
WORKING PAPERS

The case for NIT+FT in Europe. An empirical optimal taxation exercise

Nizamul **ISLAM**¹
Ugo **COLOMBINO**²

¹ LISER, Luxembourg

² University of Torino, Italy

LISER Working Papers are intended to make research findings available and stimulate comments and discussion. They have been approved for circulation but are to be considered preliminary. They have not been edited and have not been subject to any peer review.

The views expressed in this paper are those of the author(s) and do not necessarily reflect views of LISER. Errors and omissions are the sole responsibility of the author(s).

The case for NIT+FT in Europe. An empirical optimal taxation exercise¹

Nizamul Islam^a

Ugo Colombino^b

^a LISER

^b University of Torino, CHILD, LISER and IZA

Abstract

We present an exercise in empirical optimal taxation for a sample of European countries from three areas: Southern, Central and Northern Europe. For each country, we estimate a microeconomic model of labour supply for both couples and singles. A procedure that simulates the households' choices under given tax-transfer rules is then embedded in a constrained optimization program in order to identify optimal rules under the public budget constraint. The optimality criterion is the class of Kolm's social welfare function. The tax-transfer rules considered as candidates are members of a class that includes as special cases various versions of the Negative Income Tax: Conditional (means-tested) Basic Income, Unconditional Basic Income, In-Work Benefits and General Negative Income Tax, combined with a Flat Tax above the exemption level. The analysis in most cases show that: the General Negative Income Tax strictly dominates the other rules, including the current ones; the Unconditional Basic Income policy is better than the Conditional Basic Income policy; Conditional Basic Income policy may lead to a significant reduction in labour supply and poverty-trap effects; In-Work-Benefit policy is strictly dominated by the General Negative Income Tax and by the Unconditional Basic Income.

JEL: H21, C18

Keywords: Basic Income, Negative Income Tax, Optimal tax, Micro-simulation, Welfare

Contacts: nizamul.islam@liser.lu, ugo.colombino@unito.it

¹ This is part of a research project (Optimal Tax Rules in Europe: A Micro-simulation Approach - OTaRiE) at LISER that involves Philippe Van Kerm (LISER and University of Luxembourg, Luxembourg), Nizamul Islam (LISER, Luxembourg), Denisa Maria Sologon (LISER, Luxembourg), Ugo Colombino (University of Turin, Italy), Lennart Flood (Gothenburg University, Sweden), Francesco Figari (University of Insubria, Italy). We wish to thank Flavia Coda Moscarola, Francesco Figari and Marilena Locatelli, who provided us the estimation programs, originally written for Coda Moscarola et al. (2014), which have been useful as a basis for developing our programs for the estimation of the microeconomic model. The preparation of the datasets we used EUROMOD version [G3.0+]. EUROMOD is maintained, developed and managed by the Institute for Social and Economic Research (ISER) at the University of Essex, in collaboration with national teams from the EU member states. We are indebted to the many people who have contributed to the development of EUROMOD. The process of extending and updating EUROMOD is financially supported by the European Union Programme for Employment and Social Innovation 'Easi' (2014-2020). We make use of microdata from the EU Statistics on Incomes and Living Conditions (EU-SILC) made available by Eurostat (59/2013-EU-SILC-LFS). The results and their interpretation are the authors' responsibility.

1. Introduction

Since the end of the 2nd World War, means-tested transfers have been the main form of income support mechanism in most Western countries. Abstracting from many details and variations in eligibility criteria, level of generosity and population coverage, those policies adopted mechanisms that in this paper – in a stylized representation – we call Conditional Basic Income (CBI), where incomes below a certain threshold G are subsidized up to the threshold.² In other terms, own gross incomes below G are taxes according to a marginal tax rate (MTR) $t_1 = 1$ (Figure 1). This introduces a disincentive to work, especially so for people with a low wage rate. The phenomena of poverty trap, or welfare trap, or welfare dependence, have been observed – and to an increasing degree – in many countries. Welfare policies based on CBI-type mechanisms have also been criticized for other possible problems: high bureaucratic costs, “welfare stigma” effects and take-up costs leading to low take-up rates, incentives to under-reporting of income, errors in applying eligibility criteria and litigation costs (e.g. Friedman 1962, Friedman and Friedman 1980, Atkinson 2015). Also as a response to these problems, the so-called Negative Income Tax (NIT) was proposed by Friedman (1962) and supported by many authors (e.g. Tobin et al. 1967).³ The typical version of NIT is illustrated in Figure 2. The crucial difference with respect to CBI appears to be the fact that with NIT we have $t_1 < 1$ instead of $t_1 = 1$, which should moderate the welfare trap effect. As a matter of fact, the NIT proposal included the ideas of universality, simplicity and administrative cost-effectiveness as important criteria for re-designing the welfare policies, in contrast to the prevalent categorical design and the bureaucratic costs and complexities of the CBI policies. However, since the second half of the 70s, in many countries, various reforms of the income-support policies have taken a different path: work-fare programs, less generous transfers, policies targeted towards smaller segments of the population, a more sophisticated design of eligibility conditions and of the timing of transfers, in-work benefits or tax credits in order to strengthen the incentives to work (e.g. Blank et al. 1999 and Moffit 2003). Under certain aspects (namely, the search for better incentives to work) some of these policies have a resemblance to NIT, but in general they tend to move more in the direction of a categorical design and complicated eligibility criteria rather than toward universality and simplicity. On the one hand, the reforms have been successful with regards to work participation

² The qualification “Conditional” in this paper is used as equivalent to “means tested”. In the literature on income support, the term conditional is also commonly used in relation to policies where monetary transfers are conditional upon the fulfillment of certain behavioural requirements, e.g. working a minimum of hours, sending children to school etc.

³ Moffit (2003) provides an excellent analysis of the NIT proposal and of three .

incentives. On the other hand, they might have increased the administration and transaction costs of the mechanisms and – to a certain extent - also the direct cost when it comes to in-work-benefits or tax credits. Moreover, more complex conditioning and eligibility criteria might paradoxically induce more effort in overcoming the hurdles that limit the access to the policy, rather than in looking for a job or a better one, thus encouraging a waste of potentially productive resources. During the last two decades, three processes have contributed to put the current welfare policies under stress and possibly to worsen their intrinsic drawbacks. Globalization and technological progress (automation), while creating big aggregate benefits, also imply massive adjustments in re-allocation of physical and human resources. Job losses and skill destruction and an increased demand for income support interventions – at least in the short-medium term – are natural consequences. The “Big Crisis” of the last decade obviously worsened the scenario. More recently, in many countries, a new interest emerged for a reform direction somehow opposed to the one taken since the end of 70s: less conditioning, simpler designs and ultimately some form of Unconditional Basic Income (UBI), i.e. a policy based on non-means tested transfers (e.g. van Parijs 1995, Standing 2008, Atkinson 2015, Colombino 2015*b*, Sommer 2016). In a similar perspective, proposals have been put forward for a universal share of GDP (e.g. Raj 2016) or of the revenue from “common resources” (as it is actually implemented by the Alaska Permanent Fund). Experiments have been done, among others, in India (Standing 2015), Kenia (Haushofer & Shapiro 2016) and Uganda (Blattman et. 2014) with promising results. Experiments are currently being discussed in the Netherlands (BIEN 2017), planned in Ontario (Segal 2016) and in the US by the hi-tech incubator Y Combinator (Y Combinator 2017) and actually run in Finland (KELA 2016).

It must be noted at this point that both CBI and UBI can be interpreted as members of the more general class NIT. By comparing Figures 1, 2 and 3, we see that – abstracting from the issues of universal vs categorical policies and from other details of eligibility and administration – the difference boils down to the value of t_1 and t_2 : namely, $t_1 = 1$ with CBI, $t_1 = t_2 < 1$ with UBI. We have a whole class of NIT income support mechanisms, where each member of the class is characterized by the value of the two MTRs t_1 and t_2 , with the two extreme cases represented by CBI and UBI.

Figures 1, 2 and 3 assume constant MTRs, but an analogous classification of NIT-like policies can be done also by assuming non-constant MTRs. However, constant MTRs are not only a simplifying assumption for the ease of illustration but also a substantive component of policy reform proposals. The so-called Flat-Tax (FT) is – as NIT – an idea pointing towards simplification and is often associated with

NIT-like mechanisms (e.g. Hall and Rabushka 1995, Atkinson 1996). Despite the FT, the overall tax-transfer system can still be progressive in the sense that the average tax rate declines with respect to income provided a NIT is applied to low incomes or at least an exemption level is introduced). On the one hand, according to the supporters, the “package” NIT+FT, besides being simple and transparent, might provide a good equilibrium between progressivity, labour incentives and administration costs. At least the first simulations based on empirical calibrations of Mirrlees’ (1971) model suggested as optimal a rule very close to a NIT+FT. On the other hand, the opponents have various concerns upon possibly bad incentives for participation. A further motivation for focusing on the performance of a simple and stylized mechanism such as NIT+FT is that the current systems implemented in most European countries, despite the very complicated and non-linear formal appearance, in practice – for a majority of the taxpayers – turn out to be closer to a FT than the formal rules would suggest. Tax credits, deductions from taxable income and intra-household labour supply decisions tend to moderate the formal non-linearity of the tax-transfer system. As a consequence, reforms belonging to the NIT+FT class might be interpreted more as rationalizing re-designs of the current systems rather than radical replacements.

In what follows, we adopt an empirical optimal taxation perspective in order to “scan” the NIT+FT class (and its special cases) and identify optimal (i.e. social welfare maximizing) policies and compare them to the current tax-transfer systems in a sample of six European countries.

The key research questions are:

- (i) is it feasible to improve upon the current tax-transfer systems by implementing an optimal NIT+FT-like mechanism?
- (ii) How do the different optimal members of the NIT-FT class rank according to a social welfare criterion?
- (iii) What are the behavioural, fiscal and distributional implications (fiscal parameters, labour supply, poverty, winners and losers) of the optimal NIT+FT mechanisms?

Our approach to identifying the optimal policies relies on a consistent integration of microeconomic modelling, microsimulation and numerical optimization. UBI and other member of the NIT class have been analysed with theoretical models (e.g. Besley 1990, Saez 2002, FittzRoy and Jin 2015), with microsimulation models (e.g. Scutella 2004, Horstschräer et al. 2010, Clavet et al. 2013, Jensen et al.

2014, Colombino 2015b, and Sommer 2016) and with dynamic general equilibrium models (e.g. Van der Linden 2004, Fabre et al. 2014) with different results. Each one of these research lines has merits and limitations. The theoretical contributions produce neat results based on stylized models and imputed/calibrated parameters. The microsimulation exercises typically evaluate a specific reform compared to the current system. The general equilibrium models are based on a representative-agent approach. With respect to these different research strands, the specific contribution of our analysis is the numerical identification of optimal policies, based on real micro-data and on a flexible microeconomic representations of heterogeneous households' preferences, constraints and choices.

Figure 1. Conditional Basic Income (CBI)

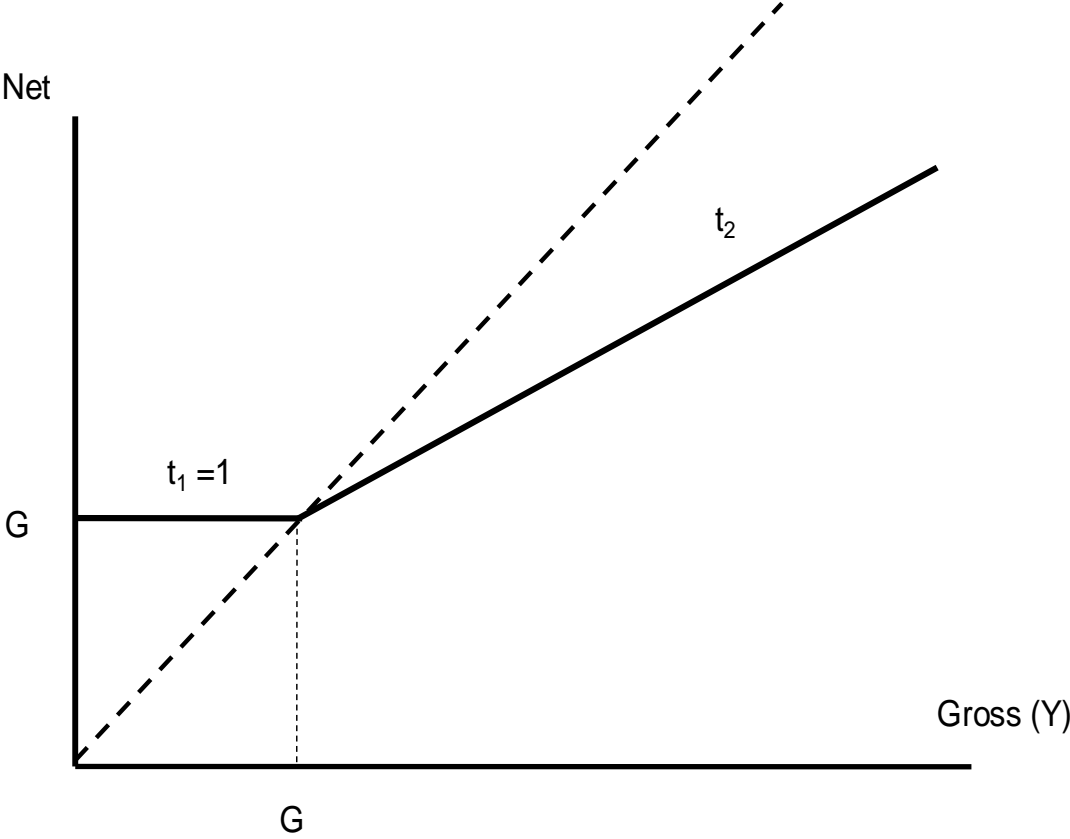


Figure 2. Negative Income Tax (NIT)

