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DOUBLE-EDGED INCENTIVES: INSTITUTIONS AND POLICY COORDINATION

Torsten Persson and Guido Tabellini

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Centre for Economic Policy Research
25–28 Old Burlington Street
London W1X 1LB
Tel: (44 71) 734 9110

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ABSTRACT

Double-Edged Incentives: Institutions and Policy Coordination*

This paper illustrates some of the most important insights of the literature on international fiscal and monetary policy coordination. It notes that the analysis of international policy interactions is enriched by taking the incentives in the domestic policy process into account. These incentives can either be tied to credibility issues or to political institutions. The paper also focuses on the role of institutions that can enforce and support international cooperation. We discuss alternative task assignments between member countries and the central policy-making level, and alternative processes for collective decision making.

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Torsten Persson
Institute for International
Economic Studies
University of Stockholm
S–106 91 Stockholm
SWEDEN
Tel: (46 8) 163 066

Guido Tabellini
IGIER
Abbazia di Mirasole
I–20090 Opera (Milano)
ITALY
Tel: (39 2) 5760 6563

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NON-TECHNICAL SUMMARY

In this paper, we take stock of the literature on both fiscal and monetary policy in the last decade, and make some suggestions on how it may proceed in the future. A large part of the literature on international macroeconomics deals with the international transmission of national macroeconomic policies. Domestic policy-makers that behave individualistically, in the sense that they do not take the international spillovers of their fiscal and monetary policies into account, may find themselves in equilibria that entail collective irrationality and inefficiency. Rational governments typically exploit these international spillovers for their own benefit or for the benefit of their citizens. This game-theoretic insight has formed the basis for a large literature on 'international policy coordination' or 'cooperation', i.e. a policy that abstains from individualistic behaviour, so as not to harm foreign citizens. The focus of the paper is on incentives and enforcement of cooperative outcomes, rather than on the details of the policy spillovers between different economies.

We illustrate some of the most important insights of the literature, using a few core two-country models, which we extend in various directions. The paper is organized in two related but self-contained parts. We begin with fiscal policy, where we use simple general equilibrium models, and consider two types of externalities. First, an externality related to international redistribution via the intertemporal terms of trade. Second, a fiscal externality in capital taxation, when capital is internationally mobile. In the second part, we discuss monetary policy. We use a 'generic' two-country macroeconomic model, which focuses on the externalities that arise from static terms of trade effects. Therefore, we do not deal with the extended literature that deals with the transmission of macroeconomic policy in the world economy.

There are various reasons for studying fiscal policy and monetary policy separately. First, there are fairly complete work-horse general equilibrium models for fiscal policy, whereas there are no such models available for monetary policy. Second, the real world institutions – domestic and international – governing policy formation are very different in the two areas. With regard to the domestic institutions, fiscal policy is the result of a collective decision made by politically motivated representatives. Monetary policy instead is typically implemented by a single-minded independent agency. With regard to international institutions, monetary policy coordination generally appears in the form of exchange rate agreements. On the fiscal policy side, there are almost no examples of institutions designed to enforce tight

international cooperation. There is one exception: a federal state can create a structure to perform this task for the different regions.

Two main themes emerge from the analysis. First, the analysis of international policy interactions is enriched by taking the incentives in the domestic policy process into account. These domestic incentives can either be tied to credibility issues or to political institutions. Generally, we identify a two-way interaction: the incentives in the domestic policy process spill over into the international arena, and the international strategic considerations partly influence domestic policy-making.

The second central theme is our focus on the role of institutions that can enforce and support international cooperation. Here we borrow from the recent microeconomic literature on principal agent relations and contracts. This approach is particularly fruitful in understanding the role of delegation in the policy process. In domestic policy formation, voters delegate the choice of fiscal policy to the legislature. The legislature in turn often delegates the choice of monetary policy to the central bank. Such domestic delegation can go a long way towards reducing the inefficiencies of non-cooperative policy-making, both in fiscal and monetary policy. Motivated largely by the current process of European integration, the arrangements we study range from ad hoc ones to substantial economic and political integration. We discuss alternative task assignments between member countries and the central policy-making level, and alternative processes for collective decision making. The design of international institutions shapes the policy outcomes and the distribution of the gains from coordination, particularly if countries are asymmetric.

