Analyzing MeMo-It supply side properties[1]

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Abstract

The aim of this paper is to review the properties of the newly released MeMo-It econometric model by looking at its supply side. The analysis hinges on the link between potential output, which determines the level of GDP in the medium term, and all the channels of transmission that can affect it. The specification of the price, wage and participation rate equations are in turn examined so as to single out the interactions that arise amongst them. The analysis points out also that no homogeneity restrictions are imposed on the price and wage equations and it suggests that the impact on model properties of this decision should be farther investigated. The final section of the paper comments on the size of MeMo-It fiscal multipliers.

Keywords: Model properties, supply side, static and dynamic homogeneity.

1. Introduction

The release of MeMo-it is a welcome addition the number of macroeconometric models used to produce forecasts for the Italian economy. Bacchini et Al. (2013) describe the model for the first time.[3] The authors begin by explaining the reason of their choice of adopting a modelling approach that follows both the LSE tradition and the Ray Fair's updates of the Cowles commission techniques. They state that "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". They also review a wide set of recent contributions on modelling choices and argue that DSGE models are closely related to theory but not closely enough to data. They conclude that, given the institutional mandate received by ISTAT – mostly related to producing forecast for the Italian economy –, such a feature would represents a serious drawback.

This article does not address the above debate. Rathere, it is aimed at providing a practitioner's view on the model properties so as to suggest possible future developments. Section two summarizes the main features of MeMo-It and in particular those of its supply side. The latter is the core of macroeconometric models as it determines most of their properties. Section three follows the standard approach in

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[3] This paper, alongside the accompanying contribution by M. E. Bontempi, is published jointly with it.

analysing models pioneered by the Warwick Macromodelling Beareau in the early 90's.[4] Whilst section four looks at fiscal multipliers of the model. Section five concludes with some suggestions on possible future developments.

2. Main features of the model

This section follows closely Bacchini et Al. (2013) and it is aimed at drawing attention to the main equations of interest.

The ISTAT team made the choice to anchor MeMo-It to a – mostly exogenous – level of potential output which drives GDP growth in the medium term. Potential output is "modelled 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)".

$$\log Ypot = HTFP + \alpha * Ldpot + (1-\alpha) = \log Kt \tag{1}$$

In turn, *Ldpot* represents potential labour in terms of total hours worked, which is a function of trend labor force participation, working age population, trend hours worked and the non-accelerating inflation rate of unemployment. The *NAIRU* depends on lags of the output gap, the unemployment rate and "other structural variables". Output gap is defined as the percentage deviation between actual output (which is computed by adding up demand aggregates) and potential output. The potential capital stock *Kt* corresponds to the full utilization of the current capital stock.

The participation rate is modelled separately for male and female population, with labour supply being primarily driven by per capita earnings.

Price of output (*PV*) is a function of the output gap, of inertia (the lagged term of *PV*) and of two sources of supply shocks, i.e import prices (*PM*) and the ratio between potential output *Ypot* and potential labour *Ldpot*

$$\Delta \log PV_t = -\beta + \psi_1 * \frac{GAP_t}{100} + \gamma * \Delta \log PV_{t-1} + \delta * \Delta \log PM_{t-1} - \psi_2 * \log \frac{Ypot_{t-1}}{Ldpot_{t-1}} \tag{2}$$

Wages respond to consumer inflation, labour productivity, unemployment and a proxy for labour market tensions.

$$\Delta \log WIpc_t = -\chi + \vartheta * \Delta \log PCH_{t-1} - \lambda * \log \frac{UR\_T_t}{100} + \omega * \frac{Yact_{t-1}}{ULA_{t-1}} + \varphi * \log CONF \tag{3}$$

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

[4] See for instance Church et Al. (1995), Wallis (1997) and Murphy (1992).

Notably, all log-differenced deflators of the components of the domestic demand are modelled as estimation-based averages of $\Delta logPV$ and $\Delta logPM$ and of effective tax rates.

Concerning the demand block, consumption is function of disposable income, interest rates and households wealth. Investment depends on potential output, user cost of capital and business uncertainity. Trade equations depend on demand and on price competitiveness.