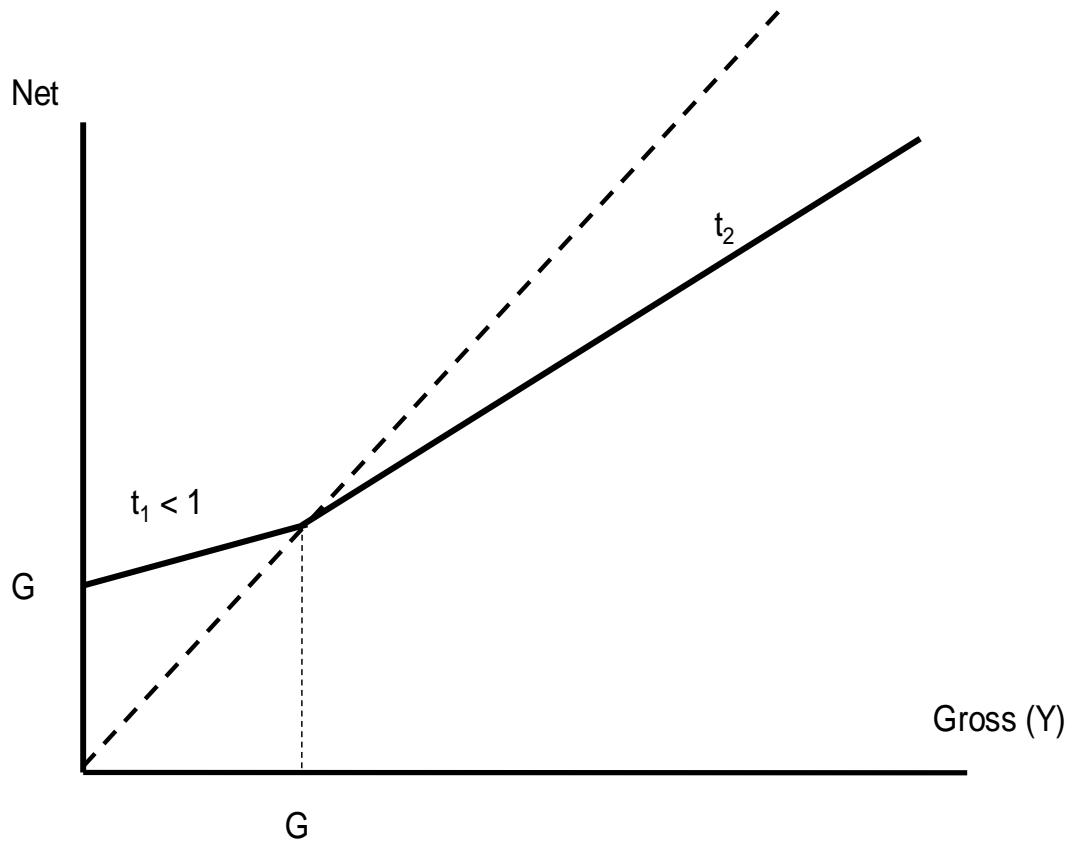
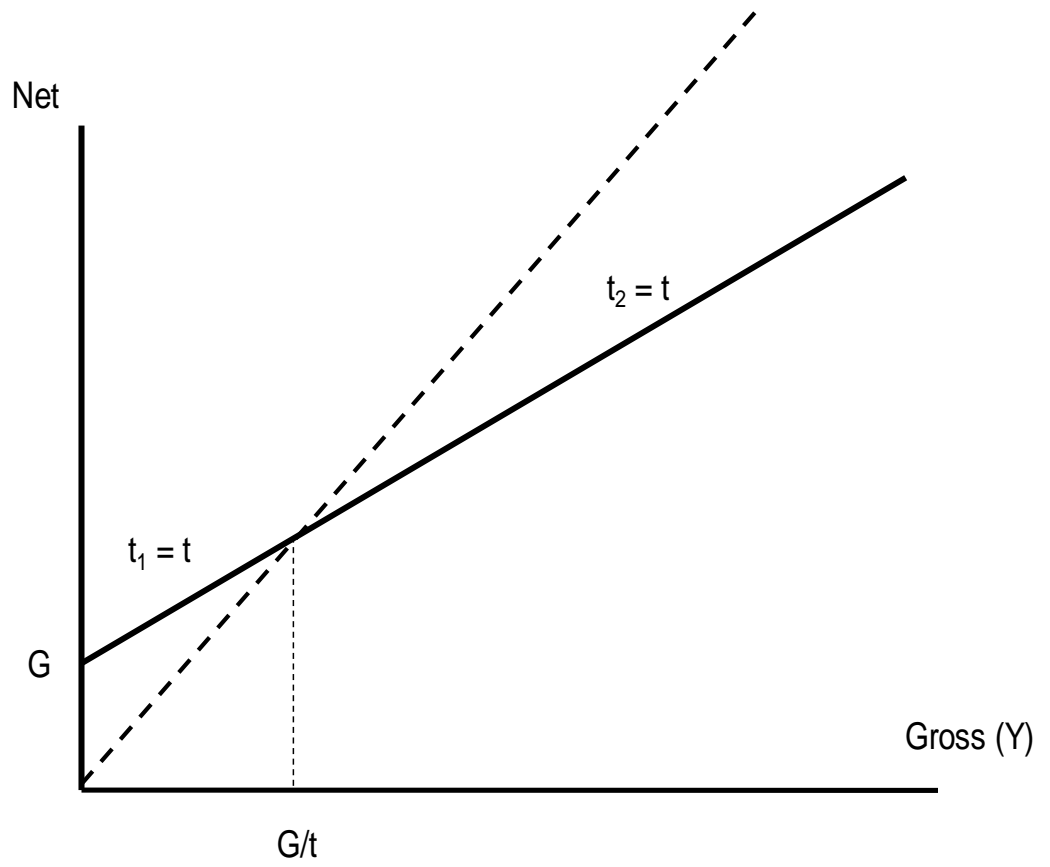


Figure 3. Unconditional Basic Income (UBI)



2. The alternative policies

All the income-support mechanisms that we consider below are matched with a FT. For the benefit of an easy interpretation of the reforms and of the simulation results, we consider stylized tax-transfer rules. On the one hand, they can be seen as simplified representation of the rules that are, or might be, actually implemented. On the other hand, they might be viewed as reforms in the direction of simplification. A Conditional Basic Income (CBI) mechanism works as follows (Figure 1). There is a threshold G , the guaranteed minimum income. If your own (gross) income Y falls below G , you receive a transfer equal to $G - Y$. If your own income is larger than G you do not receive any transfer and pay taxes on $Y - G$. Therefore, your net available income will be G if Y is smaller than G , or else; $G + (1 - t)(Y - G)$ if Y is larger than G . According to an alternative interpretation (or implementation), everyone receive a transfer G . For $Y < G$, Y is taxed away according to a MTR $t_1 = 1$ up to $Y = G$. For $Y > G$, $Y - G$ is taxed according to a MTR t_2 .

This mechanism suffers from the “welfare trap” or “welfare dependence” problem: there is no incentive to work for an income lower than G . But even a job paying more than G might not be convenient when accounting for hours to be spent on the job rather than devoted to leisure.⁴

The Unconditional Basic Income (UBI) mechanism is illustrated in Figure 3. It consists of an unconditional transfer G to everyone. The amount G would typically be lower than with CBI (for the same public budget constraint). Net available income would be $G + (1 - t)Y$, where again we assume a FT rate t . As noted with CBI, also UBI can be interpreted or implemented in a different way. Above an “exemption level” G/t , the amount $(Y - G/t)$ is taxed according to a MTR t . Below the exemption level, there is a transfer equal to $(G - tY)$. The two alternatives obviously imply the same budget constraint in a static scenario. However, they might imply some differences in an intertemporal scenario. For example, with uncertainty and imperfect credit markets, it might make a difference to receive G upfront (say at the beginning of the year) or to receive a means tested transfer (say at the end – or in the course – of the year).

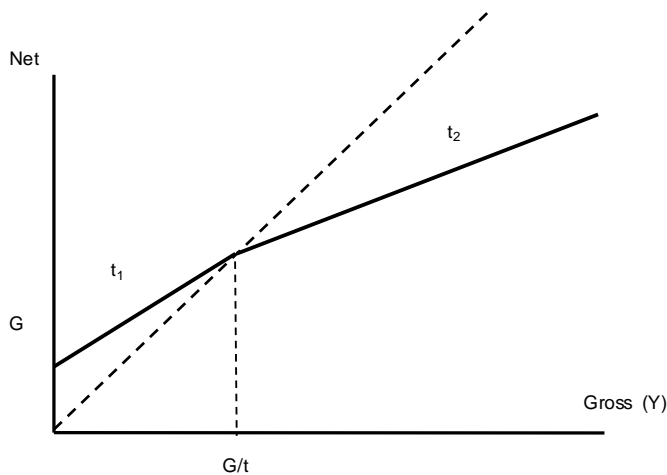
Many positive aspects of UBI are commonly acknowledged: (i) there is no welfare trap, since even starting from $Y = 0$ for every euro of earnings you get $(1 - t)$ euros; (ii) there is no incentive to under-

⁴ Empirically, one might observe people located on the horizontal segment of the budget line since non-pecuniary or intertemporal benefits from working might make that location attractive.

report income or employment status, since you receive G whatever your income or your employment status is; (iii) there is no “stigma” or marginalization effect, since everyone receives the transfer; (iv) administration costs (De Walle 1999) and take-up costs (e.g. Atkinson 2015, Paulus 2016) are relatively low. On a more general level of motivation, due to concerns upon the implications of technological progress (e.g. Acemoglu and Restrepo 2016), according to some analysts UBI might represent a viable alternative to the prevailing current policies in order to help reallocating jobs and resources in the globalized and progressively automated economy, where employers need flexibility to compete on a global scale and employees need support to redesign their careers and occupational choices (e.g. Standing 2008, Hughes 2014, Colombino 2015a, Raj 2016). Experimental evidence suggests that UBI might reduce risk-aversion and therefore promote entrepreneurial activities and investment in human capital (Blatman 2014). Although a lump-sum transfer equal for everyone might appear as “unfair” or “wasteful”, this negative perception is not justified: even with a flat tax rate t , the average (net) tax rate increases with income, due to the transfer G (a negative tax); from a different perspective, since everyone pays taxes $(1-t)Y$, the lump-sum transfer G is progressively “given back” up to the break-even point G/t . UBI has its own difficulties. It is going to be more expensive than CBI; if, and how much, more expensive depends on the respective amounts of the transfers G ; it also depends on how much UBI allows to save on administration and take-up costs. Although welfare trap effects are absent, there are however both income effect and substitution effects (due to the transfer G and to the – possibly higher than CBI’s – tax rate above the exemption level) with possible negative effects on labour supply.

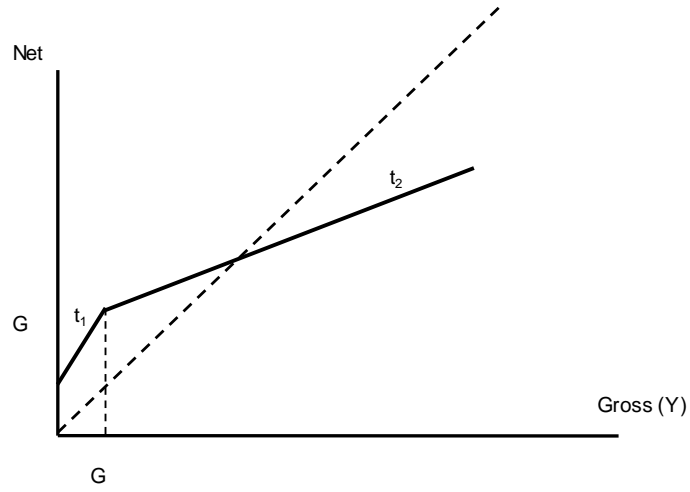
Besides CBI and UBI, we have a whole class of NIT-like mechanisms (with FT) defined by (G, t_1, t_2) as in Figure 2. Any member of this class – as we have seen with CBI and UBI – can be given two alternative interpretations/implementations. The first one works as follows. You receive an unconditional transfer G . Then your own income $Y < G/t_1$ is taxed according to a MTR t_1 , up to $Y = G/t_1$. The additional income (if any) $Y - G/t_1$ is taxed according to a MTR t_2 . In a second interpretation, G/t_1 is defined as the exemption level and if your income falls below the exemption level, you receive a transfer equal to $G - t_1 Y$. If $t_1 = t_2$, we get the UBI rule. If $t_2 < t_1 = 1$, we get a CBI rule. Intermediate cases generate a variety of incentives configurations. The original NIT proposal made by Friedman (1962) was formulated according to the second interpretation, with t_1 typically larger than t_2 , (convex profile of the tax-transfer rule as in Figure 2). However, we might also have $t_1 < t_2$ (concave profile as in Figure 4).

Figure 4 Concave NIT



The NIT class can also include simple versions of In-Work Benefits (IWB) or tax credits. Fig. 5 represents an example of IWB, where for a range of low gross incomes the marginal tax rate is negative, e.g. the net wage rate is larger than the gross wage rate. This mechanism – in the form of either a wage subsidy or of a tax credit – has become popular in the last decades especially in view of improving incentives to work (e.g. Moffit 2003, Blank et al. 1999). The simulation exercise presented in this paper considers a simple version. There is a universal transfer G . As long as gross income Y does not exceed G , disposable income is $G + (1 - t_1)Y$, with $t_1 < 0$, i.e. incomes up to G receive a subsidy computed according to negative $MTR = -t_1$. If $Y > G$, the part of gross income exceeding G is taxed according to a $MTR t_2$.

