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Alternative Basic Income Mechanisms: An Evaluation Exercise

with a Microeconometric Model

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Alternative Basic Income Mechanisms: An Evaluation Exercise with a Microeconometric Model[a]

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Abstract

We develop and estimate a microeconometric model of household labour supply in four European countries representative of different economies and welfare policy regimes: Denmark, Italy, Portugal and the United Kingdom. We then simulate, under the constraint of constant total net tax revenue (fiscal neutrality), the effects of various hypothetical tax-transfer reforms which include alternative versions of a Basic Income policy: Guaranteed Minimum Income, Work Fare, Participation Basic Income and Universal Basic Income. We produce indexes and criteria according to which the reforms can be ranked and compared to the current tax-transfer systems. The exercise can be considered as one of empirical optimal taxation, where the optimization problem is solved computationally rather than analytically. It turns out that many versions of the Basic Income policies would be superior to the current system. The most successful policies are those involving non means-tested versions of basic income (Universal or Participation Basic Income) and adopting progressive tax-rules. If – besides the fiscal neutrality constraint – also other constraints are considered, such as the implied top marginal top tax rate or the effect on female labour supply, the picture changes: unconditional policies remain optimal and feasible in Denmark and the UK; instead in Italy and Portugal universal policies appear to be too costly in terms of implied top marginal tax rates and in terms of adverse effects on female participation, and conditional policies such as Work-Fare, emerge as more desirable.

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1. Introduction

Some form of basic income support – in a limited and conditional version – is now implemented in most European countries, acting through the fiscal system or the pension system or the transfers related to children. The dimensions of these interventions, however, are overall modest and rather selective in character. All the policies actually implemented show a large variation in terms of eligibility, equivalence scales, household definition, monitoring, supplementary measures, duties on the part of recipients etc. The idea of a basic income support close to a universal coverage of the citizens and of an amount sufficient to permanently alleviate a significant portion of the poverty is far from being accepted and implemented. Critical arguments with respect to Basic Income have been mainly motivated by the assumption that it would introduce strong disincentives to work and require high tax rates in order to finance it. As a matter of fact, recent proposals or implementations of reforms both in Europe and the US seem to favour in-work benefits or work-fare policies.[1] Yet, these policies are not necessarily an alternative to some form of universal support, and do not respond to the distributive and efficiency issues that are specifically addressed by the universalistic policies.

The purpose of this study is the analysis of the behavioural, welfare and fiscal implications of the hypothetical implementation in European countries of tax-transfer reforms embodying some version of a basic income policy. As a main tool for the evaluation we develop a microeconometric model of household labour supply. We estimate the model and simulate the effects of the reforms in four European countries representative of different economies and current welfare policy regimes: Denmark, Italy, Portugal and the United Kingdom.

The parameters of the reforms are iteratively adjusted in the simulation so that the total net tax revenue collected is the same as the current one. For each country we then rank, according to various criteria, the alternative types and versions of tax-transfer reforms. Among the evaluation criteria, we also use a welfarist social welfare function. Therefore, with reference to the class of tax-transfer rules considered, we actually approximate computationally the solution to an optimal taxation problem, with special focus on income transfer mechanisms.

Interesting examples of recent contributions to the empirical design of income transfer mechanisms are Immervoll et al. (2007) and Blundell et al. (2009a). These studies start from optimal taxation formulas obtained by Saez (2002) and assign numerical values to the parameters appearing in those formulas (typically the labour supply elasticities) either by calibration (as in Immervoll et al. (2007)) or by using previous microeconometric estimates (as in Haan et al., 2007 and Blundell et al., 2009a). Instead, we solve the optimal taxation problem computationally by iteratively running the microeconometric model under the constraint of constant total net tax revenue. Under this methodological aspect, our exercise is close to Aaberge et al. (2008) and to Blundell et al. (2009b). The computational approach to solving optimal taxation problems allows for a more general and flexible representation of preferences, agents' heterogeneity and non-standard constraints on the choice set.

Section 2 defines the alternative basic income policies to be simulated. Section 3 explains the evaluation method. Section 4 reports the main results of the simulations, and Section 5 contains the concluding remarks. The model, the empirical specification, the estimates and some technical details upon the simulation method are presented in the Appendix.

[1] A useful survey of current transfer policies in Europe and the debate on reforms is provided by Immervoll et al. (2007).

2. The Basic Income policies

We will consider various members of three basic types of basic income policies, which are related both to actual or designed reforms and/or to results of the optimal income taxation literature. The first type is the mean-tested transfer. When implemented, it can take the form of a Demogrant, a Minimum Guaranteed Income, a Negative income tax etc. This mechanism envisages a transfer that declines as the own income approaches a certain threshold and therefore it implies a very high marginal tax rate imposed on (subsidized) low incomes. Most numerical simulations done with the model of Mirrlees (1971) get a tax-transfer schedule with a lump-sum transfer, very high marginal tax rates on low income and almost constant marginal tax rates on average and high income. This scenario seems to have inspired many reforms (implemented or discussed) in the three decades 1970-80-90. A second scenario emerges since the beginning of 2000, with new formulations of Mirrlees' model that make it more amenable to econometric applications and generalize it to include the decision of whether to work or not (not only – as in Mirrlees (1971) – the decision of how much to work). This extension is particularly relevant for the design of income support mechanisms. An influential contribution is represented by Saez (2002), whose model has been used in various applications (e.g. Immervoll et al., 2007; Haan et al., 2007; Blundell et al., 2009a). A typical result emerging from these studies is the superiority of policies such as in-work benefits, or tax-credit on (low) earnings. These mechanisms are also close to the idea of conditional transfers (such as Work Fare). Interestingly, analogous policies have been in part implemented or considered as alternatives to mean-tested transfers in various countries during the last decade. Finally, we have the stream of universal basic income. So far it never reached the position of a dominating scenario but it remains an inspiring idea with oscillating fortunes. The idea has strong philosophical motivations, but also cost-benefit and efficient incentives arguments are sometimes put forward: universal and unconditional transfers do not incur the costs of verifying and monitoring the eligibility conditions; they do not create poverty traps; they might promote more autonomy and more efficient choices in the educational and occupational career etc. (Standing, 2008). Atkinson (2002) suggests that various processes in the modern economies might naturally drive the social policy institutions toward the universal basic income scenario.

