An Assessment of Stability and Growth Pact Reform Proposals in a Small-Scale Macro Framework*

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Abstract

This paper contributes to the debate on fiscal governance for the European Monetary Union. We simulate a small scale macroeconomic model with forward looking agents, augmented with a public finance block. We account for both positive (output stabilization) and negative (via risk premia) effects of debt and deficit. By the appropriate choice of the exogenous fiscal variables in the fiscal block, we replicate the working of the rule embedded in the so-called "fiscal compact". We compare this rule with the Maastricht 3% deficit limit (status quo), and with an "investment" rule leaving room for public investment. We evaluate the performance in terms of output and inflation during a fiscal consolidation, as well as following demand and supply shocks at the steady state. All rules guarantee long run sustainability. The investment rule emerges robustly as the one guaranteeing the lowest output loss, followed by the status quo. The "fiscal compact" rule appears to be the most recessionary and deflationary.

Keywords: Fiscal Rules, Small scale Macroeconomic Models, golden rule, fiscal consolidation, EMU economic governance, fiscal compact

JEL-Codes: C63, E62, E63, H61

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1. Introduction

This paper assesses the macroeconomic impact of a number of fiscal rules that have been or could be implemented by countries belonging to the European Union. The European fiscal crisis, and the ensuing requirement to reduce public debt levels, paved the way for a set of reforms of the European fiscal rules. On March 2nd 2012, 25 of the 27 EU countries (the UK and the Czech Republic did not sign) adopted the *Treaty on Stability, Coordination and Governance in the Economic and Monetary Union,* that is currently (November 2012) under ratification. This so-called 'Fiscal Compact' complemented the provisions of the Maastricht Treaty and of the Stability and Growth Pact (SGP): the limit of public deficit at 3% of GDP has been supplemented with a limit on structural deficit at 0.5% of GDP, and an average yearly reduction by 1/20th of the difference between the debt to GDP ratio and the 60% of GDP Maastricht limit. The limit on structural deficit goes beyond the 3% Maastricht provision, in that it aims at introducing balanced budget constraints at the Constitutional level of each euro zone member state.

It is somewhat paradoxical that rules aimed at constraining the capacity of governments to run countercyclical policies are discussed precisely after the worldwide financial crisis required large public deficits to dampen shocks ensuing from market failures. Thus, the introduction of the above-mentioned rules raises the question of their incidence on the usual objectives of economic policies, namely the output gap and the inflation rate.

The contribution of this paper is to simulate the macroeconomic effects of the adoption of these rules in a structural small scale New-Keynesian model, in which we introduce a public finance block and a yield curve embedding risk premia. We aim at shifting the attention back from the objective of *fiscal* stabilization to the one of *macroeconomic* stabilization. As the proposed rules stand, public deficit and debt are not instruments to smooth the cycle. European authorities - governments, the ECB, or the Commission - seem to consider them as objectives of policy action rather than what they should be, namely *instruments* for obtaining the final objective of stabilizing output gap and inflation. This reversal of targets and instruments is equivalent to *a priori* denying any role to macroeconomic (in particular fiscal) policy. With this exercise we intend to account for the negative impact of excessive deficit and debt, while emphasizing their role as instruments for attaining the *final objective* of aggregate welfare maximization.

Medium or large scale New-Keynesian models have often been used to assess the impact of fiscal policy on real GDP and inflation rates. Coenen *et al.* (2012) for instance review the fiscal properties of nine dynamic stochastic general equilibrium (DSGE) models in which Keynesian features like price and wage rigidities are introduced. Most models use rule-of-thumb fiscal rules by which taxes respond to deficits or debts (as in the seminal specification of Barro, 1986). Hence, public finance sustainability is always met. In this study and in contrast with these models, we specify the fiscal rules which governments have to abide by.

While in a number of occasions fiscal rules have not been respected, we assume governments to follow the fiscal rules which have been decided at the EU level. We wish to investigate the real consequences of sticking to the rules. We assess these consequences under two different assumptions regarding the initial levels of public deficits and debts. In the first scenario – initial deficits and debts are at their current level, i.e. above their steady-state values –, we evaluate the effect of fiscal consolidation under the regimes corresponding to each fiscal rule. In the second scenario we assume that the economy starts at steady-state, and we investigate in our small-scale model the different consequences of supply or demand shocks under the different fiscal rule regimes. Most standard DSGE models deal with the second scenario, while the scenario of fiscal consolidation is specific to our paper. In both cases, our value-added stems from the comparison of the specific EU fiscal rules.

We assess the macroeconomic impact of the fiscal rules on four economies that we take as representative of the euro zone: a large (relatively) low-debt economy (France), a small high-debt one (Belgium), a large high-debt one (Italy) and a small-low debt one (the Netherlands). The size of nations – large or small – relates to the size of their fiscal multiplier. The four countries also differ in terms of the size and sign of their primary structural balance: France and the Netherlands have a large deficit, whereas Belgium has a low one, and Italy holds a large surplus.

We simulate the effect of the rules on the level and variability of the output gap, the inflation rate and the structural deficit, and the impact on the level of public debt. This is done in a framework in which on the one hand, the evolution of deficit is countercyclical, but on the other hand, excessive debt feeds back into the economy through increasing risk premia. Among the nine large-scale DSGE models reported in Coenen et al. (2012), only one, the, European Commission's QUEST III, embeds a government debt risk premium. Finally, we simulate the different rules over a 20-year horizon, consistently with the target of the one twentieth debt reduction rule.

The rules we simulate are (a) the Fiscal Compact, with its balanced (at 0.5% of GDP) structural budget and the 1/20th yearly debt reduction rule; (b) the 3% total deficit cap (status quo). We also evaluate the effect of (c) adopting an investment rule in the vein of the UK golden rule of public finances, that imposes budget balance over the cycle only for current spending, while allowing public investment to be financed through debt.[1] The simulations are carried out starting from a structural New-Keynesian model, where the IS and Phillips curves have hybrid specifications with backward and forward expectation terms. Moreover, our specification of the economy also takes into account the nonlinearity of the risk premium and the zero lower bound.

It is worth emphasizing that the macroeconomic framework is partly biased against the use of an investment rule, because we rule out the endogeneity of potential output, which could be positively affected by public investment. On the opposite, the investigation is partly biased in favor of the Fiscal Compact because we simulate the less restrictive rule among the two embedded in the Fiscal Compact.

Results are manifold. First, the adoption of the rules produces a short-run recession, even in a small country with a low multiplier and relatively low initial public debt like the Netherlands. Second, recessions sometimes foster deflation. Although we do not model deflation differently from inflation in this framework, the former is very difficult to reverse in

[1] Introduced in the 1997, the UK golden rule of public finance excludes public investment from the budget limits over the cycle. See Buiter (2001) for a comprehensive discussion.

presence of a binding fiscal constraint and of a zero lower bound for the interest rate (Woodford, 2001). Third, the investment rule performs better than the other two rules: recessions are shorter and milder; hence the average loss of output over a 20-year horizon is smaller, all the more so when the fiscal multiplier is large. Fourth, this result is strongly robust to changes in the parameters' values. Fifth, when the economy is hit by demand and supply shocks at the steady state, none of the rules emerges as superior in coping with them.

The paper is structured as follows: Section 2 introduces and discusses our model. In section 3, we simulate the two scenarios of a fiscal consolidation and of different types of shocks starting from the steady state, and give a quantitative assessment of the macroeconomic performance for the different fiscal rules. Section 4 is devoted to a robustness check of the main results, and section 5 concludes.

2. An augmented New-Keynesian model

The economy is characterized by a standard framework with the aggregate demand side described by a dynamic IS curve and the aggregate supply side by a hybrid Phillips curve, in the vein of Clarida *et al.* (1999). By hybrid, we mean that expectations are forward and backward-looking. In order to study the different fiscal rules, we add to this core a public finance block to simulate the differences between the rules. To take into account the effect of debt and deficit on private agents' behavior, we explicitly model the equations for government and central bank interest rates.

2.1 The model

The AD bloc is described by a dynamic hybrid IS curve, detailing the determinants of the output gap x_t, i.e. the percentage difference between real GDP (y) and potential GDP ($\bar{y}$):

$$x_t = \alpha_1 \cdot x_{t-1} + (1-\alpha_1) \cdot E_t x_{t+1} + \alpha_2 \cdot (r_t - E_t \pi_{t+1} - rr^*) + \alpha_3 \cdot (dsp_t - \overline{dsp}) + \varepsilon_t^d \qquad (1)$$

where α_1 stands for the incidence of backward-expectations on demand behavior, r_t and π_t are the nominal long-term interest rate and the inflation rate respectively, both in percent; rr^* is the long-term real interest rate in percent; dsp_t is structural primary balance (i.e., deficit net of interest payments and of cyclical components) as a percentage of GDP, and we define as the fiscal impulse, or fiscal stimulus, its deviation from the steady-state value $(dsp-\overline{dsp})$. $\alpha_2<0$ and $\alpha_3>0$ are parameters.

The introduction of the fiscal impulse in the expectational IS curve stems from the linearised Euler equation of a closed economy with consumption and government expenditure. Considering a simplified budget constraint for the government, with transfers and proportional taxation, public expenditure has to be considered as net of cyclical components and interest payments; its deviation from steady state is therefore captured by the deviation of the structural primary balance.[2] The introduction of backward-looking expectations in the Euler equation, on the other hand, has an empirical justification (see e.g. Fuhrer and Rudebusch, 2004).

The aggregate supply block is represented by a standard hybrid Phillips curve, where λ_1 captures the incidence of backward-expectations on supply behavior; λ_2 is the elasticity of inflation to the output gap and is a positive parameter:

$$\pi_t = \lambda_1 \cdot \pi_{t-1} + (1-\lambda_1) \cdot E_t \pi_{t+1} + \lambda_2 \cdot x_t + \varepsilon_t^s \quad (2)$$

The third equation describes the behavior of nominal government bonds' interest rates r_t along the yield curve, where i stands for central bank nominal interest rate, and γ represents the risk premium associated with upwards debt variation over the target $b*$:

$$1 + r_t = (1 + i_t) \cdot [1 + (\gamma \cdot \max(0, b_t - b^*)] + \varepsilon_t^f \quad (3)$$

Monetary policy is described through a usual Taylor rule. The central banker sets the nominal interest rate in response to expected future inflation and current output gap. We explicitly introduce a close-to-zero bound on the nominal rate (here at 0.25%):

$$i_t = \max(0.25,\ rr^* + E_t \pi_{t+1} + \Phi_1 \cdot (E_t \pi_{t+1} - \pi^*) + \Phi_2 \cdot x_t + \varepsilon_t^m) \quad (4)$$

In equations (1) to (4) the error terms ε capture exogenous shocks. Hence ε^d and ε^s represent a demand and a supply shock respectively.

