DIPARTIMENTO DEL
TESORO
MINISTERO DELL'ECONOMIA E DELLE FINANZE
Direzione I

STUDY VISIT

Econometric models at the Department of the Treasury

- **BRIDGE MODELS** - Quantitative Tools for Business Cycle Analysis
- **IGEM** – Italian General Equilibrium Model
- **IGEM II-IGEM-PA**
- **ITEM** - Italian Treasury Econometric Model
- **ITEM e OEF** - Oxford Economic Forecasting
- **QUEST III** - Quarterly European Simulation Tool
- **CGE Model** - ORANI-IT & TERMITY
- **MACGEM-IT** - A new CGE model for Italy
- **ITFIN**

Technical steps common to various models

- Fixing exogenous variables
- Renormalization: taking into account the most recent data
- Running forecast with different models
- Setting a baseline for the macroeconomic projections
- Iterating with Public finance forecasts and budget measures
  - Including the recent developments in revenues and expenditures
  - From the “unchanged legislation” to the budget measures

Institutional procedures

- A number of units are involved
  - Forecasting is the main task for the unit in charge of the Planning documents
  - Labour market unit, price unit and others contribute as well
- The common view of the Directorate: The Working group on modeling and forecasting
- The interaction with other Departments:
  - General Accounting Department (Ragioneria Generale dello Stato)
  - Finance Department (Dipartimento delle Politiche fiscali)
- Feedback from the Public Debt Management Directorate
- Parliamentary Budget Office (UPB) benchmark

Short term GDP forecast: Bridge models

- Short time forecast models are created for the needs of a continuous monitoring of Italian economy when the official statistics are not yet disposable.

- The forecasts are one/two periods ahead. The variable to predict is the Italian quarterly GDP and its components.

- Bridge models are a kind of models which link the high frequency indicators (monthly) to the aggregate of interest for the prediction (quarterly).

- The indicators are splitted in two categories: hard data (e.g.: industrial production) and soft data (e.g.: confidence indicator)

Bridge models: the indicators

SUPPLY SIDE

GDP

Industrial production
Car registrations
Real short term interest rate
Markit PMI manufacturing: new export orders

DEMAND SIDE

Private consumption

Car registrations
Industrial production of durable goods
Italian stock market index
Volumes of consumer expenditures in services and non-durable goods

Gross fixed investment

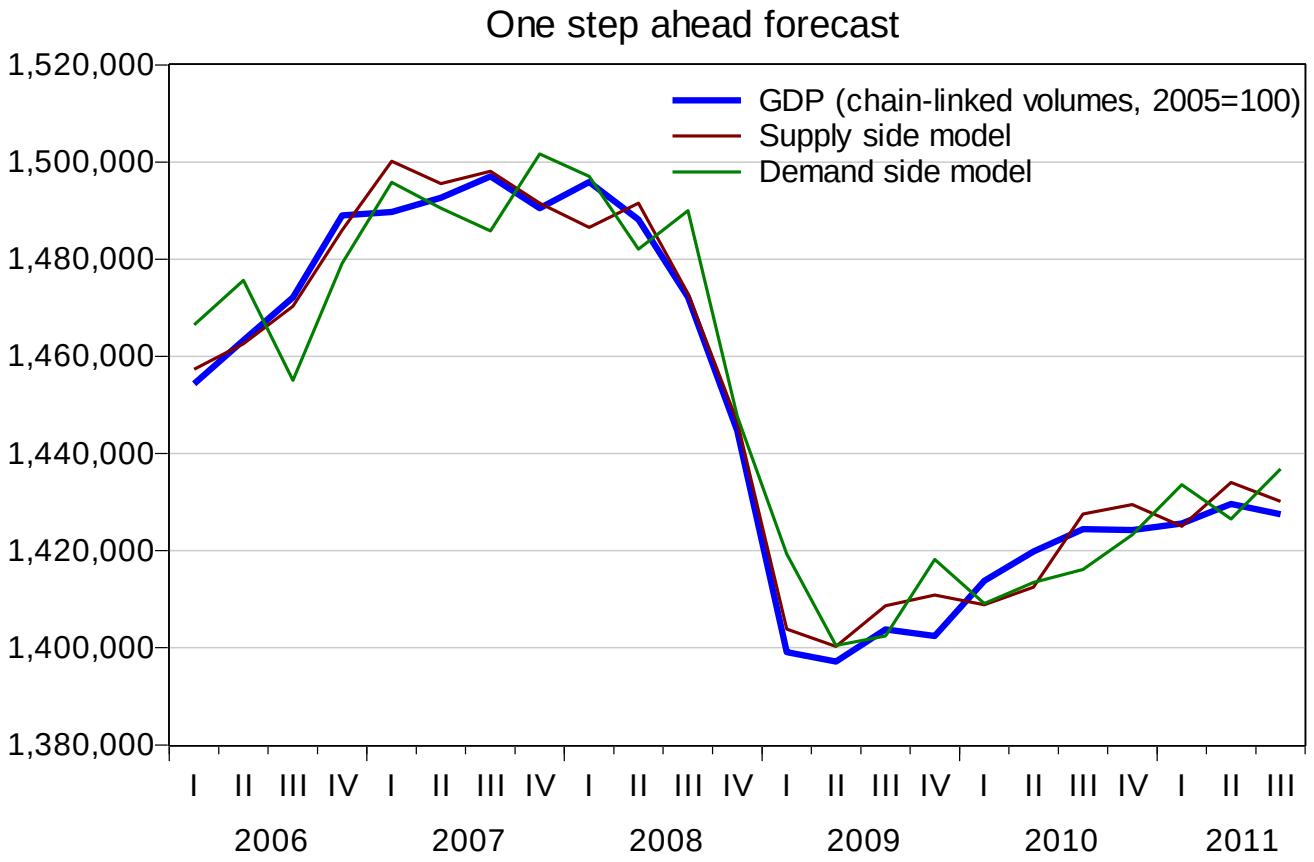
Industrial production of investment goods
Car registrations
Price index of raw materials

Import and Export

Monthly foreign trade statistics
Real effective exchange rate
PPI

Bridge models: the forecast performance

Supply side performs better than demand side



Mixed Frequency Models

- After the recent financial and economic crisis there is an increasing demand for macroeconometric models able to predict the state of the economy and to capture early signals of turning points, especially with the aim of defining an effective economic policy.
- Classical models for short term forecast used by Institutions, such as bridge models and standard factor models, have shown some limitations, especially as regards the time aggregation and the ragged-edge data problem.

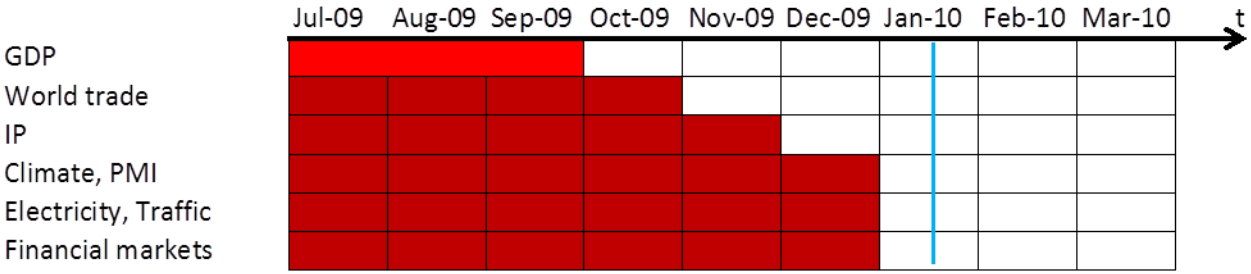
Treasury's mixed frequency model: TRILL

- Mixed frequency factor models are suitable for dealing with this limitations as they exploit efficiently the information of monthly and timely indicators.

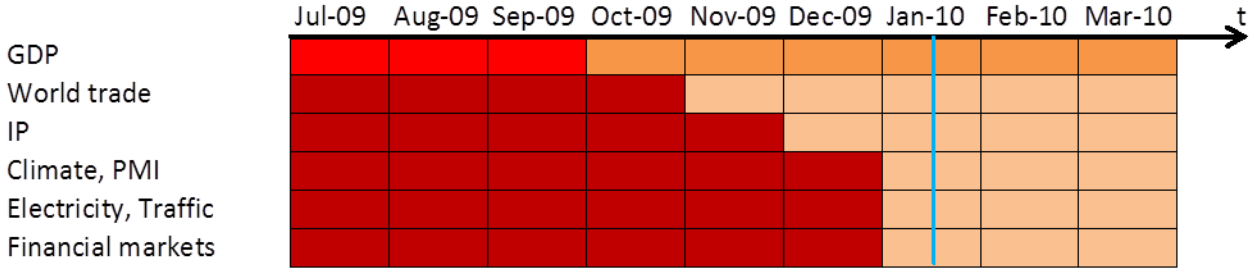
- Our model, TRILL, has at least two great advantages:
  - It is parsimonious and allows explicitly to take into account the cross correlation between indicators and the target variable (GDP) in a multivariate setting.
  - It mitigates the effect of data revisions in the estimates and thus on the forecasts.

Treasury's mixed frequency model: TRILL

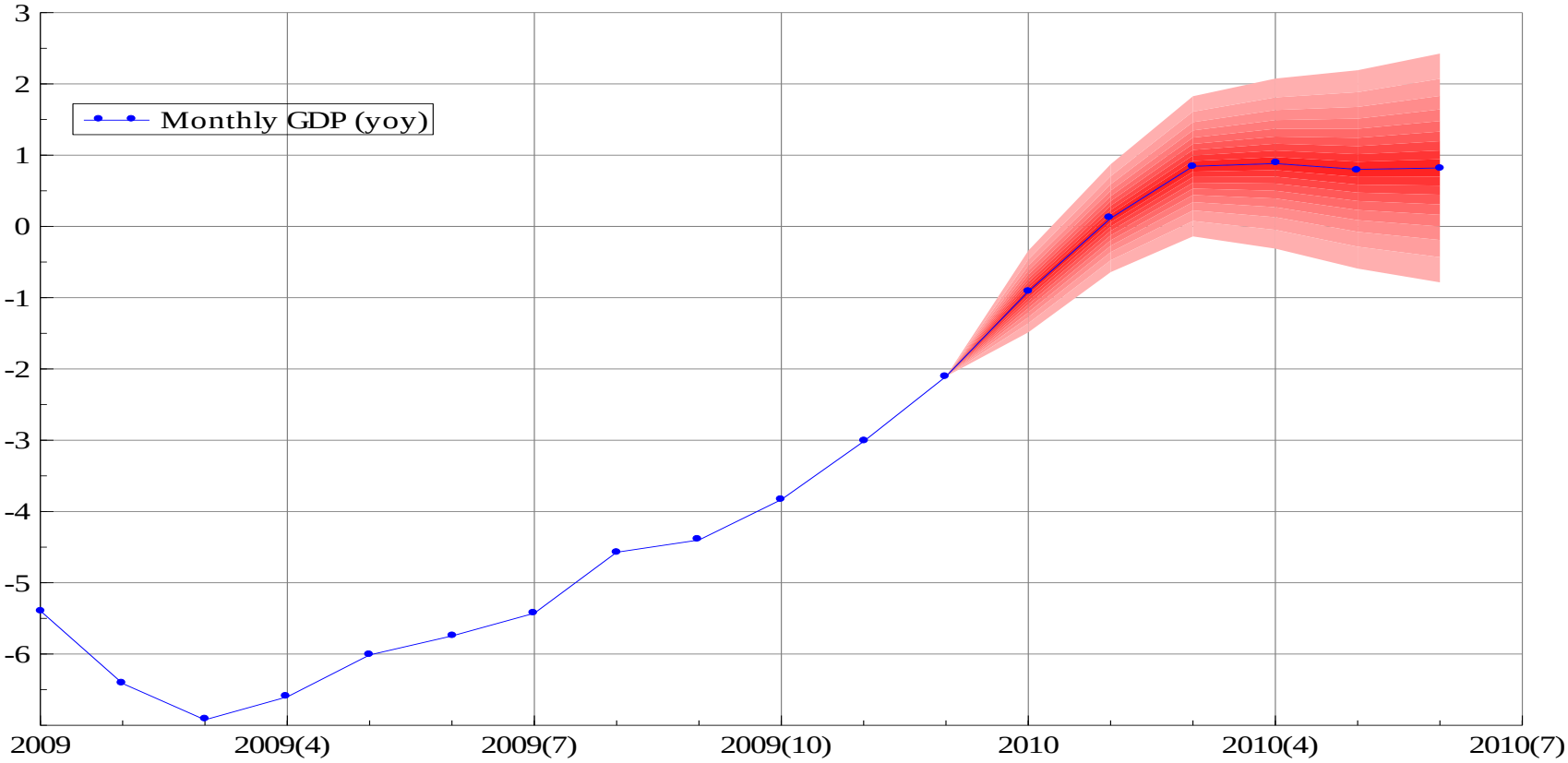
- Official data delay produces a ragged-edge information sample:



- TRILL efficiently solves, in a multivariate and integrated framework, the disaggregation in time of GDP and the problem of an unbalanced sample of indicators



GDP FORECASTS: FAN CHARTS



ITEM – The Italian Treasury Econometric Model

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ITEM, a quarterly macroeconometric model

- ITEM is a quarterly, medium-scale model of the Italian economy in use at the Department of Treasury for producing macroeconomic forecasts and evaluating the impact of shocks to fiscal and other exogenous variables
- ITEM provides a broad coverage of the Italian economic and financial variables and it includes a detailed public finance block
- It comprises 43 behavioural equations and 226 identities. It is estimated over the 1996 – 2015 interval
- Each equation's specification features the error correction mechanism (ECM)
- The expectations' formation mechanism is that of adaptive expectations
- ITEM also considers the accumulation of financial assets and liabilities of the main institutional sectors (households, firms, Government and rest of the world) and consistency between stocks and flows is ensured

ITEM vs DSGE models

- Compared to dynamic general equilibrium (DGE) models, which are more theory-dependent, such as those employed at the Italian Treasury (IGEM and QUEST), ITEM is more driven by data and is targeted to provide a satisfactory characterization of them
- The equations in ITEM are reduced-form relationships between variables that, although derived from economic theory, do not coincide with the first-order conditions from the optimization problems of agents with rational expectations
- On the other hand, however, ITEM significantly departs from the traditional econometric models in the spirit of the Cowles Commission approach
- In particular, the statistical model in ITEM features a rich dynamic structure and has a strong focus on its fit to the data
- In a nutshell, ITEM seeks to find the right balance between orientation to data and theoretical foundations and its main divergence with DGE models deals with the different weights assigned to these two dimensions

The main properties of ITEM

- In ITEM the shocks on the demand side (e.g. a shift in world demand, or government purchases) generate real effects but only in the short run; the effects are only temporary
- The shocks that generate permanent effects on the volumes of economic activity are those imparted on the supply side. For example:
  a) Shifts to tax and social contribution rates that impact on the tax wedge (and therefore on labor costs) and on the user cost of capital
  b) Shifts to labor supply and to demographic aggregates
  c) Shifts to the structural component of TFP
- ITEM has a structure and properties that are in line with those of existing macroeconometric models. In ITEM the supply side plays a relevant role
- The banking and financial sector is not modeled in detail as to what pertains the credit aggregates. The importance of credit and finance in the model arises for the relevant role assigned to interest rates

The supply side in standard macroeconometric models

In general, the models with emphasis on the supply side have the following features:

- The supply side does affect the determination of output
- In these models, the natural, structural level of output (**Y***) is determined through a production function. In particular,

$$Y^* = TFP^* \cdot L^{*a} \cdot K^{1-a} \quad , \text{ where } L^* = LF(1 - nairu)$$

L* is the natural level of employment and ***LF*** is the labor force

- The difference between **Y** and ***Y**** (the output gap) affects prices
- In the medium run, the changes in price competitiveness after a given shock let output revert back towards its natural level

The supply side in ITEM (I)

The supply side in ITEM features some distinctive characteristics:

- In ITEM changes in inventories (INVCH) act as a buffer and are obtained as a residual between resources (GDP + imports, M) and aggregate demand:

$$INVCH = (Y+M) - (C + G + I + X)$$

- GDP (Y) is equal to the market sector and non market sector gross value added (VAM and VANM) plus net indirect tax revenues (TXNET):

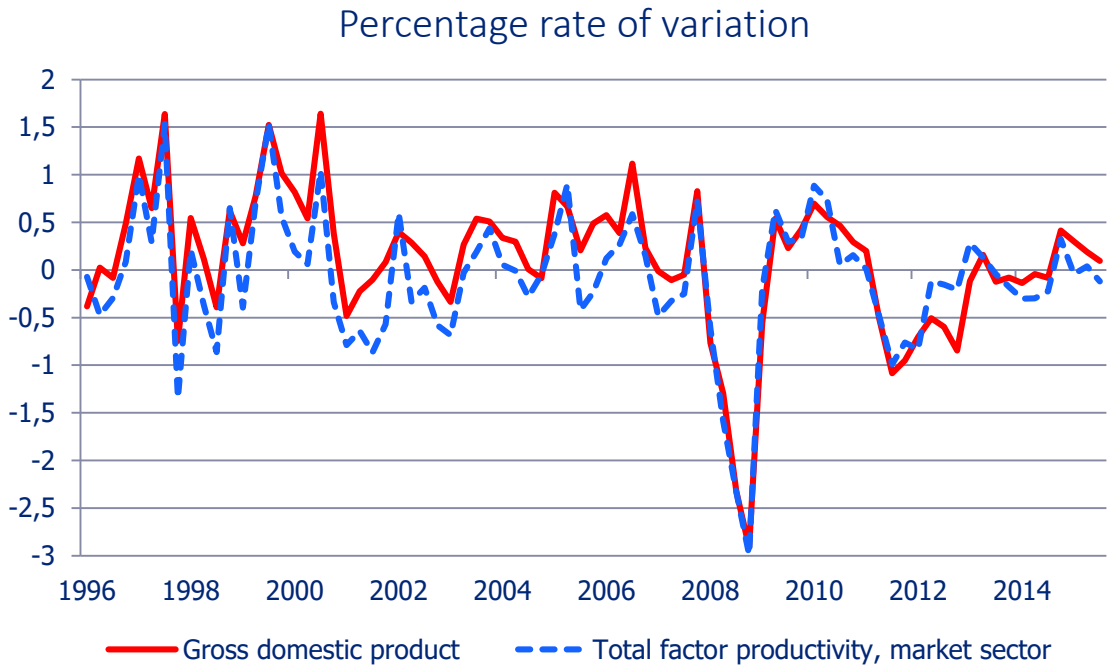
$$Y = VAM + VANM + TXNET$$

- The market sector gross value added (VAM) is determined through a Cobb-Douglas production function:

$$VAM = TFP \cdot L^{a} \cdot K^{1-a}$$

The supply side in ITEM (II)