Table 1 summarizes the structure of the hypothetical tax-transfer reforms that we consider. In the simulation exercise they completely replace the actual tax-transfer system. They are stylized cases representative of the different scenarios sketched above: Guaranteed Minimum Income (GMI), Work Fare (WF), Participation Basic Income (PBI) and Universal Basic Income (UBI). For each these four types we distinguish two version: a flat tax version, in which the income support mechanism is matched with a fixed marginal tax rate t applied to incomes above a threshold G; a progressive tax version, in which the income support mechanism is matched with a simple

progressive tax (defined by a constant degree of progressivity τ) that applies to incomes exceeding

G. The parameters t and τ are endogenously determined within the reform simulation so that the

total net tax revenue is equal to the one collected under the current tax-transfer system. This requires a two-level simulation procedure. At the “low” level household choices are simulated given the values of the tax-transfer parameters. At the “high” level the tax-transfer parameters are calibrated so that the total net tax revenue remains constant.[2] The threshold G is computed as

$G = aP\sigma$

where

P = basic Poverty Line = (1/2) median gross household income;

σ is an equivalence scale that adjusts the basic poverty line according to the number of people (N) in the household (Commissione di Indagine sulla Povertà, 1985):

$$\sigma = \begin{cases} 1.00 & \text{if} \quad N = 2 \\ 1.33 & \text{if} \quad N = 3 \\ 1.63 & \text{if} \quad N = 4 \\ 1.90 & \text{if} \quad N = 5 \\ 2.16 & \text{if} \quad N = 6 \\ 2.40 & \text{for} \quad N \geq 7; \end{cases}$$

a is a proportion: for each reform we simulate four versions with different values of a: 1, 0.75, 0.50 and 0.25. For example, $G = (0.5)P(1.33)$ means that for a household with 3 components the Basic Income is ½ of the Poverty Line times the equivalence scale 1.33.

We used gross income rather than net income in computing the basic poverty line P in order to make it independent of the country-specific 1998 tax-transfer systems. This procedure gives us a poverty line somewhat higher than what is typically adopted. On the other hand we can articulate our evaluations on the basis of the value of a.

All the tax-transfer rules are defined in terms of household income. The datasets we were able to access at the moment of estimation and simulation contained the net household income computed according to the exact tax rule in each country: therefore the estimation accounts for the appropriate tax rule, whether based on individual taxation, joint taxation or some other mechanism. However the datasets did not contain the individual unearned gross incomes. Therefore we decided to formulate the reforms in terms of total household income (i.e. as joint tax-transfer rules).

GMI (Guaranteed Minimum Income) is a version with a 100% transfer reduction rate of the Negative Income Tax proposal originally and independently conceived by Friedman (1962) and Tobin et al. (1967). As long as gross household income Y is below G the household receives a transfer $G – Y$. Otherwise $Y – G$ is taxed according to the flat rule or the progressive rule.

WF (Work Fare) is similar to GMI, but the transfer to households with $Y < G$ is given only if the husband or the wife (or both) work at least 20 weekly hours. In a similar version this rule is

[2] The calibration of the revenue-constant values of the tax-transfer parameters is performed by the algorithm Amoeba written for STATA.

discussed and evaluated by Fortin et al. (1993). This system is essentially very close to some reforms recently introduced in the US and the UK and currently discussed also in continental Europe (Earnings Tax Credit, In-Work Benefits etc.). WF belongs to a more general family of policies that induce "notches" into the household budget constraint (Blinder et al. 1985).

PBI (Participation Basic Income) is close to a proposal made by Atkinson (1996, 1998) where a basic amount of income G is transferred to everyone provided he or she is engaged in some "participation" activity (work, child-care, training etc.). We simulate a version where the condition is that at least one of the partners works (any number of hours).

UBI (Universal Basic Income) is the basic version of the system discussed for example by Van Parijs (1995) and also known in the policy debate as "citizen income" or "social dividend" (Meade, 1972; Van Trier, 1995). Under this rule, every household unconditionally receives a transfer equal to G.

Gross income Y (in PBI and UBI) or $Y - G$ (in GMI and WF) is taxed according to a Flat Tax (defined by a constant marginal tax rate t) or according to a progressive rule defined by a constant

degree of progressivity τ.

TABLE 1 here

3. Evaluation method

We develop a microeconometric model of household labour supply that is capable of simulating the household choices, taxes paid, transfers received, net available income and attained utility level given any tax-transfer rule regime, under the constraint of a constant total net tax revenue.

The Appendix provides a detailed description of the model. Here we offer an intuitive overview. Although we actually treat couples, for the sake of simplicity the following illustration considers singles.

The model assumes households are endowed with unearned income I and a market productivity that commands a wage rate w. They face a set of opportunities ("jobs") characterized by hours of market work required (h) and gross earnings (wh). The opportunity set includes non-market "jobs" (i.e. activities – such as child care or education – outside the labour market, with $h = 0$ and therefore $wh = 0$). Opportunity sets can differ across households, both in terms of wage rates and in terms of availability of market jobs (including the case of no market job available). The tax-transfer rule (actual or simulated) transforms the gross incomes (I, wh) into the net available income C. The household preferences upon alternative jobs are represented by a utility function $U(h, C, Z)$, where Z denote a set of household characteristics (age, children etc.). The model assumes households choose a job – among the available ones – so as to maximize $U(h, C, Z)$. Under this assumption, the observed choices reveal the household preferences and with appropriate datasets and statistical procedures it is therefore possible to estimate the utility function $U(h, C, Z)$. Once we have estimated the utility function, we can simulate what the household choices would be when facing a different opportunity set, e.g. one induced by a tax-transfer reform.

For the estimation and simulation exercise presented in this paper we use EUROMOD datasets from four countries: Denmark (European Community Household Panel Survey (ECHP) 1998), Italy (Survey of Household Income and Wealth (SHIW) 1998), Portugal (European Community Household Panel Survey (ECHP) 1998) and United Kingdom (Family Resources Survey (FRS) 2003).[3]

The selection criteria are as follows:

- Couples (either married or unmarried);
- Partners either employed, unemployed or inactive (students, self-employed and disabled are excluded);
- Both partners aged 20 – 55.

The above sample selection criteria adopted are rather common in the literature on behavioural evaluation of tax reforms. The choices of people under 20 or over 55 are not going to be significantly affected by the policies we simulate. On the other hand, the singles and the self-employed are certainly affected, although it remains to be seen whether their responses are significantly different from the couples included in our sample.[4]

The model shows robustness, since it has been estimated with many alternative empirical specifications with no remarkable differences in the simulation results. A model with a similar structure has been used in an out-of sample prediction test by Aaberge et al. (2008) with very satisfactory results.

