Analyzing the take-up of means-tested benefits in France

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Preliminary version

Abstract

This paper investigates take-up of two French means-tested benefits (the RMI and the API). Non take-up arises because welfare receipt induces costs that can originate from the difficulty of obtaining information on welfare programs, complexity of these programs, or psychological (stigma) effects. Aimed at providing reliable estimates of these costs, our statistical model explicitly takes into account two types of measurement error that can occur in our dataset. Results show that the estimated take-up rate is significantly higher than that computed using the raw data, and that our measure for the level of social stigma has a strong positive effect on take-up costs. Estimated costs are not high enough to induce households with no other resources to give-up their rights to the benefit. Moreover, we find evidence of under-reporting of income and of program participation in our dataset.

Keywords: take-up rate, take-up costs, stigma, means-tested benefits, measurement errors.
JEL codes: I38, I32, C34, C35

1 Introduction

The take-up rate is generally considered to be one of the key efficiency criteria of means-tested benefits, together with redistributive efficiency and inactivity and poverty trap concerns.

Although economists' interest in non take-up has steadily grown since the early 1980's, it has seldom been studied in France. Nevertheless, the computation of the take-up rate — that is, the share of agents eligible for a benefit who actually participate — and the determination of the causes of non take-up would allow the government to anticipate changes in welfare caseload, and to foresee the budgetary implications of a change in benefit levels; and also to improve the efficiency of poverty-alleviation programs *via* better knowledge of the structure of take-up costs. Indeed, Duclos (1995b) shows that the presence of imperfect take-up has an impact on the quality of the redistributive system.

This paper investigates the determinants of costs associated with participation in means-tested benefits programs. We will also estimate the take-up rate correcting for two possible sources

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of measurement errors in our dataset: under-reporting of program participation, and imperfect information regarding the household's primary income.

Most studies of the take-up costs of means-tested benefits implicitly assume that all participations are reported, and that the available information on agents' income is perfect. However, this last hypothesis seems unlikely when income information is self-reported. Moreover, if take-up costs do exist, possibly as *stigma*, then it is likely that some participants will choose not to reveal their participation. The calculation of the take-up rate disregarding these potential problems will certainly lead to underestimation of the share of eligible units actually participating. Following Duclos (1995a, 1997), we thus explicitly model the fact that, as agents' primary income is measured with errors, our calculation of theoretical benefit entitlements are also subject to errors, and that program participation is not always reported in the survey.

The empirical study will focus on two French means-tested benefits: the RMI (Minimum Guaranteed Income) and the API (Single Parent Benefit)[1], and will make use of the three first French waves of the *European Community Household Panel* covering the years 1994, 1995 and 1996.

Section 2 presents various explanations for the existence of non take-up, and Section 3 briefly summarizes the existing empirical literature. The French welfare system and the benefits studied here are described in Section 4, and Section 5 outlines an economic model of welfare participation. We present our data and econometric model in Section 6. The results will be discussed in Section 7, and Section 8 concludes.

2 Why do agents fail to participate?

Standard economic wisdom states that, in the absence of costs, any agent eligible to a benefit should actually receive it. The presence of non-participating eligible units then undoubtedly implies the existence of take-up costs. These costs can be linked to several phenomena, classified by van Oorschot (1996) into distinct categories: problems related to the information of the targeted population (information about the mere existence of the welfare program, and about its implementation); and problems related to a possible stigmatization of participants.

2.1 Apparent versus actual take-up

The computation of a take-up rate requires high-quality information on households' income, as well as on program participation. In fact, the vast majority of datasets used for this kind of study are based on self-reported information subject to different accuracy problems. First, *memory effects* can occur, and lead agents to omit some types of income, mostly when filling out retrospective calendars[2]. Second, *benefit confusions* may also occur, especially when the same agency is in charge of different benefits[3].

In addition, participating individuals who face stigma can also voluntarily omit to report program participation:

[1]See Section 4 for details on these two benefits

[2]There is also evidence of under-reporting of income in questionnaire surveys in France.

[3]The RMI and other family-related benefits are paid by the same agency in France.

> “ [...] one can also postulate that everyone knows how to manage gaps between his virtual and real social identities, that is, to implement what Goffman calls ‘social information control strategies’ ” (Ogien, 1999, chap. 5.3)

The report from the Commissariat Général du Plan (2000) also notes that “18 % [of RMI recipients] who have parents have not told them [about their receipt]”. It is thus important, when conducting statistical analysis, to attempt to distinguish between *apparent* non take-up (that is, resulting from imperfect data) and *actual* non take-up (that is, the share of units *effectively* eligible to a benefit, but *really* not participating), otherwise we may seriously overestimate the non take-up rate. The remainder of this section briefly outlines the different phenomena explaining actual non take-up.

2.2 Information costs

Information on welfare programs can hardly be regarded as perfect in France: more than a third of people entering the RMI program in the first semester of 1995 reported that they had not known (sometimes for more than six months) that they could benefit from the program (Commissariat Général du Plan, 2000, p. 87).

Once possible eligibility is known, gathering information about eligibility conditions and entitlement scales, appointments in welfare agencies, filling out forms etc... induce costs for agents who wish to assess the benefit to which they're entitled. Thus, agents face uncertainty about their eligibility for the welfare program, and the amount they could obtain. This uncertainty may lead them to give up their benefit rights if the discounted expected benefit payment is not high enough.

2.3 Complexity

Details of welfare program implementation, calculation, and payment of certain benefits, as well as the multiplicity of the required procedures has produced a welfare system of great complexity. The report from the Commissariat Général du Plan (2000) stresses the fact that the non take-up behavior might originate, at least partly, from this complexity:

> “ So, the fiction, deeply rooted in the administrative system, of a user who is not unaware of the law and who masters the totality of the procedures allowing him to enforce his rights, is not tenable [...] The complexity of guaranteed minimum income mechanisms is undoubtedly one of the causes of non take-up[4]; it also rebounds on their implementation. ” (Commissariat Général du Plan, 2000, p. 88)

Constraints are also imposed on RMI recipients: for example a “insertion contract” has to be signed, and reporting the last three months' income to an assigned caseworker is mandatory. All this, in addition to some uncertainty about the stability of income brought by the benefit, can lead some individuals giving up their rights to a benefit for which they are eligible[5].

[4] As a matter of fact, the application form for the RMI has recently been simplified.
[5] See Afsa (1996) and number 43 of *Recherches et Prévisions*.

