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MEFISTO: A NEW MICRO-SIMULATION MODEL FOR FLANDERS

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For more information on the project, see www.flemosi.be.

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MEFISTO:
A NEW MICRO-SIMULATION MODEL FOR FLANDERS

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Abstract: In this article, we introduce the structure, possibilities and limitations of the first version of the microsimulation model MEFISTO (Modelling and Evaluating Flanders' FIscal and Social TOmorrow). MEFISTO is a web-enabled microsimulation model for Flanders that is publicly available on www.flemosi.be. We compare MEFISTO to alternative models for *ex ante* policy evaluation in Flanders. We illustrate its use and user-friendliness by showing how policy reforms can easily be implemented and how the results are to be interpreted. We end the article by previewing the main directions in which the next versions of the model will be developed.

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1. INTRODUCTION

In their advice to the French government, the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP hereafter), chaired by Nobel laureates Joseph Stiglitz and Amartya Sen, made a series of practical recommendations to improve the measurement of social welfare. One of these recommendations was to '*give more prominence to the distribution of income, consumption and wealth*' (Stiglitz-Sen-Fitoussi, 2009:13)

This recommendation illustrates a renewed interest for 'inequality' and distributional issues in academic and policy-oriented writings. At least three broad strands of literature can be readily discerned. First, there is the *descriptive* strand in which numerous papers document widening inequality for different income concepts (wages and salaries, taxable income, disposable income, etc.) in different parts of the distribution (e.g. with special focus on the top incomes) and for different countries.[1] Secondly, social and economic researchers have intensified their investigations into the *driving forces* of the observed widening inequality, among which following candidates have been studied: the race between technology and education, the globalization process, outsourcing to emerging economies with lower labour costs and less developed welfare systems, the role of demographic change and, last but not least, changes in tax-benefit policies such as a decrease of the top marginal income tax rate or the introduction of more conditionality in benefits.[2] A third stream of literature focuses on the *consequences* of inequality. It has been suggested that high inequality causes financial instability, reduces growth and has a negative impact on population health and social cohesion.[3]

Now that new insights are gathered on the size of overall inequality, its driving forces and consequences, policy makers may wonder what can actually be done to reduce inequality. Two types of policy evaluation models can be helpful for that inquiry. First, *ex ante* policy evaluation tools gauge the expected effects of a policy reform before it is effectively implemented. Alternatively, *ex post* evaluation methods study the impact of a reform after implementation, by carefully distinguishing the policy effect from other confounding factors. Though *ex post* evaluation is insightful, it is essential for a policy maker to know the expected effects of the intended reform *beforehand*. Unfortunately, models for *ex ante* policy preparation and development are largely unavailable in Flanders and the existing ones are limited in scope and not publicly available for the civil society at large. The absence of such tools is deplorable given the practical advances made in many other countries and the

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1 For overviews see, for instance, Atkinson (2008), Atkinson et al. (2011) and OECD (2008).

2 Recent summaries and contributions can be found in Atkinson (2007), Autor et al. (2008), Bargain and Callan (2008), Bourguignon et al. (2008), Heathcote et al. (2010), Hyslop and Maré (2005) and OECD (2011).

3 For the influence on growth, see the overview in Aghion et al. (1999); for inequality as one of the presumed causes of the financial crisis, see Fitoussi and Saraceno (2010), and a popular account of the devastating impact of inequality on society as a whole can be found in Wilkinson and Pickett (2009).

scientific progress made during the last decennia, to which Belgian academia has made a non-negligible contribution.

The FLEMOSI project (Flemish Models of Simulation) is a coordinated effort to provide such a widely available toolbox of socio-economic policy evaluation instruments. There exist three kinds of *ex ante* models to assess the impact of a policy change during its preparatory phase: aggregate macro-economic models; models of a typical family and microsimulation models (abbreviated as MSM from now on). Aggregate or macro-economic models assess the aggregate or average impacts of policy measures on for instance GDP, consumption and welfare.[4] Models of the typical family, on the other hand, focus on a single predefined type of families and study the impact of the policy measure in a very detailed way for this type only (Van Mechelen and Verbist, 2005; OECD, 2010). Although macro models and typical family models are extremely useful for policy preparation, they remain blind for the distribution of the effects in the society, and hence they are not in line with the aforementioned recommendation of the CMEPSP. Microsimulation models, on the other hand, present the effects of policy measures at the level of all individual economic agents, allowing studying distributional and budgetary impacts of policy reforms. It is for that reason that the FLEMOSI project-team opted to develop a new microsimulation model, called MEFISTO (Modelling and Evaluating Flanders' Fiscal and Social Tomorrow).

Microsimulation models have a long pedigree. The idea has been originally formulated by Orcutt (1957) who noted that '*current models of our socio-economic system only predict aggregates and fail to predict distributions of individuals, households, or firms in single or multivariate classifications*' (Orcutt, 1957: 116). He attributed the lack of predictive power of the existing models precisely to that aggregate character. At the same time Orcutt wrote with admiration and amazement about the arrival of '*powerful giants*' to describe '*a large electronic machine, such as the IBM 704 or the UNIVAC II*' (Orcutt, 1957: 119), and was visionary when he noted that '*Solution of models of the type presented here will involve extensive calculations, and it is only the advent of very powerful computing facilities that makes this kind of model an exciting possibility*' (Orcutt, 1957: 117). Indeed, one had to wait until the arrival of the personal computer and the increased computing facilities on the desk of the researchers in the eighties to witness the real breakthrough of Orcutt's ideas.[5] Recently, the EUROMOD model has become widely recognized as being the reference MSM-model at the European level for the microsimulation of socio-economic policies.[6]

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4 Essentially we call these models 'macro' because they model the behavior for a representative agent instead of taking into account the full heterogeneity of the population.

5 A detailed account of the whole historical process and genesis of numerous types of MSM's certainly is beyond the scope of this article, but we refer the reader to Atkinson and Sutherland (1988) for an overview of the early stage of development of MSM's in Europe, and Atkinson (2009) and Bourguignon and Spadaro (2006) for historical overviews.

6 EUROMOD is a tax-benefit microsimulation model for the European Union (EU) that enables researchers and policy analysts to calculate the effects of taxes and benefits on household incomes and work incentives for the population of each country and for the EU as a whole. 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. For more

As EUROMOD is built to facilitate comparisons of policies across countries, we have chosen to develop the architecture of MEFISTO in line with the framework of EUROMOD, which will enhance the possibilities to compare Flemish and Belgian tax-benefit policies with those in other countries. The combination of, on the one hand, the many years of standing expertise in building and using MSM's at the Herman Deleeck Centre of Social Policy in Antwerp and at the Center for Economic Studies in Leuven, with, on the other hand, the international academic community behind EUROMOD also provides an opportunity to push the frontiers of the MSM-methodology. The expertise of the Center of Research in Public Economics and Population Economics in Liège will allow the expansion of the model with pension simulations, and the experience of the Interface Demography in Brussels will serve as a basis for the long term demographic projections that will be used in the FLEMOSI-project.

