Building the core of the Istat system of models for forecasting the Italian economy: MeMo-It

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Abstract

This paper provides a description of Istat's new Macroeconometric Model MeMo-It. This is the tool used by Istat to produce bi-annual medium-term forecasts of the Italian economy since May 2012.
The key model's features are illustrated and compared with other modeling approaches used in the literature. The paper describes the theoretical foundations of the model along with the set of equations and their estimation. It also presents an assessment of model's performance by focusing on the key multipliers.

Keywords: macroeconometric models, econometric forecasts, theory-first vs data-first models, model specification, fiscal policy multipliers.

1. Introduction

Since January 2011, Istat has been assigned responsibility on macroeconomic forecasting activities.[1] This is not a novel function for National Statistical Institutes (NSIs) since other statistical agencies in Europe are responsible for economic forecasting activities along with statistical data production.[2] In fact, economic modeling in NSIs can benefit from the availability of the wide range of raw and validated statistical data as well as in-house expertise on data management, integration and quality. To implement these tasks Istat created in 2011 the Econometric Studies and Economic Forecasting (SEP) Division that has responsibilities to carry out modeling and research activities, including macroeconomic short-term and medium-term forecasts. In order to ensure that appropriate Chinese walls are in place between economic modeling and statistical production functions, the SEP Division reports directly to the Department head in charge of data integration, quality and corporate innovation.

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[1] Before 2011 Isae was responsabile for macroeconomic forecasting under the Ministry of finance supervision. As a result of the decision to close down Isae, these activities have been moved to Istat.

[2] In this respect, Insee for France and Eurostat are good examples.

This led to the construction of the new macroeconometric model of the Italian economy (MeMo-It) that is presented in this paper.[3]

MeMo-It modeling approach is a mixture of both the London School of Economics (LSE) methodology, related to work on integrated and cointegrated systems, and the Cowles Commission approach referring to the specification and testing of structural macroeconometric models (Hendry et al., 1984, Fair 1974, 1976; 1984; 1994; and 2004). In order to merge theory and data, MeMo-It uses cointegration methods on dynamic sub-systems to estimate theory-interpretable and identified steady state relationships, imposed in the form of equilibrium-correction models.

MeMo-It's structure relies on two basic features: first, it should be simple and easy to communicate to the users; second, it uses annual data, in order to allow for updates twice a year (i.e. as soon as a new vintage of National Accounts, NA, is released in March and October). In this way, the model can be fully updated (both data and parameters' estimates) in the eve of each release of the forecasts.[4]

The first results of Istat's macroeconomic forecasts for 2012-2013 based on MeMo-It have been released in May2012, (http://www.istat.it/it/archivio/62667).

MeMo-It is composed by 53 stochastic equations and 78 identities, and represents an economic system including households, firms, public administration, and foreign sector.

The rest of this paper will focus on the model's characteristics and properties and it is organized as follows. Istat's macroeconomic modeling is outlined in section 2, while section 3 discusses alternative modeling approaches used in the literature and provides arguments in favor of the modeling strategy used by Istat. Section 4 summarizes the main features of MeMo-It and section 5 provides details on its block structure, along with a formal description of the key behavioral equations. Section 6 outlines the model's performance, focusing on multipliers, and section 7 concludes.

2. MeMo-It and Istat economic modeling suite

There is a general consensus in the literature on the relevance of economic forecasting but not on the methods used to perform it (Budd,1999). Naive methods link the latest information on economic activity using a judgmental approach based on the sensibility of the researcher. On the contrary, the econometric approach requires an explicit representation of the economic system through a formal model, whose quality can be tested through statistical data. Using this approach analysts can disentangle ex post the reasons for forecast's success or failure. In other terms, econometric models' outcomes - as opposed to the judgmental approach - can be formally assessed and, hopefully, improved in light of past errors. Reproducibility of outcomes is therefore the main reason supporting the Istat decision to follow formal modeling approach to carry out macroeconomic forecasts.

However, models are deliberate simplifications of the economy and, as such, are prone to errors and misinterpretations due to their high level of aggregation and to the potential

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[3] The model was developed during 2012 by an Istat project team led by Fabio Bacchini. The team was provided scientific advice by prof. Roberto Golinelli.

[4] Along with MeMo-It, Istat's forecast framework includes a set of bridge equations and VAR models to forecast short-run development in the economy (SMeMo-It).

risk of omitted information. As a result, it is unlikely that a single overriding model could cover all relevant aspects of the economy: no model is perfect by definition.

In order to be transparent (i.e. the economic relationships underlying the model must be easy to understand for users), the macroeconomic model has to be of small-scale and use a limited (parsimonious) number of variables and behavioural equations. Therefore, the strength of the modeler lies in the ability to use a potentially vast range of variables of different nature coming from alternative sources, and to appropriately combine their relevant information into a single model (or a suite of models) able to operate in different contexts, over different cyclical phases, or in different periods of the year (Bank of England, 1999, Don and Verbruggen, 2006, and Pagan and Robertson, 2007).

MeMo-It is part of a suite of economic forecasting models developed by Istat, and its role in the modeling framework is prominent, as MeMo-It is the core tool that has to ensure the overall consistency in the system.

MeMo-It is an annual model for the Italian economy that requires two sets of external (exogenous) information over the forecast period. First, consistent assumptions about the developments in the international scenario (such as trade growth, exchange rates, ECB interest rates, and the oil price). Second, an annual estimate of key GDP components obtained from short-term models based on monthly and quarterly data available at the time of forecast.

As shown in the left side of figure 1, the information listed above is exogenously provided through, (i) results based on simulations carried out using the Oxford Global Economic model (OGEM, see Oxford Economics, 2011), and (ii) results from bridge and VAR models (SMeMo-It). In SMeMo-It, selected monthly economic indicators are used to forecast the relevant quarterly National Accounts (NA) variables up to four quarters ahead (Isae, 2003). Conditional on the variables projected using the international scenario based on OGEM, MeMo-It's first simulation year is driven by the SMeMo-It results that use the available information up to the time in the year when the forecasting exercise is conducted (see figure 1). For example, for the forecasts exercise in November, SMeMo-It use the quarterly information on National Account and MeMo-It the annual data updated to the last revision available.

Figure 1 - Istat economic forecasting and policy analysis models framework
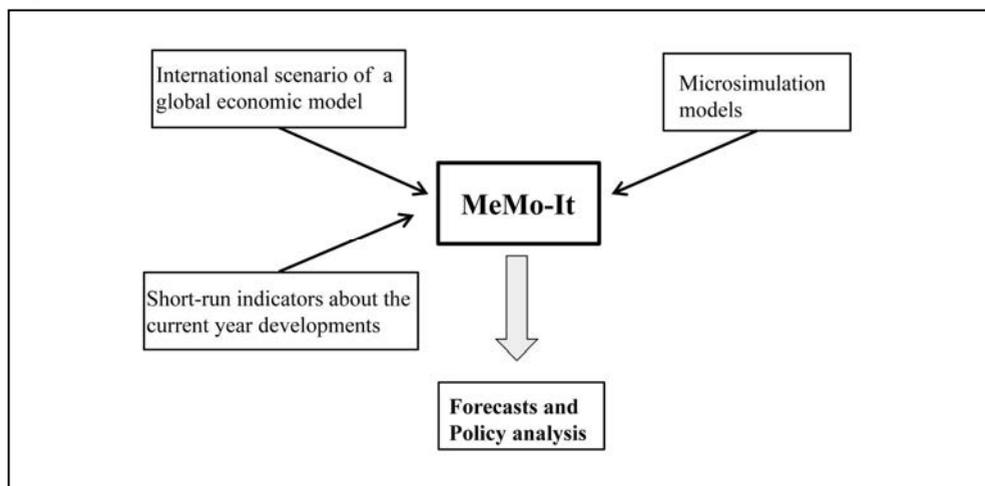
The use of quarterly data estimated via SMeMo-It improves MeMo-It forecasting ability of the current year: the benefit of incorporating into annual models information stemming from short-term indicators to forecast NA variables has been highlighted by a number of studies (for example, Borin et al., 2012, and Kapetanios et al., 2007a).[5]

The comparison of the output of the two auxiliary models in figure 1, with MeMo-It unadjusted forecasts (i.e. before any add factor is used) provides an assessment of the magnitude of potential errors due to the partial information set that can be used at the time the forecast exercise is carried out. The discrepancies in the forecast of the main aggregate among the models should be evidence for either temporary changes or emerging structural shifts in some relation. In the latter case, location shift warnings emerge and motivate the use of corrections in some MeMo-It equations (Clements and Hendry, 2008).