2.4 Social stigma

The term "social stigma" first appeared in the sociological literature, particularly in the work of Goffman (1963), and is defined as an attribute that gives rise to a negative view of its possessors by the rest of the population. Besley and Coate (1992), summarizing Goffman, state that:

> " Society is assumed to value particular individual characteristics, such as self-reliance and a willingness to work hard, and welfare claimants are perceived to lack them. Hence, if it is known that an individual is on welfare, other individuals will infer that this individual will likely posses some blemish of character. "

More precisely, stigma can only be defined in relation to a virtual identity attributed to each person:

> " A personal characteristic [...] only becomes a stigma if it does not belong to a conventional list of attributes generally attached to a predefined social identity. " (Ogien, 1999, chap. 5.3)

The notion of *reference group* to which the individual belongs is therefore of primary importance in the understanding of the social stigma phenomenon[6].

Many studies (van Oorschot, 1996; Bramley *et al.*, 2000; Reinstadler, 2000) identify the means test *per se* as a possible source of stigma .

In the field of economic science, theoretical work on the stigmatization of welfare recipients are scarce. One can nevertheless cite Besley and Coate (1992) for their theoretical models of how the level of social stigma is determined in a society, and the study of Moffit (1983) on its impact on the labour supply behaviour of agents.

Besley and Coate (1992) present two models of social stigma. The first is a statistical discrimination model where the level of stigma depends on the difference between the average disutility of labour among welfare recipients and the average disutility of labour within the population as a whole, considered as a social norm. The difference between these two averages results from the presence among welfare recipients of agents choosing to be on welfare instead of active labour force participation (denoted as "non needy", or "undeserving" claimants), and thus having a higher level of disutility of labour ("deserving" claimants, i.e. having no other choice but being on welfare are supposed to have, on average, the same level of disutility of labour as the non-participating population). A second model is based on "taxpayers' resentment" towards welfare recipients: welfare programs are financed through taxation, and taxpayers might treat welfare claimants less favorably than others, thus leading to some form of welfare stigma.

Moffit (1983) proposes a labour supply model where a means-tested benefit completes agents' income up to a certain level, but where welfare receipt can induce a disutility, either fixed, or a function of the benefit level[7]. Agents then choose their labour supply and program participation. Moffit then tests his model's implications on the *PSID* data, modelling *AFDC* participation.

[6] Also see Clark (2001) for an empirical study of the importance of the reference group on the psychological impact of unemployment.

[7] The variable component of this disutility implies a difference between marginal utilities of income provided by the benefit and other incomes.

Estimation results show evidence of the presence of a fixed disutility (that is, not depending on the benefit level).

Social stigma can thus be a central explanation of the non take-up phenomenon, even if it is not the only one.

3 Existing empirical literature

The vast majority of empirical studies investigating the issue of non take-up have focussed on Anglo-Saxons countries: see Ashenfelter (1983), Moffit (1983), Blank and Ruggles (1996), Anderson and Meyer (1997) and Bollinger and David (2001) for the United States; Blundell *et al.* (1988), Duclos (1995a, 1997) and Bramley *et al.* (2000) for the United Kingdom; Riphahn (2001) for Germany.

In France, few studies have addressed the issue of non take-up of means-tested benefits. To our knowledge, number 43 of *Recherches et prévisions* (see Math, 1996; van Oorschot, 1996 and van Oorschot and Math, 1996) is one of the few attempts to tackle this problem. Various explanations for the phenomenon are given, and the lack of reliable empirical studies in France is pointed out. Van Oorschot and Math (1996) review different studies on the take-up of RMI, but these studies do not yield uniform results, with estimated non take-up rates ranging from 9 to 33 %. More recently, Simon (2000) estimates a non take-up rate for housing benefit (*Allocation Logement*) of less than one percent, but this study cannot easily be compared to ours since it uses an administrative dataset of households that already participate in some welfare programs (Family Benefits, *Allocation Familiales*). Moreover, the benefit studied does not have the same "stigma" connotation as the RMI or the API.

All these studies (except those using administrative data, such as Ashenfelter (1983) or Anderson and Meyer (1997)) stress the potential accuracy problem of their dataset, with respect to both under-reporting of primary income, and of program participation.

Most studies find evidence of an important non take-up phenomenon: the data used by Moffit (1983) imply a non take-up rate of 55 %, leading him to postulate the existence of under-reporting of AFDC participation. Blank and Ruggles (1996) — who study the take-up behaviour of *AFDC* and *Food Stamps* in a dynamic framework — find that single mothers participate in *AFDC* program in 62 to 70 % of the months for which they are eligible. In Europe, Riphahn (2001) computes a non take-up rate of 63 % for two German means-tested benefits. In Great Britain, Duclos (1995a, 1997) estimates a non take-up rate of 20 % for *Supplementary Benefit*; and Blundell *et al.* (1988) a non take-up rate ranging from 25 to 34 % for *Housing Benefit*.

The econometric techniques used in these studies, except those of Duclos (1995a, 1997) for the *Supplementary Benefits*, of Bollinger and David (2001) for the *Food Stamps* and, in a somewhat different framework, of Hu (1998), are based on *probit* or *logit* specifications[8], thus implicitly assuming the absence of under-reporting of primary income and program participation.

4 The French welfare system

This study will focus on two French means-tested benefits: the RMI and the API.

[8]Blundell *et al.* (1988) also use the "MSCORE" model, a semi-parametric version of the *probit* model.

The RMI (*Revenu Minimum d'Insertion*, Minimum Guaranteed Income) is one of the best known French benefits. It is an almost-universal mechanism, created in December 1988, whose aim is to provide with a minimum income any person who, due to his age, physical or mental disability, or labour market conditions, is unable to work and is located outside of the traditional welfare net. This mechanism comes as a complement to older benefits, targeting narrower categories: disabled adults (*Allocation Adulte Handicapé, AAH*), single parents (*Allocation de Parent Isolé, API*), elderly population (*Minimum Viellesse*)... It has been designed from two fundamental principles: the citizenship principle which states that anyone in a society has the right to lead a dignified life; and the responsibility principle which defines a set of reciprocal duties between society and the individuals that are part of it. The universal nature of the RMI is reinforced by the access to a whole set of social rights aiming to provide welfare recipients with the basis for social and professional reintegration. Welfare recipients must (in principle) sign an "integration contract" with a local caseworker.

Eligibility for the RMI program is only based on two criteria: the recipient must be at least 25 and the household's income must fall below a certain threshold[9]. The benefit actually paid is then defined as the difference between the income threshold and the household's mean income during the three previous months.

The RMI benefit can be totally drawn concurrently with labour income for as long as three months, and then partially (with two decreases) for twelve more months. In any case, the benefit cannot be drawn concurrently with labour income if the recipient has worked more than 750 hours.