DOUBLE-EDGED INCENTIVES: INSTITUTIONS AND POLICY COORDINATION*

Torsten Persson† and Guido Tabellini‡

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1. General introduction

A large portion of international macroeconomics deals with the international transmission of national macroeconomic policies. Such spilloves naturally raise the possibility of inefficiencies: national policymakers who set their fiscal and monetary policies to maximize a domestic objective, but ignoring the externalities they impose on other countries, may find themselves in equilibria that entail collective irrationality. This well-known insight from simple game theory has formed the basis for a large literature on "international policy coordination" or "cooperation". The literature was started by the insightful work of Hamada in the mid 1970s (Hamada (1974, 1976, 1979)). For the most part, he dealt with fixed exchange rate regimes, following the monetary approach to the balance of payments in the pre-rational expectations tradition. Nevertheless, he used modern game theory to illustrate how decentralized non-cooperative policymaking would result in suboptimal outcomes. When Cooper (1985) published his survey of strategic interdependence and policy coordination, the next wave of work was only beginning to form. This wave grew progressively stronger in the eighties; it reflected methodological advances–like the rational expectations revolution and

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†IIES, Stockholm University

‡Bocconi University, and IGIER, Milano

the time consistency debate–as well as real world events–like the two oil shocks and the transition to floating exchange rates. Canzoneri and Henderson, who were themselves key contributors to this second wave of research, present many of the central arguments in their recent book (Canzoneri and Henderson (1991)).

In this chapter, we attempt to take stock of the literature in the last ten years and make some suggestions on how it may proceed in the future. We illustrate some of the most important insights of this literature, by help of a few core two-country models, which we extend in various directions. We start with fiscal policy. Our illustrations revolve around two types of externalities: one tied to international redistribution via the intertemporal terms of trade, the other to a fiscal externality in capital taxation, when capital is mobile between countries. Our fiscal-policy models are simple but fully specified two-period general equilibrium models with articulated micro foundations. In monetary policy we instead consider externalities arising from static terms of trade effects. The analysis here does not rest on explicit micro foundations, but on quadratic payoff functions and linear and static macroeconomic models.

Two main themes emerge from the analysis. First, that the analysis of international policy interactions is enriched by taking the incentives in the domestic policy process into account. These domestic incentives can either be tied to credibility issues or to political institutions. At a general level, we identify a two-way interaction: the incentives in the domestic policy process spill over into the international arena, and the international strategic considerations partly shape domestic policy. This two-way interaction has been stressed in the recent, unformalized, research in political science, triggered off by an influential article by Putnam (1988). In his critical discussion of the concrete attempts to coordinate macroeconomic policy in the 1980s, Feldstein (1988) raises similar issues.

The second central theme is our focus on the institutions that can enforce cooperation. Here we borrow from the recent microeconomic literature on principal-agent relations and contracts. This approach is particularly fruitful in understanding the role of delegation in the policy process. In domestic policy formation, voters delegate the choice of fiscal policy to the legislature. The legislature in turn often delegates the choice of monetary policy to the central bank. Such domestic delegation can go a long way towards reducing the inefficiencies of non-cooperative policymaking, both in fiscal policy and in monetary policy. A hierarchical principal-agent approach can also be helpful in analyzing international arrangements, both for fiscal and monetary policy. Motivated largely by the current process of European integration, the arrangements we study range from *ad hoc* arrangements to substantial economic and political integration. We discuss alternative task assignments between member countries and the central policy-making level, and alternative processes for collective decision making. The design of international institutions shapes the policy outcomes and the distribution of the gains from coordination, particularly if countries are asymmetric.

The chapter is organized in two related but self-contained parts. Part A deals

with fiscal policy, part B with monetary policy. A separate introduction to each part gives a more detailed road map to what we do. There are several reasons for studying these two policy areas separately. One is analytical convenience. We now have fairly complete, yet simple, work-horse general equilibrium models for fiscal policy, whereas no such simple model is available for monetary policy (a recent promising framework, however, is provided by Obstfeld and Rogoff (1994)). Hence, we follow most of the existing tradition of studying fiscal and monetary policy separately. A second reason for separating the analysis of fiscal and monetary policy is that the real world institutions—domestic and international—governing policy formation are very different in the two areas. With regard to domestic institutions, fiscal policy choices result from collective decisions of politically motivated representatives; monetary policy on the other hand is typically implemented by a singleminded independent agency. With regard to international institutions, monetary policy cooperation has generally taken the form of exchange rate agreements. For fiscal policy instead there are few examples of institutions enforcing tight international cooperation. There is one exception: federal structures can be thought of as performing this task for different regions within a single country.

Space constraints and a desire to keep our analysis simple and self contained prevent us from doing full justice to all branches of the policy coordination literature. Our focus is really on incentives and enforcement, rather than on details of the policy spillovers between different economies. Therefore, we do not cover at all the large, theoretical and empirical, literature that deals with the transmission of macroeconomic policy in the world economy. In particular, we do not cover the attempts to quantify the gains (or losses) from policy coordination on the basis of simulations with large scale econometric models. This kind of work is presented, for instance, in Bryant et al. (1988). In earlier work, Oudiz and Sachs (1984) had found that the gains from policy coordinations were likely to be small. Neither do we cover the work on the dynamics of policy coordination like the dynamic-game simulation approach to policy coordination that stemmed from the contributions in Buiter and Marston (1985). An up-to-date survey of the subsequent literature is found in Currie and Levine (1993).