Figure 5. A simple version of IWB



3. Empirical optimal taxation: combining microeconomic modelling, microsimulation and numerical optimization

Optimal Taxation concerns the question of how tax-transfers rules should be design in order to maximise a social welfare function subject to the public revenue constraint and taking into account that households choose labour supply (or more generally “effort”) in order maximize their utility function subject to the budget constraint defined by the tax-transfer rule. We depart from the Theoretical Optimal Taxation (TOT) approach that consists of computing optimal policies using theoretical formulas with imputed or calibrated parameters, as many authors have done, e.g. using the theoretical results of Mirrlees (1971) or the more recent ones such as Diamond (1998) and Saez (2001, 2002). TOT is a fundamental contribution since it sets the basic problem to be solved. The empirical applications of TOT are also useful in indicating promising directions of solution. However, in our view, the empirical applications of TOT can be usefully complemented by adopting an approach that combines microeconomic modelling, microsimulation and numerical optimization in a consistent way. The background of our analysis is represented by a series of papers where a microeconomic-numerical approach to optimal taxation is adopted. Aaberge and Colombino (2006, 2013) identify optimal taxes for Norway within the class of 9-parameter piece-wise linear tax-transfer rules. Aaberge and Colombino (2012) perform a similar exercise for Italy. Aaberge and Flood (2008) study the design of tax-credit policies in Sweden. Blundell and Shepard (2012) focus on the optimal tax-transfer systems for lone mother in the UK. Closely related contributions are Fortin et al. (1993) and Sefton and de Ven (2009). The first one uses a calibrated labour supply model to evaluate a large set of policies including NIT and work-fare policies. The second one employs a stochastic dynamic model to identify the optimal pension benefits scheme. Our methodology can be summarized as follows. First, we estimate a microeconomic model of household labour supply for six countries from different European areas (Section 4). Second, given a certain class of new tax-transfer rules, we simulate the new household choices based on the estimated household preferences and compute the attained value of a Social Welfare function (Section 5). We then apply a maximization algorithm that iterates step two in order to identify the optimal rule belonging to that class (Section 6). This procedure is more flexible than the empirical applications of the TOT provided for example by Mirrlees (1971) or Saez (2001, 2002). First, Mirrlees (1971) and Saez (2001) only cover interior solutions on the part of the agents and therefore only intensive labour supply responses are considered, while the empirical labour supply literature reveals the importance – when not the predominance – of the extensive responses. Saez (2002) presents a (discrete choice) model that includes extensive responses but introduce very special restrictive assumptions on intensive responses. Second, the empirical implementations of

TOT treat individuals, not couples. Therefore, all the implications of household simultaneous decisions are ignored. Third, in order to compute optimal taxes, even the modern reformulation of TOT approach must still assume a specific labour supply model, i.e. some structural specification that produces labour supply decisions given the individuals' preferences and budget constraints (Brewer et al. 2007).⁵ However, most empirical applications of TOT known so far assume a common quasi-linear utility function with a fixed labour supply elasticity (and of course no income effects).⁶ In principle at least some of the above limitations might be overcome in future empirical applications. However, with the approach adopted in this paper, we analyse both single and couples, account for both extensive and intensive responses and specify a flexible utility maximization framework with heterogeneous preferences and constraints. Under a different perspective, TOT is maybe too general in investigating the optimal tax-transfer rules. No a-priori parametric class of rules is chosen. In practice, however, the results boil down to a rule that is very close to a NIT (or a IWB) with a FT or with a more or less pronounced progressive tax. Giving up some of the (possibly unnecessary) generality on the side of the tax-transfer rule, permits more generality and flexibility on the side of the representation of agents, preferences, constraints and behaviour. Interestingly, the modern dynamic general equilibrium literature (e.g. Heathcote and Tsujijama 2015) appears to prefer the "Ramsey approach" (parametric tax rule) rather than the "Mirlees approach" (non-parametric tax rule).

In order to identify optimal policies, we consider four types that belong to the NIT class: Conditional basic Income (CBI), Unconditional basic Income (UBI), In Work Benefit (IWB), and General Negative Income Tax (GNIT). With GNIT we mean a NIT scheme where t_1 and t_2 are unconstrained, differently from CBI, UBI and IWB that belong to the NIT class but are defined by some constraints on t_1 and t_2 . The members of each type are defined by a policy-specific vector of parameters π :

$$\pi_{\text{CBI}} = (G, t_1, t_2), \text{ with } t_1 = 1,$$

$$\pi_{\text{UBI}} = (G, t_1, t_2), \text{ with } t_1 = t_2,$$

$$\pi_{\text{IWB}} = (G, t_1, t_2) \text{ with } t_1 < 0,$$

$$\pi_{\text{GNIT}} = (G, t_1, t_2) \text{ with no constraints on } (t_1, t_2),$$

where G is adjusted according to the household size (square root rule).

⁵ The so-called "Sufficient Statistics" (e.g. Chetty 2009) approach in general can provide only local approximations. Of course there might be particular assumptions or circumstances under which also a global solution can be attained.

⁶ An exception is Tuomala (2010).

The policies replace the whole tax-transfer system and are applied to the whole household gross income. The public budget constraint requires that the “net revenue” is the same as under the current regime. Let $P(\text{current})$ be the current public revenue from personal income taxes and personal social security contributions. Let T be the current transfers to households. Given a reform $\pi(G, t_1, t_2)$ and the corresponding public revenue $P(G, t_1, t_2)$, the formal definition of the public budget constraint is:

$$P(G, t_1, t_2) = P(\text{current}).$$

The above definition of the public budget constraint implies that the estimated optimal t_1 and t_2 include the rate of personal social security contributions.

In Section 5.1 we define a monetary measure of the (expected) maximum utility attained by household i given tax-transfer rule π , $\mu_i(\pi)$, and the Social Welfare function $W(\mu_1(\pi), \dots, \mu_N(\pi))$. The optimal tax-transfer rule π^* for a given type (UBI, CBI etc.) is then defined as:

$$\pi^* = \arg \max_{\pi} W(\mu_1(\pi), \dots, \mu_N(\pi)) \text{ s.t. } P(\pi) = P(\text{current}) \quad (1)$$

The maximization of W is performed with an iterative procedure explained in Section 6.

Since GNIT is by definition more general than the other NIT special cases, GNIT must be at least as good as the special cases. However, there are two motivations for taking care of the identification of the optimal special cases CBI, UBI and IWB. First, the optimal GNIT might indeed collapse to one of the special cases. It can happen that the best policy that we can find within the general NIT class is identical to (or not significantly different from) CBI or UBI or IWB). It is interesting to investigate whether the optimal GNIT coincides or not with one of the mechanisms that in practice have been implemented or considered in the policy debate. Second, the special cases CBI, UBI and IWB, although necessarily not superior to GNIT according to the Social Welfare criterion, might be more attractive than GNIT according to other dimensions such as the effects on labour supply or on the poverty rate. From the perspective of a policy debate, those non-welfarist dimensions (that we are able to document with our simulations) may contribute to better informed decisions. As an example, suppose GNIT and UBI turn out to be very close according to the Social Welfare metric, and at same time UBI implies a much larger reduction of the poverty rate: this would be a useful complementary information to the extent that the poverty rate is a matter of concern from the policy-maker’s point-of-view. An alternative would consist of inserting the non-welfarist dimensions into the social welfare index, e.g. as it is done with the poverty-rate augmented social welfare indexes. However, there are many non-welfarist dimension that can be

relevant from a policy perspective (poverty, labour supply, polarization etc.). In this paper we opted for, on the one hand, evaluating the reforms with a pure welfarist social welfare functions and, on the other hand, documenting the reforms' effects along various non-welfarist dimensions, which can be given different weights depending on the policy perspective.

4. The empirical model of household labour supply

We model the households as agents who can choose within an opportunity set Ω containing jobs or activities characterized by hours of work h , sector of market job s (wage employment or self-employment) and other characteristics (observed by the household but not by us). We define h as a vector with one element for the singles and two elements for the couples, $h = (h_F, h_M)$, where the subscripts F and M refer to the female and the male partner respectively. Analogously, in the case of couples, s is read as (s_F, s_M) . The above notation assumes that each household member can work only in one sector. Following Coda-Moscarola et al. (2014) we write the utility function of the i -th household at a (h, s) job as

$$U_i(h, s, \varepsilon; \boldsymbol{\pi}) = \mathbf{Y}_i(h, s; \boldsymbol{\pi})' \boldsymbol{\gamma} + \mathbf{L}_i(h)' \boldsymbol{\lambda} + \varepsilon \quad (2)$$

where:

$\boldsymbol{\gamma}$ and $\boldsymbol{\lambda}$ are parameters to be estimated;

$\mathbf{Y}_i(h, s; \boldsymbol{\pi})$ is a vector including

- household disposable income on a (h, s) job given the tax-benefit parameters $\boldsymbol{\pi}$,
- the square of the household disposable income defined above
- and the product of disposable income and household size (interaction term);

$\mathbf{L}_i(h)$ is a row vector including

- the leisure time (defined as the total number of available weekly hours (80) minus the hours of work h) separately of the two partners (for a couple) or of the individual (for a single)
- the square of leisure time(s)
- and the interaction(s) of leisure time(s) with household disposable income, age of the couple' partners or of the single, age square and three dummy variables indicating presence of children of different age range (any age, 0-6, 7-10);

ε is a random variable that accounts for the effect of unobserved (by the analyst) job characteristics.

The opportunity set each individual can choose among is $\Omega = \{(0,0), (h_1, s), (h_2, s), (h_3, s)\}$, where (0,0) denotes a non-market “job” or activity (non-participation), h_1, h_2, h_3 are values drawn from the observed distribution of hours in each hours interval 1-26 (part time), 27-52 (full time), 52-80 (extra time) and sector indicator s is equal to 1 (wage employment) or 2 (self-employment). A (h,s) job is “available” to household i with p.d.f. $f_i(h, s)$, which we call “opportunity density”.

We estimate the labour supply models of couples and singles separately. In the case of singles, we have 7 alternatives, while in the case of couples, who make joint labour-supply decision, we combine the choice alternatives of two partners, thus getting 49 alternatives.

When computing the earnings of any particular job (h, s) we face the problem that the wage rates of sector s are observed only for those who work in sector s . Moreover, for individuals who are not working we do not observe any wage rate. To deal with this issue, we follow a two-stage procedure presented in Dagsvik and Strøm (2006) and also adopted in Coda-Moscarola et al. (2014). The procedure is analogous to the well-known Heckman correction for selectivity but is specifically appropriate for distribution assumed for ε .

By assuming the ε is i.i.d. Type I extreme value and choosing a convenient specification of the opportunity density it turns out that the opportunity density $f_i(h, s)$ can be represented by a set of dummy variables D (to be define below in expression (5) we obtain the following expression for the probability that household i holds a (h,s) job (e.g. Aaberge and Colombino 2013)

$$P_i(h, s) = \frac{\exp\{\mathbf{Y}_i(h, s; \boldsymbol{\pi})' \boldsymbol{\gamma} + \mathbf{L}_i(h)' \boldsymbol{\lambda} + \ln f_i(h, s)\}}{\sum_{s=1}^2 \sum_{h \in \Omega} \exp\{\mathbf{Y}_i(h, s; \boldsymbol{\pi})' \boldsymbol{\gamma} + \mathbf{L}_i(h)' \boldsymbol{\lambda} + \ln f_i(h, s)\}} \quad (3)$$

By choosing a convenient (uniform with peaks”) specification for the opportunity density $f(\dots)$, it can be shown that expression (3) can be rewritten as follows (e.g. Aaberge and Colombino 2013, Colombino 2013):

$$P_i(h, s) = \frac{\exp\{\mathbf{Y}_i(h, s; \boldsymbol{\pi})' \boldsymbol{\gamma} + \mathbf{L}_i(h)' \boldsymbol{\lambda} + \mathbf{D}_i(h, s)' \boldsymbol{\delta}\}}{\sum_{s=1}^2 \sum_{h \in \Omega} \exp\{\mathbf{Y}_i(h, s; \boldsymbol{\pi})' \boldsymbol{\gamma} + \mathbf{L}_i(h)' \boldsymbol{\lambda} + \mathbf{D}_i(h, s)' \boldsymbol{\delta}\}} \quad (4)$$

where, for a single household, \mathbf{D}_i is the vector (with $1[\cdot]$ denoting the indicator function)

$$\begin{aligned}
D_{1,0} &= 1[s = 1, h > 0], \\
D_{1,1} &= 1[s = 1, 1 \leq h \leq 26], \\
D_{1,2} &= 1[s = 1, 27 \leq h \leq 52], \\
D_{2,0} &= 1[s = 2, h > 0], \\
D_{2,1} &= 1[s = 2, 1 \leq h \leq 26], \\
D_{2,2} &= 1[s = 2, 27 \leq h \leq 52].
\end{aligned} \tag{5}$$

and δ is vector of parameters to be estimated. For couples, \mathbf{D}_i contains two analogous sets of variables, one for each partner.

The datasets used in the analysis are the EUROMOD input data based on the European Union Statistics on Income and Living Conditions (EU-SILC) for the year 2010. The input data provide all required information on demographic characteristics and human capital, employment and wages of household members, as well as information about various sources of non-labour income. We apply common sample selection criteria for all countries under study by selecting individuals in the age range 18-65 who are not retired or disabled. Then EUROMOD⁷ provides calculations of household-level tax and transfer liabilities given the household characteristics and gross incomes according the existing tax and transfer rules. It also allows re-calculating liabilities for alternative, hypothetical Tax Transfer Rules. The target population consists of all private households throughout the national territory in every country.

⁷ EUROMOD is a large-scale pan-European tax-benefit static micro-simulation engine (e.g. Sutherland and Figari, 2013). It covers the tax-benefit schemes of the majority of European countries and allows computation of predicted household disposable income, on the basis of gross earnings, employment and other household characteristics.

5. Social welfare evaluation

5.1. Comparable Money-metric Utility

Based on the estimated model described in Section 4, we define hereafter the Comparable Money-metric Utility (CMU). This index transforms the household utility level into an inter-household comparable monetary measure that will enter as argument of the Social Welfare function (to be described in Section 5.2). First, we calculate the expected maximum utility attained by household i under tax-transfer regime π (e.g. McFadden 1978):

$$V_i^*(\pi) = \ln \left(\sum_{s=1}^2 \sum_{h \in \Omega} \exp \{ \mathbf{Y}_i(h, s; \pi)' \boldsymbol{\gamma} + \mathbf{L}_i(h)' \boldsymbol{\lambda} + \mathbf{D}_i(h, s)' \boldsymbol{\delta} \} \right) \quad (6)$$

Analogously, we define

$$V_R^*(\pi_R) = \ln \left(\sum_{s=1}^2 \sum_{h \in \Omega} \exp \{ \mathbf{Y}_R(h, s; \pi_R)' \boldsymbol{\gamma} + \mathbf{L}_R(h)' \boldsymbol{\lambda} + \mathbf{D}_R(h, s)' \boldsymbol{\delta} \} \right) \quad (7)$$

as the expected maximum utility attained by the “reference” household R under the “reference” tax-transfer regime π_R . The reference tax-transfer regime is a FT with $G=0$, i.e. a policy $\pi(0, t, t)$ subject to the public budget constraint. Since in general there might be more than one policy $\pi(0, t, t)$ that satisfies the public budget constraint, we choose the one that maximises $\sum_i V_i(0, t, t)$. The reference household is the couple household at the median value of the distribution of $V_i^*(\pi_R)$. The CMU of household i under tax regime π , $\mu_i(\pi)$, is defined as the gross income that a reference household under a reference tax-transfer regime π_0 would need in order to attain an expected maximum utility equal to $V_i^*(\pi)$. The CMU is analogous to the “equivalent income” defined by King (1983). A discussion of this type of money-metric measures is provided by Fleurbaey (2011). Although the choice of the reference household is essentially arbitrary, some choices make more sense than others. Fleurbaey (2011) presents some examples that can be motivated by ethical criteria. Decoster and Haan (2015) provide an empirical application of Fleurbaey’s ethical criteria. Our choice of the median household as reference household can be justified in terms of representativeness or centrality of its preferences. Aaberge and Colombino (2006, 2013) adopt a related, although not identical, procedure that consists of using a common utility function as argument of the social welfare function (Deaton and Muelbauer, 1980). A significant portion

of the empirical policy evaluation literature is silent upon the issue of interpersonal preference comparability. Theoretical models or general equilibrium models typically assume identical preferences or a representative individual, so that the problem is absent by construction. In the empirical literature based on microdata and micro-modelling, frequently either income is interpreted as an index of welfare or the utility levels are directly used, maybe under the assumption that the solution of the comparability problem is somehow implicitly accounted for by the social welfare function. We follow here a tradition that defines the comparability problem – as far as the empirical research is concerned – as in Deaton and Muellbauer (1980), where the adoption of the CMU approach or of the common utility are legitimate solutions.