We develop the public finance block to enable the introduction of different fiscal rules in the model. Total government deficit can be decomposed into a cyclical component and a structural component, all expressed as a percentage of GDP:

$$dt_t \equiv dc_t + ds_t \quad (5)$$

As commonly assumed in the literature (see e.g. Buti et al., 1998; and Girouard and André, 2005), the cyclical component, or cyclical deficit, depends linearly on the output gap, hence characterizing automatic stabilizers:

$$dc_t = \psi_1 \cdot x_t \quad (6)$$

The structural deficit is by construction the sum of interest payments ip and structural primary deficit dsp, interpreted as the discretionary part of fiscal policy:

[2] The government budget constraint can be written as $T(Y_t) + P_t G_t + (1 + i_{t-1}) B_t = \tau Y_t + B_{t-1}$, where we interpret T and τY as the components of public deficit related to automatic stabilizers (net transfers, affected by the business cycle, and proportional taxation). Under the assumption that the tax rate is given, there is no discretionary tax policy. Thus, G is the (real) amount of discretionary expenditure of the government, net of net transfers and interest payments, and its variation translates into variations of the primary structural balance.

$$ds_t = ip_t + dsp_t \quad (7)$$

Public debt, expressed in percentage of GDP, follows the usual law of motion, where everything else equal, a higher nominal growth rate mechanically reduces the debt to GDP ratio:

$$b_t = \frac{b_{t-1}}{1+\pi_t + x_t + \overline{y}} + dt_t \qquad (8)$$

2.2 Fiscal rules

The medium-to-long term performance of European economies depends on the macroeconomic governance tools put in place by the EU. Three main options are before policy makers: (a) a *status quo* where the ratio of public deficit to GDP must be maintained below the 3% limit. (b) The "investment rule" that allows to finance an increase in net public assets by public debt issuance. (c) The "Fiscal Compact", that embeds the double requirement of a balanced (at 0.5% of GDP) structural deficit and a constant rate of reduction of debt bringing it asymptotically to the 60%-of-GDP ratio (i.e., a 5% reduction per year of the difference between the current debt and its reference level). These rules differ on the criteria and on the type of constraints imposed to countries. Specifically, each rule imposes different constraints on the choice of endogenous and exogenous variables in the fiscal block of the model.

(a) For the status quo, we impose that total deficit is exogenously given at 3%:

$$dt = 3$$

We assume in other words that countries use the entire margin given by the rule, and never breach it. The other fiscal variables adapt to this exogenous constraint.

(b) The "investment rule" allows increasing public investment inv^g, expressed in percentage of GDP, up to a threshold equal to the inflation depreciation of steady-state debt. Thus, all else equal, the "investment rule" keeps the debt-to-GDP ratio constant. Higher investment may produce higher net interest charges; the rule forces the government to compensate them with a lower cyclically-adjusted primary deficit, i.e. with lower current expenditures *dcur*, also expressed in percentage of GDP. The "investment rule" is described as follows:

$$dsp = inv^g + dcur$$
$$inv^g = \pi \, \overline{b}$$
$$dcur = -\delta \cdot (inv^g + (ip - \overline{ip})) + (1-\delta) \cdot dcur_{t-1}$$

where the last equation assumes that the current surplus needed to finance interest payments is spread over a $1/\delta$ year period. δ represents the smoothing of expenditure over future periods, and it may have a strong impact on the restrictiveness of the rule. In the benchmark simulations below, we set δ=1 with all the cost of consolidation borne in the current period, whereas in alternative simulations, we show the effect of setting δ equal to 0.5, 0.2 and 0.1 (spreading over 2, 5 and 10 years respectively). Note that this is a severe version of the rule, first because investment is accepted only up to the limit that keeps the debt ratio on a stationary path; second, because public investment has no impact on potential growth (that we assume exogenous and constant), so that it is analytically equivalent to current spending. This puts us in a "worst-case scenario", in which we artificially shut off the long-run positive effects of the investment rule.

(c) The Fiscal Compact has two arms. As regards the debt reduction advocated by the Treaty, the exogenous variable is the yearly change in the debt ratio, supposed to be reduced each year by 5% of the difference with its reference rate (60%). In order to simulate this rule, we need to make three assumptions, not explicit in the Treaty. First, we assume the rule to be symmetric around its reference level of 60%; second, we assume it to be asymptotic, as debt is reduced of 5% of the difference between the ratio in the previous period and the reference level.[3] Finally, we assume that the debt reduction is net of the cyclical balance. Taken together, these three assumptions allow convergence to the Maastricht steady state. Moreover, the third assumption designs a mild version of the debt reduction rule, which minimizes its recessionary impact. Hence, the one twentieth rule runs as follows:

$$ds_t = -0.05 \cdot (b_{t-1} - \bar{b}) + (\pi_t + x_t + \bar{y}) \cdot b_t$$
$$\Rightarrow$$
$$dsp_t = -0.05 \cdot (b_{t-1} - \bar{b}) + (\pi_t + x_t + \bar{y}) \cdot b_t - ip_t$$

The structural balance can be decomposed into the surplus needed to reduce debt by one twentieth of its difference to its steady state value, and the room for maneuver obtained from debt depreciation..

The second arm of the Fiscal Compact concerns the limit to structural deficit. The Treaty states that general government budgets shall be balanced or in surplus, a criterion that "*shall be deemed to be respected if the annual structural balance of the general government is at its country-specific medium-term objective, as defined in the revised Stability and Growth Pact, with a lower limit of a structural deficit of 0,5 % of the gross domestic product at market prices*". This amounts to simulating the model with structural deficit exogenously constrained at $ds_t = 0.5$.

The Fiscal Compact implicitly assumes that once the 60% debt threshold is attained the structural balance rule becomes binding. This would imply that the debt ratio keeps decreasing until it stabilizes at 10,5% of GDP, converging to a steady state different from the other rules. More substantially, whether the one twentieth rule or the structural balance rule is more binding depends on the nominal growth of the economy and the level of debt. If the nominal growth rate g (with $g = x_t + \bar{y} + \pi$) is above 5%, then the structural balance rule is

[3] The letter of the Treaty is ambiguous, (TSCG, 2012; and Whelan, 2012) and it is usually associated with the requirement to reach the level of 60% in 20 years. Nevertheless discussions with Commission officials and economists lead to interpret the rule as asymptotic convergence.

always more restrictive. If the nominal growth rate g is below 5%, the level of debt under which the structural balance rule is more restrictive is 120% of GDP for $g=3\%$, 82 for $g=2\%$ and 50 for $g=0\%$. Therefore by deciding to focus on the one twentieth rule which is consistent with the Maastricht steady-state, we can reasonably argue that countries follow the least restrictive arm of the Fiscal Compact.

2.3 The steady-state

We use a Newton algorithm to compute the simultaneous solution for the equations of the model for every period, and compute a numerical simulation of the trajectory of the model's solution. The solution technique is described in Juillard (1996).

The model has a steady state with a potential real growth rate y^* of the economy exogenously set at 3%, in accordance with the underlying hypotheses of the European Union Treaty. The real natural interest rate rr^* also equals 3%, the debt target b^* is 60% and the inflation target π^* is 2%, for a nominal growth rate in steady state of 5%. At the steady-state, public deficit is therefore equal to interest payments ($\overline{dt} = \overline{ip} = 3\%$), and primary structural balance is achieved ($\overline{dsp} = 0$).

Table 1: Steady state Values for Endogenous Variables

$\overline{x}$	0
$\overline{\pi}$	π^*
$\overline{r}$	$rr^* + \pi^*$
$\overline{i}$	$rr^* + \pi^*$
$\overline{dt}$	3
$\overline{dc}$	0
$\overline{ds}$	3
$\overline{ip}$	3
$\overline{dsp}$	0
$\overline{b}$	b^*

The three fiscal rules that we assess make the economy converge to the Maastricht steady state, both in the scenario of fiscal consolidation from current debt and deficit levels, and in the scenario of an economy at steady state which is hit by supply and demand shocks.

2.4 Calibration

The output gap and inflation rate in the expectational IS and Phillips curve equations are introduced with both forward and backward components ($\alpha_1 = 0.4$ and $\lambda_1 = 0.5$). For the IS-augmented curve, this seems to be a reasonable hypothesis considering the average results by Fuhrer and Rudebusch (2004) over a wide range of estimations. Estimations by Goodhart and Hofmann (2005) however point to a relatively lower incidence of forward-looking expectations for the US and Euro area economies, which would put α_1 in the range of [0.2, 0.4]. The parameters of the expectations-augmented-Phillips curve are more controversial (and estimations are more numerous). Gali et al. (2005) and Goodhart and Hofmann (2005) find that the coefficient on lagged inflation is rather modest (around 0.2-0.3). Rudd and Whelan (2006), on the contrary, conclude that the forward-looking component is not significant, and a recent evaluation drawing on survey-based expectations concludes that the hybrid Phillips curve (with a backward component) outperforms the New-Keynesian Phillips curve with no inflation persistence, finding that the forward-looking coefficient is close to $\lambda_1 = 0.5$ (see Paloviita, 2008). We decide to follow this road, which is agnostic with respect to a debate that is yet unsettled.

Table 2: Calibration Parameter Values

α_1	0.4
α_2	- 0.2
α_3	0.8 (large country / 0.2 (small country)
λ_1	0.5
λ_2	0.2
γ	0.02
Φ_1	0.5
Φ_2	0.5
Δ	1
ψ_1	- 0.5
y^*	3%
r^*	3%
b^*	60%
π^*	2%
discount rate	0.95 [=1/1.05]

Table 2 reports the parameters in the simulations. The coefficient value of the incidence of the output gap in the hybrid Phillips curve is close to Paloviita's (2008) estimate. The parameters in the monetary rule are taken from Taylor (1993). The targets are consistent with the Maastricht Treaty and the Stability and Growth Pact's requirements, and with the model's steady state. We introduce two different values for the coefficient of the fiscal impulse in the expectational IS equation, in order to take into account the larger external leakage of domestic fiscal policy in a small open economy. It is worth noticing that even for large countries the fiscal multiplier in this calibration is significantly smaller than recent estimates (e.g. IMF, 2012) and is in line with the modeling literature for the euro zone (Smets and Wouters, 2003; Dieppe *et al.*, 2005; Adolfson *et al.*, 2007; Coenen *et al.*, 2008; Christoffel *et al.*, 2009; Ratto *et al.*, 2009; Cogan et al., 2010; Gelain, 2010; and Cwik and Wieland, 2011). Our choice of the fiscal multiplier is well below the value that risks triggering the vicious circle of austerity and economic contraction that some European peripheral countries have been experiencing since early 2010s. In other words, our estimates of the output cost of fiscal consolidation, are based on a conservative fiscal multiplier, and therefore can be interpreted as a lower bound.

The theoretical and empirical uncertainty about many of these parameters (especially α_I and λ_I) requires thorough robustness checks. The results of Monte Carlo simulations are reported in section 4.

3. Simulations

To our knowledge, there are very few examples of papers attempting at the evaluation of different fiscal rules in the EU context. Most recent papers dealing with this issue focus on one type of rule, like an expenditure rule (e.g. Hauptmeier et al., 2011), whereas those which study different rules use the classification by Kopits and Symansky (1998) (see e.g. Creel and Saraceno, 2010; and Schuknecht et al., 2011). In contrast, Creel et al. (2012) performed a comparison between various fiscal rules within a simple estimation exercise in the vein of Eichengreen and Wyplosz (1998) and Monperrus-Veroni and Saraceno (2005). These exercises start from a simple reduced form VAR system and the estimation results are the basis for a counterfactual assessment of the effect of alternative fiscal rules. While not exempt from a number of methodological problems, the paper by Eichengreen and Wyplosz and the followers using a similar methodology retained a remarkable interest because they give a measure of the magnitude of costs and benefits of the SGP and of other rules. Our analysis completes these results; instead of relying on an estimated model, it builds on a theoretical model, and the differences among countries are given by the value of the fiscal multiplier in the output gap equation and by the initial conditions of public finance variables.

