Partisan Fiscal Policy in a Monetary Union: Asymmetric Shocks, Delegation and Welfare*

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Abstract

This paper studies the impact of partisan national fiscal policy on the optimal central bank design of a two-country monetary union. In each country two parties with different preferences compete for office, their succession in power being formalized as zero-mean political shocks. These contrast with supply disturbances both because political shocks call for more, rather than less, central bank conservatism and insofar as cross-country shock asymmetry is actually beneficial to welfare. Further, by combining Rogoff-type 'weight-conservatism' with an inflation target it is possible to ensure that monetary delegation always benefits both parties.

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1 Introduction

This paper tries to bring together the literatures on central bank independence and on partisan political business cycles. The former has proposed institutional solutions to the inflation bias problem, such as the appointment of a conservative central banker (Rogoff, 1985), linear inflation contracts (Walsh, 1995) or inflation targets (Svensson, 1997). The latter has studied the macroeconomic fluctuations generated by the succession in office of parties with different ideologies, and thus different preferences over macroeconomic outcomes - firstly without, and subsequently with, rational expectations (see Hibbs (1977) and Alesina (1987), respectively).

Despite sharing in most cases a common theoretical framework - the standard one-period credibility model - these two strands of literature have remained fairly separated, particularly in the sense that the impact of rational partisan cycles on optimal monetary institutions has been neglected[1]. This is largely a consequence of the fact that most papers consider a setup where the central bank (CB) is the only policy authority, and hence it is either independent or controlled by the party that wins the elections, but not both[2]. In such a setup, topics that have been analysed include alternative procedures for the appointment of partisan CB board members (e.g. Lohmann, 1997) and the optimal length of the central banker's term in office (e.g. Waller and Walsh, 1996).

Introducing a second policy instrument - fiscal policy - makes it possible to study both issues (central bank independence and partisan cycles) together. This is arguably the relevant policy environment in today's Europe, where the highly independent European Central Bank (ECB) coexists with elected national governments in charge of fiscal policy. A few papers have already studied this setup. Ozkan (1998) uses a closed economy model similar to Alesina and Tabellini (1987); the impact of partisan governments on inflation, output and spending is derived, but no normative

[1] A partial exception is al-Nowaihi and Levine (1998), who show that Walsh contracts can be used to eliminate political monetary cycles. However, these cycles do not have the partisan nature which is the object of our analysis.

[2] At most, one can parameterize the degree of partisanship, and thus have intermediate cases between full independence and full partisan control (Waller and Walsh, 1996).

issues are addressed. Demertzis *et al.* (1999), in an even more stylized framework[3], analyse incentives for political parties to adjust their preferences in the light of an exogenous degree of central bank conservatism.

Unlike the abovementioned papers, our focus is on the implications of partisan fiscal policy for welfare and for the design of optimal monetary institutions. We use a stylised model of a two-country monetary union with an independent CB and national fiscal authorities (along the lines of e.g. Beetsma and Bovenberg, 1998), where partisanship lies in the different spending targets of the two political parties which in each country compete for office. Since there is uncertainty about the preferences of the fiscal policymaker, it is possible to draw a parallel with the literature on uncertain CB preferences (e.g. Beetsma and Jensen, 1998, or Muscatelli, 1998), and we explore this link[4] both as regards simplifying assumptions and in terms of the implications for CB design. However, since there are two political parties with different preferences, monetary policy delegation acquires a new dimension: it must improve welfare for both parties, not just for a representative/median voter. We discuss how alternative forms of monetary delegation - in particular, Rogoff conservatism and inflation targets - can be used to that end.

Modelling political cycles raises a considerable number of issues as regards the timing and outcomes of elections - particularly if, as it is the case, one considers an open economy setup. While retaining most of the standard assumptions used in the literature (such as election dates and victory probabilities of each party which are both exogenous), we wish to study the consequences for welfare and for CB design of the degree of symmetry of election results across countries - an issue we address by comparing the cases of perfect symmetry (i.e., the same party wins in both countries) and of cross-country independence. Though we develop our analysis under the assumption of elections taking place every period, we also check whether holding elections at longer intervals would make a difference for our conclusions.

[3] For instance, no explicit government budget constraint exists.

[4] We are not the first to relate these two forms of uncertainty. Muscatelli (1998) has already done it, although with a different focus (in a model with monetary policy alone, analysing whether it is preferable to have an independent CB with uncertain preferences or to face political uncertainty in monetary policy).

We find that, besides the usual inflation bias problem, fiscal political cycles also call for CB conservatism. Further, by combining 'weight-conservatism' (Rogoff, 1985) with an inflation target it is possible to ensure that CB independence can always benefit both parties. Finally, symmetry in election results is unambiguously welfare-inferior to independence; phrased differently, in a monetary union welfare is higher if asymmetric, rather than symmetric, political shocks prevail.

The remainder of this paper is structured as follows. Section 2 presents the model, with special attention being paid to the formalization of partisan disagreement in fiscal policy. Section 3 derives the equilibrium values of inflation, output and spending under the alternative assumptions of symmetric and independent election results. Section 4 analyses these two cases from a normative point of view; welfare, however, is also dependent on the parameters characterising CB independence, whose optimal values will not be the same under symmetric and independent results. Section 5 compares party preferences as regards CB parameters, derives the optimal values of the latter and discusses how to ensure that both parties benefit from monetary policy delegation; the welfare analysis of the preceding section is then resumed. Section 6 concludes.

2 The model

The model's basic structure is borrowed from Alesina and Tabellini (1987), generalised to a monetary union context as in Beetsma and Bovenberg (1998, 1999). We consider a monetary union composed of 2 countries, each of which retains its own fiscal authority. The two economies are symmetric and produce one and the same good: we then abstract from terms of trade externalities (unlike in Pina, 1999). Public spending is financed by distortionary taxation on firms' revenues and by seignorage, so that the government budget is always balanced. In each country there are two parties, liberals and conservatives, who disagree over the optimal ratio of public spending to output. The monetary union's central bank is independent, rather than politically controlled.

The supply function for country i ($i = 1, 2$) is

$$x_i = \pi - \pi^e - \tau_i - \varepsilon_i, \tag{1}$$

where x denotes output, π and π^e are actual and expected inflation, τ is the tax rate on firms' revenues, and ε is a productivity shock. We make the standard assumption that nominal wages are set one period in advance. Following several contributions (e.g. Alesina and Gatti, 1995; Beetsma and Bovenberg, 1998) production function elasticities are chosen so as to yield a unit coefficient on inflation in the equation above[5].

The government budget constraint in country i is

$$g_i = \tau_i + k\pi, \tag{2}$$

where g is public spending (hereafter referred to simply as spending) and $k > 0$ is real money holdings, both as a share of output[6].