5.2 Social Welfare function

We choose Kolm (1976) Social Welfare index, which can be defined as:

$$W = \bar{\mu} - \frac{1}{k} \ln \left[\sum_i \frac{\exp\{-k(\mu_i - \bar{\mu})\}}{N} \right] \quad (8)$$

where

$\bar{\mu} = \frac{1}{N} \sum_i \mu_i$ is an index of Efficiency ,

$\frac{1}{k} \ln \left[\sum_i \frac{\exp\{-k(\mu_i - \bar{\mu})\}}{N} \right] =$ Kolm Inequality Index,

$k =$ Inequality Aversion parameter,

$\mu_i =$ comparable money-metric utility of household i (defined in Section 5.1).

W has limits $\bar{\mu}$ as $k \rightarrow 0$ and $\min\{\mu_1, \dots, \mu_N\}$ as $k \rightarrow \infty$.

The meaning of k might be clarified by the following example. Let us take two individuals with

$\mu_2 - \mu_1 = 1$. Given the social marginal evaluation of μ_i , $\frac{\partial W}{\partial \mu_i} = \frac{e^{-k\mu_i}}{e^{-k\mu_1} + e^{-k\mu_2}}$, we get the social marginal

rate of substitution: $SMRS_{1,2} = e^{k(\mu_2 - \mu_1)} = e^k$. Now let us consider a (small) transfer $\tau < 1$ from individual

2 to individual 1 in order to reduce the inequality. Note that the social planner would be willing to take

$\exp\{k\}\tau$ from individual 2 in order to give τ to individual 1. Since $\exp\{k\} \geq 1$, $\exp\{k\}-1$ measures (approximately) the “excess willingness to pay” for a “inequality reducing” transfer from individual 2 to individual 1:

k	0.05	0.10	0.25	0.50
$\exp\{k\}-1$	0.051	0.105	0.284	0.649

The simulation results presented in Section 7 are based on $k = 0.05$ and $k = 0.00$.⁸ Kolm Inequality Index is an absolute index, meaning that it is invariant with respect to translations (i.e. to adding a constant to every μ_i). Absolute indexes are less popular than relative indexes (e.g. Gini’s or Atkinson’s), although there is no strict logical or economic motivation for preferring one to the other.⁹ Blundell and Shephard (2012) adopt a social welfare index which turns out to be very close to Kolm’s index. Their main motivation for their index seems to be the computational convenience, since it handles negative numbers (random utility levels, in their case). Our motivation in choosing Kolm’s index is analogous. In our case, μ_i is a monetary measure, yet it can happen to be negative when the utility level of household i is very far from the utility level of the reference household. Kolm’s index handles negative arguments. Alternatively, it is also possible to shift the μ_i -s by adding a constant (which would not be allowed with a relative index).

⁸ We have run simulations for $k = 0.00, 0.05, 0.10, 0.25, 0.50$ and 0.75 . The complete results are available upon request.

⁹ Atkinson and Brandolini (2010) provide a discussion of relative indexes, absolute indexes and intermediate cases.

6. Identifying the optimal policies

The maximization of W is performed numerically. In the first step, the microeconomic model simulates household choices and computes the expected maximum utility under a starting tax-transfer rule π° , $V_i(\pi^\circ)$. In the second step, $V_i(\pi^\circ)$ is transformed into the comparable money-metric index $\mu_i(\pi^\circ)$. In the third step, the Social Welfare $W(\mu_i(\pi^\circ), \dots, \mu_i(\pi^\circ))$ is computed. The steps are then iterated with new values of π until W is maximized. Since W might have local peaks, the previous steps are preceded by a grid-search for partitioning the parameter space and locate the promising areas.¹⁰

Using a microeconomic model to simulate household behaviour allows for a flexible representation of preferences and opportunities. Using microsimulation combined with numerical methods permits to identify the optimal policies with no need for explicit analytical solutions of complex optimization problems. The approach promises to lead to the identification of optimal policies that are less assumption-driven (with respect to the TOT approach) and possibly better fitted to account for the country-specific characteristics.

It is important to keep in mind that the simulated policies differ from the current policies with respect to many dimensions. First, we simulate policies with a FT, while all the countries included in the present exercise adopt – at least formally – nonlinear tax rules. Second, all the simulated policies are universal and permanent, i.e. identically applied to all the citizens, while the current systems are somehow categorical, adopt some sort of tagging and more or less complex eligibility rule, time-dependent treatments etc. In general, while the current systems might be somehow close to CBI or IWB or other versions of NIT-like mechanism, they are much more complicated. The comparison of the reforms to the current system is informative upon the effects of the reformed budget sets, including the effects of the universal and permanent extension to the whole population. It is not directly informative upon dimensions – e.g. implementation and administration costs – which are not represented in our microeconomic model.

¹⁰ In most cases we use the BFGS (Broyden–Fletcher–Goldfarb–Shanno) algorithm, which is known to have good performance also in non-smooth optimization problems. Since W might have local peaks, besides trying different starting parameters values, as a preliminary step we also use a grid-search procedure for partitioning the parameter space and locate promising areas.

7. Results

The main results of our exercise are summarized in the Tables of Appendix A and in the Graphs of Appendix B and Appendix C.¹¹ For each country, there are two tables, containing the simulation results obtained with two alternative values of the inequality aversion parameter: $k = 0.05$ and $k = 0.00$ (Section 5.2).

The Tables – one for each country – show, for each of the policies considered, the optimal tax-transfer parameters (i.e. the guaranteed minimum income G and the two marginal tax rate t_1 and t_2), the average individual labour supply, the household poverty rate, the percentage of household winners with respect to the current system and the change in the money-metric social welfare as percentage of the average household available income.

The G column reports the average monthly guaranteed minimum income G , which accounts for the distribution of household size in the sample. In the same column, in parenthesis, we also report the monthly guaranteed minimum income for a one-person household. In the last row of column G we report the average expected current transfers. When comparing the current transfers with those under the reforms, one must remember that the current transfers are typically categorical, not universal and at least in part means-tested; therefore, the computation of the average expected current transfers include also households who do not receive any transfer. In contrast, the amount G under the reforms is universal and unconditional.

The t_1 and t_2 columns report the MTRs. For the current system, we report the implicit average tax rate. Labour supply is measured by the expected annual hours of work (including the zero hours of the non-employed). The poverty rate is the percentage of households with available equalized income below 60% of the median equalized income.¹² A household is a winner under a certain policy if it attains a higher utility than under the current tax-transfer regime.

¹¹ The parameter estimates of the behavioral models for singles and couples for six countries (Section 4), Belgium, France, Ireland, Italy, Luxembourg and the United Kingdom, are available upon request from the authors.

¹² It corresponds to the concept of “at risk of poverty” of the OECD statistics.

Let W_0 and W_P respectively the Social Welfare levels attained under the current regime and under a certain policy. Note that they are monetary measures (Euros). Let C_0 the average household gross income under the current regime. The last column of the Tables contains $100 \times (W_P - W_0) / C_0$ for every policy P . The Graphs of Appendix B show – for the six countries – the location of the optimal ($k = 0.05$) policies in the space (–Inequality, Efficiency). Social Welfare (= Efficiency – Inequality) increases towards the upper-right corner. The Graphs also show the Iso-Social Welfare lines passing through the points that represent the current regime and the best optimal regime. The Graphs are useful for visualizing the Social Welfare distance between the various policies and the two components (Efficiency and –Inequality) of Social Welfare. Note that the slope (= 1) of the Iso-Social Welfare lines is always the same in all the countries: it appears to differ because the scale used in the Graphs on the two axes differs among the countries.

The Graphs of Appendix C represent net disposable household income as a function of gross household income, according to the Current system and according to the optimal ($s = 0.05$) CBI, GNIT and UBI. The line that represents the Current system is a polynomial (10th order) approximation.¹³ The comment upon the results are organized according to the research questions presented at the end of the Introduction.

- (i) *Improving upon the current system.* By looking at the last column of the Tables or at the Graphs, we can see that, when $k = 0.05$, in each country there is at least one member of the NIT class that improves upon the current system. In fact, GNIT always strictly dominates the current system.

We have previously noted that the current systems are in practice not so far – for the majority of taxpayers – from the NIT class. An implication is that the policy that we identify as first-best (the GNIT) or at least superior to the current system (other special cases of the NIT class, depending on the country) at least in some cases might indeed represent a realistic re-designs of the tax-transfer rule rather than a radically new scenario that starts from scratch (Appendix C).

¹³ Since the line representing the Current system is a polynomial approximation, the intercept in general is not equal to the Current expected G reported in the Tables of Appendix A.

The change in Social Welfare, expressed as percentage of average household income as explained above, can be interpreted as equivalent to a percentage (permanent) change of GDP. Under this criterion, the countries that might benefit more for adopting the optimal GNIT tax-transfer rule are the UK (+9.06%) and Ireland (+3.99%). More modest gains should be expected in France (+1.70%), Belgium (+1.51%) and Italy (+0.93%). The extreme case is represented by Luxembourg, where the adoption of the optimal GNIT would bring about a gain as modest as 0.1%. When $k = 0.00$, almost the same observations apply, with the exception of Luxembourg, where no reforms is better than the current system.

(ii) *Ranking of the optimal policies.* By construction, GNIT (the unconstrained version of NIT) is never inferior to the constrained versions of NIT: CBI, UBI and IWB. However, in principle, GNIT might coincide the optimal version of (some of) the special cases. With $k = 0.05$, GNIT never reduces to one of the of its special cases. The ranking of the various members of the NIT class and of the current system varies significantly among the countries. In most cases, UBI often occupies the second best position after GNIT (Belgium, Ireland, Italy Luxembourg and United Kingdom). The exception is represented by Luxembourg, where the current system is second-best behind GNIT (and however very close to it). The Social Welfare performance of CBI (the most common policy actually implemented) and IWB (a popular mechanism currently considered for reform) is, in general, disappointing, with the exception of France, where CBI is second-best after GNIT. While the other NIT-like reforms appear to produce good results even with very simple and stylized versions, IWB might require a more sophisticated design.¹⁴ When $k = 0.00$, the policy ranking is similar to the $k = 0.05$ case with some special cases. Namely, in France and in Italy, GNIT collapses to (indifferently) UBI or IWB. Moreover, as already noted above, in Luxembourg the first best would still be the current system.

(iii) *Fiscal and behavioural implications.* With $k = 0.05$, G approximately oscillates between 50% and 100% of the country-specific poverty rate. With $k = 0.00$ we observe the peculiar cases of France and Italy, where G falls down to zero for GNIT, UBI and IWB. GNIT and CBI sustain a larger G compared to UBI or IWB. As it is the case for G , also the optimal MTRs exhibit large variations among the different countries. For example, with $k = 0.05$, the MTR of the optimal UBI+FT rule goes from a minimum of 26% (France) to a maximum of 64% (Belgium). The tax-reform literature typically represents GNIT with

¹⁴ A recent contribution (Kroft et al. 2017) that adopts the “sufficient statistics” approach (Chetty, 2009) and generalises Saez (2002) also finds an optimal design which is closer to NIT than to IWB.

$t_1 > t_2$ (this was indeed the original idea in Friedman 1961). Instead, for five out of six countries we get $t_1 < t_2$, France being the exception. This result seems to be driven by the fact that the disincentive effect of high marginal tax rates is stronger for low-income households than for high-income households. In some countries, especially with $k = 0.05$, the optimal policies envisage very high (possibly unrealistic) levels of G and (t_1, t_2) . As it happens with the simulation results based on TOT, also these results must be taken as directions for reform rather than as recipes to be followed literally. Two qualifications must accompany the interpretation of results. First, as we have already noted, in a realistic policy perspective, the social welfare maximization criterion would be complemented by a consideration of non-welfarist implications of the reforms. Second, the optimal reform design obviously depends on the assumed social inequality aversion (i.e. the parameter k). In most cases, the policy rankings are very similar under $k = 0.05$ and under $k = 0.00$; moreover, with the exception of Luxembourg, we can always find at least one welfare improving reform. However, with $k = 0.00$, the values of G and (t_1, t_2) are significantly lower. This suggests that, at least within the range $k \in [0.00, 0.05]$ of social aversion to inequality, it should be possible to find optimal reforms in the NIT+FT class that are both welfare improving and also realistically sustainable. The graphs of Appendix C compare the current system and the optimal ($k = 0.05$) CBI, GNIT and UBI.

A major concern as to universalistic income support policies is the effect on labour supply. One might expect a reduction of labour supply both because of the guaranteed minimum income G (income effect) and because of higher taxes required for financing the transfers (both substitution and income effects). With the exception of IWB (which is indeed typically adopted with the main purpose of encouraging labour supply), in most countries and for most policies – at least for $k = 0.005$ – we observe indeed a (modest) reduction of hours worked, probably not so large to be considered a matter of concern. With $k = 0.00$ (and consequently less generous G and lower MTRs) the scenario is less clear-cut and we may also frequently observe a larger labour supply.

As with labour supply, what happens to the poverty rate is the result of many effects that contribute differently between the policies and between the countries. There is a “mechanical” effect due to G (which however may be more or less generous than the replaced transfers). There is an incentive effect that lead some household to remain below or at the poverty level depending on the level of G and on the MWR. There are also other incentive effects that depend on the MTRs. Most policies in most countries lead to a majority of winners, the exceptions being (with both values of k) CBI in Ireland and IWB in the UK and in Ireland and also (with $k = 0.00$) CBI in Belgium.