We first discuss the application of the different fiscal rules to a consolidation occurring in the four countries starting from current conditions; and then we examine the case of supply and demand shocks hitting an economy at the Maastricht steady state.

3.1 Fiscal Consolidation

The economy starts from 2011 levels of deficit and debt, and is tracked for a time span of 20 years. We decided to focus on fiscal consolidation abstracting from the *initial* size of the output gap and inflation which, as a consequence, in the simulations are set at their steady state values (0 for the output gap and the 2% central bank target for inflation)[4]. Initial debts and deficits for the four countries under study are 2011 OECD figures. They are reported in Table 3 below. France and Italy are larger countries than Belgium and the Netherlands; hence, by assumption, the fiscal multiplier is equal to 0.8 for the former and 0.2 for the latter.

Figures 1 to 4 show output gap and inflation, together with interest rates and the public finance variables, for France. The figures for the other countries are qualitatively similar and are presented in the Appendix.

[4] If we began with the current values of the (negative) output gap and inflation, the initial drop of output would be larger, and the interest rate would hit the zero lower bound earlier.

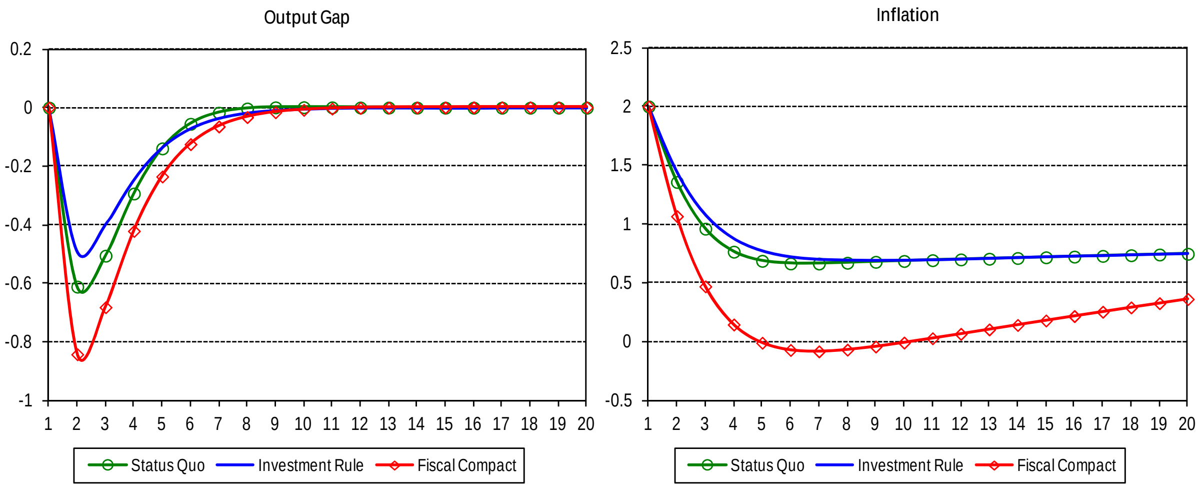
Table 3: Initial Debt and Deficit Values, 2011

	Initial Debt	Initial Structural Primary Deficit	Fiscal multiplier*
France	86	1.45	0.8
Italy	120	- 2.34	0.8
Belgium	98	0.78	0.2
Netherlands	65	2.53	0.2

Source: OECD. * Authors' assumption.

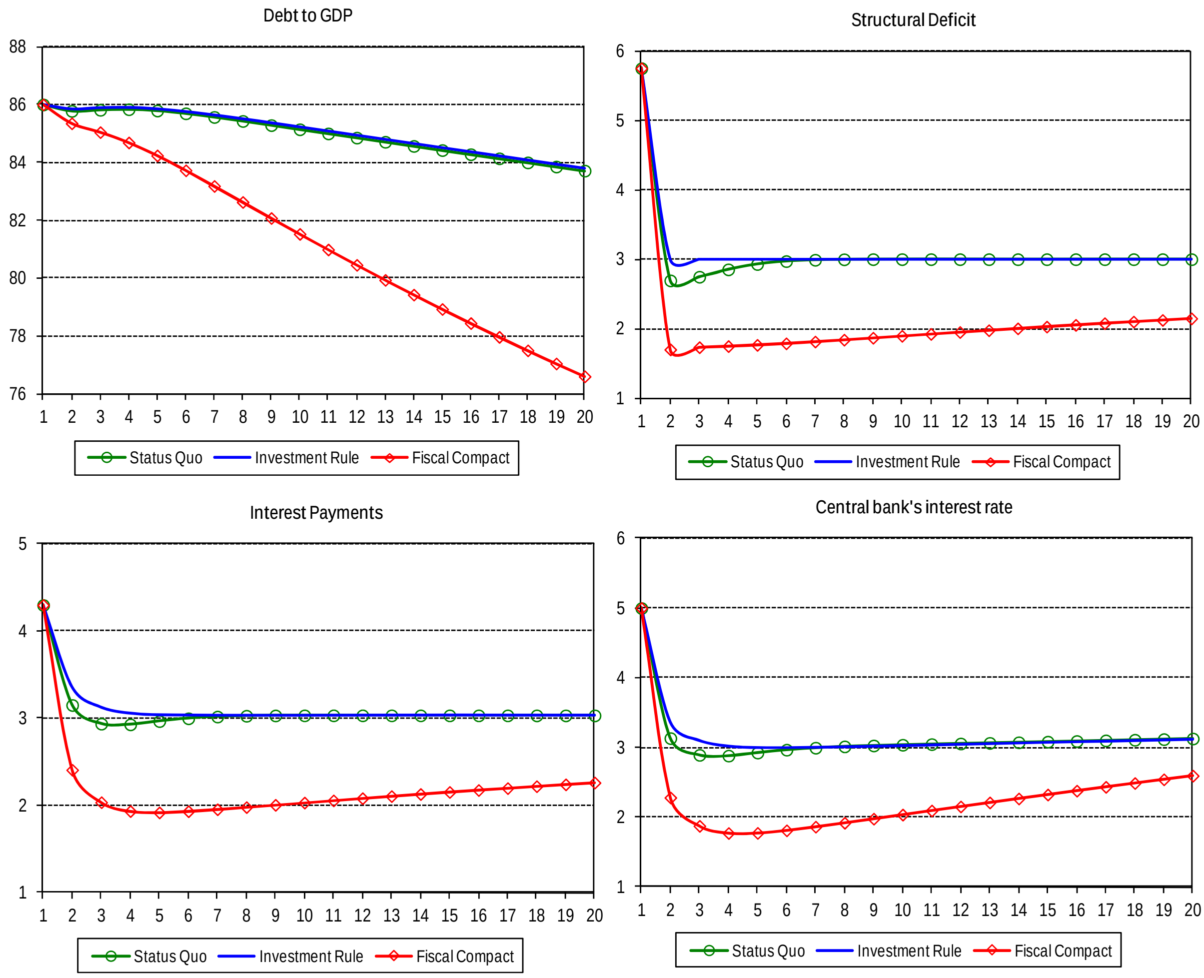
The economy starts outside the steady state equilibrium to capture the effects of a fiscal consolidation. The initial impulse stems from how fiscal rules applied in period one constrain the primary structural deficit which therefore impacts the economy. For instance, in the case of the status quo, the initial impulse brings total deficit back to 3% of GDP at period one when the rule is set up. Before discussing the outcome of each rule, it is worth pointing out two things. First, all the rules yield long run convergence of output gap, inflation, and public finance variables, towards their steady state levels. Furthermore, debt dynamics are comparable: the debt ratio steadily decreases albeit at different rates. The second feature that is common to all the rules is the deep recession induced by fiscal consolidation in the short run, which may even be deflationary and results in a sharp drop of interest rates.

Figure 1: Fiscal Consolidation Under Different Rules: France



Looking at the rules in detail, the Fiscal Compact yields the larger initial drop of output (figure 1, left panel), which causes deflation in the medium run (right panel). The status quo's output drop is larger than the one of the investment rule, whereas inflation dynamics are quite similar for these two rules. On the other hand, the long run reduction of debt is more substantial with the Fiscal Compact than for the other rules (figure 2, upper-left panel). The central bank interest rate drops below two percent, and as a consequence interest payments are lower than in the two other rules. This in turn yields faster debt reduction in the medium to long run.

Figure 2: Fiscal Consolidation Under Different Rules: France (Fiscal Variables)



To compare the different rules, we computed for each country (i.e. with different initial public finances values) the average of the discounted variables of interest (assuming a discount rate of 5%). They are reported in Table 4. The table shows that for the four countries the average loss of output is lower in the case of the investment rule. For the small countries the status quo also minimizes discounted cumulative loss, which can be explained by the assumption of a smaller fiscal multiplier. In addition, the investment rule is associated with lower output variability for all countries except the Netherlands. As can be guessed from figures 1 and 2, this can most probably be attributed to the lesser recessionary impact in the early phase of the consolidation process. In all cases, the visual impression of figure 1 for France is confirmed, and the Fiscal Compact fares worse than the other rules.

As regards inflation, the investment rule yields a lower inflation gap to its target on average, and the status quo exhibits lower variability. As expected, on the other hand, the Fiscal Compact yields substantially lower debt levels at t=20. One additional remark refers to the application of the Fiscal Compact in Italy. Setting the γ parameter on the risk premium in the government bonds' interest rates equation to 0.02 as for other simulations prevents the economy to converge back to the steady-state, possibly because of the high initial level of debt. The convergence in the Italian case thus required to set γ to zero. Even in this case, with no market penalty for large debt, the Fiscal Compact yields a larger output loss than alternative rules.

Table 4: Discounted Average Values of the Rules for 20 years

	France				*Italy*		
	Status Quo	Inv. Rule	Fiscal Compact		Status Quo	Inv. Rule	Fiscal Compact *
mean(x)	-0.07	-0.06	-0.10	mean(x)	-0.13	-0.11	-0.15
s.d.(x)	0.16	0.13	0.22	s.d.(x)	0.30	0.25	0.32
mean(π)	0.54	0.56	0.20	mean(π)	-0.09	-0.07	-0.18
s.d.(π)	0.39	0.40	0.46	s.d.(π)	0.53	0.53	0.57
mean(ds)	1.97	2.00	1.36	mean(ds)	1.84	1.90	0.55
s.d.(ds)	0.93	0.95	0.99	s.d.(ds)	0.55	0.61	0.71
b (t =20)	83.71	83.80	76.60	b (t =20)	120.59	120.75	90.21
	Belgium				*Netherlands*		
	Status Quo	Inv. Rule	Fiscal Compact		Status Quo	Inv. Rule	Fiscal Compact
mean(x)	-0.07	-0.07	-0.10	mean(x)	-0.01	-0.01	-0.02
s.d.(x)	0.13	0.12	0.19	s.d.(x)	0.02	0.02	0.03
mean(π)	0.38	0.38	0.11	mean(π)	1.11	1.11	1.07
s.d.(π)	0.44	0.45	0.50	s.d.(π)	0.35	0.36	0.34
mean(ds)	1.96	2.00	1.13	mean(ds)	2.00	2.00	1.89
s.d.(ds)	0.92	0.94	1.01	s.d.(ds)	0.95	0.96	0.95
b (t =20)	93.83	94.20	80.40	b (t =20)	63.86	63.92	62.30

Average discounted values over 20 years. * The fiscal compact enables convergence back to the steady-state in Italy only if gamma = 0. The simple average values are presented in table A in the Appendix.