MEFISTO is only one of the models built within the FLEMOSI-project, but at the same time it is one of the central tools. It is a microsimulation model implementing competences for the Belgian federal level and specific competences for the Flemish region. The model uses the most recent micro-data from the Flemish respondents of the European Union Statistics on Income and Living Conditions (EU-SILC), which is the European reference household survey for inequality and poverty analysis. Further, it uses a set of policy rules reflecting the most recent fiscal environment of direct taxation in Belgium and Flanders and it utilizes the engine of the EUROMOD microsimulation model for its calculations. This combination allows evaluating the effects of reforms of Flemish tax and benefiting policies in a detailed way.

The current version of the model focuses on the first-round or so-called *arithmetic* effects of the policy reforms, abstracting from any behavioural reaction of the individuals (such as the number of hours worked).[7] Yet, even a mere arithmetic MSM is a powerful tool for *ex ante* policy evaluation. It allows for the calculation of taxes and benefits of all individuals in the distribution, it shows gainers and losers of a reform and provides a first-round budgetary cost of the reform. We believe that the public availability of these tools is of utmost importance to enrich the public debate in the current times of crisis and austerity.

To achieve a high level of accessibility, MEFISTO will be provided in three different versions, the so-called BASIC, LIGHT and PLUS versions. Each of these versions is tailored at a specific target audience and takes a different position on the trade-off between flexibility and user-friendliness. Indeed, these different users are interested in different questions, in a different output and are willing to pay a different price in terms of user-friendliness for their desired level of flexibility and scope. First, *policy makers* are eager to assess detailed distributional and budgetary consequences of policy measures under design in the web-enabled BASIC version. Second, the democratic participation of the *civil society* and the *general public* in the discussion about proposed measures will be stimulated and enhanced by making a slimmed down version of the model publicly available online, which will be the LIGHT version. Finally,

information, see Sutherland (2007) and Lietz and Mantovani (2006) or the website of the model http://www.iser.essex.ac.uk/euromod.

7 In this Special Issue of the BTSZ, two other articles illustrate how behavioural reactions, such as labour supply or take-up of social minima can be modelled in the framework of microsimulation models (see Bouckaert and Schokkaert, 2011, and Decoster et al., 2011).

the *academic community* is interested in up-to-date models which allow the integration of the often complex tax-benefit policy environments in theoretical and empirical models, which they find in the PLUS version, a stand-alone fully-fledged version of MEFISTO.

This article aims at introducing MEFISTO in all its aspects and is structured as follows. In the next section we characterize MEFISTO as a *static arithmetic microsimulation* model for *Flanders* in terms of its constitutive characteristics. Section three advocates the need for a *new* microsimulation model at the Flemish level by comparing the model to some alternative models for *ex ante* policy evaluation in Flanders thereby highlighting its comparative advantages. The fourth section briefly overviews the architecture of MEFISTO. In section five we illustrate how the model can be used and how the results should be interpreted by looking at four illustrative policy reforms. The sixth section provides a preview of the extensions of the model in the near future. Section seven concludes.

2. MEFISTO: A STATIC ARITHMETIC MICROSIMULATION MODEL FOR FLANDERS

The only way to take the aforementioned recommendation of CMEPSP about the importance of distributional issues seriously is to compute the effect of a policy for a representative sample of the population. This is precisely what MEFISTO does. Being a microsimulation model, it allows the computation of the effect of policy reforms for a wide range of Flemish policies. It does so, based on a sample of micro-data that is representative for the entire Flemish population, taking into account its rich socio-economic diversity. Yet, many choices are open when constructing such a model: do we include behavioural reactions of individual economic agents? Do we model this behaviour through time and do we model the impact of policies through time? Which policy domains are integrated into the model? In the next five subsections we describe Mefisto as a *static arithmetic ex ante microsimulation* model for *Flanders* by means of these five constitutive characteristics.

2.1 MEFISTO is a microsimulation model

Microsimulation models calculate or estimate the effects of a proposed policy reform on a *representative population* of *individual economic agents* (i.e. households). The two basic elements of a MSM are, first, a micro data set based on a representative survey or, albeit less usual, obtained from administrative data source and second, a set of computer routines that model the legislation of the MSM's subject matter, e.g. tax-benefit legislation. We return in a more detailed way to the architecture of the model in section four.

Contrarily, the most important alternatives, aggregate macroeconomic models and models of a typical family, remain blind for these politically important distributional effects of policy choices. Consider, for instance, the famous typical family of two adults, both active on the labour market, and with two dependent children (and with a spending pattern of e.g. buying a new car every year). According to the latest EU-SILC-survey this type of households makes up only 8.8 % of the Flemish population. Not seldom though newspaper headlines on policy

reforms are based on rough calculations for this or very similar typical families.[8] The same holds for many other types of individuals or households that are used in public debates, e.g. in the context of poverty and inactivity traps. For policy makers the relevant question should be less whether we can construct a household with characteristics such that it is confronted with an inactivity trap, but rather how representative this household is.

We argue that the three aforementioned types of *ex ante* models offer complementary information and that they should be used jointly in a systematic way that allows feedback effects from the macro to micro level and vice versa. In the final section of this article we preview how the existing MSM will be integrated and connected to existing macro-economic models as well as models of a typical family.

2.2 MEFISTO is an ex ante model

Any credible socio-economic policy should be based on the best knowledge available *ex ante* and open to close scrutiny *ex post*. With '*ex post*' we refer to the application of one of the tools out of the rapidly expanding econometric toolbox of *program evaluation*. In this branch of econometrics the researcher assesses the impact of a policy reform or program by a detailed comparison of two groups: first, there is a group of individuals who have been exposed to the reform (the so-called treatment group) and second, there is a group which has not been treated (the control group) and which should be as comparable as possible. The comparison of both groups indicates the effect of the policy reform, in a very similar fashion as how new drugs are tested in medical sciences. The whole art lies in guaranteeing the randomness of the treatment to exclude selection effects and other confounding factors. For overviews of these recent developments we refer to Imbens and Wooldrigde (2009) and Angrist and Pischke (2009). The virtual nonexistence in Flanders of scientifically sound *ex post* evaluations of policy measures is deplorable, but not so much out of line with practices in other regions and countries.[9]

The absence of the use of quantitative models as a tool for *ex ante* policy preparation and development is much more difficult to extenuate given the scientific progress made during the last decennia, the practice developed in many other countries, and the expertise of Belgian academia participating in this development. MEFISTO is such an *ex*

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[8] For a recent example we refer to a headline article in the Belgian newspaper De Standaard, assessing as follows fiscal measures taken by the new government: (English translation is ours) "Our calculations are based on a typical family: adults in their forties, with two teenage children . The mother disposes of a company car, valued €25000 when newly purchased. Both parents and the two children have a savings account, some bonds, and they make use of service vouchers" (De Standaard, 2011; original quote: "Een modaal gezin. Veertigers met twee tienerkinderen, dat is het uitgangspunt van onze berekeningen. Moeder heeft een bedrijfswagen met een nieuwwaarde van 25.000 euro. De ouders en de kinderen hebben elk een spaarboekje, een paar kasbons op een effectenrekening en ze gebruiken dienstencheques".