These corrections are introduced in MeMo-It through add factors and intercept corrections, interpreted as a fine-tuning of statistical information rather than a form of combined or judgmental forecasts (Stekler, 2007).

It is well known that for the analysis of policy decision, such as changes in the tax system, introduction of heterogeneity in the model's agents (i.e. households, firms, etc.) would be relevant for the performance of the model (Cogan et al., 2010). This may lead to the need of using micro-level information which cannot be modeled at aggregate level. Therefore, as shown in figure 1, microsimulation models for households and firms could be used to generate additional results to integrate the macroeconomic dataset and enhance model performance. The link between MeMo-It and microsimulation models supports more comprehensive policy analysis (Golinelli and Mantovani, 1992) given that microeconomic models try to be exhaustive representations of particular forms of economic activity, without necessarily ensuring that variables not explained are strictly exogenous (Higson and Holly, 1990). The description of these microeconomic tools along and the corresponding micro-macro links with MeMo-It which are still in progress will be presented in future papers.

3. MeMo-It and the macroeconometric modeling literature

3.1 Theory *versus* data

In introducing their paper about model-building strategies, Kapetanios et al. (2007b) note that "a persistent question in the development of models for macroeconomic policy analysis has been the relative role of economic theory and evidence in their construction". (p. 565). Since the 1960s, following the strand of research at the Cowles Commission (Klein, 1950), when first macroeconometric models were introduced, three methods of quantitative research have emerged over time (Pagan, 1994).

At the beginning, theory - or perhaps better "theoretical reasoning" - suggested a model's specification one equation at a time: the random error was then attached. The "failure" of these models in explaining stagflation in the mid-1970s (Lucas, 1976, and Sims, 1980) produced a paradigm change emphasizing the role of statistical relationships.

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[5] The exact measure of the forecast gain obtained using SMeMo-It together with MeMo-It is part of the research agenda.

Data were regarded as realizations of a multivariate data generation process (DGP) from which the empirical model had to be reduced with the help of theoretical ideas. In this second strand of research (often referred to as London School of Economics (LSE) approach), economic theory lost its "dominance" over model specification.

Further developments (Kydland and Prescott, 1982) refer to micro-founded models based on *a priori* theory such as Real Business Cycle (RBC), or new Keynesian Dynamic Stochastic General Equilibrium models (DSGE) which gives exact micro-foundations to the macro structure, assuming representative agents who solve intertemporal optimization problems under rational expectations. In this context, theory not only is more important than data, but also reaches the highest dominance ever, as the relationships between model and empirical evidence suggest *ad hoc* errors aiming to reconcile theory and available data (see for example Smets and Wouters, 2003).

As brilliantly summarized in Pagan (2003a and 2003b), and Fukac and Pagan (2009), the three modeling approaches listed above entail a sort of dichotomy between two methodological approaches: "theory comes first" *versus* "facts come first". The dichotomy is represented by alternative optimal compositions on the curve plotted in figure 2.

In general, economics has primacy for those modeling strategies located at the top left hand corner while statistics is dominant at the bottom right hand end. Put it in another way at the top we have models (such as RBCs and DSGEs) that aim to interpret the data, while at the bottom we have models (such as VARs) that aim to summarize the data.

The position on the curve can be related to the institutional framework in which modelers operate. The total effort to be spent in the modeling activity leads to the "budget constraint" line. Its slope reflects the relative "price" based on theoretical vs. data management expertise. Figure 2 reports two alternative lines (cases).

Figure 2 - Two alternative models (points) along the "best practice" frontier
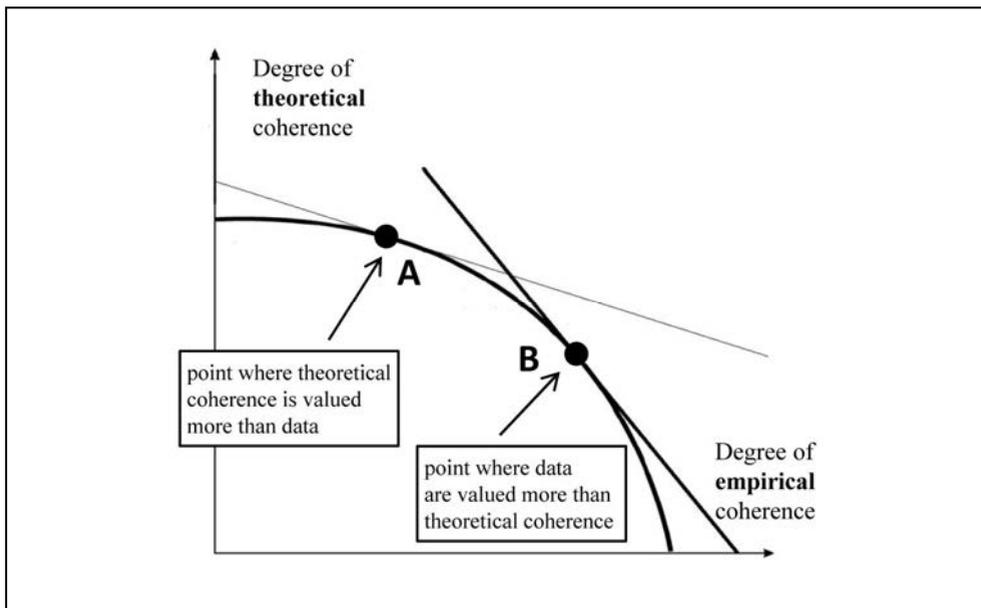
The thin line might represent the academic situation: it has a flat slope on the hypothesis that academic models pay more attention to the theoretical aspects rather than data coherence. As a result, the flat line put the "academic model" in the top-left point A of figure 2. The thick line represents the Istat modeling choice for its new model. In order to understand why Istat found its optimal point in B instead of A, we remark that Istat's "relative price" of using theory-intensive frameworks is higher, resulting in a steeper slope of the budget constraint line: this reflects the institutional tasks which are to be accomplished by Istat are: (1) to provide macroeconomic forecasts two- and five-years ahead (respectively for the macroeconomic scenario and for inflation only); (2) to produce, model and to interpret statistical data for the Italian economy. Therefore, Istat's relative price emphasizes the systematic use of the latest available (and continuously updated) statistical information to feed MeMo-It, and the integration of these best available measures with both theoretical and institutional (e.g. chain accounting identities) knowledge.

3.2 Data-based models *versus* DSGE approach

Models that follow a DSGE framework are guided by the idea of steady states (i.e., that ratios of certain variables are constants, Fukac and Pagan, 2006, and Morley, 2010). This assumption is inconsistent with the results that emerge from an assessment of most economic time series. Therefore, it is quite awkward to use parameters' estimators in models which potentially suffer from this sort of misspecification. In the DSGE context, model parameters' calibration is better motivated than estimation.[6] On the other hand, the pragmatism evoked above (and its adoption by MeMo-It philosophy) needs formal statistic inferences on the ability of the theory to explain actual data, and this requirement makes parameters' calibration techniques less attractive than their statistical estimation.