- To be more specific, we know that the TFP is a markedly procyclical variable
- This occurs because the economic statistics on labor and capital do not fully capture the cyclical variability in the unobserved degree of factor utilization (labor hoarding), which originates from adjustment costs in changing factors of production



The supply side in ITEM (III)

- The Cobb-Douglas production function can therefore be written as:

$$VAM = TFP^* \cdot (U \cdot L)^{a} \cdot (U \cdot K)^{1-a}$$

where ***TFP**** is the structural component of TFP (reflecting thecnical progress and innovation) and ***U*** is the degree of variable intensity of factor utilization

In light of the above expression, we have that $TFP = TFP^* \cdot U$

- ***TFP**** is exogenous and, in sample, it is calculated using the Hodrick-Prescott (HP) statistical filter
- ***U*** is a procyclical variable and is modeled through the following statistical equation:

$$\Delta \log U_t = \Delta \log TFP_t - \Delta \log TFP_t^* = \beta \cdot \Delta \log DEM_t - \gamma \cdot ASAD_{t-1} + \varepsilon_t$$

where ***DEM*** is a cyclical demand indicator and ***ASAD*** is the ratio between total resources and aggregate demand

- Hence, - in the short run - VAM, and therefore output Y, are primarily determined by demand conditions (U_t)

The firms' demand for inputs

- The equation of labor demand and that referred to the purchase of capital goods are specified in accordance with the first order conditions for firms' profit maximization
- In the long run – and by defining the variables in log (ignoring the intercept) – the equations have the following form:

$$L = VAM - W/P$$

$$K = L - UC / ULC$$

where:

W/P is the real wage, ***ULC*** is the unit labor cost and ***UC*** the user cost of capital

The components of aggregate demand

- Household expenditure on consumption goods is a function of real disposable income and of households' net financial wealth
- Government purchases is an exogenous variable and so is public investment
- In the long run, firms' fixed investments are a function of employment, the unit cost of labor and the user cost of capital. In the short run they also depend on a proxy of firms' *cash flow* and profits and on output (accelerator mechanism)
- Exports (X) and Imports (M; distinguishing between oil and non oil imports) have distinct equations in which they are a function of the real effective exchange rate and the evolution of demand (world and domestic demand, respectively)

Prices and wage (Cost push with wage bargaining)

- The value added deflator of the market sector is the dependent variable in the price equation. Prices *(**P**)* respond to unit labor costs *(**ULC**)* with a unit elasticity. They also respond to the gap between measured TFP and its structural component (***TFP*** *)

$$P = ULC + \varphi \cdot (TFP - TFP^*)$$

This equation implies a procyclical *mark-up*

- Real wages depend upon labor productivity *(**PROD**)*, the tax wedge *(**WEDGE**)* *and the unemployment rate (**ur**)* :

$$W/P = PROD + \delta \cdot WEDGE - \zeta \cdot ur$$

- The two equations above in the model contribute to determine an equilibrium rate of unemployment

The labor market

- The equilibrium in the labor market and the unemployment rate are also determined by an equation for labor market participation. Labor force (LF) is modelled as follows:

$$LF = N \cdot LFPR(\Delta L, Trend, W/P/PROD)$$

Where **N** is working-age population and **LFPR** is the labor force participation rate

- In the short run **LFPR** is a function of changes in the employment rate and therefore of cyclical conditions.

- In the long run, **LFPR** is determined by socio-demographic factors which are captured by a trend term and by the ratio of the real wage to labor productivity

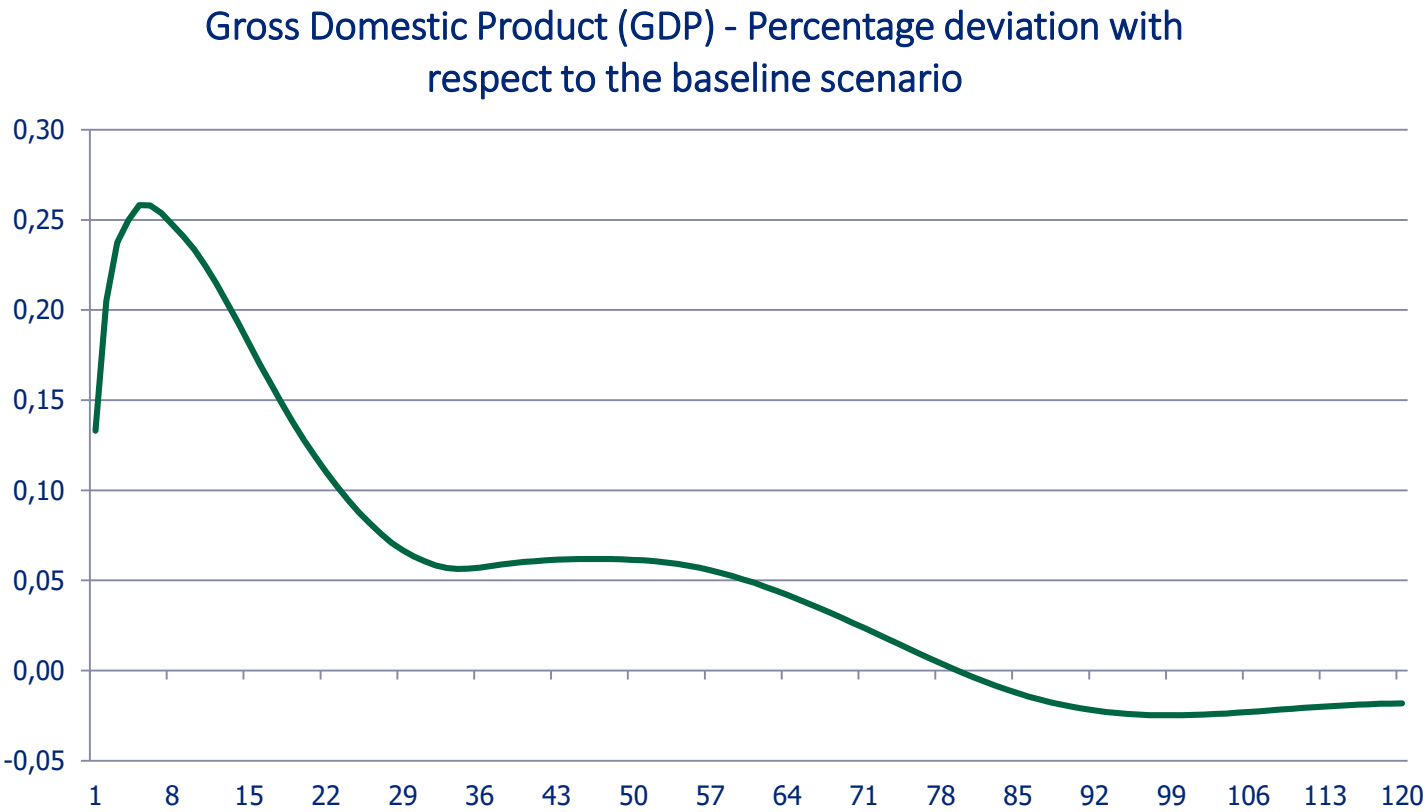
- The so called dynamic omogeneity property does not hold in the price and wage equations of ITEM. Therefore, the equilibrium unemployment rate is determined by the rate of growth of the long run drivers of economic growth (structural TFP, labor force, ec.)

The model's properties by focusing on impulse response functions

- Let us examine the model properties by focusing on dynamic impulse response functions (IRF)
- In particular, we consider a variety of exogenous shocks and examine their macroeconomic impact by focusing on the response of GDP over time
- As anticipated, shocks of the demand-type, albeit permanent, generate temporary effects on output
- Conversely, supply shocks generate permanent effects on output

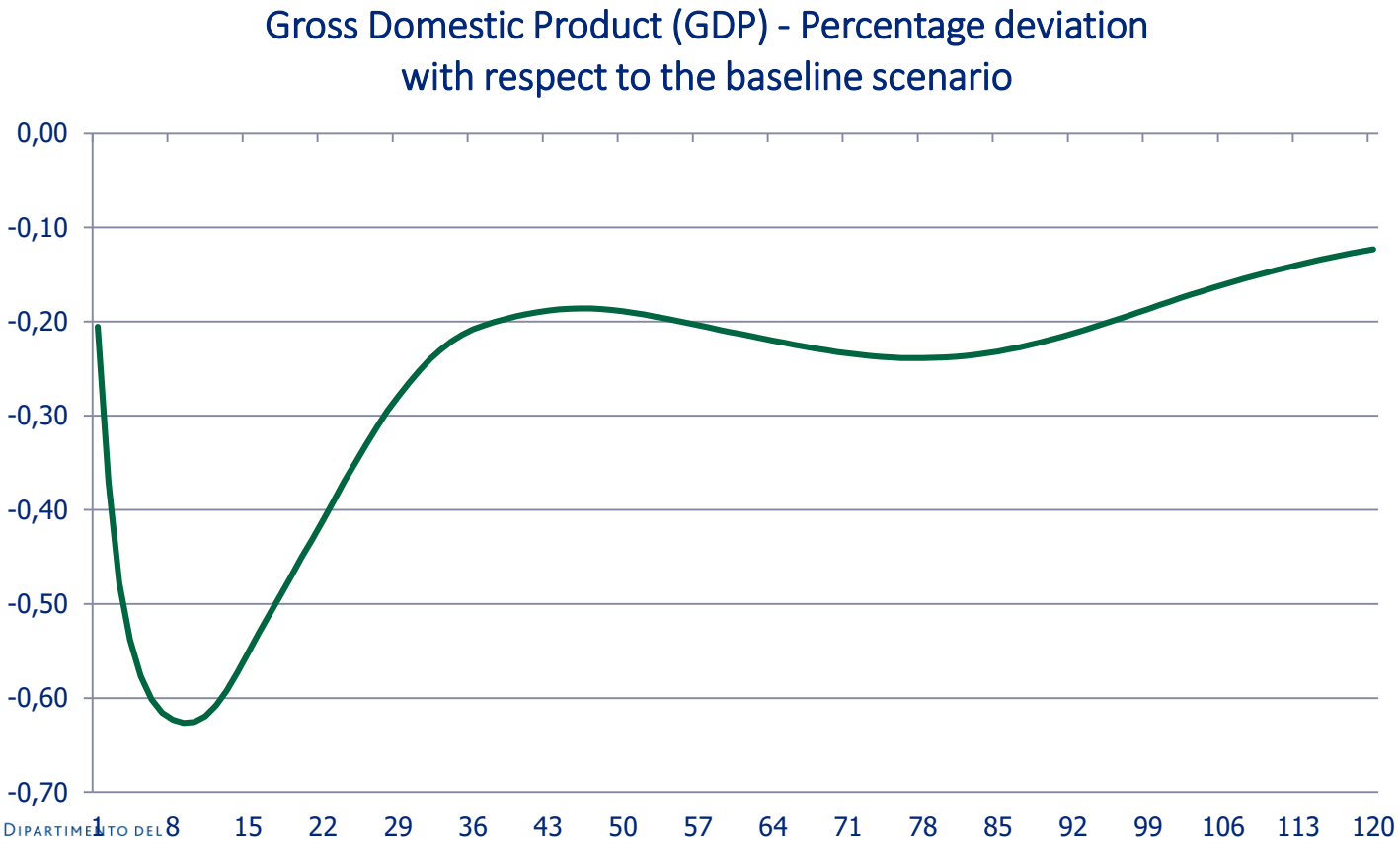
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

1) Shock to World demand (1 per cent increase)



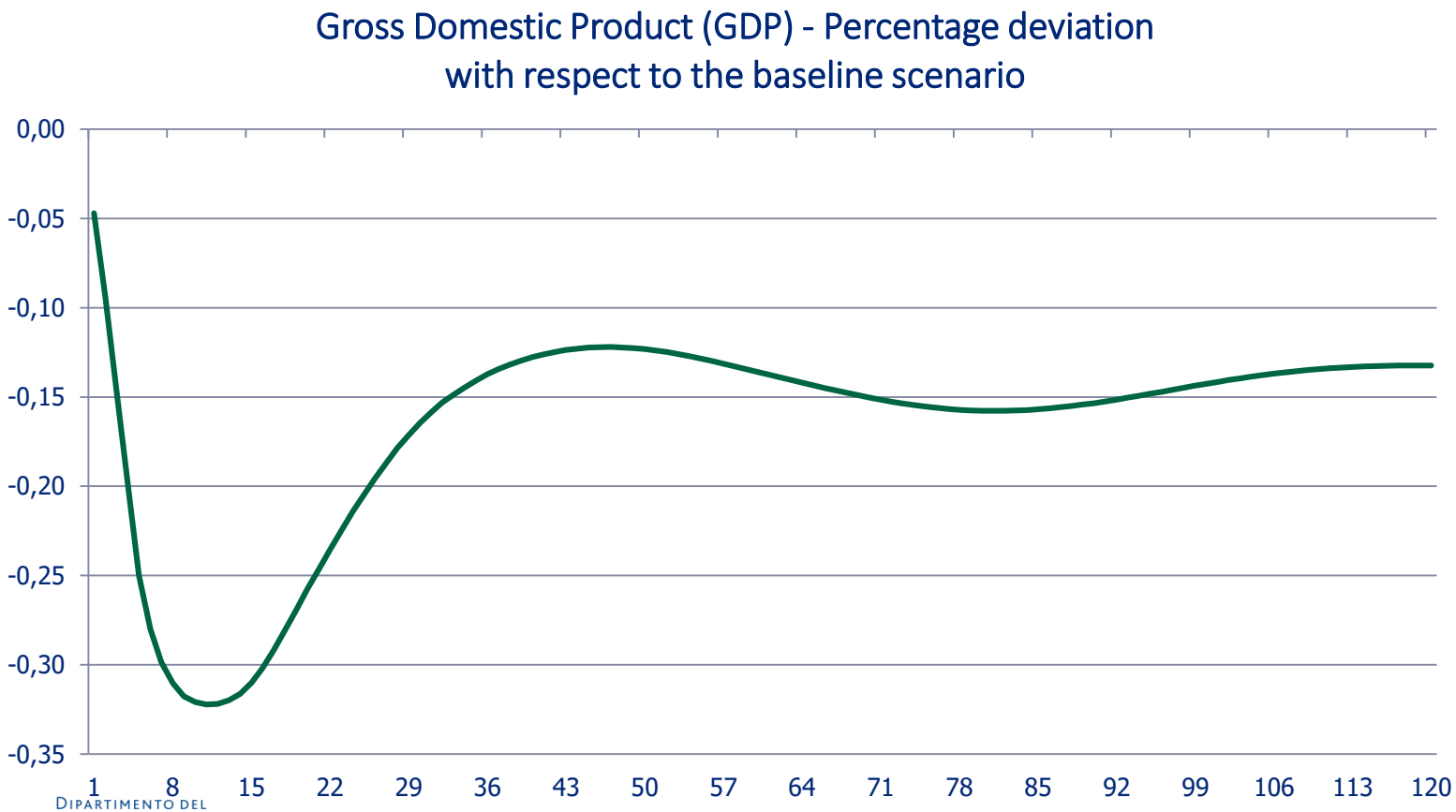
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

2) Shock to the dollar/euro nominal exchange rate (5 per cent appreciation of the euro)



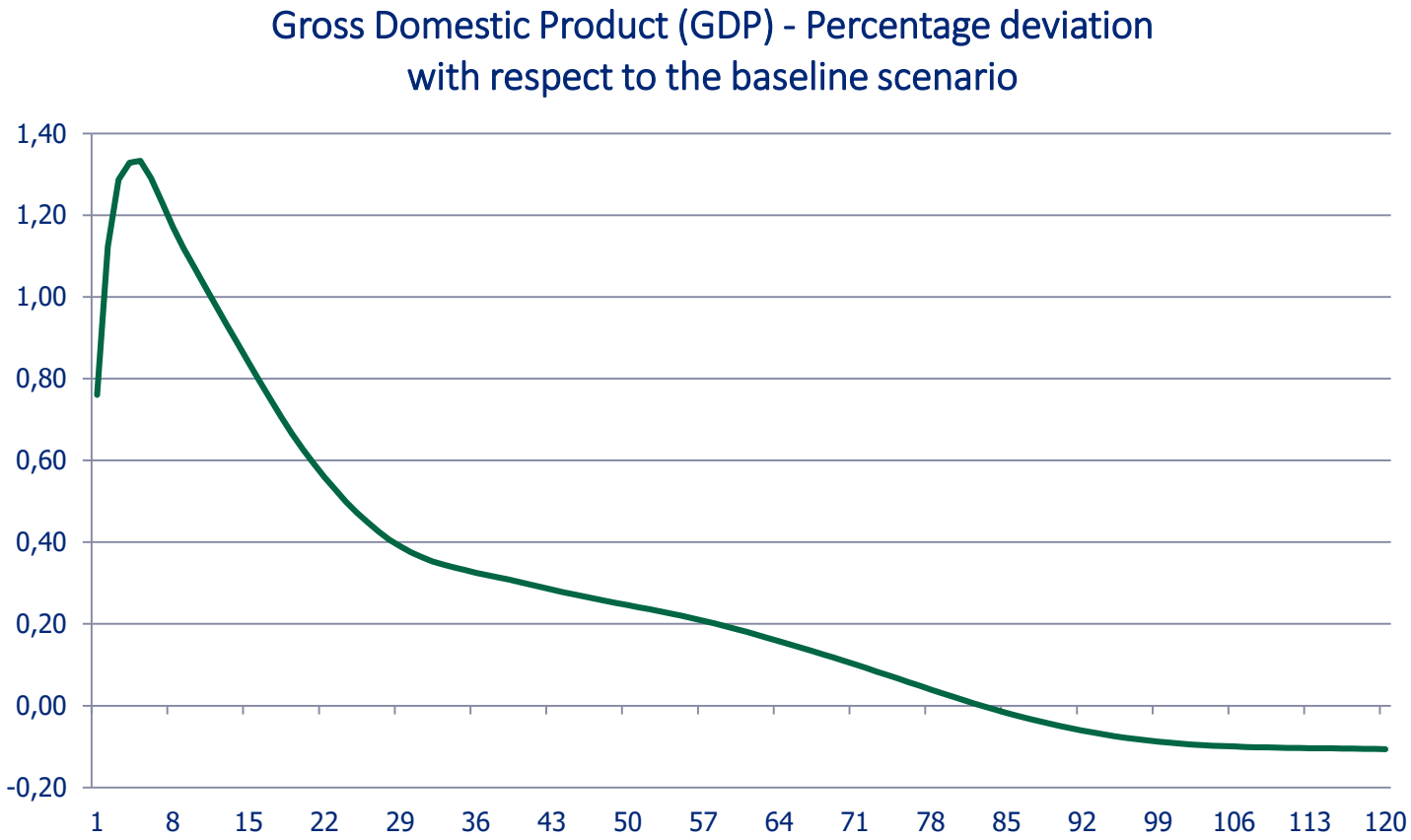
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

