MeMo-It model
Some extentions of the Istat-PBO version

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Outline

Use of the model

MeMo-It model represents the main tool used by the PBO to construct the medium-term macroeconomic forecast.

Model used by the PBO differs from the original Istat specification to adapt the MeMo-It to the specific requirements of the Office:

- accurate specification of fiscal measures
- evaluation of the effects of policy interventions
- greater detail of macroeconomic forecast

Extentions

Main extentions refer to both individual behavioural equations and to the structure of the links between specific blocks of equations. The main changes concern:

- supply-side block supplemented with equations and identities to form a short-term supply-side block, in addition to the long-term specification (potential output)
- construction of a complete and coherent structure of institutional sector accounts (non-financial accounts)
- financial market shocks taken into account through the specification of a *sovereign risk channel*.

Short-term supply side block

Supply of goods and services broken down in market and public sector. In market sector, supply is modelled as a Cobb-Douglas production function,

$$Y_t = TFP_t[L_t]^{\alpha}[K_t^{bus}]^{1-\alpha}$$

The productive factors' demand is obtained from the cost-minimization problem:

- optimal labor demand depends positively on output and negatively on real labor costs

$$L_t = \alpha Y_t/[w_t(1+\tau_t)]$$

- optimal stock of capital is given by

$$K_t = (1-\alpha)Y_t/R_t^k$$

The long-run equilibrium conditions give rise to ECM-type structural equations which are at the roots of both empirical and theoretical setup.

cont.: short-term supply side

Demand-side short-term dynamics are considered through the identity

$$Y_t^D \equiv C_t + I_t + G_t + X_t - M_t$$

The gap between short-term supply-side output and aggregate demand is explained by:

- adjustments in the demand for factors of production, change in inventories, changes in nominal variables (prices, wages),

  $$P_t = f(Y_t^{gap}, PM_t, TFP_t^c, P_t^{oil})$$

  where the TFP cyclical component, TFP^c, depends on factors utilization rates

  $$TFP_t^c = [U_t^l]^\alpha [U_t^k]^{1-\alpha}$$

Institutional sector accounts

- The model includes a complete and coherent structure of non-financial institutional sector accounts, with additivity constraints for specific nominal variables.
- Extension has involved the specification of a block for the sector of financial and non-financial corporations.
- Build upon existing and comprehensive structure of sectoral accounts for Households (including NPISH), Government and RoW as reported in Bacchini et al. (2013).
- Institutional account block is based on the reclassification scheme of non-financial accounts based on this worksheet.

Firms' sector account

The specification of firms's sector account includes both financial and non-financial corporations.

- More detailed definition of the sector specific variables (e.g., value added, gross operating surplus)
- Clearer definition of fiscal policy instruments. On the revenue side, tax bases and average effective rates (of both direct and indirect taxes)
- Improve the theroretical coherence of some behavioral equations
- Accurate specification of economic policy measures targeted to the sector

cont.: Firms' sector account

As for output at sectoral level, the modelling strategy is similar to the one adopted for the specification of short-term sypply side of the economy.

- Each individual enterprise operates in a perfectly competitive environment and uses a Cobb-Douglas technology,

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

  where Y_t is the value added, K_t the capital stock and L_t labour input (FTE) consistent with sector accounts data.
- Firm's demand for productive factors is specified according to the cost-minimization problem,

$$W_t = \alpha \mathcal{MC}_t \frac{Y_t}{(1+\tau_t^w) L_t}$$

$$R_t = (1-\alpha) \mathcal{MC}_t \frac{Y_t}{K_t Q_t}$$

cont.: Firms' sector account

Gross operating surplus, GO_t, is obtained based on the following identity

$$GO_t = Y_t - (1 + \tau_t^w) W_t L_t^d - \tau_t^{o,p} + s_t^{o,p}$$

where $\tau_t^{o,p}$ and $s_t^{o,p}$ denote the other taxes and other subsidies on production, compensation of employees are obtained as

$$WB_t = (1 + \tau_t^w) \times W_t L_t^d$$

and W_t, wage per capita, is function of labor productivity in the firms' sector and labour market conditions (theory-consistent Phillips curve)

$$W_t = f(Y_t/L_t, P_t^c, [U_t U_t^n])$$

Demand for employees, L_t^d depends on overall sector labour input and, in the short term, on cyclical factors (labour utilization rate)