The second means-tested benefit studied here is the "Single Parent Benefit" (*Allocation de Parent Isolé, API*). This was created in July 1976 and, contrary to the RMI, is one of the least known French benefits. It has been designed to ensure a minimum income to any single person raising a child (or expecting one[10]). The Single Parent Benefit (API) receipt has a limited duration: it is paid for 12 months, or until the youngest child has reached the age of three (see Afsa, 1999 for details). It is, like the RMI, a means-tested benefit where the benefit actually paid is defined as the difference between a certain threshold[9] and the mean income of the household for the last trimester.

5 A simple model of welfare participation

The basic setup of a simple dynamic model of welfare participation is as follows:

We consider an agent with utility function $U(.)$, and primary income Y_t. This income entitles her to a welfare benefit B_t. When the agent enters an eligibility spell, its length is not known with certainty. Instead, there is a certain probability P_t (either fixed or time-varying) that the eligibility spell will end in period t; the total length of the eligibility spell is thus a random variable denoted $\widetilde{T}$. Agents then face a one-off information cost (including information research, queuing, filling out forms ...) denoted C_I. If she decides to take-up the benefit, the agent will have to face a (possibly time-varying) "stigma" cost denoted C_{St}. C_I and C_{St} are positive and measured on the same scale as the utility function $U(.)$. Agents will thus decide to take-up their benefit if:

[9]See Appendix C.3 for these thresholds.
[10]Unfortunately, we have not been able to identify these individuals in our dataset.

$$\sum_{t=0}^{\widetilde{T}} P_t \left[U \left(Y_t + B_t \right) - C_{St} - U \left(Y_t \right) \right] - C_I > 0 \qquad (5.1)$$

Thus, assuming that primary income Y_t and benefit level B_t are constant over time, condition (5.1) implies that the time path of program participation will depend upon the stigma costs C_{St}: if these are constant over time, then the agent will either participate or not participate for the whole eligibility spell. On the contrary, if C_{St} varies with t, then the agent will participate in period t if stigma costs are below a certain threshold. Since C_{St} is likely to decrease monotonically with t, we will observe, within the same eligibility spell, spells of non take-up followed by spells of program participation.

6 Data and econometric specification

6.1 Data

For this study, we use the first three French waves of the *European Community Household Panel*, covering the years 1994, 1995 and 1996. This dataset is particularly adapted to our purpose since it provides detailed information on agents' income and program participation on a monthly basis. Moreover, the structure of these "income calendars", covering more than 40 types of income (labour income, unemployment insurance, social transfers etc.) allows us to compute households'[11] "theoretical eligibility" based on official benefit scales. More precisely, we build the benefit level to which the household is entitled (either RMI or API, depending on household's composition), defined as the difference between the maximum benefit level corresponding to the household's structure and the previous trimester mean income. This "calculated" benefit entitlement will be denoted B_a in the remainder of the paper; Appendix C.3 gives more details about the computation of this benefit entitlement.

Because they represent the target population for RMI and API, the households selected for the analysis are those with low and/or irregular income. We have thus excluded from the dataset households where at least one member has a full time job, or is retired and receives a retirement pension. Also excluded on the basis of age limits for RMI are households where no member is older than 25 (except for single parents who could benefit from the API program), as well as households where all members are students or are doing their military service. Moreover, we limit the scope of our analysis to households where the oldest member is younger than 75 because they could otherwise benefit from a specific welfare program (*Allocation Viellesse*). Our final sample consist of 1773 households, 34 % of which have positive calculated entitlement, and 19 % report participation in either the RMI or API programs at the date of the survey; Table 1 gives some characteristics of this sample.

Table 2 compares the "theoretical" benefit entitlement (computed on the basis of household structure and reported primary income) with the benefit level reported in the survey (only those households who report program participation are used in this comparison); Figure 1 shows the

[11] More specifically, they are "units" defined in a more restrictive way than "households": a child over 25 years still living with her parents will be considered as a separate unit (see Appendix C.3 for more details). For simplicity's sake, we will refer to those units as "households" in the remainder of the paper.

Table 1: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.
Mean age of adults	39.648	11.218	19.667	74.5
Mean education level of adults[a]	2.462	1.434	0	5
Couples	0.373	0.484	0	1
Number of children under 3	0.114	0.348	0	2
Number of children between 3 and 10	0.271	0.63	0	4
Number of children between 10 and 25	0.492	0.985	0	7
% jobless[b]	0.918	0.185	0.5	1
Reported receipt of RMI or API	0.193	0.395	0	1
Theoretically eligible	0.338	0.473	0	1
Primary income (€)	833.556	646.779	0	3895.912
Entitlement level (€)	-269.374	581.182	-2261.697	1085.970
Share of benefit recipients in the dept. (%)[c]	1.523	0.578	0.554	2.999
Receives another CAF benefit	0.27	0.444	0	1
API entitlement > RMI entitlement[d]	0.177	0.382	0	1
N		1773		

[a]See Appendix C for a definition of education levels
[b]Among adults
[c]Number of RMI recipients / department population; sources: CAF, INSEE
[d]Even if negative

empirical cumulative distributions of calculated and reported benefit entitlement for the same sub-sample. Although reported benefit receipt may also, like other incomes, suffer from measurement errors, both Table 2 and Figure 1 indicate that our computation of benefit entitlement is quite close to reported benefit levels in our dataset. We nevertheless note the presence of negative calculated entitlement for some of the households reporting program participation.

Table 2: The quality of calculated entitlement

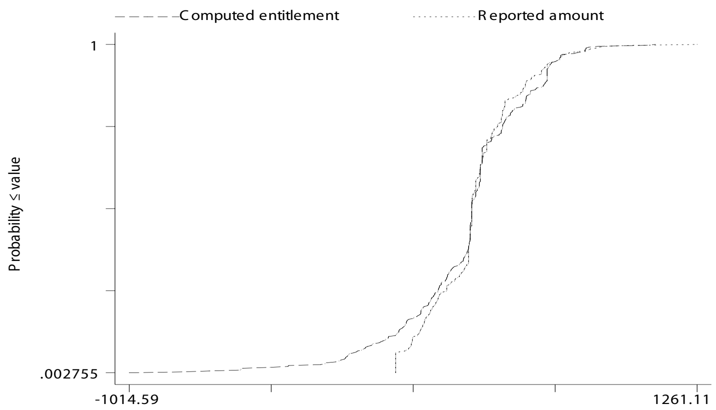
Variable	Mean	Std. Dev.	Min.	Max.
Computed entitlement (€)	309.995	257.015	-894.113	1085.970
Reported benefit (€)	341.209	174.445	15.245	995.060
N		342		

A simple cross tabulation of a dummy variable for calculated eligibility versus reported program participation (Table 3) shows that the apparent rate of non take-up to RMI or API is 48 % in our dataset[12]. We also note that 32 households for which we calculated a negative benefit entitlement actually report benefit receipt (approximately 10 % of reported benefit receipts).