When dealing with enforcement of cooperative outcomes, our focus is on institutional mechanisms. A branch of the literature, which we do not cover here, instead suggests reputational mechanisms, which rely on wellknown insights from the theory of repeated games. A comprehensive treatment of this approach to reputation in policy coordination can be found in the recent book by Canzoneri and Henderson (1991). Even though we stress the difference between institutional and reputational mechanisms, the distinction may not be all that sharp, after all. Specifically, there is a literature that emphasizes how certain institutions may strengthen the scope for reputational enforcement by, for instance, facilitating monitoring or coordinating punishments of players that deviate from cooperative behavior (see Schotter (1981)). This is the approach taken by Robert Staiger

when discussing the role of international institutions in his chapter on trade policy institutions in this volume.

An interesting branch of the literature studies policy coordination in the context of policymaker uncertainty about policy goals, model parameters, and so on. We only touch tangentially on these issues, which are well summarized in the recent book by Gosh and Masson (1994). By focusing on two-country models only, we are unable to deal with some interesting issues related to multilateralism, such as how European monetary integration would affect US-Europe interactions; an example of a study of these issues is Cohen and Wyplosz (1989). Finally, we cover neither the interaction between monetary and fiscal policy in an international strategic context (for instance, Jensen (1992), Sibert (1991), van der Ploeg (1989)), nor the recent interesting work on the politics of monetary policy cooperation (Eichengreen and Frieden (1994).

A. FISCAL POLICY

How are policies transmitted from one country to the next? This is the first question addressed by any paper on international policy coordination. One purpose of this part is to illustrate the international transmission of fiscal policies, using a simple general equilibrium model with microfoundations. We focus on two transmission mechanisms. One is changes in the terms of trade (i.e. in some world market prices). The other is changes in the net of tax return available to internationally mobile capital in different localities.[1]

Rational governments typically exploit these international spillovers for their own benefit, or for the benefit of their own citizens. Cooperation means abstaining from this individualistic behavior, so as not to harm foreign citizens. A second purpose of this part is to illustrate the prospective gains from international cooperation. When countries cooperate with each other, welfare maximizing governments set fiscal policy according to some versions of a Ramsey Rule of optimal taxation. Without cooperation, on the other hand, both countries depart from Ramsey rule in order to exploit the international spillovers for their own benefit. Thus, they both attempt to turn the terms of trade in their favor, or they both attempt to attract foreign capital. However, these attempts are self-defeating: both countries end up in an inferior equilibrium, in which policies do not obey Ramsey Rule. This is why international cooperation may be welfare improving.

An important step in this argument, though, is to postulate that governments indeed maximize social welfare. If they don't, for political or other reasons, policies do not obey Ramsey Rule anyway, and we are in the world of the third best. The question then is whether the absence of cooperation exacerbates or weakens the other domestic policy distortions. One reason why it may go the wrong way has been suggested by Vaubel (1985). If governments have a private agenda (be it re-election or a partisan ideological platform), then it may be better to have them compete rather than collude. That is, cooperation may enable the domestic and foreign incumbent to collude at the voters' expense. A second idea, due to Rogoff (1985), is that cooperation may harm credibility because it may weaken the government's resolve to fight inflation. This idea is discussed at length in part B, with regard to monetary policy, but it has an analogue in tax policy. Tax competition may be desirable, because it reduces the government temptation to confiscate wealth or to over-tax capital: if governments do not cooperate internationally, overtaxed investors can flee the country.

[1]There is a large literature on the international transmission of fiscal policy through terms of trade effects or tax competition. The books by Frenkel and Razin (1987) and by Frenkel, Razin and Sadka (1991) contain a complete theoretical discussion of both issues respectivly. The challenges *posed* by the international mobility of tax bases have also been extensively studied at a more applied level and with more institutional detail–see for instance the contributions collected in Giovannini, Hubbard and Slemrod (1993) and, with reference to European integration, Keen (1993).

The final general question adressed in the literature is how to enforce cooperation, given that it is not a best response. There are two ways to answer this question. One, stressed in much of the literature on monetary policy coordination, is "Reputation"–for references see part B. The other, to which we devote more attention, is through institution design. Policymakers do not operate in a vacuum. Their incentives are at least partly governed by domestic and international institutions. What features of domestic institutions are more likely to encourage cooperative behavior? How is conflict resolved within international institutions, when countries differ or their interests diverge? The last two sections of this part discuss some recent attempt to answer these questions, borrowing from the work of political scientists (Putnam (1988)) and from some recent literature on fiscal federalism.

2. Terms of trade effects

The purpose of this section is to illustrate a typical externality in fiscal policy, namely changes in the *terms of trade*. When countries are not atomistic relative to the rest of the world, changes in their government spending or distorting taxes affect world market prices, and thus have welfare effects abroad. This creates a motive for international policy coordination. A coordinated policy internalizes the welfare effects of the domestic policy on the rest of the world.

