

**ECB vs. Council vs. Commission:
Monetary and Fiscal Policy Interactions in the EMU
when Cyclical Conditions Are Uncertain**

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Abstract

This paper examines economic policy interactions in the Economic and Monetary Union when the assessment of cyclical conditions in real time is surrounded by uncertainty. On the basis of a simple stylised model it shows that different views about the output gap on the side of the policy players - the Council of the European Union, the European Commission and the European Central Bank – can affect the equilibrium outcome in terms of output, inflation, the budget deficit and the interest rate. More specifically, if fiscal and monetary policy decisions are taken simultaneously diverging views about the cycle can give rise to excessive activism as policy players try to push economic variables into opposite directions. The costs of such policy conflicts can be reduced by agreeing on a common assessment of the cycle, by constraining policy variables, by increasing the weight of fiscally conservative institutions. Another way to sidestep policy conflicts ensuing from diverging views of the cycle is to take policy decisions sequentially, as is the case in a Stackelberg-type of interaction. To the extent that misperceptions are random, the leader, who moves first, will assume that the follower's assessment will be in line with its own view of the cycle. This effectively precludes the kind of frictions arising in a simultaneous setup, because the leader cannot backtrack. For a given misperception of the cycle, the impact on the policy instruments and on output and inflation are generally smaller in the Stackelberg equilibrium as compared to a Nash outcome.

Key words: Monetary policy, Fiscal Policy, Economic and Monetary Union, real-time output gap estimates

JEL: E5, E61, E62, E63

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1. Introduction

Economic policy making in the Economic and Monetary Union (EMU) takes place in a unique institutional set up. Monetary policy is the prerogative of the European Central Bank (ECB), a highly independent institution that formulates and implements its actions for the Union as a whole with the primary objective to achieve price stability. Conversely, fiscal policy remains in the hands of national governments, which at the European level are represented by the Council of the European Union. With a view to avoiding negative externalities from excessive deficits, national fiscal policies are constrained by the provisions of the Stability and Growth Pact (SGP) according to which Member States are expected to bring their fiscal position towards a medium-term objective providing sufficient margins to let automatic fiscal stabilisers play fully while safeguarding against the risk of breaching the 3% of GDP deficit threshold. The European Commission, together with the Council, is entrusted with the implementation of the provisions of the Pact.

A fast growing literature has examined various facets of the policy interactions in the EMU. To begin with, a number of papers have explored the peculiarity of a policy regime with a hard-nosed central bank and multiple fiscal authorities that are independent but subject to constraints on budget deficits. The focus is on the economic rationale for imposing constraints on national budget deficits to avoid an excessive accumulation of public debt. One key conclusion is that independent fiscal authorities only partly internalise the constraints on monetary policy arising from their choices.¹ A further series of papers focused attention on the scope for and the benefits of co-operation between fiscal and monetary authorities giving rise to different classes of findings. First, the benefits depend on the preferences of policy makers over output and inflation (Dixit and Lambertini, 2003, Beetsma et al., 2001) or the nature of the shocks (Buti et al., 2001b). Second, the EMU policy regime influences preferences: a conservative central bank increases the likelihood of an output-concerned government being elected.

While these theoretical papers have incorporated specific peculiarities of the EMU's regime, the interaction between the ECB, the Council and the Commission have been studied less and no paper, to our knowledge, has tried to analyse it in a formal setting. The fiscal stance in the EMU is set through a complex game in which the national dimension via the Council and the EU

¹ A comprehensive overview of this branch of the literature is in Buti et al. (2001a).

dimension via the Commission interact. The co-ordination sequence involves the following steps: at the end of each year Member States present stability programmes, the Commission assesses them and recommends an opinion, which is in turn adopted, possibly after introducing some changes, by the Council. For countries in excessive deficit the interaction is similar. The Commission prepares legislative acts for the successive steps of the procedure, which in turn are discussed, possibly amended and approved by the Council. A number of policy papers have described and drawn broad conclusions about the relative role of the Commission and the Council (Deroose and Langedijck, 2003, von Hagen and Mundschenck, 2001, Jaquet and Pisani-Ferry, 2000, Buti et al., 2003) but without formal analysis.

Another element which so far has received less attention when analysing economic policy in the EMU is that policy decisions are generally taken on the basis of incomplete information about the prevailing cyclical conditions. Orphanides and van Norden (2002) were the first to examine the empirical dimension of the issue and its implications for US monetary policy, showing that real-time estimates underpinning policy decision are subject to large revisions. Similar results in the field of fiscal policy were found by Forni and Momigliano (2004). Allsopp and Artis (2003) provide a short qualitative discussion of the policy implications of this uncertainty in the EMU. In particular, they argue that fiscal and monetary policy makers may have different perceptions of the cycle which affect their policy decisions and in turn the equilibrium outcome of the economy. They also infer that disputes over the appropriate policy between the fiscal authorities and the ECB could be fierce. To our knowledge no formal framework has been developed so far to account for this kind measurement issues in economic policy interactions in the EMU.

Against this backdrop, this paper examines two innovations to the existing literature on fiscal and monetary policy interactions in the EMU. First, it presents a simple model which tries to capture the main institutional features of the EMU: alongside the Council of the European Union, representing the Member States, the European Commission is added as separate entity with potentially different policy preferences. Second, the cyclical conditions of the economy as measured by the output gap are unknown when policy decisions are taken. Policy makers base their actions upon real-time estimates that are subject to uncertainty. The 'true' state of the world is revealed only *ex post*.

Starting with the role of the Commission in the 'EMU policy game', there are a number of elements in the institutional interaction between the Commission and the Council suggesting that the former is fiscally more conservative. The most apparent piece of evidence are the events that

led to the SGP-crisis in 2003 when the Council decided not to adopt the recommendations of the Commission concerning the excessive deficit procedures for Germany and France, which would have moved both countries closer to the economic sanctions foreseen by the Pact. Other less apparent indications are the differences between the text of Commission recommendations issued under the provisions of the SGP and the final version negotiated and adopted by the Council.² A cursory comparison between the initial and the final documents confirms our conclusion. Almost universally, the texts adopted by the Council are softer than those initially put forward by the Commission. Finally, there are a number of official Commission documents that are not subject to negotiations with the Council, such as the annual Public Finance Report. All these elements taken together reveal a higher preference for cautious fiscal policy.³

As regards the uncertainty surrounding real-time output gap estimates there is increasing empirical evidence in the literature coupled with many practical cases that reached a considerable degree of prominence over the past several years. At the end of the 1990's for instance at the back of the ITC boom policy makers in the EU expected the high rates of economic growth to be the result of a structural improvement in the economy rather than a temporary expansion. As a consequence, the output gap estimates available at the time did not signal particularly favourable economic conditions, an assessment, which, with the benefit of hindsight, turned out to be markedly wrong. As of today it is clear that most EU economies were operating well above potential at the turn of the decade and that fiscal policies were generally too loose (European Commission, 2006b). When examining the interaction between fiscal and monetary policy the uncertainty of real-time output gap estimates *per se* assumes additional importance because, as mentioned above, different players may have different perceptions of prevailing cyclical conditions in real time and base their respective policy decisions upon such diverging assessments. Evidence for this is more of an anecdotal kind, yet quite frequent in the financial press. Very often Finance Ministers and Central Bankers disagree about the appropriate policy stance on the basis of a different assessment of economic conditions.⁴ Policy makers may even

² Since 2003 the text prepared by the Commission is made public.

³ This has not always been the case. At the time of the Maastricht negotiations the Commission was initially not in favour of a deficit ceiling. The Council led by Germany got its way. For a review of the debate at the time of the Maastricht negotiations, see Italianer (1993).

⁴ The following excerpt from the Financial Times of November 7, 2006 illustrates the point: *Hawks at the European Central Bank are troubled by the inflationary outlook, with one member of the bank's rate-setting board claiming that the rise in consumer prices and credit was "alarming". But some EU finance ministers meeting in Brussels take a more dovish stance, pointing to the European Commission's autumn forecast which shows inflation set to fall below the ECB's 2 per cent target in 2008. Karl-Heinz Grasser, Austria's finance minister, spoke for many when he said: "Core inflation is absolutely under control – it's going back." The debate reopens tensions last seen at the end of 2005 when finance ministers publicly urged the ECB to refrain from rate rises, fearing it could snuff out a nascent recovery. Most ministers now privately admit they were wrong.*

have incentives to exploit the uncertainty in real time in a strategic way by systematically overestimating output gaps (see Jonung and Larch, 2006). The common practice of projecting high medium-term growth rates in the stability and convergence programmes accentuates the negative output gap of today.