The relative prominence of data coherency depicted in point B of figure 2 is also admissible on the theoretical ground, as it reflects the epistemological pragmatism advocated in Colander et al. (2008), Hoover et al (2008), and Morley (2010). Following this approach, the idea of optimizing agents in micro-founded models stands for a metaphor, because of the insurmountable problems in aggregating behaviors across actual individuals (Hoover, 2006).[7] Belonging to this methodological strand, MeMo-It makes explicit reference to the empirical information in order to assess the data-admissibility of the theoretical constructs, and does not assume explicit micro-foundations of weak-form.[8] In doing so, MeMo-It deals with the "fallacy of composition" problem to which representative agents' models can be prone (Howitt, 2006), as the aggregation of heterogeneous micro-decisions invariably leads to macro-relations with very different dynamic properties. In general, no simple transition from micro- to macro-behavior seems possible (Pesaran and Smith, 2011).

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[6] However, recently Bayesian estimation methods have been introduced to estimate DSGE parameters, but their statistical properties are unclear. More importantly, for the advocates of "point B" models, very little specification testing is carried out.

[7] Besides the representative agent critique, Driffil (2011) quotes a full paragraph of papers arguing against DSGE by pointing out that they are burdened with far too much economic theory (much of it of dubious value); illuminated by far too little examination of data, facts and history.

[8] A model has weak-form micro-foundations if decisions by agents are governed by explicit dynamic optimization problems. Strong-form micro-foundations require that the formulation of the optimization problem is consistent with the microeconomic evidence; see Faust (2009, p. 53). In other terms, strong-form micro-foundations require that the theoretical model is supported by data.

Another practice in modeling micro-founded models (both RBC and DSGE) is that of filtering out the permanent components from original data. Besides the risk of using wrong filters to extract the cyclical components (Harvey and Jaeger, 1993, and Catão and Pagan, 2011), the use of filtered data implies more attention to dynamics, and leads to the issue of linking the (modeled) filtered series with the actual ones. The Bank of England proposed a "hybrid" route (Harrison et al, 2005) to account for this problem, which however does not seem particularly attractive for MeMo-It. In fact, the combination of core variables (i.e. those filtered and modeled under pure theoretical guidance) and non-core variables (i.e. those not filtered and not included in the core relationships) by additional short-term equations (explaining the non-core variables as a function of the dynamic path of the core variables) is not viable in our context, as MeMo-It aims to interpret and describe the original data.[9]

Finally, Fair (2012a) lists a number of additional examples in which the micro-founded approach makes a problematic use of official statistics.

3.3 MeMo-It theory background

Sims (1980) proposed the VAR approach as a better alternative strategy for empirical macromodeling because he thought the challenging research program to improve traditional macromodeling was impossible to carry out, at least in the short run. However, after more than 30 years (i.e., well beyond Sims's paper "short run") in which also some limitations of VAR and Computable General Equilibrium (CGE) paradigms have been discovered, a range of new formal econometric tools are available to test for wrong specification.

In fact, starting from Sims's critique, there has been an increasing use of statistical integration-cointegration techniques (see the milestone works of Dickey and Fuller, 1979, Engle and Granger, 1987 and Johansen, 1995) to formally test long-run relationships suggested by the economic theory. In other terms, the cointegration property checks whether the theoretical model is a valid approximation of a steady-state situation which, in turn, can be used as an attractor in the specification of dynamic empirical models in equilibrium correction (EqC) form (see the seminal "LSE approach" paper of Hendry et al., 1984). In the same way, Kozicki (2012) suggests that time-series advances, allowing for improvements in the joint modeling of long-run relationships derived from economic theory and short-run dynamics, have led to the development of macroeconometric models that fall between the classical Cowles Commission and the New Keynesian DSGE approaches.

As the cointegration property is invariant to widening the dataset, cointegration analysis is usually accomplished within blocks (subsystems) of strongly interrelated variables in order to make as much use as possible of theory in the blocks' specification (Jansen, 2002). In this way, the modeler can: (i) test whether the theory is relevant in the specification of an empirical model which *also* accommodates institutional features; (ii) try to account for heterogeneity among agents; and (iii) explore in an appropriate way the time dimension of the dataset (Hall, 1995, Granger, 1999, Bardsen et al., 2006, and Bardsen and Nymonen, 2009).

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[9] Further, again from the point of view of the modeller who is oriented towards "point B models", it is particularly worrying that - as it is often the case - the dynamics between core and non-core variables deliver estimates of the speed of adjustment which are very slow.

Therefore, a model's ability to fit the data is an essential quality of empirical models as, given the absence of theoretical truisms, the implications of economic theory have to be confronted with the data in a systematic way. The work of Juselius and Johansen (2005) summarizes this methodological approach (derived from the LSE approach) that is accomplished within the modeling frame of stochastic difference equation in EqC form (Juselius 2009).[10] While the use of cointegration techniques requires a lot of realism about the difficulties in the measurement of the long run relationship and in the assessment of economic theories, in modeling MeMo-It we rather prefer to face these problems instead of assuming *a priori* the knowledge of the answers, as theorists and calibrators are prone to do (Pesaran, 1997, and Smith, 2006).

Garratt et al. (2003) is a good example of an emerging class of medium-small scale models to which MeMo-It aims to belong. In these models, theoretical steady state properties are estimated as cointegrating (long-run) level-relationships, while theory-based short-run cross-equation restrictions are either ignored or, at best, tested in their data congruency before entering the system.[11]

Overall, the statistical assessment of the cointegration properties and, more generally, of the dynamic relationships inside blocks of variables is one possible way to account for the economic theory in "point B" models, i.e., where the data adequacy of the model is more valued. Pesaran and Smith (2011) refer to "avoiding the straitjacket", and give explicit support to the methodology that we can broadly label as the LSE approach in the following way: "[this approach] uses the long-run cointegrating information in the data, but allows more flexible short-run dynamics; recognizes the interconnectedness of large systems and develops methods to estimate high-dimensional systems that help identify certain types of shocks" (p. 15).

Another pragmatic way to react to Sims-Lucas arguments against the early empirical models is their direct improvement by introducing other (both new and revised) techniques (but not explicitly cointegration) to better estimate, test, and analyze them. This wide line of research has been conducted (almost alone, over the last 40 years) by Ray Fair, who can be seen as the most prominent advocate of the "improved" Cowles Commission modeling approach. Since early 1970s, every ten years, Fair (1974 and 1976; 1984; 1994; and 2004) has published a book which can be seen as the update of the best-practice to implement the Cowles Commission simultaneous macro-modeling framework. In each book, Fair updates his *US model* (for the US economy)[12] to analyze several important empirical questions, such as "testing for a New Economy in the 1990s" (Fair, 2004, chapter 6).

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[10] Juselius and Franchi (2007) use this LSE approach and reject the basic hypotheses underlying the theoretical DSGE/RBC models. However, Favero (2009), with reference to models of monetary policy, is slightly less pessimistic: even though he acknowledges the usefulness of the advances due to the LSE approach, he still sees potential improvements in the use of DSGE models approximated by restricted VARs; for forecasting purposes see also Del Negro and Schorfheide (2003). Again on the forecasting side, but in the cointegration field, Anderson et al. (2002) introduce a vector EqC model anchored to long-run relationships suggested by economic theory which delivers forecasts of comparable quality as those made by government agencies and private forecasters.

[11] The recent versions of OECD and Oxford Economics global models are based on this modelling approach too (Hervé et al., 2011, and Oxford Economics, 2011).

[12] Since the 1984 book, the MC model, i.e., his multi-country model, is also described and used in empirical analyses.