8. Conclusions

We have presented an exercise in empirical optimal taxation for a sample of European countries from three areas: Southern, Central and Northern Europe. For each country, we estimate a microeconomic model of labour supply for both couples and singles. A procedure that simulates the households' choices under given tax-transfer rules is then embedded in a constrained optimization program in order to identify optimal rules under the public budget constraint. The optimality criterion is the class of Kolm's social welfare function, which takes as arguments the households' equivalent incomes and is characterized by the inequality aversion parameter k , with $k = 0$ representing a pure utilitarian criterion and $k > 0$ representing social preferences that give some (negative) weight to inequality. The tax-transfer rules considered as candidates are members of a class that includes as special cases various versions of the Negative Income Tax (NIT): Conditional Basis Income (CBI), Unconditional Basic Income (UBI), In-Work Benefits (IWB) and General Negative Income Tax GNIT), all combined with a Flat Tax above the exemption level. GNIT by construction cannot be worse than the other special members of the NIT class. With $k = 0.05$, GNIT strictly dominates the other NIT-like mechanisms, although in some cases social welfare performances of the first- and of the second-best policy (often UBI) are very close. GNIT always strictly dominates the current tax-transfer system in all the countries. With the exception of Luxembourg, there is at least one other policy (besides GNIT) that is superior to the current system. In most cases the UBI is better than CBI and IWB. CBI may lead to a significant reduction in labour supply and to poverty-trap effects. With $k = 0.00$ the ranking of policies is very close to what we obtain with $k = 0.05$ with some exceptions. In France and in Italy, the optimal GNIT, UBI and IWB collapse to a common FT with $G=0$. Moreover, in Luxembourg no reform is able to improve upon the current system.

To the extent that our sample of countries is representative, the results suggest that there might be a case for supporting a NIT+FT tax-transfer rule as a promising reform for European countries, especially – due to the simplicity of the NIT+FT rule – in the perspective of implementing a common type of tax-transfer rule. However, the optimal tax-transfer parameters of all the policies present large variations from one country to the other. On the one hand, this confirms the added value of the approach we adopt (based on a flexible microeconomic models, on rich datasets and on numerical optimization) with respect to the traditional empirical optimal taxation exercises (based on imputed or calibrated parameters and on analytical maximization). On the other hand, the variance of results calls for an analysis of how the optimal tax-transfer parameters depends on the “deep” characteristic, or the “primitives” of the different countries. This further step is left for future work.

References

- Aaberge, R. & Colombino, U. (2013). Using a microeconomic model of household labour supply to design optimal income taxes. *Scandinavian Journal of Economics* 115(2), 449–475.
- Aaberge, R. & Colombino, U. (2012). Accounting for family background when designing optimal income taxes: a microeconomic simulation analysis. *Journal of Population Economics* 25(2), 741–761.
- Aaberge, R. & Colombino, U. (2006). Designing optimal taxes with a microeconomic model of household labour supply. IZA Discussion Papers 2468, Institute for the Study of Labor (IZA).
- Aaberge, R. & Flood, L. (2008). Evaluation of an in-work tax credit reform in Sweden: Effects on labor supply and welfare participation of single mothers. IZA Discussion Papers 3736, Institute for the Study of Labor (IZA).
- Acemoglu, A. and P. Restrepo (2016). The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment, NBER Working Papers 22252.
- Atkinson, A. B. (1996). *Public Economics in Action: The Basic Income/Flat Tax Proposal*.
- Atkinson, A. B. (2015). *Inequality. What Can be Done?* Harvard University Press.
- Atkinson, A. B. and A. Brandolini (2010). On Analyzing the World Distribution of Income, *World Bank Economic Review*, 24(1), 1-37.
- Besley, T. (1990) Means Testing versus Universal Provision in Poverty Alleviation Programmes, *Economica*, 57(225), 119-129.
- BIEN (2017). THE NETHERLANDS: Social Assistance Experiments Under Review
<http://basicincome.org/news/2017/05/netherlands-social-assistance-experiments-review/>

Blank, Rebecca M., D. Card, and P. K. Robins (1999). Financial Incentives for Increasing Work and Income Among Low-Income Families. NBER Working Paper No. 6998.

Blattman, C., Fiala, N. and Martinez, S. (2014). Generating skilled employment in developing countries: Experimental evidence from Uganda. *Quarterly Journal of Economics*, 129 (2): 697–752.

Blundell, R. & Shephard, A. (2012). Employment, hours of work and the optimal taxation of low-income families. *Review of Economic Studies* 79(2), 481–510.

Brewer, M., Saez, E. and A. Shephard, (2008) Means-testing and tax rates on earnings (Mirrlees Commission Report), Institute for Fiscal Studies, London.

Chetty, R. (2009). Sufficient Statistics for Welfare Analysis: A Bridge Between Structural and Reduced-Form Methods, *Annual Review of Economics*, Annual Reviews 1(1), 451-488.

Clavet, N., J. Duclos, and G. Lacroix. *Fighting Poverty: Assessing the Effect of Guaranteed Minimum Income Proposals in Québec* (2013). Discussion paper no. 7283, IZA.

Coda Moscarola, Flavia & Colombino, Ugo & Figari, Francesco & Locatelli, Marilena (2014). Shifting taxes from labour to property. A simulation under labour market equilibrium, EUROMOD Working Papers EM20/14, EUROMOD at the Institute for Social and Economic Research.
<<https://ideas.repec.org/p/ese/emodwp/em20-14.html>>

Colombino, U. (2015a). Five crossroads on the way to basic income. An Italian tour. *Italian Economic Journal* 1(3), 353–389.

Colombino, U. (2015b). Is unconditional basic income a viable alternative to other social welfare measures? *IZA World of Labor* p. 128.

Colombino, U. (2013). A new equilibrium simulation procedure with discrete choice models. *International Journal of Microsimulation* 6(3), 25–49.

Dagsvik, J. and Strøm, S. (2006). Sectoral labour supply, choice restrictions and functional form. *Journal of Applied Econometrics* 21(6), 803–826.

Deaton, A. and J. Muellbauer (1980). *Economics and Consumer Behavior*, Cambridge University Press.

Decoster, A. and P. Haan (2015). Empirical welfare analysis with preference heterogeneity, *International Tax and Public Finance*, 22(2), 224-251.

Diamond, P. (1998). Optimal Income Taxation An Example with a U-Shaped pattern of Optimal Marginal Tax Rates, *American Economic Review*, 88, 83-95.

De Walle, V. (1999). Public spending and the poor. in: Policy research working papers. Technical Report doi:10.1596/1813-9450-1476, World Bank.

Fabre, A., Pallage, S. and C. Zimmerman (2014). Universal Basic Income versus Unemployment Insurance, Federal Reserve Bank of St. Louis, Working Paper 201-047A, <http://research.stlouisfed.org/wp/2014/2014-047.pdf>

FitzRoy, F. and J. Y. Jin (2015). A basic income can raise employment and welfare for a majority School of Economics & Finance Discussion Paper, no. 1508, University of St Andrews, St Andrews.

Fleurbaey, M. (2011). Willingness-to-pay and the equivalence approach, *Revue d'économie politique*, 121(1), 35-58.

Fortin, B., Truchon, M. & Beausejour, L. (1993). On reforming the welfare system: Workfare meets the negative income tax. *Journal of Public Economics* 51(2), 119–151.

Friedman, M. (1962). *Capitalism and Freedom*. Chicago: University of Chicago Press.

Friedman, M. and R. D. Friedman (1980). *Free to Choose: A Personal Statement*, Harcourt, Brace, Javanovic, New York.

Hall, R., and A. E. Rabushka (1995). *The Flat Tax*, Stanford: Hoover Institution Press.

Hauhofer, J. and Shapiro, J. (2016). The Short-Term Impact of Unconditional Cash Transfers to the Poor: Experimental Evidence from Kenya. *Quarterly Journal of Economics* online:
https://www.princeton.edu/~joha/publications/Haushofer_Shapiro_UCT_2016.04.25.pdf.

Heathcote, J. and H. Tsujiyama (2015). Optimal Income Taxation: Mirrlees Meets Ramsey, CEPR Discussion Papers 10380, <https://ideas.repec.org/p/cpr/ceprdp/10380.html>

Horstschräer, J., M. Clauss, and R. Schnabel (2010). An Unconditional Basic Income in the Family Context: Labor Supply and Distributional Effects, Discussion paper no. 10-091, ZEW Center for European Economic Research, <http://econstor.eu/bitstream/10419/42222/1/64028048X.pdf>.

Hughes, J. J. (2014). A strategic opening for a basic income guarantee in the global crisis created by AI, robots, desktop manufacturing and biomedicine, *Journal of Evolution and Technology* 24(1), 45–61.

Jensen, R., Rostam-Afschar, D. and V. Steiner (2014). Getting the Poor to Work: Three Reforms for a Busy Germany, <http://davud.rostam-afschar.de/cv/cv.pdf>.

KELA (2016). Basic Income Experiment 2017-2018
<http://www.kela.fi/web/en/basic-income-experiment-2017-2018>.

King M. A. (1983). Welfare analysis of tax reforms using household data. *Journal of Public Economics*, Volume 21, Issue 2, 183-214.

Kolm, S. C. (1976). Inequal Inequalities I, *Journal of Economic Theory*. 12, 416-442.

Kroft, K., Kucko, K., Lehmann, E. and J. Schmieder (2017). Optimal Income Taxation with Unemployment and Wage Responses: A Sufficient Statistics Approach, CESIFO Working Paper No. 6686.

McFadden, D. (1978). Modelling the Choice of Residential Location. In: A. Karlqvist, F. Snickars and J. Weibull, Eds., *Spatial Interaction Theory and Planning Models*, North Holland, 1978, pp. 75-96. P. (ed.). *Frontiers in Econometrics*, Academic Press.

Mirrlees, J. A. (1971). An exploration in the theory of optimum income taxation. *Review of Economic Studies* 38(2), 175–208.

Moffitt, R., A. (2003). The Negative Income Tax and the Evolution of U.S. Welfare Policy, *Journal of Economic Perspectives*, American Economic Association, 17(3), 119-140.

Paulus, A. (2016). The antipoverty performance of universal and means-tested benefits with costly take-up, *ImPRovE Working Papers 16/12*, Herman Deleeck Centre for Social Policy, University of Antwerp. <https://ideas.repec.org/p/hdl/improv/1612.html>

Raj D. (2016). The Universal Basic Share, <http://debrajray.blogspot.it/2016/07/the-universal-basic-share.html>.

Saez, E. (2002). Optimal income transfer programs: Intensive versus extensive labor supply responses. *Quarterly Journal of Economics* 117(3), 1039–1073.

Saez, E. (2001). Using elasticities to derive optimal income tax rates. *Review of Economic Studies* 68(234), 205–229.

Scutella, R. (2004). Moves to a Basic Income-Flat Tax System in Australia: Implications for the Distribution of Income and Supply of Labour. Working paper no. wp2004n05. Melbourne Institute of Applied Economic and Social Research. http://www.melbourneinstitute.com/downloads/working_paper_series/wp2004n05.pdf

Sefton J. and J. Van De Ven (2009). Optimal Design of Means Tested Retirement Benefits, *Economic Journal*, 119(541), 461-481.

Segal H. D. (2016). Finding a Better Way: A Basic Income Pilot Project for Ontario
https://files.ontario.ca/discussionpaper_nov3_english_final.pdf

Sommer, M. (2016). A Feasible Basic Income Scheme for Germany: Effects on Labor Supply, Poverty, and Income Inequality. Springer, ISBN 978-3-319-24064-0.

Standing, G. (2008). How cash transfers promote the case for basic income. *Basic Income Studies* 3(1).

Standing, G. (2015). *Basic Income: A Transformative Policy for India*. Bloomsbury Academic.

Sutherland, H. and F. Figari (2013). EUROMOD: the European Union tax-benefit microsimulation model. *International Journal of Microsimulation*, 6(1) 4-26.

Tobin, J., Pechman, J. and P. Mieszkowski (1967). Is a Negative Income Tax Practical? *Yale Law Journal*, 77 (November) 1-27.

Tuomala, M. (2010). On optimal non-linear income taxation: numerical results revisited, *International Tax and Public Finance*, 17(3), 259-270.

Van der Linden, B. (2004). Active Citizen's Income, Unconditional Income and Participation under Imperfect Competition: A Welfare Analysis, *Oxford Economic Papers*, 56(1) 98-117

Van Parijs, P. (1995). *Real Freedom for All*. Oxford University Press.

Y Combinator (2017). Basic Income Project Proposal, Y Combinator Research,
<https://static1.squarespace.com/static/599c23b2e6f2e1aeb8d35ec6/t/59c3188c4c326da3497c355f/1505958039366/YCR-Basic-Income-Proposal.pdf>

Appendix A.