In this section we focus on intertemporal terms of trade effects. Larger government surpluses increase the world real interest rate via distorting taxation; the welfare effect is positive on net creditors and negative on net debtors. Thus, net creditor countries have an incentive to expand budget surpluses beyond what is dictated by their domestic objectives, to exploit the terms of trade effect; the opposite is true for net debtor countries. Naturally, for the-world as a whole the welfare effects of changes in the terms of trade wash out: what one country gains, the other looses. Hence policy coordination calls for neglecting the terms of trade effects and paying attention only to the internal objectives.

In models with more than one commodity, fiscal policy also changes the relative price of exportables versus importables. In this case too, policy coordination amounts to neglecting (i.e. abstaining from exploiting) the terms of trade effects. In fact, our discussion of international spillovers of monetary policy in part B will largely revolve around such atemporal terms of trade effects.

The analysis of policy induced terms of trade effects dates back at least to Nurkse's (1945) study of competitive depreciations. Johnson's (1965) seminal contribution on trade wars was probably the first to study the strategic implications of a conflict over the terms of trade.

2.1. The model

The world is made up of two countries, each inhabited by a representative consumer. There are two periods, and one (traded) commodity. Public consumption, g, is exogenous and only takes place in the second period. Consider the home country first. Consumer preferences are defined over private consumption, c, and leisure, x :

$$u = U(c_1) + c_2 + V(x_1) + V(x_2), \tag{2.1}$$

where U and V are well behaved concave utility functions. Output is non-storable and is produced with only one input, labor, denoted l. The real wage is unity, and the government can only tax labor income. Hence we can write the consumer budget constraints in periods 1 and 2 respectively as:

$$\begin{aligned} l_1\,(1-\tau_1) &\geq c_1 + qa \\ l_1\,(1-\tau_1) + a &\geq c_2, \end{aligned} \tag{2.2}$$

where τ is the tax rate on labor income, and a denotes the assets (or liabilities if negative) acquired by the consumer in the first period, at the world market price q. Thus, a denotes a claim to one unit of period two output, and q is the price of future goods, the inverse of the (gross) world real interest rate.

In line with the assumption that government spending takes place in period 2 only, we can write the government budget constraints in the two periods as:

$$\begin{aligned} \tau_1 l_1 &\geq q\,b \\ \tau_2 l_2 + b &\geq g\ , \end{aligned} \tag{2.3}$$

where a positive value of b denotes the assets accumulated by the public sector, whereas a negative value denotes public debt. Implicitly, it is assumed that b and a are perfect substitutes, and thus have the same world price q.

Together, these budget constraints imply a resource constraint for the country as a whole: the present discounted value of net exports must sum to zero:

$$z_1 + q\ z_2 = 0 \tag{2.4}$$

where net exports are $z_1 = l_1 - c_1$ and $z_2 = l_2 - c_2 - g$ in periods 1 and 2 respectively. The foreign country is identical in all these respects. Foreign country variables are denoted with a "*" .

For intertemporal terms of trade effects to play a role, the two countries must have a net external position different from zero. Therefore we assume that labor is more productive in period 1 than in period 2 in the home country, while the opposite is true in the foreign country. Specifically, the home consumer can split its effective time endowments between leisure and labor in the two periods according to the following constraints :

$$\begin{aligned} 1 + e &\geq x_1 + l_1 \\ 1 - e &\geq x_2 + l_2 \end{aligned} \tag{2.5}$$

where $e > 0$ is a measure of the higher period-1 productivity of labor (or equivalently of the more abundant effective time endowment). The foreign consumer faces the same constraints, except that e enters with the opposite sign in both expressions. Under this assumption, the home country is a net external creditor, and the foreign country a net debtor.

The equilibrium condition in period 1 output markets (or equivalently in the world financial markets) closes the model:

$$z_1 + z_1^* = 0 \ . \tag{2.6}$$

Going through the private optimality conditions, it is easy to show that first period net exports in the home country can be written as a function $z_1 = Z(q, b)$, decreasing in both arguments. Intuitively, larger public assets (a higher value of b) require a higher labor tax rate in period 1 (see the government budget constraint), and thus smaller labor and output supplies in period 1. And a higher market price q of future goods (a lower interest rate) reduces net exports for three reinforcing reasons: (i) it increases consumption of the cheaper period 1 good; (ii) it discourages period 1 labor supply via an intertemporal substitution effect; (iii) it forces the government to increase the labor income tax, so as to buy the same amount b of public assets, and this further discourages period 1 labor supply. Exactly the same arguments apply to the foreign country. [2]

The equilibrium condition 2.6 thus defines the equilibrium market price as a function of public assets in both countries, $q = Q(b, b^*)$. Applying the implicit function theorem to 2.6, it is easy to show that the function Q is decreasing in both arguments: a greater accumulation of public assets in either country (a larger budget surplus) brings about a smaller equilibrium value of q, and thus a higher world real interest rate.