Setting aside the investment rule, which is currently not an option in the policy debate, we can observe that the status quo performs considerably better than the 5% debt reduction rule in terms of macroeconomic performance.

To conclude, for all possible initial situations (large and small countries; high and low initial debt), the model yields the unequivocal result that implementing the investment rule would minimize the average loss of output, and would also prove less deflationary than the different EU fiscal rules. Among these, the status quo is largely to be preferred if we use the output gap as a metrics, while the debt reduction rule is less inflationary and yields faster debt reduction. The simulations show that relatively larger structural deficits are not necessarily inconsistent with output stabilization and public finances sustainability. Because of depressed growth, debt ratios may actually decrease less than actually planned during fiscal consolidation.

3.2 Supply and Demand Shocks at the Steady State

The previous section dealt with the performance of the different rules during a fiscal consolidation process, starting from high debt ratios. Our next question is how these rules would affect the dynamics of the economy if it were hit by a demand shock (in the output gap equation) or by a supply shock (in the Phillips curve equation) when at the steady state. Both shocks are temporary shocks with the value of each exogenous variable namely ε^d and ε^s being equal to minus one during one period. The results are summarized in Table 5, where we distinguish between "small" countries (with a low fiscal multiplier) and "large" ones (with a large fiscal multiplier).

The table shows first that the differences between the fiscal rules are very marginal, a result that is not surprising given that we are studying adjustments close to the steady state. When the economy is hit by demand and supply shocks at the steady state, none of the rules emerges as superior. The status quo seems slightly worse than the two others regarding the variance of output, while the Fiscal Compact appears better, at the margin, regarding the debt level. The reader should bear in mind, however, that as this is a rule designed to come back to the debt reference level of 60% of GDP, its rationale seems quite limited for policymakers when debt is close to the steady state.

Although not surprising, the outcome of these simulations is important. Two interpretations are possible. On the one hand, the Maastricht rule – the status quo – is not worse than alternative rules, which vindicates the claim that in normal times this rule gives sufficient fiscal margins for maneuver (see e.g. Buti and Giudice, 2002). On the other hand, the rule is not superior to the two others despite the fact that the simulation takes place exactly at the Maastricht steady state. The lack of enforcement of the Maastricht rule by EU governments has certainly had to do with the costly convergence path that we described in the previous section as well as with the absence of relative advantage of this rule at the steady state.

Table 5: Response to Demand and Supply Shocks Starting from Steady State

Small countries - Fiscal Multiplier = 0.2							
Negative Demand Shock				*Positive Supply Shock*			
	Status Quo	Inv. Rule	Fiscal Compact		Status Quo	Inv. Rule	Fiscal Compact
mean(x)	-0.05	-0.05	-0.05	mean(x)	0.07	0.07	0.07
s.d.(x)	0.21	0.19	0.19	s.d.(x)	0.14	0.12	0.12
mean(π)	1.14	1.13	1.12	mean(π)	1.12	1.11	1.11
s.d.(π)	0.29	0.29	0.29	s.d.(π)	0.30	0.29	0.29
mean(ds)	1.84	1.87	1.83	mean(ds)	1.91	1.87	1.87
s.d.(ds)	0.50	0.54	0.53	s.d.(ds)	0.59	0.54	0.53
b $(t=20)$	61.27	61.53	60.93	b $(t=20)$	60.39	60.03	60.01
Large countries - Fiscal Multiplier = 0.8							
Negative Demand Shock				*Positive Supply Shock*			
	Status Quo	Inv. Rule	Fiscal Compact		Status Quo	Inv. Rule	Fiscal Compact
mean(x)	-0.04	-0.03	-0.03	mean(x)	0.10	0.08	0.08
s.d.(x)	0.19	0.14	0.13	s.d.(x)	0.23	0.17	0.17
mean(π)	1.17	1.18	1.16	mean(π)	1.19	1.15	1.16
s.d.(π)	0.31	0.32	0.32	s.d.(π)	0.31	0.30	0.30
mean(ds)	1.85	1.87	1.85	mean(ds)	1.92	1.87	1.88
s.d.(ds)	0.51	0.54	0.53	s.d.(ds)	0.61	0.54	0.53
b $(t = 20)$	60.90	60.92	60.65	b $(t = 20)$	59.62	59.50	59.64

Average discounted values over 20 years.

3.3 The lower bound of the Investment rule

It is worth recalling that our simulations are partly biased against the use of the investment rule, since we rule out the endogeneity of potential output, which could be positively affected by public investment. Indeed, we consider the negative effect of public investment on output and public debt – through the interest rate and risk-premia –. The crowding-out effect of public debt and deficit *via* interest rates (implicitly) on capital accumulation and (explicitly) on output is included in the model, in contrast with the probable effects of public investment as education, health or infrastructures on the potential of the economy.

Moreover, we deliberately set the smoothing parameter of expenditures δ in the investment rule to 1 which is equivalent to assuming that interest payments are not spread over many years but financed by a current surplus. Relaxing this assumption and smoothing the financing of interest payments and the cost of consolidation over different periods of time yields very different outcomes. Table 6 shows the macroeconomic performance of the investment rule in France for different values of δ. As expected, smoothing the consolidation over several years reduces the restrictiveness of the rule: the output loss is smaller over 2 years or even turns to an output gain over 5 or 10 years. The inflation gap to the target is smaller when the smoothing horizon increases. On the other hand, output and inflation volatility increases. This is not the more interesting result, however. One would expect that a more gradual financing of interest charges, driven by higher and more persistent deficits, would come at the expense of a higher debt ratio. However, there is no such tradeoff: the debt ratio at $t=20$ is smaller, for all three longer horizons, than in the 1-year case. This result mirrors the situation where debt ratios may actually decrease less than actually planned because of depressed growth during fiscal consolidation; here debt ratios may actually decrease more rapidly thanks to preserved growth when fiscal consolidation is smoothed.

Table 6 - Smoothing over the Business Cycle

Investment rule Fiscal Consolidation - France				
	1y	*2y*	*5y*	*10y*
mean(x)	-0.06	-0.04	0.01	0.09
s.d.(x)	0.13	0.08	0.21	0.55
mean(π)	0.56	0.57	0.63	0.74
s.d.(π)	0.40	0.43	0.52	0.80
mean(ds)	2.00	2.03	2.14	2.32
s.d.(ds)	0.95	1.00	1.23	1.84
b (t =20)	83.80	83.76	83.53	82.99

Average discounted values over 20 years. δ equals 0.5, 0.2 and 0.1 for 2, 5 and 10 years respectively.

4. Robustness

The results of our simulations show that the investment rule fares better in terms of output performance than the two other rules in the fiscal consolidation scenario. That results was obtained with a particular set of parameter values, as described in section 2.4. While these values are all reasonable, we need to check for the robustness of this result, performing a Monte Carlo experiment over the space of the most relevant parameters. The objective is to make sure that the comparison between the three rules has not been dependent on the particular set of parameter chosen in Table 2.

We investigate the most representative parameters, i.e. the ones capturing the degree of backward looking expectations in the IS and Phillips curves (α_1 and λ_1 respectively); the impact of real interest rates (α_2) and of the fiscal impulse (α_3) on the output gap (IS curve); the impact of the output gap on inflation in the Phillips curve (λ_2); the risk premium in the government bonds' interest rates equation (γ), and the initial levels of debt (b_{init}) and structural primary deficit (dsp_{init}).

The simulation is conducted as follows:

a) We make random draws of the parameters, within a certain range chosen to be consistent with most of the existing literature.
b) For each draw, we simulate the model for the three rules and select the run only if they all converge.
c) We record the average of discounted output gap and inflation values for each rule, and each parameter draw, over 20 periods.

The range of the 8 parameters random draws is reported in Table 7. We ran 11000 simulations, and for about 96% of them (10591), the solution algorithm converged for the three rules. Non-convergence was most of the time due to the Fiscal Compact rule and to high values of γ the parameter capturing the risk premium in the government bonds' interest rates equation.

Table 7: Parameter Ranges for the Monte Carlo

Parameter	*Range*
α_1	[0.1 , 0.8]
α_2	[-0.9 , -0.1]
α_3	[0.2 , 0.8]
λ_1	[0.2 , 0.8]
λ_2	[0.1 , 0.5]
γ	[0 , 0.03]
b_{init}	[60 , 100]
dsp_{init}	[-1 , 4]

The 10591 converging iterations form our dataset. In Table 8, we report the descriptive statistics for the average of discounted output gap and inflation over the twenty years following the adoption of each of the three rules.

The results are remarkably stable and insensitive to large changes in parameters. The standard deviation of the average of the discounted output gap and inflation is higher for the one twentieth rule than for the two other rules. This confirms that the debt reduction rule, even if it converges, is more sensitive than the others to parameter variations.

Table 8: Monte Carlo Simulation

	Output Gap			**Inflation**		
	Status Quo	Inv. Rule	Fiscal Compact	Status Quo	Inv. Rule	Fiscal Compact
mean	-0.037	-0.035	-0.059	0.819	0.826	0.658
s.d.	0.040	0.039	0.052	0.256	0.253	0.349
min	-0.407	-0.399	-0.500	0.132	0.133	-0.278
max	0.000	0.000	0.000	1.246	1.246	1.246

Average over the 10591 simulations of the discounted sum of output gap and inflation.

Turning at the analysis of the results, we show that the investment rule fares significantly better than the others (the difference is significantly different from zero). The investment rule always provides the lowest output loss and inflation gap vis-à-vis the inflation target. Were the investment rule applied during the consolidation process, then the cost in terms of output gap would be of approximately one half lower than for the Fiscal Compact rule, over the parameters range. The sensitivity analysis run with this Monte Carlo experiment therefore confirms that the result according to which the investment rule outperforms the others in term of output loss is strongly robust to large parameters changes.

5. Conclusion

This paper evaluates the macroeconomic impact of a set of different fiscal rules that were, will, or might be implemented in Europe. We simulate a small-scale New Keynesian model with both forward- and backward expectations. The calibration draws on the existing literature and on the 2011 values of public finance data of 4 eurozone countries which we take as representative of the different types of eurozone member states. The three fiscal rules are: the status quo 3% limit on public deficit, a debt reduction scheme and an investment rule in the vein of the UK golden rule of public finances.

We focus on two different scenarios. The first involves assessing the path followed by the four economies under each fiscal rule under fiscal consolidation from 2011 debt and deficit levels, towards the Maastricht steady state. The second assesses the impact of demand and supply shocks affecting the economy at the steady state.

