (SDN) - Syria (SYR) - Tajikistan (TJK) - Timor (TLS) - Tunisia (TUN) - Ukraine (UKR) - Uzbekistan (UZB) - Vanuatu (VUT) - Vietnam (VNM) - Yemen (YEM) - Zambia (ZMB)
Upper-middle income	Albania (ALB) - Algeria (DZA) - American Samoa (ASM) - Argentina (ARG) - Azerbaijan (AZE) - Belarus (BLR) - Belize (BLZ) - Bosnia and Herzegovina (BIH) - Botswana (BWA) - Brazil (BRA) - Bulgaria (BGR) - China (CHN) - Colombia (COL) - Costa Rica (CRI) - Croatia (HRV) - Cuba (CUB) - Czechoslovakia (OWID_CZS) - Dominica (DMA) - Dominican Republic (DOM) - Ecuador (ECU) - Equatorial Guinea (GNQ) - Fiji (FJI) - Gabon (GAB) - Grenada (GRD) - Guyana (GUY) - Iran (IRN) - Iraq (IRQ) - Jamaica (JAM) - Kazakhstan (KAZ) - Lebanon (LBN) - Libya (LBY) - Malaysia (MYS) - Maldives (MDV) - Marshall Islands (MHL) - Mauritius (MUS) - Mayotte (MYT) - Mexico (MEX) - Montenegro (MNE) - Namibia (NAM) - Nauru (NRU) - North Macedonia (MKD) - Panama (PAN) - Paraguay (PRY) - Peru (PER) - Romania (ROU) - Russia (RUS) - Saint Lucia (LCA) - Saint Vincent and the Grenadines (VCT) - Samoa (WSM) - Serbia (SRB) - South Africa (ZAF) - Suriname (SUR) - Thailand (THA) - Tonga (TON) - Turkey (TUR) - Turkmenistan (TKM) - Tuvalu (TUV) - Venezuela (VEN)
High income	Andorra (AND) - Antigua and Barbuda (ATG) - Aruba (ABW) - Australia (AUS) - Austria (AUT) - Bahamas (BHS) - Bahrain (BHR) - Barbados (BRB) - Belgium (BEL) - Bermuda (BMU) - British Virgin Islands (VGB) - Brunei (BRN) - Canada (CAN) - Cayman Islands (CYM) - Channel Islands (OWID_CIS) - Chile (CHL) - Curacao (CUW) - Cyprus (CYP) - Czechia (CZE) - Denmark (DNK) - Estonia (EST) - Faeroe Islands (FRO) - Finland (FIN) - France (FRA) - French Polynesia (PYF) - Germany (DEU) - Gibraltar (GIB) - Greece (GRC) - Greenland (GRL) - Guam (GUM) - Hong Kong (HKG) - Hungary (HUN) - Iceland (ISL) - Ireland (IRL) - Isle of Man (IMN) - Israel (ISR) - Italy (ITA) - Japan (JPN) - Kuwait (KWT) - Latvia (LVA) - Liechtenstein (LIE) - Lithuania (LTU) - Luxembourg (LUX) - Macao (MAC) - Malta (MLT) - Monaco (MCO) - Netherlands (NLD) - Netherlands Antilles (ANT) - New Caledonia (NCL) - New Zealand (NZL) - Northern Mariana Islands (MNP) - Norway (NOR) - Oman (OMN) - Palau (PLW) - Poland (POL) - Portugal (PRT) - Puerto Rico (PRI) - Qatar (QAT) - Saint Kitts and Nevis (KNA) - Saint Martin (French part) (MAF) - San Marino (SMR) - Saudi Arabia (SAU) - Seychelles (SYC) - Singapore (SGP) - Sint Maarten (Dutch part) (SXM) - Slovakia (SVK) - Slovenia (SVN) - South Korea (KOR) - Spain (ESP) - Sweden (SWE) - Switzerland (CHE) - Taiwan (TWN) - Trinidad and Tobago (TTO) - Turks and Caicos Islands (TCA) - United Arab Emirates (ARE) - United Kingdom (GBR) - United States (USA) - United States Virgin Islands (VIR) - Uruguay (URY)

Tax haven list from Alstadsæter et al. (2022) (based on Hines Jr and Rice (1994) and additions from Tørsløv et al. (2018)) - Income level classification from the World Bank - World Development Indicators (2017).

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C - Descriptive Statistics and Rationales

Table 3: Domestic vs. foreign global activity within the OECD's CbCR data.

Localisation	Revenues	Profit	Income Tax Paid	Income Tax Accrued	Stated Capital	Tangible Assets	Employees
	(Billions of USD)						(Millions)
			2016				
Domestic	25034.37 (65%)	2526.29 (62%)	443.11 (68%)	438.42 (69%)	17145.39 (59%)	14768.96 (75%)	45 (61%)
Foreign	13705.58 (35%)	1550.45 (38%)	206.01 (32%)	198.31 (31%)	11944.33 (41%)	4988.12 (25%)	29 (39%)
Of Which Tax Havens	3509.32 (8%)	566.31 (12%)	27.53 (4%)	26.6 (4%)	5426.01 (16%)	999.73 (5%)	2 (3%)
			2017				
Domestic	37950.25 (64%)	4243.74 (61%)	622.63 (66%)	677.48 (67%)	28609.72 (61%)	20746.7 (73%)	74 (62%)
Foreign	21566.3 (36%)	2692.24 (39%)	321.1 (34%)	327.16 (33%)	18269.79 (39%)	7606.06 (27%)	45 (38%)
Of Which Tax Havens	6238.32 (9%)	1072.13 (15%)	45.85 (5%)	51.04 (5%)	8531.26 (15%)	2026.25 (7%)	3 (3%)

Lecture: In 2017, 2/3 of the income tax paid accrue to the ultimate parent jurisdiction, i.e., the country where the firm is headquartered. 1/3 of tax liability goes to foreign country in which the MNE may exercise activity. Overall only 5% of the total tax liability accrues to tax havens where activity is reported whereas 15% of global profits are reported there.

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Table 4: Data availability: number of jurisdiction in which activity is reported per country.

Ultimate Parent Jurisdiction	Availability	With positive profits	Of which Tax Havens
Argentina	19	15	1
Australia	82	57	17
Austria	6	5	
Belgium	21	21	3
Bermuda	97	65	29
Brazil	39	31	11
Canada	15	15	1
Switzerland	122	121	25
Chile	10	10	
China (People's Republic of)	125	92	17
Germany	161	120	30
Denmark	115	115	18
Spain	120	80	23
Finland	2	2	
France	90	40	16
United Kingdom	7	6	
Greece	6	6	
Indonesia	43	31	11
Isle of Man	7	7	1
India	164	134	34
Ireland	2	2	1
Italy	110	81	18
Japan	200	185	40
Korea	2	2	
Luxembourg	92	91	15
Latvia	14		1
Mexico	97	61	22
Malaysia	36	27	9
Netherlands	2	2	1
Norway	6	6	
Peru	20	12	5
Poland	5		
Romania	7	7	1
Singapore	29	38	6
Slovenia	7	6	
Sweden	7	7	
United States	143	94	30
South Africa	139	115	26

Lecture: US multinationals report activity in 143 jurisdiction across the world. Within 94 of them, the aggregated MNE groups' profits are positive. US multinationals provide statistics in 30 countries considered as havens.