[9] Notable exceptions include Cockx et al. (2005) who evaluate the activation policy of long term unemployed, and Ooghe (2011) who uses a regression discontinuity approach to evaluate the effect of additional financing for primary schools aimed at targets of equality of opportunity.

ante model, meaning that rather than evaluating a policy reform *ex post*, it simulates the effects of potential policy reforms on the Flemish population *before they are actually implemented*. The results of such a simulation should therefore not be misunderstood. *Ex ante* policy evaluations (for instance, the analysis of the "Jobkorting" in this issue) do *not* evaluate the impact of this policy measure by means of an econometric evaluation *ex post.* They only chart the budgetary, distributional and (sometimes) behavioural effects of the *expected* result of the policy reform. Of course, once data are available on the effectiveness of the reform, nothing prevents us to use the toolbox of program evaluation to check our predicted results against observed behaviour, *au contraire*. However, it should be clear that this is not what is produced by the ex-ante simulations of MEFISTO.

2.3 MEFISTO is an arithmetic model

In the publicly available BASIC and LIGHT version of MEFISTO, agents are assumed to behave in exactly the same way before and after the reform. An individual who works, say, part-time before the reform won't change his labour supply decision when facing a much lower marginal tax rate. Obviously, such an assumption is restrictive and not very realistic (especially for large policy reforms). Models that make abstraction of these behavioural responses are called *arithmetic* ones. Like most other MSM's, the BASIC and LIGHT version of MEFISTO are purely arithmetic.[10]

But even an arithmetic MSM is a powerful tool for *ex ante* policy. An arithmetic tax-benefit MSM allows the calculation of taxes and benefits, and hence disposable income after taxes, for all individual agents in the population. Therefore policy changes (e.g. the introduction of the "Jobkorting" or any of the other examples discussed in section five) are translated into changes of individual or household disposable incomes, and hence of welfare of individual economic agents. This allows assessing the impact of the policy change on inequality, on the risk of being in poverty and, when suitably aggregated over the whole population, also produces a first round net budgetary cost of the reform. Although the exclusion of behavioural responses poses a strong limitation, it increases simplicity of using and interpreting the model. In addition, it takes away the need to make assumptions about behavioural responses.

Furthermore, an arithmetic MSM is a *condition sine qua non* for the estimation of behavioural models. By gradually increasing labour supply (i.e. hours worked) of individuals in the sample, and tracking the corresponding change in disposable income, the MSM allows the estimation of effective marginal tax rates and participation tax rates for the whole population.

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[10] As already mentioned in footnote 10 we do also estimate behavioural models, but for methodological and pedagogical reasons we have opted not to integrate these models in an automatic way in the web-enabled BASIC and LIGHT version of MEFISTO. Academic users of the PLUS version though, can straightforwardly integrate MEFISTO with a labour-supply model that explicitly models the labour supply decision of the individual agents (see e.g. Decoster et al., 2011 in this issue).

2.4 MEFISTO is a static model

Not only behaviour is assumed constant in the arithmetic microsimulation model MEFISTO, also the demographic states of the individuals are assumed to be fixed. Such a MSM is called a *static* model.

In contrast, *dynamic* MSM's (such as the model MIDAS of the Federal Planning Bureau; see the next section) determine endogenously the demographic characteristics such as age, marital status, household composition etc., in the course of the simulation. Individuals decide to marry, to split up, to have an additional child, to retire from the labour force, or they undergo events linked to the passage of time (such as growing older or passing away).[11] No need to say that a dynamic model obviously gives valuable additional insights for the (very) long run. The model in fact produces full life cycles for the individuals, such that life cycle distributional analysis – including all the difficulties associated with this at the conceptual level – become possible. For an overview of dynamic microsimulation models, we refer to e.g. O'Donoghue (2001).

Since the methodology, the conceptual framework and the data requirements are more complicated and radically different from the ones in a static model, we have deliberately chosen to stay within the static framework. In section 6 we briefly sketch how we will try to still incorporate long term demographic projections in our static framework by means of the technique of static reweighting.

2.5 MEFISTO is a Flemish model

MEFISTO uses for its calculation the engine of the EUROMOD microsimulation model. Contrary to the EUROMOD project though, which attempts to include policies for all members of the European Union, MEFISTO focuses specifically on the detailed modelling of the set of policy instruments for the Flemish government. Belgian federal competences are modelled as well, as far as they affect the Flemish subpopulation. This will help to clarify the interaction effects between federal and Flemish policy measures. The micro-data used for MEFISTO consists of the subset of Flemish respondents in the SILC survey (see section four for additional details on the data set).

[11] In fact the original suggestion of Orcutt in his 1957-paper was indeed to construct such a dynamic model.

3. WHY A NEW MICRO-SIMULATION MODEL FOR FLANDERS?

There exist a number of tax-benefit models for Belgium and Flanders[12]. This observation raises a valid question on the value added of *another* Flemish microsimulation model. In this section, we will argue that MEFISTO indeed provides added value compared to the existing models, particularly in terms of its availability, user-friendliness and the scope of the covered (Flemish) competences. We do that based on six objective criteria for classifying and evaluating the attractiveness of a microsimulation model in a Flemish policy context. These six criteria are 1) public availability of the model, 2) user-friendliness by means of a graphic user interface, 3) a wide scope of competences, 4) an inclusion of behavioural reactions, 5) a long-term perspective and 6) an inclusion of macro linkages. The choice of these criteria rests obviously on our value judgements. Alternative criteria can certainly be defended, but we believe that the current set of criteria has some *prima facie* attractiveness.

Table 1 summarizes the degree to which each of the criteria is present in the different models that we compare. Additionally, we add the main input data source in the rightmost column.