3) Shock to oil price (10 per cent increase)



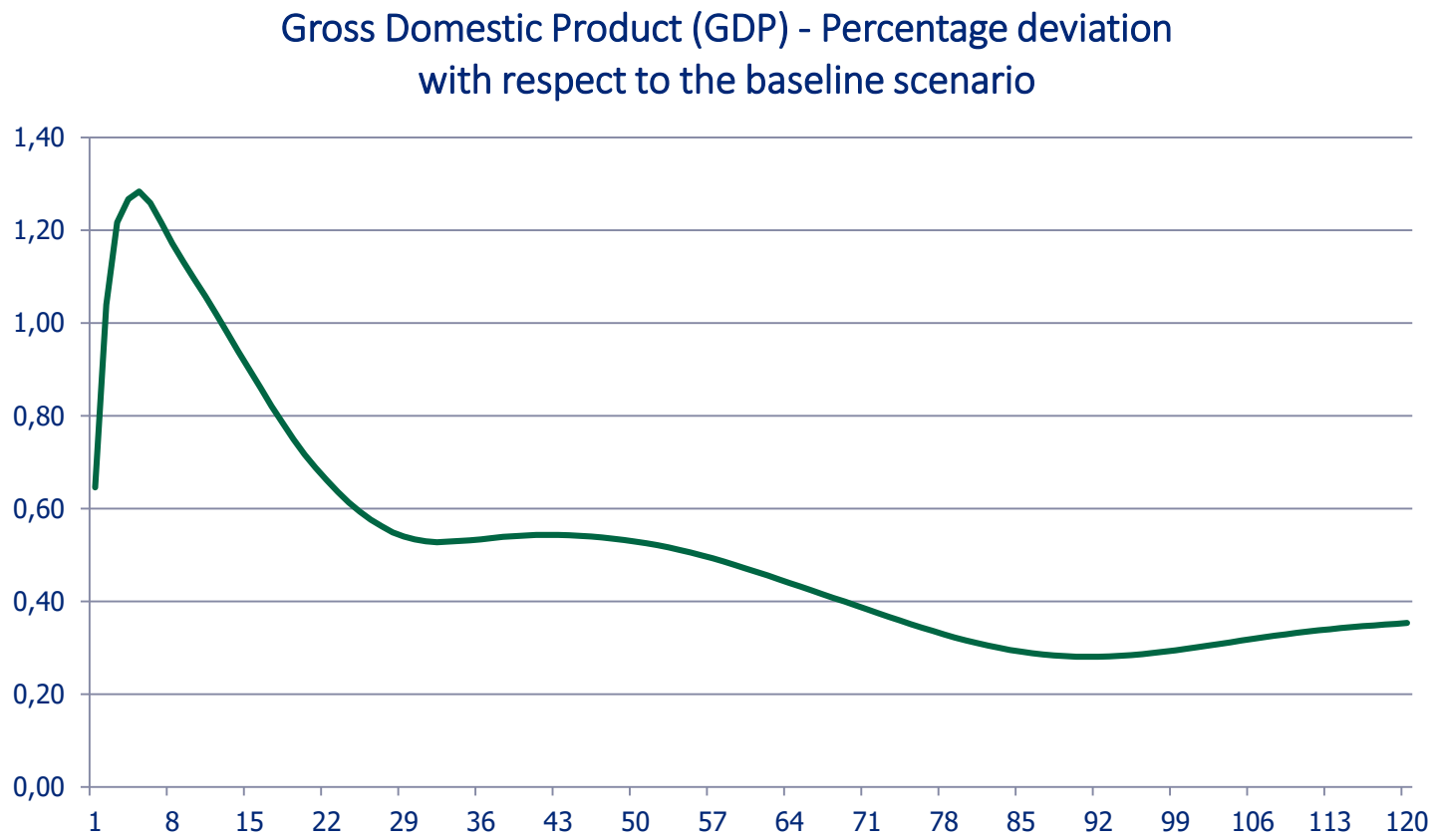
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

4) Shock to Government purchases (increase equal to one per cent of GDP)



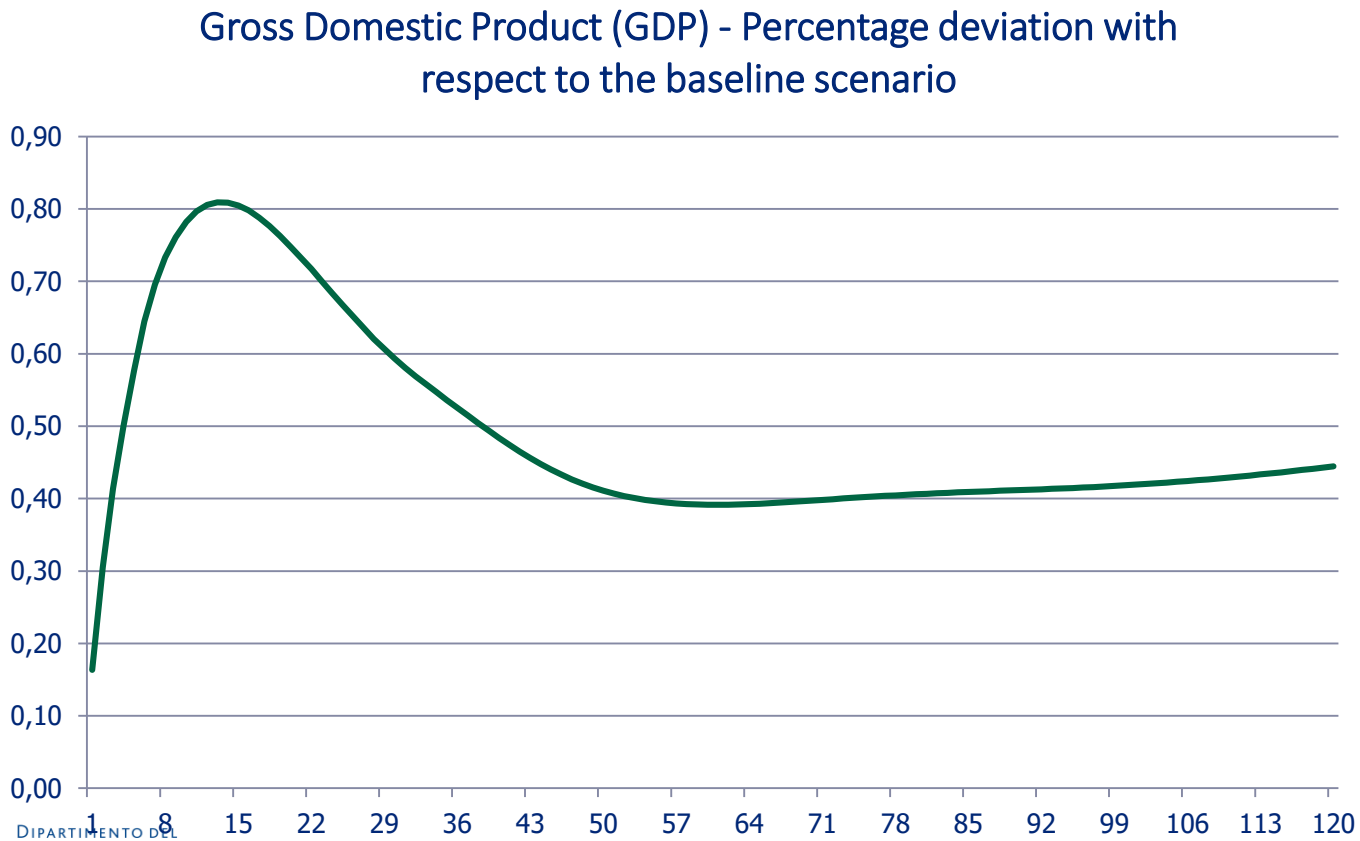
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

5) Shock to public investments (increase equal to one per cent of GDP)



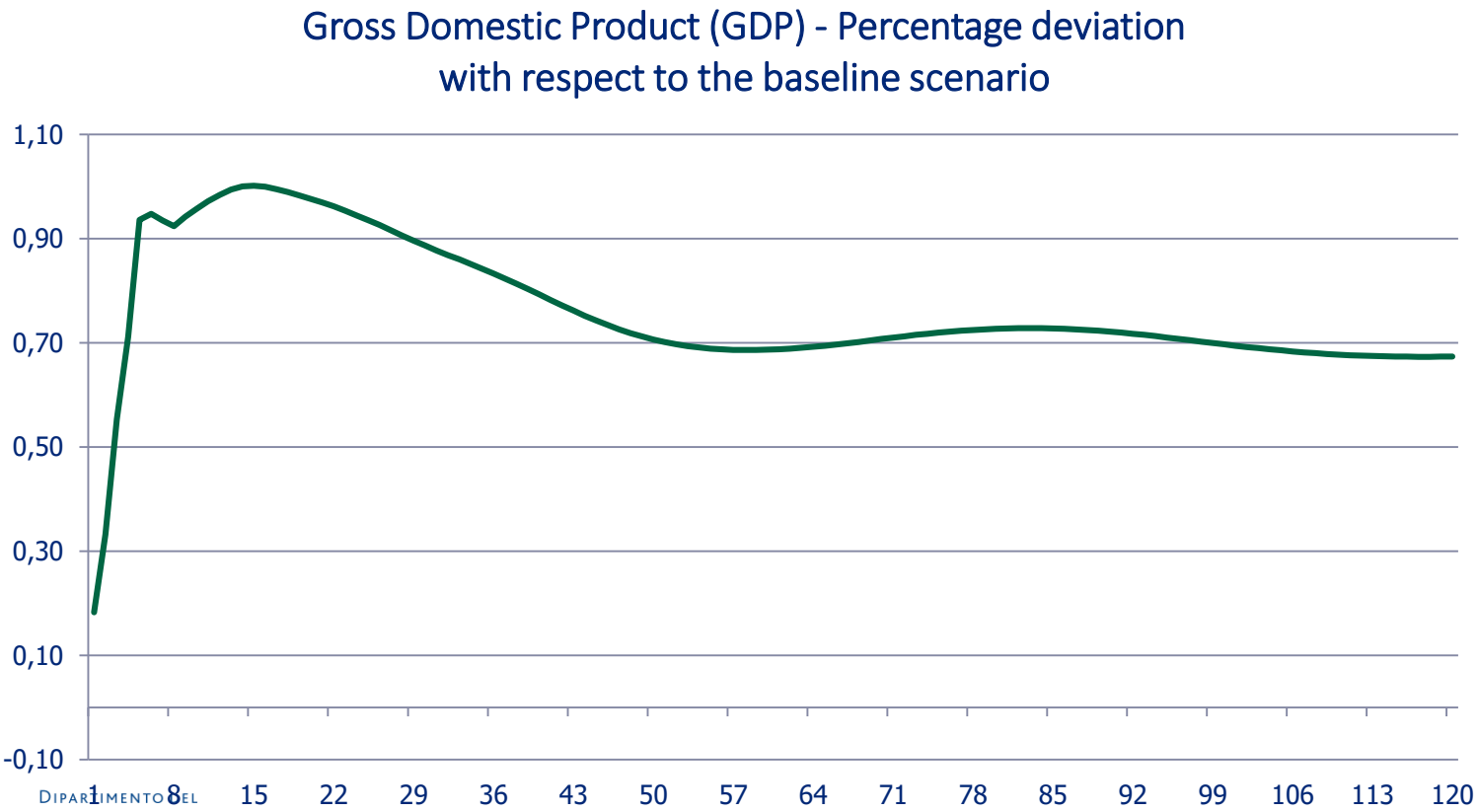
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

6) Shock to household income tax rate (reduction of the implicit tax rate so as to have an ex-ante reduction in tax revenues equal to one per cent of GDP)



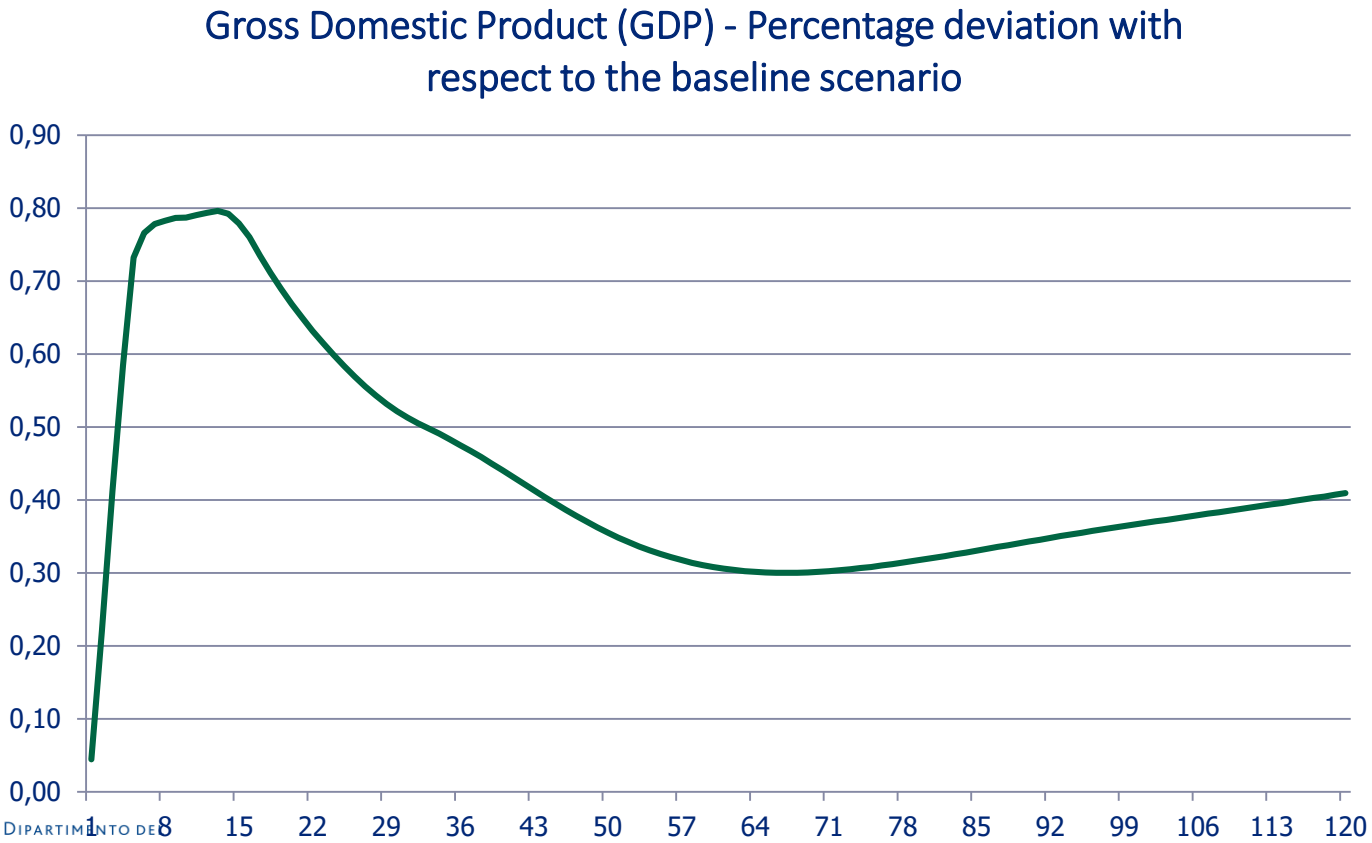
The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

7) Shock to the social security contribution rate for the employers (reduction of the implicit tax rate so as to have an ex-ante reduction in tax revenues equal to one per cent of GDP)



The model's properties: Dynamic response (IRF) of GDP to exogenous (and permanent) shocks

8) Shock to the indirect tax rate (VAT; reduction of the implicit tax rate so as to have an ex-ante reduction in tax revenues equal to one per cent of GDP)



Fiscal Multipliers with ITEM (I)

- In analysing the model properties we pay special attention to the fiscal multipliers, as ITEM is characterized by a detailed breakdown of the public finance aggregates on both the taxation and spending side

- A large number of expenditure items are considered, which, in general, are treated as exogenous in the model

- On the revenue side, ITEM features a variety of aggregates corresponding to different revenue items in the government budget: for each of them, the model considers implicit tax rates that are treated as exogenous

- Model elasticities for a variety of fiscal policy shocks can therefore be derived on both the expenditure and revenue side of the government budget. In the previous figures we have presented the pattern of some of these elasticties

- We also compute average multipliers, obtained as weighted average of the multipliers for each fiscal item

Fiscal Multipliers with ITEM (II)

Type of intervention	weights	Years 1	2	3	4	5
VAT	*0.28*	0.3	0.8	0.8	0.8	0.7
Social security contributions	*0.27*	0.4	0.9	1.0	1.0	1.0
IRPEF (personal income tax)	*0.33*	0.3	0.7	0.8	0.8	0.8
IRES (corporate income tax)	*0.06*	0.2	0.3	0.4	0.4	0.3
IRAP (regional tax on net produc. value)	*0.06*	0.4	0.8	0.9	1.0	0.9
Revenues - weighted average of effects	*1.00*	0.4	0.8	0.8	0.8	0.8
Public investment	*0.11*	1.0	1.2	1.1	0.9	0.8
Investment subsidies	*0.04*	0.2	0.3	0.3	0.3	0.3
Government purchases	*0.39*	1.1	1.3	1.0	0.9	0.7
Public employment	*0.47*	1.2	1.1	0.9	0.7	0.6
Expenditure - weighed average of effects	*1.00*	1.1	1.1	0.9	0.8	0.7

Fiscal Multipliers with ITEM (III)

- In ITEM, as in the standard econometric models, fiscal multipliers and impulse response functions to shocks are not state-dependent. In other words , their values do not depend on the cyclical conditions of the baseline scenario on which a given shock is imparted

- Moreover, in ITEM the size of the macroeconomic effects in response to a given shock is proportional to the size of the shock, without any type of non-linearity

- Against this backdrop, we are aware of the literature on fiscal multipliers being different in bad and good times. In ITEM, conversely, fiscal multipliers do differ depending on the type of fiscal item that is shocked but they do not differ depending on the initial state of the economy (e.g., Blanchard-Leigh 2013; Auerbach-Gorodnichenko 2012)

A comparison between model elasticties of ITEM and those of the Bank of Italy econometric model (BIQM) (Percentage deviation of GDP from the baseline scenario)

Type of shock \ Years	1		2		3		4		5	
	ITEM	BIQM	ITEM	BIQM	ITEM	BIQM	ITEM	BIQM	ITEM	BIQM
Foreign demand	0.2	0.1	0.3	0.1	0.2	0.1	0.2	0.2	0.1	0.2
Nominal effective exchange rate	-0.4	-0.1	-0.6	-0.2	-0.6	-0.4	-0.6	-0.5	-0.5	-0.6
Oil price	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.4	-0.3	-0.4
Public investment	1.0	0.9	1.2	1.1	1.1	1.2	0.9	1.2	0.8	1.1
Indirect taxes	0.3	0.3	0.8	0.5	0.8	0.7	0.8	0.7	0.7	0.7
Firms' social security contributions	0.4	0.4	0.9	1.2	1.0	1.6	1.0	1.7	1.0	1.7
Household income tax	0.3	0.1	0.7	0.3	0.8	0.5	0.8	0.6	0.8	0.7

For BIQM see Bulligan, G. et al. (2017) "The Bank of Italy econometric model: an update of the main equations and model elasticities", Banca d'Italia Working Paper, No. 1130 (see Appendix B).