In order to illustrate some of the behavioural implications of the estimated model, in Table 2 we report the wage elasticities of labour supply, i.e. the percentage change in labour supply as a response to a 1% increase in the wage rate. Labour supply can be seen as composed of two parts. One is the number of people who are willing to work, the so-called participants. The other is the number of hours the participants are willing to work. The right-hand panel of Table 1 concerns the participation elasticity. For each country, the Table tells us the percentage change in the number of participants (male or female) as a response to a 1% increase of the (male or female) wage rate. For example, in Denmark the female participation elasticity with respect to the female wage rate (i.e. the own female participation elasticity) is 0.82%. Again in Denmark, the male participation elasticity with respect to the female wage rate (i.e. the cross male participation elasticity) is very close to zero, -0.06%. The left-hand side of the Table concerns the total labour supply effect, i.e. it includes both the participation effect and the hour effect. The own female elasticity in Denmark is 1.55%. It tells us the total change in the number of hours the female population is willing to work, accounting both for the change in the number of participants and in the number of hours worked by the participants. If we subtracts the participation elasticity from the total elasticity we get the conditional hour

[3] The EUROMOD project, among other outputs, produces comparable datasets and microsimulation algorithms for computing the household budget sets given a specific tax-transfer rule. EUROMOD was originally developed at the Department of Economics at Cambridge University and then at Essex, under the direction of Holly Sutherland. An initial overview of the EUROMOD project is provided by Bourguignon et al. (2000). These four countries were chosen because when developing and estimating the model we had a limited access to the EUROMOD datasets and the four datasets eventually used were the only ones accessible containing sufficient and comparable information and still providing some variety of economic and institutional environment. We are currently working at the extension of the exercise to all the European countries covered by EUROMOD.

[4] The inclusion of singles and self-employed is part of a current development of our project.

elasticity 1.55% - 0.82% = 0.73%. Table 2 reveals that the behavioural responses vary a lot both by gender and by country. The heterogeneity of behavioural responses is crucial in shaping the effects of the tax-transfer reforms upon different segments of the population and in different countries.

TABLE 2 here

Since the tax-transfer reforms in general have different effects on different households we need a criterion to "aggregate" all the micro-effects into a synthetic index in order to be able to compare and evaluate the reforms. Sen (1974, 1976) proposed to compare different statuses of the economy by computing what is now known as Sen's Social Welfare function, namely $\mu(1-I)$, where μ is the average income and I is the Gini coefficient of the income distribution. This index has the intuitive appeal of expressing social welfare as the product of an efficiency measure (average income, i.e. the average size of the pie's slices) time a familiar equality measure (1 – Gini coefficient, i.e. the equality of the pie's slices). We apply the same idea in two of the four criteria we use to evaluate the reforms. The criteria are defined as follows.

S(C) = Social Welfare (income-based). It is the same Sen's index as explained above.

S(U) = Social Welfare (utility-based). This is the same as S(C) but with utility replacing income. Let $v^n(\Re)$ be the maximum utility attained by household n (computed as explained in Section A.6 of the Appendix). We then consider the sample average of $v^n(\Re)$: $\mu(\Re)=\sum_n v^n(\Re)$. Let $I(\Re)$ be the Gini coefficient of the sample distribution of $v(\Re)$. The utility-based Social Welfare function under the tax-transfer regime $\Re$ is then defined as follows:[5]

$$S_{\Re}(U)=\mu(\Re)\big(1-I(\Re)\big).$$

W(U) = proportion of utility winners, i.e. households whose attained maximum utility increases after the reform.

W(C) = proportion of income winners, i.e. households whose net available income increases after the reform.

The four criteria are considered in order to enlarge the perspective from which the reforms might be judged. Given our approach, in principle S(U) should be the appropriate criterion. However in the policy debate net available income C and therefore Sen's S(C) are more commonly used as measures of welfare. Also, the number of winners conveys useful information on the consensus the reform is likely to receive.

The reforms are simulated under the constraint of being fiscally neutral, i.e. they generate the same total net tax revenue as the current 1998 system. However, beside fiscal neutrality, there are other constraints that might be relevant in view of the feasibility of the reforms. Therefore we also consider the implications of accounting for the top marginal tax rate required and for the change in the female participation rate. The top marginal tax rate is relevant not so much for the incentives (which are taken into account by the behavioural model) but rather for the political economy

[5] For a theoretical justification of this social welfare function (as a member of a wider class) see for example Aaberge (2007) and Aaberge et al. (2008).

implications (e.g. support or aversion by high-income households). The effects upon female participation rates might also be important both from a socio-economic point-of-view and from a political economy perspective. For example, a substantial increase of female participation rates is one of the Lisbon goals.

4. Results of the simulation

In Table 3 we illustrate some of the behavioural and fiscal effects of basic income policies.[6] For each country, the Table report results for the current 1998 system, the best policy based on S(U) and the best policy also based on S(U) but taking into account the additional constraints on the top marginal tax rate and on female participation mentioned in Section 3. Overall, the reforms implement a larger redistribution compared to the current 1998 system, which entails a lower Gini coefficient. There are some negative effects on labour supply, which can be due to higher transfers and/or to higher top marginal tax rates. A lower labour supply translates itself into a somewhat lower average net available income. Therefore an efficiency-equality trade-off emerges. Typically, however, the loss of efficiency is more than compensated by the reduction in inequality, so that most of the reforms improve upon the current systems when judged according to Sen's Social Welfare function. It can be added that the losses in efficiency are rather modest. The reason is twofold. First, higher top marginal tax rates mostly impact on high income households whose labour supply elasticity is very low. Second, higher transfers – at the aggregate level – have a negative effect on labour supply, but such an effect is moderated by two factors: (i) intra-household interactions might imply that the reduction in one partner's supply is partly compensated by an increase in the other one's; (ii) for some households, at low level of income, leisure might be an inferior good, so that an increase in unearned income might induce a higher labour supply.

TABLE 3 here

In what follows we focus upon the ranking of the policies in terms of social welfare effects. Table 4 summarizes the main results. The evaluation criteria are explained in Section 3. For each country and each criterion, we "grade" a reform:

with an "A" if it is the best one in that country according to that criterion;

with a "B" if it is the second best in that country according to that criterion;

with a "C" if it performs better than the current tax-transfer system in that country according to that criterion.

TABLE 4 here

Table 4 also informs upon the additional constrained discussed at the end of Section 3. The implications of these additional constraints are signalled in the table by marks added to the grades (A, B or C) explained above. We mark a grade with a "°" if that reform in that country requires a top

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[6] Detailed numerical results illustrating the behavioural and welfare effects of the reforms are available upon request from the corresponding author.

marginal tax rate higher that 55%. We choose this figure as a hypothetical politically feasible upper limit because it is close to the top marginal tax rate applied to personal incomes in European countries; in 2000, the four highest top effective marginal tax rates applied in Europe are 60.0% (Netherlands), 55.4% (Sweden), 54.3% Denmark and 53.8% (Germany).[7] We mark a grade with a "*" if that reform in that country implies a reduction of the female participation rate.