We start with STASIM, which has been developed by the Herman Deleeck Centre for Social Policy at the University of Antwerp. It is not a microsimulation model *stricto sensu*, but a typical family model. It uses typical families to compute the impact of tax and benefit measures on disposable income (Van Mechelen and Verbist, 2005). By relying on family types rather than representative data the data constraints are largely removed. It is the researcher himself who chooses whether a household member of the selected typical family works or not, whether he is long term unemployed or not, whether he or she is struck by a serious disease or not, etc. The fact that this kind of model does not depend on an underlying micro data set makes it relatively easy to maintain. However, this ease of development and maintenance comes at a price: as all other typical family models, STASIM does not allow for distributional analyses. Thanks to a user-interface the model is user friendly, but it is not publicly available. The model does not include any behavioural reactions in terms of labour supply, benefit take-up or consumption; no macro or long-term links are present, which means that macro indicators such as inflation, economic growth, labour demand or population composition are assumed to be constant. It enables detailed calculations for replacement rates as well as the evolution of the various categories of social security benefits, social contributions and personal income taxes since 1989 onwards.[13] STASIM also includes some social measures that are part of Flemish competences, such as those aimed at reducing childcare costs.

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[12] Many of these models have initially been developed with financial support of Federal Science Policy (e.g. ASTER, MIMOSIS, SIRe).

[13] The reason why typical family models go more easily back in time is precisely because no data set is required.

Table 1: Overview of active Belgian *ex ante* policy models

Models	Publicly available	user-friendly	Wide scope	Behaviour included	long-term perspective	Macro linkages	central dataset
STASIM	-	+	+	-	-	-	FAMILY TYPE
SIRE	-	-	-	-	-	-	IPCAL
MIMOSIS	-	-	+	-	-	-	DWH (2009)
ASTER	-	+	-	+	-	-	HBS (BE)
MIDAS	-	-	-	+	+	+	PSBH
MISIM	-	-	+	-	-	-	SEP/PSBH/ SILC (BE)
EUROMOD	-	+	-	-	-	-	SILC (EU)
MEFISTO (LIGHT)	+	+	-	-	-	-	SILC (BE)
MEFISTO (BASIC)	+	+	+	-	-	-	SILC (BE)
MEFISTO (PLUS)	-	-	+	+	(+)	(+)	SILC (BE)

The next two models in

Table 1 run on register data, namely SIRe (developed and maintained by the FPS Finance, see e.g. Standaert and Valenduc (1996), et al. 1996) and MIMOSIS (developed for and maintained by the FPS Social Security, see e.g. Decoster et al. 2008b, 2009). For SIRe the policy scope is restricted to personal income taxes, whereas MIMOSIS allows for simulations in all personal income taxes and all social security branches. The SIRe model runs on a sample of the so-called IPCAL data base which contains the fiscal forms of the Belgian citizens. MIMOSIS has been used for estimating behavioural reactions in the form of labour supply effects (see Decoster et al. 2007) and runs on a large register data set from the Datawarehouse (DWH) Labour Market and Social Protection from 2009.[14] Both models are exclusively federal and have neither macro nor long-term links.

[14] The most recent version of the MIMOSIS model runs on a sample of register data sampled on January 1st, 2009, with most income data referring to 2008.

ASTER is the only model that covers indirect taxes. It has been developed at the Center for Economic Studies of KU Leuven and runs on the Belgian version of the Household Budget Survey (HBS) (see e.g. Decoster, 1995). It includes behavioural reactions in spending as results of price changes. It has a user friendly interface which makes simulations of changing tax rates relatively straightforward, but unfortunately the model is not web-enabled.

MIDAS, which is based at the Federal Planning Bureau, is the only fully dynamic micro-simulation model in the table. It runs on the 2002 wave of the Panel Survey of Belgian Households (PSBH). It includes behavioural reactions of individuals, and is used for long-term projections (see e.g. De Vil et al., 2010a). Furthermore, the model is constructed to produce results that are coherent with the demographic, macro-economic and socio-economic scenarios provided by the macro model MALTESE (for more details, see De Vil et al., 2010b).

MISIM and EUROMOD both run on the SILC data. MISIM is a static tax-benefit model and was originally developed in the 90s for the data of the Socio-Economic Panel (Herman Deleeck Centre for Social Policy, see Verbist, 2003). It covers personal income taxes and an important part of social security benefits. It has also been used to analyse Flemish competences, such as education (see Cantillon et al., 2006). EUROMOD is a European static tax-benefit model, covering similar federal policy domains as the previous model (see e.g. Sutherland, 2007). It is explicitly designed for international comparative research for all EU member states and also aims to be user friendly through its user interface. At present there is unfortunately no web-enabled public access available.

As discussed above, there are three versions of MEFISTO currently available. These form the last three rows of Table 1. Each of the versions balances user-friendliness and flexibility (and scope) on a different way, and is tailored at the needs of its users, respectively the civil society, policy makers and academic users. Both the BASIC and LIGHT version are web-enabled. At present, the combination of user-friendliness and scope offered by the BASIC version is rather unique in the world.[15] In the present version of the BASIC and LIGHT versions of MEFISTO there is no labour supply behaviour included, nor long term projects or macro linkages. Future developments of MEFISTO, which are described in section 6, will further complete the rows with '+'s. The PLUS version of MEFISTO is very flexible and allows the academic users to compute and simulate a wide variety of policy reforms, including labour supply and non-take up behaviour. In the near future, long term projections (through static reweighting) and macro linkages will become readily available in the PLUS version of MEFISTO (see section 6 for more details).

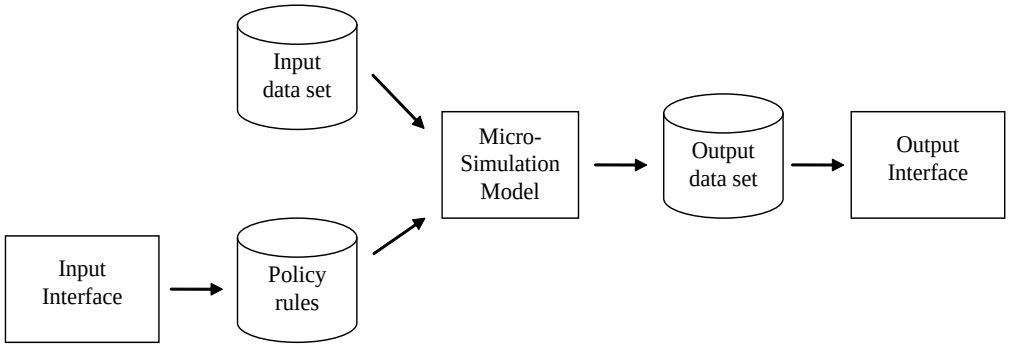
[15] Some other web-enabled large scale tax-benefit micro simulation models include a series of African models developed by WIDER http://african-models.wider.unu.edu/ and a recent French model http://www.revolution-fiscale.fr/ that accompanies Landais et al. (2011). The scope of these models is more limited though.