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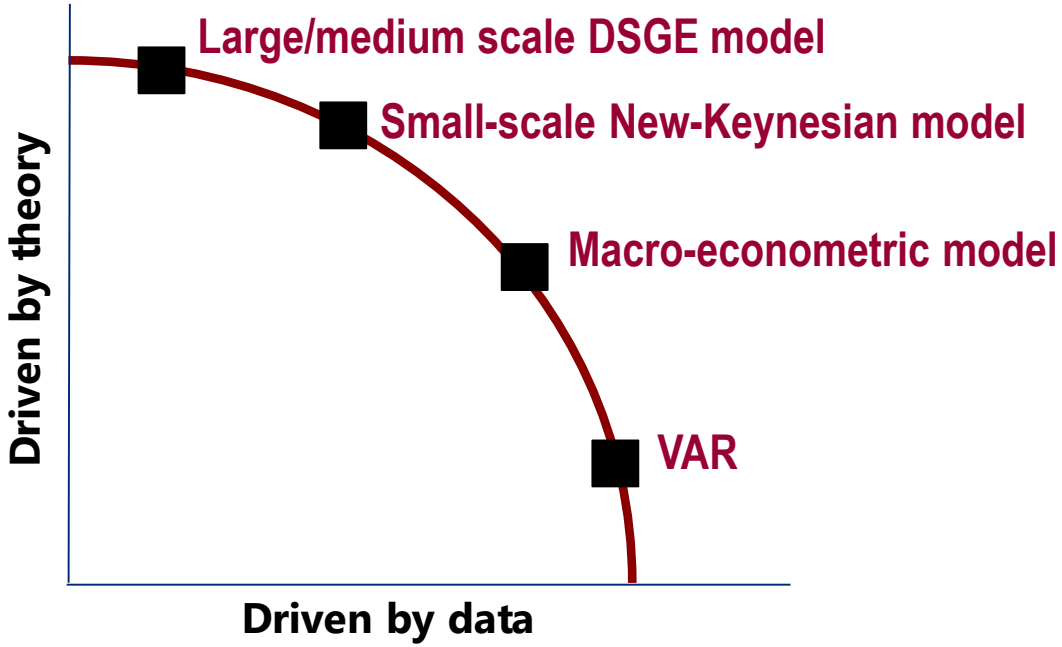
DSGE models at MEF

Macro-model portfolio in most institutions

- Different models have different comparative advantage in what is required by policymakers
- Those mainly driven by data: forecasting
- Those mainly driven by theory: policy analysis



Adapted from Pagan (2003), "Report on Modeling and Forecasting at the Bank of England," *Bank of England Quarterly Bulletin*, (Spring), 60-88

DGE Models – Methodology and Potentials

- During the last three decades macroeconomic modelling has recorded deep changes both in methodological and theoretical aspects

- Basic dynamic general equilibrium (DGE) models capture elements of the New Keynesian paradigm, (such as imperfect competition and frictions in price and wage setting) into a dynamic general equilibrium framework

- Large scale DGE models have found their way to policy institutions, i.e. Bank of Canada (ToTEM), Bank of England (BEQM), European Central Bank (NAWM), Norges Bank (NEMO), Sveriges Riksbank (RAMSES), the US Federal Reserve (SIGMA), the IMF (GEM), the European Commission (QUEST III).

DGE Models – Advantages of this approach

- They provide many results of a textbook IS-LM model in a fully dynamic coherent micro-founded context (better understanding of the transmission mechanisms of policy interventions and of shocks)

- It should be possible to escape the Lucas (1976) critique, contrary to the traditional macroeconometric models in which the estimated parameters are not invariant to policy shifts or to expected policy changes

- Thanks to the developments in computational techniques, DGE modelling is a quite flexible technique

DGE models in use to support policy making

Fiscal policy:

- Fiscal stimulus measures in response to crisis,
- Effects gov. debt on growth,
- Sovereign risk premia,
- Effects of fiscal consolidations

Finance/Banking reforms:

- Financial crisis, boom&bust, house prices,
- Financial transaction taxes
- Banking reform, capital stock requirements

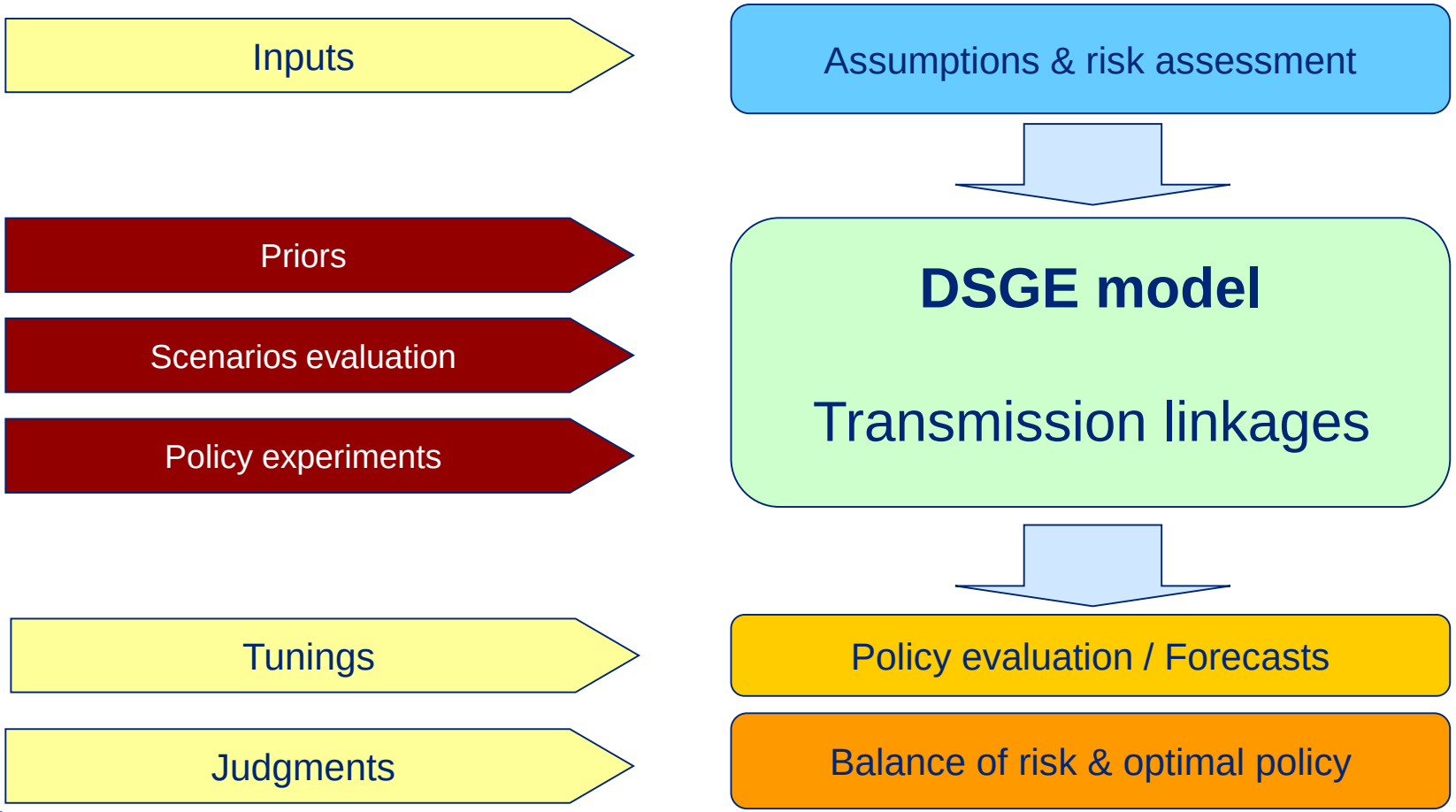
Sector specific reforms (traditionally CGE domain):

- Climate change, carbon tax
- Oil price shocks
- Services Directives

Structural reforms:

- Labour market reform,
- Product market reform,
- Promoting R&D
- Structural and Cohesion Funds

Policymaking process & DSGE



DSGE models at MEF

- Two main *families*:
  1. QUEST macroeconomic model
     Developed and updated at EC
  2. IGEM – Italian General Equilibrium Model
     Developed at MEF → focus on labor market
     - Several extensions
       IGEM II (unemployment)
       IGEM-PA (public administration)
       IGEM-F (bank sector frictions)
       IGEM-B (Bayesian estimates)

Quest III - Quarterly European Simulation Tool

- QUEST is a large-scale dynamic general equilibrium model, one of the latest versions of the class of DGE models developed by the European Commission.

- QUEST III with R&D has been adapted to Italy (already employed by the Commission in multi-country studies, see D.Auria et al. 2009).

- This version of QUEST III is augmented with R&D (as in Jones 1995, 2005and and Romer 1990). The endogenous mechanism of growth allows to study policies aimed at increasing the rate of knowledge creation.

Quest III - Quarterly European Simulation Tool

- QUEST as a simulation tool mainly employed to analyze the effects of structural reforms and the response of the economy to a variety of shocks.

- Version more suitable to study structural reforms in the spirit of Europe 2020 strategy.

- The model, calibrated to quarterly data, features eight types of economic agents: households-workers, trade unions, final goods firms, intermediate goods firms, R&D sector, foreign sector, the government and the central bank

- Adjustment costs on nominal and real variables capture the typical persistence of macrovariables and mimic their empirical dynamics in response to shocks.

Quest III - Quarterly European Simulation Tool

- The explicit consideration of an R&D sector allows to map many policy interventions aimed at increasing the rate of knowledge creation (i.e. smart growth policies)

- By modeling final and intermediate goods markets as imperfectly competitive and by embodying entry and administrative burden costs, the model can be used to assess the effects of competition-enhancing policy (i.e. internal market policies)

- The distinction between three skill categories (low, medium, high), the inclusion of benefit replacement rates, labor taxes and of imperfect competition allow study the implications of many labor market reforms (i.e. inclusive growth policies: e.g.,, changing the skill composition of the labor force, subsidizing employment of the high-skilled workers in the R&D sector etc.)

Quest III - Quarterly European Simulation Tool

- Optimizing households (non-liquidity constrained households) and hand-to-mouth consumers (differentiation necessary to reproduce empirically relevant Keynesian effects of fiscal policy)

- Innovation: new designs depend on the number of skilled workers employed and on the existing stock of ideas

- Monetary policy is described by a Taylor rule

Quest III - Quarterly European Simulation Tool

Economy populated by:

Households
Low|Medium|High skilled

Final goods producing firms
Monopolistic competition

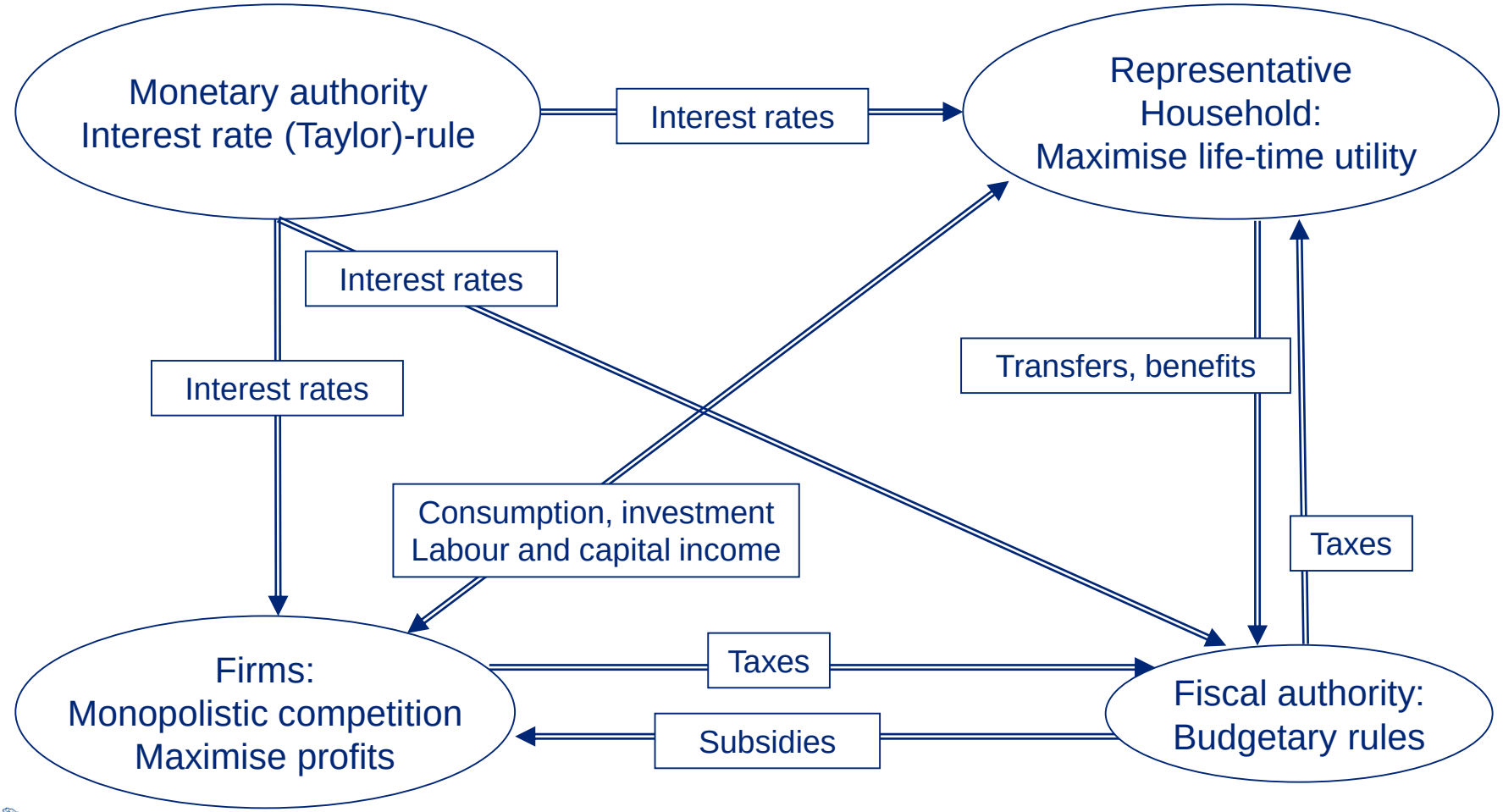
R&D institute

Intermediate goods producing firms
Monopolistic competition

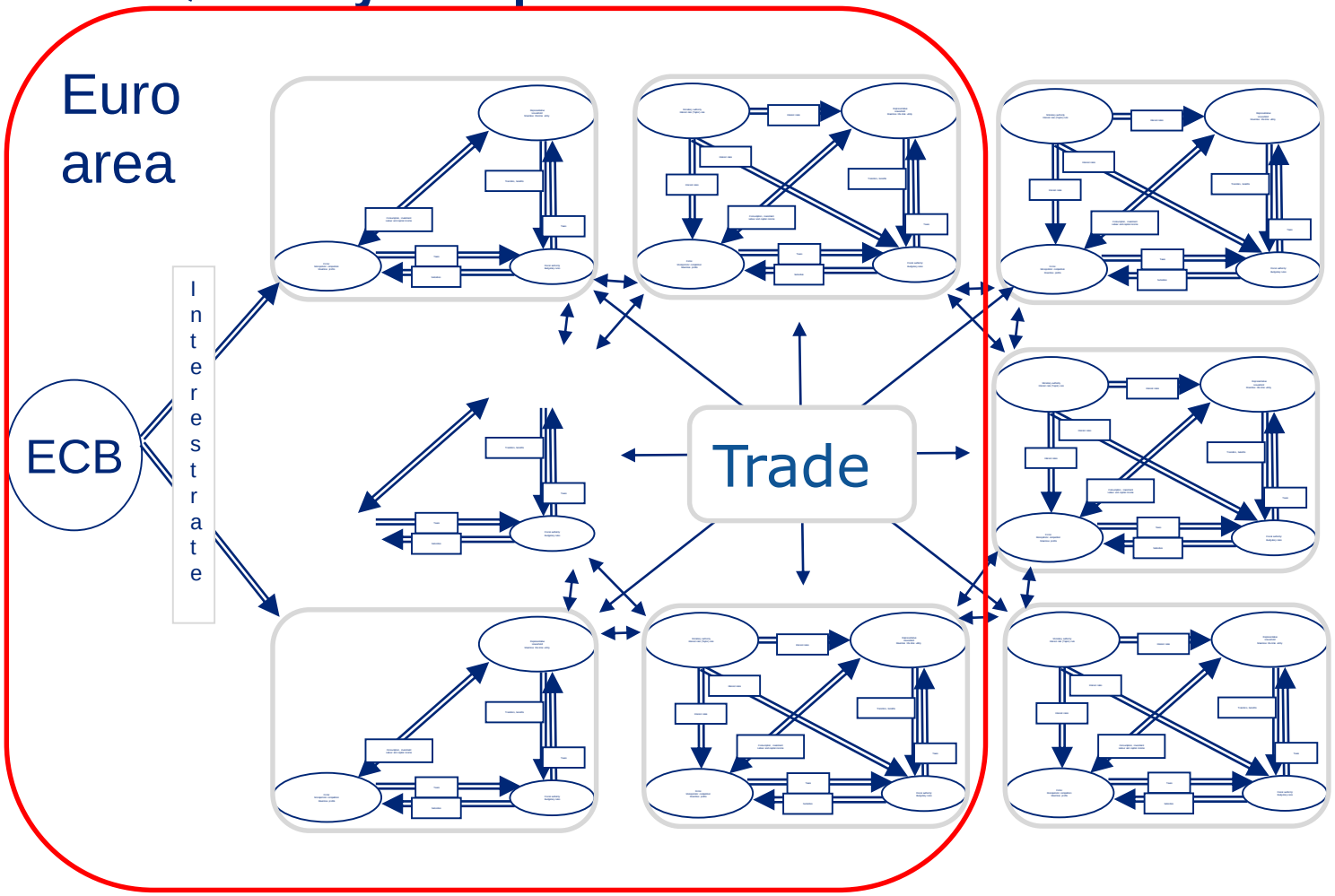
Monetary authority
Central Bank

Fiscal authority
Government

Quest III - Quarterly European Simulation Tool



Quest III - Quarterly European Simulation Tool



Quest III - Quarterly European Simulation Tool

- R&R intuition: Production with exogenous technology:

$$Y = A^{ex} \cdot K^{1-\alpha} \cdot L^{\alpha}$$

- Production with endogenous technology under the product-variety framework (Dixit-Stiglitz, 1977)

$$Y = \left(\sum_{i=1}^{A^{en}} x_i^{\theta} \right)^{\frac{1-\alpha}{\theta}} \cdot L^{\alpha}$$

- A^{en} is intermediate goods (x) variety, endogenously determined in the model ⟶ increasing variety is the engine of growth!