We start by commenting on the grades and ignoring for the moment the additional marks. A first observation suggested by Table 4 is that for each country there are many reforms that would improve upon the current system according to at least one of the criteria. Italy appears to be the country most amenable to a reform, in the sense that any type of basic income reform (in some version) would improve upon the current status. From this point of view, the United Kingdom comes second after Italy, Portugal is third and last comes Denmark. Otherwise said, Denmark has (already) a successful policy of income support and it is therefore difficult to improve upon it.

The second observation is that overall the most successful reforms are PBI and UBI, in particular in their progressive versions. PBI+PT and UBI+PT get 12 "A", 8 "B" and 75 "C". On the other hand, PBI+FT and UBI+FT get 3 "A", 11 "B" and 67 "C". Therefore there seems to be some indication of the superiority of unconditional policies. An exception is represented by GMI in Italy, where it shows a performance comparable to that attained by PBI and UBI. The good performance of the unconditional policies seems to be due to the combination of two elements: (i) they have a stronger equalizing effect; (ii) the negative effect on labour supply is moderated by the absence of "poverty traps" (present in system like GMI or WF) and turns out to be comparable to the one implied by conditional policies.

A third indication is that progressive systems seem to perform somewhat better than flat systems. We already noted that the progressive versions of PBI and UBI overall get higher grades than their non progressive versions. But this is true also of GMI. This is due to the interaction between the pattern of labour supply elasticities and the structure of the tax rule. Optimal taxation theory tells us that if the main goal of the design of the tax-transfer rule were efficiency i.e. the maximization of the pie's size, then, loosely speaking, we should impose higher taxes on people who are less responsive to the economic incentives; more precisely– other things being equal – the marginal tax rate imposed on a given income level should be higher (lower) the lower (higher) is the labour supply elasticity (w.r.t. wage rates) of households at that income level. Most numerical exercises applying optimal taxation results typically assumed a constant elasticity of labour supply, which obviously contributes to producing an almost flat tax profile. However, a pervasive result in the microeconometric analysis of labour supply behaviour is the inverse relationship between income level and labour supply elasticity. Members of households with higher income tend to show a lower elasticity of labour supply, and the opposite is true of members of households with lower incomes. The intuition behind these empirical findings is that people earning higher incomes typically work more (so that it is difficult for them to work even more) and occupy jobs with better non-pecuniary benefits (so that they are relatively less responsive to monetary incentives). Progressive rules apply higher marginal tax rates on higher incomes and lower marginal tax rates on lower incomes. Therefore the progressive rules tend to exploit more efficiently the elasticity profile. Moreover, they also contribute to a more equal distribution of income and/or of utility.[8]

[7] OECD tax database (http://www.oecd.org/ctp/taxdatabase).

[8] Detailed evidence on the pattern of labour supply elasticity is provided for example by Aaberge et al. (2002) for Italy and by Aaberge et al. (2008) for Norway. Aaberge et al. (2008) compute an optimal tax rule that turn out to require

Based on the S(U) criterion and ignoring again the additional markings, the best reforms turn out to be as follows:

Denmark: UBI+PT (*a*=1);

Italy: either GMI+PT (*a*=1) or UBI+PT (*a*=1);

Portugal: UBI+PT (*a*=0.75);

UK: either UBI+PT (*a*=0.75) or PBI+PT (*a*=0.75).

The above picture can change substantially if we also account for the additional constraints mentioned above and signalled by the marks attached to the grades shown in Table 3. If we assume that the reforms requiring a top marginal tax rate higher than 55% and/or implying a reduction of the female participation rate are not feasible, then many reforms exit the social planner's opportunity set. Denmark is not affected by the additional constraints: all the reforms satisfy them. On the other hand, in Portugal only two reforms survive: PBI+FT (*a*=0.25) and WF+PT (*a*=1). What is left in Italy crucially depends on the evaluation criterion. If S(U) is used, then the only feasible and welfare-improving reform is WF+PT (*a*=0.75). If one uses other evaluation criteria more reforms remain acceptable (various versions of GMI, WF and PBI). Also for the UK the set of acceptable reforms depends on the evaluation criterion. According to S(U), only UBI+PT (*a*=0.25) remains acceptable.

Limiting again ourselves to the S(U) criterion, among the feasible policies left after accounting for the additional criteria, the new best reforms are now as follows:

Denmark: UBI+PT (*a*=1);

Italy: WF+PT (*a*=0.75);

Portugal: WF+PT (*a*=0.75);

UK: UBI+PT (*a*=0.25).

The superiority of the unconditional policies is preserved in Denmark and the UK, not so in Italy and Portugal where now WF turns out as the best choice.

A fourth observation based on Table 4 is that the results show a significant variability across countries. This is probably one of the implications of using a flexible microeconometric model that is capable of capturing enough of the heterogeneity of household characteristics and heterogeneity between countries. Immervoll et al. (2007) find that in-work benefits (close to our WF) dominate – on a social welfare basis – more universal policies (close to our UBI or GMI). The picture emerging from our exercise is less clear-cut: as a matter of fact, a pure social welfare-based evaluation would suggest a slight superiority of the universal policies. The analysis of Immervoll et al. (2007) is based on theoretical optimal taxation results (Saez, 2002) that require restrictive assumptions on

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lower (higher) tax rates on lower (higher) incomes as compared to the current rule. A maybe superficial interpretation of the first results reported by Mirlees (1971) has contributed to the widespread idea that the optimal tax rule is close to a flat one, and possibly even regressive. More recently this idea has been questioned both on theoretical and empirical basis: see Aaberge et al. (2008), Tuomala (1990, 2008), Røed et al. (2002) and Keen et al. (2006). It must be added that these analyses adopt a pure welfarist criterion, i.e. maximization of social welfare function. There are other dimensions (administrative simplicity, compliance etc.) along which the flat rules might have important advantages (Keen et al., 2006).

preferences and choices (no income effects, no interaction among partners, little heterogeneity in behaviour), which might contribute to explaining the differences between their results and ours.

5. Conclusions

We have developed a microeconometric model of household labour supply, which allows simulating the effects of complex reforms of the tax-transfer rules. We have estimated the model for four European countries (Denmark, Italy, Portugal and United Kingdom). We have then simulated the effects of introducing various alternative types of Basic Income policies keeping total net tax revenue constant. We report many indexes and criteria according to which the performances of the alternative policies can be ranked. As long as the evaluation is based on welfarist criteria (i.e. a social welfare function or the number of utility-based winners), four general suggestions emerge rather clearly:

i) the universal policies tend to show a better performance;
ii) the progressive tax rules seem able to exploit more efficiently the pattern of behavioural responses;
iii) there is very large policy space in every country for improving upon the current status;
iv) there are significant differences across countries in the performance of tax-transfer reforms.