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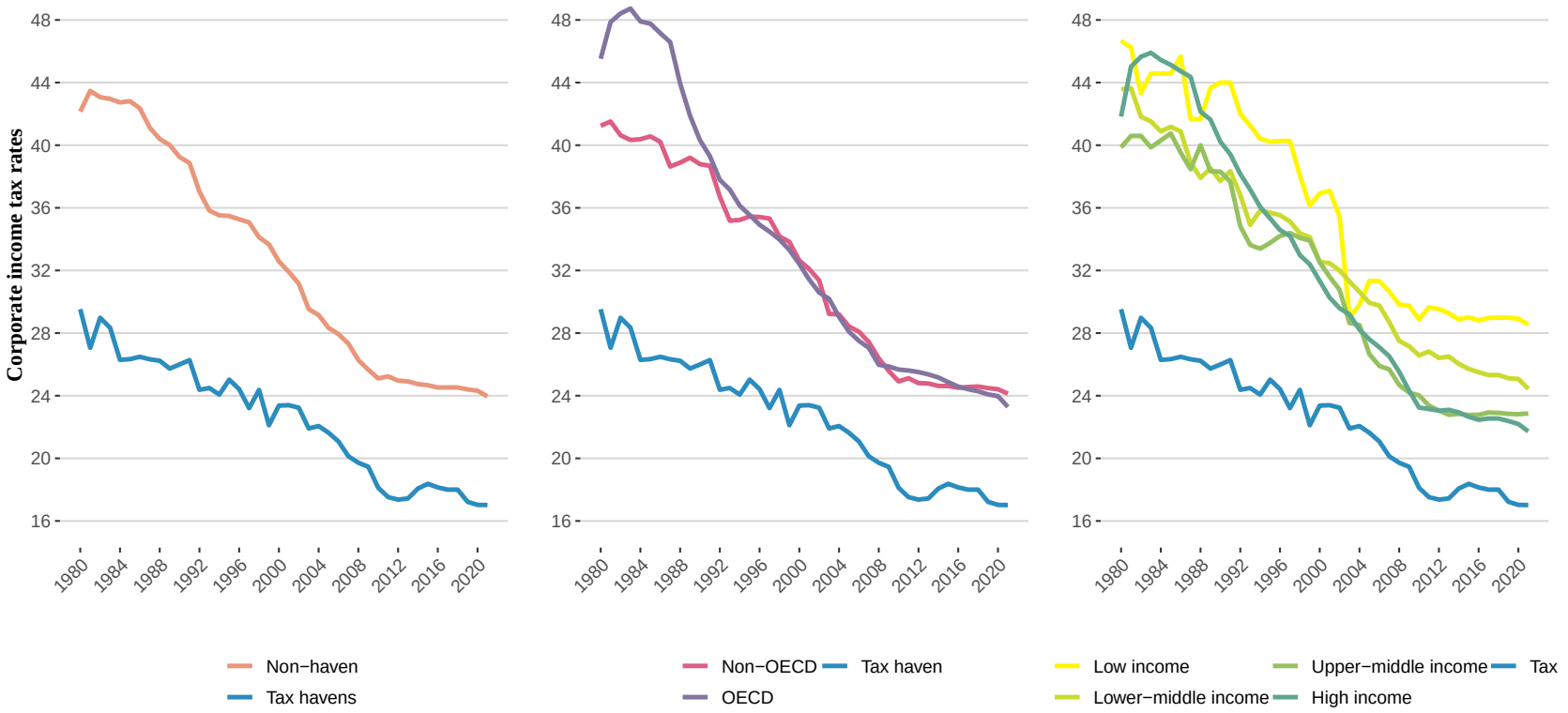
Figure 1: Legal corporate income tax rates trends depending on various groups.



Lecture: The figure shows the average corporate income tax rates among countries depending on groups. The average CIT rates reached 42% for non-havens in the early nineties and fell down to 24% in 2020. The spread between the average TH's legal rate and the average non-havens' rate has shrunk over the last thirty years.

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Figure 2: Corporate income tax revenues (% GDP) trends depending on various groups.

Lecture: The figure shows the average corporate income tax revenues among countries depending on groups in percentage of GDP. The global trend is increasing between 1990 and 2018 leading by upper-middle income country group. As percentage of GDP, CIT revenues in low-income countries reach on average 2.2% in 2018.

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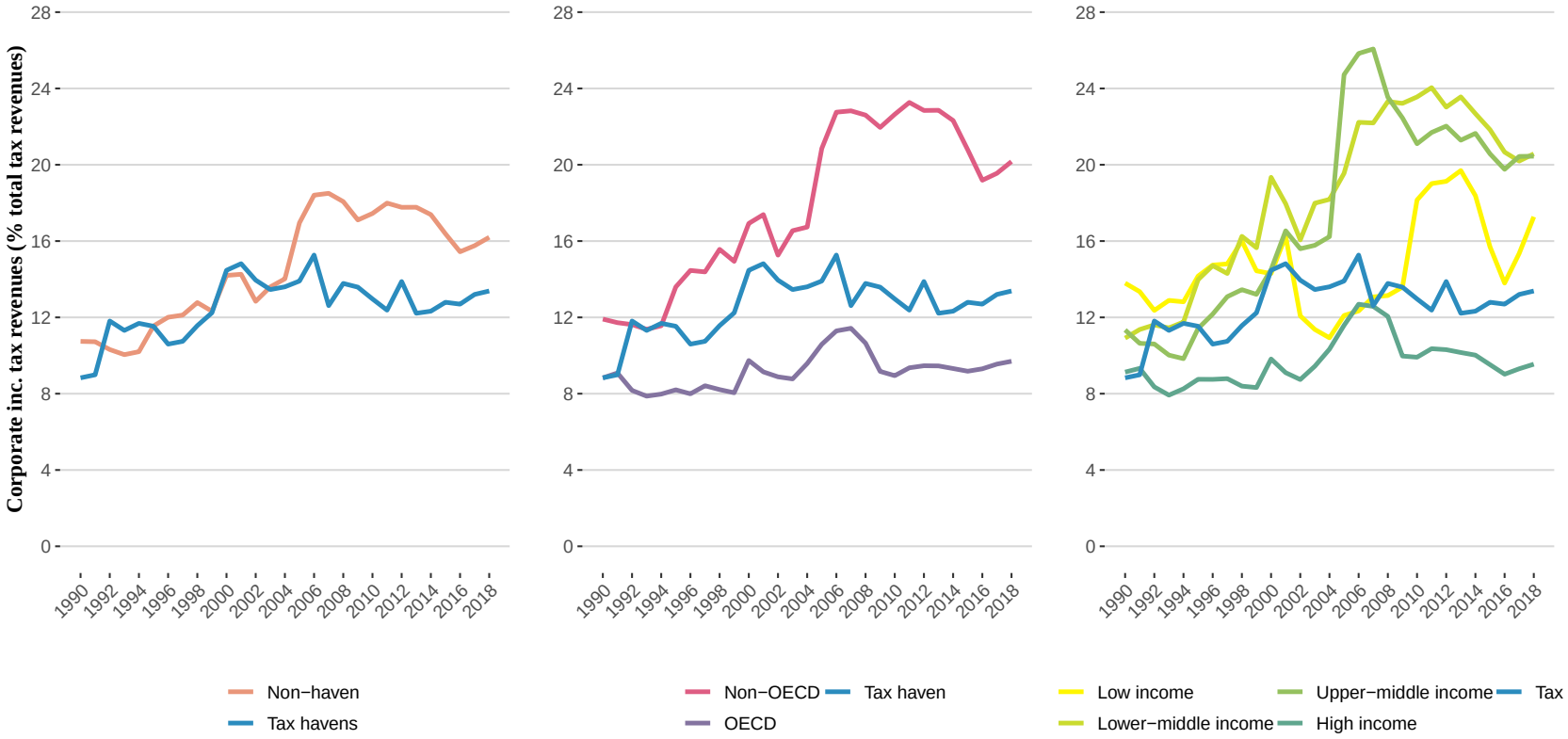
Figure 3: Corporate income tax revenues (% global fiscal revenues) trends depending on various groups.



Lecture: The figure shows the average corporate income tax revenues among countries depending on groups in percentage of global fiscal revenues. The global trend is increasing between 1990 and 2018 leading by upper-middle income and lower-middle income country groups. As percentage of global fiscal revenues, CIT revenues in low-income countries reach on average 18% in 2018.

