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## IV. METHODOLOGICAL NOTES

Two notes are provided with reference to the methods and models used for the estimates contained in the DBP:

- 1) A note containing a brief description of the models used in the DBP<sup>25</sup> for the macroeconomic framework and the impact of structural reforms;
- 2) A methodological note on the forecasting criteria provided as an exhibit to the 2017 Economic and Financial Document, with detailed information supplied about the methodology, the forecasting process, and the models used for the macroeconomic and public finance forecasts<sup>26</sup>.

### IV.1 BRIEF DESCRIPTION OF THE MODELS USED

#### The Italian treasury econometric model (ITEM)

The Italian Treasury Econometric Model (ITEM) has been developed and used in the Department of Treasury of the Italian Ministry of the Economy and Finance. ITEM describes the behaviour of key aggregates for the Italian economy at a macroeconomic level. The model includes 371 variables (247 of which are endogenous), and is based on 36 behavioural equations and 211 identities. It is an economic quantitative analysis tool used for both forecasting (it computes medium-term projections conditioned on the international economic framework) and assessing the macroeconomic impact of economic-policy measures or changes in international economic variables. One of ITEM's key features is the joint and explicit representation of the economic environment on both the demand and the supply side. However, the demand conditions influence the responses for the near term, whereas the conditions on the supply side determine the level of equilibrium of the economy in the medium term.

Recently (2016) an important revision of the ITEM econometric model has been carried out, both following the introduction of the new European System of Account (ESA 2010), and to take into account the need of an update sample including most recent data. Indeed the prolonged and severe recession of the Italian economy after the financial crisis has requested to check whether it has led to structural changes in the relations between the variables underlying the different equations of the model. The ITEM model was then re-estimated using the time series of national accounts built according to ESA 2010, considering an estimation sample between 1996: Q1 (starting date of time series defined with ESA 2010) and 2013: Q4. It has been necessary to introduce, in the specification of the different equations, innovations and improvements to capture more appropriately the relationships between the different aggregates taking into account both of the new system of accounts and the estimation sample updated with recent data.

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<sup>25</sup> For additional information, see:

[http://www.dt.mef.gov.it/it/analisi\\_programmazione\\_economico\\_finanziaria/modellistica/](http://www.dt.mef.gov.it/it/analisi_programmazione_economico_finanziaria/modellistica/)

<sup>26</sup> In particular, see Chapters I-III.

## Italian General Equilibrium Model (IGEM)

IGEM is a medium-scale Dynamic General Equilibrium (DGE) model specifically designed for the Italian economy. The model, which is based on explicit microeconomic foundations, has been used to evaluate alternative economic-policy measures, to study the response to temporary shocks of a varying nature and also for effecting long-term analyses (structural reforms). IGEM has all of the main characteristics of a New Keynesian (NK) model, such as the presence of real and nominal rigidities, but it is extended and adapted to the Italian labour market which incorporates a heterogeneous mix of contracts and professional positions. This heterogeneity is an essential factor in pinpointing some of the key mechanisms for transmission of fiscal policies and the effects thereof on GDP and employment. As a result of the flexibility with which IGEM was designed, the additional differentiation allows for simulating a vast array of economic-policy measures, including from a demand perspective, and for replicating the main stylised facts in line with current literature.

## QUEST III - Italy

QUEST III with R&D is one of the latest versions of the class of Dynamic Stochastic General Equilibrium (DSGE) models developed by the European Commission. The QUEST model is a simulation tool to analyse the effects of structural reforms and the response of the economy to a variety of shocks or policy measures. In particular, the version of model used at the Department of Treasury is an extension of the DSGE model developed at the DG ECFIN for quantitative policy analysis and modified for endogenous growth. The Department of Treasury's simulation exercises use the version of the model calibrated for Italy, already employed by the European Commission in multi-country analyses of structural reforms. The endogenous growth version of QUEST III is particularly well-suited to analysing the impact of structural, growth-enhancing economic reforms in relation to the Lisbon Strategy. By including several nominal and real rigidities and imperfectly competitive markets, the model can be used, for example, to study the effect of policies to stimulate competition and reforms aimed at upgrading the quality of human capital.

## MACGEM-IT - A New CGE model for Italy

MACGEM-IT is a static Computable General Equilibrium Model (CGE) for the Italian economy created by the Direction I at the Treasury Department in cooperation with the Department of Economics and Law of the University of Macerata. Built to reflect the characteristics of Italian economy, MACGEM-IT is able to quantify the disaggregated, direct and indirect impacts of fiscal policies.