The objective functions for the CB (subscript M), a liberal government in country i (subscript L), and a conservative government in country i (subscript C) are, respectively:

$$W_M = \frac{1}{2}\left[(\pi - \pi_T)^2 + \alpha_M \sum_{i=1}^{2} (x_i - x_T)^2 /2\right] \tag{3}$$

$$W_{L,i} = \frac{1}{2}\left[\pi^2 + \alpha\left(x_i - x_T\right)^2 + \beta\left(g_i - \gamma - \gamma_L\right)^2\right] \tag{4}$$

$$W_{C,i} = \frac{1}{2}\left[\pi^2 + \alpha\left(x_i - x_T\right)^2 + \beta\left(g_i - \gamma + \gamma_C\right)^2\right] \tag{5}$$

[5] As usual, equation (1) follows from the first-order condition (FOC) of a price-taking firm. Maximizing profits $P(1-\tau)Y - WL$ with technology $Y = L^{\eta}e^{-u}$ (where L is labour and u is a disturbance) yields, in logs, the FOC $y = \frac{\eta}{1-\eta}(\log\eta + p - w - \tau - \frac{u}{\eta})$. The nominal wage w equals $\widehat{w}$ (the trade union's target real wage) plus p^e (the rational expectation of p, formed one period in advance). Eliminating constant terms from the FOC, defining $\varepsilon = u/\eta$, setting $\eta = 1/2$ and adding and subtracting p_{-1}, we reach (1).

[6] More accurately, both as a share of a policy-independent measure of non-distortionary output - the output that would prevail in the absence of shocks and tax and labour market distortions. Each country is assumed to receive half of the seignorage revenues generated by the common CB: see Beetsma and Bovenberg (1999, p. 320) for a derivation of the budget constraint.

These loss functions feature the usual 'over-ambitious' output target, $x_T > 0$, giving rise to an inflation bias problem. W_M allows for both weight-conservatism, corresponding to a value of α_M different from (lower than) α, and an inflation target (π_T). We thus include in our setup two of the most widely studied institutional solutions to the time-consistency problem, based on Rogoff (1985) and Svensson (1997), respectively. The absence of spending from W_M implies no loss of generality, since g is assumed to be the fiscal instrument. There is partisan disagreement over the spending target (liberals aim at $\gamma + \gamma_L$, conservatives at $\gamma - \gamma_C$, with γ, γ_L, $\gamma_C > 0$), a feature we will shortly return to.

The timing of events is the following:

0. At a constitutional stage, an independent CB is appointed, with an optimally designed loss function (i.e., the optimal values for α_M and π_T are chosen).

1. Nominal wages are set one period in advance by national-wide trade unions aiming at preserving a certain real wage.

2. Elections take place in each country. Liberals win with an exogenous probability P, conservatives win with probability $1 - P$.

3. Supply shocks ε_i occur.

4. The CB and the elected governments, simultaneously and in a non-coordinated fashion, set their policy instruments so as to minimize their respective loss functions. The CB is assumed to directly set π, whereas governments choose g; taxes are therefore residually determined. Nash behaviour is assumed for simplicity (see Beetsma and Bovenberg, 1998, for an analysis of fiscal leadership).

Stages 2. and 3. require the specification of the joint distribution of electoral victories and productivity disturbances in the two countries forming the monetary union. As regards elections, we consider two cases: symmetric electoral outcomes, whereby the same party wins in both countries, and independent electoral outcomes, where each country's probabilities do not affect the other's. Under the former assumption, there will be two liberal governments with probability P and two conservative governments with probability $1-P$; under independence, the probabilities are P^2 for two liberals governments, $(1-P)^2$ for two conservative governments, and $2P(1-P)$ for different governments (one liberal and one conservative) in the two countries. Supply shocks are specified as *iid* with variance $V(\varepsilon_i) = \sigma^2, i = 1, 2$ and a cross-country correlation of ρ. Finally, election results and productivity disturbances are assumed to be independent of each other.

The assumption of one-period terms of office (since elections are held every period) is made for convenience and without any loss of generality. Annex 3 shows that all our results carry over to multi-period terms of office.

To close this section we return to the issue of modelling partisan disagreement. Previous studies of partisan political cycles have featured conflict over relative weights (e.g. Alesina and Gatti, 1995, where liberals attach a higher weight to output relative to inflation), over targets (e.g. Sapir and Sekkat, 1999, where conservatives aim at a lower inflation target), or both (as in the path-breaking contribution of Alesina, 1987, and in Ozkan, 1998). For the sake of analytical tractability, this paper models the spending target as the only bone of contention between parties. Furthermore, we impose one additional simplifying assumption,

$$P\gamma_L - (1 - P)\,\gamma_C = 0, \tag{6}$$

for which we offer three lines of defence. First, as will become apparent in the next section, it greatly simplifies the analysis, making it possible to reach analytical results instead of being forced to resort to numerical simulations (a problem faced by Ozkan, 1998). Second, though it may seem over-restrictive, (i) it leaves the differences between macroeconomic outcomes under liberal and conservative rule qualitatively unaffected (relative to the more complex specification of Ozkan, 1998) and (ii) it does not entail losing the possibility of distinguishing between changes in the victory probabilities (P) and changes in the degree of political polarisation (the difference between the spending targets of liberals and conservatives, i.e., $\gamma_L + \gamma_C$)[7]. Last but not least, if one regards the arrival to power of a given party as a shock to the spending

[7] For given P, political polarisation ($\gamma_L + \gamma_C$) can be changed by manipulation of γ_L and γ_C under the contraint of a constant ratio γ_L/γ_C. For a given degree of polarisation, P can also be changed, though adjustments must be made in γ_L and γ_C as well: denoting $\gamma_L + \gamma_C$ by a constant δ, one must have $\gamma_L = (1 - P)\,\delta$, $\gamma_C = P\delta$.

target of the fiscal authority, then equation (6) merely states that such a disturbance has a zero mean, while at the same time ensuring (as shown in later sections) that uncertainty about fiscal preferences does not affect the first moments, but only the second moments, of macroeconomic variables. This insulation of first moments from shocks to the tastes of the policymaker can also be found in the literature on uncertain CB preferences, as a consequence of particular modelling specifications (see Beetsma and Jensen, 1998, or Muscatelli, 1998, and constrast with Nolan and Schaling, 1996, where such specifications were still absent).

3 Equilibrium macroeconomic outcomes

In this section we derive the equilibrium values of inflation, output and spending, and compare such macroeconomic outcomes under liberal and conservative rule.

The first-order conditions (FOCs) for the CB, a liberal government in country i, and a conservative government in country i $(i = 1, 2)$ are, respectively,

$$\pi - \pi_T + \frac{1}{2}\alpha_M \mu \left(x_1 - x_T\right) + \frac{1}{2}\alpha_M \mu \left(x_2 - x_T\right) = 0, \tag{7}$$

$$-\alpha \left(x_i - x_T\right) + \beta \left(g_i - \gamma - \gamma_L\right) = 0 \tag{8}$$

and

$$-\alpha \left(x_i - x_T\right) + \beta \left(g_i - \gamma + \gamma_C\right) = 0, \tag{9}$$

where $\mu = k + 1$. Notice that inserting the budget constraint into the output supply function yields

$$x_i = \mu\pi - \pi^e - g_i - \varepsilon_i, \tag{10}$$

which is then plugged into equations (7) to (9).