These two facts (i.e. the fairly high rate of non take-up and the presence of negative computed entitlement among households reporting program participation) lead us to suspect the presence of under-reporting of program participation[13], as well as measurement errors for the household income

[12]Also see Table 10 in Appendix C.
[13]Besley and Coate (1992) note that individuals facing a stigma might attempt to camouflage their benefit receipt. Likewise, Moffit (1983) suspects under-reporting of benefit receipt in his sample.

Figure 1: Quality of entitlement computation



variables in our dataset. These features of our data call for an appropriate modelling strategy, taking into account possible data accuracy problems; which would otherwise biais estimation of the take-up rate.

The structure of data in the *European Community Household Panel* forces us to a number of approximations in our calculation of households' primary income: for each type of income, the agent lists the months in which he received it, and then indicates the total amount received for the whole year. To recreate monthly income, we have no other choice but to divide the total amount by the number of months of receipt, and to impute that amount to every listed month. This method inevitably leads to some imprecision that our statistical model of Section 6.2 will attempt to correct.

Table 3: Eligibility versus receipt

	Negative entitlement	**Positive entitlement**	**Total**
Not reporting program participation	1142	289	1431
(%)	(97.27)	(48.25)	(80.71)
Reporting program participation	32	310	342
(%)	(2.73)	(51.75)	(19.29)
Total	1174	599	1773
(%)	(100)	(100)	(100)

Table 4 presents descriptive statistics for the sub-sample of households with positive calculated entitlement, according to their program participation. These descriptive statistics may help to identify variables influencing participation decisions. However, they cannot be used to separate the “participation costs” effects from “under-reporting”. The statistical analysis of Section 6.2 will enable us to distinguish between these two effects.

Table 4: Descriptive statistics (2): sub-sample of entitled households

	Reporting participation		**Not reporting participation**	
Variable	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**
Mean age of adults[a]	38.357	10.635	35.876	10.688
Mean education level of adults[a]	2.348	1.376	2.779	1.557
Couple[b]	0.197	0.398	0.26	0.439
Number of children under 3	0.116	0.35	0.118	0.333
Number of children between 3 and 10	0.358	0.671	0.315	0.652
Number of children between 10 and 25	0.565	0.939	0.588	1.202
Share of benefit recipients in the dept.[a]	1.612	0.589	1.45	0.537
Primary income[a] (€)	219.326	274.530	441.626	442.793
N	310		289	

[a]Statistically different at the 1 % level
[b]Statistically different at the 10 % level

6.2 Statistical model

This section builds on the model developed by J.-Y. Duclos (1995a, 1997).

Consider agents for which we have calculated a "theoretical" entitlement B_a, either positive or negative. However, B_a might not be the *actual* agent's entitlement, which we will refer to as B^*[14].

Since we cannot observe the true value of B^*, we calculate B_a and suppose that $B^* = B_a + \upsilon$, with $\upsilon \rightsquigarrow N\left(\mu_\upsilon, \sigma_\upsilon^2\right)$.[15]

As described in Section 2, program participation entails costs[16] of $C = X\beta + \varepsilon$ where ε is a disturbance term. Those costs being positive, we have: $\varepsilon \geq -X\beta$ (the distribution of ε is left truncated at $-X\beta$). The (untruncated) distribution of ε is normal, with mean zero, and variance σ_ε^2.

The net benefit of program participation can thus be written as the difference between the actual entitlement (B^*) and the costs induced by program participation (C):

$$NB = B^* - C$$
$$= B_a - X\beta + \upsilon - \varepsilon$$

The agent will decide to participate in the program and to receive his benefit if and only if the net benefit from participation is positive. We define as P the participation decision, with

[14]More precisely, B^* is the entitlement level which would be calculated by the welfare agency. The possibility of administrative calculation errors (a difference between the *legal* entitlement level as defined by the law and the one calculated by the welfare agency) raises the issue of welfare *fraud*, i.e. legally ineligible agents who nevertheless manage to get the administration to calculate a positive entitlement. Unfortunately, without additional information, we won't be able to separate those administrative errors from data imprecisions. These considerations lead us to re-define slightly our definition of non take-up as "the share of agents for which the welfare agency would calculate a positive entitlement who do not participate in the program".

[15]We allow for systematic error in the computation of the entitlement level by allowing μ_υ to be different from zero.

[16]Those costs can be interpreted as the monetary valuation of the costs entailed by the phenomena described in Section 2.

$P = \begin{cases} 1 & \text{if } NB > 0 \\ 0 & \text{if } NB \leq 0 \end{cases}$

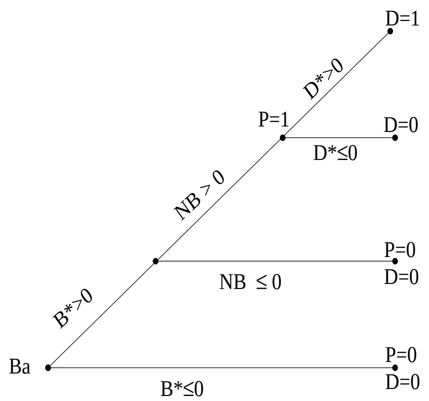
In order to take into account potential under-reporting of program participation, we assume that the agent will not always report a (potential) benefit receipt in the survey.

We thus assume she will report program participation if $D^* = Z\gamma + \mu > 0$, where μ follows a standard normal distribution. Our modelling strategy differs on this point from Duclos (1995a and 1997) who assumes that only a certain category of retired agents forget to report program participation with a fixed probability.

Denoting D the decision to report program participation, with $D = \begin{cases} 1 & \text{if } D^* > 0 \\ 0 & \text{if } D^* \leq 0 \end{cases}$

The analyst observes B_a and D, but is not able, from raw data, to distinguish the different paths leading to $D = 0$ in the tree of figure 2.

Figure 2: Structure of the model



The probability of observing $D = 0$ or $D = 1$ can thus be written as:

$$Pr(D = 1) = Pr(B^* > 0, NB > 0, D^* > 0) \tag{6.1}$$

and

$$Pr(D = 0) = [Pr(B^* > 0, NB > 0, D^* < 0) + Pr(B^* > 0, NB \leq 0) + Pr(B^* \leq 0, NB \leq 0)] \tag{6.2}$$

The joint density of (ε, μ) can be written as[17]:

$$f_{\varepsilon,\mu}(\varepsilon, \mu) = \frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)} \begin{cases} \frac{1}{\sigma_\varepsilon \sigma_\mu} \phi\left(\frac{\varepsilon}{\sigma_\varepsilon}\right) \phi\left(\frac{\mu}{\sigma_\mu}\right) & \text{if } \varepsilon \geq -X\beta \\ 0 & \text{otherwise} \end{cases}$$

To derive the log-likelihood function, we must distinguish two cases according to the value of υ.