Fair (1993) lists six different improvements[13] to the old-fashioned models which have been introduced to answer the mid/end-1970s critiques and to keep "point B" modeling activity on the frontier:[14] (i) parameters of large scale and possibly non-linear models can be estimated with instrumental-variables methods in order to account for possible endogenous regressors (i.e., two-stage and three-stage least squares, 2SLS and 3SLS, and generalized method of moments, GMM); (ii) stochastic simulations of models can be used in order to evaluate the degree of uncertainty surrounding model's; (iii) model-consistent expectations (since the seminal paper by Fair, 1979) can be introduced (if needed by the theory and if relevant for data analysis) in order to handle the issue of rational expectations;[15] (iv) a number of diagnostic tests are available to analyze the residuals of single and/or systems of equations (with both asymptotic and simulated test distributions;[16] (v) forecast encompassing tests of model predictions against those of purely statistical uni- and multivariate models (such as AR and VAR); (vi) the analysis of the model "multipliers" is the way to better understand the consistency of the full empirical system with the underlying economic theories. In this context, one or more exogenous variables of the multipliers are changed, and the effects on endogenous variables due to these changes are computed from either deterministic or stochastic solutions of the model.

As noted in Hendry and Chong (1986), since system's characteristics are the prime concern of macroeconometric models, it might be the case that the validity of every individual component does not guarantee an acceptable overall performance. Therefore, it is understandable why the six Fair techniques listed above produce outcomes which usually refer to the performance and behavior of the whole model rather than to its single elements.

4. Summary of MeMo-It settings

MeMo-It modeling approach is a mixture of both London School of Economics approach and Fair-updated Cowles Commission techniques: in order to merge theory and data, MeMo-It uses cointegration methods on dynamic sub-systems to estimate theory-interpretable and identified steady state relationships, imposed in the form of equilibrium-correction models. However, in absence of weak exogeneity property (see Pesaran et al., 2001), single equations are preliminarily inspected by estimating parameters with two-stage least squares (2SLS). When the whole model is assembled, all MeMo-It parameters are simultaneously estimated with three-stage least squares (3SLS). Note that the use of conventional *formulae* for

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[13] Improvements made possible also thanks to the advances in computer techniques and in hardware power.

[14] Of course, the advocates of the "point A" DSGE models do not fully agree with Fair's claim that models obtained thanks to improvements in the Cowles Commission approach are the better way to macro modelling. Fernandez-Villaverde (2008).

[15] In models adopting "consistent expectations (CE)" technique, all expectations in the model are formed using the future simulated values from the model itself. Intuitively, CE implementation requires an iterative search across alternative solutions to find the one in which variable values expected through the simulation period are indeed generated by the simulation; see Dungan and Wilson (1988).

[16] The aim of these tests is to prevent models from mis-specified dynamics, and to assess the persistence over time (inertia) of variables' fluctuations. Pesaran and Chudik (2011) show that the aggregation across heterogeneous agents with simple micro dynamics can lead to considerably more complicated macro dynamics if micro units are related (i.e., random micro shocks do not cancel out). Therefore, modelling macro dynamics may require more flexible dynamics for adequately represent aggregated data across heterogeneous individuals.

computing the asymptotic covariance of the 2SLS/3SLS estimators and the Wald-type test statistics remain good approximations despite the fact that model variables may be integrated (Hsiao, 1997a and 1997b).

MeMo-It periodicity is annual. This choice has two main advantages. First, from the data coherence point of view it must be noted that, despite very different theoretical views, Fernandez-Villaverde (2008) strongly agrees with the Fair ideas of keeping the model's database as updated as possible: "Statistical agencies are constantly revising data, both to incorporate further information and to update their definitions to reflect advances in economic theory and measurement (p. 699). The issue faced by all macro modelers is how to incorporate those changes in a consistent way. One possibility, followed by Fair (the most reasonable one from our point of view), is to always use the most recent vintage of data. This amounts to asking the model to account for what we currently think actually happened, As seen, annual data entail two NA data releases per year (in March and October), just in the eve of the two releases of the MeMo-It forecast scenarios in May and November. Therefore, as soon as new data are released, MeMo-It database is updated and the whole model is re-estimated with the new (revised) statistical evidence, in order to look for the occurrence of relevant location shifts in the most recent part of the sample to be accounted for with intercept corrections (see Clements and Hendry, 2008);[17] occasionally, some equations may also be revised.

Second, the annual periodicity makes it easier to model medium-long term features of the economy, which helps longer range forecasts (five years ahead and beyond) because, from annual data, medium-term business cycles may be easier to detect (Comin and Gertler, 2006).

In this section we have tried to answer questions such as: "Why Istat decided to build its model by following a mixture of LSE-type data-driven modeling and of Fair-updated Cowles Commission approach instead of adhering to the current strong *vogue* of the DSGE models?". As a bottom line, we can quote Faust (2009, p. 47) to answer the previous question:

> "In bringing new technologies we often see the following pattern: a new idea is adopted *and experiences some initial success; inflated optimism arises among experts regarding what has been achieved; traditional cautions are neglected; catastrophe follows; after a period of recovery, the new idea settles into its more modest but rightful productive place.*"

We hope that the traditional critiques to the macro-modeling strategy can be emended in order to make past errors avoidable: nowadays, it could be that the cautious MeMo-It approach is able to give useful empirical outcomes. More explicitly, "the new humility is not symptomatic of failure, just as the bravado of the 1960s was not symptomatic of success", Diebold (1998, p. 188).

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[17] In looking for location shifts, we can also benefit of the comparison of MeMo-It current-year forecast with those of OGEM and SMeMo-It models, as described in Section 2.

5. The block-structure of MeMo-It

The diagram in figure 3 outlines MeMo-It main relationships. In particular, the five rectangles represent the model's basic blocks which are progressively numbered from 1 to 5 to refer to the subsections where their details are given: supply side (5.1), labor market (5.2), demand side (5.3), prices (5.4), and Government (5.5). In addition, three rhombuses denote the main sources of external information for the age- and gender-structure of the population, the ECB policy interest rate (in the financial sector) and global variables, such as world demand, exchange rates, oil price and other import prices. Arrows identify the causal structure of the MeMo-It relationships across blocks.

Figure 3 - Outline of MeMo-It block relationships
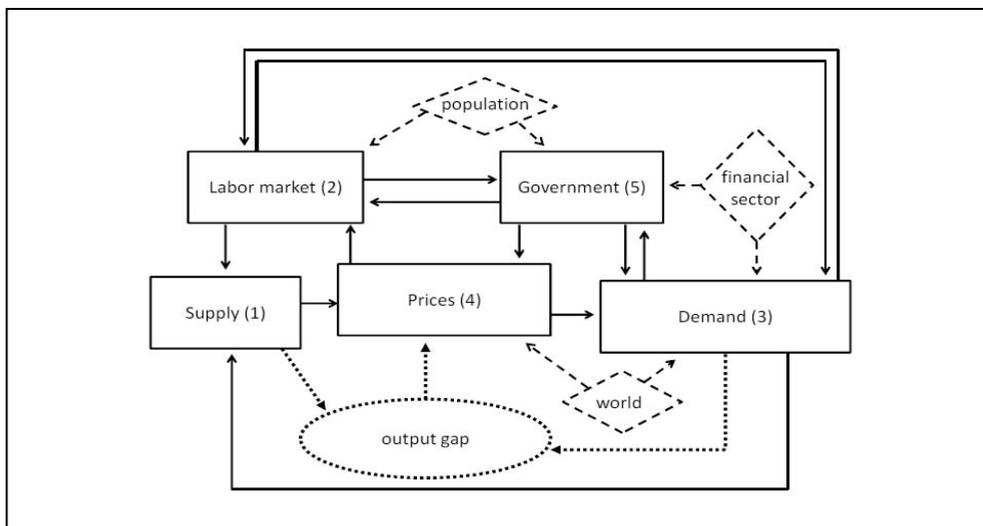
MeMo-It is substantially based on the New-Keynesian approach where the supply side of the economy plays a central role. Accordingly, the underlying key assumption is that in the short-run the economic activity is mainly driven by the demand side, while in the long run the economic system converges to potential output given by the supply side. Prices react to the output gap and, in this way, they accounts for the disequilibrium of supply and demand. The dotted arrows in the lower portion of figure 4 represent the interactions arising from such disequilibrium (between the supply and demand rectangles) with the output gap (in the oval circle) which, in turn, affects the prices rectangle.