- Skill trade off: Final production needs all types of skills. Then R&D production can employ only high-skilled ⟶ Allocating more high-skilled to R&D decreases the share of high-skilled available for final goods production!

Quest III - Quarterly European Simulation Tool

- Fill the gap approach (vs. benchmark/% change on GDP)

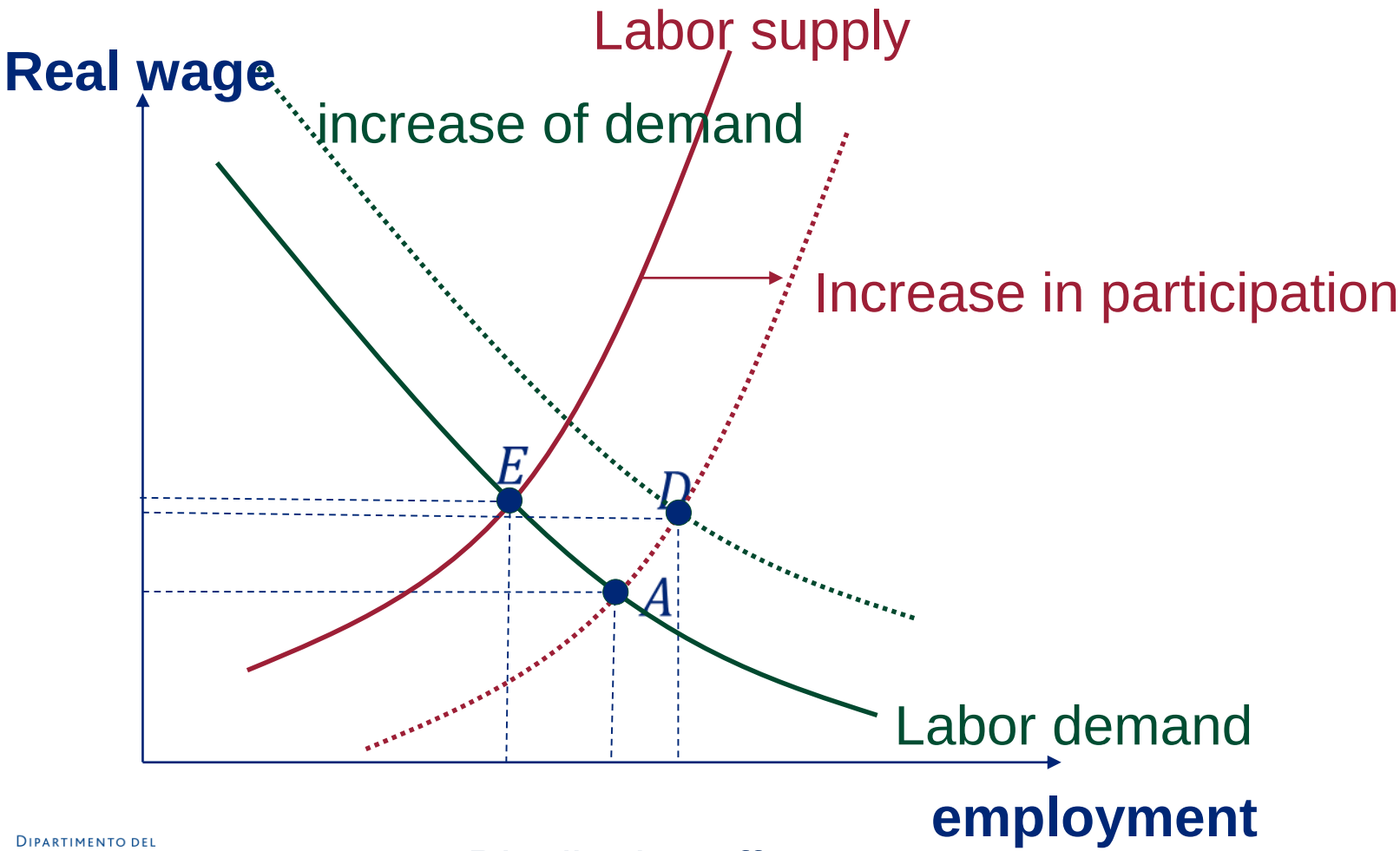
- Skills a) Low-to-medium (halve the gap with Germany in 20 years); b) Medium-to-high (halve the gap with Spain in 20 years)

Skill change (gap filled at 1/2)	5 years	10 years	30 years
Low-to-medium skilled [ben. Germany]	0.8	1.7	3.5
Medium-to-high skilled [ben. Spain]	0.2	0.4	1.1

- Participation: Medium skill (gap with Germany)

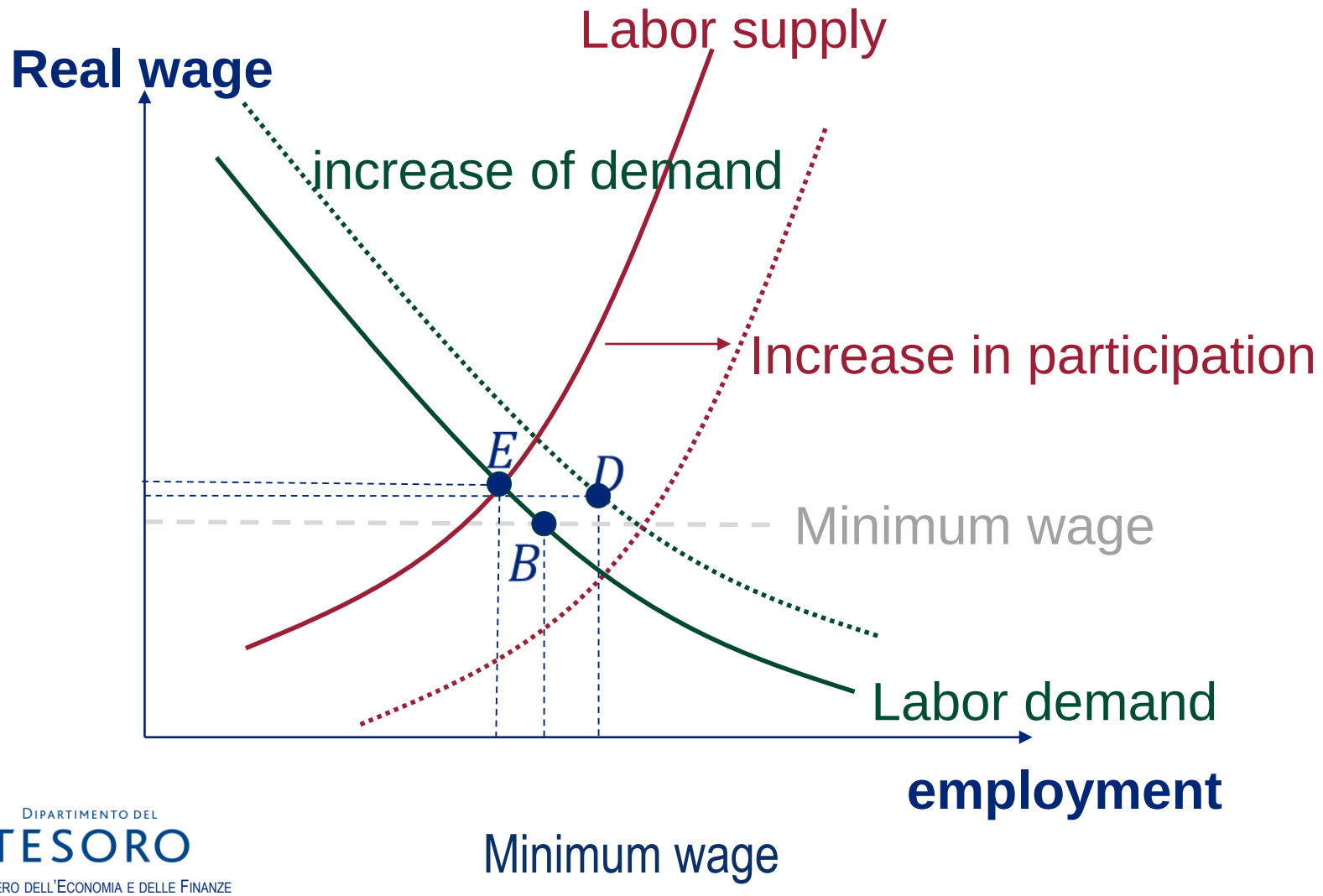
Participation gap filled at:	1/4	1/2	1/1
Medium-skilled [benchmark Germany]	0.9-1.2	1.8-2.3	3.8-4.6

Quest III - Quarterly European Simulation Tool



Distribution effects

Quest III - Quarterly European Simulation Tool



IGEM: Italian General Equilibrium Model

- IGEM is the outcome of a two-year project aimed at the development of a new modeling tool for policy analysis

- IGEM has been designed to capture specific features of the Italian economy in a general equilibrium setting, so providing a strong framework of analysis able to identify interrelationships and linkages across macrovariables

- Contrary to the existing models IGEM features a detailed labor market in which different contract types coexist, so to better describe the Italian economy whose labor market is strongly heterogeneous and provide a rationale for the existence of low-income households with no access to financial markets.

IGEM: Italian General Equilibrium Model

- IGEM shares several features with the models developed in other institutions

- Consistently with conventional New Keynesian (NK) models, IGEM presents a large assortment of nominal and real frictions affecting the short to medium term behavior of the economy, while classical features prevail in the long term, where output is determined by technology, preferences and the supply of factor inputs (capital and labor).

- Given the complexity and the size of the model this version is calibrated using quarterly data on the Italian economy (smaller versions will be estimated using Bayesian techniques)

IGEM: Italian General Equilibrium Model

- The labor force in IGEM is divided in three different categories: (i) employees (skilled and unskilled) with a stable contract of employment; (ii) atypical workers who have flexible working patterns, such as temporary workers, homeworkers and those who are in short-term contracts; (iii) self-employed workers and professionals who may supply work under a contract for services.
- Hiring and firing those who are qualified as employees entail high adjustment costs.
- Similarly, the degree of nominal wage stickiness is much higher for employees as well as their market power. By contrast, atypical workers who often fail to qualify for employment protection rights, have low hiring and firing costs and no market power. Together with self-employed workers they represent the more volatile component of the workforce, more subject to the effects of business cycle fluctuations.

IGEM: Italian General Equilibrium Model

- This heterogeneity in the labor market allows to include a large battery of fiscal instruments into the model opening up to the possibility of exploring the effects of several fiscal reforms aimed at increasing employment, favoring social inclusion and reducing inequalities.

- This heterogeneity is strictly related to that considered in consumption.

- Ricardian households supply labor services as employees and as self-employed workers, while non Ricardian consumers supply labor services as atypical workers and as unskilled employees.

- Intuitively, workers with stable contracts have an easy access to credit, while atypical workers with flexible labor patterns are more likely to be liquidity constrained.

IGEM: Italian General Equilibrium Model

- Monopolistic trade unions set wages of skilled and unskilled subordinate workers so as to maximize households' expected utility.

- Market power introduces a wedge between the real wage rate and the marginal rate of substitution between leisure and consumption.

- Further, self-employed and professionals are assumed to work on their own under the tutelage of the professional orders (or registers).

- Hence despite this category of workers are not covered by the legal and trade-union protections afforded to employees, they have some market power in setting their remuneration.

IGEM: Italian General Equilibrium Model

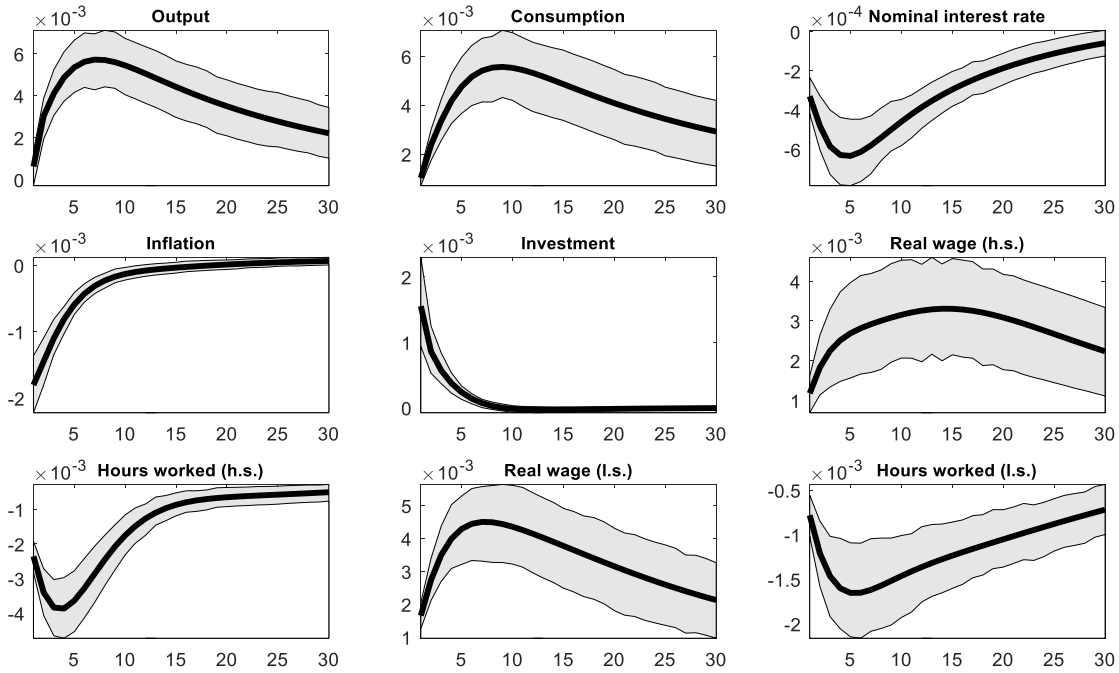
- The monetary authority controls the nominal interest rate and responds to inflation and output variations

- The model allows for a variety of different reaction functions to be incorporated (active v. passive interest rate rules, current, backward or forward rules).

- To ensure that the fiscal budget constraint is met the fiscal authority is assumed to adopt a fiscal rule.

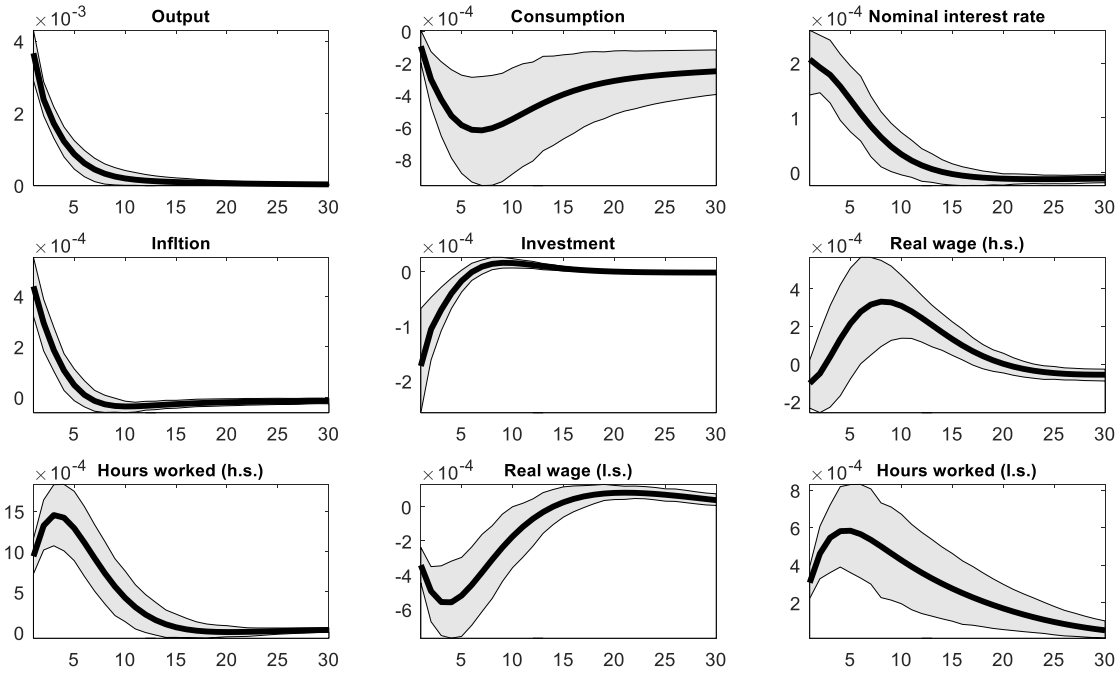
- Italy as a small open economy, i.e. the foreign sector is modeled as exogenous, but some market power in setting import and export prices.