When, besides fiscal neutrality, the other constraints (top marginal tax rate and female participation) are also taken into account, clearly the size of the feasible policies is reduced. If for example we set an upper limit of 55% to the top marginal tax rate and drop the policies that imply a reduction in female participation rate, the country-specific results tend to diverge. On the one hand, countries like Denmark and the UK seem still able to support Universal Basic Income systems as optimal policies. Instead in countries like Italy and Portugal the price of supporting unconditional policies seems too high and policies like WF emerge as more appropriate.

The question of what configurations of country-specific characteristics lead to such divergent results cannot be solved within the limits of the modelling effort illustrated in this paper and requires further investigation. In exercises based on theoretical optimal taxation results (such as Immervoll et al. 2007) one can directly identify a correspondence between optimal tax rules and a few parameters such as labour supply elasticities or moments of the skills distribution. The exercise presented in this paper is an example of computational optimal taxation (as in Aaberge et al., 2008 and Blundell et al. 2009b). The welfare properties of tax-transfer reforms are identified by simulating detailed microeconometric models. The identification of the mapping from country-specific characteristics to optimal reforms requires a large variety of datasets and new theoretical and statistical concepts that are objects of our current research.

Appendix. The microecometric model

A.1. Household behaviour

The basic modelling framework is similar to the one adopted, among others, by Van Soest (1995), Aaberge et al. (1995, 1999, 2000a, 2000b, 2004, 2008), Duncan et al. (1996), i.e. the Random Utility model.[9] We will consider households with two decision-makers (i.e. couples) aged 20 - 55. Of course there might be other people in the household, but their behaviour is taken as exogenous.

Household n is assumed to solve the following problem

$$\text{(A.1)} \quad \begin{aligned} &\max_{C,h_F,h_M} U^n(C,h_F,h_M) \\ &h_F \in \Omega \\ &h_M \in \Omega \\ &C^n = R(w_F^n h_F, w_M^n h_M, y^n) \end{aligned}$$

where

$U^n\left(C,h_F,h_M\right)$ = utility function

h_g = average weekly hours of work required by the j-th job in the choice set for partner g, g = F (female) or g = M (male);

Ω = set of 12 discrete values (see Appendix A.3);

w_g^n = hourly wage rate of partner g;

y^n = vector of exogenous household gross incomes;

C^n = net disposable household income;

R = tax-transfer rule that transforms gross incomes into net available household income. In the estimation samples the tax-transfer rules are those actually applied in the four countries and are replicated by the EUROMOD microsimulation algorithms.

The first two constraints of problem (A.1) say that the hours of work h_g are chosen within a discrete set of values Ω including also 0 hours. This discrete set of h values can be interpreted as the actual choice set (maybe determined by institutional constraints) or as approximations to the true (possibly continuous) choice set.

The third constraint says that net income C is the result of a tax-transfer rule R applied to gross incomes.

We write the utility function $U^n(C,h_F,h_M,\varepsilon)$ as the sum of a systematic part and a random component:

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[9] Surveys of various approaches to modelling labour supply for tax reform simulation are provided by Blundell et al. (1999), Creedy et al. (2005), Bourguignon et al. (2006) and Meghir et al. (2008).

(A.2) $V(C, h_F, h_M; Z^n, \vartheta) + \varepsilon = V(R(w_F^n h_F, w_M^n h_M, y^n), h_F, h_M; Z^n, \vartheta) + \varepsilon$

where Z^n is a vector of household characteristics, ϑ is a vector of parameters to be estimated and ε is a random variable capturing the effect of unobserved (by the econometrician) variables upon the evaluation of (C, h_F, h_M) by household *n*. This interpretation of the random variable ε is the same that was offered by McFadden in his presentations of the Conditional Logit model (McFadden, 1974). Besides the observed variables, there are characteristics of the job or of the household-job match that are observed by the household but not by the econometrician. The random variable ε is meant to account for the contribution to utility by those characteristics. Most of the labour supply literature adopting the Conditional Logit framework tends instead to privilege a different interpretation, where the true utility function is just the component *V* of expression (A.2) and the random variable ε is an optimization error. An implication of this interpretation is that at the end the econometrician is assumed to know more than the household itself: the econometrician knows that the true utility is *V*, while the households base their choice on a wrong utility level *U*. We find this interpretation less acceptable than the one originally proposed by McFadden, so here we follow the latter. The interpretation we adopt, on the other hand, implies that we cannot test for the (local) quasi-concavity of the utility function: we estimate *V*, and we could make a test on *V*, but the true utility function is not *V* but *U*, and *U* is a function of an unknown random variable ε.

Under the assumption that ε is i.i.d. extreme value, it is well known that the probability that household *n* subject to tax-transfer regime *R* chooses $h_F = f, h_M = m$ is given by

(A.3) $$P^n(f, m; \vartheta, R) = \frac{\exp\left\{V\left(R(w_F^n f, w_M^n m, y^n), f, m; Z^n, \vartheta\right)\right\}}{\sum_{h_F \in \Omega} \sum_{h_M \in \Omega} \exp\left\{V\left(R(w_F^n h_F, w_M^n h_M, y^n), h_F, h_M; Z^n, \vartheta\right)\right\}}$$

A.2. Empirical specification of preferences

We choose a quadratic specification since it is linear-in-parameters and it represents a good compromise between flexibility and ease of estimation:

(A.4) $$\begin{aligned} V = {} & \theta_C C + \theta_F (T - h_F) + \theta_M (T - h_M) + \\ & + \theta_{CC} C^2 + \theta_{FF} (T - h_F)^2 + \theta_{MM} (T - h_M)^2 + \\ & + \theta_{CF} C (T - h_M) + \theta_{CM} C (T - h_M) + \theta_{FM} (T - h_F)(T - h_M) \end{aligned}$$

where *T* denotes total available time.

Some of the above parameters θs are made dependent on household or individual characteristics:

(A.5) $$\begin{aligned} \theta_F = {} & \beta_{F0} + \beta_{F1} (\text{Age of the wife}) + \beta_{F2} (\#\text{Children}) + \\ & + \beta_{F3} (\#\text{Children under 6}) + \beta_{F4} (\#\text{Children 6-10}) \\ \theta_M = {} & \beta_{M0} + \beta_{M1} (\text{Age of the husband}) + \beta_{M2} (\#\text{Children}) + \\ & + \beta_{M3} (\#\text{Children under 6}) + \beta_{M4} (\#\text{Children 6-10}) \\ \theta_C = {} & \beta_{C0} + \beta_{C1} (\#\text{Children}) + \beta_{C2} (\#\text{Children under 6}) + \\ & + \beta_{C3} (\#\text{Children 6-10}). \end{aligned}$$

A.3. Empirical specification of the opportunity sets

We assume that each partner can choose between 10 values (from 1 to 80) of weekly hours of work. Each value is randomly drawn from one of the following ten intervals: 1-8, 9-16, 17-24, 25-32, 33-40, 41-48, 49-56, 57-64, 65-72, 73-80. Moreover they can also choose to be out-of-work, either as non-participants or as unemployed (therefore there are two distinct alternatives with zero hours of work: we further clarify this point at the end of this section). Thus each household chooses among 144 alternatives. In order to compute net household income C for each one of the household jobs contained in $\Omega \times \Omega$, we use the EUROMOD Microsimulation model. In other words EUROMOD mimics the tax-transfer rule R. Wage rates for those who are observed as not employed are imputed on the basis of a wage equation estimated on the employed subsample and corrected for sample selection.