In turn, price changes feedback into demand variables' rectangle and into wages in the labor sector rectangle. Real wages and employment affect income distribution and households consumption (in the demand rectangle).

Consumption and incomes in the demand rectangle are the tax bases which, combined with (exogenous) rates, define different form of taxation in the Government rectangle. Direct taxation and public transfers generate income redistribution that impacts demand, while indirect tax and social security contribution rates affect prices and labor cost.

Finally, investments and output in the demand rectangle respectively contribute to supply rectangle through capital stock formation (lower arrow), and employment in the labor market rectangle (upper arrow).

In the following five subsections (numbered as, in brackets, the rectangles of Figure 3) we introduce main features of each block, together with the most relevant equations.[18]

5.1 The supply side

Potential output is modeled as a constant returns to scale Cobb-Douglas production function with two productive inputs, labor and capital stock, assuming a Harrod-neutral technical progress (Beffy et al, 2006; D'Auria et al, 2010), and is defined as:

$$log Ypot_t \equiv HTFP + 0.64 \, log \, Ldpot_t + 0.36 \, log \, K_t \tag{1}$$

where potential labor input (*Ldpot*), expressed in terms of total hours worked, is given by trend labor force participation, working age population, trend hours worked and the NAIRU rate of unemployment (in turn, modeled as a function of lags of the output gap, *GAP*, and the unemployment rate, *UR_T*, plus other structural variables). The left-hand side of figure 4 gives a complete view of these relationships, together with the related parts of the labor market which will be discussed below.

Figure 4 - MeMo-It supply block (left) and the related parts of the labor market
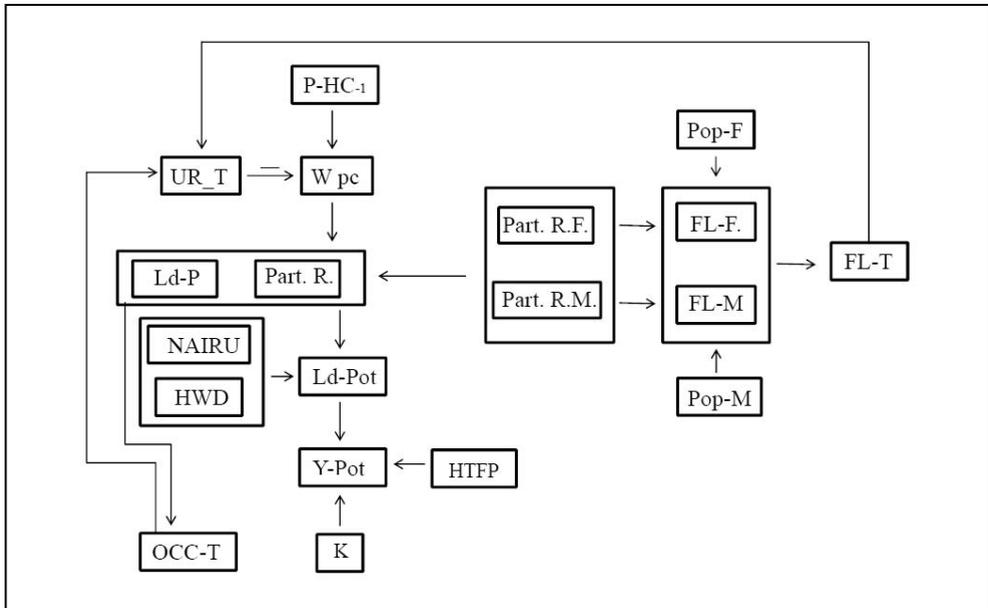
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Potential capital stock (K)[19] is given by the full utilization of the existing capital stock, which is by definition an index of the overall capacity. *HTFP* is the trend component of the Solow residual (total factor productivity). Note that the parameter 0.64 in equation (1) is calibrated on the basis of the average labor share over the historical period.

Finally, as depicted in figure 3, short-run fluctuations are represented by the output gap, which is defined as the deviation of actual (*Yact*) from potential (*Ypot*) GDP:

$$GAP_t \equiv 100 \times \frac{Yact_t - Ypot_t}{Ypot_t} \tag{2}$$

5.2 The labor market

The labor market is represented by three sets of equations that define labor demand, labor supply, and wages. The relationships of these variables with the supply side of MeMo-It are depicted in figure 4.

Labor demand is consistent with the Cobb Douglas production function (Hamermesh 1996, 1999) estimated. Under perfect competition, labor is paid on the basis of its marginal product: labor demand depends on output, and negatively on real wages.

Labor demand is specified according to two behavioral equations and one identity. Labor input is measured in terms of full time equivalent units. The labor demand of the private sector (*LDP*) refers to both employees and self-employed and is specified as follows:

$$\Delta logLDP_t = + 0.49 \ \Delta log \ \frac{YO_t * PY_t}{WPC_t * (1 + TSSC_t)} + 0.39 \ \Delta logLDP_{t-1} - 0.05 \ logLDP_{t-1}$$

$$+ 0.06 \ logYO_{t-1} - 0.09 \ log \ \frac{WPC_{t-1} * (1 + TSSC_{t-1})}{PY_{t-1}} \tag{3}$$

where *YO* is the value added in real terms, *PY* is the GDP deflator, *WPC**(1+*TSSC*) represents compensation of employees per-capita at current prices (*WPC*) augmented with effective payroll tax rate (*TSSC*). Labor demand in the economy is obtained by adding to *LDP* the labor input in the public sector, which is assumed to be exogenous. The corresponding figures in terms of total employment in the economy is defined by *OCCT*.

The labor supply accounts for the diverging patterns of the long-run development of participation rates for both men and women and of business cycle (Lucas and Rapping, 1969). The labor supply equation for females, expressed in terms of participation rates, is specified as follows:

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[19] Capital stock is calculated using a perpetual inventory method approach on the basis of investment spending; see Goldsmith (1951).

$$\Delta logPART\_RF_t = 0.12\, \Delta log\, \frac{WPC_{t-1}}{PCH_{t-1}} + 0.55\, \Delta log\, \frac{OCCT_t}{POP\_F_t} * SHARE\_F_t -$$

$$0.03\, \Delta log\, \frac{HWDW_{t-1}}{PCH_{t-1}} - 0.37\, \Delta logPART\_RM_{t-1} + 0.27\, \Delta logPART\_RF_{t-1} \qquad (4)$$

where *PART_RF* is the female participation rate, *WPC* are per capita earnings, *PCH* is the private consumption deflator, *OCCT* is total employment in the economy, *SHARE_F* is incidence of female employment in total employment, *POP_F* is the female population aged 15 to 64 years. As a result, $\frac{OCCT_t}{POP\_F_t} * SHARE\_F$ is the employment rate (Bodo and Visco, 1987). *HWDW* is an indicator of the nominal wealth of households (Fair, 2004). This specification implies that female labor supply responds to real wage movements as well as to observed variation in real wealth. Finally, *PART_RM* is the male participation rate, which is included in the female equation consistent with households labor supply models (Lundberg, 1988).

The equation for male participation rate is expressed as follows:

$$\Delta logPART\_RM_t = 0.11\, \Delta log\, \frac{WPC_t}{PCH_t} + 0.23\, \Delta log\, \frac{OCCT_t}{POP\_M_t} * (1 - SHARE\_F) - 0.12$$

$$\Delta logPART\_RF_{t-2} \qquad (5)$$

where *POP_M* is the male population aged 15 to 64 years. As a result

$\frac{OCCT_t}{POP\_M_t} * (1 - SHARE\_F_t)$ is the male employment rate.