The main results are first that abiding by the rules produces in all cases a short-run recession, even in a country with a small fiscal multiplier and a low initial public debt like the Netherlands. Second, during a consolidation phase, the investment rule performs better than the other rules: the recession is milder and shorter, thus leading to a substantially lower average loss of output over a 20-year horizon. Third, if the economy is hit by a demand or supply shock at the steady state, none of the rules emerges as superior in coping with them.. Finally, the Fiscal Compact, with its constant debt reduction rule, generally imposes large costs to the economy, while not necessarily performing better in terms of public finances' sustainability. These results are robust to parameters changes.

This leads to a general concluding remark. The Fiscal Compact requires a constant debt reduction, together with a "semi-balanced" (at 0.5%) structural deficit. This implies that, once the target level of 60% is reached, the debt ratio will continue to decrease, led by the structural deficit balance. Our results show that these rules are extremely costly, in terms of output loss, if compared to the investment rule or even the status quo. Such a drastic consolidation strategy embedded into EU constitutional laws threatens future macroeconomic performances of eurozone countries. .

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APPENDIX

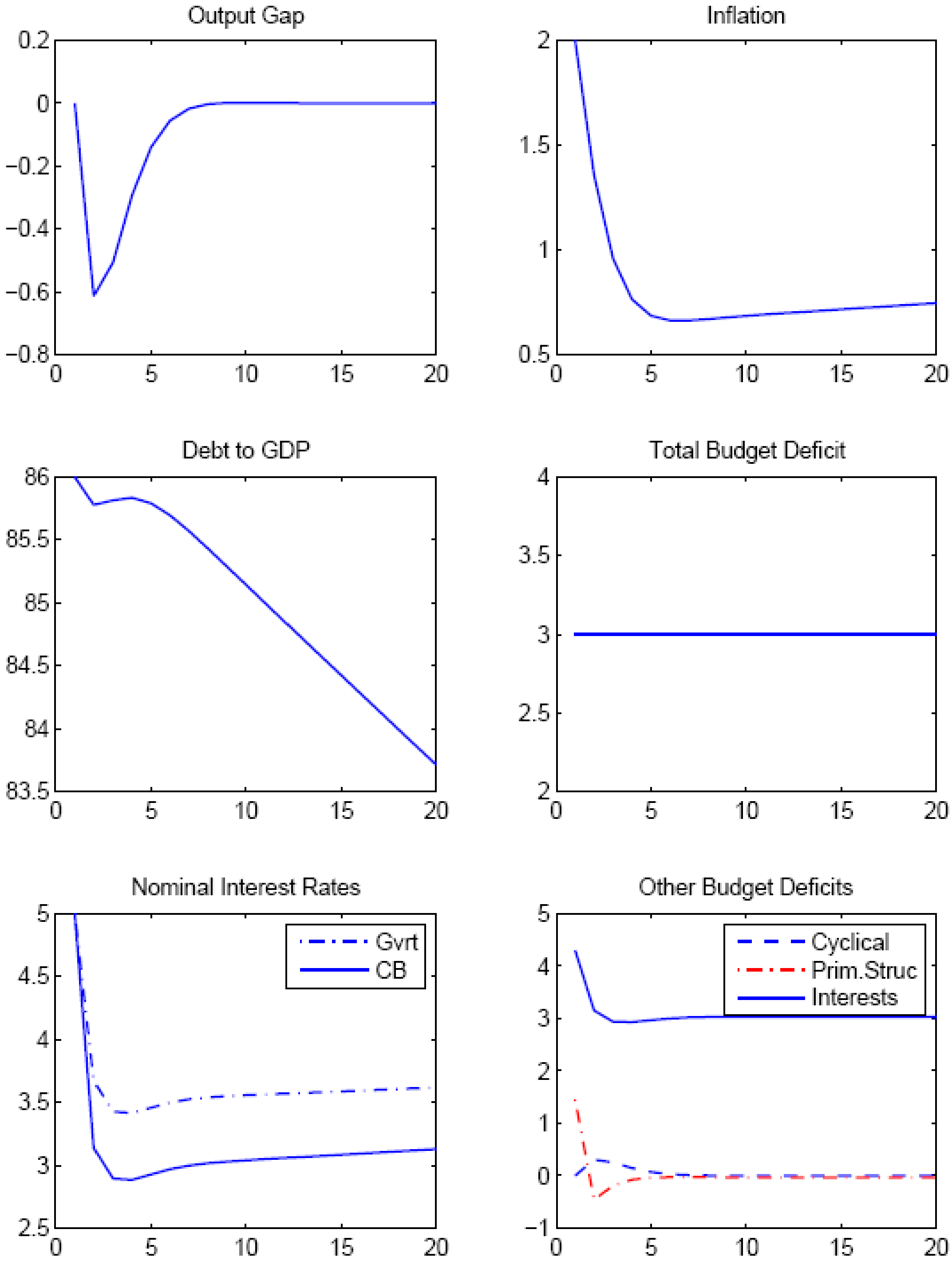
Table A: Simple Average Values of the Rules for 20 years
Fiscal Consolidation Scenario

	France				*Italy*		
	Status Quo	Inv. Rule	Fiscal Compact		Status Quo	Inv. Rule	Fiscal Compact *
mean(*x*)	-0.08	-0.07	-0.12	mean(*x*)	-0.15	-0.13	-0.18
s.d.(*x*)	0.18	0.14	0.24	s.d.(*x*)	0.34	0.28	0.37
mean(p)	0.82	0.84	0.27	mean(p)	-0.26	-0.23	-0.35
s.d.(p)	0.32	0.33	0.48	s.d.(p)	0.62	0.63	0.66
mean(*ds*)	3.10	3.14	2.11	mean(*ds*)	2.96	3.03	0.91
s.d.(*ds*)	0.63	0.61	0.87	s.d.(*ds*)	0.23	0.15	0.78
b (t =20)	83.71	83.80	76.60	*b (t =20)*	120.59	120.75	90.21
	Belgium				*Netherlands*		
	Status Quo	Inv. Rule	Fiscal Compact		Status Quo	Inv. Rule	Fiscal Compact
mean(*x*)	-0.08	-0.08	-0.12	mean(*x*)	-0.01	-0.01	-0.02
s.d.(*x*)	0.15	0.14	0.22	s.d.(*x*)	0.02	0.02	0.03
mean(p)	0.53	0.53	0.11	mean(p)	1.78	1.78	1.72
s.d.(p)	0.43	0.43	0.55	s.d.(p)	0.06	0.07	0.09
mean(*ds*)	3.09	3.13	1.77	mean(*ds*)	3.13	3.14	2.97
s.d.(*ds*)	0.61	0.60	0.95	s.d.(*ds*)	0.62	0.62	0.66
b (t =20)	93.83	94.20	80.40	*b (t =20)*	63.86	63.92	62.30

Average discounted values over 20 years. * The fiscal compact enables convergence back to the steady-state in Italy only if gamma = 0.