The model is based on the economic flows identified by the national accounting system and it follows the assumptions on functions and exogenous parameters that are generally accepted. MACGEM-IT model formalizes the relationships among agents in the economy by modelling the functions of behaviours (production, consumption and accumulation) which are able to represent the interdependencies among activities, primary factors and institutional sectors.

Although its framework traces the general equilibrium model, MACGEM-IT includes proper rigidities and imperfections regarding the behaviour of some agents and markets, such as the Government and the labour market.

The impacts of policy measures are observed within the income circular flow and are assessed through the main macroeconomic aggregates' performance, expressed both in real and nominal terms, and are broken down by commodity, activity and Institutional Sector.

In its current version, MACGEM-IT is a static and disaggregated model with multi-input and multi-output production functions. Each agent maximises its own objective function represented by: the maximum profit given the production capacity for activities; the maximum utility given the resources exogenously determined for Institutional Sectors (Households, Firms, Government and Rest of the World).

As mentioned, the production of goods and services by activity (multi-output production function) is modelled using a nested production function in order to capture the substitutions and complements across primary factors and/or intermediate goods in the production process (multi-input production function).

Flows that refers to Government are fully detailed in MACGEM-IT. It takes into consideration the current institutional and regulatory framework, outlining the complex transmission mechanisms of the policy measures with respect to the creation of Government revenues and expenditures.

More specifically, taxes are modelled in detail according to the current fiscal regulation in order to reflect the actual tax bases and tax rates. They also include taxes on products, taxes on activities and taxes on incomes.

## **IV.2 ESTIMATION OF POTENTIAL GDP, THE OUTPUT GAP AND STRUCTURAL BALANCES**

The method used for estimating Italy's potential GDP and output gap is the one agreed at EU level, and is based on a Cobb-Douglas<sup>27</sup> production function whose specifications are to be discussed and decided by the Output Gap Working Group (OGWG) which is part of the European Council's Economic Policy Committee. For additional details on the model, see Section III.3 of the Methodological Note<sup>28</sup> provided as an exhibit to the 2017 EFD.

The estimates in this document have been produced on the basis of the macroeconomic scenario contained in the Update to the 2017 EFD for the years of 2017-2020<sup>29</sup>, with a distinction made between the projections based on trend scenario and those based on the policy scenario. Moreover, estimates have been updated to take into account the recent national account release by ISTAT that occurred after the publication of the 2017 Update of EFD. The parameters reported in the following table were used for the computation of the Non Accelerating Wage

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<sup>27</sup> For additional details, see: D'Auria et al., 2010, 'The production function methodology for calculating potential growth rates and output gaps, European Economy', (Economic Papers n. 420)

<sup>28</sup> In this regard, see:

[http://www.rgs.mef.gov.it/\\_Documenti/VERSIONE-](http://www.rgs.mef.gov.it/_Documenti/VERSIONE-)

[I/Attivita/Contabilita\\_finanza\\_pubblica/DEF/2017/DEF-2017-Notametodologica.pdf](http://www.rgs.mef.gov.it/_Documenti/VERSIONE-I/Attivita/Contabilita_finanza_pubblica/DEF/2017/DEF-2017-Notametodologica.pdf)

<sup>29</sup> For further details on the growth sensitivity analysis, see section III.2 of the EFD 2017 Methodological Note.

Rate of Unemployment (NAWRU). The initialization priors of the trend-cycle decomposition model for Total Factor Productivity (TFP) have also been revised in order to improve the realism of results. With the new priors, trend growth in TFP turns positive in 2017, in line with the Solow Residual observed for recent years and forecasted for future ones.

More specifically, the mean and the variance of the innovation process driving the variance of the cycle equation have been calibrated, respectively, on values of 0.00153 and 0.001531. The initial conditions on the mean and the standard deviation of the cycle amplitude were calibrated on 0.607 and 0.215, respectively, while the mean and variance of the innovation of the second equation were revised to 0.005818 and 0.005819. In addition, the average and variance of trend innovation have been calibrated on the value of 0.0000003539.

**TABLE IV.2-1 INITIAL PARAMETERS FOR THE NAWRU ESTIMATE**

<b>Unchanged Policies and Policy Scenario</b>	
	<b>Value</b>
LB Trend innov var	0
LB Trend slope var	0.04
LB Cycle innov var	0
LB Innovation var 2nd eq.	0
UB Trend innov var	0.095
UB Trend slope var	0.045
UB Cycle innov var	0.19
UB Innovation var 2nd eq.	0.00081614
Exogenous 2nd eq.	0

### **IV.3 METHODOLOGICAL NOTE ON THE CRITERIA FOR FORMULATING MACROECONOMIC AND BUDGETARY PROJECTIONS**

See the document “Nota metodologica sui criteri di formulazione delle previsioni tendenziali” (in Italian only)