The remainder of the paper is organised as follows. Section 2 presents the stylised economic model of policy interaction when cyclical conditions are not known in real time. Section 3 examines the implications of the model for the non-cooperative policy regime when policy makers ‘play’ Nash. The misperceptions of the output gap are taken to be purely random. Section 4, by contrast, discusses a case in which fiscal authorities are assumed to systematically underestimate fiscal conditions so as to *ex ante* justify higher fiscal deficits or lower interest rates. Section 5 lifts the assumption underlying the Nash equilibrium, namely that policy players ignore the effects on one’s own policy stemming from the other’s behaviour, and looks at interactions of the Stackelberg type. Section 6 concludes.

2. A simple model

Our model describes in a stylised way the policy interactions in the EMU in a simple one-period and one-good set up.⁵ The economies of Member States are defined in terms of the following aggregate demand and supply equations:

$$(1) \quad y = \phi_1 d - \phi_2 (i - \pi^e)$$

$$(2) \quad \pi = \pi^e + \omega y$$

where y denotes the output gap of the euro area, defined as the difference between actual output and potential output, π is actual inflation, again of the euro area, π^e expected inflation and i the nominal interest rate.

Aggregate demand depends positively on the level of the budget deficit and negatively on the level of the real interest rate, defined as the difference between the nominal interest rate i and expected inflation π^e . Equation (2) is a standard ‘Lucas supply’ function, where actual inflation π reacts one-by-one to a variation in the expected rate of inflation, and depends positively on the output gap.

⁵ Our theoretical framework is an extension of Buti et al. (2001a and 2001b).

As regards the monetary authority, the European Central Bank (ECB) chooses the interest rate by minimising the following loss function:

$$(3) \quad L_M = \sigma_M \hat{y}_M^2 + \lambda_M \pi^2 + \beta i^2$$

where the parameters σ_M , λ_M and β are the weights attached to the policy objective of stabilising output, inflation and the interest rate respectively. The expression \hat{y}_M stands for the perceived or estimated output gap in real time and will be discussed in detail below.

A strict interpretation of the ECB mandate would lead to think that its only objective would be to ensure price stability. However, in line with the provisions of the Treaty, according to which the ECB should contribute to overall objectives of the community, once the primary objective of price stabilization is reached we assume the ECB also cares about output. Moreover, further to the conclusions in the literature (see Clarida et al., 1999, Favero and Rovelli, 2000, Buti et al., 2001b) we consider that the ECB shows caution in its decisions by smoothing the interest rate.⁶ The relative weight attached to the output objective is assumed to be comparatively small.

Turning to fiscal policy, it is assumed to involve two separate dimensions. The national dimension represented by the Council of the European Union and the community dimension, represented by the European Commission. To have the Council, representing the Member States, instead of modelling separate economies such as in Beetsma et al. (2001) or Van Aarle et al. (2002) can be defended on two grounds. Firstly, it would reflect the so called 'large countries effects', in the sense that the large Member States have a decisive say in the Council and the fiscal stance decided by the big countries has a significant impact on the economic outcome of the euro area as a whole, which in turn is the relevant one for the policy decisions of the European Central Bank. Secondly, some authors such as Lambertini and Rovelli (2002) make reference to perfect symmetry and cooperation among Member States to justify the assumption of one single fiscal authority. Experience has shown that also when the fiscal position of small countries is discussed, 'political solidarity' makes the members of the Council behave as one.

The Council and the Commission are characterised by separate loss functions

$$(4) \quad L_C = \sigma_C \hat{y}_C^2 + \lambda_C \pi^2 + \alpha_C d^2$$

⁶ In the early years, the ECB has moved interest rates in small subsequent steps (25 basis points). This lends support to the interest rate smoothing assumption.

$$(5) \quad L_{EC} = \sigma_{EC} \hat{y}_{EC}^2 + \lambda_{EC} \pi^2 + \alpha_{EC} d^2$$

Both institutions are assumed to pursue the same policy objectives, namely to stabilize the output gap y , the inflation rate π and the budget deficit d , but to attach different weights to them.⁷ The specific preferences are indicated by the sub-index c for the Council and EC for the European Commission attached to the weights σ , λ and α . As highlighted in the introduction to this paper, the Commission is expected to be more conservative as regards the deficit, i.e. $\alpha_{EC} > \alpha_C$.

When setting their respective policy instruments, neither the monetary nor the fiscal authority will generally know the ‘true’ level of the output gap. The output gap y is not directly observed in real-time. Policy makers typically base their decisions on estimates, which are subsequently revised as data of later periods become available. Only the arrival of new data generally clarifies both the position in the cycle and the type of shocks affecting the economy.⁸

To account for the uncertainty surrounding real-time estimates of the output gap, we assume that policy makers do not know the ‘true’ output gap when choosing their optimal policy stance. Specifically, policy decisions are based on estimates denoted as $\hat{y}_i = (y - \theta_i)$, where θ_i denotes the measurement error with respect to the ‘true’ output gap y . The sub-index i refers to the different policy players to highlight that monetary and fiscal authority will generally have different perceptions of the output gap in real time. The measurement error θ_i is assumed to be purely random with mean zero and a finite variance σ_{θ_i} . Hence, while in any given year the assessment of the cycle may be incorrect, there is no systematic bias. A positive (negative) θ_i indicates that the output gap is assessed to be negative (positive). We also assume that the assessment of the cycle is not shared among policy makers, i.e. the fiscal policy makers do not know the real-time assessment of the cycle of the monetary authority and *vice versa*.

In principle, even the two fiscal policy institutions, which in our model jointly determine the fiscal stance of the euro area, could have different views about the position in the cycle. However, in July 2002 the EU Member States agreed upon a common method for estimating real-time potential output and the output gap.⁹ The commonly agreed method serves as reference

⁷ Without loss of generality the target value of both the inflation rate and the deficit are set equal to zero.

⁸ We could also include additive random shocks to the demand and supply equations (1) and (2) as is typically the case in models exploring economic policy interactions. However, the additivity of such shocks and the quadratic-linearity of our set-up give rise to what is referred to as certainty equivalence and would not alter the conclusions of our analysis.

⁹ A detailed description of the method is in Denis et al. (2006).

in the assessment of fiscal policy and in formulating policy recommendations in the context of the EU fiscal framework. We therefore assume that the Council and the Commission share the same measurement error, i.e. $\hat{y}_C = \hat{y}_{EC} = \hat{y}_F$.

We model the interaction between the Council and the Commission as cooperation. This is defined by the procedures of the EU fiscal surveillance framework, where the Commission prepares recommendations under the provisions of the SGP and negotiates them with the Council, which generally adopts a compromise.¹⁰ The compromise will reflect the relative bargaining power of the two institutions. According to this cooperative approach, the Council and the Commission jointly set the deficit d by minimising a common loss function derived as a linear combination of equation (4) and (5):

$$(6) \quad L_F = \mu L_C + (1 - \mu)L_{EC}$$

where the parameter μ (ranging from 0 to 1) indicates the relative bargaining power of the Council as opposed to the Commission.

The common loss function (6) can be re-written as

$$(7) \quad L_F = \sigma_F \hat{y}_F^2 + \lambda_F \pi^2 + \alpha d^2$$

The weights attached to the various objectives by the two fiscal authorities taken together are a function of μ , specifically α , the weight attached to the budget deficit. It will rise with the bargaining power of the Commission, which is assumed to be more fiscally conservative. There are of course other possible explanations for a change in the overall weight attached to the deficit objective on the side of the fiscal authority. In particular, for a given distribution of bargaining power between the Council and the Commission α could increase because of a shift in preferences in the sense that the Council could become more concerned about fiscal conditions. Such a shift could be linked to the strengthening of fiscal rules or the establishment of fiscal Councils at the national level, two elements signalling a revealed preference for fiscal conservatism. A recent study by the European Commission (2006a) in fact shows a clear trend towards stronger fiscal governance in EU members since 1995.