3. Understanding MeMo-It model properties

There are two, complementary, ways to look at model properties. One is to understand what drives the model behaviour in the long term, the other relates to the medium term and to adjustments from the short term to the medium term.

In relation to the long term, the main issues to be addressed are: what drives GDP growth, whether the unemployment rate settles to a constant value and the net asset stocks of institutional sectors (do they stabilize in the long term as ratio to GDP?). This area of analysis is related to the consistency of model behaviour with its theoretical framework and with the so called steady state properties.

Although most of these properties should be built into the model by construction, it is worthwhile verifying compliancy with theory by way of simulations. The standard approach here is to perform a baseline long-run simulation based on smooth projections of exogenous variables and to verify if the model settles to a stable rate of growth consistent with its theoretical framework. Given the choice of modelling choice of Potential output in MeMo-It (i.e. constant return to scale and Harrod Neutral technological progress) – if holding the NAIRU constant – GDP growth should end up being the sum of TFP growth and growth of labour supply.

Long-run properties are not determinant when trying to assess the model capability to perform forecasts or to evaluate the impact of fiscal policy on GDP. Within this framework it is relevant to understand the model behaviour in the short to medium term.

One way to analyse these properties is to find out how the model responds to shocks to exogenous variables. They are usually given a permanent and constant shock (so called step changes) with respect to their baseline values. The percentage change of endogenous variables of the new simulations with respect to the baseline are then computed. When the shock occurs to a government controlled variable (either expenditure or a tax rate) then the change of endogenous variables are called fiscal multipliers. However important insights on model properties are gained also by changing other exogenous variables such as foreign demand, exchange rates, interest rates, Total Factor Productivity and population growth.

The other means of gaining insight into model properties is to analyse the main model equations and to gauge how the model performs from their specification, the sign of their coefficients and their interrelations. The two methodologies are closely related as simulation can be run to verify what the model inspection suggests and, at the same time, it is equally possible that in order to properly understand the results of simulation it is necessary to look back at the model manual.

Most of the model properties are determined by the modelling of the supply side, including the specification of the price and wage equations.

MeMo-It falls within the category of new-keynesian econometric models. Their distinctive feature is to have output driven in the short term by demand conditions and in

the medium term by the supply side. The means by which this property is achieved is to have a potential output measure built into the model (see for instance Richardson (1990) or Oxford Economics (2011)). If output exceeds (is below) its potential level, there is a price increases (decrease) which determines a loss (gain) of competitiveness. GDP hits its potential level in the medium term because net foreign demand adjusts.[5]

When trying to understand the model properties it is useful to start by distinguishing between shocks that affect the level of GDP temporarily and shocks that generate permanent effects on output. These are usually defined respectively as demand side and supply side shocks. So an initial task is to work out which alteration to exogenous variables will feed into which of the two above categories. Model simulation will then provide evidence on the size of the output response to the shock and the time needed for the output response to reach its peak or, in the case of demand shocks, the time needed for output to return to its baseline value.

A straightforward starting point for undertaking the above analysis is to notice that all the shocks affecting potential output are deemed to change the equilibrium level of GDP. This feature, of course, was deliberately built into the model by the ISTAT team. With reference to equation (1), changes affecting the supply side are those to the trend component of Total Factor Productivity, working age population, working hours, trend participation rate, the NAIRU and, finally, to capital stock. Inspection of the investment equation highlights that capital stock is influenced by the user stock of capital and by gross operating surplus.

Whilst a few of the above variables, amongst which population and Total Factor Productivity, are clearly exogenous in MeMo-It, it is not immediately clear which additional variables will have a permanent effect on GDP. Although it is not within the scope of this paper to undertake a systematic analysis of this topic a few critical issues can be pointed out.

First, it is a challenge to assess which fiscal variables, and in particular tax rates, feed into the supply side of the model. The case of the VAT rate provides a good example. A decrease in the VAT rates will cause a reduction of consumer prices. This will raise both participation, which in MeMo-It depends on real wage levels, and consumption. Several forces (i.e. channels of transmission) at this point will come into play. First of all, owing to a higher participation rate, unemployment should at least initially increase. At the same time, in the short term the output gap should become positive due to higher demand. In turn, this will tend to raise inflation offsetting, at least partially, the direct impact on prices of the VAT decrease. Overall, unless the change in the actual participation rate feeds into the participation trend level there should be no permanent effect on output. In facts, it is important to verify the link between the participation rate of male and female population – affected by the real wage level – and the trend participation rate, which is a component of the potential output equation. The wording of the paper on MeMo-It seems to suggest that there is such a link but it is not completely clear on this matter.