4. ARCHITECTURE OF MEFISTO

In this section we survey some aspects of the architecture of MEFISTO. Some insight in the structure of the model will be helpful for a better understanding of the possibilities and limitations of the model. An impatient reader who is eager to learn how to implement policy reforms and how to interpret the results, however, can skip this section and move immediately to the next that provides examples and illustrations.

From an architectural point of view, a microsimulation model like MEFISTO requires two kinds of inputs: an input data set and a set of policy rules. Users can change policy parameters through an input interface. Results of the simulation are presented to the user in an output interface, based on an output data set generated during the simulation. Figure 1 gives a schematic representation.

Figure 1: Schematic representation of the architecture of MEFISTO



A first building block is the *input data set* which contains gross incomes along with various socio-economic variables for a representative sample of the total population. The input data set for MEFISTO is the EU-SILC. To be precise, we use a subsample of the Belgian version of EU-SILC which only contains the Flemish residents.[16] Since its start in 2004, EU-SILC has become the standard micro data set for distributional and poverty analysis in the EU (see Decancq et al. 2012).

Working with a data set obtained through a survey rather than based on register data has advantages and disadvantages. Survey data contain additional information on socio-economic variables which are often not available in register data (from administrative or fiscal sources). However, surveys tend to suffer from underrepresentation at the top and/or bottom of the income distribution. Fiscal data, on the other hand, do not contain sub-populations who are fiscally exempted. Due to the limited sample size of surveys like EU-SILC, specific reforms

[16] The Belgian version of EU-SILC is more detailed than the European version which has been aggregated and harmonized by EUROSTAT to ease European cross-country comparisons. In February 2012, the basic MEFISTO model uses data for 3,428 households (8,271 individuals) which are collected in 2008 (incomes of 2007) and uprated to 2010 levels. These input data cannot be downloaded by the users in the BASIC and LIGHT versions, to guarantee compliance with the user agreements

affecting only a particular subpopulation may be biased or not representative (there is only a small number of families with children in childcare present in EU-SILC, for instance).

The second building block of a micro-simulation model consists of a set of parameterized *policy rules* which capture the current tax-benefit system. These policy rules are a translation of the fiscal legislation into a sequence of computer routines.[17] Fiscal legislation changes over time, such that every year a new set of policy rules has to be constructed to keep the model up-to-date. This updating process is rather cumbersome and labour-intensive. It is for this reason that MEFISTO uses the same mathematical grammar as EUROMOD. For the Flemish subpopulation, MEFISTO extends the policy scope of EUROMOD considerably by including specific Flemish competences. For the common set of policy rules, however, the close connection between MEFISTO and the EUROMOD model leads to important spill-overs in terms of updating and validation of the results.

MEFISTO applies the actual policy rules to each fiscal unit of the input data set and simulates the taxes paid and the benefits received. These simulated taxes and benefits are stored for each fiscal unit in the *output data set*, the third building block of MEFISTO. Since the gross incomes are observed in the input data set, and since taxes and benefits have been simulated for each fiscal unit, it is straightforward to compute disposable income for each household, by subtracting simulated taxes from gross incomes and adding simulated benefits. These disposable incomes are corrected for differences in household size by using the standard OECD equivalence scales.[18] The obtained distribution of simulated disposable income is the so-called baseline distribution. It is this baseline and not the actual situation, which is used as the benchmark for later comparisons with the simulated reform distributions.

Although it is the baseline which is used as benchmark, it is important to know how well the baseline reproduces external statistics on the distribution of gross wages and disposable income and on the different components of government revenue.[19] When comparing the simulated baseline distribution of disposable income with the observed distribution from the EU-SILC, we observe an underestimation of income inequality. We measure income inequality by means of the well-known Gini coefficient which takes a value of 0 when there is total equality and a value of 100 in case of maximal inequality. The Gini coefficient of the simulated baseline is 20.93 compared to 25.36 for the observed distribution in policy year 2010. Such an underestimation is rather common in tax-benefit models. [20]

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[17] As of February 2012, the BASIC MEFISTO model implements the tax benefit legislation of 2010. Users of the Plus version have full access to the (source code) of the policy rules, users of the BASIC and LIGHT versions can only change a subset of essential parameters.

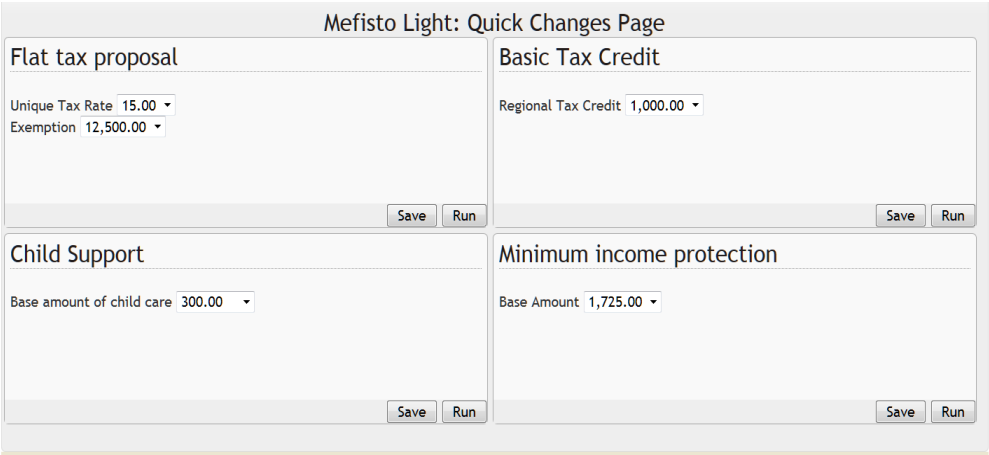
[18] Note that we assume full income pooling within the household so that all within-household inequality is neglected.

[19] For this reason a yearly validation report is published. As we cannot go into the full details of these country reports in the scope of this article, we refer to Vanhille and Spiritus (2011) for a full report of the EUROMOD policies of 2009, which serve as a basis for the MEFISTO policies, and to Decoster and Spiritus (2011) for a validation of the results from MEFISTO.