The uncertainty represented by the measurement errors θ_i differs from other types of uncertainties examined in the literature. The most common way of introducing uncertainty is to

¹⁰ Implicitly, we assume that the resulting deficit decisions are implemented so that the Council sticks to the agreed compromise.

have additive errors in the equations describing the economy typically representing random disturbances to supply and demand respectively. However, the uncertainty exclusively refers to the specific moment a shock arrives. Moreover, shocks are assumed to come with a 'label'. Both policy makers know what kind of shock they are facing. Another type of uncertainty discussed in the literature is linked to the parameters of the model. For instance the impact of the output gap on inflation as measured by the parameter ω in equation (2) may not be known with certainty (e.g. $\omega = \bar{\omega} + \zeta$ where ζ is a stochastic process). In this case, the error term enters multiplicatively in the equilibrium outcome and as shown by Brainard (1967) it will be optimal to respond more cautiously than would be the case in the absence of uncertainty. Nonetheless, like in the case of the additive disturbances the model uncertainty is also part of the model and shared by all policy makers.

By way of contrast, the measurement errors θ_i in our framework are exogenous to the model and are not common to all policy makers. Conceptually, they can have two different interpretations. First, they may be a reflection of the genuine uncertainty about the future course of the economy. Specifically, monetary and fiscal authority may base their policy decisions on different macroeconomic projections. Since real-time output gap estimates typically involve output projections of future years different economic outlooks will result in a different assessment of the current cyclical position. Second, a disagreement about the cyclical position may reflect a disagreement about the nature of the shock. An economic slowdown could for instance be interpreted as a negative demand shock, and hence have only temporary effects, by the fiscal authority but as a negative supply - more lasting - shock by the monetary authority. The fiscal authority would typically prescribe a fiscal expansion while the monetary authority would insist on fiscal discipline and respond with a monetary tightening. *Vice versa* an improvement in the economic conditions may be attributed to structural reforms by the fiscal authority while interpreted as cyclical by the central bank.¹¹

In terms of the implicit chronology of our model the policy makers must choose their policy before the 'true' output gap y is realised. The equilibrium outcome will depend on how the policy players are assumed to interact. Two types of interaction are possible: non-cooperative interactions and coordination.

¹¹ These examples actually portray a recent dispute between the ECB and the Council. A case in point is the different interpretation of the acceleration in labour productivity, which took place in 2006-2007.

The findings and conclusions in the literature about which type is better or preferable are ambiguous. According to Issing (2001), there is no need of formal co-ordination between monetary and fiscal authorities, because "not much can be expected from attempts to coordinate these macroeconomic policies ex-ante [...] they give rise to the risk of confusing the specific roles, mandates and responsibilities of the policies in question". His conclusion is that "if there is already an efficient initial assignment of responsibilities in place, which does take into account the individual policy-makers' objectives and actions, calls for policy co-ordination [...] would not be necessary". In a similar vein, Alesina et al. (2001) highlight that real-time coordination is not only unnecessary but, for political economy reasons, would, in most circumstances, be positively harmful and that "the possible strategic coordination problem is adequately dealt with by the cooperative agreement, the SGP, which is after all a piece of rule-based coordination". This helps explain why, as stated in Allsopp and Artis (2003), the ECB has always "been a vociferous supporter of the provisions of the SGP, as well as adopting a negative attitude to ideas for more positive coordination of economic policies". Buti et al. (2001b) give a further explanation for the traditional aversion of central banks against ex-ante coordination of macroeconomic policies: Central banks may be reluctant to engage in co-ordination due to the 'suspicion' about the real objectives of fiscal authorities.¹²

In this paper we focus attention on policy interactions where there is cooperation among the fiscal authorities, the Council and the Commission, but non-cooperation with the monetary authority, the ECB. We chose this set-up because we think it better reflects the type of policy interactions in the EMU. As regards the type of non-cooperative interactions between monetary and fiscal authorities we examine the Nash and the Stackelberg equilibrium. The corresponding results are discussed in turn.

3. The Nash equilibrium

This section analyses the economic outcome of our stylised model for the non-cooperative case, in which policy makers choose their optimal policy simultaneously taking the behaviour of the other player as given. Specifically, the fiscal authority, Council and Commission, minimises loss

¹² At the same time Buti et al. (2001b) also show that in certain circumstances co-operation can be preferable notably in the presence of supply shock. Besides this, there is a whole strand of the literature on 'gouvernement économique' which supports co-ordination to achieve an optimal policy mix for the currency area as a whole (for a summary see Pisani-Ferry, 2006).

function (7) with respect to the deficit and the monetary authority, the ECB, minimise loss function (3) with respect to the interest rate, both assuming that its own behaviour will not affect that of the other player.

Differentiating (7) with respect to d and solving for d gives the reaction function of the fiscal authority:

$$(8) \quad d = \frac{\phi_1 [\phi_2 \Omega_F i - \pi^e \lambda_F \omega (\phi_2 \omega + 1) + \Omega_F \theta_F]}{Y_F}$$

where $\Omega_F = (\lambda_F \omega^2 + \sigma_F)$ and $Y_F = (\phi_1^2 \Omega_F + \alpha)$. The deficit is increased when the monetary authority tightens its policy instrument in order to counter the effect on output. The deficit is decreased in the event of mounting inflationary expectations as they reduce the real interest rate and boost output. As regards cyclical conditions, the deficit is increased in case the assessment is comparatively unfavourable i.e. in case fiscal authorities estimate a negative output gap ($\theta_F > 0$). The impact of a negative perception rises with the relative preference for the stabilisation of output and declines with the effectiveness of fiscal policy.

Turning to the optimisation problem of the monetary authority, minimising equation (3) gives the reaction function of the monetary authority:

$$(9) \quad i = \frac{\phi_2 [\phi_1 \Omega_M d + \pi^e \lambda_M \omega (\phi_1 \omega + 1) - \Omega_M \theta_M]}{Y_M}$$

where $\Omega_M = (\lambda_M \omega^2 + \sigma_M)$ and $Y_M = (\phi_2^2 \Omega_M + \beta)$. The ECB increases its policy rate when the fiscal authority implements a fiscal expansion in view of the ensuing inflationary pressure. Like the fiscal authority, it loosens its policy stance with the aim to stabilise output when its assessment of cyclical conditions turns negative. Of course, this result directly follows from our specific choice of the ECB's loss function, which in addition to inflation also includes an output objective. If the monetary authority focused attention exclusively on inflation and the interest rate, the misperception of the cycle would not have any direct effect on monetary policy. Only the indirect effects via the misperception of the fiscal authority on the deficit would play a role.

The Nash equilibrium is determined by the intersection of the two reaction functions. The equilibrium levels of the deficit d^N and the interest rate i^N are obtained by assuming that policy makers have no systematic incentive to deviate from the preferred values of the output and

inflation ($y = 0, \pi = \pi^e = 0$). More specifically, the misperception of the cycle is not biased towards positive or negative output gaps. In this case, cross-substituting from (8) and (9) yields

$$(10) \quad d^N = \frac{\phi_1 \Omega_F [Y_M \theta_F - \phi_2^2 \Omega_M \theta_M]}{X}$$

$$(11) \quad i^N = \frac{\phi_2 \Omega_M [\phi_1^2 \Omega_F \theta_F - Y_F \theta_M]}{X}$$

where $X = \phi_1^2 \beta \Omega_F + \phi_2^2 \alpha \Omega_M + \alpha \beta$. Equation (10) and (11) show that diverging views produce opposite effects on the equilibrium value of the policy instruments. Pessimism on the side of the Council cum Commission leads to a higher deficit as fiscal authorities try to minimise their loss from a perceived negative output gap. If the assessment of the cycle is not shared by the ECB the fiscal expansion triggers a monetary tightening because, based on its own assessment, the monetary authority anticipates rising demand pressure. Consequently, different perceptions of the fiscal and monetary authority lead to conflicting policy reactions. A tightening by the fiscal authority is accompanied by a loosening of the monetary authority and *vice versa*.