[17]For estimation purposes, we assume that ε and μ are independently distributed.

1. $\upsilon \leq -B_a$

   The actual benefit entitlement is negative: $B^* \leq 0$ and the agent receives 0[18]

   The net benefit can thus be written as: $NB = -X\beta - \varepsilon$, which is independent from υ (and < 0 because costs are positive)

   The joint density of (υ, NB, μ) is:

$$f^a_{\upsilon,NB,\mu}(\upsilon, NB, \mu) = \frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)} \begin{cases} \frac{1}{\sigma_\upsilon\sigma_\varepsilon\sigma_\mu}\phi\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon}\right)\phi\left(\frac{NB+X\beta}{\sigma_\varepsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right) & \text{if } NB \leq 0 \\ 0 & \text{elsewhere} \end{cases} \tag{6.3}$$

2. $\upsilon > -B_a$

   The actual benefit entitlement is positive, $B^* > 0$ and the net benefit is thus: $NB = B_a + \upsilon - X\beta - \varepsilon$

   NB both depends on and is correlated with, υ

   Moreover, costs being positive, we have $NB \leq B_a + \upsilon$

   The joint density of (υ, NB, μ) is thus:

$$f^b_{\upsilon,NB,\mu}(\upsilon, NB, \mu) = \\ \frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)} \begin{cases} \frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon}, \frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}}, \rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right) & \text{if } NB \leq B_a + \upsilon \\ 0 & \text{elsewhere} \end{cases} \tag{6.4}$$

   with:

   $\sigma_{NB} = \sqrt{\sigma^2_\upsilon + \sigma^2_\varepsilon}$

   $\rho_{NB\upsilon} = \frac{\sigma_\upsilon}{\sigma_{NB}}$

The probability of observing $(D = 1)$, i.e. equation (6.1), can be re-written as:

$$P(D = 1) = \int_{-B_a}^{\infty}\int_0^{B_a+\upsilon}\int_{-Z\gamma}^{\infty} f^b_{\upsilon,NB,\mu}(\upsilon, NB, \mu)\,\partial\mu\partial NB\partial\upsilon \tag{6.5}$$

Equation (6.5) represents the probability that the actual entitlement is positive, that the net benefit also is positive, and that the agent has decided to report his program participation.

The probability of observing $(D = 0)$, i.e. equation (6.2), can be re-written as:

$$P(D = 0) = \begin{bmatrix} \int_{-B_a}^{\infty}\int_0^{B_a+\upsilon}\int_{-\infty}^{-Z\gamma} f^b_{\upsilon,NB,\mu}(\upsilon, NB, \mu)\,\partial\mu\partial NB\partial\upsilon \\ +\int_{-B_a}^{\infty}\int_{-\infty}^{0}\int_{-\infty}^{\infty} f^b_{\upsilon,NB,\mu}(\upsilon, NB, \mu)\,\partial\mu\partial NB\partial\upsilon \\ +\int_{-\infty}^{-B_a}\int_{-\infty}^{0}\int_{-\infty}^{\infty} f^a_{\upsilon,NB,\mu}(\upsilon, NB, \mu)\,\partial\mu\partial NB\partial\upsilon \end{bmatrix} \tag{6.6}$$

[18] Obviously, an agent with a negative entitlement, i.e. whose primary income is greater than the guaranteed income, will not have to pay the welfare agency. The benefit actually received can be written as $max[0, B^*]$

Equation (6.6) represents the probability that the actual entitlement is positive, that the net benefit also is positive, but that the agent has decided not to report his program participation; or that actual entitlement is positive, but net benefit is not, whatever the decision to report program participation would have been; or that actual entitlement is negative, and thus that net benefit is negative (because costs are positive), whatever the decision to report program participation would have been.

After some rearranging[19], equation (6.6) becomes:

$$P(D=0)=\frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)}\left[\begin{array}{c}\Phi\left(\frac{-Z\gamma}{\sigma_\mu}\right)\left(\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)-\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\right)\\ +\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\\ +\Phi\left(\frac{-B_a-\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)\end{array}\right]$$

Likewise[19], equation (6.5) becomes:

$$P(D=1)=\frac{\Phi\left(\frac{Z\gamma}{\sigma_\mu}\right)}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)}\left[\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)-\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\right]$$

The log-likelihood of our sample can then be written as[20]:

$$LL=\left\{\begin{array}{l}\sum\limits_{D=0,1}\left[-\ln\left(\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)\right)\right]\\ +\sum\limits_{D=1}\left[\begin{array}{c}\ln\left(\Phi\left(\frac{Z\gamma}{\sigma_\mu}\right)\right)\\ +\ln\left(\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)-\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\right)\end{array}\right]\\ +\sum\limits_{D=0}\left[\ln\left(\begin{array}{c}\Phi\left(\frac{-Z\gamma}{\sigma_\mu}\right)\left(\begin{array}{c}\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)\\ -\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\end{array}\right)\\ +\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\\ +\Phi\left(\frac{-B_a-\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)\end{array}\right)\right]\end{array}\right. \tag{6.7}$$

7 Estimation results

The modelling strategy developed in Section 6.2 allows us to separate *actual* non take-up from *apparent* non take-up. The actual non take-up results from participation and/or information costs and is modelled through the "cost equation". The apparent non take-up arises from (*i*) under-reporting of program participation, modelled through the "declaration equation"; and from (*ii*) data accuracy problems (namely under-reporting of primary income) leading to an incorrect computation of agents' entitlement. Item (*ii*) is modelled through a "measurement errors equation".

[19]See Appendix A

[20]For identification reasons, we impose $\sigma_\mu = 1$ when maximizing (6.7)

Unfortunately, the cost equation does not allow us to structurally disentangle the various sources of participation/information costs.

7.1 Model specification

The variables used in this analysis reflect the socio-economic characteristics of households: the mean age of adults, their education level, number and age of children and so on . The share of benefit recipients in the department is used here as a proxy for the level of social stigma as defined by Besley and Coate (1992)[21]. Their model links the level of social stigma in the society to the difference in average labour disutility between welfare recipients and the rest of the population, and not to the share of welfare recipients. However, if one is ready to assume that labour disutility is uniformly distributed in the population, then a higher rate of welfare recipients implies a lower level of labour disutility among welfare recipients.