Although generating the alternatives in the opportunity set with a probabilistic sampling seems to provide a better performance – especially in reform simulation – as compared to the most common usage of imputing a fixed and equal set of alternatives to everyone, here we adopt a simpler method, especially in view of making the model easily replicable, modifiable and accessible to a large audience (for example the EUROMOD users). A comparison and evaluation of different procedures to specify the choice set is provided by Aaberge et al. (2009).

Most countries show a more or less pronounced concentration of people around hours corresponding to full-time, part-time and non-working. The model outlined above is typically unable to reproduce these peaks. A useful procedure consists of adding dummies. We define the following dummies for part-time, full-time, overtime, working and not working but looking for work (the excluded condition being "not working and not looking for work"):

$$D_{g1}(h_g) = \begin{cases} 1 \text{ if } 17 \le h_g \le 32 \\ 0 \text{ otherwise} \end{cases}$$

$$D_{g2}(h_g) = \begin{cases} 1 \text{ if } 33 \le h_g \le 48 \\ 0 \text{ otherwise} \end{cases}$$

$$\text{(A.6)} \quad D_{g3}(h_g) = \begin{cases} 1 \text{ if } 49 \le h_g \\ 0 \text{ otherwise} \end{cases}$$

$$D_{g4}(h_g) = \begin{cases} 1 \text{ if } 0 < h_g \\ 0 \text{ otherwise} \end{cases}$$

$$D_{g5}(h_g) = \begin{cases} 1 \text{ if } h_g = 0 \text{ and looking for work} \\ 0 \text{ otherwise} \end{cases}$$

with g = F (female) or M (male).

Aaberge et al. (1995, 1999) provide a formal justification of this procedure. Assuming a non-uniform probability density function of the alternatives in the opportunity set and adopting a convenient empirical specification of the density function leads to rewriting the choice probabilities $P^n(f, m; \vartheta, R)$ as follows.

$$\text{(A.7)}\quad \frac{\exp\left\{V\left(R(w_F^n f, w_M^n m, y^n), f, m; Z^n, \theta\right) + \sum_{k=1}^{5}\gamma_{Fk} D_{Fk}\left(f\right) + \sum_{k=1}^{5}\gamma_{Mk} D_{Mk}\left(m\right)\right\}}{\sum_{h_F \in \Omega}\sum_{h_M \in \Omega}\exp\left\{V\left(R(w_F^n h_F, w_M^n h_M, y^n), h_F, h_M; Z^n, \theta\right) + \sum_{k=1}^{5}\gamma_{Fk} D_{Fk}\left(h_F\right) + \sum_{k=1}^{5}\gamma_{Mk} D_{Mk}\left(h_M\right)\right\}}$$

where the γ's and the θ's are parameters to be estimated and where Z^n denotes the vector of characteristics (specified in expression (A.5)) of household *n*.

If (f^n, m^n) is the observed choice for the n-th household, the ML estimate of ϑ is

$$\text{(A.8)}\quad \vartheta^{ML} = \arg\max_{\vartheta} \sum_{n=1}^{N} \ln P^n(f^n, m^n; \vartheta, R).$$

A maybe uncommon feature of the model we are adopting here is the treatment of unemployment (as different from non participation) as a choice. The unemployment status entails a utility level that is different from both employment and non-participation. Depending on the opportunities available in the opportunity set and on the cost of accessing such opportunities, either choosing employment or non participation or unemployment might turn out to be the optimal choice. Certainly the opportunity of choosing to be unemployed (and receive, for example, unemployment benefits) rather than a non participant is not open to everyone: this is accounted for by the dummy D_{g5} defined above.

A.4. Estimates

For the estimation and simulation exercise presented in this paper we use datasets from four countries: Denmark (European Community Household Panel Survey (ECHP) 1998), Italy (Survey of Household Income and Wealth (SHIW) 1998), Portugal (European Community Household Panel Survey (ECHP) 1998) and United Kingdom (Family Resources Survey (FRS) 2003).

The selection criteria are as follows:

- Couples (either married or unmarried);
- Partners either employed, unemployed or inactive (students, self-employed and disabled are excluded);
- Both partners aged 20 – 55.

The above sample selection criteria adopted are rather common in the literature on behavioural evaluation of tax reforms. The choices of people under 20 or over 55 are not going to be significantly affected by the policies we simulate. On the other hand, the singles and the self-employed are certainly affected, although it remains to be seen whether their responses are significantly different from the couples included in our sample. The inclusion of singles and self-employed is part of a current development of our project.

Expression (A.7) can be used with country-specific samples to compute the Likelihood function to be maximized in order to obtain country-specific estimates of the parameters θ and γ. We also follow a different route, consisting of pooling the four country-specific samples into a unique sample and then using expression (A.7) enriched by allowing β_{C0}, β_{F0}, β_{M0} (expression (A.5)) and all the γ's (expression (A.7)) to vary between countries. Microeconometric models of labour supply are typically estimated on one country-specific cross section sample: as a consequence, all the households face the same tax rule. On the contrary, with the procedure using the pooled sample, the households face different tax rules. This should provide a sharper identification of the preference parameters.

TABLE A.1 here

The estimates based on the pooled sample (which contains 5330 observations) are reported in Table A.1.[10] The results are overall satisfactory in terms of statistical significance and economic interpretation. Some of the parameters are allowed to change between countries. Differences in parameters among the countries can be due to a host of institutional or cultural factors that can be accounted for (by allowing some of the parameters to differ) but not explained within our modelling approach. When the parameters are allowed to differ, the first column of estimates reports the parameter value specific for Italy while the other columns report the difference of the country-specific parameter (respectively for Denmark, Portugal or United Kingdom) compared to the Italy-specific parameter. Otherwise, the first column reports the estimates of the parameters assumed as common among the countries.