[20] There is a series of possible explanations for this underestimation of inequality. First, due to data limitations in EU-SILC, various deductibles can unfortunately not be simulated. Second, possible

Users of a micro-simulation model are typically interested in the distributional impact of a change in one or more policy parameters in the set of actual policy rules. Through the *input interface* the desired policy reform can be implemented. Figure 2 provides an example of the input interface of the LIGHT version of MEFISTO.[21] The model then simulates taxes and benefits with the reformed policy rules. The comparison between the baseline distribution of disposable income and the reform distribution shows the distributional impact of the reform. Through the *output interface*, the user can focus on the preferred statistics to summarize this distributional change (such as a measure of change in inequality, poverty or the budgetary impact). The reader finds examples of the output interfaces in the next section.

Figure 2 Input screen of MEFISTO LIGHT (Source: www.flemosi.be)



tax evasion and non-take up of minimum income protection (see Bouckaert and Schokkaert, 2011 in this issue of BTSZ), might affect the results. Third, information is sometimes missing to define the tax units in the same way as the fiscal authorities do. Fourth, there may also be some misreporting in the data, e.g. due to rounding of income amounts by respondents while the MSM gives an exact amount.

[21] The input interface of the BASIC model is shown in the next section by means of some illustrative simulations (e.g. Figure 3).

5. USING AND INTERPRETING MEFISTO: FOUR ILLUSTRATIONS

MEFISTO provides four perspectives in the standard output. Each of these perspectives focuses on one aspect of the distributional impact of the desired policy reform. These perspectives are: 1) gainers and losers, 2) impact on inequality, 3) budgetary impact and 4) impact on poverty. In this section we illustrate these four perspectives with four different policy reforms, namely a flat tax reform, a basic tax credit (the so-called 'jobkorting', an extra child allowance, and a minimum income protection reform. The purpose of this analysis is not to give a thorough discussion of the topics at hand, but rather to illustrate the possibilities of the model.[22] We emphasize that the results presented here are first-order effects, which means that they do not incorporate any behavioural reactions in the form of changes in labour supply and fertility. Given the readership of this journal we will mainly focus on the implementation of the reforms in the BASIC version of MEFISTO, but the illustrated reforms can be implemented through the LIGHT version of MEFISTO straightforwardly (As can be seen from Figure 2, the input screen of the LIGHT version contains all the necessary parameters to implement these four selected reforms).

5.1 A flat tax reform

The first simulation replaces all current personal income tax rates with a flat tax rate of 15% and a base exempted income of 12,500 euro (that is almost a doubling of the actual amount).[23] The relevant parameters from the input interface are shown in

Figure 3. This input interface contains 43 policy parameters in total, within a clear and intuitive structure; each of these parameters can be set at any value. Where necessary help screens are provided which provide guides to the user and some indispensable definitions (mainly based on the Fiscaal Memento, the publication of the Ministry of Finance which summarizes the current state of tax legislation).

By pushing on the 'run' button, the EUROMOD engine computes the impact of the reform for each of the households in the data set. The output screens appear automatically afterwards.

In the output interface of the model one can find the summary outcomes of the reform for the four perspectives mentioned above. We focus here on the discussion of gainers and losers, which provides Figure 4 as summary output. Individuals are classified in deciles according to their disposable equivalized income before the reform. The average impact of the reform for a given decile is presented in euro per month. The more skewed to the right the distribution of gains is, or the more the gains are increasing with the pre-reform disposable income, the more pro-rich the reform is (and vice versa).

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[22] Still, the best way of getting acquainted with MEFISTO is to experiment in a hands-on way with its web-version that can be freely accessed on www.flemosi.be.

[23] These figures have been proposed by Pompen and Niemegeers in De Standaard of August, 28th 2008.

Figure 3: Input screens for flat tax reform (Source: www.flemosi.be)

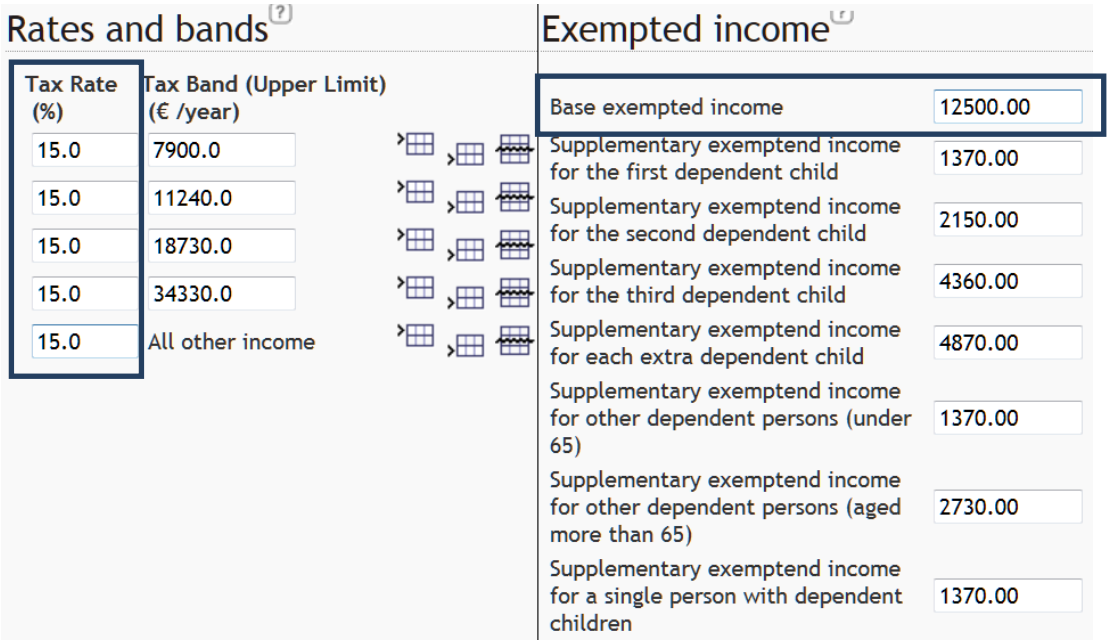
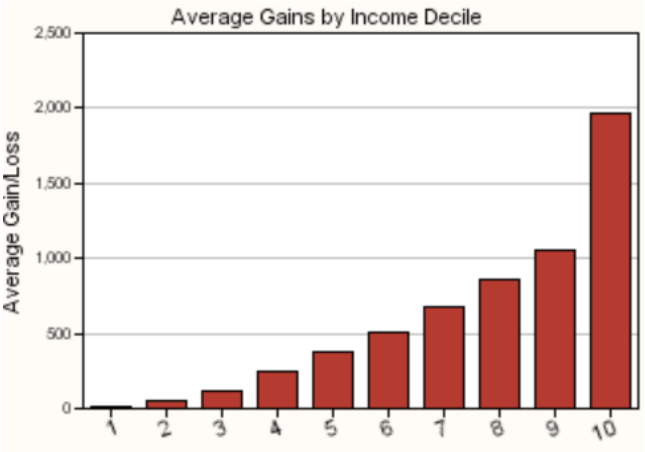