Figure 1 and 2 provide a graphic illustration of the game. With no measurement uncertainty, the reaction function of the fiscal authority $d(i)$ and of the monetary authority $i(d)$ intersect at the origin where the both the deficit and inflation are equal to zero. Figure 1 displays the case in which the fiscal and the monetary authority have diverging views about the cyclical position of the economy: the fiscal authority estimates a negative, the monetary authority a positive output gap. As this constellation gives rise to the policy conflict described above, in equilibrium the fiscal authority runs a sizeable deficit and the interest rate goes up. By way of contrast, Figure 2 displays a situation in which both authorities estimate a negative output gap. In this case both the deficit and the interest rate are significantly lower compared to the equilibrium with diverging assessments of the cycle.

Taking into account the negotiations within the fiscal authority, i.e. between the Council and the Commission, the size of the fiscal tightening or loosening in the event of a diverging view of the cycle depend on the relative bargaining power of the two institutions. A 'strong', fiscally conservative Commission (characterised by a larger α in equation (10) and (11)) or, alternatively, stronger fiscal governance at the national level, would dampen the policy conflict as fiscal imbalances are considered to be more costly. As can be seen from equation (10) and (11), both

the equilibrium deficit (surplus) and interest rate would be lower.¹³ In terms of Figure 1 and Figure 2 a stronger Commission implies that the reaction function of the fiscal authority moves closer to the origin.

Figure 1: Nash equilibrium - Diverging views of the cycle

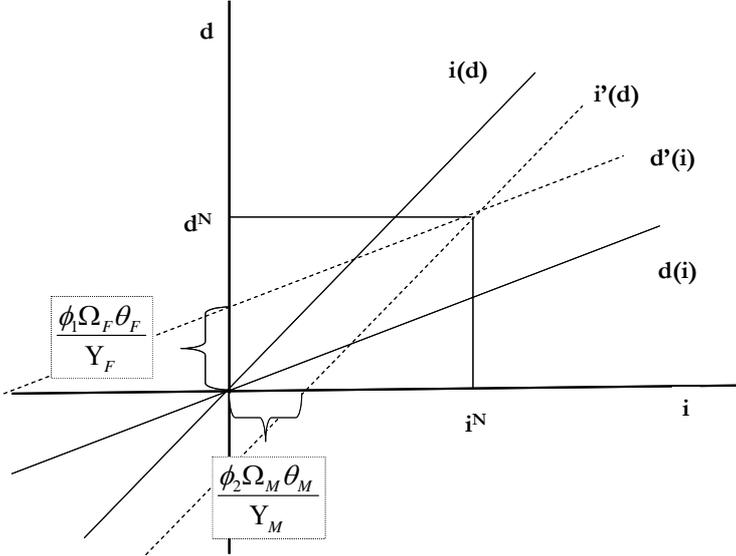
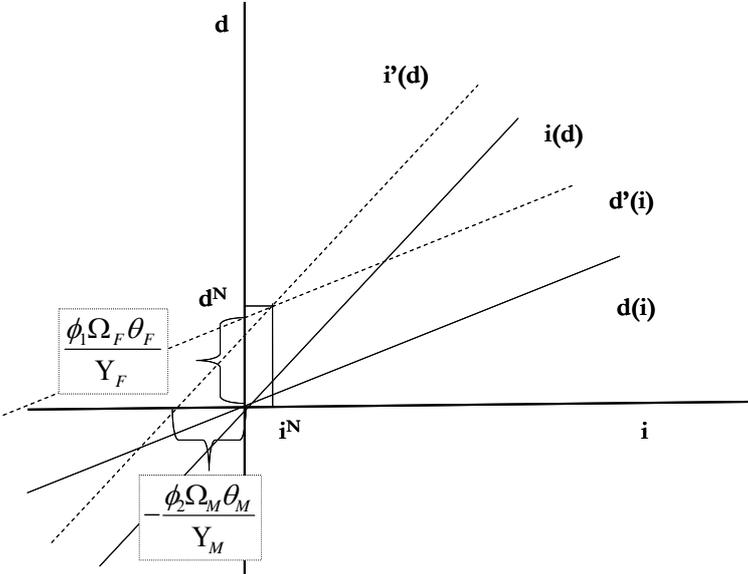


Figure 2: Nash Equilibrium - Converging views of the cycle



¹³ The result holds under the plausible assumption that the fiscal authority attaches more weight to the output target and less weight to the inflation target than the monetary authority, i.e. the reaction function of the fiscal authority is flatter than the one of the monetary authority.

In the policy discussion it is sometimes argued that in case fiscal policy makers risk being too optimistic about the medium-term growth prospects of the economy (which typically implies that the current position vis-à-vis the supposedly high level of potential output is less favourable) monetary authorities should respond by basing their policy decisions on particularly cautious economic projections, the idea being that excessive optimism should be dampened by a corresponding degree of prudence. However, in our stylised model such a contraposition would actually exacerbate the policy conflict. The increase in the deficit induced by a high estimate of trend GDP compared to actual GDP on the side of the fiscal authority would be stepped up in response to an increase in interest rates resulting from a particularly cautious economic outlook on the side of the monetary authority. This result is in line with the findings of Dixit and Lambertini (2001) who examine a situation where fiscal and monetary authority deliberately target different output and inflation targets. The result is what they call a non-co-operative race giving rise to a too expansionary fiscal policy and a too tight monetary policy stance. Our model indicates that such a race can also take place when the fiscal and the monetary authority pursue the same output target, but as is the case in practice, need to base their policy decisions on estimates of where the economy stands vis-à-vis the common objective.

Overall, caution and optimism do not offset each other. They are mutually reinforcing and can have negative effects on the loss of the policy players. In our model, it is better for both players to have the same wrong perception of the cycle than erring into opposing directions.¹⁴ This conclusion is reached when comparing the loss incurred *ex post*, i.e. when the 'true' output gap is revealed to policy players. Whilst this result is fairly general, it can be simplified in two polar cases: (i) when the misperception has the same size and the same sign; and (ii) when the misperception has the same size but opposite signs.¹⁵ The intuition behind this result is relatively straightforward. When fiscal and monetary authority share the same assessment of the cycle they also share the loss of closing the perceived output gap because policy instruments are used in a complementary way. Conversely, when the fiscal and the monetary authority hold opposite views, there is no burden sharing. The two policymakers have to rely on their own policy instruments to

¹⁴ These conclusions strictly refer to the loss functions of the policy players and not to the social welfare. The implications for the latter could be different depending on how the social loss function is defined.

¹⁵ The loss for errors of the same size and same sign is lower than the loss for errors of the same size but opposite signs. For the fiscal authority the difference is $-\frac{4\alpha\phi_1^2\phi_2^4\Omega_M\Omega_F}{\alpha\phi_2^2\Omega_M + \beta\phi_1^2\Omega_F + \alpha\beta}$; for the monetary authority we have

$$-\frac{4\beta\phi_1^4\phi_2^2\Omega_M\Omega_F}{\alpha\phi_2^2\Omega_M + \beta\phi_1^2\Omega_F + \alpha\beta}.$$

steer the output gap and inflation into the desired direction and hence have to bear the full costs. Clearly, there is no difference in the loss between shared and opposing assessments of the cycle if one of the players does not target output.

The conflict between optimism and prudence in the assessment of the cycle emerging from our stylised model captures the intuition of Allsopp and Artis (2003) mentioned in the introduction of this paper. The practical difficulty in estimating potential output and the output gap in real time may give rise to serious disputes and frictions in terms of policy measures. A sort of 'tug-of-war' takes place with a view to correcting the possible misperception of the other policy player.

The 'tug-of-war' ensuing from misperceptions about the cycle reflects the attempt to achieve a common goal with different views about the relative position vis-à-vis the goal. If the fiscal authority perceives a negative output gap it will always try to support output, while monetary authorities will always attempt to dampen output in case it believes it lies above its potential level. The degree of friction is reduced if the monetary authority does not have an output objective. In that case its own estimates of the output gap would no longer influence its policy decisions and the misperceptions on the side of the fiscal authority would only matter indirectly via their impact on inflation. In terms of equation (10) and (11) this corresponds to a situation in which σ_M is set to zero: the effect of a misperception on the side of the fiscal authority on both the deficit and the interest rate decline as the central bank no longer tries to counterbalance the perceived effect output ensuing from the policy decision of the fiscal authority.