$$L_t^d = f(L_t, ul_t)$$

cont.: Firms' sector account

Gross saving, GS, is obtained by the accounting identity

$$GS_t = GO_t + NPI_t - IRES_t + CT_t$$

- NPI_t, the net property income, is a function of stock of net financial assets specific to the institutional sector, NFA_t, interest rate, R_t, and output gap, GAP_t,

$$NPI_t = f(NFA_t, R_t, GAP_t)$$

- $IRES_t$ are the corporate income taxes

$$IRES_t = TIRES_t \times GO_t$$

- CT_t, the other current transfers, is function of unemployment rate, firm demographics, B_t, non-life insurance premiums, A_t,

$$CT_t^e = f(U_t, B_t, A_t)$$

cont.: Firms' sector account

Net lending/net borrowing, NL_t,

$$NL_t = GS_t + OCE_t - GCF_t$$

is obtained by summing to gross saving the balance of capital transfers, OCE_t, and subtracting the investment expenditure, GCF_t, that are specified as

$$\log GCF_t = -\tfrac{1}{\psi} \log a_2 + \tfrac{1}{\psi} \log [K_t^{\psi} - a_1(1-\delta)K_{t-1}^{\psi}].$$

assuming the presence of adjustment costs ($\psi < 1$) that penalise the level of investments (Christiano et al., 2005).

Sovereign risk channel

- We introduce a *sovereign risk channel* through which sovereign default risk raises *funding costs* in the private sector.
- An upward revision of the projected government deficit pushes up the risk premium on public debt and, through the sovereign risk channel, spills over to private borrowing costs and amplifies the transmission of shocks to aggregate demand.
- Higher private funding costs, when monetary policy is constrained to ZLB, slow down activity.
- When monetary policy is constrained, the sovereign risk channel tends to reduce the fiscal multiplier. Sign and the size of the government spending multiplier depend on the state of the economy.

cont.: Sovereign risk channel

Starting point: Bontempi (2013) suggest to account for the interaction of financial markets behaviors and real variables. We extend the model with two relationships:

- The *sovereign risk premium*: it is endogenous and modelled as a function of debt to GDP ratio. Implicit is the assumption of fiscal limits to credible commitment on the part of fiscal policy makers (Bi and Traum, 2012).
- The equation for interest rate is augmented with the default probability, so that in the long-term interest rates depend on risk-free interest rate and default probability.

cont.: Sovereign risk channel

Default probability: we rely on Bi and Traum (2012) business cycle model.

We endogenize sovereign default probability using the notion of a fiscal limit (Bi, 2012). Whenever the debt level rises above the fiscal limit, b_t^*, default will occur. The default scheme is as follows:

$$\Delta_t = \begin{cases} 0 & \text{if} \quad b_{t-1} < b_t^* \\ \delta & \text{if} \quad b_{t-1} \geq b_t^* \end{cases}$$

We specify the cumulative density function of the fiscal limit distribution as a logistical function with parameters η_1 and η_2 dictating its shape

$$Pr(b_{t-1} \geq b_t^*) = \frac{exp(\eta_1 + \eta_2 b_{t-1})}{1 + exp(\eta_1 + \eta_2 b_{t-1})}$$