Tables

Table A.1.a. Belgium. Optimal ($k = 0.05$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	1274 (804)	1	0.44	1635	0	57	-1.07
GNIT	827 (522)	0.28	0.72	1635	5	61	1.51
UBI	1434 (905)	0.64	0.64	1645	7.9	57	1.29
IWB	699 (441)	-0.02	0.52	1672	9	65	0.37
Current	381 (240)*	0.38**		1645	15	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.1.b. Belgium. Optimal ($k = 0.00$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	387 (244)	1	0.31	1736	19	47	-4.38
GNIT	721 (455)	0.25	0.69	1657	11	62	1.05
UBI	1289 (813)	0.59	0.59	1609	8	61	0.60
IWB	623 (393)	-0.02	0.49	1684	9	62	-0.38
Current	381 (240)*	0.38**		1645	15	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.2.a. France. Optimal ($k = 0.05$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	594 (374)	1	0.17	1688	18.5	72	1.48
GNIT	195 (123)	0.36	0.16	1690	18.4	74	1.7
UBI	511 (322)	0.26	0.26	1645	7.9	57	0.23
IWB	389 (245)	-0.03	0.26	1684	9	73	0.06
Current	376 (237)**	0.24**		1645	15	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.2.b. France. Optimal ($k = 0.00$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	566 (358)	1	0.16	1688	18	73	1.90
GNIT	0 (0)	0.14	0.14	1692	14	74	2.61
UBI	0 (0)	0.14	0.14	1692	14	74	2.61
IWB	0 (0)	0.14	0.14	1692	14	74	2.61
Current	376 (237)*	0.24**			14	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.3.a. Ireland. Optimal ($k = 0.05$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	1662 (981)	1	0.27	1188	26.6	47	-2.81
GNIT	1531 (904)	0.32	0.89	1191	12.8	61	3.99
UBI	1799 (1062)	0.57	0.57	1161	0	57	1.48
IWB	837 (494)	-0.09	0.31	1274	15.8	48	-0.41
Current	806 (476) *	26**		1249	19.6	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.3.b. Ireland. Optimal ($k = 0.00$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	1644 (969)	1	0.26	1191	26.6	46	-2.67
GNIT	1581 (930)	0.34	0.89	1185	12.1	61	4.47
UBI	1851 (1089)	0.58	0.58	1155	0	57	2.02
IWB	741 (436)	-0.01	0.27	1285	17	47	-1.21
Current	806 (476) *	26**		1249	19.6	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.4.a. Italy. Optimal ($k = 0.05$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	539 (337)	1	0.31	1530	29.2	65	0.53
GNIT	485 (303)	0.37	0.47	1510	21.3	72	0.93
UBI	314 (196)	0.35	0.35	1535	25.8	73	0.62
IWB	230 (144)	-0.04	0.35	1539	16.2	73	0.59
Current	46(29) *	0.25**		1540	26.6	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.4.b. Italy. Optimal ($k = 0.00$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	195 (130)	1	0.26	1556	26.6	63	1.58
GNIT	0 (0)	0.23	0.23	1568	20.3	59	1.61
UBI	0 (0)	0.23	0.23	1568	20.3	59	1.61
IWB	0 (0)	0.23	0.23	1568	20.3	59	1.61
Current	46 (29) *	0.25**		1540	26.6	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.5.a. Luxembourg. Optimal ($k = 0.05$) CBI, GNIT, UBI and IWB

	G = monthly transfer (one person household)	t_1	t_2	Expected annual hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	1015 (626)	1	0.19	1664	20	62	-1.01
GNIT	981 (605)	0.19	0.49	1643	11	63	0.1
UBI	2103 (1297)	0.48	0.48	1642	3.7	51	-0.16
IWB	879 (542)	-0.01	0.33	1660	7.5	65	-0.24
Current	589 (363)*	0.26**		1648	10.7	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.5.b. Luxembourg. Optimal ($k = 0.00$) CBI, GNIT, UBI and IWB

	G (monthly transfer)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	820 (506)	1	0.18	1665	19	63	-1.80
GNIT	846 (522)	0.16	0.49	1640	11.7	65	-0.24
UBI	2066 (1275)	0.47	0.47	1640	3.8	53	-0.48
IWB	795 (491)	-0.01	0.31	1652	7.9	64	-0.78
Current	589 (363)*	0.26**		1648	10.7	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

Table A.6.a. United Kingdom. Optimal ($k = 0.05$) CBI, GNIT, UBI and IWB

	G	t_1	t_2	Hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	1026 (641)	1	0.25	1182	27.3	56	-0.46
GNIT	1238 (774)	0.63	0.64	1157	16	76	9.06
UBI	1078 (674)	0.55	0.55	1175	30.3	74	6.91
IZB	278 (174)	-0.03	0.19	1262	23.3	46	-6.6
Current	261 (163)*	0.22**		1196	30.3	...	...

(*) Average expected monthly transfer

(**) Implicit average tax rate under the current tax-transfer rule

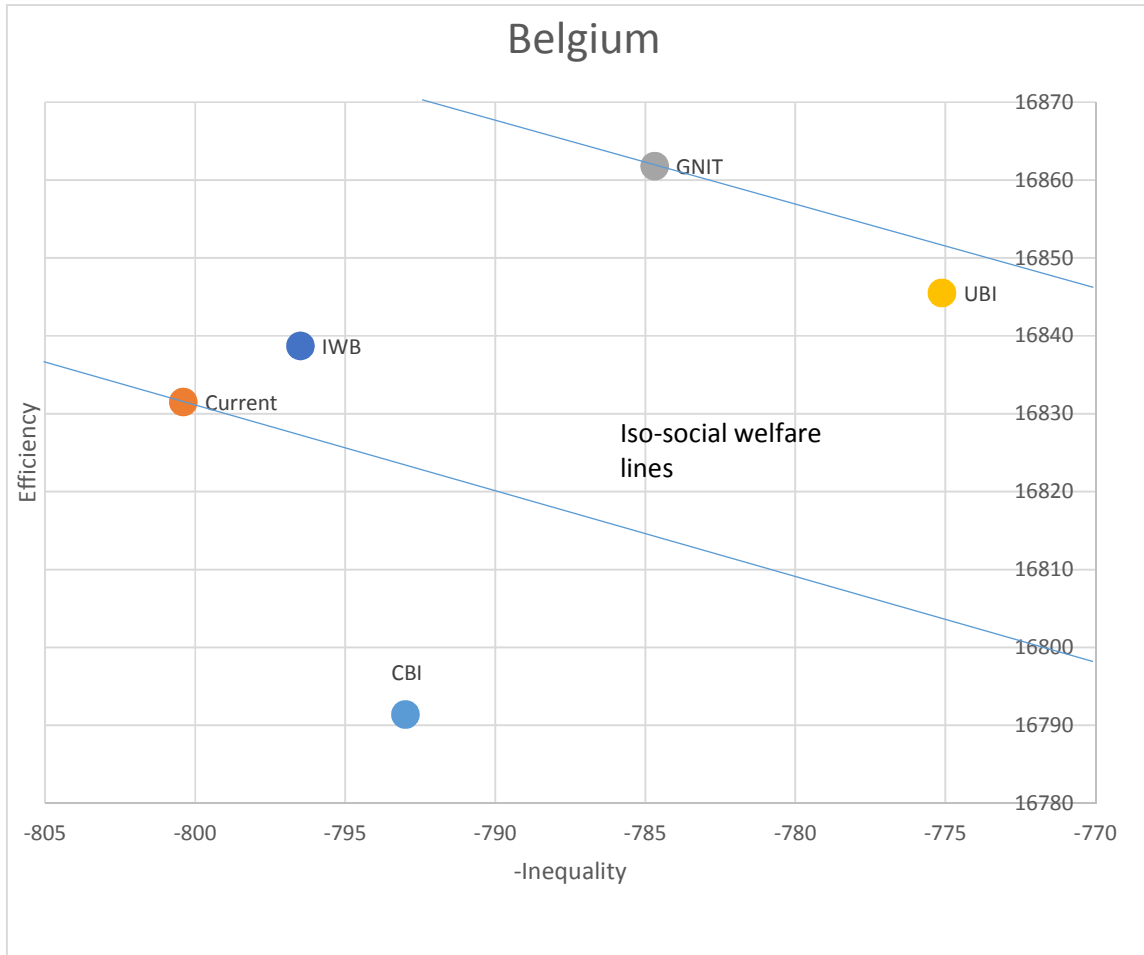
Table A.6.b. United Kingdom. Optimal ($k = 0.00$) CBI, GNIT, UBI and IWB

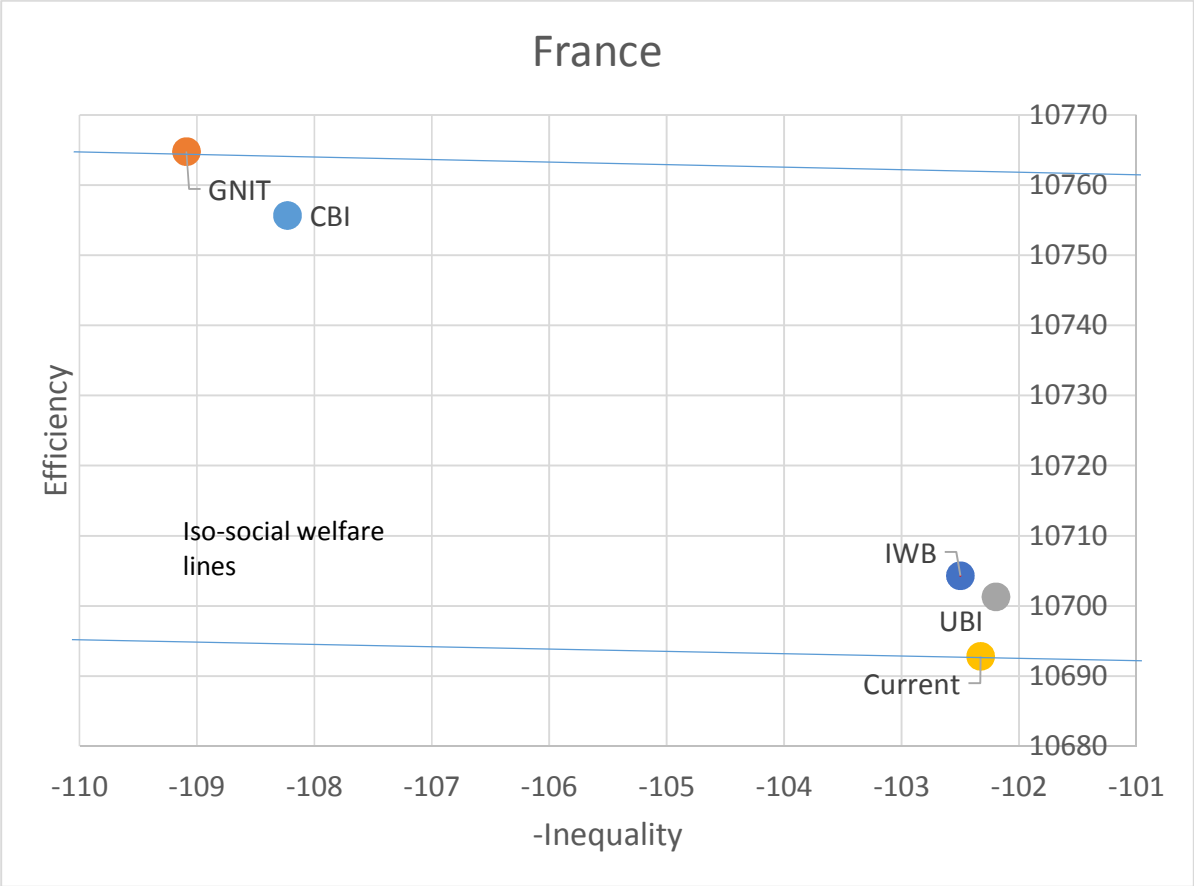
	G (monthly transfer)	t_1	t_2	Annual expected hours of work	Poverty (%)	Winners w.r.t. Current (%)	% Δ Social Welfare w.r.t. Current
CBI	802 (501)	1	0.17	1208	36.7	50	-5.14
GNIT	1112 (695)	0.50	0.70	1173	16.7	77	9.90
UBI	1000 (625)	0.55	0.55	1185	16.7	72	5.81
IZB	181 (113)	-0.02	0.13	1272	24.1	41	-10.09
Current	261 (163)*	0.22**		1196	30.3	...	...

(*) Average expected monthly transfer

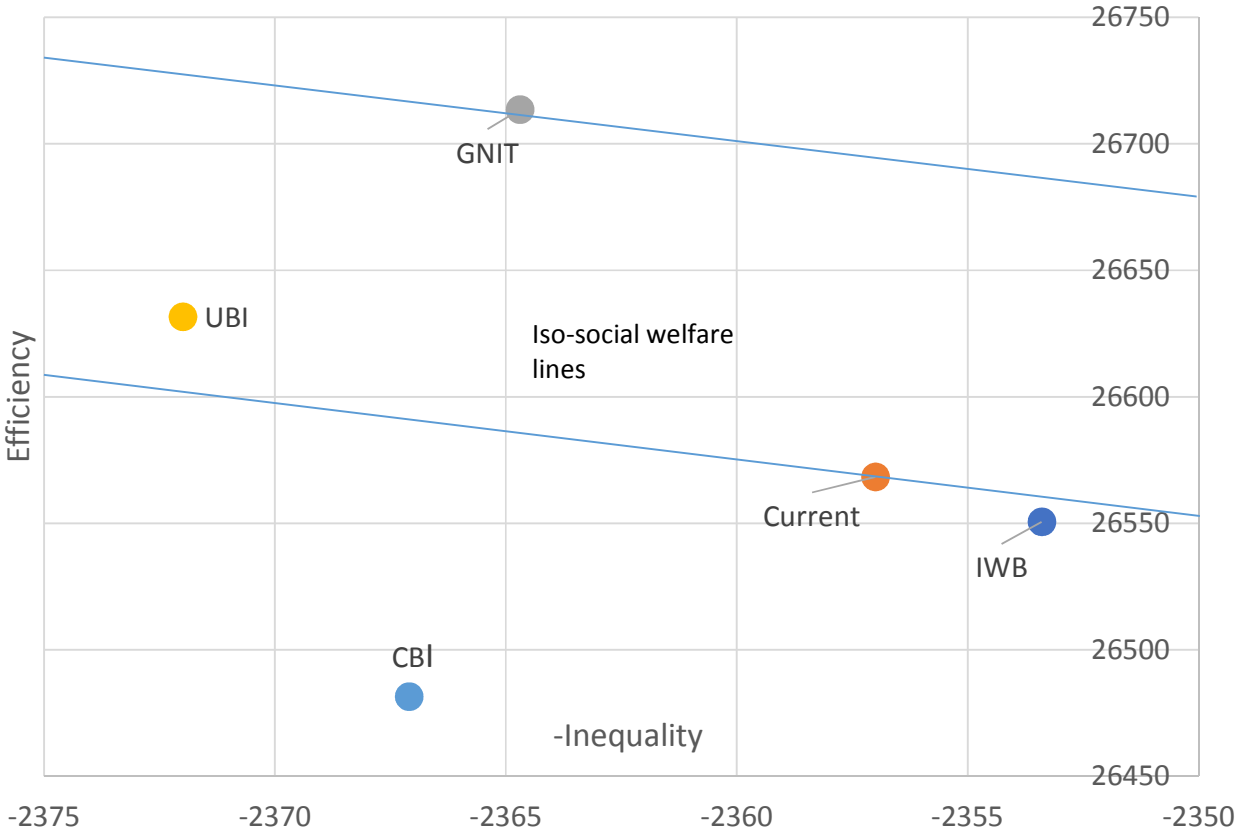
(**) Implicit average tax rate under the current tax-transfer rule