The declaration equation controls for the age and education level of adults. Identification of the parameters of the cost equation, which could rely simply on the non-linearity of the equations, is better handled *via* an exclusion restriction. Since such a variable — which would ideally influence the declaration decision, but not participation costs — is not easy to find, we have decided to use a dummy variable for the receipt of benefits paid by the welfare agency in charge of RMI and API (Caisse Nationale d'Allocation Familiale, CNAF). Indeed, since all these benefits are paid by the same welfare agency, it is possible that benefit confusions occur, agents reporting them as family-related benefits. Moreover, we use a dummy indicating if API entitlement is greater than RMI entitlement, since API might carry less stigma than RMI does, thus inducing participants to be less reluctant to report program participation.

Errors in the computation of benefit entitlement will depend on two dummy variables: one indicating if the household is composed of non married couples[22]; and one indicating if primary income is positive.

7.2 Results

Estimated coefficients are given in Table 5. The results show that participation costs typically rise with age, whereas the probability of reporting program participation rises with age also. Education does not significantly affect participation costs, but does decrease the probability of program participation. The insignificance of education in the cost equation can be interpreted as resulting from two opposite phenomena: a positive information effect (individuals with higher education may be more likely to master complex procedures); and a negative stigma effect (participation in a means-tested benefit program might not be part of the " attributes attached to a predefined social identity " of highly-educated individuals). Household structure also matters: couples face higher participation costs, while the number of children reduces such costs. However, this latter effect depends on the children's age: the younger they are, the larger this is (although the number of children between 3 and 10 is the only statistically significant variable). Housing costs (either rent

[21]We are aware that this variable only partially reflects the level of social stigma in individuals' reference group, but the data available to us, which is not estimated from our data, but which is based on the number of *actual* benefit recipients as given by the welfare agency, do not allow a finer decomposition.

[22]We had noticed that 59 % of households for which $B_a < 0$ but $D = 1$ are non married couples.

Table 5: Estimation results

Variable	Coefficient	(Std. Err.)
Cost equation		
Mean age of adults	0.056*	(0.026)
(Mean age of adults)^2	-0.0004	(0.0004)
Mean education level of adults	-0.040	(0.095)
Couple	0.500†	(0.291)
Number of children under 3	-1.864	(1.395)
Number of children between 3 and 10	-0.650**	(0.131)
Number of children between 10 and 25	-0.045	(0.146)
Has housing costs	-0.447	(0.313)
ln(share of ben. recipients in the dept.)	-1.413**	(0.327)
Declaration equation		
ln(mean age of adults)	3.181*	(1.435)
Mean education level of adults	-0.374**	(0.142)
Participates in other CNAF programs	-0.586	(0.556)
API entitlement > RMI entitlement	0.718	(0.569)
Intercept	-8.547†	(4.596)
Measurement errors		
Primary income >0	-1.607**	(0.042)
Unmarried couple	1.015**	(0.144)
Other variables		
σ_ε	0.118**	(0.002)
σ_υ	2.192**	(0.122)
N	1773	
Log-likelihood	-441.236	
$\chi^2_{(15)}$	7203.901	

Significance levels: †: 10 % *: 5 % **: 1 %

or a loan repayment) also have a negative but insignificant effect on participation costs. The rate of RMI recipients in the department, which acts here as a proxy for the level of social stigma as defined by Besley and Coate (1992) faced by potential program participants, has a statistically significant negative impact on participation costs. One can therefore argue that the social environment of households, that is to say their reference group, has a strong impact on the level of participation costs, probably through social stigma.

Focusing now on the declaration equation, we note the sign of the coefficients related to the receipt of another CNAF welfare program; and the sign of the coefficient reflecting that API entitlement is greater that RMI entitlement: it seems that benefit confusions do occur, and that individuals are more reluctant to report RMI participation compared to API participation.

Turning now to the variables determining measurement errors, the estimated coefficients reveal that households having reported a positive primary income have under-reported it, with an average unreported primary income of 1607 FF (€ 245). On the contrary, unmarried couples have asserted rights that are, on average, higher by 1000 FF (€ 152) than those that we computed[23].

[23] What are here called here "measurement errors" refer to the difference not between computed and legal entitlements, but between computed and asserted rights. It is plausible that some unmarried couples have registered as

For comparison purposes, Table 6 presents the results of *probit* estimation of the probability of taking up RMI or API benefit (the sample being restricted to households for which the calculated entitlement is positive).

Table 6: *Probit* model

Variable	**Coefficient**	**(Std. Err)**
Entitlement level	0.381**	(0.048)
Mean age of adults	0.135**	(0.042)
(Mean age of adults)^2	-0.001**	(0.001)
Mean education level of adults	-0.099*	(0.044)
Couple	-0.579**	(0.153)
Number of children below 3	0.234	(0.196)
Number of children between 3 and 10	-0.038	(0.099)
Number of children between 10 and 25	-0.141*	(0.065)
Has housing costs	0.184	(0.140)
ln(share of ben. recipients in the dept.)	0.441**	(0.154)
Intercept	-3.431**	(0.888)
N	598	
Log-likelihood	-353.287	
$\chi^2_{(10)}$	122.193	

Significance levels: †: 10 % ∗: 5 % ∗∗: 1 %

Most variables (such as housing costs, couple, share of benefit recipients) work the same way as in Table 5. However, while *probit* estimates suggest a negative effect of education, our model's estimates indicate that participation costs are uncorrelated with education, but that higher-educated agents will tend to conceal their participation in means-tested benefit programs. Similarly, the coefficients for the mean age of adults from the *probit* estimates indicate a higher take-up rate for the older agents, while our model's estimates show that while program participation is more likely to be revealed by older agents, participation costs tend to increase with age. These results highlight the need for an appropriate modelling strategy which disentangles apparent from actual non take-up. The results of the *probit* and of our model imply rather different policy measures aimed at increasing the efficiency of welfare programs through a higher take-up rate.

7.3 Take-up costs

The point estimates given in Table 5 enable us to compute expected participation costs for various sub-samples. Note that these costs differ from the linear prediction $X\beta$ because one has to adjust for the truncation at $-X\beta$ of the distribution of ε[24]. These costs can be interpreted as the monetary valuation of the disutility caused by the phenomena described in Section 2.

These costs, which are non-negligible for households without children, are in all cases below the income threshold defined by law[25]. The existence of participation costs will thus not lead agents

singles in order to exclude the other person's income from the entitlement computation.