The alternative channel through which the VAT change could have a permanent impact is if it feeds into the NAIRU. As from equation (1), also this variable influences the labour

[5] Also internal demand can be crowded out by inflation. For instance price increases can reduce the real value of financial assess. It is not clear weather this channel operates in MeMo-It.

market component (i.e. *Lpot*) of potential output.[6] The outcome of the fourth simulation (VAT tax reduction), which will be discussed further below, conveys a positive medium term impact. However the channel mentioned by the authors in explaining this increase is typically a demand side one, i.e. the disposable income increase.

The second issue to be pointed out coincides with the modeling choices of prices and wages. They are relevant not only because inflation forecasts are one of the main aims of the model, but also in relation to a clear understanding of the model properties. Indeed, the interaction between wage and price behavior is key in shaping both the model equilibrium and responses to shocks.

The first step of the analysis here consists in asserting that there is no direct link between wage dynamics and price behavior as the value added price equation (2) corresponds to a Philips curve and prices are not modelled as a mark-up on unit labour costs. The inverse is not true, however, because wages respond to consumer prices, which are a function also of the value added deflator.

This preliminary assessment needs to be complemented with further inspection of the relevant model equations and the relationship between price dynamics and cost factors should also be fully examined.

The absence of a wage inflation term in the price equation could lead to incorrect conclusions. It could be argued that in the case of a negative demand shock which causes the labour market slacke, and some downward pressure on wages via a higher unemployment rate, There will be no stabilizing mechanism driving back the economy to its medium term equilibrium. In facts lower wages will imply lower demand which will open a negative output gap leading in turn to lower prices.

A very similar argument can be used for supply side factors affecting wages, such as a change in social security contributions or a productivity increase. For instance, an increase in social security contributions will raise the share of total wages as a percentage of value added; this variable affects negatively, in turn, labour demand, labour income and consumption. The propagation mechanism will eventually reach the value added price through changes in the two GAP (labour and output) variables. In this case the gaps will become negative exerting a downward pressure on prices. Overall a negative impact on the economy it is to be expected, which is consistent with theory. It remains to be seen how the contribution increase will eventually lead to raising prices, which is what is also to be expected on an ex-ante basis. This is a typical case in which inspection of model equations requires support by simulation analysis.

An equally important issue related to wage and price equations specifications concerns the transmission mechanisms and the impact of nominal shocks on the economy. Both equations are characterized by nominal rigidity (e.g. wages do not react immediately to price changes by the same proportion). This is a common feature of most new-keinesian models and it implies that nominal shocks can alter resource allocation and have real effects, at least in the short term. Whether the above effects are temporary or permanent depends on two model properties. One is static homogeneity, which requires that the real equilibrium is unaltered if the level of all nominal variables are changed by the same proportion. This prevents the existence of a trade off in the long run between nominal and real variables.

[6] On the contrary if the tax wedge is one the structural variables that affect the NAIRU in the MeMo-It model and a bridge is built between each individual tax rates and the tax wedge then a permanent effect will be in place.

In practical terms static homogeneity property implies that the log-level coefficients of the (nominal) independent variables add-up to one. This restriction is often tested and imposed in many econometric models and it coincides with the long run estimates of error correction models. Even if static homogeneity holds, the level of activity could still be function of the steady state rate of inflation; dynamic homogeneity must be insured for output to be completely independent from nominal variables. In fact, in the absence of dynamic homogeneity there will be a trade-off between the rate of inflation and output. Also this kind of restrictions can be tested and imposed[7].

In MeMo-It price and wage equations do not have a fully-fledged ECM representation (i.e. a specification in which the dependent variable and one or more independent variables have a lagged log level term). In fact the price equation, as outlined, it's a Philips Curve with the nominal variables modeled in differences only. Furthermore, the absence of dynamic homogeneity seems to imply that the Philips curve is not vertical in the long run. The impact on model properties should be investigated by shocking nominal exogenous variables (for instance the international level of prices and the nominal exchange rate) and finding out the model response of a few key variables.