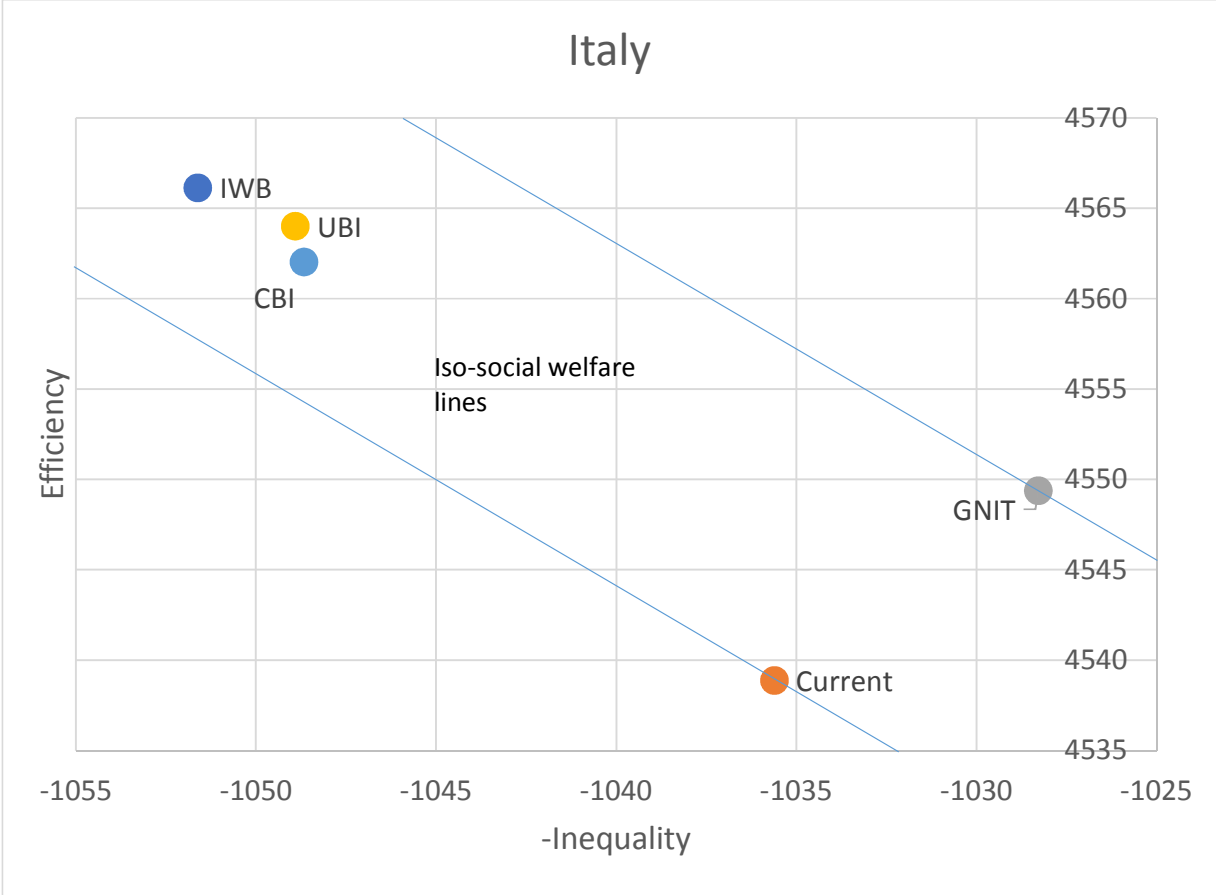
Appendix B
Graphs of Social Welfare components (k = 0.05)