It may seem counter intuitive that budget surpluses raise world real interest rates. In this model the budget effect operates entirely via distorting taxes and the supply side of the economy. A larger period-1 budget surplus corresponds to a higher labor income tax which reduces period 1 labor supply in the country where it originates, and thus creates a world wide excess demand for period 1 goods. [3] To restore equilibrium, an increase in the real interest rate is needed. Naturally, this result is not general, and in other models the link between budget surpluses and the real interest rate would be reversed. What is important is that unilateral changes in fiscal policy generally affect the world real interest rate, and that this creates a motive for international policy coordination.

[2] Because of the linearity of period 2 consumption in the utility function, all income effects are absorbed by c_2. Points (i) and (ii) in the text thus reflect only the substitution effects induced by a change in q.

[3] Remember that all income effects here are absorbed by c_2.

2.2. Coordinated versus non-coordinated policies

We now turn to the welfare effects of alternative economic policies. There is one independent policy instruments in each country in the first period. We take it to be b.[4] It is convenient to work with the consumer indirect utility function, defined over the relative price q and the policy variable:

$$u = J(b,\ g, q)\ . \tag{2.7}$$

This function thus summarizes all the welfare effects of the domestic economic policies and of world prices on the home consumer. A similar function is defined for the foreign consumer.

In the absence of international coordination, a benevolent home government sets economic policy to maximize 2.7, taking foreign policy as given and realizing that the world price obeys the equilibrium function $q = Q(b,\ b^*)$. The foreign government behaves symmetrically. A policy equilibrium without international coordination is thus a Nash equilibrium between the two governments.

Letting a subscript denote a partial derivative, we can write the reaction function of the home government in period 1 as:

$$J_b + J_q Q_b = 0 \tag{2.8}$$

A similar expression holds for the foreign country. The first term on the left hand side captures the domestic effects of a larger government surplus. Since g is held constant, this term reflects tax smoothing considerations: when $J_b = 0$, the policy satisfies the intertemporal Ramsey rule of optimal taxation. Moreover, by the envelope theorem, $J_q = z_2$. Hence 2.8 can be rewritten as:

$$J_b = -z_2 Q_b. \tag{2.9}$$

We know from the previous discussion that $Q_b < 0$. Equation 2.9 thus says that, in a Nash equilibrium, the home country deviates from Ramsey rule by running a larger government surplus ($J_b < 0$) if it is a net creditor (if $z_2 < 0$). Moreover, the deviation from Ramsey rule is larger when the net foreign position is larger and the interest rate is more sensitive to domestic policies. A similar argument holds for the foreign country. As illustrated by 2.9, the reason for this behavior is the incentive to exploit the intertemporal terms of trade effects of fiscal policies.

[4]Public consumption is given, so there is nothing to choose in period 2. In period one, the government budget constraint and the consumer first-order conditions define a one to one mapping between b and τ_1. Despite this equivalence, the choice of the policy instruments here could make a difference The reason is that, as shown below, in the absence of policy coordination the two governments behave as Nash players. If the slope of their reaction functions is affected by which instrument is set, then the choice of instruments makes a difference, like in Bertrand versus Cournot equilibria in oligopoly.

Under our assumptions in equation 2.5, the home country is a net creditor while the foreign country is a net debtor. Thus the home government has a bias in favor of large budget surpluses, while the opposite is true abroad. These two biases tend to offset each other, so that in the Nash equilibrium the real interest rate is not very different from what it would be if both countries abstained from exploiting the terms of trade. It is therefore the countries may gain by coordinating their policies.

In fact, policy coordination implies exactly that: to abstain from exploiting the terms of-trade effects and to obey Ramsey rule. To show it, let us define policy coordination as a cooperative equilibrium, namely a regime in which the two governments set their policies to maximize worldwide welfare, defined as the sum of domestic and foreign consumers indirect utilities. The corresponding first-order condition for the home government is:

$$J_b + (J_q + J_q^*)Q_b = 0 \ . \tag{2.10}$$

A similar condition holds for foreign policy. By the envelope theorem, $J_q + J_q^* = z_2 + z_2^* = 0$. Hence equation 2.10 reduces to $J_b = 0$, the Ramsey rule.

As argued above, the equilibrium interest rates in the Nash and in the cooperative equilibrium do not differ much, because the Nash actions of the two governments offset each other. Non-cooperative policymaking thus distorts each country's tax policy to no avail. Not surprisingly, policy cooperation leaves both countries better off. Because cooperation is not a Nash equilibrium, however, both countries have an incentive to unilaterally deviate to their Nash strategies. How, then, can policy coordination be sustained? The answer can take one of two forms. Policy coordination can be sustained either by long term relationships between countries that create "reputational" incentives, or by institutions that enforce policy commitments. In this chapter, we mainly address the second possibility and in this fiscal policy part it is addressed in sections 5 and 6.