The first step to solve the model is to find π^e, which requires consideration of the several possible inflation outcomes in the wake of elections. If liberals win in both countries, the three-equation system formed by (7) and versions of (8) for countries 1 and 2 yields

$$\pi = \frac{\alpha_M \mu \beta \left(\pi^e + \gamma + x_T + \gamma_L + \frac{\varepsilon_1 + \varepsilon_2}{2}\right) + (\alpha + \beta)\,\pi_T}{\alpha_M \mu^2 \beta + \alpha + \beta}. \tag{11}$$

If conservatives win in both countries, a similar process - though of course using (9) instead of (8) - gives

$$\pi = \frac{\alpha_M \mu \beta \left(\pi^e + \gamma + x_T - \gamma_C + \frac{\varepsilon_1 + \varepsilon_2}{2}\right) + (\alpha + \beta)\,\pi_T}{\alpha_M \mu^2 \beta + \alpha + \beta}. \tag{12}$$

Finally, if liberals win in one of the countries and conservatives are the victors in the other, then, from equations (7) to (9), one obtains

$$\pi = \frac{\alpha_M \mu \beta \left(\pi^e + \gamma + x_T + \frac{\gamma_L - \gamma_C}{2} + \frac{\varepsilon_1 + \varepsilon_2}{2}\right) + (\alpha + \beta)\,\pi_T}{\alpha_M \mu^2 \beta + \alpha + \beta}. \tag{13}$$

Weighing these three possible inflation outcomes by their respective probabilities under each of the two cases considered (independence *versus* symmetry in election results) yields π^e.

When electoral results are independent across countries, the probabilities mentioned above are, respectively, P^2, $(1-P)^2$ and $2P(1-P)$. In the symmetry scenario, the corresponding figures are simply P, $1-P$, and 0. Some algebra shows that expected inflation is the same in both cases:

$$\pi^e = \frac{(\alpha + \beta)\,\pi_T + \alpha_M \mu \beta\,(x_T + \gamma) + \alpha_M \mu \beta\,(P\gamma_L - (1-P)\,\gamma_C)}{\alpha + \beta + \alpha_M \mu^2 \beta - \alpha_M \mu \beta}, \tag{14}$$

which simplifies to

$$\pi^e = \frac{(\alpha + \beta)\,\pi_T + \alpha_M \mu \beta\,(x_T + \gamma)}{\alpha + \beta + \alpha_M \mu^2 \beta - \alpha_M \mu \beta} \tag{15}$$

once account is taken of equation (6). As claimed in the previous section, this simplifying assumption ensures that partisan differences in spending targets do not influence the first moments of macroeconomic variables.

To obtain actual macroeconomic outcomes, insert (15) in (10), and the latter in the FOCs. For each possible configuration of electoral results, one chooses which FOCs to use in exactly the same way as when determining π^e. The ensuing equilibria can be presented in a synthetic way by regarding partisan spending targets as zero-mean political shocks: for each country a random variable η_i is defined, taking the value γ_L when the liberal party is in power (probability P), and the value $-\gamma_C$ when conservatives win the elections (probability $1-P$). Further, we denote the average political shock $(\eta_1+\eta_2)/2$ by η_A, and country i's idiosyncratic political disturbance $\eta_i - \eta_A$ $\left(= \left(\eta_i - \eta_j\right)/2\right)$ by $\eta_{I,i}$; and likewise for the average and idiosyncratic economic (productivity) shocks ε_A and $\varepsilon_{I,i}$. Using this notation, one has, with $\phi = \alpha_M\mu^2\beta + \alpha + \beta$:

$$\pi = \frac{\alpha_M\mu\beta\left(x_T+\gamma\right)+\left(\alpha+\beta\right)\pi_T}{\phi-\alpha_M\mu\beta} + \frac{\alpha_M\mu\beta}{\phi}\eta_A + \frac{\alpha_M\mu\beta}{\phi}\varepsilon_A \tag{16}$$

$$x_i - x_T = \frac{-\beta\left(x_T+\gamma\right)+\beta\left(\mu-1\right)\pi_T}{\phi-\alpha_M\mu\beta} - \frac{\beta}{\phi}\eta_A - \frac{\beta}{\alpha+\beta}\eta_{I,i} - \frac{\beta}{\phi}\varepsilon_A - \frac{\beta}{\alpha+\beta}\varepsilon_{I,i} \tag{17}$$

$$g_i - \gamma = \frac{-\alpha\left(x_T+\gamma\right)+\alpha\left(\mu-1\right)\pi_T}{\phi-\alpha_M\mu\beta} + \frac{\phi-\alpha}{\phi}\eta_A + \frac{\beta}{\alpha+\beta}\eta_{I,i} - \frac{\alpha}{\phi}\varepsilon_A - \frac{\alpha}{\alpha+\beta}\varepsilon_{I,i} \tag{18}$$

From these equations one can infer that a liberal government gives rise to macroeconomic conditions characterized by higher inflation, lower output and higher spending than under conservative rule[8]. These findings, as well as the underlying mechanisms, are similar to Ozkan's (1998): the liberals' higher spending target leads them to set higher taxes, with contractionary consequences for output; in turn, lower output raises the central bank's incentives to generate inflation (which mitigates, but does not reverse, the adverse impact of higher taxes on output).

4 Welfare and asymmetric shocks

The object of this section is to study how welfare is affected by the degree of cross-country symmetry in election results - or, put differently, in political shocks. We compare economic and political disturbances as far as the consequences of asymmetry are concerned. Throughout we treat the parameter charactering CB weight-conservatism, α_M, as exogenous. After determining its optimal values in the following section, we will return to the welfare comparisons now undertaken.

[8]Naturally, different governments give rise to different values of η_A and $\eta_{I,i}$: for instance, when liberals win in both countries $\eta_A = \gamma_L$ and $\eta_{I,i} = 0$.

As usual in static credibility models, the expected welfare loss is a function of the first and second moments of the relevant macroeconomic variables (inflation, output and spending, in our case). Ignoring the initial 1/2 in the objective functions of section 2, we can therefore write the expected loss of the liberal party in country i as

$$E(W_{L,i}) = (E(\pi))^2 + \alpha (E(x_i - x_T))^2 + \beta (E(g_i - \gamma - \gamma_L))^2 + V(\pi) + \alpha V(x_i) + \beta V(g_i), \tag{19}$$

while the counterpart for the conservative party replaces γ_L by $-\gamma_C$. One can immediately conclude that, due to our way of modelling partisan disagreement, the two parties suffer different losses as regards the average values of macroeconomic variables (in particular, spending), but are equally affected by economic volatility. This will have important consequences for the remainder of our analysis.

We now introduce some terminological and notational conventions. The sum of the first three terms in the above equation will be referred to as the systematic (or deterministic) welfare loss, and denoted by $\overline{W}$. We will call stochastic welfare loss - $\widetilde{W}$ - to the sum of the three final terms. Subscripts L and C identify political parties, while superscripts S and I denote the cases of symmetric and independent election results, respectively. The absence of subscripts and/or superscripts in a variable or expression indicates that the latter holds in both of the cases that such lower and upper indices are supposed to distinguish.