Figure 4: Output screen: average gains by income decile of a flat tax reform (Source: www.flemosi.be)



The average gain per month would on average be almost 600 euro. Absolute gains clearly increase with income: the largest gains are found in the top decile, with an average gain of around 2,000 euro per month, whereas the bottom decile would hardly win in this scenario. This is clearly a pro-rich reform. There are however no losers, against 80% of gainers. A more detailed decomposition of the gainers and losers by subgroups can be obtained when selecting the 'more' button. It is possible to focus on the income deciles, but also on the age of the head of the household, occupation of the head of the household or tenure status. Such an analysis (not shown here for reasons of brevity) shows for instance that a large majority

(76%) of those without an occupation would gain nothing from this reform, whereas largest gains are recorded by the group of legislators, senior officials and managers.

Our aim here is to illustrate some of the possibilities and limitations of MEFISTO, rather than to perform a full analysis of the policy reforms. Behavioural responses for instance, important to calculate the total impact of the reform, are ignored, as is the loss of government revenue. One would need to look for a revenue neutral tariff or take account of the impact on the level and distribution of public goods to fully assess the distributional impact of this reform. For a more thorough analysis of a Belgian flat income tax, see Decoster et al. (2008a).

5.2 An additional in-work tax credit (jobkorting)

With our second reform we simulate the introduction of an extra in-work tax credit in Flanders: the basic amount of the 'jobkorting' is substantially increased from 125 to 1000 euro. What would be the effect of such an extra tax credit on income inequality?

After adjusting the parameters in the appropriate parameters in the input screen and running the model, we observe in the output screen when focussing on the impact on inequality an increase of the Gini coefficient with 0.26 points, indicating a very small increase in inequality. This result may be surprising, as the extra basic tax credit is a lump sum, which one might expect to lead to a sharper decrease in inequality as a lump sum amount is relatively more important for lower incomes. However, the in-work tax credit is only given to those at work, who are relatively more present in the higher end of the income distribution.

A more thorough ex-ante analysis of the effects of a change in the work tax credit (including behavioural responses, such as the change in labour supply) can be found in Decoster et al. (2011) in this special issue.

5.3 Reforming child allowances

In our third example we reform the system of child benefits, by setting all basic amounts at 300 euro per child. This means that the rank progressivity of the system is abolished: in the current system the amount for the second child is higher than for the first child, and the amounts for the third and subsequent children are higher than for the first two children. We show the output screen for budgetary impacts of such a reform in

Figure 5. As can be seen, this measure would cost an extra 2.67 billion euro per year, which entails an increase of 72%.

As in the output screen of 'Gainers and losers', also here additional information can be obtained through a decomposition by subpopulation. The total cost of the reform can be broken down according to decile, age, occupation of the head of household, and tenure status. One result that is found is that the largest budgetary impact is found where the head of household is between 22 and 60 years old, as to be expected.

Figure 5: Output screen: reforming child allowances (in millions of euro per year) (Source: www.flemosi.be)

Total cost of your measures: + 2,655 More >>

	Before	After	Change
Personal Income Taxes	23,461	23,461	0
Social Security Contributions	28,577	28,577	0
Child Benefits	3,739	6,413	+ 2,674
Unemployment Benefits	5,464	5,464	0
Minimum Income Protection	303	284	- 19

Millions of €s per year

Figure 6: Output screen: change in poverty indicators after reform in social assistance (Source: www.flemosi.be)

Change in Numbers of People in Poverty: - 281,167 More >>

	Before	After	Change
People in Poverty	583,177	302,010	- 281,167
Poverty Rate (percent)	9.59	4.97	-4.63
Poverty Gap (total, €000,000s)	110	62	- 48
Poverty Gap (Per Poor Person)	189.02	204.16	+ 15.14

5.4 A reform in minimum income protection

Finally, we illustrate a reform in the domain of social assistance. We raise the amount of minimum income protection to 1,725 euro per month. Figure 6 shows a selection of poverty indicators. The poverty line for a single is set at 60% of median equivalent disposable income observed in the data set at hand, which is about 1,009 euro per month. The poverty rate measures the percentage of Flemish individuals below this threshold (see Decancq et al. 2012). Our reform would reduce the number of people below the original poverty line with about 280,000 individuals. This would be an astonishing reduction in poverty, bringing a group of people out of poverty roughly equal to size of Ghent, Flanders' second city. It would correspond to almost halving the poverty rate (i.e. from 9.59% to 4.97%). This intervention would, however, come at a cost of several billion euro.

The total poverty gap measures the total amount of money necessary to bring all individuals in poverty up to the original poverty line. Also for this indicator we find a considerable reduction. The poverty gap per poor person divides this number by the total number of poor individuals. It increases, which is due to the poverty gap decreasing proportionally less than the number of poor individuals with respect to the original poverty line.

A more detailed breakdown according to deciles and other socio-economic characteristics can be obtained by clicking on 'more'. It shows for instance that especially people living in rented accommodation would be moved out of poverty following this reform. This is explained by the fact that often the lower incomes live in rented accommodation (both private market and social renting).

It should again be noted that effects of this measure on labour supply are ignored, as are the effects of non-take up behaviour in the income support. For more information about this last point, see Bouckaert and Schokkaert (2011).

6. FUTURE EXTENSIONS OF MEFISTO

In this final section we offer a preview of the directions in which MEFISTO will be further extended within the FLEMOSI project in the next years.

6.1 Enlarging the scope

Even if the scope of the current version of MEFISTO is already wide, further efforts will be made to include policy parameters related to indirect taxation, retirement, education, environment and renewable energy taxes and subsidies and housing policies in all three versions of MEFISTO. This will allow a detailed study of the interactions between the various policy domains and open a new series of highly policy relevant research questions.

To do so, important extensions have to be made in the two input building blocks discussed in section four. First of all, the set of policy rules has to be extended, sometimes with thorny and complicated policy rules. Luckily some experience has been gathered in the past by the different project teams (notably, the Center of Economic studies (KU Leuven) on indirect taxation; the Center of Research in Public Economics and Population Economics (ULg) on retirement and the Herman Deleeck Centre of Social Policy on education, environmental and housing policies). Second, the current core data set MEFISTO, that is EU-SILC will be further enriched with variables from other sources like the Belgian Household Budget Surveys, and fiscal register data (IPCAL). This will be done by statistical matching techniques based on spending patterns or multivariate distance metrics.