We close the subsection with two remarks. One concerns the set of policy instruments. We have followed the literature in taking it to be exogenously determined. This is unsatisfactory for two reasons. First, in this model a more efficient instrument for affecting the terms of trade is a capital export tax (for the creditor country), or an import tax (for the debtor country).[5] Second, if policy coordination is not self-enforcing, then any international agreement concerning specific policy instruments can be side-stepped by means of other instruments, not covered by the agreement. This problem arises in many other areas of policy analysis–see for instance the chapter by Rodrik in this volume– and unfortunately there is no easy way around it.

The other remark concerns our definition of cooperation as the maximization of worldwide welfare. This definition becomes problematic if there are relevant asymmetries, so that the two countries not necessarily enter with equal weights

[5]Naturally policy coordination would remain welfare improving in this case too.

in the world social welfare function. In this case, implementation of efficient equilibria may require lump-sum side payments. If side payments are ruled out, an additional constraint must be imposed on the cooperative outcome. This point is addressed in Chari and Kehoe (1990) and is further discussed in Section 6 below.

2.3. Notes on the literature

Frenkel and Razin (1985), (1987), and van Wijnbergen (1986), discuss the international transmission of fiscal policies in a similar but more general intertemporal model without capital. Devereux (1987) describes a model where the benefits of cooperation derive from terms of trade effects similar to those of this section. Similar issues arise also in overlapping generations models. See, in particular, Persson (1985), Buiter (1987) and Chang (1988).

3. Cooperation among politically motivated governments

A central assumption in section 2 is that governments act as benevolent social planners. If governments are politically motivated–by a desire to be reappointed or to implement a partisan policy platform–international policy cooperation is not always welfare improving. Intuitively, international cooperation may enable the incumbent governments at home and abroad to collude at the expense of voters or of political opponents. If economic policies are distorted by political incentive constraints, international competition, rather than cooperation, may be desirable, as it may relax or offset the domestic incentive constraints. We illustrate this point, by an extension of our previous model.

3.1. Political instability and government myopia

Let public consumption in the second period be a choice variable of the government, alongside with public assets, b. Moreover, and more importantly, assume that consumers in both countries are heterogeneous in their evaluations of public consumption. Specifically, suppose that the i^{th} consumer preferences in the home country are given by the following utility function

$$u^i = U(c_1) + c_2 + V(x_1) + V(x_2) + \alpha^i H(g) \,, \tag{3.1}$$

where the notation is as in the previous section, H is a concave and well behaved utility function, and consumers differ in the weight α^i assigned to public consumption. Policy decisions are taken sequentially over time by majority vote. In period 1 there is a majority vote, in each country, on the budget surplus, b and b^* respectively. And in period 2 there is another vote on g and g^*. In all other respects the model is identical to that of section 1.

As all the voters have the same preferences, except for the linear parameter α^i, their preferences are single peaked and the median voter result holds (see Grandmont (1978)). The political equilibrium–defined as a policy that cannot be beaten under majority rule in a pair-wise comparison–coincides with the policy preferred by the median voter. The key political feature emphasized in this section is that the identity of the median voter may change over time. Because political decisions are taken sequentially, shocks to the participation rate or changes in the eligibility of the voters can bring about changes in the identity of the median voter. This political instability distorts the intertemporal preferences of the legislator, giving rise to excessive myopia or farsightedness, depending on the circumstances.

Specifically, let α_t^m be the weight assigned to public consumption by the home median voter in period t, for $t = 1, 2$. We want to allow for $\alpha_1^m \neq \alpha_2^m$ in both countries. We refer to an individual with a large α as a "liberal", and one with a small α as a "conservative". For simplicity (but with no loss of generality) we assume that α_2^m is known with certainty in period 1.

Consider how the size of public consumption is chosen in period 2, given b and b^*. As argued in the previous section, there are no policy spillovers across countries in period 2. Thus the equilibrium policy is chosen independently in each country. At home, public consumption is set by the home median to maximize his indirect utility function. This indirect utility function is *ex post*, in the sense that b is predetermined and q does not enter any of the relevant (period 2) budget constraints — see 2.2, 2.3 above. Thus it can be written as:

$$\hat{u}_2^m = \hat{J}(b,\ g) + \alpha_2^m H(g). \tag{3.2}$$

The equilibrium policy maximizes 3.2, and must satisfy the first order condition:

$$\hat{J}_g + \alpha_2^m H_g = 0\ . \tag{3.3}$$

Equation 3.3 implicitly defines equilibrium public consumption: $g = G(b, \alpha_2^m)$. It is easy to show that G is increasing in both arguments. Thus, a more liberal median voter spends more. Larger inherited public assets also imply more public spending, as the marginal cost of distorting taxation is smaller. An analogous result holds for the foreign country.[6]

Next, turn to period 1, and suppose initially that there is no international policy coordination. The home median voter chooses b to maximize his *ex ante* indirect utility function, taking into account the effect of his choices on the world interest rate through the function $Q(\cdot)$, as well as the incentive constraint that public consumption is chosen by the second period median voter through the function $G(\cdot)$. The corresponding first order condition for b is:

[6]The result that $G_b > 0$ follows by applying the implicit function theorem to 3.3, and noting that $\hat{J}_{gb} = -\hat{J}_{gg} > 0$).

$$J_b + J_q Q_b + G_b(J_g + \alpha_1^m H_g) = 0. \tag{3.4}$$

The first term on the left hand side of 3.4 is the usual optimal taxation effect. The second term is the terms of trade effect discussed in the previous section. The last term captures the political incentive constraint. Public consumption will be set next period by a legislator with different policy preferences. The optimal budget surplus thus takes into account the effect on future public spending. In other words, the budget surplus is set strategically, to influence future domestic policies. An analogous first order condition holds for the foreign country.