The averages of π, $x - x_T$ and $g - \gamma$ are given by the first term on the right-hand side of equations (16) to (18), respectively, and do not depend on the degree of cross-country symmetry in election results. Hence, symmetry *versus* independence only matters for macroeconomic volatility. And since the latter affects liberals and conservatives in the same way, the welfare comparisons of this section apply to both parties.

From equations (16) to (18), the joint distribution of productivity shocks specified in section 2 and the independence of economic and political disturbances (by assumption) and of average and idiosyncratic shocks (by construction), one has:

$$V^j(\pi) = \left(\frac{\alpha_M \mu \beta}{\phi}\right)^2 V^j(\eta_A) + \left(\frac{\alpha_M \mu \beta}{\phi}\right)^2 V(\varepsilon_A) \tag{20}$$

$$V^j(x_i) = \left(\frac{\beta}{\phi}\right)^2 V^j(\eta_A) + \left(\frac{\beta}{\alpha+\beta}\right)^2 V^j(\eta_{I,i}) + \left(\frac{\beta}{\phi}\right)^2 V(\varepsilon_A) + \left(\frac{\beta}{\alpha+\beta}\right)^2 V(\varepsilon_I) \tag{21}$$

$$V^j(g_i) = \left(\frac{\phi-\alpha}{\phi}\right)^2 V^j(\eta_A) + \left(\frac{\beta}{\alpha+\beta}\right)^2 V^j(\eta_{I,i}) + \left(\frac{\alpha}{\phi}\right)^2 V(\varepsilon_A) + \left(\frac{\alpha}{\alpha+\beta}\right)^2 V(\varepsilon_I) \tag{22}$$

where $j = S, I$ and

$$\begin{aligned} V^S(\eta_A) &= P\gamma_L^2 + (1-P)\,\gamma_C^2 \\ V^S(\eta_{I,i}) &= 0 \\ V^I(\eta_A) &= P^2\gamma_L^2 + (1-P)^2\,\gamma_C^2 + 2P\,(1-P)\left(\tfrac{\gamma_L-\gamma_C}{2}\right)^2 \\ V^I(\eta_{I,i}) &= 2P\,(1-P)\left(\tfrac{\gamma_L+\gamma_C}{2}\right)^2 \\ V(\varepsilon_A) &= \tfrac{1+\rho}{2}\sigma^2 \\ V(\varepsilon_I) &= \tfrac{1-\rho}{2}\sigma^2. \end{aligned} \tag{23}$$

It is straightforward to show that inflation is less volatile under independence of electoral outcomes (since $V^I(\eta_A) < V^S(\eta_A)$): when different parties are in office, the impact of partisan spending targets on the monetary union's average output (to which the CB responds) cancels out to some extent, smoothing inflation volatility. The impact of independence *versus* symmetry on the variances of output and spending is at first sight ambiguous, since under independence the volatility of the average shock η_A is smoothed but idiosyncratic variability increases ($V^I(\eta_{I,i}) > V^S(\eta_{I,i})$): annex 1 shows that output is actually more volatile under independence, the opposite taking place as regards spending.

As for overall welfare, the difference between country i's losses under symmetry and under independence is given by

$$\widetilde{W}_i^S - \widetilde{W}_i^I = \frac{(\alpha_M \mu \beta)^2\,(\alpha\mu^2\beta + \alpha + \beta)}{(\alpha+\beta)\,(\alpha_M\mu^2\beta + \alpha + \beta)^2} V^I(\eta_{I,i}), \tag{24}$$

which is unambiguously non-negative. Therefore, one concludes that, for a given value of α_M, independence is welfare-improving (unless $\alpha_M = 0$, in which case the degree of symmetry of electoral outcomes does not make a difference for welfare). The explanation lies in the fact that, when the two monetary union members have different governments, the destabilizing impact of partisan spending on home output is higher than under similar governments, since monetary stabilization is weaker (as national political shocks cancel out to some extent). Then governments, when trading off output against spending in their FOCs - see (8) and (9) - opt for more moderation in partisan fiscal policy[9]. The upshot is that having two different governments leads to a milder partisan behaviour, and therefore alleviates the distortion which lies at the root of politically-induced macroeconomic instability.

It is interesting to compare political and economic shocks as far as the consequences of cross-country asymmetry are concerned. In line with the theory of optimum currency areas (initiated by Mundell, 1961), it holds in our model that asymmetric productivity shocks have in general worse consequences for welfare than symmetric disturbances, precisely because of the inability of monetary policy to stabilize national disturbances that cancel each other out (see annex 1 for details). When it comes to political shocks, however, the higher asymmetry that underlies independent (as opposed to symmetric) election results turns out to be welfare-improving, for the reasons explored in the previous paragraph.

5 The optimal design of the Central Bank

We now tackle the issue of monetary policy delegation - the choice of parameters α_M and π_T so as to minimize *ex-ante* welfare losses. As acknowledged by previous studies (e.g. Alesina and Gatti, 1995, or Muscatelli, 1998), the existence of partisan disagreement in society gives an extra dimension to delegation: the latter must yield

[9] From equations (17) and (18), one can check these statements. For instance, a liberal government in country i will spend less when country j's government is conservative than when it is also liberal: $\frac{\phi-\alpha}{\phi}\eta_A + \frac{\beta}{\alpha+\beta}\eta_{I,i}$ equals $\frac{\phi-\alpha}{\phi}\frac{\gamma_L-\gamma_C}{2} + \frac{\beta}{\alpha+\beta}\frac{\gamma_L+\gamma_C}{2}$ $\left(= \frac{\beta}{\alpha+\beta}\gamma_L + \frac{\alpha_M\alpha\beta\mu^2}{(\alpha+\beta)\phi}\frac{\gamma_L-\gamma_C}{2}\right)$ in the former case and $\frac{\phi-\alpha}{\phi}\gamma_L$ $\left(= \frac{\beta}{\alpha+\beta}\gamma_L + \frac{\alpha_M\alpha\beta\mu^2}{(\alpha+\beta)\phi}\gamma_L\right)$ in the latter (which is bigger).

gains to *both* political parties. Otherwise, any party which stands to lose from the chosen monetary arrangements will have no incentive to respect the independence of the CB when it comes to power[10]. The alternative to an independent CB is the direct conduct of monetary policy by the fiscal authorities; since in our model only fiscal policy has a partisan dimension[11], this alternative simply corresponds to setting $\alpha_M = \alpha$ and $\pi_T = 0$.

One can observe that while the first moments of inflation, spending and output are affected by both the weight α_M and the target π_T, the second moments only depend on α_M. Further, as noted before, parties differ as far as systematic welfare losses are concerned, but not as regards stochastic losses: partisan disagreement on the optimal monetary arrangements is therefore confined to the former welfare component. While our goal is to determine the loss-minimizing values of α_M and π_T, we take advantage of the previous observations to proceed in three steps. First, we derive the optimal weight α_M for stochastic losses alone, discussing the opposite impacts of economic and political shocks. Second, we focus on systematic losses and characterize the partisan conflict in the choice of each of the two delegation parameters (α_M and π_T) taken separately. Finally, considering overall welfare and both delegation parameters, we derive an efficient frontier of values for α_M and π_T, and show that, to ensure that delegation benefits both parties (and is thus feasible), the weight and the target must be combined, rather than used in isolation.