Equation (12) and (13) show the equilibrium level of the output gap and the rate of inflation. They are obtained by replacing equation (10) and (11) in equation (1) and (2):

$$(12) \quad y^N = \frac{\beta\phi_1^2\Omega_F\theta_F + \alpha\phi_2^2\Omega_M\theta_M}{X},$$

$$(13) \quad \pi^N = \omega \frac{\beta\phi_1^2\Omega_F\theta_F + \alpha\phi_2^2\Omega_M\theta_M}{X}.$$

The equations show that if both authorities base their policy decision on correct real-time estimates of potential output ($\theta_F = \theta_M = 0$), the equilibrium output gap and equilibrium rate of inflation will be equal to zero, which means that both authorities succeed in reaching their inflation and output targets, and they will do so while keep their policy instruments at the optimal level. In Figure 1 this implies that the equilibrium will be located at the origin.

A further point to highlight concerns the effect of misperceptions. Those of the fiscal authority matter only to the extent that the monetary authority faces a cost in changing its policy rate. If the central bank did not smooth interest rates (i.e. $\beta = 0$) the measurement errors on the side of the fiscal authority and the ensuing fiscal policy moves would be completely neutralised via immediate and comparatively strong changes in the interest rate.¹⁶ Similarly, the misperceptions of the monetary authority would have no effect on equilibrium output and on inflation if the central bank exclusively cared about inflation. A perceived negative output gap would no longer trigger a reduction in the interest rate.¹⁷

Taking both points together the conclusions are the following. Misperceptions about the cycle are completely irrelevant in terms of output and inflation if the central bank (i) does not care about output and (ii) does not smooth interest rates. This would typically be the case, when the central bank pursues only an inflation objective and uses aggressively the interest rate to attain it.¹⁸ The more general point is that misperceptions play no role for output and inflation if at least one policy player is completely free in setting its policy instrument and does not target the variable that is subject to uncertainty.

As regards the relative bargaining power of the Council vis-à-vis the Commission, where the Commission attaches more weight to the deficit objective, the equilibrium equations for output and inflation have clear implications. A 'strong' Commission would dampen the effect of misperceptions on the side of the fiscal authority on both economic variables. Conversely, the misperceptions by the monetary authority would have larger effects on equilibrium output and inflation because, as mentioned before, a 'strong' Commission would imply a muted reaction in terms of policy instruments.

4. Systematic misperceptions on the side of the fiscal authority

The results and conclusions of the Nash-equilibrium are based on the assumption that the misperceptions of the cycle are random and zero on average. However, there are both empirical

¹⁶ This corresponds to the result in Buti et al. (2001b) that with no interest rate smoothing demand shocks, which move inflation and output into the same direction, are fully offset by changes in the interest rate.

¹⁷ A comprehensive presentation of the effects of misperceptions of the cycle both by the fiscal and the monetary authority on the equilibrium level of the deficit, the interest rate, the output gap and inflation is provided in Annex 1.

¹⁸ Indeed, the neutrality of output and inflation with respect to misperceptions of the cycle would also arise if the policy roles were inverted, i.e. in case the fiscal authority did not care about output and could choose any budget balance to achieve a given inflation target.

and anecdotal evidence suggesting that fiscal authorities may have an incentive to systematically overestimate medium-term growth prospects, which in turn amounts to paint a less favourable picture of the cycle. Jonung and Larch (2006) detect a tendency among large euro area countries to base budgetary plans on optimistic growth projections and to *ex post* blame lower than expected growth on bad luck. Such a conduct gives rise to an expansionary bias in fiscal policy. Strauch et al. (2004) arrive at similar conclusions. As regards anecdotal evidence there are a series of instances typically linked to the implementation of structural reforms where national governments may be tempted to be particularly optimistic about the effects of their actions. They may argue that a projected or ongoing economic recovery are the desired results of the reform efforts to lift the speed limits of the economy and hence will not give rise to inflationary pressures.¹⁹ Incentives leading to over optimism in growth projections may be even stronger in electoral periods (see Buti and van den Noord, 2004).

In this section we consider the interaction between Council cum Commission and the ECB assuming that the former on top of the random measurement uncertainty systematically estimates a negative output gap (i.e. $\theta_F = \theta_F^R + \theta_F^S$, where $E(\theta_F^R) = 0$ and $\theta_F^S > 0$) while the independent monetary authority, apart from making random mistakes about the output gap in real time, has no 'hidden agenda'. One possible solution to this problem is to assume that the ECB completely pre-empt the misperceptions of the other player. Specifically, the monetary authority is taken to set the interest rate that induces the fiscal authority to choose a level of the deficit which will close the output gap and hence, yields inflation in line with expectations (in our case equal to zero). As shown in the Annex, under the assumption that the monetary internalises fully the systematic bias θ_F^S of the fiscal authorities, the equilibrium level of output and inflation are simply:

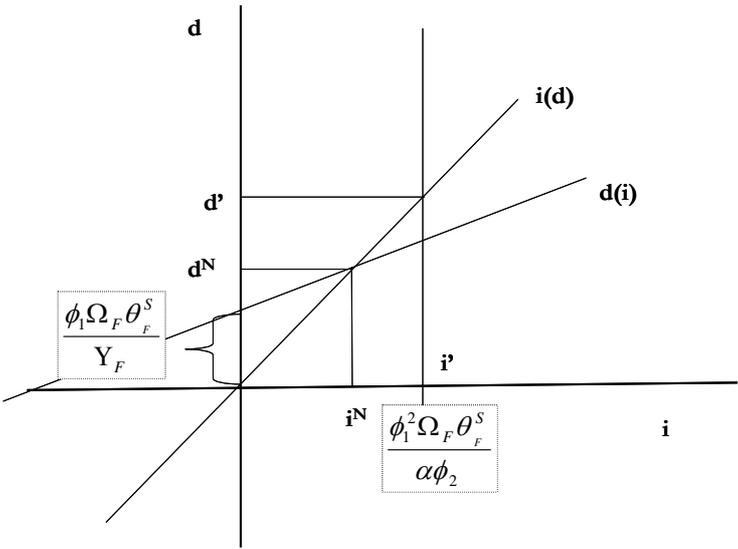
$$(14) \quad y' = \theta_M$$

$$(15) \quad \pi' = \omega \theta_M$$

¹⁹ The debate about the sources of the increase in labour productivity observed over the course of the 2006 economic recovery is a case in point. One side sees the increase as the result of the positive effort to reform the labour markets, financial markets and product markets. For instance: *The ECB is expected to raise its main interest rate by a quarter percentage point to 3.5% at its December meeting. Karl-Heinz Grasser, Austria's finance minister, agreed and said that the ECB should not be forced to raise interest rates if governments continued their reforms* (Financial Times, 7 November 2006). The ECB's view is quite different. It was *inter alia* expressed in Gomez-Salvador et al. (2006) who reach rather cautious conclusions favouring the interpretation that productivity gains are a cyclical phenomenon. Further and more explicit evidence in support of this interpretation came from the President of the ECB on 7 December after the Governing Council had decided to raise the policy rate. Asked whether successful implementation of structural reforms might

Since the measurement error of the central bank is taken to be purely random with zero mean, this result is compatible with rational expectations of the economic agents that on average inflation will be equal to zero.²⁰ However, as shown in Figure 3 the flip side of sticking to the target is a tighter policy stance. For a given size of the systematic misperception on the side of the fiscal authority both the deficit and the interest rate are significantly above the Nash outcome.²¹

Figure 3: Systematic misperception versus Nash equilibrium



Notes: For illustrative purposes the figure is drawn for the case in which the random measurement errors of both policy players are zero. Only the systematic misperception on the side of the fiscal authority is considered

One way to moderate the effect of a systematic misperception on the policy stance is a 'strong', fiscally more conservative Commission. An increase in the parameter α dampens the equilibrium level of the interest rate and the deficit. Stronger fiscal governance at the national level is likely to curb systematic misperceptions of the fiscal authority in the first place. For instance, Jonung and Larch (2006) provide evidence that macroeconomic forecasts produced by

have increased potential growth in the euro area, J-C. Trichet replied that it was '*too early to say we see sufficient evidence of structural reforms that we have a significant change in the growth potential of Europe. We do not change our sentiments of the underlying potential.*'

²⁰ Equations (14) and (15) are a special case of the Nash or a Stackelberg outcome (see Section 5) when the central bank only cares about inflation and picks any interest rate, which, taking into account the misperception of the fiscal authority, brings actual output in line with its real-time estimate of potential output without any costs; i.e. $\beta = 0$.