cont.: Sovereign risk channel

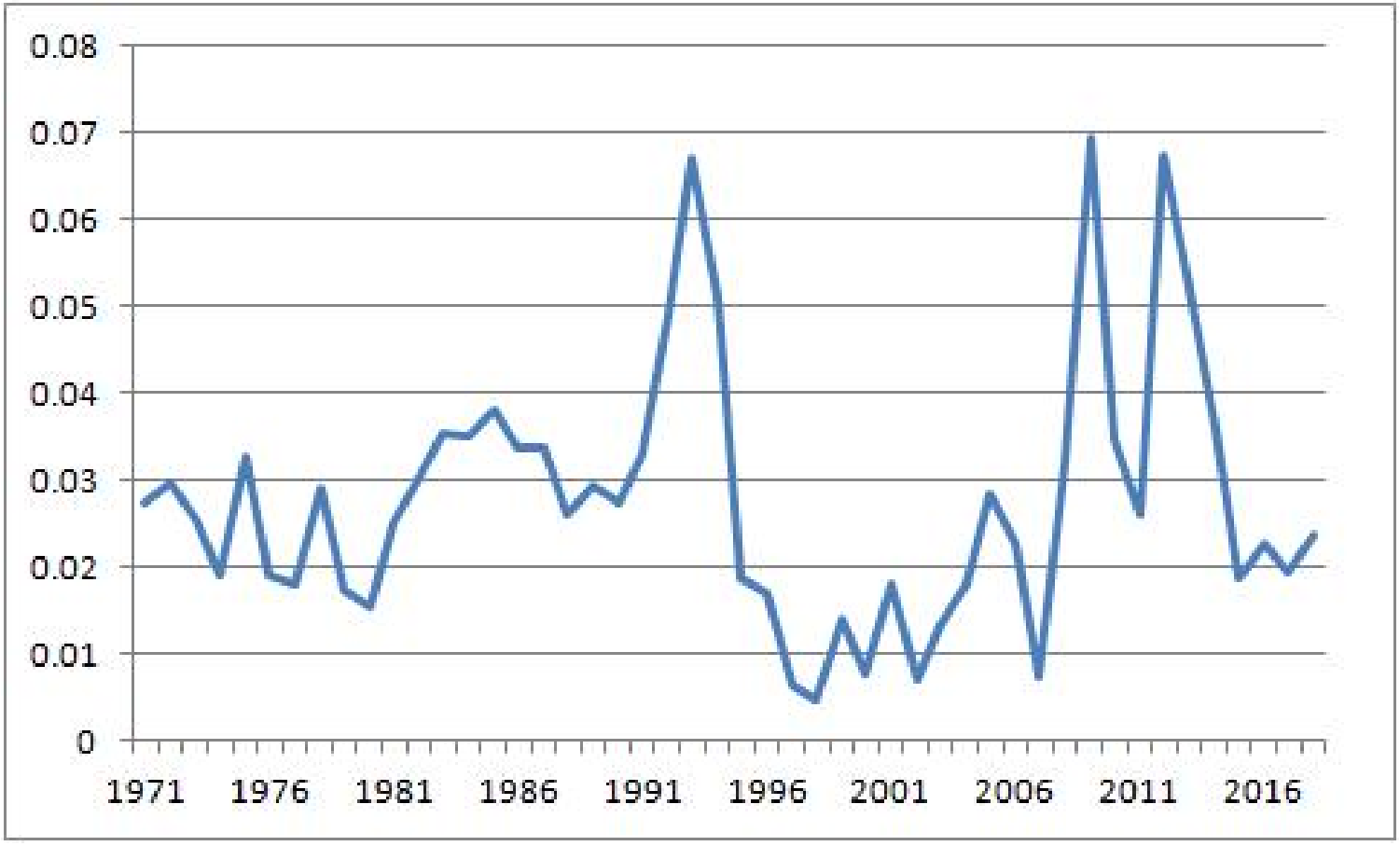
Equation for interest rate is augmented with the estimated default probability. In the long-run, it is driven by this equilibrium relatioship

$$log(R_t) = log(R_t^*) + \Delta(1 - Pr())$$

An increase in default probability impact the private sector:

- household decision of consumption and saving are affected through disposable income (non-labour income) and the stock of net financial assets hold by households;
- firms decision in investment expenditure are affected through the interest rate channel, which enter the user cost functions and the demand for capital.

Default probability



Output effects

First, given this framework, a permanent increase of cumulated default probability by 0.1, other things being equal, causes a drop in GDP by about 0.15 pp. (0.2 pp. in 4 years).