As shown in Section 4, the variances of inflation, output and spending can be decomposed into two parts, one due to political shocks and the other to productivity disturbances. If one minimizes $\widetilde{W}_i$ *w.r.t.* α_M considering only the terms due to the latter type of shocks, the optimum weight is $\alpha_M = \alpha$, whereas if attention is restricted to the volatility components associated to political disturbances, the minimizer turns out to be $\alpha_M = 0$ for both symmetric and independent electoral results (refer to

[10] We assume throughout that, provided both parties derive *ex-ante* gains from monetary policy delegation, central bank independence will be respected - i.e., governments will resist the temptation to override the monetary authority once nominal contracts have been signed. See Lohmann (1996) for an analysis of this assumption.

[11] This is due both to the fact that disagreement only concerns spending targets and to the assumption of spending (rather than taxes) as the fiscal instrument.

Annex 2 for details).

Therefore, the two kinds of shocks exert opposite impacts on the optimal degree of conservatism: while supply shocks are best dealt with by a representative CB ($\alpha_M = \alpha$, a well-known result), uncertainty in fiscal policy calls for maximum conservatism ($\alpha_M = 0$). This latter finding can be understood as follows. A smaller weight decreases the politically-induced variability of inflation at the cost of a more volatile output, and if there were no other factors to consider the optimal α_M would then be positive. However, the increased vulnerability of output moderates the partisan manipulation of spending - the very source of instability - and hence conservatism also makes spending less volatile. Full conservatism ($\alpha_M = 0$) is thus optimal: the knowledge that the CB will do nothing to shield output from the consequences of fiscal policy dampens the pursuit of partisan targets.

Our finding that uncertainty about the preferences of fiscal authorities calls for a more conservative CB can be related to Beetsma and Jensen's (1998) conclusion that optimal conservatism increases in the presence of uncertain CB preferences. However, their result, unlike ours, is grounded on the interaction of uncertain preferences with supply shocks. One can also draw a parallel between our work and Alesina and Gatti (1995), to the extent that in both partisan policy enhances the net advantages of CB conservatism. This latter paper, nonetheless, considers a closed economy without fiscal policy, and thus partisan policy and monetary delegation are compared rather than jointly analysed.

The optimal α_M for overall stochastic losses will lie somewhere between the optima for each kind of shocks. Annex 2 proves the following proposition.

Proposition 1 *For each degree of cross-country symmetry in election results, the value of* α_M *that minimizes stochastic welfare losses is unique and it holds that* $0 < \alpha_M < \alpha$, $\partial \alpha_M / \partial V(\varepsilon_A) > 0$, $\partial \alpha_M / \partial V(\eta_A) < 0$.

We now turn to the determination of the values of α_M and/or π_T that minimize systematic welfare losses (i.e., those associated with the first moments of macroeconomic variables). Such values are subject to partisan disagreement, but independent of the degree of symmetry in election results. Focussing on the choices of each delegation device when the other is not available, i.e., on α_M when $\pi_T = 0$, and on π_T when $\alpha_M = \alpha$, we obtain, for liberals,

$$\alpha_M = \alpha \frac{\mu - 1}{\mu} \frac{(\alpha + \beta)(x_T + \gamma) + (\alpha + \beta)\gamma_L}{(\alpha + \beta)(x_T + \gamma) - \alpha\beta(\mu - 1)^2 \gamma_L} \tag{25}$$

and

$$\pi_T = \alpha\beta \frac{(\mu - 1)(\alpha\beta\mu(\mu - 1) + \alpha + \beta)\gamma_L - (\alpha + \beta)(x_T + \gamma)}{(\alpha + \beta)\left(\alpha\beta(\mu - 1)^2 + \alpha + \beta\right)}, \tag{26}$$

whereas for conservatives one merely replaces in the expressions above γ_L by $-\gamma_C$.

Unsurprisingly, the conservative party always favours a more conservative CB - through lower values of either α_M or π_T - than the liberals. The reason lies in the circumstance that liberals have a more ambitious spending target, and therefore attach a higher importance to seignorage revenues. While the optimal CB for conservatives is unambiguously conservative (i.e., $\alpha_M < \alpha$ or $\pi_T < 0$), the optimal CB for liberals can either be conservative or anti-conservative (in the latter case, $\alpha_M > \alpha$ or $\pi_T > 0$). As a consequence, there may be cases where mutually advantageous delegation is impossible. Whenever liberals want $\pi_T > 0$, departing from the non-delegation value of $\pi_T = 0$ inevitably makes one of the parties worse off (as demonstrated in Annex 2); and a similar problem takes place if liberals would like to set $\alpha_M > \alpha$.

We have now paved the way to analyse delegation taking into account overall welfare and both parameters α_M and π_T. Our aim is to derive an efficient frontier of values for these parameters by minimizing a weighted average of both parties' welfare losses, subject to the constraints that each party is left at least as well off as without delegation (participation constraints). Formally:

$$\begin{aligned}
&\min_{\alpha_M, \pi_T} \theta E(W_{L,i}(\alpha_M, \pi_T)) + (1 - \theta) E(W_{C,i}(\alpha_M, \pi_T)) \\
&s.t. \\
&E(W_{L,i}(\alpha_M, \pi_T)) \leq E(W_{L,i}(\alpha, 0)) \\
&E(W_{C,i}(\alpha_M, \pi_T)) \leq E(W_{C,i}(\alpha, 0)),
\end{aligned} \tag{27}$$

where $0 \leq \theta \leq 1$.

Bearing in mind that expected welfare corresponds to the sum of $\overline{W}_i$ and $\widetilde{W}_i$, the latter being common to both parties and affected by α_M alone, the objective function above can be rewritten as $\theta \overline{W}_{L,i}(\alpha_M, \pi_T) + (1-\theta)\overline{W}_{C,i}(\alpha_M, \pi_T) + \widetilde{W}_i(\alpha_M)$. Some algebra shows that the FOCs of minimizing the two first terms of this expression *w.r.t.* α_M and π_T are formally identical. The FOC *w.r.t.* π_T yields

$$\pi_T = \frac{\mu\beta\left(\alpha\beta(\mu-1)^2\omega - (\alpha+\beta)(x_T+\gamma)\right)\alpha_M + \alpha\beta(\mu-1)(\alpha+\beta)(x_T+\gamma+\omega)}{(\alpha+\beta)\left(\alpha\beta(\mu-1)^2+\alpha+\beta\right)}, \tag{28}$$

with $\omega = \theta\gamma_L - (1-\theta)\gamma_C$. Inserting this expression into the FOC *w.r.t.* α_M makes the latter simplify to $d\widetilde{W}_i/d\alpha_M = 0$, the solution of which has already been characterized in Proposition 1. The ensuing value for α_M is then plugged back into equation (28) to derive the optimal inflation target. Participation constraints translate into restrictions on θ (see Proposition 2 below).