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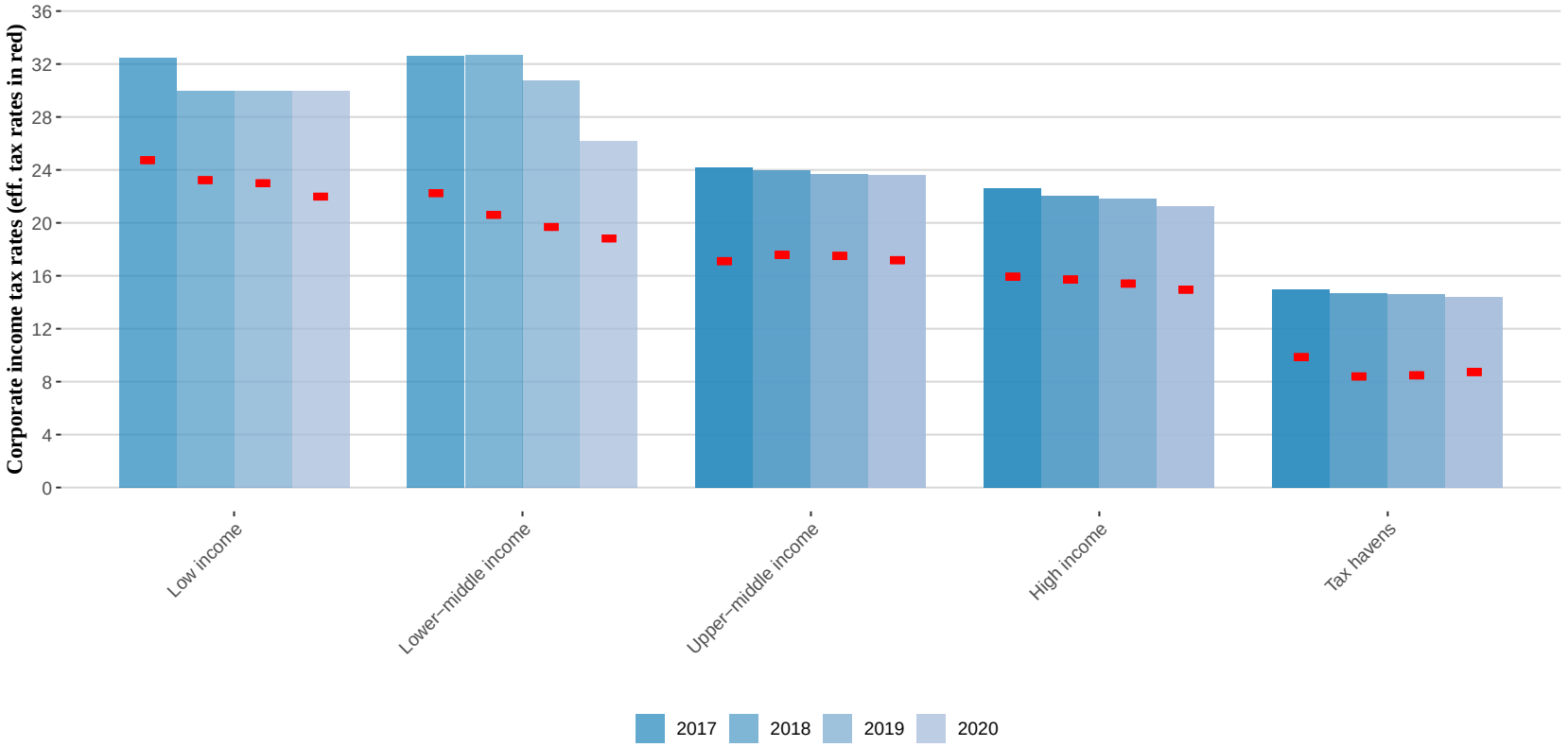
Figure 4: Effective tax rates (in red) per income group and tax havens over 2017-2020.



Lecture: The stacked bars represent legal rates and the red dots shows the ETR per income groups. Over the last four years, legal rates continued to fall. For every country group, the average ETR stands below the average legal rates and the decline is also observable.

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D - More on Theory

D.1 - No Incentive for a MNE to Create Establishments in Several HTJs in the Sole Objective to Shift More

Consider a MNE who truly earns p in the country she is headquartered in. She has no incentives to split its true earnings creating establishments in other HTJs on the only purpose to minimize its costs if there is no productivity increase ($p = \sum_{i=1}^{I} p_i$). Indeed, in the aggregate case, the enterprise faces costs equal to $aS^2/2p$. In the disaggregated case costs are equal to $a\sum_{i=1}^{I}(s_i)^2/2p_i$.

The MNEs still tries to minimize its costs assuming that $S = \sum_{i=1}^{I} s_i$. The associated Lagrangian and first-order conditions for all country i are,

$$\mathcal{L} = -\frac{a}{2}\sum_{i=1}^{I}\frac{(s_i)^2}{p_i} + \lambda\Big(\sum_{i=1}^{I} s_i - S\Big)$$

$$\forall i, \quad -\frac{a}{p_i}s_i + \lambda = 0 \quad \Rightarrow \quad \forall i,j,\ i \neq j, \quad s_i = s_j\frac{p_i}{p_j}$$

$$\sum_{i=1} s_i = S$$

Using the first-order conditions lead to an amount of profit shifted in by each subsidiary located in a HTJ to be proportional to the share of true earnings so that total costs are unchanged,

$$s_i = \frac{p_i}{p}S \quad \Rightarrow \quad \frac{a}{2}\sum_{i=1}^{I}\frac{(s_i)^2}{p_i} = \frac{a}{2}\sum_{i=1}^{I}\Big(\frac{p_i}{p}S\Big)^2\frac{1}{p_i} = \frac{aS^2}{2p}$$

I generalize this rationale to every HTJ so it reinforces the assumption that profit shifted are captured by a single representative MNE headquartered per HTJ.

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D.2 - Standard Utilitarian Equilibrium Computations

To reach the optimal policy function T^U, I reintroduce equations (8) & (7) into the equation (2). I recall that $\Gamma_h \pi_h = -\gamma_h s_h$ and $\sum_h = H$,

$$\begin{aligned}
& \Gamma\pi + \sum_h (1-T_h)\Gamma_h\pi_h = 0 \\
\Leftrightarrow \quad & \Gamma\pi\Big[1 - \frac{\sum_h (T-T_h)}{a(1-T)}\Big] - \sum_h (1-T_h)\gamma_h s_h = 0 \\
\Leftrightarrow \quad & \Gamma\Big[a(1-T) - \sum_h T + \sum_h T_h\Big] - \sum_h (1-T_h)\gamma_h (T_h - T) = 0 \\
\Leftrightarrow \quad & T\Big[\Gamma(a+H) - \sum_h (1-T_h)\gamma_h\Big] - \Big[\Gamma(a + \sum_h T_h) - \sum_h T_h(1-T_h)\gamma_h\Big] = 0
\end{aligned}$$

Recall the expected properties. The domestic tax rate,

(1) Increases with the cost proportionality factor,

$$\begin{aligned}
\frac{\partial T}{\partial a} \geq 0 \quad \Leftrightarrow \quad & \frac{\Gamma\Big[\Gamma(a+H) - \sum_h (1-T_h)\gamma_h\Big] - \Big[\Gamma(a+\sum_h T_h) - \sum_h T_h(1-T_h)\gamma_h\Big]\Gamma}{\Big[\Gamma(a+H) - \sum_h (1-T_h)\gamma_h\Big]^2} \geq 0 \\
\Leftrightarrow \quad & \Gamma(a+H) - \sum_h (1-T_h)\gamma_h - \Gamma(a + \sum_h T_h) + \sum_h T_h(1-T_h)\gamma_h \geq 0
\end{aligned}$$

This is always verified and the same condition as for T to be lower than 1 (in the case of {C0 ; C1}) ;

(2) Decreases with TH's rates as predicted by fiscal dumping,

$$\forall h,\ \frac{\partial T}{\partial T_h} \geq 0 \quad \Leftrightarrow \quad \frac{\Big[\Gamma + \gamma_h(1-2T_h)\Big]\Big[\Gamma(a+H) - \sum_h (1-T_h)\gamma_h\Big] - \Big[\Gamma(a+\sum_h T_h) - \sum_h T_h(1-T_h)\gamma_h\Big]\gamma_h}{\Big[\Gamma(a+H) - \sum_h (1-T_h)\gamma_h\Big]^2} \geq 0$$