²¹ This can easily be shown by comparing the partial derivatives with respect to θ_F and θ_M of the equation (10) and (27) and of equation (11) and (28) in the Annex.

independent institutions for the purpose of budget formation are generally unbiased and in turn support on average a lower deficit (higher surplus).

Comparing our framework with the 'classic' model of Barro and Gordon (1983), we find some interesting similarities and differences. The systematic misperception of the cycle by our fiscal authority can be compared with the objective of the policy maker in the Barro-Gordon setup to push the unemployment rate below the natural level. However, the policy instruments are different: in the Barro-Gordon model it is the printing press, in our model it is the government budget balance.

Taking the expectations of economic agents as given, the policy maker in the Barro-Gordon model pushes the inflation rate above the social optimum with a view to achieve its target for unemployment. If economic agents are rational they will anticipate this behaviour and set their inflation expectations accordingly. As a result, in equilibrium the employment rate will be at the natural level, but inflation will be sub-optimally high.

In our model policy making is entrusted to two players, the Council cum Commission and the ECB, where the first controls the budget balance and is assumed to aim for output above its potential level (i.e. on average $\theta_F^S > 0$), while the ECB controls the interest rate and aims at stabilising inflation by, subject to some purely random measurement errors. In this respect, the behaviour of the central bank could be assimilated to the one of the rational economic agents in the Barro-Gordon model. The monetary authority anticipates the attempt of the fiscal authorities to systematically push actual output above potential and sets its policy instrument (the interest rate) so as to neutralise the objective of the fiscal authority. In equilibrium, the systematic misperception on the side of the fiscal authority has no effects on the output and on inflation, but on the policy stance, i.e. the deficit and the interest rate are higher compared to a situation without systematic misperceptions. This result mirrors the sub-optimally high level of the inflation rate in the Barro-Gordon model. In other words, while in Barro-Gordon the equilibrium is characterised by an inflation bias, in our model it features a deficit bias.

5. Stackelberg equilibrium

The Nash equilibrium discussed in Section 3 is based on the assumption that policy makers minimise their loss functions simultaneously disregarding spillovers on to one's policy actions

arising from the other party's behaviour. One possible alternative discussed in the literature is an interaction of the Stackelberg type, where one of the players, the leader, is taken to anticipate the reaction of the other player, the follower, to its own decisions. *A priori* in the EMU setting it is not clear which institutions leads and which follows. Generally it is assumed that the central bank moves first and the fiscal authority follows (see for instance Dixit and Lambertini, 2003). However, the opposite view is also found in the literature. For instance, Bean (1998) argues that fiscal authorities are in the position of a 'Stackelberg leader', in the sense that fiscal policy is decided taking into account the anticipated reactions functions of the monetary authorities. Similarly, Beetsma and Bovenberg (1998) reason that fiscal policy decisions take a long time, whereas monetary policy can be adjusted quickly. Hence, fiscal policy would be the leader because it *de facto* commits to a specific fiscal stance it cannot change sufficiently quickly.

In this section we examine the equilibrium outcome of Stackelberg interactions for both possibilities. Monetary and the fiscal authority take in turn the role of a Stackelberg leader and a Stackelberg follower. Conceptually, the leader takes the first move. It thereby reveals his view of the world via the chosen policy stance and gives the follower the chance to set its policy instruments in line with its own policy objectives and perceptions of the cycle.

We first take the case in which the monetary authority leads: it is in a position to predict the fiscal authority's response for a given choice of the interest rate. In our model, on top of the interest rate, the response of the fiscal authority also depends on its (mis)perception of the cycle: the parameter θ_F . If the output gap is perceived to be negative in real time the fiscal authority will set a higher deficit for any given interest rate as compared to a situation in which the real-time assessment of the cycle is more positive.

To the extent that the real-time assessments of the cyclical position are not shared across policy makers, the Stackelberg leader needs to make a conjecture about the fiscal authority's view of the world.²² Since the measurement errors are assumed to be random, the simplest and probably most sensible *ex-ante* guess on the side of the monetary authority is to assume that the fiscal authority has the same view of the cycle. Alternative conjectures are of course possible. The leader could for instance assume that the perception of the follower is systematically biased. In that case we would rather have the particular situation described in Section 4. In that case, the

²² Even if the fiscal policy makers were to announce their assessment it could still be argued that the monetary authority remains suspicious about the real objectives of the fiscal authority.

only way the monetary authority can be expected to achieve its inflation target is to focus exclusively on prices and to forget about interest rate smoothing and the output gap.

In the following we present the results pertaining to the leader's conjecture that the follower bases its decision on the same output gap estimate. In this case the loss function of the monetary authority is:

$$(16) \quad L_M = \sigma_M \left\{ \phi_1 \left[\frac{\phi_1 (\phi_2 \Omega_F i - \pi^e \lambda_F \omega (\phi_2 \omega + 1) + \theta_M \Omega_F)}{Y_F} \right] - \phi_2 (i - \pi^e) - \theta_M \right\}^2 + \lambda_M \pi^2 + \beta i^2$$

The respective equilibrium interest rate chosen by the Stackelberg leader when $\pi = \pi^e = 0$ is

$$(17) \quad i^{S,M} = - \frac{\alpha^2 \phi_2 \Omega_M \theta_M}{XY_F - \alpha \phi_1^2 \phi_2^2 \Omega_M \Omega_F}$$

Conversely, the fiscal authority chooses its optimal policy in the standard way, i.e. by taking the behaviour of the other player as given. As a result, its reaction function is unchanged with respect to the Nash interaction; it behaves according to equation (8). The equilibrium level of the deficit is obtained by substituting for the equilibrium level of the interest rate:

$$(18) \quad d^{S,M} = \frac{\phi_1 \Omega_F [(\beta Y_F^2 + \alpha^2 \phi_2^2 \Omega_M) \theta_F - \alpha^2 \phi_2^2 \Omega_M \theta_M]}{(XY_F - \alpha \phi_1^2 \phi_2^2 \Omega_M \Omega_F) Y_F}$$

When roles are inverted, that is when the fiscal authority leads, the equilibrium outcome for the deficit, the interest rate, the output gap and inflation are:

$$(19) \quad d^{S,F} = \frac{\beta^2 \phi_1 \Omega_F \theta_F}{XY_M - \beta \phi_1^2 \phi_2^2 \Omega_M \Omega_F}$$

$$(20) \quad i^{S,F} = - \frac{\phi_2 \Omega_M [(\alpha Y_M^2 + \beta^2 \phi_1^2 \Omega_F) \theta_M - \beta^2 \phi_1^2 \Omega_F \theta_F]}{(XY_M - \beta \phi_1^2 \phi_2^2 \Omega_M \Omega_F) Y_M}$$

The equilibrium equations of the deficit and the interest rate (17) to (20) highlight a number of noteworthy features of the Stackelberg interaction. Firstly, the misperception of the follower does not appear in the equilibrium equation of the policy instrument of the leader, i.e. the misperception of the fiscal authority θ_F is not in equation (17) and the misperception of the monetary authority θ_M is not in equation (19). This result directly follows from the conjecture of the leader that the follower will base its policy decision on the same real-time output gap estimate. Thus, the leader does not, or cannot, engage in the kind of policy conflict typical of the

Nash outcome where everything happens simultaneously. In the implicit chronology of the Stackelberg interaction the leader moves first anticipating the reaction of the follower to its own policy instrument and by making a conjecture about the misperception of the follower. Once its policy instrument is set it can no longer backtrack, whatever the real-time output gap estimate and the ensuing policy choice of the follower may be.