It is straightforward that the optimal combination (α_M, π_T) outperforms any of these two delegation parameters used individually[12]. Perhaps more importantly, the availability of both weight-conservatism and an inflation target always makes it possible to appoint an independent CB which benefits both parties. More formally, annex 2 establishes the following proposition.

Proposition 2 *For each degree of cross-country symmetry in election results, it is always possible to find values of θ such that π_T and α_M given by equation (28) and Proposition 1, respectively, solve problem (27). If, however, one adds either the constraint $\alpha_M = \alpha$ or the constraint $\pi_T = 0$, it may be the case that, whatever θ, the only solution to problem (27) is $(\alpha_M, \pi_T) = (\alpha, 0)$.*

The intuition behind the second part of this proposition (mutually advantageous delegation may be impossible when there is only one delegation parameter) has already been presented. As for the first part, the availability of both α_M and π_T makes

[12] Having just one delegation parameter corresponds to the previous problem under one additional constraint: $\pi_T = 0$ if we are left with α_M, or $\alpha_M = \alpha$ if π_T can be freely set.

it possible to allocate the former to the 'consensus area' of delegation ($\widetilde{W_i}$), while the latter is devoted to attaining a mutually acceptable solution in the 'conflict area' ($\overline{W_i}$). The fact that such a solution can always be found hinges on the interchangeability of α_M and π_T as regards systematic losses, and, more specifically, on the possibility of, for any value of α_M, finding a π_T such that $\overline{W}_{j,i}(\alpha_M, \pi_T) = \overline{W}_{j,i}(\alpha, 0), j = L, C$ - implying that, at the vary least, one can always emulate non-delegation as regards $\overline{W_i}$, while reaping the benefits of an optimal α_M in terms of $\widetilde{W_i}$ (see annex 2 for details).

Proposition 2 adds to the literature that discusses the relative strengths of different forms of monetary delegation. The key finding of this line of research has been the restoration of a useful role for weight-independence (Rogoff's conservative CB) - instead of, or alongside, non-state-contingent inflation targets or contracts - when shock stabilization under a representative (i.e., non-independent) CB is suboptimal (see Herrendorf and Lockwood, 1997, Beetsma and Jensen, 1998 or Pina, 1999, where more references can be found). This paper reinforces the role of weight-independence as part of the optimal delegation arrangements: not only does the optimal combination of α_M and π_T outperform any of the two delegation devices used individually, but it also ensures the political feasibility of CB independence.

We close this section by revisiting our results about the welfare consequences of different electoral assumptions in the light of the optimal CB arrangements. We had concluded that, for any given $\alpha_M > 0$, cross-country independence of election results yields higher welfare (smaller losses) than symmetry. Account must be taken, however, of the fact that the optimal value of α_M will not be the same in the two cases: the variance of the average political shock will be higher under symmetry ($V^S(\eta_A) > V^I(\eta_A)$), thus inducing a more conservative CB ($\alpha_M^S < \alpha_M^I$). Nonetheless, the advantage of independence (more asymmetry in political disturbances) still holds: if setting in the independence case a value of α_M equal to the best choice under symmetry (i.e., equal to α_M^S) is enough to ensure smaller losses, then the gain can only be increased when α_M is chosen optimally.

6 Concluding remarks

In this paper we have performed a joint analysis of partisan political cycles and central bank independence. We have modelled national fiscal policy as the locus of partisan conflict, and, noting that political uncertainty boils down to shocks to the preferences of the fiscal authority, we have adopted specifications which ensure that, like in the literature on uncertain central banker preferences, the impact of uncertainty is restricted to the second moments of macroeconomic variables, first moments being the same as if fiscal policy did not have a partisan character. This modelling strategy has made it possible to rely exclusively on analytical results, rather than numerical simulations.

Our variant of the one-period credibility model features both political and economic shocks, which are compared on two counts: consequences for the optimal degree of CB conservatism, and welfare impact of different degrees of shock asymmetry. We have concluded that, unlike productivity disturbances, political shocks call for more weight-conservatism, and cross-country asymmetry in such shocks is welfare-improving. Behind these two results lie similar mechanisms. Both conservatism and asymmetric shocks limit the stabilization role of monetary policy, which leaves output more vulnerable to disturbances; in turn, the perception of this increased vulnerability exerts a moderating influence on the partisan manipulation of government spending - the very source of political shocks.

We have also investigated the political viability of CB independence - not in the sense of addressing the incentives to override the monetary authority once inflation expectations have been formed and nominal contracts signed, but rather in terms of studying which institutional arrangements ensure that both political parties benefit from the delegation of monetary policy. Our findings reinforce previous contributions in underlining the usefulness of Rogoff-type conservatism as part of the optimal CB design: combining conservatism with an inflation target not only improves on the separate use of each of the two, but also guarantees that a delegation scheme which is in the interest of both parties can always be found.

Within the framework of political fiscal cycles and an independent CB - which we believe to be relevant in the current European context - many different model specifications are possible. We have checked that doing away with the assumption of one-period terms of office leaves all our findings unaffected. Deeper changes in the model constitute an avenue for future work: for instance, modelling opportunistic, rather than partisan, political cycles (Rogoff, 1990) may be an interesting possibility.

Annex 1

We start by comparing the variances of x and g in the independence and symmetry cases. One has

$$V^S(x_i) - V^I(x_i) = \left(\left(\frac{\beta}{\alpha_M \mu^2 \beta + \alpha + \beta}\right)^2 - \left(\frac{\beta}{\alpha + \beta}\right)^2\right) V^I(\eta_{I,i}) < 0$$

and

$$V^S(g_i) - V^I(g_i) = \left(\left(\frac{\alpha_M \mu^2 \beta + \beta}{\alpha_M \mu^2 \beta + \alpha + \beta}\right)^2 - \left(\frac{\beta}{\alpha + \beta}\right)^2\right) V^I(\eta_{I,i}) > 0,$$

confirming our claim that (provided $\alpha_M > 0$) output is more volatile under independence, and spending under symmetry.

We now consider the consequences of asymmetry in productivity shocks by studying how volatilities are affected when ρ (the cross-country correlation of such shocks) varies. It follows from equations (20) to (23) that $\partial V(\pi)/\partial\rho > 0$, $\partial V(x_i)/\partial\rho < 0$ and $\partial V(g_i)/\partial\rho < 0$ (unless $\alpha_M = 0$, in which case the three previous derivatives are zero). As for overall welfare, one has

$$\frac{\partial E(W_i)}{\partial \rho} = \frac{\partial \widetilde{W}_i}{\partial \rho} = -\frac{(\alpha_M \mu^2 \alpha \beta + (2\alpha - \alpha_M)(\alpha + \beta))\, \alpha_M \mu^2 \beta^2}{(\alpha + \beta)(\alpha_M \mu^2 \beta + \alpha + \beta)^2} \frac{\sigma^2}{2}.$$

A sufficient condition for this expression to be negative is $0 < \alpha_M < 2\alpha$, which Section 5 and Annex 2 show to hold at the optimum. Therefore, as claimed, shock asymmetry (low ρ) induces higher welfare losses[13].