[24]Expected costs are given by (*cf.* Greene, 2000, p. 899):

$$E\left[\text{Costs}\right] = X\beta + E\left[\varepsilon|\varepsilon > -X\beta\right] = X\beta + \sigma_\varepsilon \left(\frac{\phi\left(\frac{-X\beta}{\sigma_\varepsilon}\right)}{1-\Phi\left(\frac{-X\beta}{\sigma_\varepsilon}\right)}\right)$$

[25]See Appendix C.3 for these thresholds.

Table 7: Expected costs

	Single persons	Couples
All	103 €	146 €
No children	108 €	196 €
At least one child under 3	2 €	5 €
Children over 3	78 €	128 €

without any primary income to give up their rights to the benefit. Only those agents with positive primary income, and thus with a smaller benefit entitlement, might, due to participation costs, not take-up the benefit to which they are entitled.

7.4 A measure of the non take-up rate

An intuitive definition of the rate of non take-up would be the share of eligible households who do not participate in the program. Unfortunately, we cannot be certain if an unit is truly entitled to positive benefit. However, our model provides the probability of being eligible, and the probability of actually participating in the welfare program. We can thus define a measure of the non take-up rate as the probability of not participating in the program, conditional on being entitled to a positive benefit:

$$T_1 = \Pr\left(P = 0 | B^* > 0\right) \tag{7.1}$$

where the probabilities are computed from the point estimates of our statistical model.

The mean non take-up rate in our sample is 35 %, a figure which is considerably lower than the one computed from raw data (48 %, see Table 3). Table 8 gives estimated[26] rates of non take-up for various sub-samples.

Table 8: Rates of non take-up (%)

	Single persons	Couples
All	0.32	0.40
No children	0.37	0.64
At least one child under 3	0	0.002
Children older than 3	0.16	0.34

As in Table 7, estimated non take-up rates strongly vary with household's structure: the non take-up phenomenon is almost non-existent in households with children under 3 (who are not provided with schooling), probably because the additional costs due the presence of young children lead to a greater marginal utility of income for these households. When children in the household are old enough to go to school, their impact on participation costs becomes weaker, but still strong enough to cut the non take-up rate by half compared to households without children.

In addition to explanations in terms of marginal utility of income, it can be argued that households with children have better information about their rights and the welfare benefits for which

[26] Appendix B gives the formula for these rates.

they could be eligible. Indeed, most of these households are already in contact with welfare agencies because they receive family-related benefits.

8 Conclusion

This paper aimed at a better understanding of the puzzling phenomenon of the non take-up of benefits. We consider two French means-tested benefits using data from three waves the *European Community Household Panel*. Following Duclos (1995a, 1997), our statistical model distinguishes actual non take-up — due to participation costs — from apparent non take-up — due to both under-reporting of primary income and of program participation.

Results show some evidence of non take-up due to participation costs and stigma effects, and confirm the presence of measurement errors with respect to both primary income and program participation, thus confirming the need for an appropriate modelling strategy. Our model's estimates of the effects of age and education on the probability of program participation contradict the conclusions obtained from "naive" *probit* estimation.

Estimated expected participation costs imply that agents with full benefit entitlement (i.e. with no primary income) will, on average, face costs that will not lead them to give up their benefit. Moreover, our estimate of the non take-up rate is clearly inferior to that obtained in the raw data.

Appendix

A Likelihood function

Substituting (6.3) and (6.4) in (6.5) and (6.6) acording to the integration domain, we obtain:

$$P\left(D=0\right)=$$
$$\frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)}\left[\begin{array}{c}\int_{-B_a}^{\infty}\int_{0}^{B_a+\upsilon}\int_{-\infty}^{-Z\gamma}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\+\int_{-B_a}^{\infty}\int_{-\infty}^{0}\int_{-\infty}^{\infty}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\+\int_{-\infty}^{-B_a}\int_{-\infty}^{0}\int_{-\infty}^{\infty}\frac{1}{\sigma_\upsilon\sigma_\varepsilon\sigma_\mu}\phi\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon}\right)\phi\left(\frac{NB+X\beta}{\sigma_\varepsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\end{array}\right] \tag{A.1}$$

$$P\left(D=1\right)=$$
$$\frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)}\int_{-B_a}^{\infty}\int_{0}^{B_a+\upsilon}\int_{-Z\gamma}^{\infty}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon \tag{A.2}$$

Simplification of (A.1):

$$\int_{-\infty}^{-B_a}\int_{-\infty}^{0}\int_{-\infty}^{\infty}\frac{1}{\sigma_\upsilon\sigma_\varepsilon\sigma_\mu}\phi\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon}\right)\phi\left(\frac{NB+X\beta}{\sigma_\varepsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon=\Phi\left(\frac{-B_a-\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)$$

$$\begin{aligned}&\int_{-B_a}^{\infty}\int_{-\infty}^{0}\int_{-\infty}^{\infty}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\=&\int_{-B_a}^{\infty}\int_{-\infty}^{0}\frac{1}{\sigma_\upsilon\sigma_{NB}}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\partial NB\partial\upsilon\\=&\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\end{aligned}$$

$$\begin{aligned}&\int_{-B_a}^{\infty}\int_{0}^{B_a+\upsilon}\int_{-\infty}^{-Z\gamma}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\=&\int_{-\infty}^{-B_a}\int_{0}^{B_a+\upsilon}\int_{-\infty}^{-Z\gamma}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{-\upsilon+\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\=&\int_{-\infty}^{-B_a}\int_{-\infty}^{B_a+\upsilon}\int_{-\infty}^{-Z\gamma}\phi_2\left(\right)\phi\left(\right)\partial\mu\partial NB\partial\upsilon-\int_{-\infty}^{-B_a}\int_{-\infty}^{0}\int_{-\infty}^{-Z\gamma}\phi_2\left(\right)\phi\left(\right)\partial\mu\partial NB\partial\upsilon\end{aligned}$$

$$\int_{-\infty}^{-B_a}\int_{-\infty}^{0}\int_{-\infty}^{-Z\gamma}\phi_2\left(\right)\phi\left(\right)\partial\mu\partial NB\partial\upsilon=\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\Phi\left(\frac{-Z\gamma}{\sigma_\mu}\right)$$

By a change of variables from NB to $NB-\upsilon$, we obtain:
$\int_{-\infty}^{-B_a}\int_{-\infty}^{B_a+\upsilon}\int_{-\infty}^{-Z\gamma}\phi_2\left(\right)\phi\left(\right)\partial\mu\partial NB\partial\upsilon=\Phi\left(\frac{-Z\gamma}{\sigma_\mu}\right)\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)$
Indeed: $\sigma_{(NB-\upsilon)}=\sigma_\varepsilon$; $\rho_{(NB-\upsilon)\upsilon}=0$; $E\left[NB-\upsilon\right]=B_a-X\beta$