The condition, for $T_h > 1/2$, is reduced to (since all other components are positive),

$$\Gamma \geq -\gamma_h(1-2T_h) > 0$$

and always verified if $T_h < 1/2$ meaning that Γ must be higher than a negative value (Γ is positive). Since tax havens exhibit low rate by definition, they have all a rate lower than 50% so we can stick into this condition and consider that domestic rate do decrease when havens' rate decrease ;

(3) Decreases with the number of TH in the world. Since Γ is positive,

$$\frac{\partial T}{\partial H} = -\frac{\Gamma}{\Big[\Gamma(a+H)\Big]^2} < 0$$

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D.3 - GSMWW Equilibrium Computations

Step-by-step computations led me to a quadratic equation to solve in order to pin down optimal rates under this objective that encompasses a wide range of redistributive view. For simplicity I put $(1-\beta)(\overline{g}-\underline{g}) = G$. Recall that $\Gamma_h \pi_h = -\gamma_h s_h$, $\sum_h = H$ and simple computations allow to find $s_h/\pi = (T_h - T)/[a(1-T) - HT - \sum_h T_h]$. Thus starting from equation (3),

$$
\begin{aligned}
& G\pi[1-T\Gamma] + \underline{g}\pi\Big[-\Gamma - \sum_h (1-T_h)\frac{\Gamma_h \pi_h}{\pi}\Big] = 0 \\
\Leftrightarrow \quad & G[1-T\Gamma] + \underline{g}\Big[-\Gamma + \sum_h (1-T_h)\gamma_h \frac{s_h}{\pi}\Big] = 0 \\
\Leftrightarrow \quad & G[1-T\Gamma] + \underline{g}\Big[-\Gamma + \sum_h (1-T_h)\gamma_h \frac{(T_h - T)}{a(1-T) - HT - \sum_h T_h}\Big] = 0 \\
\Leftrightarrow \quad & G[1-T\Gamma] + \underline{g}\Big[\frac{-\Gamma a + \Gamma T(a+H) - \Gamma \sum_h T_h + \sum_h (1-T_h)\gamma_h (T_h - T)}{a - a(T+H) - \sum_h T_h}\Big] = 0 \\
\Leftrightarrow \quad & G[1-T\Gamma][a - T(a+H) + \sum_h T_h] \\
& \qquad = -\underline{g}[-\Gamma a + \Gamma T(a+H) - \Gamma \sum_h T_h + \sum_h (1-T_h)\gamma_h (T_h - T)] \\
\Leftrightarrow \quad & Ga - TG\Gamma a - TG(a+H) - T^2 G\Gamma(a+H) \\
& \qquad + G\sum_h T_h - TG\Gamma \sum_h T_h + T\underline{g}\Gamma(a+H) - T\underline{g}\sum_h (1-T_h)\gamma_h \\
& \qquad\qquad - \underline{g}\Big[\Gamma(a + \sum_h T_h) - \sum_h (1-T_h)T_h \gamma_h\Big] = 0 \\
\Leftrightarrow \quad & T^2\Big[G\Gamma(a+H)\Big] \\
& \qquad + T\Big[\underline{g}\Big(\Gamma(a+H) - \sum_h (1-T_h)\gamma_h\Big) - G\Big(\Gamma(a + \sum_h T_h) + (a+H)\Big)\Big] \\
& \qquad\qquad + \Big[G(a + \sum_h T_h) + \underline{g}\Big(\sum_h (1-T_h)T_h\gamma_h - \Gamma(a + \sum_h T_h)\Big)\Big] = 0
\end{aligned}
$$

I provide this quadratic equation to `.RStudio` and solve for real roots. I check on this last stage if a reach the Rawlsian and Utilitarian cases to spot potential mistakes. For the Rawlsian, i.e., $\{\underline{g}; \overline{g}\} = \{0; 1\}$ and for the pure utilitarian case, i.e., $\{\underline{g}; \overline{g}\} = \{1; 1\}$, it simplifies very well analytically and results are similar. I double-checked with the `quadratricRoots()` function I've created and results are identical. The GSMWW formula actually encompasses those redistributive objectives.

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D.4 - "Race to the Bottom" Nash Equilibrium with Independent MNE's

For independent and not identical MNEs, the fiscal base is now the sum of profits reported by the entire set of MNEs headquartered in the country. The reaction function on CIT rates is given by,

$$\frac{\partial B}{\partial T}\Big(\equiv \frac{\partial \sum_{j\in J} \pi_j}{\partial T}\Big) = 0 \quad \Leftrightarrow \quad -\sum_{j\in J} \frac{\partial S_j}{\partial(1-T)} + \sum_{j\in J} \frac{\partial S_j}{\partial(1-T)} \frac{\partial c_j}{\partial S_j} = 0$$
$$\Leftrightarrow \quad \sum_{j\in J} -\gamma_j \frac{S_j}{(1-T)} + \sum_{j\in J} \gamma_j \frac{S_j}{(1-T)} \frac{\partial c_j}{\partial S_j} = 0$$

Together with the optimal formula for shifted profits, i.e., equation (7),

$$-\sum_{j\in J} \gamma_j S_j + \sum_{j\in J} \gamma_j S_j \frac{a_j}{p_j} |S_j| = 0$$
$$\Leftrightarrow \quad -\sum_{j\in J} \gamma_j \sum_h \frac{p_j}{a_j} \frac{T_h - T}{(1-T)} + \sum_{j\in J} \gamma_j \sum_h \frac{p_j}{a_j} \frac{T_h - T}{(1-T)} \frac{a_j}{p_j} \sum_h \frac{p_j}{a_j} \frac{T_h - T}{(1-T)} = 0$$
$$\Leftrightarrow \quad -\frac{1}{(1-T)} \sum_j \gamma_j \frac{p_j}{a_j} \Big(\sum_h T_h - HT \Big) + \frac{1}{(1-T)^2} \sum_j \gamma_j \frac{p_j}{a_j} \Big(\sum_h T_h - T \Big) \Big(HT - \sum_h T_h \Big) = 0$$
$$\Leftrightarrow \quad T(H+1) = 1 + \sum_h T_h$$

I reach the same result. No matter the number of independent MNEs in one country, the distribution of productivity (captured trough p_j) and the ability to conceal profits (captured trhough a_j), defining tax rates with the sole objective of maximizing the tax base leads to a decrease in these rates through with the existence of TH and an even bigger decrease as their number grows and their rates fall down: $\forall h,\ -\partial T/\partial T_h < 0$ and $\partial T/\partial H < 0$.

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E - Welfare Effects

Table 5: Numerical simulations for γ based on conditions drawn in the Utilitarian case.

			Condition 01	Condition 02	Condition 1
		γ lower than ...	$\frac{a+\sum_h T_h}{\sum_h T_h(1-T_h)}\Gamma$	$\frac{a+H}{\sum_h(1-T_h)}\Gamma$	$\frac{H-\sum_h T_h}{\sum_h(1-T_h)-\sum_h T_h(1-T_h)}\Gamma$
	Estimated Γ in ...				
Heckmeyer & Overesch (2017)	0.546		0.921	0.722	**0.675**
	0.789		1.330	1.043	**0.975**
	1.026		1.729	1.356	**1.268**
Huizinga & Laeven (2008)	0.970		1.636	1.282	**1.199**
	1.430		2.411	1.891	**1.768**
	1.790		3.726	2.922	**2.932**

Lecture: The columns "Condition 01" and "Condition 02" show jointly the upper limit for γ allowing T^U to be greater than 0. The column "Condition 1" shows the upper limit for γ allowing T^U to be lower than 1. Since γ must be lower than each of these boundaries, the condition with the lower numerical value bounds.

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Table 6: Optimal rates under various theories of social justice accounting for fiscal competition.