Annex 2

First, we prove Proposition 1. The problem is

$$\min_{\alpha_M} \widetilde{W}_i(\alpha_M) = \frac{(\alpha_M \mu \beta)^2 + \alpha \beta^2 + \beta \alpha^2}{(\alpha_M \mu^2 \beta + \alpha + \beta)^2} V(\varepsilon_A) + \beta^2 \frac{\alpha_M^2 \mu^2 + \alpha + \beta (\alpha_M \mu^2 + 1)^2}{(\alpha_M \mu^2 \beta + \alpha + \beta)^2} V^j(\eta_A), j = I, S$$

whose FOC can be rearranged as

$$\frac{\alpha - \alpha_M}{\alpha_M} = \frac{\alpha + \beta + \alpha \beta \mu^2}{\alpha + \beta} \frac{V^j(\eta_A)}{V(\varepsilon_A)}, j = I, S.$$

[13] An application of the envelope theorem, as the optimal α_M will depend on ρ.

Since the right-hand side of this equation is positive, it holds that $0 < \alpha_M < \alpha$[14]. Further, as the left-hand side is strictly decreasing in α_M (whereas the right-hand side does not depend on α_M), uniqueness ensues, as well as $\partial\alpha_M/\partial V(\varepsilon_A) > 0$, $\partial\alpha_M/\partial V(\eta_A) < 0$.

Second, we study the monotonicity of $\overline{W}_{L,i}$ (and, similarly, of $\overline{W}_{C,i}$) when each of the delegation parameters α_M and π_T is considered separately.

When $\pi_T = 0$, some algebra shows that

$$\frac{\partial \overline{W}_{L,i}}{\partial \alpha_M} = \frac{2\mu^2\beta^2 (x_T + \gamma)\left((\alpha+\beta)(x_T+\gamma) - \alpha\beta(\mu-1)^2\gamma_L\right)}{(\alpha_M\mu^2\beta + \alpha + \beta - \alpha_M\mu\beta)^3}(\alpha_M - \overline{\alpha}_{M,L}),$$

where $\overline{\alpha}_{M,L}$ is the value of α_M given by equation (25). Then $\overline{W}_{L,i}(\alpha_M)$ decreases for $\alpha_M < \overline{\alpha}_{M,L}$, reaches a minimum at $\alpha_M = \overline{\alpha}_{M,L}$, and increases for $\alpha_M > \overline{\alpha}_{M,L}$. The loss $\overline{W}_{C,i}(\alpha_M)$ has a similar behaviour, although with a different minimizer[15]. It follows that, if $\overline{\alpha}_{M,L} > \alpha$, no value of α_M can benefit both parties relative to the no-delegation scenario ($\alpha_M = \alpha$): setting $\alpha_M > \alpha$ decreases liberals' losses at the expense of conservatives (since it is always the case that $\overline{\alpha}_{M,C} < \alpha$), the opposite taking place if $\alpha_M < \alpha$.

When $\alpha_M = \alpha$ (or, indeed, for any value of α_M), $\overline{W}_{L,i}(\pi_T)$ and $\overline{W}_{C,i}(\pi_T)$ are quadratic in π_T, with minimizers given by equation (26) and its counterpart for conservatives, respectively. From the ensuing patterns of monotonicity it is also clear that, whenever liberals would like $\pi_T > 0$, departing from $\pi_T = 0$ inevitably makes one of the parties worse off.

Finally, the proof of Proposition 2 is presented. One can show that setting

$$\pi_T = \frac{\alpha\beta\mu(x_T+\gamma) - \alpha_M\beta\mu(x_T+\gamma)}{\alpha\beta\mu(\mu-1)+\alpha+\beta}$$

makes average inflation, output and spending exactly the same as in the absence of delegation (i.e., with $\alpha_M = \alpha$ and $\pi_T = 0$)[16]. Denoting the above inflation target by $\widehat{\pi}_T$, it follows that, for any α_M, $\overline{W}_{j,i}(\alpha_M, \widehat{\pi}_T) = \overline{W}_{j,i}(\alpha, 0), j = L, C$.

[14] Although a closed form can be obtained for α_M, it is not particularly illuminating.

[15] We assume parameter configurations that ensure a positive α_M in equation (25), as well as in its conservative counterpart.

[16] This result follows from equating the first moments of inflation, output and spending (given by the first right-hand-side terms of equations (16), (17) or (18), respectively) with generic α_M and π_T to similar expressions with $\alpha_M = \alpha$ and $\pi_T = 0$, and solving for π_T.

The next step consists in comparing $\widehat{\pi}_T$ with the preferred targets of each party, given by (28) with $\theta = 1$ (for liberals) and $\theta = 0$ (for conservatives), and rearranged below for convenience:

$$\pi_{T,L} = \frac{\alpha_M \beta \mu (\mu - 1) + (\alpha + \beta)}{(\alpha + \beta)\left(\alpha\beta (\mu - 1)^2 + \alpha + \beta\right)} \alpha\beta (\mu - 1) \gamma_L + \frac{\alpha\beta (\mu - 1)(x_T + \gamma) - \alpha_M \mu \beta (x_T + \gamma)}{\alpha\beta (\mu - 1)^2 + \alpha + \beta}$$

$$\pi_{T,C} = -\frac{\alpha_M \beta \mu (\mu - 1) + (\alpha + \beta)}{(\alpha + \beta)\left(\alpha\beta (\mu - 1)^2 + \alpha + \beta\right)} \alpha\beta (\mu - 1) \gamma_C + \frac{\alpha\beta (\mu - 1)(x_T + \gamma) - \alpha_M \mu \beta (x_T + \gamma)}{\alpha\beta (\mu - 1)^2 + \alpha + \beta}$$

It is clear that $\pi_{T,C} < \pi_{T,L}$, and it also holds that $\pi_{T,C} < \widehat{\pi}_T$, whereas both $\pi_{T,L} < \widehat{\pi}_T$ and $\pi_{T,L} \geq \widehat{\pi}_T$ are possible.

Consider first the case of $\pi_{T,C} < \pi_{T,L} < \widehat{\pi}_T$. Bearing in mind our previous study of the monotonicity of $\overline{W}_{L,i}(\pi_T)$ and $\overline{W}_{C,i}(\pi_T)$, one sees that any $\theta \in [0, 1]$ - i.e., using equation (28), any $\pi_T \in [\pi_{T,C}, \pi_{T,L}]$ - is better for conservatives than the equivalent of no delegation ($\widehat{\pi}_T$). As for liberals, there also exists a range of θ values which make delegation advantageous: such range *contains* $[\theta_L, 1]$, where θ_L is the value of θ which, once inserted in equation (28), yields π_T such that $|\pi_T - \pi_{T,L}| = |\pi_{T,L} - \widehat{\pi}_T|$[17]. Therefore, an example of a mutually advantageous θ is simply $\theta = 1$.