Equation 3.4 can be simplified further, recalling that $J_q = z_2$ and noting that $J_g = \tilde{J}_g$, to obtain: [7]

$$J_b = -z_2 Q_b + (\alpha_2^m - \alpha_1^m) G_b H_g \tag{3.5}$$

Equation 3.5 is identical to the reaction function 2.9 derived in section 2, except that on the right hand side there is one more term capturing the political incentive constraint. As $H_g > 0$ and $G_b > 0$, this term has the same sign as $(\alpha_2^m - \alpha_1^m)$. Thus, the political incentive constraint can reinforce or weaken the bias in favor of large budget surpluses. If the first period legislator is more conservative than its successor $(\alpha_2^m > \alpha_1^m)$, there is a political bias is in favor of small budget surpluses. The reason is that small budget surpluses–larger deficits–are used strategically to force a spending cut on the future legislator. The opposite is true if the first period legislator is more liberal than its successor $(\alpha_2^m < \alpha_1^m)$.

3.2. The benefits of cooperation reconsidered

Suppose now that the home and foreign legislators cooperate with each other. That is, suppose that, once the identity of the current and future majorities are publicly known, the current majorities in the two countries are allowed to strike a deal. The deal says that fiscal policies are set to maximize the sum of the home and foreign median voters welfare. This arrangement can be thought of as either cooperation among two governments (elected by the corresponding median voters), or as cooperation among the two legislatures.

Repeating the same steps as above and as in section 2, it is easy to verify that the cooperative policy must satisfy an expression identical to 3.4, except that the term $z_2 Q_b$ is missing. Under international coordination the two countries thus again abstain from exploiting the terms of trade effects of fiscal policy. This leaves policy determined exclusively by domestic considerations. But now, with politically motivated governments, there are two domestic considerations: the Ramsey rule, and the domestic political distortion. If the terms of trade effects and the political effects offset each other, the Ramsey optimum is closer to the

[7] $J_g = \tilde{J}_g$ follows from the linearity of consumer preferences in c_2, and from the fact that J_g is a partial derivative, which *is* taken holding b and q fixed.

non-cooperative than to the cooperative equilibrium. This happens if the net debtor country is run by a more liberal policymaker in period 1, or if the net creditor country is run by more conservative policymaker in period 1. In other words, if the home country is a net creditor, cooperation generates an outcome further away from Ramsey rule if $\alpha_2^m > \alpha_1^m$, whereas the reverse holds abroad.

Can we say that in this case cooperation is counterproductive, in that it decreases welfare of both countries? Clearly this is not literally true of the period 1 median voters in both countries. They are better off with cooperation than without it, since they are more able to reach their domestic objectives. But these domestic objectives are distorted by a political incentive constraint (the strategic effect of budget surpluses). In the presence of these constraints, a correct comparison evaluates *ex ante* welfare with and without cooperation. Specifically, assume that individuals know their own preferences (their α^i parameter), but don't know the other voters preferences. In particular, assume they don't know the identity of the period-1 and period-2 majorities in both countries. It can be shown that in this case the Ramsey rule is optimal for every voter irrespective of her α^i parameter. In this sense, cooperation is indeed counterproductive whenever it takes equilibrium policies further away from the Ramsey rule.

3.3. Notes on the literature

The idea that international policy cooperation may be counterproductive because it enables collusion among politically motivated governments is found in Vaubel (1985), without reference to a specific model. Putnam (1989) also discusses it at length with reference to specific real world episodes. Edwards and Keen (1993) make essentially the same point in a model of tax competition where governments destroy resources for their own private benefit. The result that political instability may lead to excessive budget deficits is discussed at length in Persson and Tabellini (1990), who in turn summarize earlier work by Persson and Svensson (1989), Alesina and Tabellini (1990), Tabellini and Alesina (1990). The analysis of international policy coordination with a political bias towards budget deficits is due to Tabellini (1990), who focuses on an slightly different economic model. Finally, the result of this section can also be interpreted as saying that cooperation among a subset of players may be counterproductive, an interpretation stressed by Canzoneri and Henderson (1991) in a nonpolitical model of monetary policy. (See further Part B, below.)