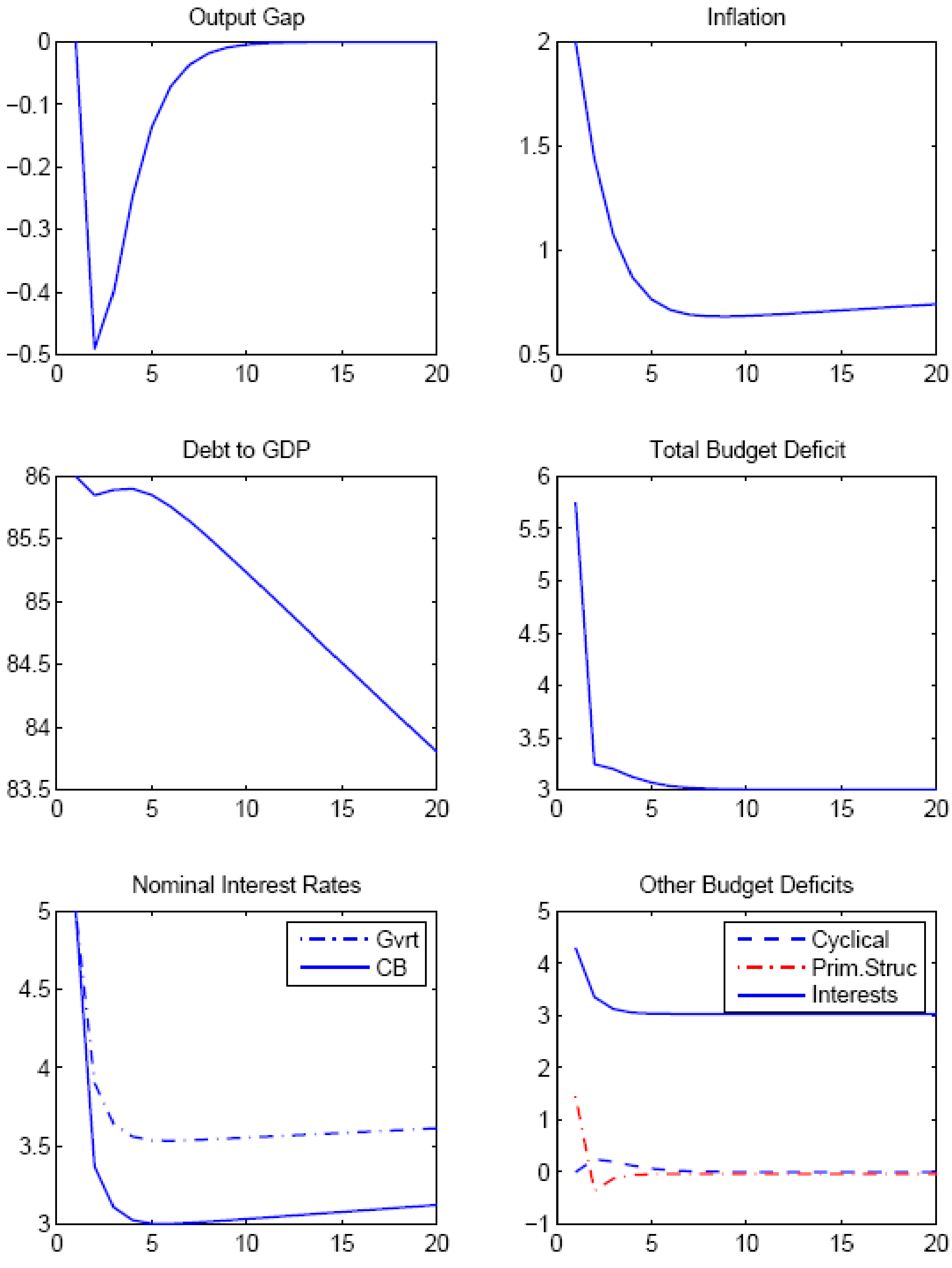
FRANCE

Status Quo



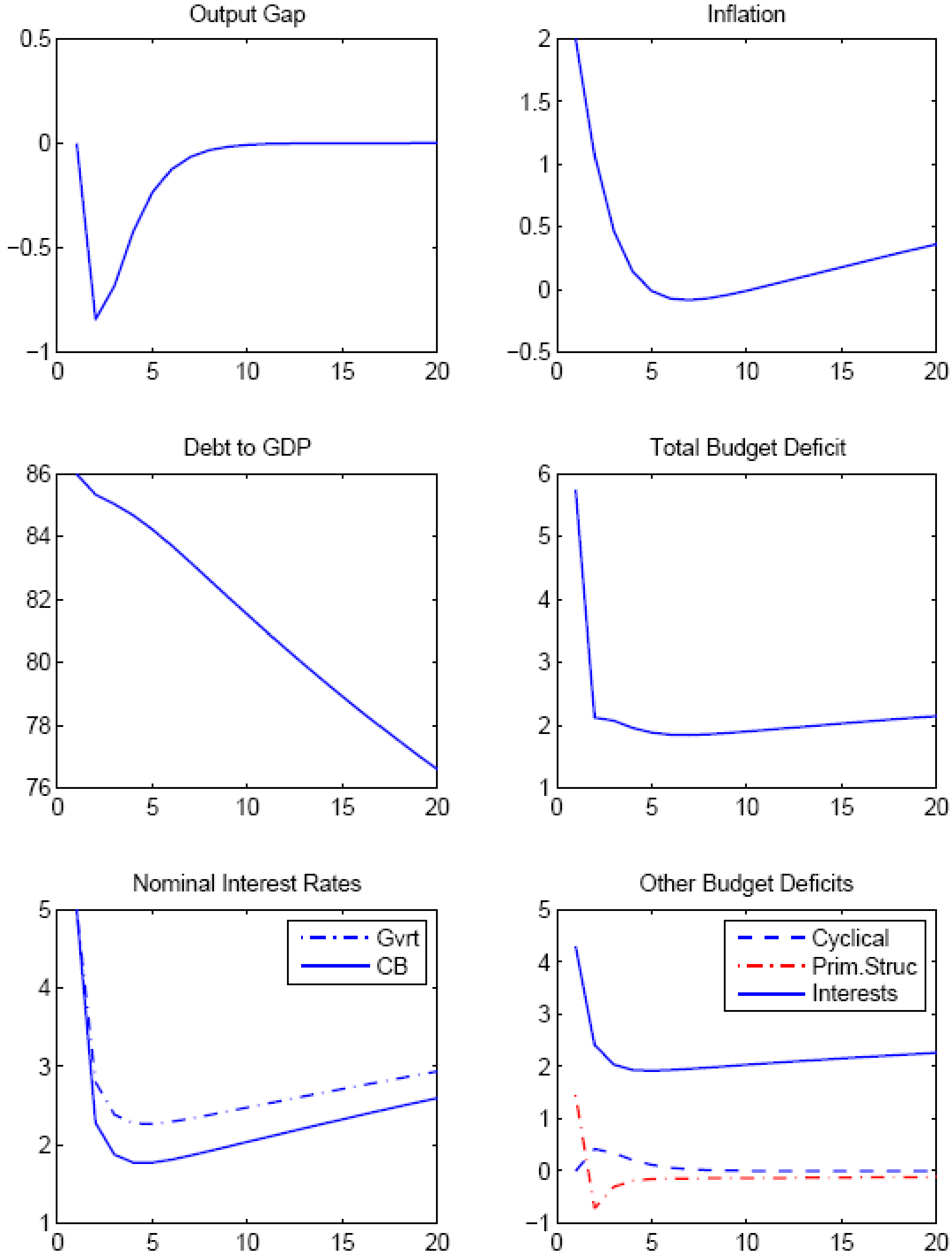
FRANCE

Investment Rule



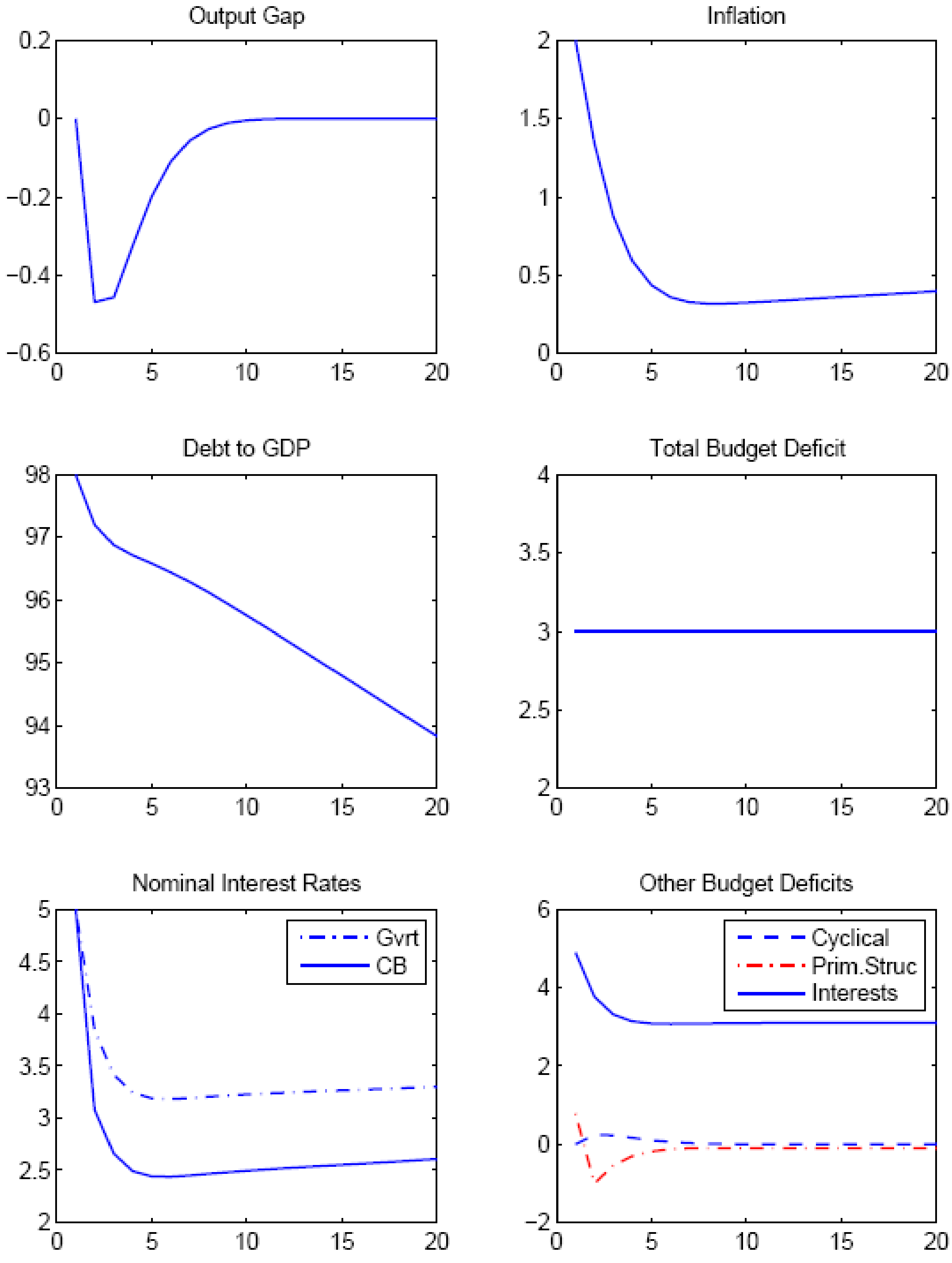
FRANCE

Fiscal Compact



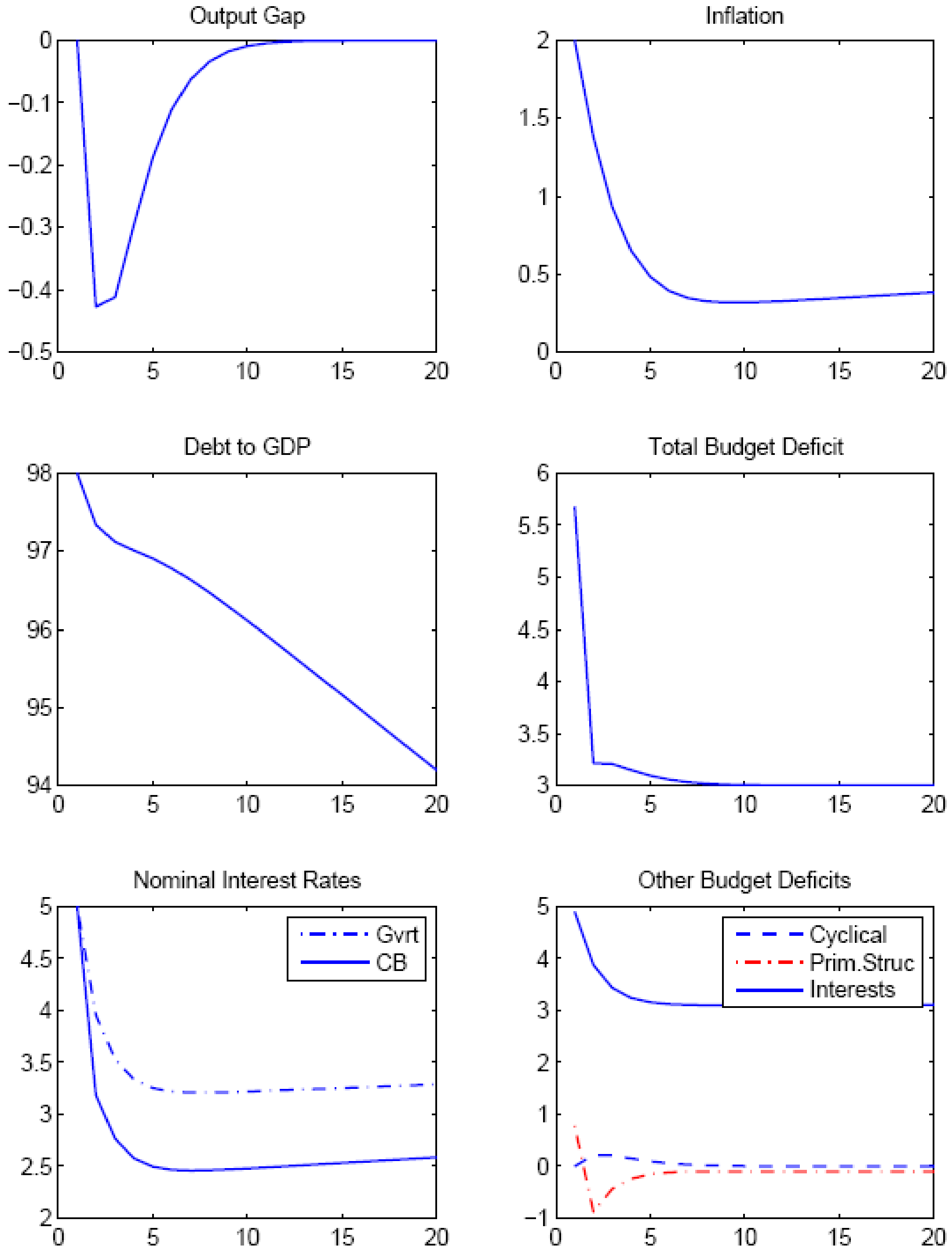
BELGIUM