IGEM: Italian General Equilibrium Model



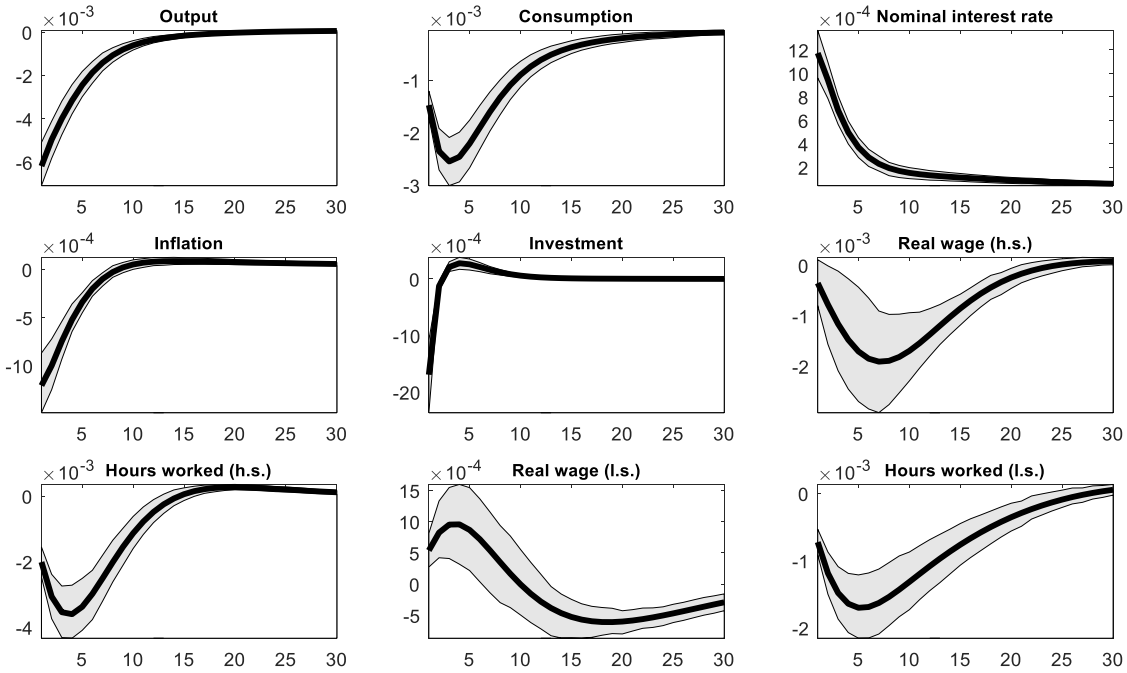
TPF shock

IGEM: Italian General Equilibrium Model



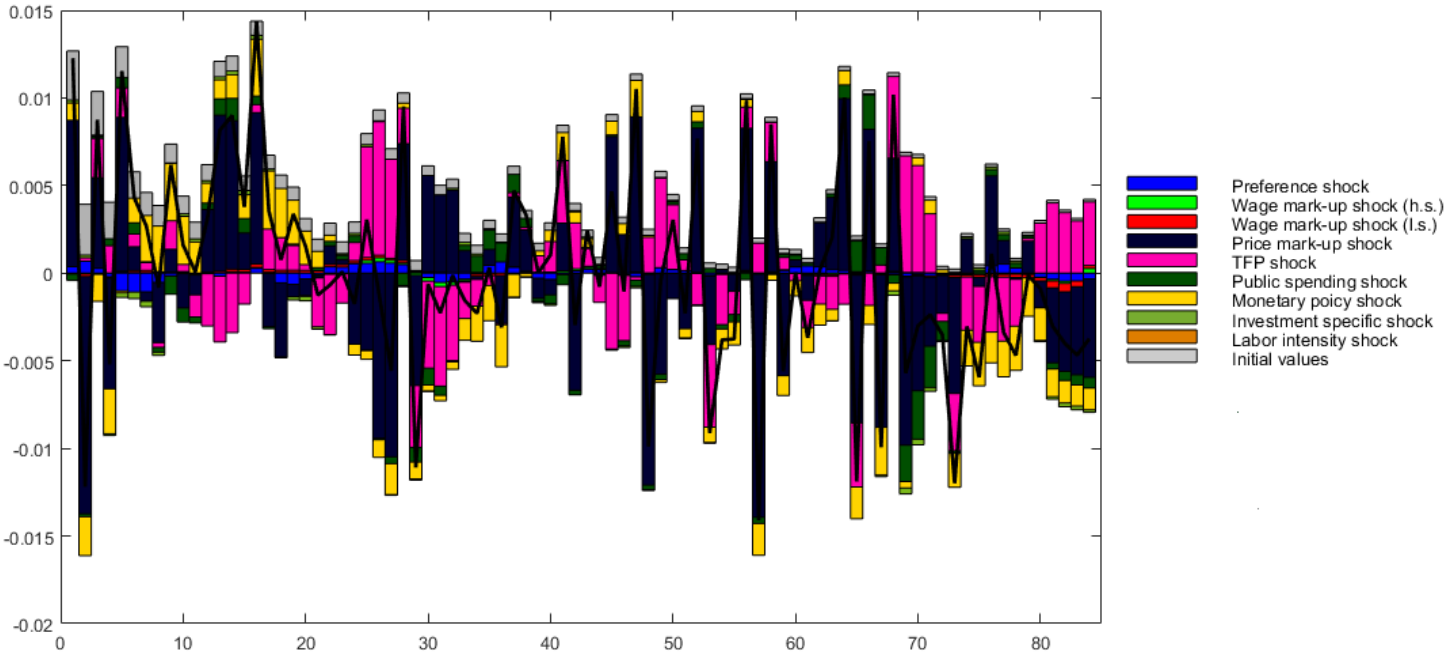
Public consumption shock

IGEM: Italian General Equilibrium Model



Monetary policy shock

IGEM: Italian General Equilibrium Model



Historical decomposition of output

An example: Italy NRP 2017

- DSGE used to evaluate the reform program
- Reform Areas
  - Public Administration
  - Competition
  - Labor Market
  - Justice
  - Education (School System)
  - Provisions related to Nonperforming Loans and bankruptcy procedures
  - Provisions related to “Industria 4.0”: Comprehensive policy package embodying measures to favor innovative investments, measures to improve skills and related to “Finance for growth”

Italy NRP 2017: Impact on GDP

- To gauge the quantitative impact of the NRP, each of the main reform areas is mapped onto a model

  QUEST III (QUEST2009/2012), IGEM, ITEM

  Quantitative translation of measures is a delicate issue

- The impact on GDP of each of the main reform:

	T+5	T+10	Long run	
Public Administration	0.5	0.8	1,2	QUEST
Competition	0.2	0.5	1.0	QUEST
Labour Market	0.6	0.9	1.3	IGEM
Justice	0.1	0.2	0.9	QUEST
School System	0.2	0.3	1.3	QUEST
Nonperforming Loans and Bankruptcy Procedures	0.1	0.1	0.1	ITEM
Industria 4.0	1.2	1.9	4.1	QUEST/IGEM
TOTAL	**2.9**	**4.7**	**9.9**	

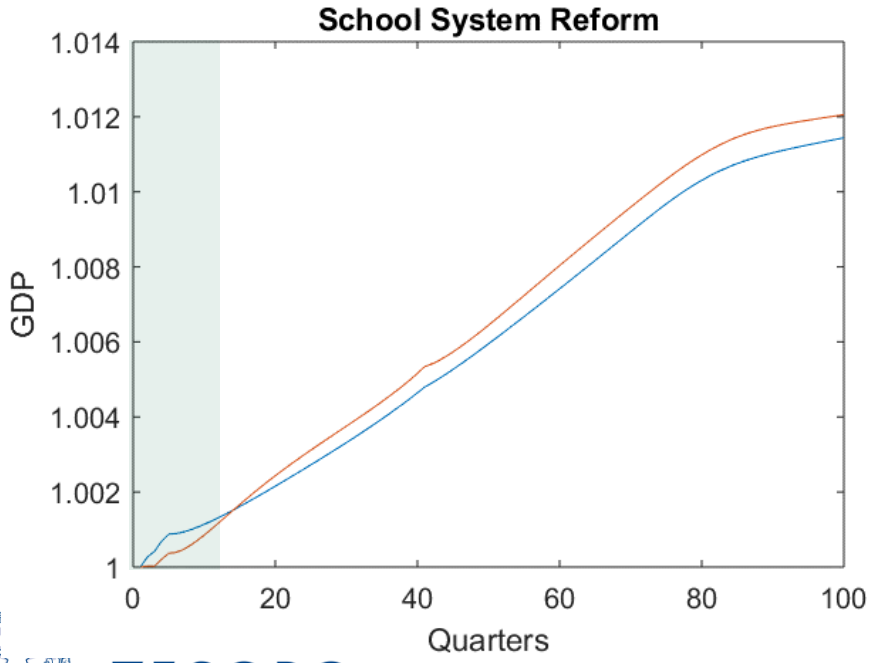
(source: DEF, 2017: Section III)

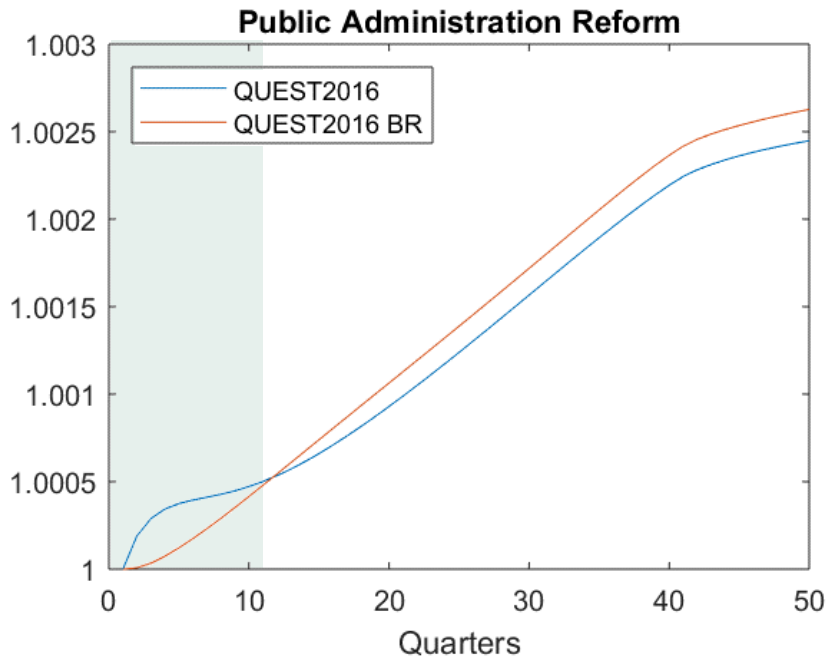
Looking forward (under development projects)

- Learning the reforms: Expectation formation and market sentiments (IGEM–L)
- Sovereign debt default and the spread (IGEM–F/L)
- Estimating price- and wage- setting structures (IGEM–B2)

IGEM–L: Learning the reforms

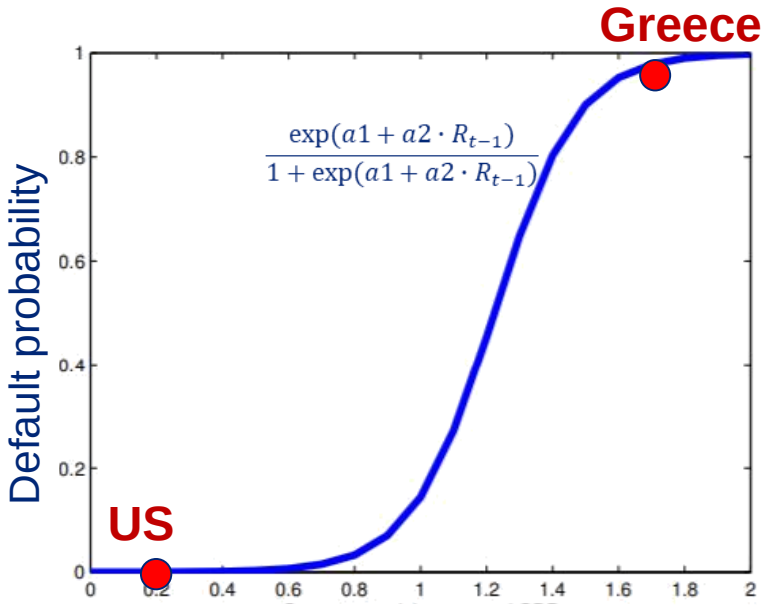
- Some agents slowly understand the impact of changes associated to structural reforms so they forecast the future on the basis of extrapolative or adaptive processes. Assumptions about who is what ... Law of large numbers
- A caveat: Agents fully understand and believe the reform plan announced. But they are not able to correctly forecasts the effects of the reforms
- We already extend QUEST III to our learning approach





IGEM–F/S: Sovereign debt default and the spread

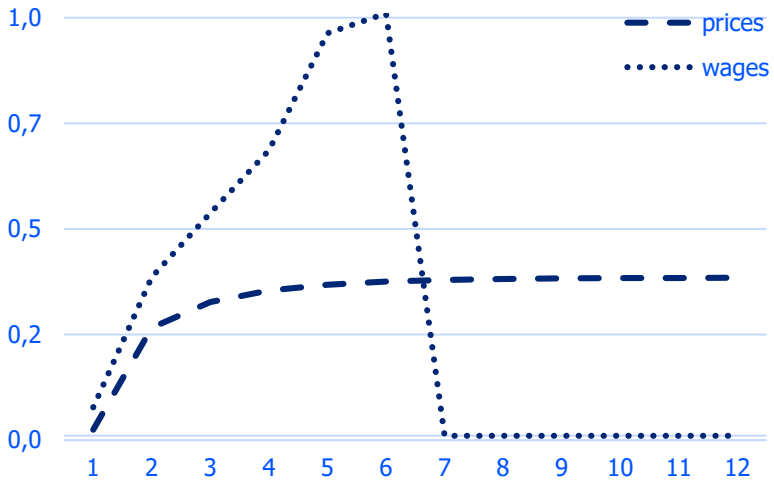
Link	Debt/GDP	→ Bailout risk
Link	Bailout risk	→ Spread
Link	Spread Banks'	→ Collateral
Link	Bank collateral	→ Economy



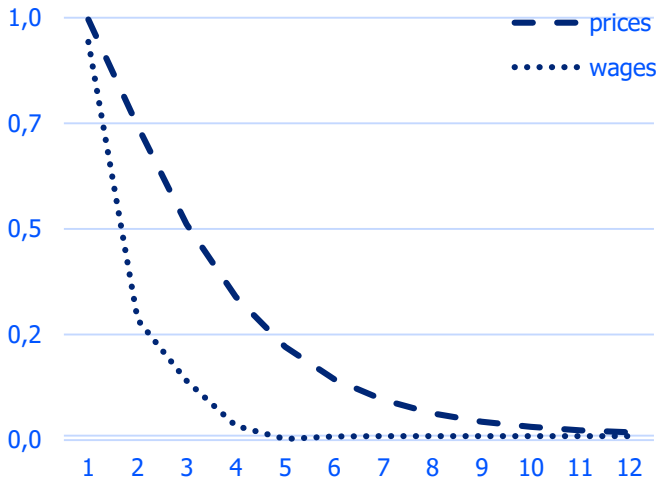
$a1 = -9{,}7480 \quad a2 = 1{,}9921$

IGEM–B2: Estimating price- and wage- setting structures

- Nominal rigidities are crucial to understand short-run policy transmission
- Bayesian estimations of price and wage hazard and survival function



Hazard function



Survival function

MACGEM – IT

Multisectoral Applied Computable General Equilibrium Model for Italian Treasury

MACGEM-IT : the new CGE model for Italy

The MACGEM-IT model is a *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.

- It is a *disaggregated* model with *multi-input* and *multi-output* production functions
- It includes proper *rigidities* and *imperfections* regarding the behaviour of some agents and markets, such as the Government and the labour market.

Built to reflect the characteristics of Italian economy, MACGEM-IT is able to quantify the disaggregated, direct and indirect impacts of policies.

Some possible applications:

- fiscal policies aimed at stimulating selected final demand components,
- Fiscal policies aimed at supporting selected activities and/or industries and/or products.

Objectives of the MEF-DED collaboration

Development of the MACGEM-IT model able to:

- identify the peculiarities of the Italian economic system;
- quantify the overall impacts (direct, indirect and induced) of the policy scenarios

Construction of the Social Accounting Matrix (SAM) database to:

- identify agents that operates in the economic system with a high level of disaggregation;
- quantify the economic flows occurring among the operators in the production phase and in the allocation and distribution of income.

The MACGEM-IT model (1)

- It formalizes the existing 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.