Baseline paper for Γ *estimate*	*Heckmeyer & Overesch (2017)*			*Huizinga & Laeven (2008)*		
	Lower bound	Preferred estimate	Upper bound	Lower bound	Preferred estimate	Upper bound
Scenario $\{\Gamma\,;\,\gamma\}$	$\{0.546\,;0.615\}$	$\{0.789\,;\,0.883\}$	$\{1.026\,;\,1.146\}$	$\{0.970\,;\,1.085\}$	$\{1.430\,;\,1.599\}$	$\{2.210\,;\,2.470\}$
Theory of social justice						
Rawls	1	1	0.971	1	**0.699**	0.452
Pure Utilitarism	0.532	0.532	0.532	0.532	**0.532**	0.532
Moderately redistributive						
$\beta = 0.1$	1	1	0.877	0.931	**0.649**	0.485
$\beta = 0.5$	1	1	0.812	0.865	**0.624**	0.495
Highly redistributive						
$\beta = 0.1$	1	1	0.945	1	**0.684**	0.465
$\beta = 0.5$	1	1	0.926	0.980	**0.673**	0.472

Lecture: Under the preferred estimation of *Huizinga & Laeven (2008)*, a Rawlsian government will set the CIT rate at 70%. A Rawlsian planner accounts for the behavioral response of the MNE which escape its fiscal duty through PS activity. Such planner does not account for the benefits capitalists retire thanks to extra-dividends paid. A pure utilitarist planner does account for this second channel and thus reduce its optimal rate compared to the Rawlsian objective (53.2%). Other rates are ordered following the intuition: the more redistributive the objective of the government, the more the planner favors consumers through the transfer effect so the higher the rate. The more consumers there are in society, the higher the rate.

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Table 7: Welfare effects of tax competition from the "Race to the bottom" game: Rawlsian and Utilitarian objective. True earnings are redistributed thanks to employment location.

	Apportionment formula based on employment location											
	ΔU						ΔR					
	$\beta = 0.1$			$\beta = 0.5$			$\beta = 0.1$			$\beta = 0.5$		
	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists
Country												
ARG	-24.51	-48.38	-5.40	-24.51	-48.38	-16.68	-49.19	-72.46	-19.44	-49.19	-72.46	-38.65
AUS	-28.99	-57.98	-5.80	-28.99	-57.98	-19.48	-52.19	-77.58	-19.76	-52.19	-77.58	-40.70
BRA	-25.46	-50.39	-5.50	-25.46	-50.39	-17.28	-49.82	-73.53	-19.52	-49.82	-73.53	-39.09
CAN	-37.39	-76.90	-5.75	-37.39	-76.90	-24.42	-57.85	-87.68	-19.73	-57.85	-87.68	-44.35
CHN	-32.90	-66.60	-5.93	-32.90	-66.60	-21.85	-54.83	-82.18	-19.88	-54.83	-82.18	-42.45
DEU	-37.32	-76.90	-5.73	-37.32	-76.90	-24.36	-57.78	-87.68	-19.68	-57.78	-87.68	-44.27
DNK	-34.90	-71.37	-5.87	-34.90	-71.37	-22.99	-56.13	-84.72	-19.77	-56.13	-84.72	-43.23
ESP	-32.89	-66.60	-5.93	-32.89	-66.60	-21.84	-54.81	-82.18	-19.87	-54.81	-82.18	-42.43
FRA	-13.78	-26.62	-3.54	-13.78	-26.62	-9.58	-41.92	-60.86	-17.80	-41.92	-60.86	-33.37
IDN	-32.91	-66.60	-5.94	-32.91	-66.60	-21.86	-54.84	-82.18	-19.89	-54.84	-82.18	-42.46
IND	-8.87	-16.95	-2.41	-8.87	-16.95	-6.22	-38.65	-55.69	-16.88	-38.65	-55.69	-30.93
ITA	-33.59	-68.22	-5.92	-33.59	-68.22	-22.24	-55.28	-83.05	-19.85	-55.28	-83.05	-42.72
JPN	-34.02	-69.17	-5.92	-34.02	-69.17	-22.50	-55.57	-83.56	-19.86	-55.57	-83.56	-42.91
LVA	-37.39	-76.90	-5.75	-37.39	-76.90	-24.43	-57.86	-87.68	-19.74	-57.86	-87.68	-44.35
MEX	-29.00	-57.98	-5.81	-29.00	-57.98	-19.50	-52.21	-77.58	-19.78	-52.21	-77.58	-40.72
MYS	-33.51	-68.22	-5.90	-33.51	-68.22	-22.18	-55.20	-83.05	-19.79	-55.20	-83.05	-42.63
PER	-29.36	-58.88	-5.81	-29.36	-58.88	-19.70	-52.41	-78.07	-19.74	-52.41	-78.07	-40.82
ROU	-37.40	-76.90	-5.75	-37.40	-76.90	-24.43	-57.86	-87.68	-19.74	-57.86	-87.68	-44.36
USA	-24.47	-48.38	-5.38	-24.47	-48.38	-16.64	-49.14	-72.46	-19.39	-49.14	-72.46	-38.59
ZAF	-30.62	-61.53	-5.89	-30.62	-61.53	-20.48	-53.29	-79.48	-19.84	-53.29	-79.48	-41.44
World average												
Simple	-29.96	-60.57	-5.50	-29.96	-60.57	-19.93	-52.84	-78.97	-19.50	-52.84	-78.97	-41.02
Population weighted	-24.01	-48.13	-4.71	-24.01	-48.13	-16.10	-48.84	-72.33	-18.84	-48.84	-72.33	-38.21

Lecture: ΔU corresponds to the welfare variation of tax competition for an Utilitarian government. ΔR corresponds to the welfare variation of tax competition for a Rawlsian government. The total welfare variation is given by the change in social objective from the theory of justice J to the "race to the bottom" game in percentage of variation. According to previous notations, for any theory of justice $J \in \{R\,;\,U\,;\,G\}$ I get $(W^J - W^{FC})/W^{FC}$. Consumers' welfare changes to the extent $(1-\beta) \times (\underline{c}^{FC} - \underline{c}^J)/\underline{c}^J$. Capitalists' welfare variation is given by $\beta \times (\overline{c}^{FC} - \overline{c}^J)/\overline{c}^J$. The simple world average formula among the I HTJs is: $\sum_i (W_i^{FC} - W_i^J)/\sum_i W_i^J$. The weighted world average formula per population N_i is given by: $\sum_i N_i(W_i^{FC} - W_i^J)/\sum_i N_i W_i^J$. The redistribution formula is given by, $\pi + \sum_h \pi_h = e \times (\pi + \sum_h \pi_h) + \sum_h e_h \times (\pi + \sum_h \pi_h)$ with e_i the share of total employees in country i reported by the MNE and $e + \sum_h e_h = 1$.

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Table 8: Welfare effects of tax competition from the "Race to the bottom" game: moderately and highly redistributive governments. True earnings are redistributed thanks to employment location.