Total labor force (*LFT*) is then obtained from the estimates of participation rates by gender. Finally, the unemployment rate (*URT*) is specified as an identity in terms of the ratio between the amount of unemployed persons (*FLT-OCCT*) and the labor force.

5.3 The demand side

The demand side is focused on the behavior of economic agents (households, firms), of the public sector and of the rest of the world. Households purchase consumption goods and services, perform residential investments, and accumulate real and financial wealth. Firms invest in other (non-residential) assets, such as machineries and equipment. The public sector affects directly the final demand through its consumption and investment plans, and the rest of the world determines the foreign component of final demand. Main relationships are depicted in figure 5.

Figure 5 - MeMo-It demand block
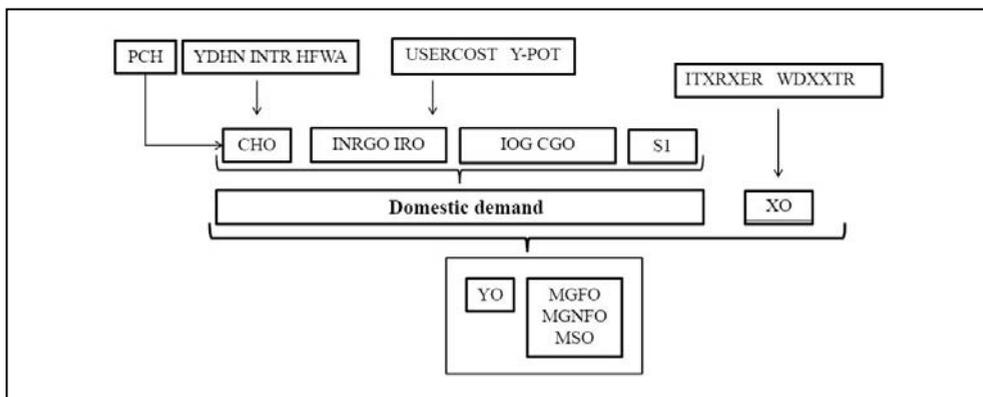
Private consumption and the household sector

Private consumption is modeled according to the permanent income hypothesis (Friedman, 1957), and consistently with Rossi and Visco (1995) and Bassanetti and Zollino (2008), who adopted a similar approach to model the behavior of the Italian consumers.

Real private consumption (*CHO*) is represented by the following relationship between disposable income, financial wealth and interest rate.

$$\Delta logCHO_t = 0.01 + 1.16\,\Delta log\ \frac{YDHN_t}{PCH_t}\ + 0.35\,\Delta log\ \frac{YDHN_{t-1}}{PCH_{t-1}}\ - 0.11$$

$$log\ \frac{CHO_{t-1}\times PCH_{t-1}}{YDHN_{t-1}}\ - 0.15\,\Delta log(\ \frac{1+INTR_{t-1}}{100}\ ) + 0.14\,\Delta log\ \frac{HWFA_{t-1}}{YDHN_{t-1}} \qquad (6)$$

Where $YDHN$ is the disposable income (net of interests) at current prices, $HWFA$ is the financial wealth at current prices, PCH is the consumption deflator and $INTR$ is the short-term nominal interest rate.

The share of disposable income, which is not consumed by the households, increases their real and financial wealth stocks. These two stocks (measured at market prices) are modeled following the perpetual inventory method. The equation for residential investment (IRO) is the following:

$$\Delta logIRO_t = -0.30 + \Delta log\ \frac{YDHN_t}{PIR_t}\ - 0.45\,[\ log(1+\frac{IRN_t}{100}\ ) - \Delta logPIR_t\ ] - 0.12$$

$$log\ \frac{IRO_{t-1}\times PIR_{t-1}}{YDHN_{t-1}}\ + 0.46\,\Delta logPIR_{t-1} \qquad (7)$$

where PIR is the residential investment deflator and IRN is the long-term nominal interest rate.

Investments and the firms sector

Firms purchase machineries, equipment and other goods. These investments are driven by the share of potential output (*Y_POT*), a persistence factor (investments' dynamics), the user cost of capital (*USERCOST*), the gross operating surplus (*GOS*) as a proxy for retained earnings, and the uncertainty (*UNCERT*), measured as the conditional volatility of business cycle shocks. The user cost of capital measures the price of capital services and it is expressed as a function of borrowing cost, depreciation and capital gains on the asset price. The estimated equation for private investment (excluding dwellings, *INRNGO*) is:

$$\frac{INRNGO_t}{Y\_POT_{t-1}} = 0.62 \ \frac{INRNGO_{t-1}}{Y\_POT_{t-2}} \ -0.14 \ \frac{INRNGO_{t-2}}{Y\_POT_{t-3}} \ - 0.07$$

$$(USERCOST_{t-1} + \frac{2 \times USERCOST_{t-2}}{3 \times PINRNG_{t-3}}) - 0.01 \ (\ UNCERT_{t-2} + UNCERT_{t-1} \ ) +$$

$$0.04 \ (\frac{GOS_t + GOS_{t-1} + GOS_{t-2} + GOS_{t-3}}{PY_{t-1} \times Y\_POT_{t-1}} \ ) \tag{8}$$

where $PINRNG$ is the deflator for private investment (excluding dwellings). In MeMo-It, the *UNCERT* variable is modeled as a first-order AR process with parameter equal to 0.35.

Imports, exports and the foreign sector

The foreign sector equation specification is based on an identity accounting for all the transactions between the country and the rest of the world $ROWSALDO$ as follows:

$$ROWSALDO = (XO_t \times PX_t - MO_t \times PM_t) + (WB_t - WBH_t) + (APETIND_t - APUCP_t - TINDN_t)$$
$$+ ROWDT_t + ROWID_t + ROWSB_t + ROWOTH_t \tag{9}$$

where $(XO \times PX - MO \times PM)$ is the trade balance in value XO and MO are exports and imports in volume and PX and PM are the export and import deflators; $(WB - WBH)$ are the net foreign incomes; $(APETIND - APUCP - TINDN)$ are the net indirect taxes; $ROWDT$ are current taxes on income and wealth; $ROWID$ are net capital incomes; $ROWSB$ are social benefits; $ROWOTH$ are other unilateral transfers.

The theoretical approach followed to model the foreign sector behavior refers to the most recent literature, such as Milesi-Ferretti and Lane (2011), and Obstfeld and Rogoff, (2010).

The foreign sector is represented by four equations: one for real exports of goods and services, and the others for real imports of goods and services (i.e. imports of non-fuel goods, imports of fuel goods, and imports of services).

Real exports are expressed as follows:

$\Delta \log XO_t = 1.70 + 1.16 \ \Delta \log WDXXTR_t + 0.30 \ \Delta \log WDXXTR_{t-1} -0.55 \ \Delta \log ITXRXER_t - 0.26 \ \log XO_{t-1} + 0.16 \ \log WDXXTR_{t-1} -0.22 \ \log ITXRXER_{t-1}$ (10)

where $WDXXTR$ represents the world exports in value and $ITXRXER$ the effective real exchange rate.

Real imports of non-fuel goods are specified as follows:

$$\Delta\log \frac{MGNFO_t}{DDO_t} = 1.74 -0.37 \log \frac{MGNFO_{t-1}}{DDO_{t-1}} -0.51\log \frac{PMGNF_{t-1}}{PDD_{t-1}} \tag{11}$$

where DDO is the domestic demand in real terms, $PMNFG$ is the deflator of non-fuel goods imports.

Real imports of fuel goods are modeled as:

$$\Delta\log \frac{MGFO_t}{DDO_t} = -0.16 + 0.66\ \Delta\log PETROL_{t-1} - 0.08 \log \frac{MGFO_{t-1}}{DDO_{t-1}} - 0.05 \log \frac{PMGF_{t-1}}{PDD_{t-1}} \tag{12}$$

where $PETROL$ is the total consumption of oil and $PMFG$ is the deflator of fuel goods imports.