- It analyses the economic impact of policy measures in a general context (*income circular flow*) on the main macroeconomic variables in aggregate and disaggregate terms and in real and nominal terms (Production by commodity, Value Added by activity, Prices, Income by Institutional Sectors)

- It offers an interpretation of the Italian economy response to policy measures especially in disaggregate terms

The MACGEM-IT model (2)

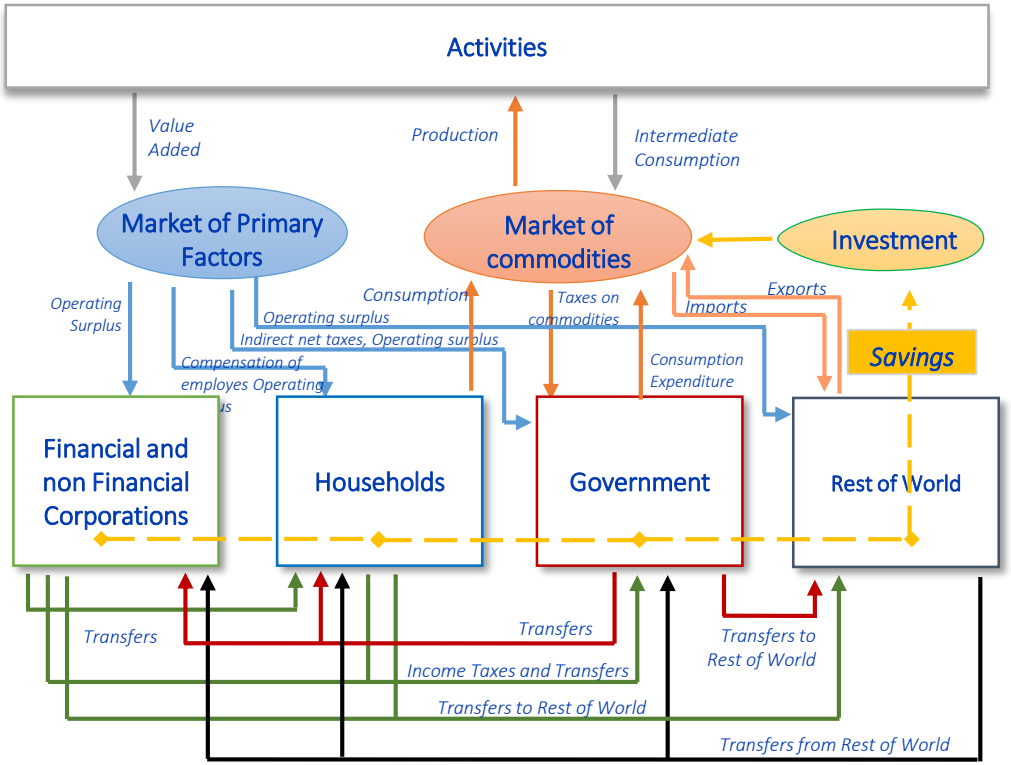
.

- Each agent maximizes 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*).

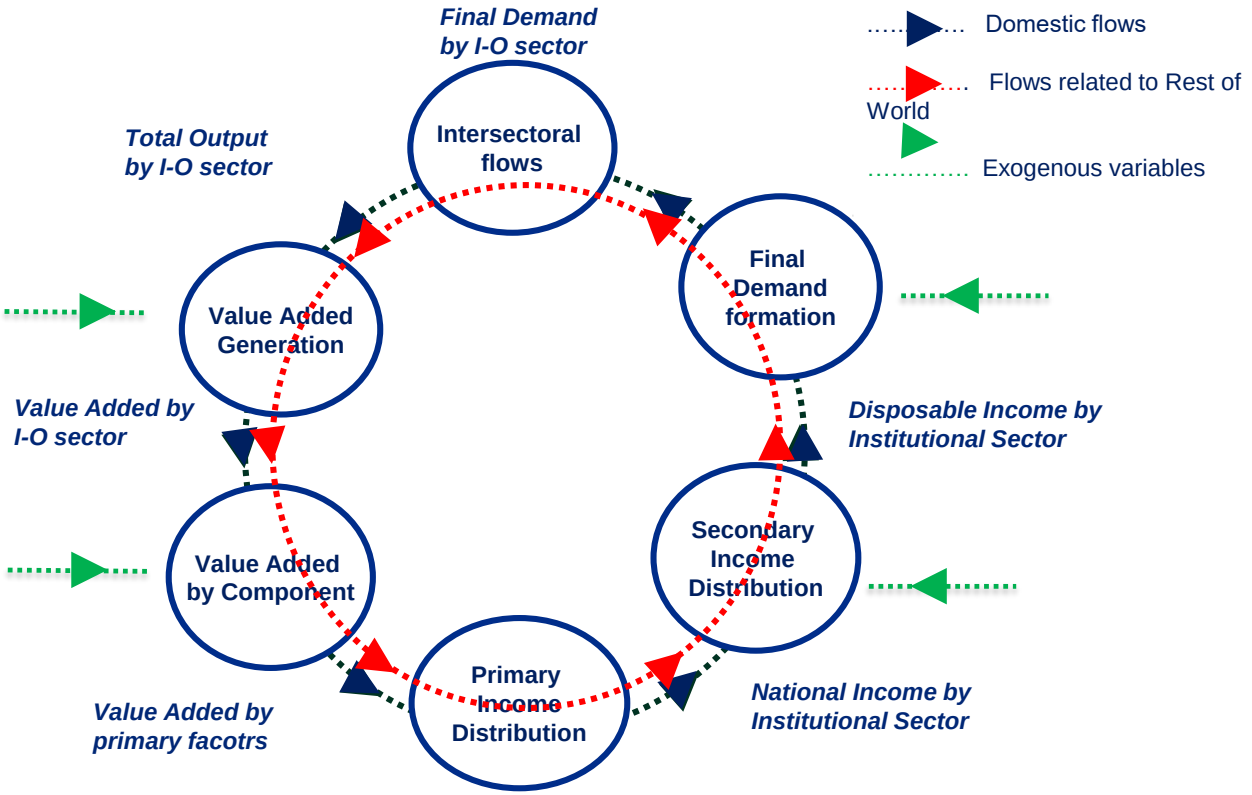
- It takes into consideration the current institutional and regulatory framework and provides a detailed disaggregation of the flows related to taxes on activities, products and incomes.

- It outlines the complex transmission mechanisms of the policy measures with respect to the creation of Government revenues and expenditures.

The structure of the MACGEM-IT model



The income circular flow and the SAM



The calibration of the MACGEM-IT model

- The Social Accounting Matrix (SAM) for Italian economy Provides the economic flows among operators representing the initial balance of the entire economic system (Socci, 2004).
- Compared to I-O Tables in the SAM:
  - multipliers are defined as global because they include the income distribution effect (primary and secondary income distribution)
  - it is possible to analyze the response of Institutional Sectors in terms of final demand formation and Income change (target of the model)
- Represents the fundamental database for the calibration of the CGE parameters such as technical coefficients of production, tax rates, consumption shares etc.

The structure of the SAM

- 63 activities
- 63 commodities associated to the activities
- 2 Primary factors:
  - Labour
  - Capital
- 26 categories of Indirect Net Taxes:
  - 13 on I-O activities and 13 on I-O commodities
- Exports and Imports by commodity
- 16 categories of income taxes
- 11 categories of transfers
- Gross Fixed Investment
- Change in Inventories and values

- 11 Institutional Sectors:
  - Households
  - No-profit Institutions(ISP)
  - Financial and non Financial corporates
  - Public Administration disaggregated as:
    - Central Government
    - Social Security Institution
    - Regions
    - Provinces
    - Municipalities
    - Other local and central government
  - Rest of the World

Main characteristics of MACGEM-IT model

I. *Multi-sectoral disaggregate model*

- Multi-input, multi-output and multi-sectoral model
- Institutional Sectors maximise their utility (consumption) given their budget constraint
- Market of Primary Factors is competitive
- Market of Labour is not competitive (*Trade Union wage-bargain*)

EXOGENOUS VARIABLES:

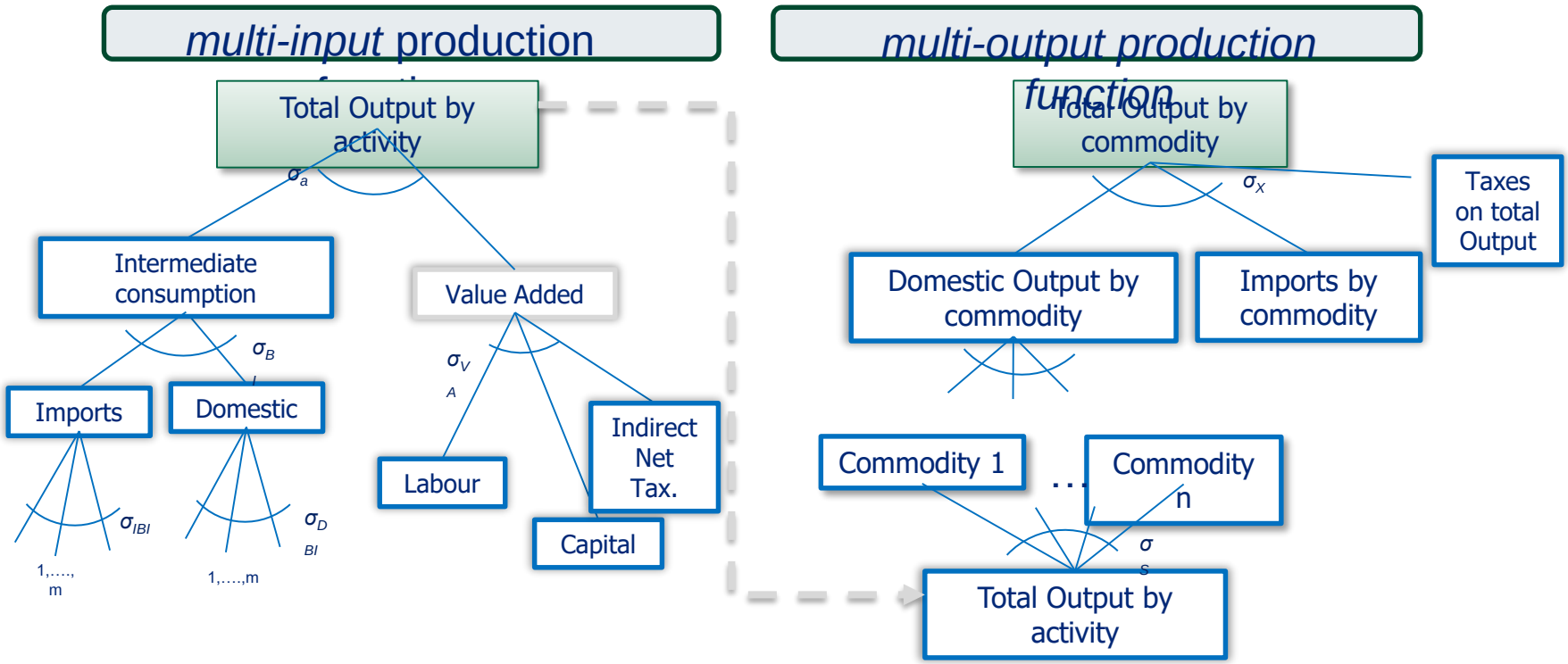
- Exchange rate
- Price of imported commodities
- Exports
- Labour Force
- Capital endowment

Main characteristics of MACGEM-IT model

II. *The Production*

- The ***total output by activity*** is a nested *Constant Elasticity of Substitution* (CES) production function to emphasise any complementarities and/or substitution effects among inputs [*multi-input production function*]
- Each activity has a ***principal*** and ***secondary*** production [*multi-output production function*]
- The ***total output by commodity*** is obtained combining the primary and secondary productions by activities (*domestic output*) and imports
- ***Armington assumption*** (Armington, 1969): imported and domestically produced commodities are not perfect substitutes.

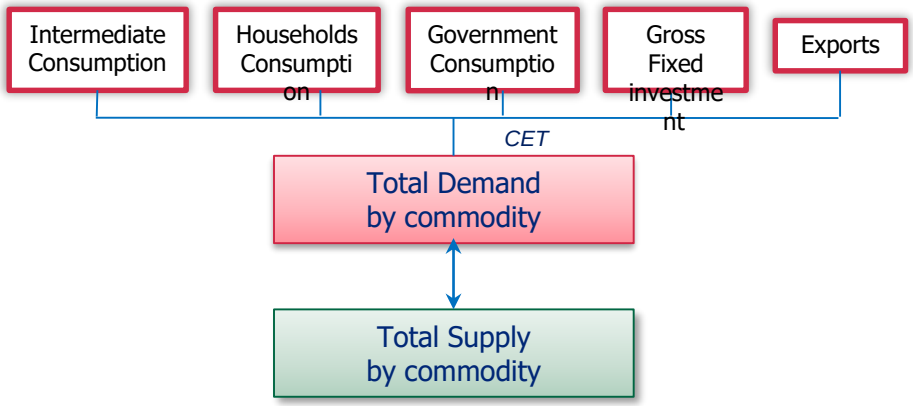
The production function in MACGEM-IT



Main characteristics of MACGEM-IT model

III. The market of commodities

- Perfectly competitive markets
- The value of output by commodity equals the sum of intermediate consumption and final demand
- Commodities' prices adjust to balance total demand and total supply (market clearing condition).



Main characteristics of MACGEM-IT model

IV. Primary factors markets

- Primary factors are perfectly mobile across sectors.
- Total endowments are exogenously determined.
- The factors demand derives from activities' process of profit maximisation.
- The price of primary factors fluctuates to balance the demand and the supply
- Labour market is not competitive: wages are negotiated by Trade Unions

Main characteristics of MACGEM-IT model

V. Gross Disposable Income formation

It derives from the sum of:

- ✓ Incomes generated by the production processes (compensation of employees, mixed income, operating surplus and tax revenues) that are distributed to the Institutional Sectors according to the property of primary factors that generated the incomes.
- ✓ Transfers from other Institutional Sectors
- ✓ Income taxes (when considering the Public Administration)

Net of:

- Income taxes payed to the Public Administration
- Transfers payed to other Institutional Sectors

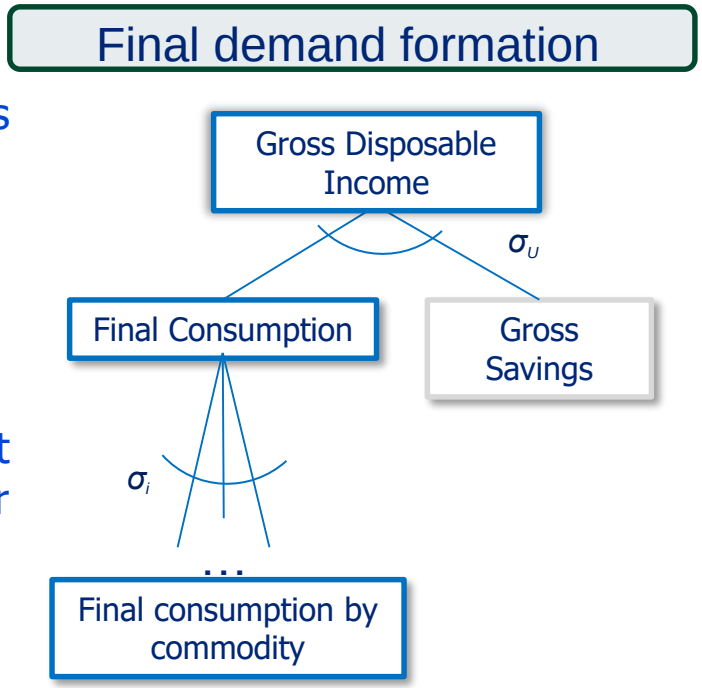
Main characteristics of MACGEM-IT model

VI. The final demand formation

The disposable income by Institutional Sectors is alternatively allocated to:

- Final Consumption
- Gross Savings

Financial and non-financial corporations do not have any consumption, thus all their disposable income turns into gross savings.



Main characteristics of MACGEM-IT model

VII. The closure conditions

- *Saving-Investment condition*

  Investment is saving-driven. It is determined by the sum of savings from Households, Firms, Government and Rest of World.

- *Balance with rest of the world*
  - Foreign savings are flexible and nominal exchange rate is fixed
  - Imports are endogenously determined
  - Exports are exogenous

- *Closure condition on Government*
  - Tax rates are fixed
  - Consumption expenditure is exogenous
  - Saving is endogenous and calculated as the difference between Government disposable incomes and total expenditure

MACGEM-IT model extensions

The MACGEM-IT model is developed in three versions:

1. *Static National* MAGCEM-IT model
2. *Dynamic National* MACGEM-IT model
3. *Multi-regional* MACGEM-IT model

1. *Static National* MAGCEM-IT model

- The static version of the MACGEM-IT model allows quantifying the direct and indirect effects of economic policies in disaggregated terms in all phases of income generation, distribution and use.
- The parameters of the model are calibrated on the basis of the national SAM for Italy.
- The exogenous parameters and variables of the model are validated through the construction of standard shock simulation exercises.

2. *Dynamic national* MACGEM-IT model

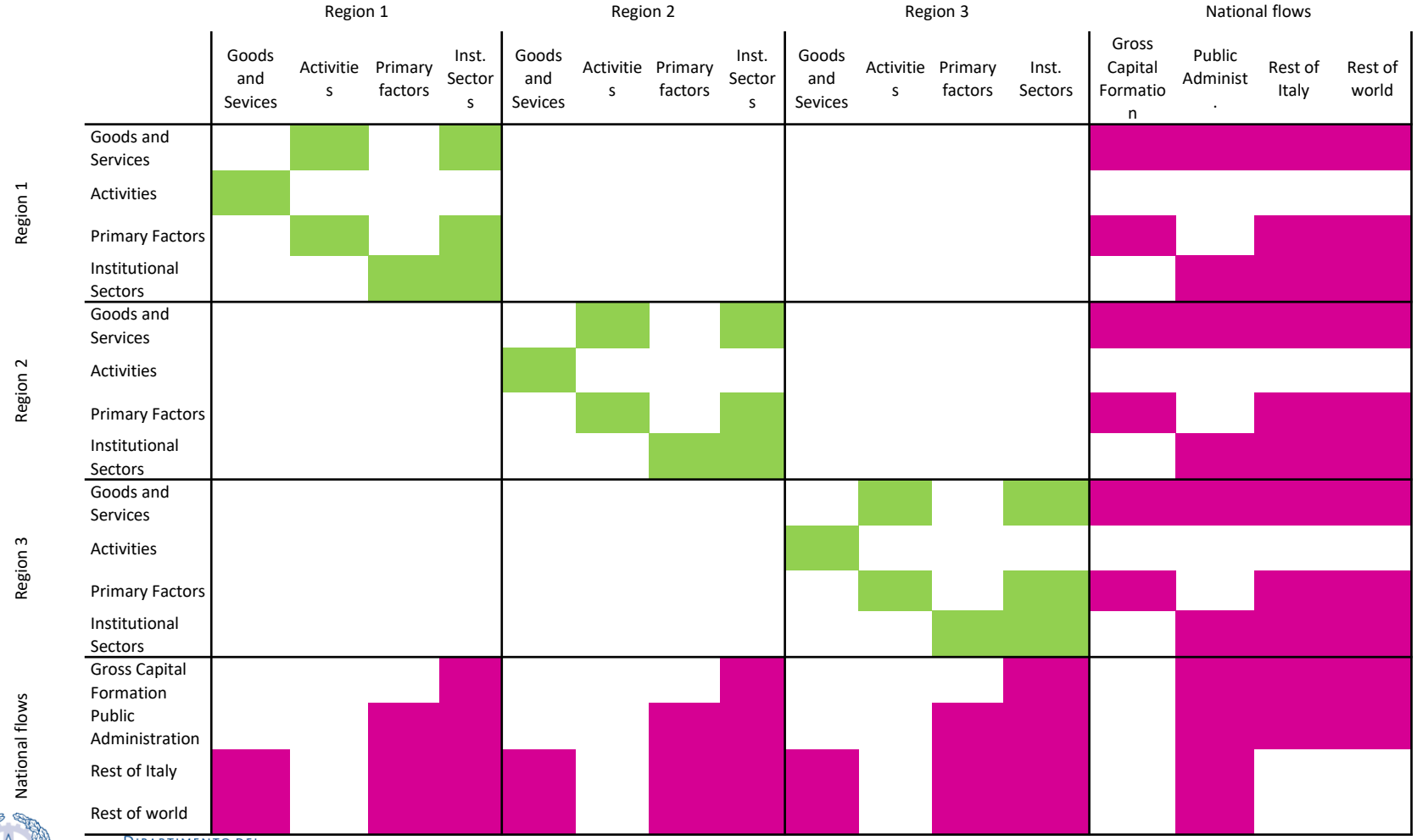
- The dynamic version of the MACGEM-IT model allows to quantifying the direct and indirect effects of economic policies in disaggregated terms and in a pre-determined time horizon (Dixon and Jorgenson, 2013).
- The baseline equilibrium is obtained from the calibration procedure on the basis of the national SAM for Italy
- The dynamic is introduced as a sequence of mono-periodic static equilibria linked together by capital accumulation condition (Lau et al. 2002)

3. *Multi-regional* MACGEM-IT model

- The multi-regional version of the MACGEM-IT model allows to assess the direct and indirect effects of economic policies throughout the national territory in disaggregated terms and at regional level.