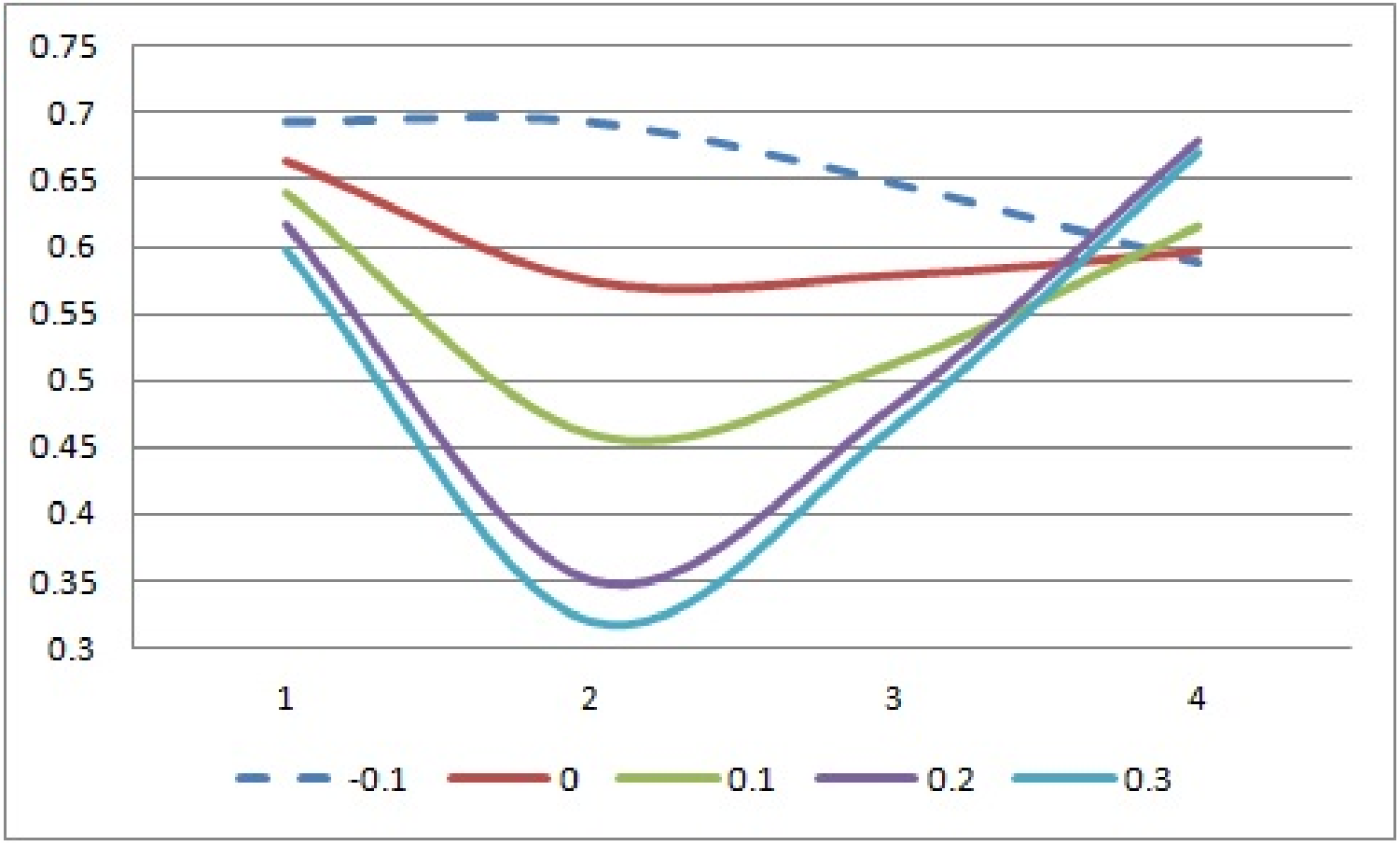
Second, the impact of increasing default probability can be evaluated through the output response to changes in Government expenditure.

We assess how the output response varies depending on two dimensions: strengths of the sovereign risk channel, duration of the ZLB period.

Approximate results as monetary policy is exogenous. Monetary policy stance is proxied by 3M interest rate.

Fiscal shock is permanent and equal to 1% of nominal GDP in the initial year of simulation.

Goverment expenditure multipliers



Each schedule corresponds to a degree of responsivness of risk channel; ZLB duration on X axis

Further developments

- Extend institutional sector accounts with sector financial accounts.
- Model a credit channel, eventually breaking down the firm sector into financial and non-financial corporations
- It allows for more accurate estimates of the effects of risk channel through the balance sheet of private sector