Consider now $\pi_{T,C} < \widehat{\pi}_T \leq \pi_{T,L}$. In this case, departing from the equivalent of no delegation ($\widehat{\pi}_T$) always increases the systematic losses of (at least) one of the parties. Then, a mutually acceptable solution is the value of θ, which, once inserted in equation (28), yields $\pi_T = \widehat{\pi}_T$[18]. This establishes the first part of Proposition 2.

As for the second part, it simply follows from our analysis of the monotonicity of $\overline{W}_i$ when only one of the delegation parameters α_M and π_T is available. In the case of $\pi_T = 0$, the fact that α_M also affects $\widetilde{W}_i$ is not enough to ensure that a mutually advantageous $\alpha_M \neq \alpha$ always exists: if $\overline{\alpha}_{M,L} > \alpha$ and $V(\eta_A)$ is small, what liberals gain from $\alpha_M < \alpha$ in terms of $\widetilde{W}_i$ may not compensate what they lose in terms of $\overline{W}_i$.

[17] Because systematic losses are quadratic, π_T should not be 'too far away' from $\pi_{T,L}$: more specifically, it should not be further away than $\widehat{\pi}_T$ is. We have stressed the word 'contains' because liberals may accept delegation even if $\theta < \theta_L$, provided that the gains from the optimal α_M as regards $\widetilde{W}_i$ outweigh the losses from the 'too conservative' inflation target.

[18] Again, values of θ in the vicinity of this one will also ensure mutually advantageous delegation, provided that gains in $\widetilde{W}_i$ outweigh losses in $\overline{W}_i$.

Annex 3

Here we show that our main findings carry over to a situation of multi-period governments. Consider that the two countries simultaneously hold elections every n periods[19]: therefore, there is a proportion $1/n$ of periods with elections, and a proportion $(n-1)/n$ of periods without. In the latter, the preferences of the fiscal authority are known with certainty at the moment of setting nominal wages, which allows us to bypass equations (11) to (13) when solving the model. In a non-election period, we obtain (again, with $\phi = \alpha_M \mu^2 \beta + \alpha + \beta$):

$$\pi = \frac{\alpha_M \mu \beta \left(x_T + \gamma\right) + \left(\alpha + \beta\right) \pi_T}{\phi - \alpha_M \mu \beta} + \frac{\alpha_M \mu \beta}{\phi - \alpha_M \mu \beta} \eta_A + \frac{\alpha_M \mu \beta}{\phi} \varepsilon_A$$

$$x_i - x_T = \frac{-\beta \left(x_T + \gamma\right) + \beta \left(\mu - 1\right) \pi_T}{\phi - \alpha_M \mu \beta} - \frac{\beta}{\phi - \alpha_M \mu \beta} \eta_A - \frac{\beta}{\alpha + \beta} \eta_{I,i} - \frac{\beta}{\phi} \varepsilon_A - \frac{\beta}{\alpha + \beta} \varepsilon_{I,i}$$

$$g_i - \gamma = \frac{-\alpha \left(x_T + \gamma\right) + \alpha \left(\mu - 1\right) \pi_T}{\phi - \alpha_M \mu \beta} + \frac{\phi - \alpha - \alpha_M \mu \beta}{\phi - \alpha_M \mu \beta} \eta_A + \frac{\beta}{\alpha + \beta} \eta_{I,i} - \frac{\alpha}{\phi} \varepsilon_A - \frac{\alpha}{\alpha + \beta} \varepsilon_{I,i}$$

One observes that, while averages are the same as in an election period, the response to political shocks[20] is now different, giving rise to the following expressions for variances (superscript NE denotes a non-election period, shock variances are the same as in equation (23), and $j = I, S$):

$$V^{j,NE}(\pi) = \left(\frac{\alpha_M \mu \beta}{\phi - \alpha_M \mu \beta}\right)^2 V^j(\eta_A) + \left(\frac{\alpha_M \mu \beta}{\phi}\right)^2 V(\varepsilon_A)$$

$$V^{j,NE}(x_i) = \left(\frac{\beta}{\phi - \alpha_M \mu \beta}\right)^2 V^j(\eta_A) + \left(\frac{\beta}{\alpha + \beta}\right)^2 V^j(\eta_{I,i}) + \left(\frac{\beta}{\phi}\right)^2 V(\varepsilon_A) + \left(\frac{\beta}{\alpha + \beta}\right)^2 V(\varepsilon_I)$$

$$V^{j,NE}(g_i) = \left(\frac{\phi - \alpha - \alpha_M \mu \beta}{\phi - \alpha_M \mu \beta}\right)^2 V^j(\eta_A) + \left(\frac{\beta}{\alpha + \beta}\right)^2 V^j(\eta_{I,i}) + \left(\frac{\alpha}{\phi}\right)^2 V(\varepsilon_A) + \left(\frac{\alpha}{\alpha + \beta}\right)^2 V(\varepsilon_I)$$

Some algebra shows that

[19] See Sapir and Sekkat (1999) for an analysis of the cross-country synchronization of election dates (simultaneous *versus* staggered elections).

[20] Even without electoral uncertainty, there is still political variability, since parties alternate in power according to their probabilities of electoral success.

$$\widetilde{W}_i^{S,NE} - \widetilde{W}_i^{I,NE} = \frac{(\alpha_M \mu\beta)^2 \left(\alpha\beta(\mu-1)^2 + \alpha + \beta\right)}{(\alpha+\beta)(\alpha_M \mu^2 \beta + \alpha + \beta - \alpha_M \mu\beta)^2} V(\eta_{I,i}) \geq 0,$$

which confirms the advantage of asymmetry in political shocks.

Proposition 1 continues to hold. The problem is now

$$\min_{\alpha_M} \widetilde{W}_i^j = \frac{1}{n}\widetilde{W}_i^{j,E} + \frac{n-1}{n}\widetilde{W}_i^{j,NE}, j = I, S$$

where superscript E refers to election periods ($\widetilde{W}_i^{j,E}$ thus corresponding to the expression at the beginning of Annex 2). The ensuing FOC can be presented as

$$\frac{\alpha - \alpha_M}{\alpha_M}\left[\frac{1}{n}\frac{\alpha+\beta+\alpha\beta\mu^2}{\alpha+\beta} + \frac{n-1}{n}\frac{\alpha+\beta+\alpha\beta(\mu-1)^2}{\alpha+\beta}\left(\frac{\phi}{\phi - \alpha_M\mu\beta}\right)^3\right]^{-1} = \frac{V^j(\eta_A)}{V(\varepsilon_A)},$$

where the expression within square brackets is positive (which ensures $0 < \alpha_M < \alpha$) and increasing in α_M. Thus the whole of the left-hand side is decreasing in α_M (at least in the relevant interval $0 < \alpha_M < \alpha$), guaranteeing uniqueness, $\partial\alpha_M/\partial V(\varepsilon_A) > 0$ and $\partial\alpha_M/\partial V(\eta_A) < 0$.

Proposition 2 also remains valid, since all our analysis of systematic welfare losses and optimal inflation targets carries over without any changes to non-election periods (the reason being that $\overline{W}_i^E = \overline{W}_i^{NE}$). The only adaptation to make is, naturally, that the optimal weight α_M is now implicitly defined by the FOC above rather than by that at the beginning of Annex 2.

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