Secondly, in qualitative terms the effect of a misperception is the same as in the Nash outcome. As far as the follower is concerned the results described in Section 3 still hold. Whenever the output gap is perceived to be negative (positive) the respective policy instrument will be loosened (tightened). However, the size of the loosening (tightening) is smaller because of the leader's capacity to internalise the effect of its policy decision on the policy instrument of the follower. In case the leader perceives a negative output gap it will loosen its policy instrument by less because it knows that part of the policy move will be offset by the follower. As a result, there is less activism on the policy instruments of both the leader and the follower. For a given misperception of the cycle the equilibrium deficit and interest rate will be lower than in the Nash outcome.

A result that carries over from the Stackelberg interaction concerns the effect of a 'strong', fiscally more conservative Commission or, alternatively, of stronger fiscal governance at the national level. An increase in α tends to mitigate the effects of misperceptions on the deficit, the output gap and the rate of inflation. Conversely, monetary policy gets more active in case the assessment of the cycle is the same across policy players because it gets less 'help' from the fiscal side.

A further feature of the Stackelberg outcome refers to the effect of misperceptions on the equilibrium level of the output gap and inflation (see the Annex for the respective equilibrium equations). Compared to the Nash outcome the results depend on whether the erroneous assessment of the cycle is with the leader or the follower. For a given misperception of the leader, the level of output turns out closer to potential and the rate of inflation will be closer to the target. The opposite is the case if the misperception is on the side of the follower. The result related to the misperception of the leader reflects the fact that policy instruments in the Stackelberg equilibrium will be less tight or less loose. The muted activism in terms of policy instruments is passed on to output and inflation. By contrast, the more expansionary effect of an erroneous assessment of the follower is linked to the above mentioned implicit chronology of the Stackelberg interaction. The leader moves first and assumes that the follower will share the same view of the cycle. As a result, when the follower sets its own instrument on the basis of his actual

assessment of the cycle in real time, the policy decision has an unobstructed impact on output and inflation.

The follower also has the chance of completely offsetting the effect of a misperception on the side of the leader if there is no constraint on the policy instrument. Specifically, when monetary policy leads, the fiscal authority can neutralise any misperception on the side of the leader in case it was completely indifferent about and/or completely free in setting the level of the deficit ($\alpha = 0$). Similarly, when the fiscal authority leads, the monetary authority can control the output gap in line with its own perceptions provided it does not pursue interest rate smoothing ($\beta = 0$).

In practice, however, the freedom of setting policy instruments is mostly limited or possible within well-defined ranges only. As regards the deficit, the 3% of GDP threshold of the EU Treaty is the most obvious though not the only constraint. Under the provisions of the SGP Member States are also expected to consistently consolidate towards a medium-term budgetary objective (consistent with public debt sustainability and potential growth) and to let automatic stabilisers operate once the objective is achieved. As regards monetary policy, the consensus in the literature and the empirical evidence mentioned before indicate that central banks tend to adjust interest rates in a gradual manner. Against this backdrop, it is more realistic to assume that Stackelberg followers will generally have the possibility to reduce rather than fully offset the effect of a misperception on the side of the leader.

Overall, the Stackelberg type of interaction gives generally rise to lower policy frictions compared with the Nash-equilibrium. This lower degree of policy activism has important implications as regards the question of whether policy players are better off when sharing the same assessment of the cycle as compared to holding opposing views. Unlike in the Nash equilibrium, where erring into the same direction generates a lower loss for both players, the situation is more complex in the Stackelberg interaction. For the follower, erring into the same or opposite directions makes no difference.²³ The loss is the same in both cases because the policy choice of the leader is exclusively made on the basis of its own assessment of the cycle. Therefore, the actual sign of the follower's misperception plays no role. Conversely, the leader is actually better off if the follower holds a perception of the cycle that has the opposite sign. In that case there is an offsetting effect on output and inflation without paying the price in terms of a policy conflict. By analogy, if the misperceptions are of the same sign the leader overreacts on his own

²³ The result is derived in a separate appendix (available upon request).

instrument as compared to the Nash outcome because once the follower takes its complementary policy move the leader is bound by his preceding decision.

How does all this relate to policy making in the EMU? The first point refers to the type of policy interaction; i.e. Nash versus Stackelberg. Rather than being a Nash game, the actual interaction in the EMU is more likely to be one in which policy makers set their policies anticipating the response of the other. This conclusion could be questioned on the ground that in a system with decentralised fiscal policy making fiscal authorities, especially of smaller countries, may believe that the central bank will not react to policy measures of an individual country. However, coordination between the fiscal authorities is becoming increasingly more prominent as evidenced by the role of the Euro group. As regards the allocation of roles in terms of leader and follower the issue is more difficult. One decisive criterion is the cost and speed of changing the policy instrument. The leader is generally characterised as the player that wants to credibly commit to a specific policy course with a view to influencing the behaviour of the follower. The objective difficulty of reversing a decision can be taken to have the necessary commitment value. Against this backdrop and in line with Beetsma and Bovenberg (1998) the monetary policy would rather be the follower as it commands a comparatively fast-moving instrument. By contrast, significant changes in EMU-wide fiscal policy would have to be co-ordinated among Member States and are subject to political approval at the national level. Once the course is set it is rather difficult to change it. Assigning the role of the follower to monetary policy does not affect its capacity to pursue the objective of price stability. The commitment to price stability is actually reinforced by the possibility to counteract fiscal policy decisions that may impact on inflation.

6. Conclusions

The model presented in this paper examines in a stylised fashion the interaction between fiscal and monetary policy in the EMU. It proposes two innovations as compared to the existing literature. Firstly, it accounts for the fact that fiscal policy, while remaining a prerogative of Member States, is determined within the framework of the EU budgetary surveillance. Alongside the Council the European Commission is presented as an independent institution with different preferences concerning the budget balance. Specifically, we explore the implications of having a fiscal authority comprising the Council and the Commission, where the latter can be assumed to be fiscally more conservative. Secondly, the model allows for uncertainty in the assessment of

cyclical conditions in real time. The policy decisions are based on estimates of the output gap which, as in real life, generally turn out to be off the mark.

The formal analysis of our model supports a number of conclusions. To start with, if decisions are taken simultaneously diverging perceptions about the economy's position in the cycle give rise to policy frictions as policy makers seek to counterbalance each other's policy choices. The conflict reflects the attempt to achieve a common goal with different views about the relative position vis-à-vis the goal. If the fiscal authority perceives a negative output gap it will always try to support output, while monetary authorities will always attempt to dampen the effect of such a fiscal loosening in case it believes output lies above or at its potential level. In equilibrium, the interest rate and the government deficit can be significantly higher or lower as compared to a situation without real-time uncertainty of the output gap; the same holds for the equilibrium outcome in terms of output and inflation.

There are several ways of overcoming the policy conflict. The most obvious is to agree on a common assessment of the cycle. While such an agreement would not qualify as policy coordination *per se*, it would require a common economic forecast and a common methodology for estimating real-time output gaps. Another option is to put constraints on the policy instruments. Specifically, the effect on output and inflation ensuing from diverging views of the cyclical position is dampened if changes in the policy instruments are either costly in terms of preferences or limited by institutional barriers. A corollary for the interaction between Council and Commission is that a stronger bargaining power of the fiscally more conservative agent (in our analysis the Commission) would limit the use of the deficit. The same effect can be expected to be achieved by strengthening fiscal governance at the national level.

An alternative way to reduce the policy conflict ensuing from diverging views of the cycle is to have policies set in a sequential way. In the Stackelberg-type of interaction the leader moves first. It chooses its policy instrument knowing the follower's reaction function and assuming that follower will share the assessment of the cycle. This eliminates the policy conflict of simultaneous decision making because the leader cannot revise its choice vis-à-vis his original conjecture once the view of the world of the follower and its policy are revealed. Theoretically, even the Stackelberg interaction may give rise to policy frictions if the leader were to attach a lower weight to the output and a higher weight to the inflation objective. In that case the leader may anticipate an excessive policy reaction of the follower, if the latter can choose its policy instrument with no or very low costs.

As regards the specific allocation of roles in the Stackelberg interaction, our analysis seem to suggest that the fiscal authority is or should be the leader because it commands a 'slow-moving instrument' and hence is interested in committing to a policy course.