Reclassification scheme

back

	2012						2013					
	ECO	HH	E	GVT	EXT	CHK	ECO	HH	E	GVT	EXT	CHK
Gross domestic product (B.1g)	1628.0						1618.9					
- Taxes on products (D.21p)	186.2						184.7					
+ Subsidies on products (D.31r)	21.0						22.6					
= Gross value added (B.1g-D.21+D.31)	**1462.8**	**453.7**	**790.2**	**218.9**		**0.0**	**1456.8**	**454.2**	**783.8**	**218.8**		**0.0**
- Other taxes on production (D.29p)	62.0	21.5	30.6	9.9			56.9	18.2	28.9	9.8		
+ Other subsidies on production (D.39r)	10.2	4.2	6.0	0.0			10.8	4.5	6.3	0.0		
- Compensation of employees (D.1p)	651.0	48.5	436.3	166.2	3.7		648.0	48.2	435.0	164.7	3.2	
= Gross operating surplus (B.2g) / mixed income	**760.0**	**387.8**	**329.3**	**42.9**			**762.7**	**392.3**	**326.2**	**44.3**		
+ Compensation of employees (D.1r)	654.7	654.7			N	**0.0**	651.1	651.1			N	**-0.1**
HH: Wages and salaries (D.11r)		477.4						474.5				
HH: Employer's social contributions (D.12r)		177.3						176.5				
+ Taxes on production and imports (D.2r = D.21r+D.29r)	246.1			246.1	2.1	**0.0**	239.7			239.7	1.9	**0.0**
EXT: Taxes on products (D.21r) (Taxes paid to EU)					2.1						1.9	
EXT: Other taxes on production (net) (D.29)					0.0						0.0	
- Subsidies (D.3p = D.31p+D.39p)	26.1			26.1	5.1	**0.0**	28.1			28.1	5.2	**0.0**
EXT: Subsidies on products (D.31p) (Subsidies from EU)					5.1						5.2	
EXT: Other subsidies on production (net) (D.39)					0.0						0.0	
+ Property income (net) (D.4)	-10.1	178.7	-113.7	-75.1	11.9	**1.8**	-9.2	165.8	-106.7	-68.3	13.7	**4.5**
GVT: Property income (received) (D.4r)				9.0						10.0		
GVT: Property income (paid, excluding interests) (D.4-D.41p)				0.1						0.0		
GVT: Interest paid (D.41p)				84.1						78.2		
= Balance of primary income (gross) / Gross national	**1624.6**	**1221.2**	**215.6**	**187.8**			**1616.1**	**1209.1**	**219.5**	**187.5**		
+ Current taxes on income and wealth (D.5r)	239.7			239.7			241.5			241.5		
+ Social contributions (D.61r)	247.2	2.0	29.3	215.8	0.3		245.8	1.9	28.7	215.2	0.1	
GVT: Actual social contributions (D.611r)				211.7						211.1		
GVT: Imputed social contributions (D.612r)				4.1						4.1		
+ Social benefits (D.62r)	342.0	342.0					351.1	351.1				
+ Other current transfers (D.7r)	99.9	46.3	32.0	21.5	18.2		96.6	45.0	30.2	21.3	18.7	
= Total revenue	**2553.5**	**1611.6**	**276.9**	**664.9**			**2551.1**	**1607.2**	**278.4**	**665.5**		
- Current taxes on income and wealth (D.5p)	239.2	199.2	38.8	1.2	0.5	**0.0**	240.9	198.6	41.1	1.2	0.9	**0.3**
- Social contributions (D.61p)	247.5	247.5				**0.0**	245.9	245.9				**0.0**
- Social benefits (D.62p)	342.0	1.6	26.8	311.4	-2.2	**0.0**	351.1	1.5	27.5	319.7	-2.5	**0.0**
- Other current transfers (D.7p)	121.8	54.7	40.5	26.6		**3.7**	118.5	53.4	37.7	27.4		**3.3**
= Disposable income (B.6g)	**1605.1**	**1108.6**	**170.9**	**325.7**			**1597.1**	**1107.8**	**172.1**	**317.2**		
+ Adjustment for change in net equity of pension fund	0.0	2.7	-2.7	0.0	0.0	**0.0**	0.0	1.7	-1.7	0.0	0.0	**0.0**
- Final consumption expenditure (P.3)	1311.1	995.4		315.7			1294.2	979.4		314.8		
GVT: Individual consumption expenditure (P.31)				184.6						183.7		
GVT: Collective consumption expenditure (P.32)				131.1						131.1		
= Gross saving (B.8g)	**294.0**	**115.8**	**168.2**	**10.0**			**303.0**	**130.2**	**170.4**	**2.4**		
+ Capital transfers (net) (D.9)	2.2	1.0	18.4	-17.2	-2.1	**0.1**	3.4	-0.5	13.8	-9.9	-3.4	**0.0**
GVT: Capital taxes (D.91r)				1.5						4.1		
GVT: Other capital transfers (D.9r-D.91r)				4.4						5.2		
GVT: Capital transfers (D.9p)				23.1						19.2		
- Acq. less disp. of non-fin. non-prod. assets (K.2)	-1.8	-0.4	-1.6	0.2	1.7	**-0.1**	3.4	-0.3	3.6	0.1	-3.0	**0.4**
- Gross fixed capital formaton (P.51)	303.5	101.8	160.5	41.2		**0.0**	288.6	97.1	153.2	38.3		**0.0**
- Changes in inventories / valuables (P.52 + P.53)	-1.2	2.4	-3.7	0.0		**0.0**	-0.8	2.2	-3.0	0.0		**0.0**
= Net lending / net borrowing (B.9)	**-4.2**	**13.0**	**31.4**	**-48.6**	**2.4**	**-1.8**	**15.1**	**30.7**	**30.4**	**-46.0**	**-14.7**	**0.4**

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