The crucial preference parameters are:

β_{C0} and θ_{CC} (related to the marginal utility of income);

β_{F0} and θ_{FF} (related to the marginal utility of wife's leisure);

β_{M0} and θ_{MM} (related to the marginal utility of husband's leisure).

The other parameters β's and θ's measure the effects of various interactions of leisure times and income among themselves and with household characteristics.

The marginal utility of income and the marginal utility of wife's and husband's leisure appear to be positive and decreasing (at least at the observed choices).

The wife's and the husband's leisure appear to be complements, in the sense that more leisure of one of them has a positive effect on the marginal utility of leisure of the other one.

The parameters γ's reflect differences between the countries with respect to the availability of the various opportunities and with respect to specific utility gains or losses (besides those due to income and leisure) attached to them. There appear to be large differences between the countries in the estimated values of these parameters. This result is hardly surprising given the large differences among the countries with regards to the institutional environment and the labour market structure and regulations.

[10] The estimates and the simulations based on country-specific samples are available upon request from the authors. While the country-specific and the pooled estimates might differ based on a coefficient-by-coefficient comparison, the simulation results are very similar.

A.5. Simulation method

The estimated model is used to simulate the effects of alternative hypothetical tax-transfer reforms. Suppose we are interested in some alternative tax-transfer rule $\Re$. Let $P^n(f,m;\vartheta^{ML},\Re)$ be the probability that household n chooses (f,m) under the $\Re$ tax-transfer regime, computed on the basis of the estimated parameters ϑ^{ML}, i.e.

$$\text{(A.9)}\quad \frac{\exp\left\{V\left(\Re(w_F^n f, w_M^n m, y^n), f, m; Z^n, \theta^{ML}\right) + \sum_{k=1}^{5}\gamma_{Fk}^{ML} D_{Fk}\left(f\right) + \sum_{k=1}^{5}\gamma_{Mk}^{ML} D_{Mk}\left(m\right)\right\}}{\sum_{h_F\in\Omega}\sum_{h_M\in\Omega}\exp\left\{V\left(\Re(w_F^n h_F, w_M^n h_M, y^n), h_F, h_M; Z^n, \theta^{ML}\right) + \sum_{k=1}^{5}\gamma_{Fk}^{ML} D_{Fk}\left(h_F\right) + \sum_{k=1}^{5}\gamma_{Mk}^{ML} D_{Mk}\left(h_M\right)\right\}}.$$

Suppose we are interested in simulating the expected value of some function $\varphi^n(f,m)$: it might be the net available income under the new rule, hours worked, taxes paid etc. Then we compute the expected value of that variable after the policy is implemented as follows:

$$\text{(A.10)}\qquad E(\varphi^n(f,m)) = \sum_{f\in\Omega}\sum_{m\in\Omega}\varphi^n(f,m)P^n(f,m;\vartheta^{ML},\Re)\,.$$

A.6. Maximum expected utility

In section 3 of the main text we define the utility-based Social Welfare function, which require the computation of the expected maximum utility attained by household *n* under tax-transfer regime, $v^n(\Re)$. We use the following expression:[11]

(A.11) $$v^n(\Re) = \ln\left(\sum_{h_F \in \Omega} \sum_{h_M \in \Omega} \exp\left\{ V\left(R(w_F^n h_F, w_M^n h_M, y^n), h_F, h_M; \bar{Z}, \theta^{ML} \right) + \sum_{k=1}^{5} \gamma_{Fk}^{ML} D_{Fk} + \sum_{k=1}^{5} \gamma_{Fk}^{ML} D_{Mk} \right\} \right).$$ where

$\bar{Z}$ denotes the vector of sample average values of household characteristics. We use $\bar{Z}$ as reference value in order to ensure interpersonal comparison of utility among different households (Deaton and Muellbauer, 1980).

[11] For the derivation of this expression, see McFadden (1978) and Ben-Akiva et al. (1985). The same methodology for empirical welfare evaluation is used by Colombino (1998).

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Table 1. The Policies

GMI	With Flat Tax (FT)	$C=\begin{cases} G \text{ if } Y\le G \\ G+(1-t)(Y-G) \text{ if } Y>G \end{cases}$
	With Progressive Tax (PT)	$C=\begin{cases} G \text{ if } Y\le G \\ G+(Y-G)^{(1-\tau)} \text{ if } Y>G \end{cases}$
WF	With Flat Tax (FT)	$C=\begin{cases} G \text{ if } Y\le G \text{ and } \max(h_F,h_M)\ \ge\ 20 \\ Y \text{ if } Y\le G \text{ and } \max(h_F,h_M) < 20 \\ (1-t)Y \text{ if } Y>G \text{ and } \max(h_F,h_M) < 20 \\ G+(1-t)(Y-G) \text{ if } Y>G \text{ and } \max(h_F,h_M)\ \ge\ 20 \end{cases}$
	With Progressive Tax (PT)	$C=\begin{cases} G \text{ if } Y\le G \text{ and } \max(h_F,h_M)\ \ge\ 20 \\ Y \text{ if } Y\le G \text{ and } \max(h_F,h_M) < 20 \\ Y^{(1-\tau)} \text{ if } Y>G \text{ and } \max(h_F,h_M) < 20 \\ G+(Y-G)^{(1-\tau)} \text{ if } Y>G \text{ and } \max(h_F,h_M)\ \ge\ 20 \end{cases}$
PBI	With Flat Tax (FT)	$C=\begin{cases} G+(1-t)Y \text{ if } \max(h_F,h_M) > 0 \\ (1-t)Y \text{ if } \max(h_F,h_M) = 0 \end{cases}$
	With Progressive Tax (PT)	$C=\begin{cases} G+Y^{(1-\tau)} \text{ if } \max(h_F,h_M) > 0 \\ Y^{(1-\tau)} \text{ if } \max(h_F,h_M) = 0 \end{cases}$
UBI	With Flat Tax (FT)	$C=G+(1-t)Y$
	With Progressive Tax (PT)	$C=G+Y^{(1-\tau)}$

Table 2. Elasticities of labour supply with respect to the wage rate

		male wage rate						male wage rate			
TOTAL EXPECTED HOURS OF WORK		Denmark	Italy	Portugal	UK	PARTICIPATION RATE		Denmark	Italy	Portugal	UK
	male	0.20	0.09	1.11	0.15		male	0.12	0.29	0.33	0.28
	female	0.29	0.07	0.67	0.20		female	0.19	0.07	0.52	0.13
		female wage rate						female wage rate			
		Denmark	Italy	Portugal	UK			Denmark	Italy	Portugal	UK
	male	-0.36	-0.24	0.01	-0.29		male	-0.06	-0.15	0.02	-0.04
	female	1.55	1.65	1.78	1.99		female	0.82	1.44	1.24	0.95