Finally, real imports of services are specified as:

$$\Delta\log \frac{MSO_t}{DDO_t} = -2.27 - 0.59\ (\Delta\log PMS_{t-1} - \Delta\log PDD_{t-1}) - 0.30\log \frac{MGFO_{t-1}}{DDO_{t-1}} +1.85\ \frac{QR_{t-1}}{100} \tag{13}$$

where PMS is the deflator of imported services and QR is the capacity utilization rate.

The net capital income, that mainly includes profits and dividends, is derived by an account relationship and it is explained by the public sector balance. The inclusion of this variable allows to control for the impact of an improvement of the public sector balance that is expected to reduce the risk premium (Caporale and Williams, 2002). The reduction of the risk premium should improve the capital income mainly through the reduction of interest's component. Finally the equation of other unilateral transfers - which includes current, capital, public and private unilateral transfers - expresses a negative correlation between world exports and inflows of transfers.

5.4 Prices and wages

The theoretical framework of the pivot equation for the block of the prices is inspired by a general formulation of the Gordon (1981)'s triangle model, revised and reintroduced in Gordon (1988), where the value added deflator (measured as log levels in first differences, $\Delta\log PV_t$) is explained by three basic determinants: dynamics,[20] demand shocks (excess demand, GAP_t), and supply shocks, which are in turn measured by cost pushing foreign-prices shocks, by labor productivity shocks and by random and uncorrelated stochastic disturbances.

Formally, the pivot equation of MeMo-It block of prices is represented as:

$$\Delta logPV_t = -0.28 + 0.50\ \frac{GAP_t}{100} + 0.51\ \Delta logPV_{t-1} + 0.10\ \Delta logPM_{t-1} - 0.09\ log \frac{Ypot_{t-1}}{Ldpot_{t-1}} \tag{14}$$

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[20] As in Gordon's papers and in accordance with the traditional Keynesian approach, here we assume backward looking expectations, that lead to explanatory inflation inertia in the triangle model. Put differently, MeMo-It pivotal inflation equation might be interpreted as a New-Keynesian Phillips curve (Galì and Gertler, 1999) where expectation are backward- and not forward-looking; see Gordon (2011).

where $\Delta logPV_{t-1}$ measures inflation inertia, GAP_t is the output gap, and the last two explanatory variables are proxies for supply shocks.

Although it belongs to the labor market block, for analogy with the topic tackled in this section, we also report below the estimation results of a traditional Phillips (1958) curve for the log-levels in differences in per capita nominal wage, $\Delta logWIpct$, as it has been developed in the field of cointegration approach by Golinelli (1998). Specifically, MeMo-It wage inflation is modeled as:

$$\Delta logWIpc_t = \text{-}0.22 + 0.63\,\Delta logPCH_{t-1} - 0.04\,log\frac{UR\_T_t}{100} + 0.55\,log\frac{Yact_{t-1}}{ULA_{t-1}} + 0.016\,logCONF_t \quad (15)$$

where $\Delta logPCH_{t-1}$ is the lagged household consumption inflation, UR_T is the unemployment rate, $\dfrac{Yact_{t-1}}{ULA_{t-1}}$ measures labor productivity, and $CONF$ is a proxy measure of the tension on the labor market.

The two equations listed above respectively represent the main sources of income distribution, i.e. the pivot relationship for the domestic prices before taxes (more precisely, the valued added deflator at factor costs), and the nominal per capita domestic wage income. Regarding the sources of price fluctuation coming from abroad, we modeled the total imports' inflation (i.e. the change in log-levels of total imports deflator, $\Delta logPM_t$) as the weighted average of three imported inflation categories:

$$\Delta logPM_t = 0.004 + 0.15\,\Delta logPMGF + 0.81\,\Delta logPMGNF + 0.04\,\Delta logPMS \qquad (16)$$

where: $\Delta logPMGF$, $\Delta logPMGNF$, and $\Delta logPMS$ are the inflation rates of energy goods, non-energy goods, and services respectively. In turn, each of these rates is modeled by a different equation, starting from a general autoregressive-distributed lags (ARDL) model of the first order for: oil price inflation in Dollars ($\Delta logOIL$), log of the relative price of import in non energy goods with respect to world manufactured export ($log\dfrac{PMGNF}{MANEXPRI}$), and the nominal exchange rate of US Dollar against Euro ($\Delta logDOLL\_EUR$). The three retained equations are those which are both congruent with data and have significant parameters.

Given the domestic and foreign pivot prices (PV and PM) all log-differenced deflators of the components of the domestic demand (i.e. households consumption, PCH, Public spending, PCG, non-residential investments, $PINR$, and residential investments PIR) are modeled as estimation-based averages of $\Delta logPV$ and $\Delta logPM$, and of TIVA, TINDR, TCPR, i.e. the effective rates of VAT, other indirect taxes, and subsidies to production respectively. Finally, export price inflation is modeled in a similar way as that of domestic demand components, except for the fact that it is assumed a priori that indirect taxation does not contribute to export prices. As for disaggregate import inflation equations above, models of domestic demand components and exports come from a general-to-specific reduction procedure starting from a general ARDL model.

5.5 - The public sector

The public sector in MeMo-It is represented according to an institutional approach. The endogenous variables are broadly defined by accounting identities and algebraic relations that describe in a stylized way the accounting and normative rules governing the most relevant items of the general government balance sheet account. This allows for the evaluation of both direct and indirect effects of fiscal policies, and to assess the impact of macroeconomic changes on government accounts.

The general representation of the public sector is reported in table 1 where relative independent variables are indicated in brackets and highlighted in bold if exogenous,

On the expenditure side, we break down spending by purchases of good and services, compensation of employees, investments, private production subsidies, contribution to private investments, interest payments, and social benefits.

Good and services net purchases in value (E2) are exogenous and represent a policy instrument. The other outlays (except for the residual item) are endogenously determined in other blocks of the model. Public investment (E6) is set exogenously in real terms and shaped by inflation in nominal terms. Compensation of employees (E1) depends on the average per-capita wage rate for civil servant, in turn related to the private wages estimated in the labor sector of the model, and the number of public employees, that is assumed to be exogenous. Subsidies on private production (E3) and investment (E7) are exogenous. Interest payments (E4) are obtained by multiplying the average cost of the debt, estimated as a function of a lags structure of short- and long-term interest rates and the debt stock. Social benefits in nominal terms (E5) are linked to population age structure and a price indicator.

On the revenue side, social contributions and indirect and direct taxes are modeled explicitly. Social contributions are the sum of those paid by employers (R1) and those paid by employees and by self-employed (R2). Among direct taxes, we model separately taxes on households income (R8), on firm profits (R9) and on capital yields (R10). Indirect taxes are decomposed in value added tax (R3), local tax on productive activities (R5) and excise duties on mineral oils (R4). These outlays are calculated by multiplying the corresponding base (endogenous in the model) by the specific implicit average rate (policy instrument). Excise duties on mineral oils in particular depend on oil barrels consumption (in turn, a function of GDP, energy intensity and oil price in euro) and the tax rate. The property tax (R6) is set exogenously as other residual revenue items.

In MeMo-It the endogenous items of the public sector balance sheet are defined by the product of exogenous policy rates times the corresponding tax bases which in turn are endogenously determined in other blocks of the model.

Therefore, for previous years, such implicit rates are defined by the ratios of specific tax items to the corresponding macroeconomic aggregates which proxy their bases. For the forecast period, the pattern of the policy variables is assumed in order to reflect the fiscal stance. This activity is carried out along 3 steps.

In the first step a baseline scenario is defined on the basis of a simulation from MeMo-It where the updated macroeconomic framework is embedded while fiscal policy instruments are left unchanged.