We thus have:

$$P\left(D=0\right)=\frac{1}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)}\left[\begin{array}{c}\Phi\left(\frac{-Z\gamma}{\sigma_\mu}\right)\left(\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)-\Phi_2\left(\frac{-B_a-\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\right)\\+\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\\+\Phi\left(\frac{-B_a-\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)\end{array}\right]\quad\text{(A.3)}$$

Simplification of (A.2): (we use the same change of variables as before)

$$\begin{aligned}&\int_{-B_a}^{\infty}\int_{0}^{B_a+\upsilon}\int_{-Z\gamma}^{\infty}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{\upsilon-\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},\rho_{NB\upsilon}\right)\phi\left(\frac{\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\
=&\int_{-B_a}^{\infty}\int_{0}^{B_a+\upsilon}\int_{-Z\gamma}^{\infty}\frac{1}{\sigma_\upsilon\sigma_{NB}\sigma_\mu}\phi_2\left(\frac{-\upsilon+\mu_\upsilon}{\sigma_\upsilon},\frac{NB-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\phi\left(\frac{-\mu}{\sigma_\mu}\right)\partial\mu\partial NB\partial\upsilon\\
=&\int_{-B_a}^{\infty}\int_{-\infty}^{B_a+\upsilon}\int_{-Z\gamma}^{\infty}\phi_2\left(\right)\phi\left(\right)\partial\mu\partial NB\partial\upsilon-\int_{-B_a}^{\infty}\int_{-\infty}^{0}\int_{-Z\gamma}^{\infty}\phi_2\left(\right)\phi\left(\right)\partial\mu\partial NB\partial\upsilon\\
=&\Phi\left(\frac{Z\gamma}{\sigma\mu}\right)\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)-\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\Phi\left(\frac{Z\gamma}{\sigma\mu}\right)\end{aligned}$$

We thus obtain:

$$P\left(D=1\right)=\frac{\Phi\left(\frac{Z\gamma}{\sigma\mu}\right)}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)}\left[\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)-\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)\right]\quad\text{(A.4)}$$

B Take-up rates

Equation (7.1) defines the conditional probability of not participating in the welfare program, given that the agent is truly entitled. This can be written as:

$$
\begin{aligned}
T_1 &= \Pr\left(P=0|B^*>0\right)\\
&= \frac{\Pr\left(P=0,B^*>0\right)}{\Pr\left(B^*>0\right)}\\
&= \frac{\Pr\left(NB<0,B^*>0\right)}{\Pr\left(B^*>0\right)}\\
&= \frac{\int_{-B_a}^{\infty}\int_{-\infty}^{0} f_{\upsilon,NB}\left(\upsilon,NB\right)\partial NB\partial\upsilon}{\int_{-B_a}^{\infty} f_{\upsilon}\left(\upsilon\right)\partial\upsilon}\\
&= \frac{\Phi_2\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon},\frac{-B_a-\mu_\upsilon+X\beta}{\sigma_{NB}},-\rho_{NB\upsilon}\right)}{\Phi\left(\frac{X\beta}{\sigma_\varepsilon}\right)\Phi\left(\frac{B_a+\mu_\upsilon}{\sigma_\upsilon}\right)}
\end{aligned}
$$

C Data

C.1 Education levels

Table 9 shows the education levels used in the estimation.

Table 9: Education level

Code	Level
0	No schooling
1	Primary schooling
2	High school
3	Technical (short cycle)
4	Technical (long cycle)
5	College

C.2 Cumulative distributions

Table 10 gives further details about participation levels.

Table 10: Cumulative distributions of reported participations and non-participations

Computed entitlement (€)	**Participations**	**Non participation**	**Participation rates**[a]
-2400 to -2250	0	0.21	
-2250 to -2100	0	0.63	
-2100 to -1950	0	1.33	
-1950 to -1800	0	2.45	
-1800 to -1650	0	3.92	
-1650 to -1500	0	5.46	
-1500 to -1350	0	7.49	
-1350 to -1200	0	9.24	
-1200 to -1050	0	12.60	
-1050 to -900	0	16.72	
-900 to -750	0.58	23.09	
-750 to -600	0.87	30.37	
-600 to -450	1.16	38.98	
-450 to -300	1.45	48.99	
-300 to -150	4.94	66.34	
-150 to 0	9.30	79.99	
0 to 150	20.64	87.54	26.53 %
150 to 300	35.76	91.25	49.52 %
300 to 450	75.29	97.83	59.13 %
450 to 600	86.34	98.95	70.37 %
600 to 750	97.09	99.79	75.51 %
750 to 900	99.42	100.00	72.73 %
900 to 1050	99.71	100.00	100 %
1050 to 1200	100.00	100.00	100 %

[a]In each entitlement bracket

C.3 Entitlement computation

Computation of households benefit entitlement was made on the basis of the official benefit scales as given by *Liaisons Sociales*. The different household types depend on the number of individuals (adults and children younger than 25) in the household.

For each household (the basic unit of the *European Community Household Panel*), we have defined the following entitlement units:

- Parents and children younger than 25.
- For children older than 25 (or 18 for single parents), their entitlement is calculated as separate units.
- The same goes for individuals with no family links to the household head, and for his ascendants.

Tables 11, 12 and 13 show the income thresholds for the RMI (€) according to the year and household structure. Table 14 gives the income thresholds for API (€) according to year and number of children. An inclusive amount (different every year) is imputed to the household's income if they have no housing costs.

Table 11: RMI thresholds in 1994

	Single persons	Couples
No children	350.34	525.51
1 child	525.51	630.61
2 children	630.61	770.75
By additional child	+ 140.14	

Table 12: RMI thresholds in 1995

	Single persons	Couples
No children	354.44	531.81
1 child	531.81	638.18
2 children	638.18	778
By additional child	+ 141.82	

Table 13: RMI thresholds in 1996

	Single persons	Couples
No children	361.99	542.98
1 child	542.98	651.58
2 children	651.58	796.38
By additional child	+ 144.8	

Table 14: API thresholds

	1994	1995	1996
1 child	626.26	633.73	633.73
2 children	782.82	792.12	792.12
By additional child	+ 156.56	+ 158.39	+ 158.39

The benefit entitlement is defined as the difference between the income threshold corresponding to the household's structure and the mean primary income during the last three months.

The different income types taken into account are:

1. Family benefits
2. Disabled adult benefit
3. Labor income
4. Illness allowance
5. Unemployment benefit
6. Retirement pensions
7. Widowhood benefit

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