Status Quo



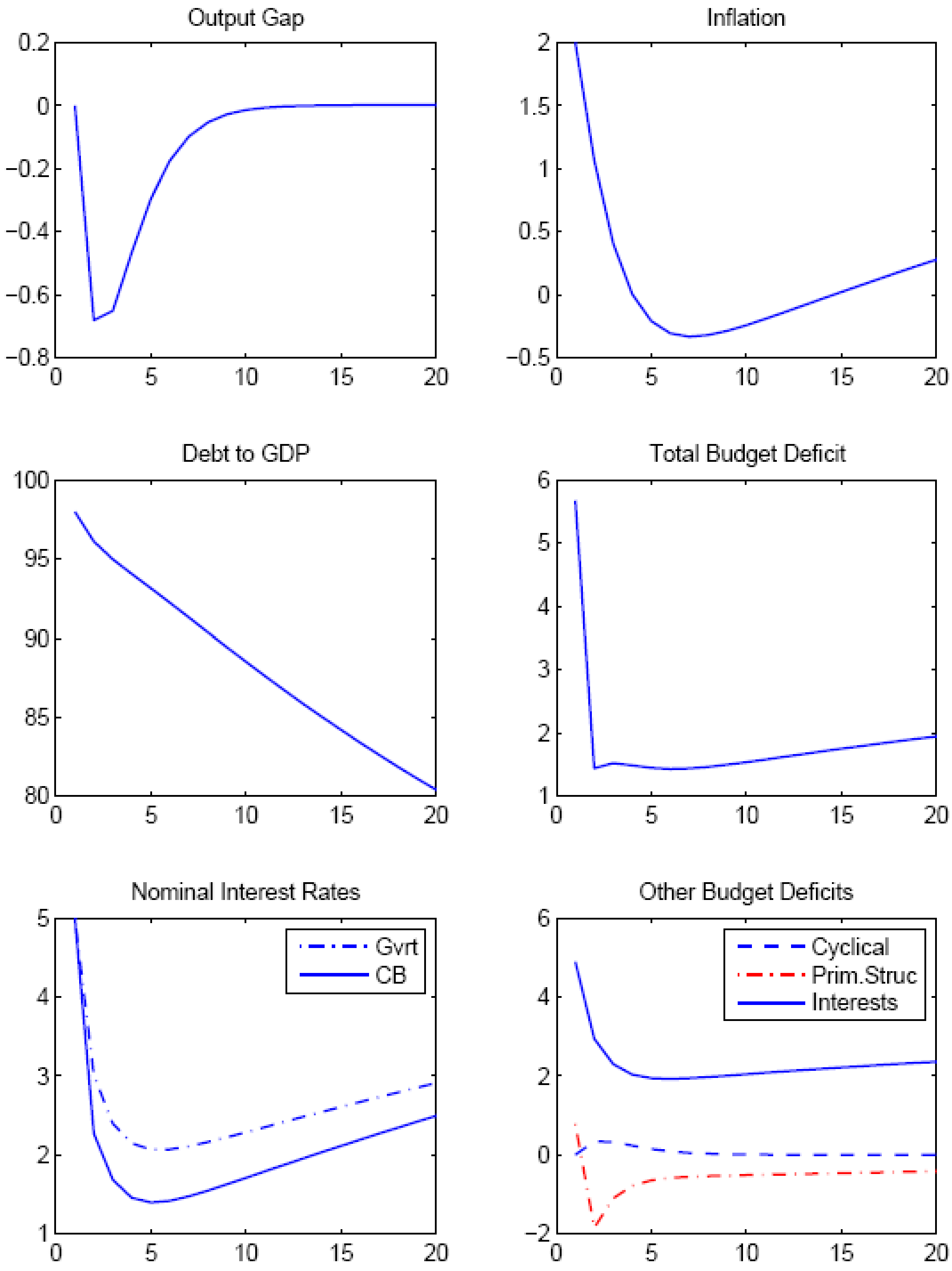
BELGIUM

Investment rule



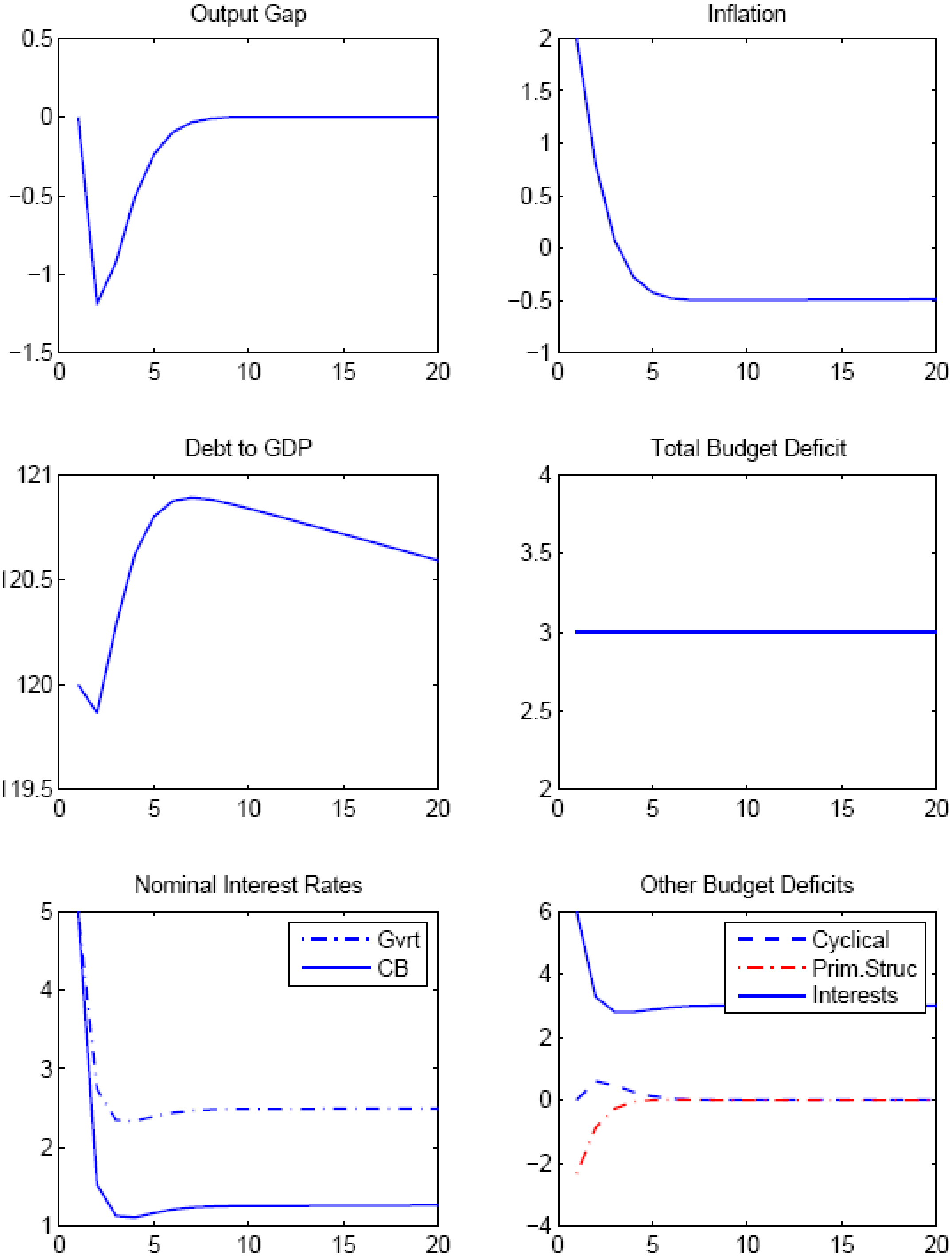
BELGIUM

Fiscal Compact



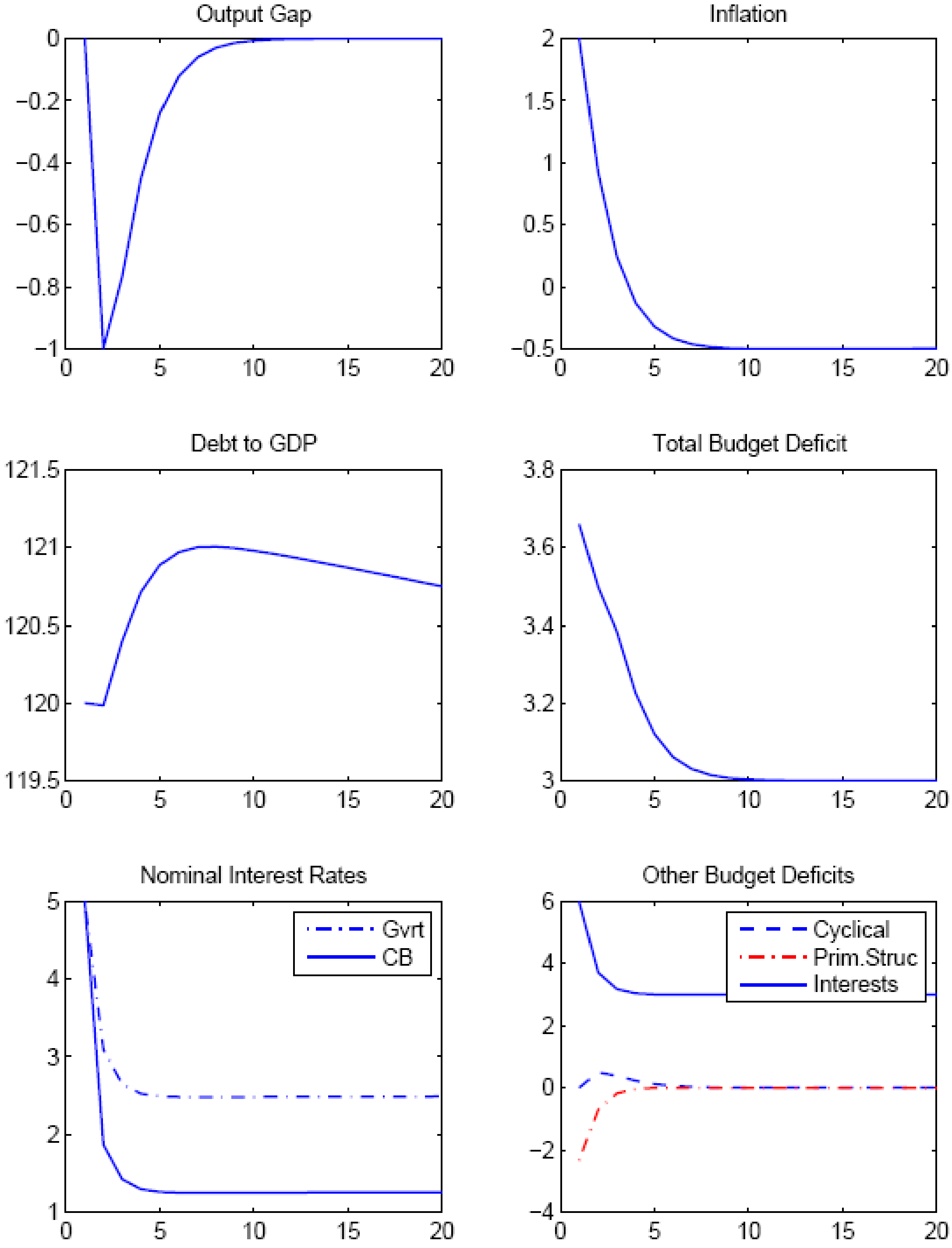
ITALY

Status Quo



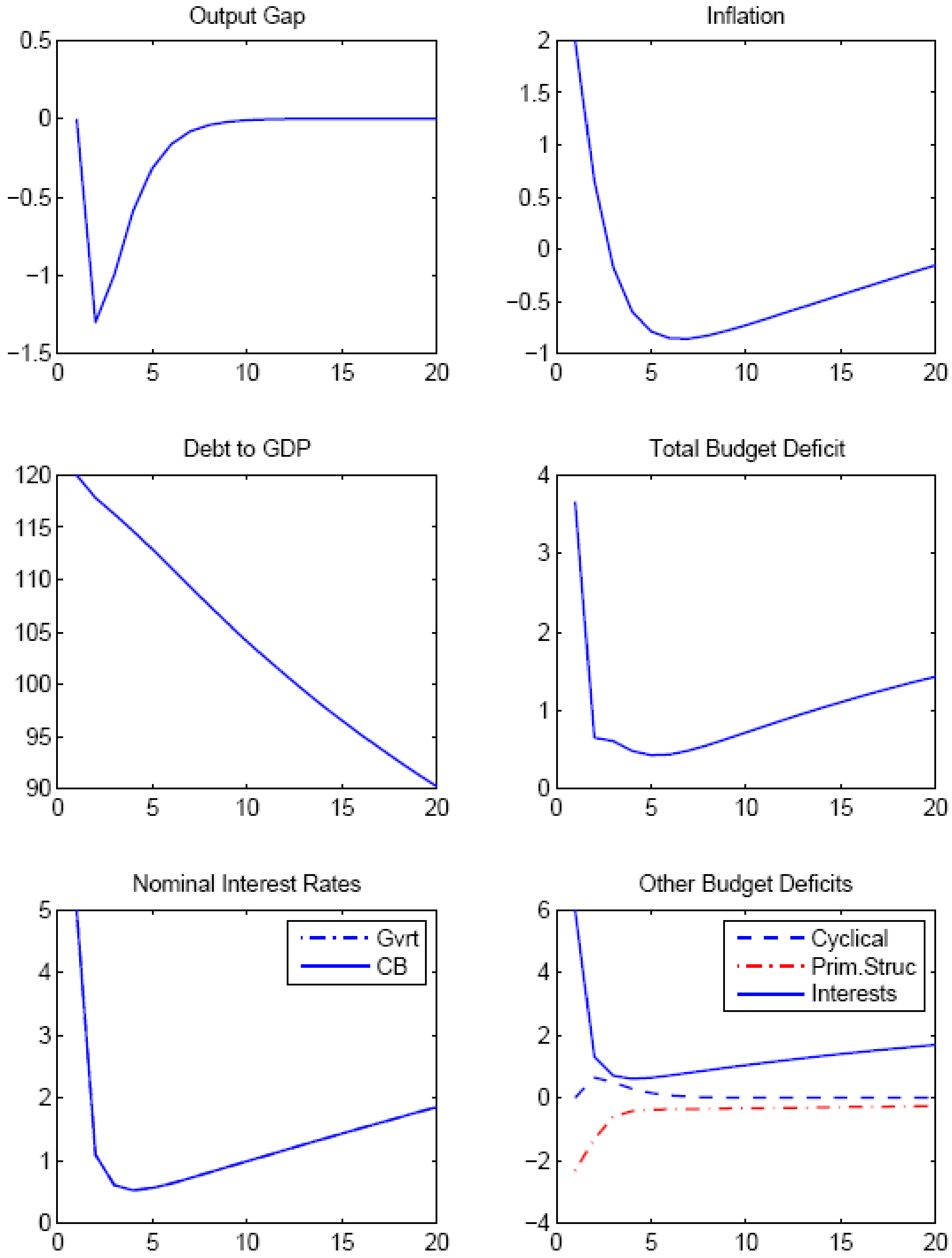