Of course, the choice not to impose homogeneity (and other) restrictions is fully legitimate and it is consistent with the claim made by the authors that theory should not prevail on data. Such restrictions could be even counterproductive if their introduction reduces the model capability to produce good quality forecasts. Furthermore, their introduction, especially dynamic homogeneity, could be discarded if taking into account the monetary policy setting in Europe. According to this view, the ECB would not allow for permanent (or long lasting) changes of the rate of inflation[8] with respect to its target values.

4. Fiscal Multipliers

The other mentioned methodology which is used for model evaluation is the multipliers' analysis[9]. The set of results provided by the authors refers to fiscal policy shocks – government consumption, increase of transfers to households, personal tax decrease and consumption tax decrease – which are all worth one percent of GDP on an ex-ant basis. These shocks can be divided into two categories: expenditure shocks and tax shocks. The first ones are generally considered to act on the demand side of the economy and are, therefore, expected to produce only temporary effects. Tax shocks activate, at least potentially, an higher number of channels of transmission. To start with, they affect households consumption because acting either on the nominal disposable income or on the level of consumer price. However, they could also impact on the supply side by affecting wage and price behavior (thus influencing competitiveness) and/or labor supply. The existence of these effects depends on the model structure and on the specification of a few key equations.

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[7] See for instance, Angelini et Al. (2006).

[8] The absence of static homogeneity could be more worrisome as, for instance, the model response to an Euro devaluation could lead to a permanent change to the level of output. Would this be a plausible and likely outcome?

[9] Of course, it is not only the output behaviour that provides information on model properties but also the response of other key model variables. The largest possible number of additional model variables should be provided so as to improve the understanding of transmission channels.

The size of multipliers provided by the authors is on the lower tail of the results generally produced by macromodels.[10] This is certainly the case for the consumption shock multiplier, which is equal to 0.7 in the first year. The impact on GDP declines afterwards and it reverts to zero in the final part of the simulation horizon. The peak value of the output response to a shock to government consumption is normally around one. In fact, the size of this multiplier and the speed of its return to zero depend on the price response caused by the positive output gap – usually conveyed by the price equation – as well as on the price elasticities of the export and import equations. Model simulation results can help verifying what holds down the value of the multiplier in MeMo-It. The size of the transfer to household multiplier is even smaller than the government consumption. However this result, as explained by the authors, is consistent with the notion that transfers to families should have a smaller impact on output than direct purchase of goods by the public sector. The multiplier of the personal income tax simulation has a pattern very similar to the income transfers simulation. Indeed, both seem to activate the same transmission channels, i.e. a change of households disposable income. It is unclear why both have a positive, although very small, positive medium term impact on GDP. Finally the VAT decrease simulation is the only one that shows a positive and permanent effect. The reason of it was related by the authors to labour supply effects.

5. The way forward

MeMo-It is a "young" model and the effort put up by the ISTAT team in building it in a very short span of time is highly commendable. With no doubt the debate spurred by its release will bring forward new ideas that should allow the team to further raise the standards achieved with the first release.

This paper suggests that there is a key area for possible improvements. The ISTAT team might want to work on a fine tuning of the supply side block. Thus it could further consider the trade-offs between free parameter estimation and testing and imposing restrictions that can enhance the model medium term behavior. Extensive model simulations can be used to assess progress being made and to evaluate the impact of the changes under scrutiny.

Furthermore it is advisable to further extend on the modeling of financial assets of institutional sectors. It is quite important for MeMo-It to track asset stocks changes relating them to saving and investment decisions. In fact, when running policy simulations, it important to check how asset positions – not only those of the government – unfolds as a consequence of policy changes. This kind of evaluation has become extremely important in the framework of policy assessment in the European Union.

[10] This statement is supported by comparison of multiplier provided in table 1 of Bacchini et Al. (2013) with the values provided by model manuals of the Oxford Economic Forecasting, of the Italian Treasury ITEM econometric model.

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