Our model suffers from a number of limitations. Firstly, it is static in nature. Time is modelled only implicitly. In the long run, if the game was repeated players will probably internalise the scope for agreeing on the assessment of the cycle. Nevertheless, the ECB may be reluctant to engage in co-ordination due to the 'suspicion' about the real objectives of fiscal authorities. Secondly, while highlighting some interesting elements the interaction between the Council and the Commission is comparatively simple. The actual interplay between the two institutions goes beyond a linear combination of preferences. Thirdly, we do not model expectations of economic agents separately. We take a shortcut by assuming that the central bank will behave in such a way as to guarantee that inflation is on average in line with the target and it is fully credible. Hence, economic agents can rest assured about price developments. Fourthly, we do not fully explore the implications of the stochastic nature of the measurement errors of real-time output gap estimates. The formal analysis could for instance explicitly allow for the variance of the random misperceptions. While this would formally complete the model we believe it would not alter the main findings of our work. Finally, we focus on the loss functions of the policy actors and do not explore the general welfare implications, as measured by the loss of a representative agent, of different types of interactions and different combinations of misperceptions. Some of these points will be subject of further work.

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Annex

A1. The effect of misperceptions on the Nash equilibrium

A useful way to examine the effect of misperceptions of the economic cycle on the equilibrium outcome of our model when fiscal and monetary authorities are 'playing' Nash is to compare the relative size of the effect between policy players. This can be done by putting side by side the partial derivatives of equation (10) and (13) with respect to the parameters θ_M and θ_F . The corresponding ratios are shown below:

$$(21) \quad y^N: \frac{\frac{\partial y^N}{\partial \theta_M}}{\frac{\partial y^N}{\partial \theta_F}} = \frac{\phi_2^2 \alpha \Omega_M}{\phi_1^2 \beta \Omega_F}$$

$$(22) \quad \pi^N: \frac{\frac{\partial \pi^N}{\partial \theta_M}}{\frac{\partial \pi^N}{\partial \theta_F}} = \frac{\phi_2^2 \alpha \Omega_M}{\phi_1^2 \beta \Omega_F}$$

$$(23) \quad d^N: \frac{\frac{\partial d^N}{\partial \theta_M}}{\frac{\partial d^N}{\partial \theta_F}} = \frac{-\phi_1 \phi_2^2 \Omega_M \Omega_F}{\phi_1 \Omega_F Y_M}$$

$$(24) \quad i^N: \frac{\frac{\partial i^N}{\partial \theta_M}}{\frac{\partial i^N}{\partial \theta_F}} = \frac{-\phi_2 \Omega_M Y_F}{\phi_1^2 \phi_2 \Omega_M \Omega_F}$$

Depending on the parameters of the model, the absolute value of the ratio can be bigger (smaller) than one indicating that a misperception on the side of the monetary authority has a larger impact (smaller) than the misperception of the fiscal authority.

The first point to note is that misperceptions of the same size and sign push the output gap and inflation into the same direction. Hence, if the monetary and the fiscal authority err into the same direction the effect on output will cumulate. Moreover, the relative strength of the two effects is the same. It depends on the effectiveness of monetary (ϕ_2) versus fiscal policy (ϕ_1), on the relative weights attached to the output and the inflation objective (σ_M vs. σ_F and λ_M vs. λ_F)

and to the relative weights attached to the policy instrument (β vs. α), i.e. the deficit and the interest rate. It increases with the effectiveness of monetary policy, with the weight the monetary authority attaches to the output and the inflation objective and with the weight the fiscal authority attaches to the deficit objective. Apart from the parameter σ , for which it is save to assume that it will generally be smaller for the monetary authority, and for the parameter α which can be assumed to be bigger than β there are is no clear *a priori* concerning the other elements. Only more or less well-informed conjectures are possible. For instance, the effectiveness of monetary and fiscal policy will typically depend on the size of the economy, the structure of the economy as well as on the structure and development of financial markets.

As regards the equilibrium levels of the policy instruments d and i misperceptions of the same size and sign produce opposite effects depending on whether they originate on the side of the fiscal or the monetary authority.

A2. Systematic misperceptions on the side of the fiscal authority

Against the backdrop of a systematic misperception on the side of the fiscal authority, or equivalently an over-ambitious output objective of fiscal authority, the central bank aims at aligning actual output with its own real-time estimate of potential output, which, based on its own assessment of the cycle, delivers inflation equal to expectations. From equation (1) and (2) we obtain the following relation

$$(25) \quad \theta_M = \phi_1 d - \phi_2 i + \pi^e \frac{(\omega \phi_2 + 1)}{\omega}$$

which can be solved for the level of the deficit, which, for a given interest rate, closes the output gap as estimated in real time by the monetary authority:

$$(26) \quad d = \frac{\omega \phi_2 i + \omega \theta_M - \pi^e (\omega \phi_2 + 1)}{\omega \phi_1}.$$

Formally, equation (26) is the first order condition for the case when the monetary authority minimises the loss function $L_M = (\pi)^2 = [\pi^e + \omega(\phi_1 d - \phi_2(i - \pi^e) - \theta_M)]^2$ i.e. the monetary authority focuses exclusively attention on inflation. In the presence of systematic misperceptions on the side of the fiscal authority a loss function allowing for interest rate or output smoothing

would not permit the monetary authority to achieve its inflation objective of zero inflation and economic agent could no longer be assumed to expect inflation to be zero on average.

The next step is to take into account the behaviour of the fiscal authority. This is done by substituting equation (26) into the reaction function of the fiscal authority, i.e. equation (8). Solving for the interest rate, and setting inflation expectations equal to zero²⁴, gives the ‘rule-of-thumb’ of the monetary authority that neutralises the effect on output and inflation of the systematic misperception of the cycle by the fiscal authority:

$$(27) \quad i' = \frac{\phi_1^2 \Omega_F (\theta_F^S + \theta_F^R) - Y_F \theta_M}{\phi_2 \alpha}$$

The equilibrium level of the deficit is the one where the two reaction functions intersect. Thus, plugging the new interest rate into the reaction function of the fiscal authority gives:

$$(28) \quad d' = \frac{\phi_1 \Omega_F (\theta_F^S + \theta_F^R - \theta_M)}{\alpha}$$

Since θ_F^R and θ_M are assumed to be random measurement errors with mean zero there will on average be a deficit bias.

A3. Output gap and inflation in the Stackelberg equilibrium

The equilibrium output in case of *fiscal 'leadership'* is obtained by substituting the equilibrium deficit (19) and (20) deficit in the demand and supply equation (1) and (2) respectively:

$$(29) \quad y^{S,F} = \frac{\beta^3 \phi_1^2 \Omega_F \theta_F + \phi_2^2 \Omega_M (\beta^2 \phi_1^2 \Omega_F + \alpha Y_M^2) \theta_M}{(XY_M - \beta \phi_1^2 \phi_2^2 \Omega_M \Omega_F) Y_M}$$

Equilibrium inflation is:

$$(30) \quad \pi^{S,F} = \omega \frac{\beta^3 \phi_1^2 \Omega_F \theta_F + \phi_2^2 \Omega_M (\beta^2 \phi_1^2 \Omega_F + \alpha Y_M^2) \theta_M}{(XY_M - \beta \phi_1^2 \phi_2^2 \Omega_M \Omega_F) Y_M}.$$

²⁴ This assumption is warranted by the strategy of the central bank which sets its policy instrument that yields equilibrium inflation in line with its target.

For the case of *monetary leadership* we find the following expressions for equilibrium output and inflation:

$$(31) \quad y^{S,M} = \frac{\alpha^3 \phi_2^2 \Omega_M \theta_M + \phi_1^2 \Omega_F (\alpha^2 \phi_2^2 \Omega_M + \beta Y_F^2) \theta_F}{(XY_F - \alpha \phi_1^2 \phi_2^2 \Omega_M \Omega_F) Y_F},$$

$$(32) \quad \pi^{S,M} = \omega \frac{\alpha^3 \phi_2^2 \Omega_M \theta_M + \phi_1^2 \Omega_F (\alpha^2 \phi_2^2 \Omega_M + \beta Y_F^2) \theta_F}{(XY_F - \alpha \phi_1^2 \phi_2^2 \Omega_M \Omega_F) Y_F}.$$