- The parameters of the multi-regional model are calibrated on the basis of the multi-regional SAM for Italy that include the economic flows occurring among the 20 Italian regions. The aggregate value of these flows is consistent with the national SAM.

Multi-regional SAM: simplified structure



The validation of the static national MACGEM-IT model

We tested the response of the model to standard shocks:

1. Increase in world demand corresponding to an increase in exports by 1% in real terms
2. Appreciation of nominal effective exchange rate of 5%
3. Increase in Oil price by 10%
4. Increase in public investment corresponding to 1% of GDP
5. Reduction of the income tax on households corresponding to 1% of GDP
6. Reduction of indirect taxes corresponding to 1% of GDP
7. Reduction of corporate income taxes corresponding to 1% of GDP
8. Reduction of social contributions corresponding to 1% of GDP

1. Increase in world demand corresponding to an increase in (real) exports by 1%

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	0.3
Imports (goods and services)	0.5
Exports (goods and services)	1.0
Consumption	0.3
Gross Fixed Investment	0.2
GDP Deflator	0.1
Import Deflator (goods and services)	0.0
Export Deflator (goods and services)	0.1
Consumption Deflator	0.1
Real Wage	0.2
Employment	0.2

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
15	Manufacture of basic metals	0.57
19	Manufacture of machinery and equipment n.e.c.	0.55
11	Manufacture of chemicals and chemical products	0.49
18	Manufacture of electrical equipment	0.49
13	Manufacture of rubber and plastic products	0.47
16	Manufacture of fabricated metal products, except machinery and equipment	0.47
32	Water transport	0.47
6	Manufacture of textiles, wearing apparel, leather and related products	0.45
21	Manufacture of other transport equipment	0.44
8	Manufacture of paper and paper products	0.43
20	Manufacture of motor vehicles, trailers and semi-trailers	0.42
50	Rental and leasing industries	0.42
29	Wholesale trade, except of motor vehicles and motorcycles	0.41
14	Manufacture of other non-metallic mineral products	0.41
22	Manufacture of furniture; other manufacturing	0.40

2. Appreciation of nominal effective exchange rate of 5%

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	-0.4
Imports (goods and services)	0.0
Exports (goods and services)	-1.1
Consumption	0.1
Gross Fixed Investment	-0.6
GDP Deflator	-0.6
Import Deflator (goods and services)	-2.4
Export Deflator (goods and services)	-1.3
Consumption Deflator	-0.9
Real Wage	-1.2
Employment	-0.2

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
19	Manufacture of machinery and equipment n.e.c.	-1.17
4	Mining and quarrying	-1.16
50	Rental and leasing industries	-1.00
21	Manufacture of other transport equipment	-0.99
16	Manufacture of fabricated metal products, except machinery and equipment	-0.99
18	Manufacture of electrical equipment	-0.98
46	Architectural and engineering industries; technical testing and analysis	-0.97
15	Manufacture of basic metals	-0.92
49	Other professional, scientific and technical industries; veterinary industries	-0.89
20	Manufacture of motor vehicles, trailers and semi-trailers	-0.89
17	Manufacture of computer, electronic and optical products	-0.88
29	Wholesale trade, except of motor vehicles and motorcycles	-0.85
12	Manufacture of basic pharmaceutical products and pharmaceutical preparations	-0.82
11	Manufacture of chemicals and chemical products	-0.81
22	Manufacture of furniture; other manufacturing	-0.80

3. Increase in Oil price by 10%.

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	-0.3
Imports (goods and services)	-0.4
Exports (goods and services)	-0.3
Consumption	-0.5
Gross Fixed Investment	-0.1
GDP Deflator	0.3
Import Deflator (goods and services)	1.7
Export Deflator (goods and services)	0.7
Consumption Deflator	0.7
Real Wage	0.1
Employment	-0.2

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
33	Air transport	-0.50
30	Retail trade, except of motor vehicles and motorcycles	-0.47
11	Manufacture of chemicals and chemical products	-0.43
15	Manufacture of basic metals	-0.39
24	Electricity, gas, steam and air conditioning supply	-0.39
14	Manufacture of other non-metallic mineral products	-0.37
42	Insurance, reinsurance and pension funding, except compulsory social security	-0.35
62	Other personal service industries	-0.35
44	Real estate industries including imputed rents of owner-occupied dwellings	-0.34
5	Manufacture of food products; beverages and tobacco products	-0.31
8	Manufacture of paper and paper products	-0.31
6	Manufacture of textiles, wearing apparel, leather and related products	-0.31
28	Wholesale and retail trade and repair of motor vehicles and motorcycles	-0.30
58	Creative, arts and entertainment industries; libraries, archives, museums, gambling and betting industries	-0.30
32	Water transport	-0.30

4. Increase in public investment corresponding to 1% of GDP

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	1.2
Imports (goods and services)	1.3
Exports (goods and services)	-0.3
Consumption	0.9
Gross Fixed Investment	5.8
GDP Deflator	0.5
Import Deflator (goods and services)	0.0
Export Deflator (goods and services)	0.3
Consumption Deflator	0.3
Real Wage	1.3
Employment	0.9

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
27	Construction	4.59
47	Scientific research and development	3.80
23	Repair and installation of machinery and equipment	3.30
40	Computer programming, consultancy, and information service industries	2.45
17	Manufacture of computer, electronic and optical products	1.99
7	Manufacture of wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.84
46	Architectural and engineering industries; technical testing and analysis	1.83
45	Legal and accounting industries; industries of head offices; management consultancy industries	1.76
14	Manufacture of other non-metallic mineral products	1.71
21	Manufacture of other transport equipment	1.71
16	Manufacture of fabricated metal products, except machinery and equipment	1.66
30	Retail trade, except of motor vehicles and motorcycles	1.61
61	Repair of computers and personal and household goods	1.57
49	Other professional, scientific and technical industries; veterinary industries	1.54
50	Rental and leasing industries	1.51

5. Reduction of the income tax on households corresponding to 1% of GDP

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	1.3
Imports (goods and services)	1.4
Exports (goods and services)	-0.3
Consumption	2.4
Gross Fixed Investment	1.2
GDP Deflator	0.5
Import Deflator (goods and services)	0.0
Export Deflator (goods and services)	0.3
Consumption Deflator	0.3
Real Wage	1.3
Employment	0.8

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
30	Retail trade, except of motor vehicles and motorcycles	3.04
63	Industries of households as employers; undifferentiated goods and services for own use	2.41
44	Real estate industries including imputed rents of owner-occupied dwellings	2.28
62	Other personal service industries	2.27
3	Fishing and aquaculture	2.11
36	Accommodation and food service industries	2.05
28	Wholesale and retail trade and repair of motor vehicles and motorcycles	2.03
1	Crop and animal production, hunting and related service industries	2.00
42	Insurance, reinsurance and pension funding, except compulsory social security	1.89
58	Creative, arts and entertainment industries; libraries, archives, museums, gambling and betting industries	1.81
39	Telecommunication	1.78
61	Repair of computers and personal and household goods	1.76
5	Manufacture of food products; beverages and tobacco products	1.74
24	Electricity, gas, steam and air conditioning supply	1.72
38	Motion picture, video, television programme production; programming and broadcasting	1.66

6. Reduction of indirect taxes corresponding to 1% of GDP

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	0.7
Imports (goods and services)	0.5
Exports (goods and services)	1.1
Consumption	0.8
Gross Fixed Investment	0.1
GDP Deflator	-1.5
Import Deflator (goods and services)	0.0
Export Deflator (goods and services)	-1.1
Consumption Deflator	-1.4
Real Wage	0.8
Employment	0.1

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
63	Industries of households as employers; undifferentiated goods and services for own use	0.77
33	Air transport	0.47
11	Manufacture of chemicals and chemical products	0.45
30	Retail trade, except of motor vehicles and motorcycles	0.39
60	Industries of membership organisations	0.32
31	Land transport and transport via pipelines	0.31
15	Manufacture of basic metals	0.31
32	Water transport	0.31
35	Postal and courier industries	0.28
13	Manufacture of rubber and plastic products	0.28
26	Sewerage, waste management, remediation industries	0.27
44	Real estate industries including imputed rents of owner-occupied dwellings	0.27
19	Manufacture of machinery and equipment n.e.c.	0.26
8	Manufacture of paper and paper products	0.25
18	Manufacture of electrical equipment	0.23

7. Reduction of corporate income taxes corresponding to 1% of GDP

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	0.8
Imports (goods and services)	0.9
Exports (goods and services)	-0.2
Consumption	0.5
Gross Fixed Investment	3.3
GDP Deflator	0.3
Import Deflator (goods and services)	0.0
Export Deflator (goods and services)	0.2
Consumption Deflator	0.2
Real Wage	0.5
Employment	0.5

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
27	Construction	2.63
47	Scientific research and development	2.19
23	Repair and installation of machinery and equipment	1.86
40	Computer programming, consultancy, and information service industries	1.45
46	Architectural and engineering industries; technical testing and analysis	1.28
17	Manufacture of computer, electronic and optical products	1.20
45	Legal and accounting industries; industries of head offices; management consultancy industries	1.06
16	Manufacture of fabricated metal products, except machinery and equipment	1.03
7	Manufacture of wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.01
21	Manufacture of other transport equipment	0.98
30	Retail trade, except of motor vehicles and motorcycles	0.96
61	Repair of computers and personal and household goods	0.95
19	Manufacture of machinery and equipment n.e.c.	0.95
22	Manufacture of furniture; other manufacturing	0.95
49	Other professional, scientific and technical industries; veterinary industries	0.95

8. Reduction of social contributions corresponding to 1% of GDP

Impact on main macroeconomic variables

Macroeconomic variables	% change from benchmark
GDP	0.8
Imports (goods and services)	0.8
Exports (goods and services)	-0.1
Consumption	1.5
Gross Fixed Investment	0.3
GDP Deflator	0.1
Import Deflator (goods and services)	0.0
Export Deflator (goods and services)	0.1
Consumption Deflator	0.0
Real Wage	-0.2
Employment	0.4

Impact on Value Added in disaggregate terms (top performances).

nr.	Industries	% change
27	Construction	2.63
47	Scientific research and development	2.19
23	Repair and installation of machinery and equipment	1.86
40	Computer programming, consultancy, and information service industries	1.45
46	Architectural and engineering industries; technical testing and analysis	1.28
17	Manufacture of computer, electronic and optical products	1.20
45	Legal and accounting industries; industries of head offices; management consultancy industries	1.06
16	Manufacture of fabricated metal products, except machinery and equipment	1.03
7	Manufacture of wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	1.01
21	Manufacture of other transport equipment	0.98
30	Retail trade, except of motor vehicles and motorcycles	0.96
61	Repair of computers and personal and household goods	0.95
19	Manufacture of machinery and equipment n.e.c.	0.95
22	Manufacture of furniture; other manufacturing	0.95
49	Other professional, scientific and technical industries; veterinary industries	0.95

The econometric model ITFIN

MEF Dipartimento del Tesoro

The ITFIN econometric model: an introduction

- ITFIN is a quarterly econometric model for the Italian economy currently being developed by the Treasury Department
- It has a dynamic structure in which the evolution of financial assets and liabilities of the different sectors of the economy originates from financial flows. This ensures consistency between stocks and flows
- In turn, the financial positions in terms of the assets and liabilities of the various sectors impinge on the economic and financial decisions of agents and on the pattern of the real economy
- The breakdown of the model in institutional sectors is very detailed and reflects the one of the financial accounts
- In addition, the model considers a wide detail also as regards the type of financial instruments issued and held by each sector

The ITFIN model: differences with the models used at DT (I)

- ITTFIN, as well as the other Treasury's econometric model, ITEM, is a highly data-driven model
- The relationships between the variables in the behavioral equations, although partly derived from economic theory, have a rich dynamic component shaped by the data. In both models, the specification of the different equations is a reduced form characterization of the data
- While ITFIN, as ITEM, is a data-driven model, other quantitative models of the Treasury, IGEM and QUEST III, are more guided by theory
- IGEM and QUEST III are Dynamic stochastic general equilibrium models where equations are structural, as they are the first order conditions for the optimal choice of economic agents
- The main difference between the two approaches therefore lies in a different weight given to the data (greater in ITFIN and ITEM) and the theoretical foundations (greater in IGEM)

The ITFIN model: differences with the models used at DT (II)

- Compared to the ITEM econometric model, ITFIN reproduces in detail the functioning of the banking, monetary and financial marketa. There is a stronger focus on the financial structure of the economy
- The various exogenous impulses imparted in the model — not just the financial shocks — transmit to the economic system through propagation channels that have to do with the financial sector
- On the other hand, the public finance bloc (both Government revenue and expenditure) and the relationships that shape the pattern of macroeconomic aggregates are more detailed in ITEM
- In ITFIN, as in ITEM, the agents' expectation formation mechanism is that of adaptive expectations. In IGEM, instead, there are rational expectations
- For the reasons set out above, the different models in use and in the way of development at the DT should be considered as complementary quantitative instruments for economic analysis

The institutional sector approach

The breakdown of the sectors considered in the model is as follows:

- Households (HH)
- Non-financial corporations (NFC)
- Financial corporations (FC) = Financial intermediaries except the Central Bank (FC) + Other financial intermediaries except non-monetary mutual funds (OFC) + Financial Auxiliaries (FA)
- Public Administration (GOV) = Central Government (GC) + Local Government (GL) + Social Security and Welfare Institutions (GSS)
- Other financial corporations (ICPF) = Insurance Companies (ASS) + Pension Funds (PF) + Non-Monetary mutual Funds (MF)
- Central Bank (CB)
- Rest of the world (RDM)

The databanking of the model

- An automated procedure has been developed to draw the financial accounts data maintained by the Bank of Italy and update the time series
- For each of the institutional sectors, information is collected, both for stocks and flows, disaggregated by
  - the type of financial instrument
  - the fact that the instrument is a sector liability or asset
  - the counterpart sector issuing or holding it
- These databases are kept both in xls format and as a database of EViews
- From the original comprehensive database, variables are aggregated for particular assets and/or liabilities if the model does not require the same level of breakdown of the financial accounts
- For some financial instruments and sectors, net financial assets are calculated if a separate information on assets and liabilities is not needed
- Of course, the model's data includes the ISTAT data on national economic accounts, with reference both to macroeconomic aggregates and to those of the economic accounts of the institutional sectors

The "*who holds what and how much*" matrix

- To understand the financial structure of the ITFIN model, it is appropriate to build the matrices for displaying "*who holds what and how much*" in the financial accounts as well as in the model

- The rows in the matrices refer to the instruments and the columns to the sectors that are net holders (+) or net issuers (–) of these instruments

- In the matrix below, cells are filled only when the specific sector-financial instrument combination is explicitly considered in the model

- The first matrix allows to visualize the empty cells, that is the aggregates not taken into account in the model

The *who holds what and how much"'* matrix of ITFIN

	NFCs	Banks	ICPFs	Government	Households	Central Bank	RoW	Σ
Real assets								
Houses*					$+Houses_H$			+K
Financial assets								
Deposits	$+D_{NFC,B}$	$-D_B$	$+D_{ICPF,B}$		$+D_{H,B}$	$+D_{CB,B}$	$+D_{RoW,B}$	0
Bank bonds*		$-B_B$	$+B_{B,ICPF}$		$+B_{B,H}$		$+B_{B,RoW}$	0
Gov bonds*		$+B_{G,B}$	$+B_{G,ICPF}$	$-B_G$	$+B_{G,H}$	$+B_{G,CB}$	$+B_{G,RoW}$	0
Gov Bills		$+b_{G,B}$	$+b_{G,ICPF}$	$-b_G$	$+b_{G,H}$		$+b_{G,RoW}$	0
RoW bonds			$+B_{RoW,ICPF}$				$-B_{RoW,ICPF}$	0
Mortgages		$+M_{B,H}$			$-M_{B,H}$			0
Loans	$-L_{B,NFC}$	$+L_{B,NFC}$						0
NFC equity*	$-E_{NFC}$		$+E_{NFC,ICPF}$		$+E_{NFC,H}$		$+E_{NFC,RoW}$	0
Bank equity		$-E_{B,RoW}$					$+E_{B,RoW}$	0
RoW equity			$+E_{RoW,ICPF}$				$-E_{RoW,ICPF}$	0
Ins. res. and guarantees			$-ITR_{ICPF,H}$		$+ITR_{ICPF,H}$			0
ICPF mutual funds			$-MF_{ICPF,H}$		$+MF_H$			0
RoW mutual funds					$+MF_H$		$-MF_{RoW,H}$	0
CB Reserves		$+R$				$-R$		0
Net Worth	$-NW_{NFC}$	$-NW_B$	$-NW_{ICPF}$	$-NW_G$	$-NW_H$	$-NW_{CB}$	$-NW_{RoW}$	-K
Σ	0	0	0	0	0	0	0	0

The end

Thank you!!!

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