Table 3. Behavioural and fiscal effects of basic income policies

	Transfers	***TMT***	***h_male***	***h_female***	***C***	***Gini***	***S(C)***
Denmark							
Current	1317	0.54	38.06	27.93	3371	0.33	2265
UBI+PT(*a*=1)[(a)]	1576	0.52	38.35	29.64	3399	0.28	2437
UBI+PT(*a*=1)[(b)]	1576	0.52	38.35	29.64	3399	0.28	2437
Italy							
Current	189	0.42	35.79	14.38	1815	0.24	1388
GMI+PT(*a*=1)[(a)]	339	0.80	32.32	11.93	1587	0.11	1414
WF+PT(*a*=0.75)[(b)]	63	0.36	36.19	14.04	1830	0.20	1460
Portugal							
Current	69	0.35	41.44	24.49	896	0.35	581
UBI+PT(*a*=.75)[(a)]	397	0.55	39.80	21.78	805	0.22	631
WF+PT(*a*=0.75)[(b)]	47	0.19	42.06	24.49	904	0.37	571
UK							
Current	192	0.40	44.92	23.49	2523	0.21	1991
UBI+PT(*a*=.75)[(a)]	1263	0.60	43.27	21.39	2413	0.14	2078
UBI+PT(*a*=.25)[(b)]	421	0.26	45.89	23.75	2569	0.22	2017

(a): policy with highest S(U)

(b): policy with highest S(U) accounting for the additional constraints

Legenda:

Transfers = average annual transfers received *per* household (1998 Euros)

TMT = top marginal tax rate

h_male = average weekly male hours of work (including non participants)

h_female = average weekly female hours of work (including non participants)

C = monthly net available income *per* household (1998 Euros)

Gini = Gini coefficient of C

S(C) = Sen's social welfare = C*(1- Gini)

Table 4. Summary evaluation of alternative basic income policies.

		Denmark				Italy				Portugal				United Kingdom			
		S(U)	S(C)	W(U)	W(C)	S(U)	S(C)	W(U)	W(C)	S(U)	S(C)	W(U)	W(C)	S(U)	S(C)	W(U)	W(C)
GMI + FT	a=1.00					A°*	C°*	C°*		C*	C*						
	a=0.75					C*		C*								C*	C*
	a=0.50							A*	C*								C
	a=0.25							C	C								C
WF + FT	a=1.00					C*	C*	C*	C*	C*	C*			C*	C*		
	a=0.75						C	C	C						C	C	C
	a=0.50						C	C	C								C
	a=0.25								C								C
PBI + FT	a=1.00	C	A	C	B	C°*	B°*	C°*	C°*		A°*			C°*	C°*	C°*	
	a=0.75			C	C	C°*	C°*	C°*	C°*	B*	C*			B°*	B°*	C°*	
	a=0.50			C	C	C*	C*	C*	C*	C*	C*			C*	C*	C*	C*
	a=0.25						C	C	B	C					C	C	C
UBI + FT	a=1.00	C	B	B	A	A°*		C°*	C°*	C°*	C°*			C°	C°	C°	
	a=0.75	C		C	C	B°*		C°*	C°*	C*	C*			B°*	C°*	C°*	
	a=0.50			C	C			C*	C*	C*	C*			C*	C*	C*	C*
	a=0.25							C*	C*						C*	C*	C*
GMI + PT	a=1.00					A°*	C°*	C°*		C*	C*			C*	C*	C*	
	a=0.75					C*	C*	C*								C*	C*
	a=0.50					C*		B*	C*								C
	a=0.25							C	C								C
WF + PT	a=1.00					C*	C*	C*	C*	C	C			C*	C*		
	a=0.75					C	C	C	C						C	C	C
	a=0.50						C	C	C								C
	a=0.25								C								C
PBI + PT	a=1.00	B	C	A	C	C°*	A°*	C°*	C°*	C°*	B°*	C°*	C°*	C°*	C°*	C°*	
	a=0.75	C		C	C	C°*	C°*	C°*	C°*	B*	C*	A*	C*	A°*	A°*	C°*	C°*
	a=0.50			C		C*	C*	C*	C*	C*	C*	C*	C*	C*	C*	C*	C*
	a=0.25						C	C	A			B*	C*		C	B	A
UBI + PT	a=1.00	A	C	A	C	A°*		C°*		C°*	C°*	C°*	C°*	C°*	C°*	C°*	
	a=0.75	C		C	C	B°*	C°*	C°*		A°*	C°*	C°*	C°*	A°*	C°*	C°*	
	a=0.50						C*	C*	C*	C*	C*	C*	C*	C*	C*	C*	C*
	a=0.25						C*	C*	C*			C*	C*	C	C	A	B

Table A.1. Parameter estimates

	Italy (or common)	Denmark - Italy	Portugal - Italy	UK – Italy
β_{F0}	0.272***	0.024	-0.048***	-0.040***
β_{F1}	0.916e-03***			
β_{F2}	0.410e-02***			
β_{F3}	0.013***			
β_{F4}	0.685e-02***			
β_{M0}	0.072***	0.039***	0.027***	-0-046***
β_{M1}	-0.553e-04			
β_{M2}	-0.461e-02**			
β_{M3}	0.839e-03			
β_{M4}	0.223e-02			
β_{C0}	0.536e-03***	0.205e-03**	0.289e-02***	0.141e-03
β_{C1}	0.369e-04			
β_{C2}	0.425e-04			
β_{C3}	0.107e-03**			
θ_{CC}	-2.700e-08***			
θ_{FF}	-0.211e-02***			
θ_{MM}	-0.7912-03***			
θ_{CF}	-0.319e-07***			

Table A.1. Parameter estimates (cont'd)

	Italy (or common)	Denmark - Italy	Portugal - Italy	UK – Italy
θ_{CM}	0.811e-07***			
θ_{FM}	0.798e-03***			
γ_{F1}	1.620***	-1.257***	-2.467***	-2.291***
γ_{F2}	3.238***	-0.254	-1.851***	-3.223***
γ_{F3}	1.658***	0.706	-2.251***	-2.180***
γ_{F4}	-4.203***	4.865***	1.090***	2.658***
γ_{F5}	-1.803***	2.822***	0.102	-0.519**
γ_{M1}	1.638***	-0.996*	-1.027**	-1.626***
γ_{M2}	4.757***	-0.317	-0.108	-2.781***
γ_{M3}	3.582***	0.398	-0.336	-2.426***
γ_{M4}	-2.558***	10.111***	1.229**	1.343***
γ_{M5}	-0.139	6.816***	-1.341***	-0.971**

Note to Table A.1:

*** = significance < 1%

** = significance < 5%

* = significance < 10%

For the meaning of the coefficient symbols see eq. A.4, A.5, and A.7.