	Apportionment formula based on employment location												
	ΔGM							ΔGH					
	$\beta = 0.1$			$\beta = 0.5$				$\beta = 0.1$			$\beta = 0.5$		
	Total	Consumers	Capitalists	Total	Consumers	Capitalists		Total	Consumers	Capitalists	Total	Consumers	Capitalists
Country													
ARG	-41.56	-66.32	-13.91	-37.83	-62.96	-27.88		-46.88	-70.69	-17.64	-45.20	-69.36	-34.74
AUS	-45.02	-72.58	-14.27	-41.51	-69.85	-30.30		-50.02	-76.14	-17.97	-48.43	-75.06	-36.92
BRA	-42.29	-67.63	-14.00	-38.60	-64.40	-28.40		-47.54	-71.83	-17.72	-45.88	-70.55	-35.20
CAN	-51.53	-84.93	-14.23	-48.43	-83.43	-34.58		-55.94	-86.89	-17.94	-54.54	-86.29	-40.80
CHN	-48.05	-78.20	-14.39	-44.73	-76.03	-32.35		-52.77	-81.03	-18.09	-51.28	-80.17	-38.78
DEU	-51.45	-84.93	-14.19	-48.36	-83.43	-34.51		-55.86	-86.89	-17.89	-54.47	-86.29	-40.72
DNK	-49.57	-81.32	-14.29	-46.35	-79.45	-33.30		-54.15	-83.74	-17.98	-52.70	-83.00	-39.62
ESP	-48.04	-78.20	-14.39	-44.72	-76.03	-32.34		-52.76	-81.03	-18.08	-51.27	-80.17	-38.76
FRA	-33.22	-52.12	-12.19	-28.96	-47.35	-21.70		-39.29	-58.34	-15.97	-37.37	-56.44	-29.13
IDN	-48.06	-78.20	-14.40	-44.74	-76.03	-32.36		-52.79	-81.03	-18.10	-51.29	-80.17	-38.79
IND	-29.45	-45.81	-11.18	-24.94	-40.41	-18.82		-35.86	-52.85	-15.02	-33.83	-50.70	-26.53
ITA	-48.57	-79.26	-14.37	-45.29	-77.19	-32.68		-53.24	-81.95	-18.06	-51.77	-81.13	-39.07
JPN	-48.91	-79.89	-14.37	-45.65	-77.88	-32.91		-53.56	-82.50	-18.07	-52.09	-81.70	-39.28
LVA	-51.53	-84.93	-14.24	-48.44	-83.43	-34.59		-55.94	-86.89	-17.94	-54.55	-86.29	-40.81
MEX	-45.03	-72.58	-14.28	-41.52	-69.85	-30.32		-50.03	-76.14	-17.99	-48.45	-75.06	-36.94
MYS	-48.49	-79.26	-14.32	-45.21	-77.19	-32.60		-53.16	-81.95	-18.00	-51.69	-81.13	-38.98
PER	-45.29	-73.17	-14.26	-41.80	-70.50	-30.47		-50.26	-76.66	-17.95	-48.68	-75.59	-37.06
ROU	-51.54	-84.93	-14.24	-48.44	-83.43	-34.59		-55.95	-86.89	-17.95	-54.55	-86.29	-40.81
USA	-41.51	-66.32	-13.88	-37.78	-62.96	-27.83		-46.83	-70.69	-17.59	-45.14	-69.36	-34.68
ZAF	-46.28	-74.90	-14.35	-42.85	-72.40	-31.16		-51.17	-78.16	-18.05	-49.62	-77.17	-37.70
World average													
Simple	-45.77	-74.28	-13.99	-42.31	-71.71	-30.68		-50.70	-77.62	-17.70	-49.14	-76.59	-37.27
Population weighted	-41.16	-66.16	-13.28	-37.41	-62.78	-27.37	-46.51	-70.55	-17.03	-44.82	-69.21	-34.27	

Lecture: ΔGM corresponds to the welfare variation of tax competition for a moderately redistributive government. ΔGH corresponds to the welfare variation of tax competition for a highly redistributive government. The total welfare variation is given by the change in social objective from the theory of justice J to the "race to the bottom" game in percentage of variation. According to previous notations, for any theory of justice $J \in \{R\,;\,U\,;\,G\}$ I get $(W^J - W^{FC})/W^{FC})$. Consumers' welfare changes to the extent $(1-\beta) \times (\underline{c}^{FC} - \underline{c}^J)/\underline{c}^J$. Capitalists' welfare variation is given by $\beta \times (\overline{c}^{FC} - \overline{c}^J)/\overline{c}^J$. The simple world average formula among the I HTJs is: $\sum_i (W_i^{FC} - W_i^J)/\sum_i W_i^J$. The weighted world average formula per population N_i is given by: $\sum_i N_i(W_i^{FC} - W_i^J)/\sum_i N_i W_i^J$. The redistribution formula is given by, $\pi + \sum_h \pi_h = e \times (\pi + \sum_h \pi_h) + \sum_h e_h \times (\pi + \sum_h \pi_h)$ with e_i the share of total employees in country i reported by the MNE and $e + \sum_h e_h = 1$.

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Table 9: Welfare effects of tax competition from the "Race to the bottom" game: Rawlsian and Utilitarian objective. True earnings are redistributed thanks to stated capital location.

	Apportionment formula based on stated capital location											
	ΔU						ΔR					
	$\beta = 0.1$			$\beta = 0.5$			$\beta = 0.1$			$\beta = 0.5$		
	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists
Country												
ARG	-24.50	-48.38	-5.39	-24.50	-48.38	-16.67	-49.18	-72.46	-19.43	-49.18	-72.46	-38.64
AUS	-28.96	-57.98	-5.79	-28.96	-57.98	-19.46	-52.15	-77.58	-19.73	-52.15	-77.58	-40.66
BRA	-25.30	-50.39	-5.44	-25.30	-50.39	-17.13	-49.61	-73.53	-19.33	-49.61	-73.53	-38.84
CAN	-37.37	-76.90	-5.75	-37.37	-76.90	-24.41	-57.83	-87.68	-19.72	-57.83	-87.68	-44.33
CHN	-32.64	-66.60	-5.85	-32.64	-66.60	-21.62	-54.53	-82.18	-19.64	-54.53	-82.18	-42.11
DEU	-37.08	-76.90	-5.67	-37.08	-76.90	-24.15	-57.53	-87.68	-19.48	-57.53	-87.68	-43.99
DNK	-34.61	-71.37	-5.78	-34.61	-71.37	-22.73	-55.82	-84.72	-19.52	-55.82	-84.72	-42.88
ESP	-32.77	-66.60	-5.89	-32.77	-66.60	-21.73	-54.68	-82.18	-19.76	-54.68	-82.18	-42.28
FRA	-13.66	-26.62	-3.49	-13.66	-26.62	-9.47	-41.66	-60.86	-17.56	-41.66	-60.86	-33.07
IDN	-32.84	-66.60	-5.92	-32.84	-66.60	-21.80	-54.77	-82.18	-19.83	-54.77	-82.18	-42.38
IND	-8.74	-16.95	-2.34	-8.74	-16.95	-6.10	-38.27	-55.69	-16.50	-38.27	-55.69	-30.49
ITA	-33.49	-68.22	-5.89	-33.49	-68.22	-22.16	-55.17	-83.05	-19.76	-55.17	-83.05	-42.59
JPN	-33.86	-69.17	-5.87	-33.86	-69.17	-22.36	-55.40	-83.56	-19.72	-55.40	-83.56	-42.72
LVA	-37.34	-76.90	-5.74	-37.34	-76.90	-24.38	-57.80	-87.68	-19.69	-57.80	-87.68	-44.29
MEX	-28.86	-57.98	-5.76	-28.86	-57.98	-19.37	-52.04	-77.58	-19.63	-52.04	-77.58	-40.52
MYS	-33.52	-68.22	-5.90	-33.52	-68.22	-22.19	-55.21	-83.05	-19.80	-55.21	-83.05	-42.64
PER	-29.26	-58.88	-5.78	-29.26	-58.88	-19.61	-52.30	-78.07	-19.64	-52.30	-78.07	-40.69
ROU	-37.40	-76.90	-5.75	-37.40	-76.90	-24.43	-57.86	-87.68	-19.74	-57.86	-87.68	-44.36
USA	-24.14	-48.38	-5.25	-24.14	-48.38	-16.34	-48.68	-72.46	-18.98	-48.68	-72.46	-38.07
ZAF	-30.32	-61.53	-5.79	-30.32	-61.53	-20.22	-52.94	-79.48	-19.55	-52.94	-79.48	-41.04
World average												
Simple	-29.83	-60.57	-5.45	-29.83	-60.57	-19.82	-52.67	-78.97	-19.35	-52.67	-78.97	-40.83
Population weighted	-23.82	-48.13	-4.64	-23.82	-48.13	-15.93	-48.54	-72.33	-18.58	-48.54	-72.33	-37.87

Lecture: ΔU corresponds to the welfare variation of tax competition for an Utilitarian government. ΔR corresponds to the welfare variation of tax competition for a Rawlsian government. The total welfare variation is given by the change in social objective from the theory of justice J to the "race to the bottom" game in percentage of variation. According to previous notations, for any theory of justice $J \in \{R\,;\,U\,;\,G\}$ I get $(W^J - W^{FC})/W^{FC}$. Consumers' welfare changes to the extent $(1-\beta) \times (\underline{c}^{FC} - \underline{c}^J)/\underline{c}^J$. Capitalists' welfare variation is given by $\beta \times (\overline{c}^{FC} - \overline{c}^J)/\overline{c}^J$. The simple world average formula among the I HTJs is: $\sum_i (W_i^{FC} - W_i^J)/\sum_i W_i^J$. The weighted world average formula per population N_i is given by: $\sum_i N_i(W_i^{FC} - W_i^J)/\sum_i N_i W_i^J$. The redistribution formula is given by, $\pi + \sum_h \pi_h = k \times (\pi + \sum_h \pi_h) + \sum_h k_h \times (\pi + \sum_h \pi_h)$ with k_i the share of stated capital in country i by the MNE and $k + \sum_h k_h = 1$.