ITALY

Investment rule



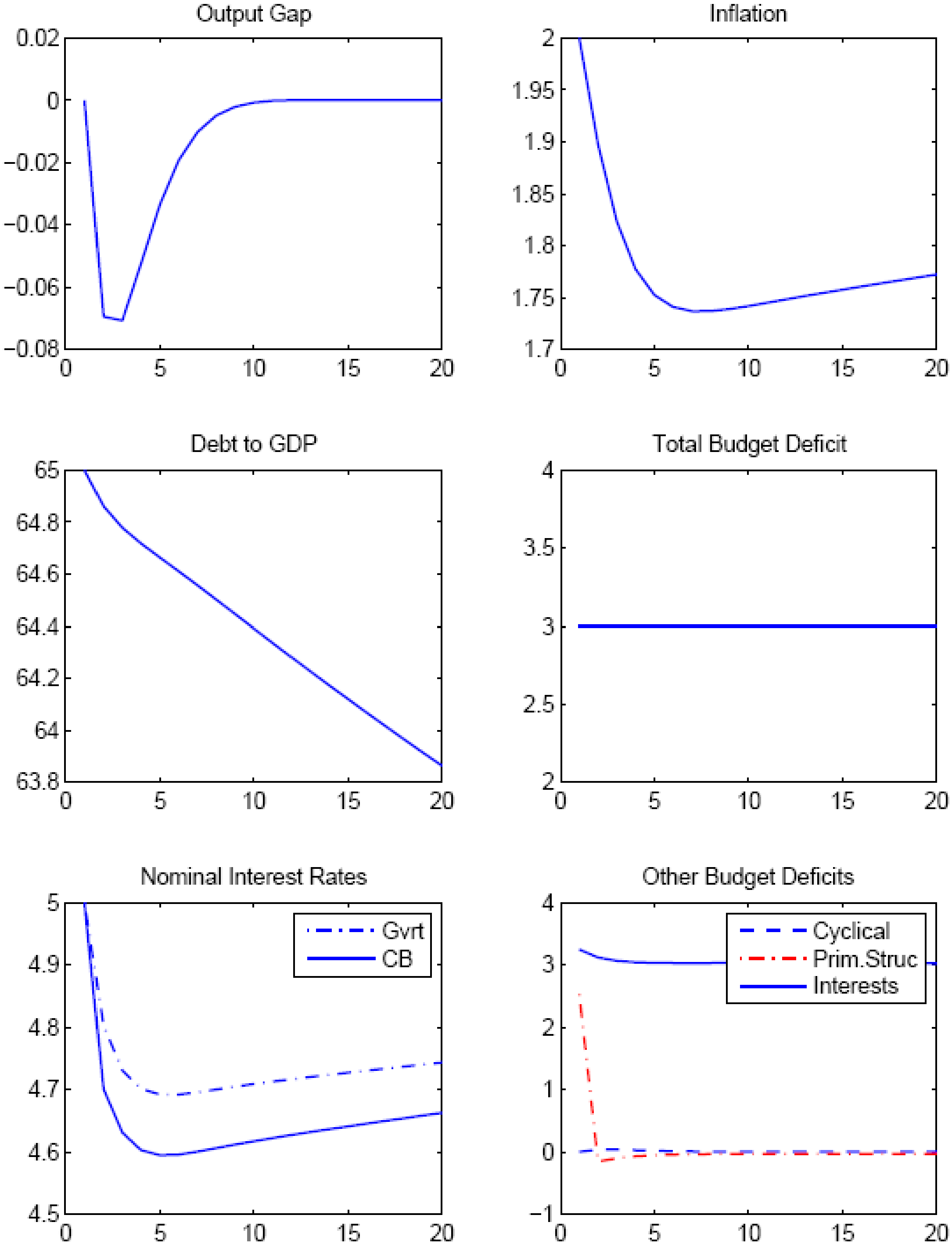
ITALY

Fiscal Compact, with $\gamma = 0$



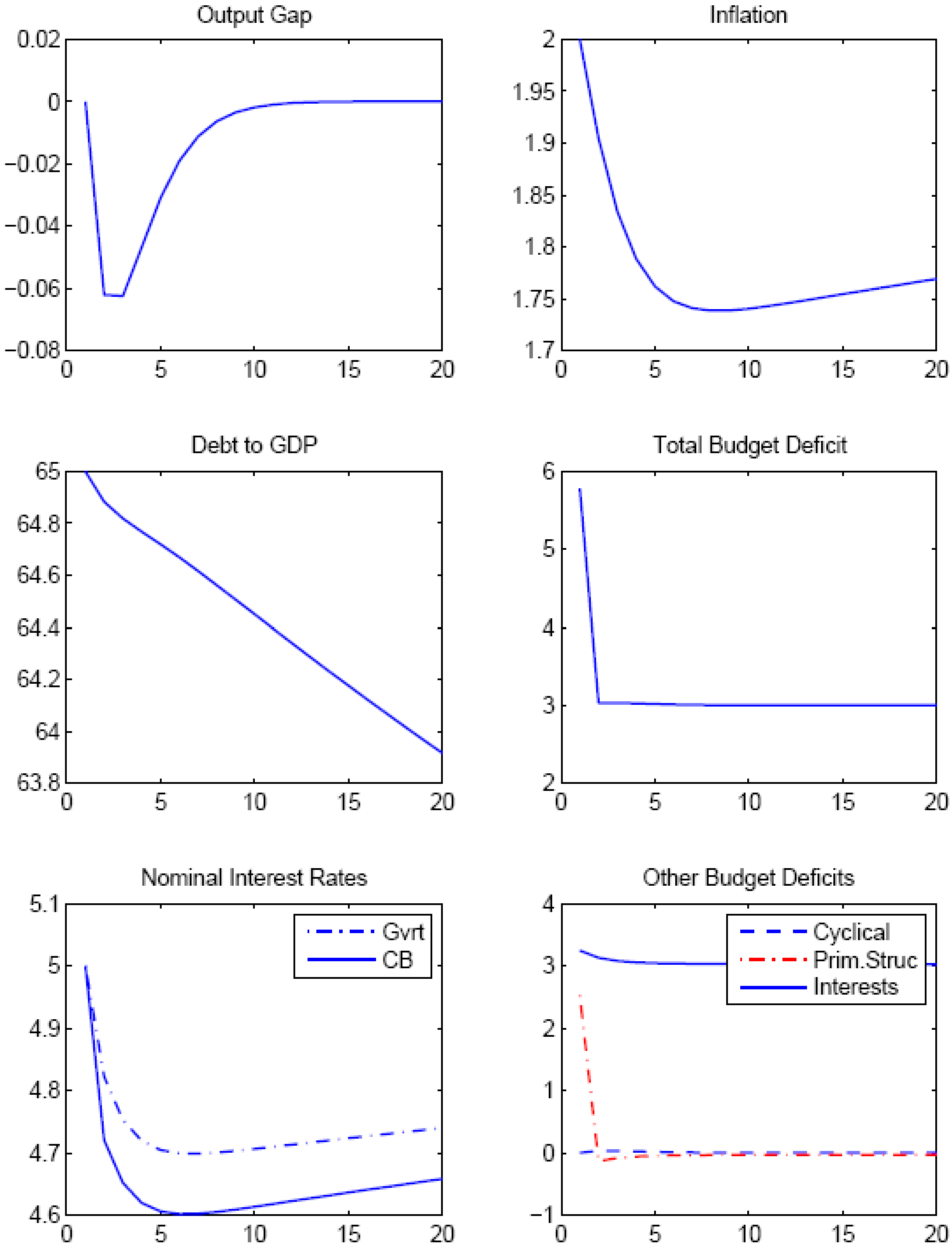
NETHERLANDS

Status Quo



NETHERLANDS

Investment rule



NETHERLANDS

Fiscal Compact