Finally, this broadened scope raises interesting new conceptual questions on the evaluation of individual well-being. Future well-being evaluations aim at including important non-cash income elements, such as imputed rents, publicly provided services such as education and health services and possibly amenity values (noise, air pollution, recreation) and transport quality elements (public transport accessibility, congestion) (Verbist et al., 2012). These conceptual extensions implement another recommendation of the CMEPSP on the multidimensionality of well-being (Stiglitz-Sen-Fitoussi, 2009: 14)

6.2 Including behaviour

A further extension of MEFISTO will build upon the recent scientific progress of modelling behavioural reactions on top of the current arithmetic version of MEFISTO. In particular, we will develop advanced behavioural models for labour supply including constraints at the demand side of the labour market, for retirement decisions, take-up of benefits and savings behaviour. Some of these behavioural reactions are of great importance even in an unchanged policy environment. The take-up of social benefits e.g. cannot be neglected if one tries to describe the real world income distribution or poverty incidence. The integration of these behavioural models within the MSM makes the model more powerful to assess policy changes. The distributional analysis of winners and losers may be affected. And the comparison of the first round budgetary impact effect with the *net* budgetary effects after incorporating behavioural feedback allows the estimation of the so-called cost recovery effects of policy changes.

6.3 Inclusion of a macro and demographic link

Finally, we stress that MEFISTO is a partial equilibrium model that assumes many interesting and policy relevant variables as exogenous (e.g. gross wages, technology, demographic structure). This suggests that we can push the analysis of the effects of policy changes even further. Indeed, take the case of a policy which decreases labour taxes, with the presumed effect of increasing labour supply. This increase in labour supply will probably induce a change in the equilibrium wage in the labour market, depending on, e.g. labour demand by firms. This change in wages will then again translate into a change in disposable income, in consumer demand, in price changes of goods and services, again in demand for production factors, etc… Modelling all these interactions further down the road is the distinctive feature of macro-modelling, and more especially of Computable General Equilibrium-modelling. Unfortunately, most of these CGE-models are built upon the assumption of one (or a very limited number) of representative agents, and hence give up the advantage of the MSM-methodology in terms of distribution sensitivity.

Recent academic research has progressed, however, on building links and feedbacks between MSM'S on the one hand and macro models on the other (see Aaberge et al. 2007, Bourguignon et al. 2008, Peichl and Schaefer, 2009, or at the theoretical level Magnani and Mercenier, 2009). This linkage strategy allows keeping the best of both methodologies into one integrated assessment of policy changes. As with the MSM we will not start from scratch, but adapt and accommodate an existing and widely used CGE-model for use in the regional context of Flanders, and for explicit linking with the MSM. The modelling platform we have taken as starting point is the GEM-E3 model (see E^3M Lab, 2008 for more information). This is a long term (2015-2050) CGE model with 18 sectors. It contains a Belgian module, which is linked to all other European countries and the rest of the world. At present, the model is mainly used to advise the European Commission on the country effects of policy scenarios for climate, environment, energy and indirect tax policies, but it is readily available to study general economic policies. A recent prototype has been constructed that contains a regionalised Belgian module that is subdivided into three regions which each have their own economic policies and their own government budget constraint.

In section 2 we described MEFISTO as a *static* model. This evidently prevents us to produce genuine dynamic analyses of policy reforms. Yet, as an intermediate step, MEFISTO will be enriched with long term demographic projections, through the method of *static reweighting* (see e.g. Immervoll et al. 2005). This amounts to using observed and forecasted transition probabilities between different demographic states, to construct reweighting factors which can then be applied to the original baseline population weights of EU-SILC to produce a snapshot of future families.[24] In this approach, the demographic structure of the future generations is mimicked by giving more weight in the current data set to subgroups that are forecasted to be more sizeable in the future. If due to ageing the size of the group of elderly increases, for instance, the already present elderly in the current data set get a higher weight which reflects their forecasted population share in the future. Repeated runs of the static MEFISTO on these successive populations can then give an impression of what the effects of policies look like in a changing demographic environment. Such a static reweighting will not turn MEFISTO into a truly dynamic model, but we believe that it leads to interesting insights in a context of rapid demographic change.

6.4 Integration with a typical family model

Finally, we also construct the model MOTYFF, which stands for "Modelling Of a Typical Flemish Family". MOTYFF is a typical family model as studied in section three, MOTYFF uses the same set of policy rules as MEFISTO, which allows for a complementary use of both models (as suggested by the Peer Review on Ex Ante Social Impact Assessment, hosted by the Belgian Federal Public Service for Social Security on 17-18 november 2011). Rather than working with the underlying data of EU-SILC, the user provides the characteristics of the family (in terms of age, family composition, employment status, wage level, etc.). With MOTYFF, one can investigate how the income of the selected household is affected after a socio-economic policy change (for instance, the abolition of the "jobkorting").

Besides the apparent advantage of a typical family model as MOTYFF in terms of its mild data requirements, it is also a useful complement to a genuine MSM. Precisely the main advantage of a MSM, i.e. the assessment of policies and their complex interactions for a representative and heterogeneous population often raises new questions on the interpretation of the results. For that reason, the computation of the effects for some typical families or individuals, identified by the MSM, leads to additional insights. The model can, for instance, highlight the underlying mechanisms behind poverty or inactivity traps.

[24] For first results on this static reweighting method within the FLEMOSI project, see Schockaert and Surkyn (2012).

7. CONCLUSION

In this paper we have introduced MEFISTO as a novel microsimulation model for Flanders. A comparison of the model with the existing models of ex-ante policy evaluation has shown that MEFISTO has important comparative advantages, especially in its availability, user-friendliness and scope. Further extensions of the model along these characteristics will be rolled out in the years to come. It is our hope and conviction that MEFISTO will help to enrich the public debate to choose the most appropriate taxation and social policy reforms in Flanders in the current challenging times. Now, more than ever, it is important that policies are evaluated according to the highest standards available, both *ex ante* as well as *ex post.*

Developing policy models as MEFISTO is obviously laborious and requires very specific knowledge. Some of this know-how is present in Belgian universities, other in the public administrations. One of the challenges for the further development of applicable policy evaluation tools in Flanders is therefore to bridge the gap between these two centres of complementary competence. This is necessary, both in terms of dissemination of results, highlighting of pressing policy questions, provision of access to valuable administrative and survey data sets, as well as in terms of long term funding perspectives. If these challenges can be faced, there is no doubt that more powerful and accessible policy evaluation tools like MEFISTO can be further developed and applied in the near future and that policy making in Flanders will benefit from this.

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