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Table 10: Welfare effects of tax competition from the "Race to the bottom" game: moderately and highly redistributive governments. True earnings are redistributed thanks to stated capital location.

	Apportionment formula based on stated capital location											
	ΔGM						ΔGH					
	$\beta = 0.1$			$\beta = 0.5$			$\beta = 0.1$			$\beta = 0.5$		
	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists
Country												
ARG	-41.55	-66.32	-13.90	-37.82	-62.96	-27.87	-46.87	-70.69	-17.62	-45.19	-69.36	-34.73
AUS	-44.98	-72.58	-14.25	-41.47	-69.85	-30.26	-49.98	-76.14	-17.94	-48.40	-75.06	-36.88
BRA	-42.08	-67.63	-13.86	-38.40	-64.40	-28.19	-47.33	-71.83	-17.54	-45.67	-70.55	-34.97
CAN	-51.51	-84.93	-14.22	-48.41	-83.43	-34.56	-55.92	-86.89	-17.93	-54.52	-86.29	-40.78
CHN	-47.75	-78.20	-14.21	-44.44	-76.03	-32.05	-52.48	-81.03	-17.87	-50.98	-80.17	-38.46
DEU	-51.20	-84.93	-14.04	-48.10	-83.43	-34.25	-55.61	-86.89	-17.71	-54.21	-86.29	-40.45
DNK	-49.25	-81.32	-14.10	-46.03	-79.45	-32.98	-53.83	-83.74	-17.75	-52.38	-83.00	-39.28
ESP	-47.90	-78.20	-14.30	-44.58	-76.03	-32.20	-52.62	-81.03	-17.98	-51.13	-80.17	-38.62
FRA	-32.99	-52.12	-12.01	-28.74	-47.35	-21.48	-39.03	-58.34	-15.75	-37.12	-56.44	-28.85
IDN	-47.99	-78.20	-14.36	-44.67	-76.03	-32.29	-52.71	-81.03	-18.05	-51.22	-80.17	-38.71
IND	-29.11	-45.81	-10.92	-24.64	-40.41	-18.50	-35.49	-52.85	-14.68	-33.47	-50.70	-26.13
ITA	-48.46	-79.26	-14.30	-45.18	-77.19	-32.57	-53.13	-81.95	-17.98	-51.66	-81.13	-38.95
JPN	-48.73	-79.89	-14.26	-45.47	-77.88	-32.73	-53.38	-82.50	-17.94	-51.91	-81.70	-39.09
LVA	-51.47	-84.93	-14.20	-48.38	-83.43	-34.53	-55.88	-86.89	-17.90	-54.49	-86.29	-40.74
MEX	-44.87	-72.58	-14.17	-41.36	-69.85	-30.15	-49.86	-76.14	-17.85	-48.28	-75.06	-36.75
MYS	-48.50	-79.26	-14.32	-45.22	-77.19	-32.61	-53.17	-81.95	-18.01	-51.70	-81.13	-38.99
PER	-45.17	-73.17	-14.18	-41.68	-70.50	-30.35	-50.14	-76.66	-17.86	-48.56	-75.59	-36.93
ROU	-51.54	-84.93	-14.24	-48.44	-83.43	-34.59	-55.95	-86.89	-17.95	-54.55	-86.29	-40.81
USA	-41.07	-66.32	-13.57	-37.35	-62.96	-27.39	-46.37	-70.69	-17.21	-44.69	-69.36	-34.19
ZAF	-45.93	-74.90	-14.12	-42.51	-72.40	-30.82	-50.82	-78.16	-17.78	-49.27	-77.17	-37.32
World average												
Simple	-45.60	-74.28	-13.88	-42.14	-71.71	-30.52	-50.53	-77.62	-17.56	-48.97	-76.59	-37.08
Population weighted	-40.89	-66.16	-13.08	-37.14	-62.78	-27.10	-46.22	-70.55	-16.78	-44.53	-69.21	-33.95

Lecture: ΔGM corresponds to the welfare variation of tax competition for a moderately redistributive government. ΔGH corresponds to the welfare variation of tax competition for a highly redistributive government. The total welfare variation is given by the change in social objective from the theory of justice J to the "race to the bottom" game in percentage of variation. According to previous notations, for any theory of justice $J \in \{R\,;\,U\,;\,G\}$ I get $(W^J - W^{FC})/W^{FC})$. Consumers' welfare changes to the extent $(1-\beta) \times (\underline{c}^{FC} - \underline{c}^J)/\underline{c}^J$. Capitalists' welfare variation is given by $\beta \times (\bar{c}^{FC} - \bar{c}^J)/\bar{c}^J$. The simple world average formula among the I HTJs is: $\sum_i (W_i^{FC} - W_i^J)/\sum_i W_i^J$. The weighted world average formula per population N_i is given by: $\sum_i N_i(W_i^{FC} - W_i^J)/\sum_i N_i W_i^J$. The redistribution formula is given by, $\pi + \sum_h \pi_h = k \times (\pi + \sum_h \pi_h) + \sum_h k_h \times (\pi + \sum_h \pi_h)$ with k_i the share of stated capital in country i by the MNE and $k + \sum_h k_h = 1$.

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Table 11: Welfare effects of tax competition from the "Race to the bottom" game: Rawlsian and Utilitarian objective. True earnings are redistributed thanks to wage bill location.

	Apportionment formula based on wage bill location											
	ΔU						ΔR					
		$\beta = 0.1$			$\beta = 0.5$			$\beta = 0.1$			$\beta = 0.5$	
	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists
Country												
ARG	-24.51	-48.38	-5.40	-24.51	-48.38	-16.68	-49.19	-72.46	-19.44	-49.19	-72.46	-38.65
AUS	-29.00	-57.98	-5.81	-29.00	-57.98	-19.49	-52.20	-77.58	-19.77	-52.20	-77.58	-40.71
BRA	-25.46	-50.39	-5.50	-25.46	-50.39	-17.28	-49.82	-73.53	-19.52	-49.82	-73.53	-39.08
CAN	-37.40	-76.90	-5.75	-37.40	-76.90	-24.43	-57.86	-87.68	-19.74	-57.86	-87.68	-44.36
CHN	-32.84	-66.60	-5.92	-32.84	-66.60	-21.80	-54.77	-82.18	-19.83	-54.77	-82.18	-42.38
DEU	-37.34	-76.90	-5.74	-37.34	-76.90	-24.38	-57.80	-87.68	-19.70	-57.80	-87.68	-44.29
DNK	-34.83	-71.37	-5.85	-34.83	-71.37	-22.92	-56.06	-84.72	-19.70	-56.06	-84.72	-43.14
ESP	-32.88	-66.60	-5.93	-32.88	-66.60	-21.84	-54.81	-82.18	-19.87	-54.81	-82.18	-42.43
FRA	-13.78	-26.62	-3.54	-13.78	-26.62	-9.58	-41.91	-60.86	-17.79	-41.91	-60.86	-33.35
IDN	-32.84	-66.60	-5.92	-32.84	-66.60	-21.80	-54.76	-82.18	-19.83	-54.76	-82.18	-42.37
IND	-8.85	-16.95	-2.40	-8.85	-16.95	-6.20	-38.58	-55.69	-16.80	-38.58	-55.69	-30.85
ITA	-33.60	-68.22	-5.93	-33.60	-68.22	-22.25	-55.29	-83.05	-19.86	-55.29	-83.05	-42.73
JPN	-34.01	-69.17	-5.91	-34.01	-69.17	-22.49	-55.56	-83.56	-19.84	-55.56	-83.56	-42.90
LVA	-37.39	-76.90	-5.75	-37.39	-76.90	-24.42	-57.85	-87.68	-19.73	-57.85	-87.68	-44.35
MEX	-28.99	-57.98	-5.80	-28.99	-57.98	-19.49	-52.19	-77.58	-19.77	-52.19	-77.58	-40.70
MYS	-33.09	-68.22	-5.77	-33.09	-68.22	-21.81	-54.72	-83.05	-19.41	-54.72	-83.05	-42.10
PER	-29.31	-58.88	-5.79	-29.31	-58.88	-19.66	-52.35	-78.07	-19.69	-52.35	-78.07	-40.76
ROU	-37.40	-76.90	-5.75	-37.40	-76.90	-24.43	-57.86	-87.68	-19.74	-57.86	-87.68	-44.36
USA	-24.48	-48.38	-5.38	-24.48	-48.38	-16.65	-49.15	-72.46	-19.40	-49.15	-72.46	-38.60
ZAF	-30.59	-61.53	-5.88	-30.59	-61.53	-20.45	-53.25	-79.48	-19.81	-53.25	-79.48	-41.39
World average												
Simple	-29.93	-60.57	-5.49	-29.93	-60.57	-19.90	-52.80	-78.97	-19.46	-52.80	-78.97	-40.97
Population weighted	-23.97	-48.13	-4.70	-23.97	-48.13	-16.07	-48.79	-72.33	-18.79	-48.79	-72.33	-38.15