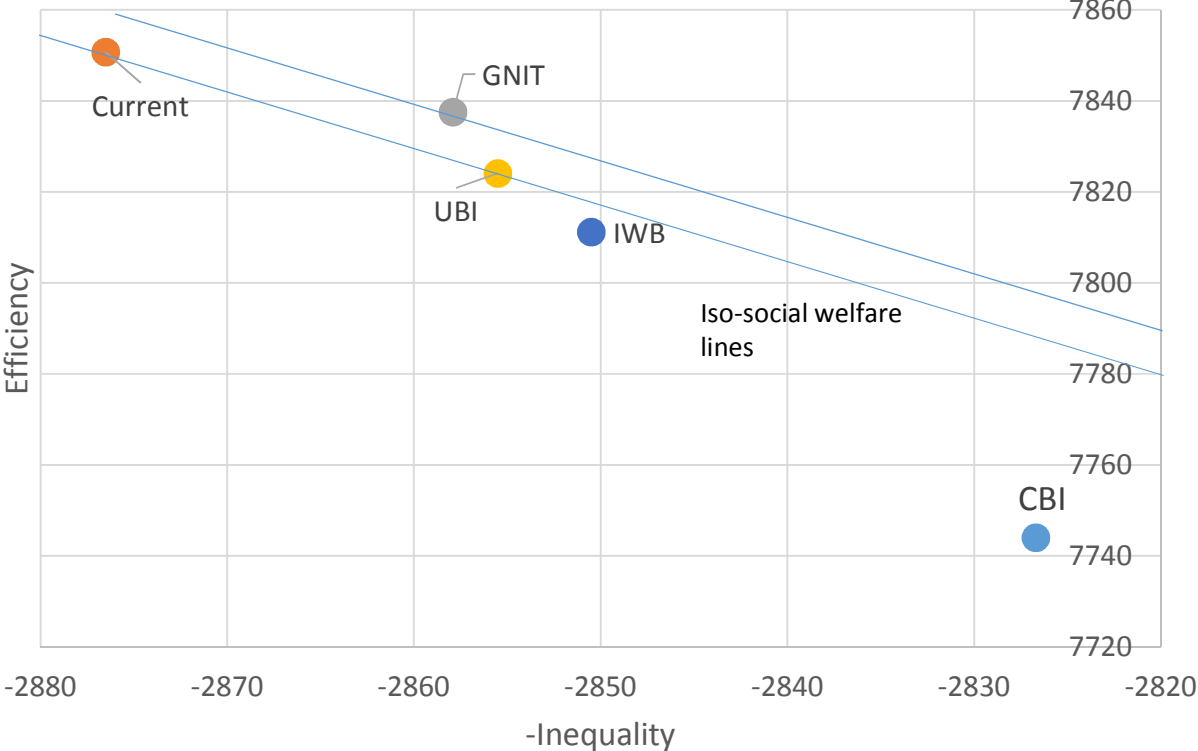


Ireland

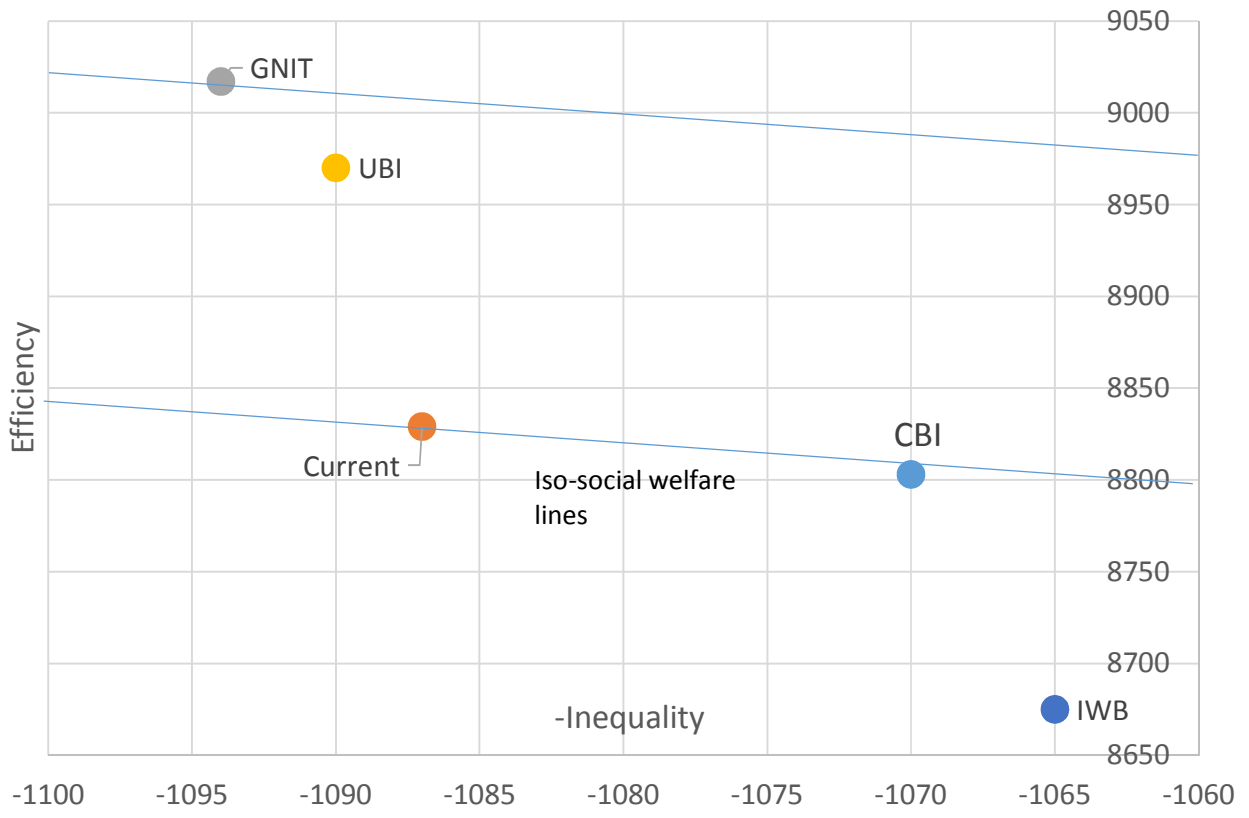




Luxembourg



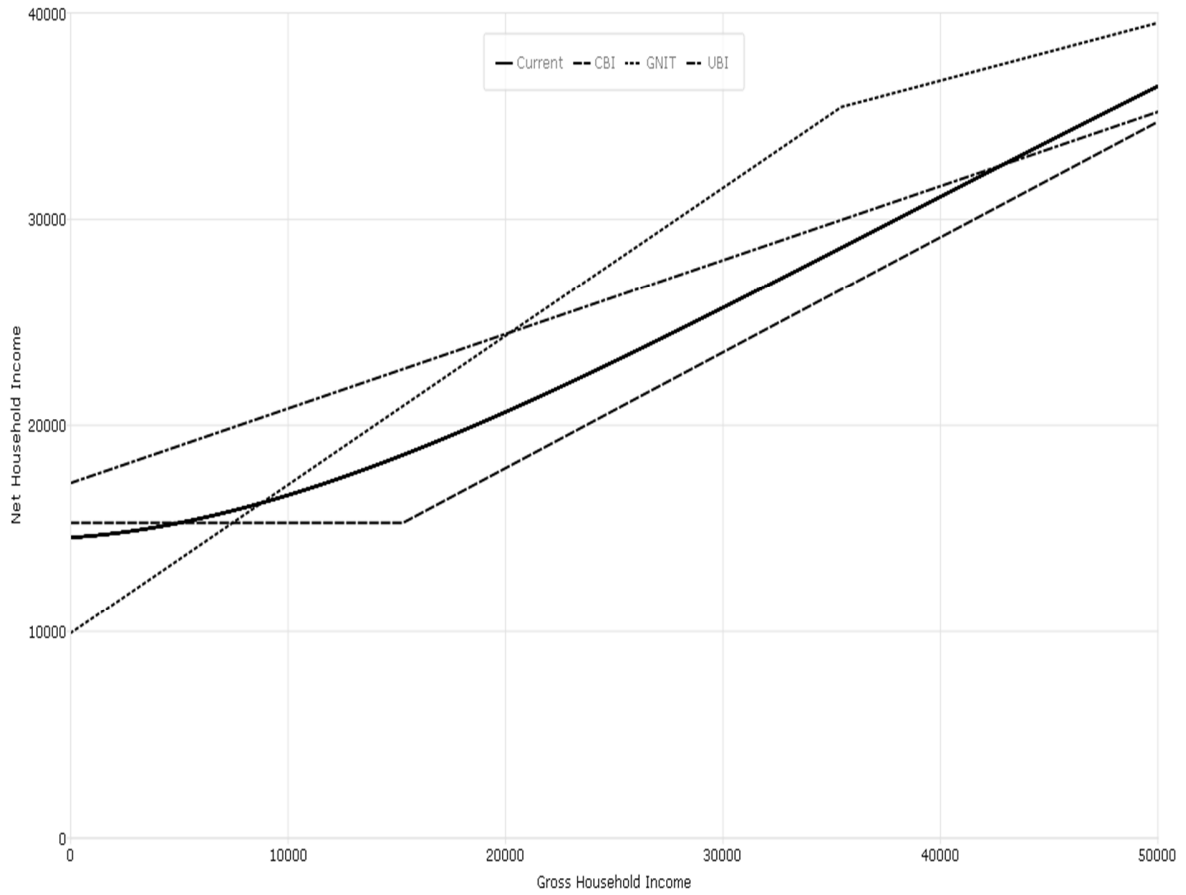
United Kingdom



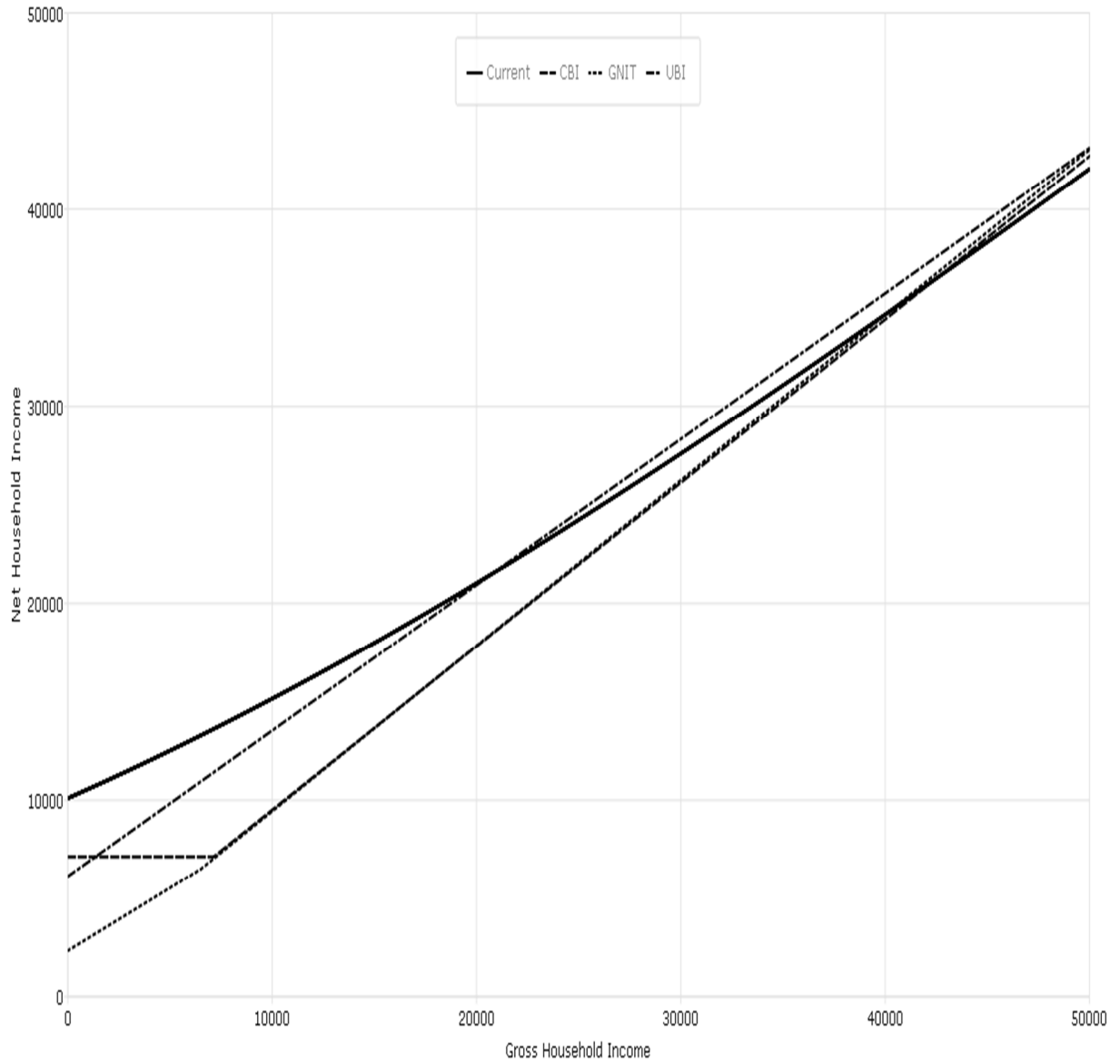
Appendix C

Graph

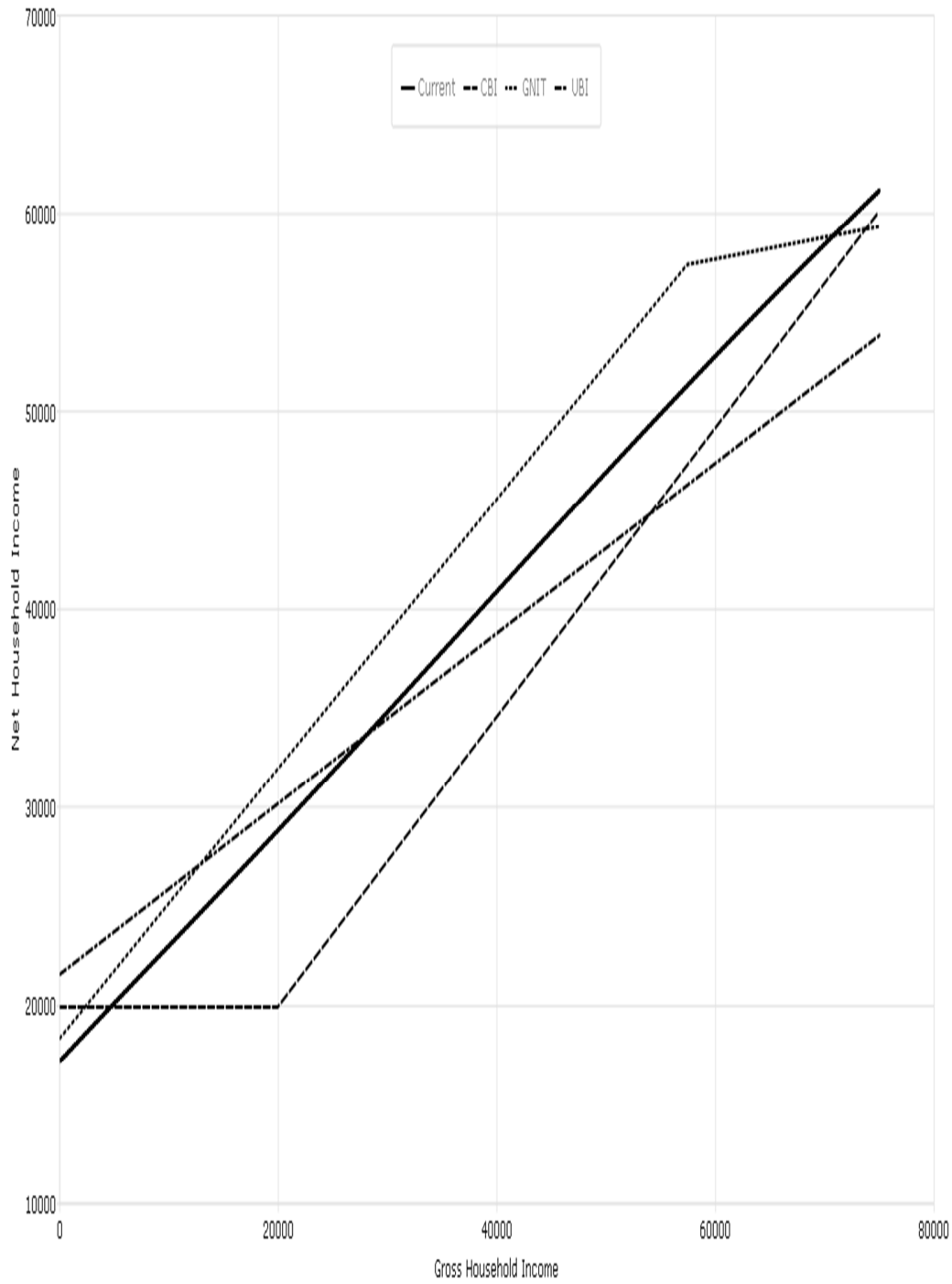
C.1. Gross income vs Disposable income under different tax-transfer rules: Belgium



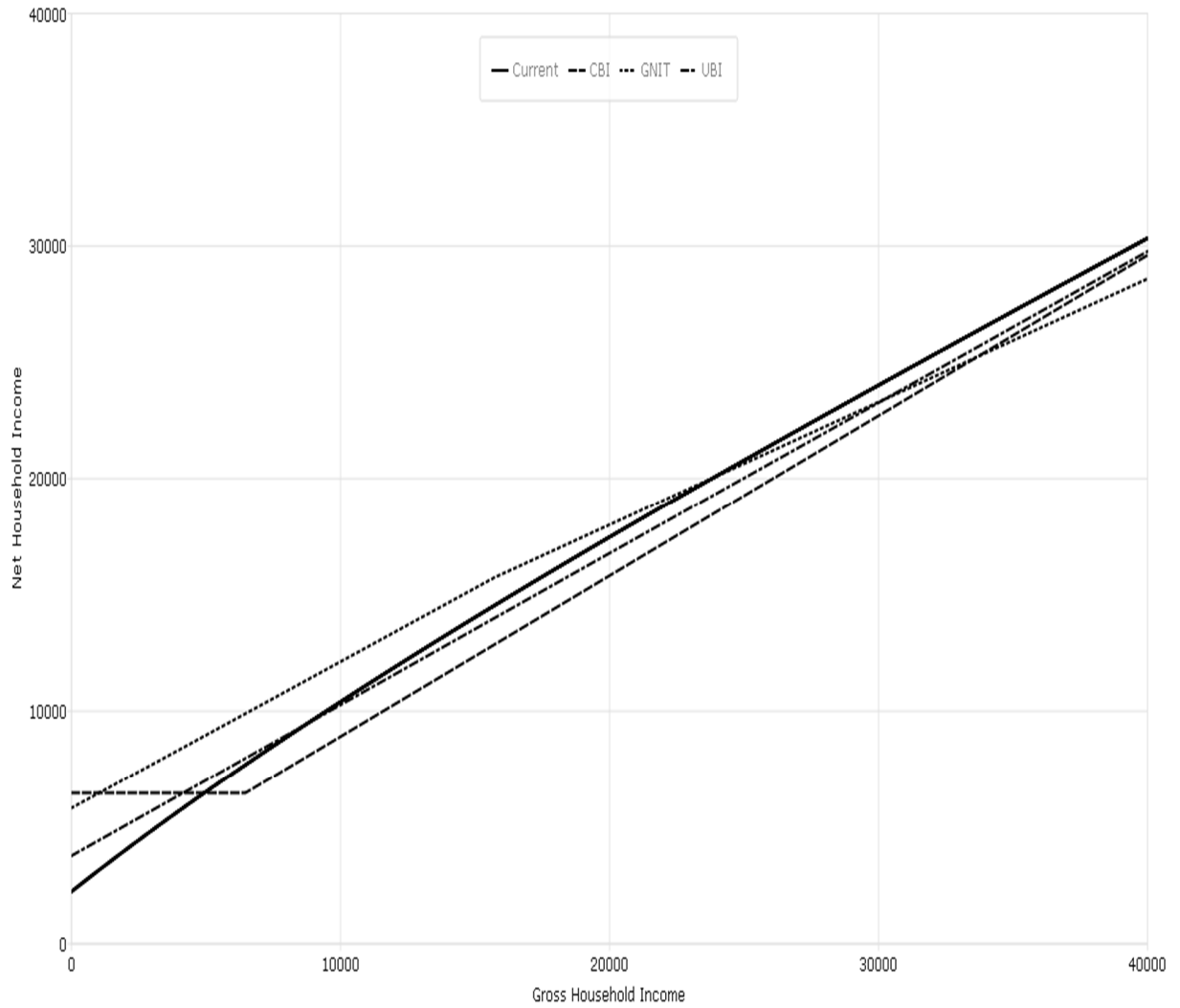
Graph C.2. Gross income vs Disposable income under different tax-transfer rules: France



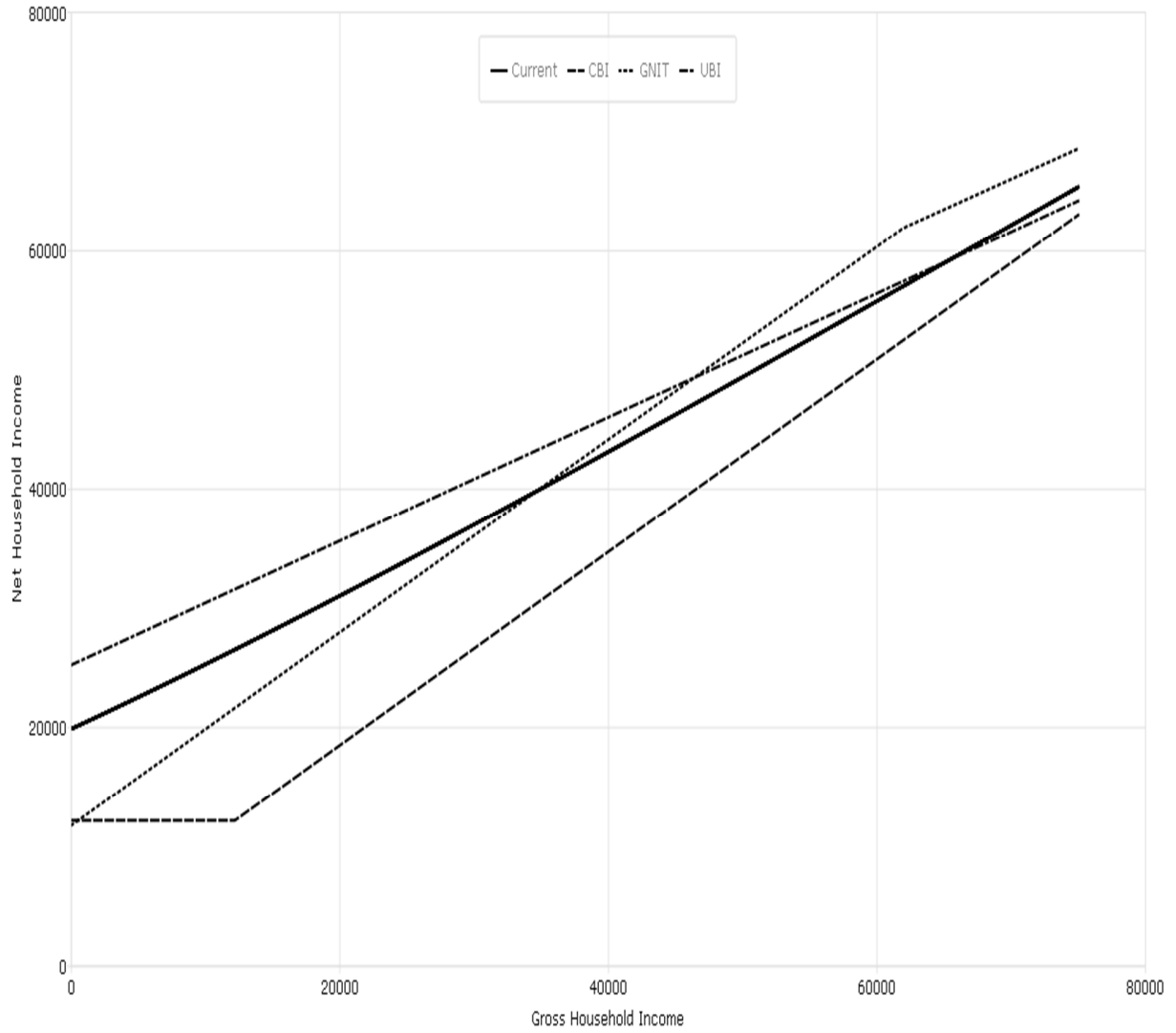
Graph C.3. Gross income vs Disposable income under different tax-transfer rules: Ireland



Graph C.4. Gross income vs Disposable income under different tax-transfer rules: Italy



Graph C.5. Gross income vs Disposable income under different tax-transfer rules: Luxembourg



Graph C.6. Gross income vs Disposable income under different tax-transfer rules: United Kingdom