Table 1 - Public sector representation in MeMo-It

Expenditures	Revenues
E1. Compensation of employees *(average public wage; **public employment**)*	**R1. Social security contributions of employers** *(wage income; **contributions rate**)*
E2. Good and services net purchases	**R2. Social security contributions of employees and self employed** *(wage income; households gross operating surplus as proxy as proxy of self-employed labor income; **contributions rates**)*
E3. Private production subsides *(Gross domestic product; **rate of government subsidies on value added**)*	**R3. Value added tax (IVA)** *(Households consumption; government and ISP consumption; **value added average tax rate**)*
E4. Interest payments *(Stock of public debt; average cost of government debt)*	**R4. Excise tax on petroleum products** *(Total petroleum consumption (barrels);**excise on petroleum products tax rate**)*
E5. Social benefits *(**Population age structure**; Inflation)*	**R5. Regional tax on business (IRAP)** *(Value added at factor cost; **regional tax rate on business**)*
E6. Gross capital formation *(**Volume of public investment**; investment deflator)*	**R6. Property tax (IMU)**
E7. Private investment grants *(Gross private fixed capital formation; **coverage of government subsidies on private***)*	**R7. Other indirect taxes**
E8. Other expenditures	**R8. Personal income tax (IRPEF)** *(Wage income ; households gross operating surplus; households net social benefits income; **personal income implicit average tax rate**)*
	R9. Corporate income tax (IRES) *(Corporate gross operating surplus; **corporate income implicit average tax rate**)*
	R10. Interest and capital income tax *(Households net interest and dividend income; **interest and capital income implicit average tax rate**)*
	R11. Other direct taxes
	R12. Capital and other current taxes

In the second step the MeMo-It fiscal policy instruments[21] are designed according to the new fiscal policies as they are estimated in official planning documents or in assumed simulation scenarios .

In the third step, the main items of general government account are endogenously forecasted by MeMo-It simultaneous interactions between fiscal policy instruments and macroeconomic variables (tax bases - such as income and consumption - prices, private wages, interest rates, etc.).[22]

General government net lending is calculated by subtracting total expenditures from total receipts. Public debt is the cumulative net lending corrected for an exogenous variable to consider stock-flow adjustments (e.g., due to net acquisition of financial assets, changes in volume due to reclassifications, and statistical discrepancy).

For forecasting purposes, policy instruments and exogenous variables are set in order to reflect fiscal policy stance announced by government.

6. Memo-It's fiscal multipliers

Multipliers evaluation is the natural way to look to the model mechanics linking its performances to the theoretical assumptions described by the model specification.

Multipliers' analysis is a sort of impulse-response summary of the reduced form of model's parameters which is informative of the performance of MeMo-It. At the same time multipliers' analysis shed lights on the principal features of the transmission mechanism embodied in the model. These features are relevant in the economic debate on the growth impact of fiscal policy (Cogan et al., 2010, Coenen et al., 2012, Fair 2012b, Reichling and Whalen, 2012).

The term multiplier quantifies the effects on a number of endogenous variables, such as GDP and inflation, of permanent changes in exogenous variables, such as the fiscal instruments. For each endogenous variable we compute and report the deviations (in percentage points for the variables in flows, in absolute differences for variables representing ratios or rates) between the shocked solution and a baseline scenario over the period 2012 to 2018.

In particular, we report the results of four alternative fiscal *stimula*: an increase (i) in Government spending (GS) and (ii) in Government transfers to households (TRH); and a reduction in (iii) households income taxes (ITH), and (iv) in consumption taxes (CT). In order to make results comparable the four fiscal impulses are normalized to yield a permanent impulse (i.e. a reduction in fiscal revenues or an increase of Government spending) which *ex ante* is equal to one percent of baseline GDP in the initial year (i.e. 2012).

Regarding the model's assumptions on monetary policy in the shocked scenarios, we assume an accommodative monetary stance. To complement the results, we also report the

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[21] In government budget planning documents (DEF, Stability Law), impact effects are usually evaluated under the assumption of no changes in the behavior of economic agents (i.e. unchanged tax base) so they can be easily translated into fiscal policy instruments changes.

[22] As explicitly stated in section 2, at this stage we do not account for microeconomic effects originating from policy-induced distributional changes across agents.

findings of an exercise of a monetary policy restriction: a sustained increase in short-term interest rate of 100 basis points.

The direct effects of the four simulated fiscal policy measures pass through different channels in MeMo-It. The increase in public spending (Hp 1) directly affects the domestic demand in real terms, while the increase in transfers to households (Hp 2) and the reduction in households income tax (Hp 3) both affect households disposable income in nominal terms and, in this way, affect consumption. Finally, the reduction in consumption taxes (Hp 4) is implemented through a decrease in the VAT tax rate which leads to reduction fall in consumption prices and an increase in households income in real terms. This, in turn, affects consumption spending Table 2 reports the GDP multipliers. The comparison of the effectiveness of the four alternative fiscal policy instruments clearly shows that short-term growth multipliers are larger for public spending, consistent with most empirical findings (see for example IMF, 2012). However, in the medium-term, tax cuts have a larger impact on potential output and stimulate stronger growth.

Table 2 - Effect of fiscal multipliers on GDP for 4 different instruments

	2012	2013	2014	2015	2016	2017	2018
Hp 1:	0.7	0.5	0.4	0.3	0.2	0.1	0
Hp 2:	0.2	0.4	0.3	0.3	0.2	0.1	0.1
Hp 3:	0.2	0.4	0.4	0.3	0.3	0.2	0.1
Hp 4:	0.1	0.4	0.4	0.4	0.4	0.4	0.3

As an example of the behavior of MeMo-It, table 3 reports the outcome of the HP 1 scenario with respect to real GDP, unemployment rate, consumer prices, and trade balance on GDP. The positive effect on GDP of the increase in Government spending implies pressure on the prices through the output gap. At the same time there are expected slight positive effects on unemployment and negative effects on trade balance because of larger domestic demand and of the worsening of the competitiveness.

Table 3 - Effect of multipliers for HP 1 scenario for relevant variables

	2012	2013	2014	2015	2016	2017	2018
GDP	0.7	0.5	0.4	0.3	0.2	0.1	0
Unemployment	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.1
Consumer price	0.3	0.7	1	1.4	1.6	1.7	1.7
Trade balance (% GDP)	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Overall, the fiscal multipliers are in line with the new-Keynesian models and much smaller than those in Keynesian models (similar results are in Cogan et al., 2010) because the effect on GDP diminishes as the non-government components are crowded out by higher inflation (due to demand pressures on supply and sticky prices). Additionally, if we compare the multiplier results in this paper with those by Coenen et al. (2012) using various DSGE models, we note that the time profile is similar. Qualitatively, similar results (but with reference to the whole Euro Area) are also reported in Oxford Economics (2011), and Hervé et al. (2011). This suggests that, despite different methodological approaches and unequal degree of coherence with data, MeMo-It new-

Keynesian theoretical roots clearly emerge: while in the short run it is possible to manage domestic demand, in the long run fiscal deficits lead to higher prices, lower competitiveness, lower investment and lower output.

7. What next?

This paper provides a snapshot of the main features of the MeMo-It, the macroeconometric model developed by Istat in 2012. However, model development is a continuous process that requires frequent updates of the existing tools to reflect data revisions and updates. Updating the model also involves a complete re-estimation of the most recent specification, unless the emergence of signals of parameter shifts suggests interventions to change the specification of some equations/blocks.

In addition to refining on the model, more efforts are planned on the short-term forecasting tools. The number of bridge equations will be enlarged in order to cover a larger portion of quarterly NAvariables (including public sector variables) and to extend the coverage from real-terms indicators to price indexes and NA deflators.

Finally, as witnessed by the high quality of the discussions which follow, new and better tools are constantly being developed by economic researchers. We aim to use these developments in order to contribute to the outwards shift of the frontier depicted in figure 2 above.

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