Lecture: ΔU corresponds to the welfare variation of tax competition for an Utilitarian government. ΔR corresponds to the welfare variation of tax competition for a Rawlsian government. The total welfare variation is given by the change in social objective from the theory of justice J to the "race to the bottom" game in percentage of variation. According to previous notations, for any theory of justice $J \in \{R\,;\,U\,;\,G\}$ I get $(W^J - W^{FC})/W^{FC}$. Consumers' welfare changes to the extent $(1-\beta) \times (\underline{c}^{FC} - \underline{c}^J)/\underline{c}^J$. Capitalists' welfare variation is given by $\beta \times (\overline{c}^{FC} - \overline{c}^J)/\overline{c}^J$. The simple world average formula among the I HTJs is: $\sum_i (W_i^{FC} - W_i^J)/\sum_i W_i^J$. The weighted world average formula per population N_i is given by: $\sum_i N_i(W_i^{FC} - W_i^J)/\sum_i N_i W_i^J$. The redistribution formula is given by, $\pi + \sum_h \pi_h = w \times \left(\pi + \sum_h \pi_h\right) + \sum_h w_h \times (\pi + \sum_h \pi_h)$ with w_i the share of wage bill stated in country i by the MNE and $w + \sum_h w_h = 1$.

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Table 12: Welfare effects of tax competition from the "Race to the bottom" game: moderately and highly redistributive governments. True earnings are redistributed thanks to wage bill location.

	Apportionment formula based on wage bill location											
	ΔGM						ΔGH					
	$\beta = 0.1$			$\beta = 0.5$			$\beta = 0.1$			$\beta = 0.5$		
	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists	Total	Consumers	Capitalists
Country												
ARG	-41.56	-66.32	-13.91	-37.83	-62.96	-27.88	-46.88	-70.69	-17.64	-45.20	-69.36	-34.74
AUS	-45.03	-72.58	-14.28	-41.52	-69.85	-30.31	-50.03	-76.14	-17.98	-48.45	-75.06	-36.93
BRA	-42.29	-67.63	-14.00	-38.60	-64.40	-28.39	-47.54	-71.83	-17.72	-45.88	-70.55	-35.20
CAN	-51.54	-84.93	-14.24	-48.44	-83.43	-34.59	-55.95	-86.89	-17.95	-54.55	-86.29	-40.81
CHN	-47.99	-78.20	-14.36	-44.67	-76.03	-32.29	-52.71	-81.03	-18.05	-51.22	-80.17	-38.71
DEU	-51.48	-84.93	-14.20	-48.38	-83.43	-34.53	-55.89	-86.89	-17.90	-54.49	-86.29	-40.75
DNK	-49.49	-81.32	-14.25	-46.27	-79.45	-33.22	-54.07	-83.74	-17.92	-52.62	-83.00	-39.54
ESP	-48.03	-78.20	-14.38	-44.71	-76.03	-32.33	-52.76	-81.03	-18.08	-51.26	-80.17	-38.76
FRA	-33.21	-52.12	-12.18	-28.95	-47.35	-21.69	-39.27	-58.34	-15.96	-37.35	-56.44	-29.11
IDN	-47.98	-78.20	-14.35	-44.67	-76.03	-32.28	-52.71	-81.03	-18.05	-51.22	-80.17	-38.71
IND	-29.38	-45.81	-11.13	-24.88	-40.41	-18.76	-35.79	-52.85	-14.95	-33.76	-50.70	-26.45
ITA	-48.59	-79.26	-14.38	-45.30	-77.19	-32.69	-53.26	-81.95	-18.07	-51.78	-81.13	-39.09
JPN	-48.90	-79.89	-14.36	-45.63	-77.88	-32.89	-53.54	-82.50	-18.06	-52.07	-81.70	-39.26
LVA	-51.53	-84.93	-14.23	-48.43	-83.43	-34.58	-55.94	-86.89	-17.94	-54.54	-86.29	-40.80
MEX	-45.02	-72.58	-14.27	-41.51	-69.85	-30.30	-50.02	-76.14	-17.98	-48.44	-75.06	-36.92
MYS	-48.01	-79.26	-14.03	-44.73	-77.19	-32.12	-52.69	-81.95	-17.65	-51.21	-81.13	-38.47
PER	-45.23	-73.17	-14.22	-41.74	-70.50	-30.41	-50.20	-76.66	-17.90	-48.62	-75.59	-37.00
ROU	-51.54	-84.93	-14.24	-48.44	-83.43	-34.59	-55.95	-86.89	-17.95	-54.55	-86.29	-40.81
USA	-41.52	-66.32	-13.88	-37.79	-62.96	-27.84	-46.84	-70.69	-17.60	-45.16	-69.36	-34.69
ZAF	-46.24	-74.90	-14.32	-42.81	-72.40	-31.13	-51.13	-78.16	-18.02	-49.58	-77.17	-37.66
World average												
Simple	-45.73	-74.28	-13.96	-42.27	-71.71	-30.64	-50.66	-77.62	-17.67	-49.10	-76.59	-37.22
Population weighted	-41.11	-66.16	-13.25	-37.36	-62.78	-27.32	-46.46	-70.55	-16.98	-44.77	-69.21	-34.21

Lecture: ΔGM corresponds to the welfare variation of tax competition for a moderately redistributive government. ΔGH corresponds to the welfare variation of tax competition for a highly redistributive government. The total welfare variation is given by the change in social objective from the theory of justice J to the "race to the bottom" game in percentage of variation. According to previous notations, for any theory of justice $J \in \{R\,;\,U\,;\,G\}$ I get $(W^J - W^{FC})/W^{FC})$. Consumers' welfare changes to the extent $(1-\beta) \times (\underline{c}^{FC} - \underline{c}^J)/\underline{c}^J$. Capitalists' welfare variation is given by $\beta \times (\bar{c}^{FC} - \bar{c}^J)/\bar{c}^J$. The simple world average formula among the I HTJs is: $\sum_i (W_i^{FC} - W_i^J)/\sum_i W_i^J$. The weighted world average formula per population N_i is given by: $\sum_i N_i(W_i^{FC} - W_i^J)/\sum_i N_i W_i^J$. The redistribution formula is given by, $\pi + \sum_h \pi_h = k \times (\pi + \sum_h \pi_h) + \sum_h k_h \times (\pi + \sum_h \pi_h)$ with k_i the share of stated capital in country i by the MNE and $k + \sum_h k_h = 1$.

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