4. Tax competition

A second important externality in fiscal policy arises if tax bases are internationally mobile. In this section we consider a typical example, namely capital taxation. With internationally mobile capital governments have an incentive to

keep taxes low, to attract capital from abroad. As both governments do that, capital does not move in a (symmetric) Nash equilibrium, but taxes are inefficiently low. Cooperation calls for raising taxes on capital in both countries.

4.1. The model

The model is similar to that of sections 2 and 3, except that the tax base is capital rather than labor. Again we assume two identical representative consumers, two periods and a single commodity. Public consumption takes place in the second period. Consumer preferences in the home country are:

$$u = U(c_1) + c_2 + H(g) \ , \tag{4.1}$$

where the notation is the same as above.

In the first period the consumer receives an exogenous endowment e, that can be consumed or invested at home or abroad. The investment technology is identical in the two countries: One unit invested today yields one unit tomorrow, gross of taxes. Foreign investment, however, carries some "mobility costs", meant to capture the extra transaction and information costs associated with foreign investment. For simplicity, these costs are borne in the second period, when the fruits of investment mature. Capital invested at home is taxed at the domestic rate θ, whereas capital invested abroad is taxed at the foreign rate θ^*. Under these assumptions, we can write the consumer budget constraints as:

$$\begin{aligned} e \geq c_1 + k + f \equiv c_1 + s \\ c_2 \leq (1-\theta)\, k + (1-\theta^*)\, f - M\,(f) \equiv \\ \equiv (1-\theta)\, s + (\theta - \theta^*)\, f - M\,(f) \end{aligned} \tag{4.2}$$

where k and f denote domestic and foreign investment of the home country $s \equiv k+f$ denotes savings, and $M(f)$ is a function capturing the mobility costs of foreign investment. We assume that $M(0) = 0$, $M_f > 0$ if $f > 0$, and $M_{ff} > 0$.

Finally, the government budget constraint in the second period is:

$$g \leq \theta k + \theta f^* \equiv \theta(s - f + f^*) \tag{4.3}$$

where an * denotes a foreign variable. Implicit in 4.2 and 4.3 is thus the assumption that capital is taxed according to the source principle, and not the residence principle, and that the same rate applies irrespective of who owns the capital.[8]

By the private optimality conditions, in an interior optimum, savings are a function of the domestic tax rate, $s = S(\theta) \equiv 1 - U_c^{-1}(1-\theta)$, with $S_\theta < 0$. Moreover, investment abroad is a function $f = F(\theta,\, \theta^*)$, with $F_\theta = -F_{\theta^*}^* > 0$. Thus, a unilaterally higher capital tax rate at home encourages capital flight, and

[8]This assumption is appropriate in the case of industrial capital and foreign direct investments. Even in the case of financial capital, it may not be too far fetched if there are enforcement problems.

vice versa if the foreign tax rate rises. Finally, domestic investment at home can be written as: $k = K(\theta, \theta^*) = S(\theta) - F(\theta, \theta^*)$. Thus, a higher capital tax rate in the home country discourages home investment in two ways: it reduces savings and induces capital flight by home citizens. The foreign country is identical in all respects. In particular, $F_\theta^* = F_\theta$ and $F_\theta^* = F_{\theta^*}$.

4.2. Equilibrium policies with and without cooperation

Consider first the cooperative equilibrium as defined in the previous section, namely as the pair of policies that maximize world wide welfare. The timing of events is as follows. (1) In period 1 governments choose tax policy; (2) Having observed the policy, consumers choose how much to save and where to invest; (3) In period 2 no new decision is made, and the budget constraints dictate how much private and public consumption is feasible, given the period 1 choices. Thus, we remain in the typical framework of optimal taxation theory and abstract from any credibility problem vis-a-vis private investors. This assumption is removed in the next section.

To compute the optimal tax rates, use the previous notation to write the home consumer indirect utility function as:

$$v(\theta, \theta^*) \equiv U(1 - s(\theta)) + (1 - \theta)s(\theta) + (\theta - \theta^*)F(\theta, \theta^*) \\ -M(F(\theta, \theta^*) + H[\theta(s(\theta) - F(\theta, \theta^*) + F(\theta, \theta^*))].$$

The foreign consumer indirect utility function, $v(\theta, \theta^*)$, is analogously defined. Optimal tax rates maximize $[v(\theta, \theta^*) + v^*(\theta, \theta^*)]$.

Appealing to the envelope theorem and going through this optimal taxation exercise, one can pin down the equilibrium tax rate in the home country by the following optimality condition (a similar condition holds for the foreign country).[9]

$$H_g = \frac{1}{1 - \eta^C} \,. \tag{4.4}$$

In 4.4 $\eta^C > 0$ denotes the elasticity of the relevant tax bases (k and f^*) for the home government with respect to the domestic tax rate, in a cooperative equilibrium. The left hand side of 4.4 is the marginal benefit of public consumption. The right hand side is the marginal cost of higher taxes, which also reflects the tax distortion on investment decisions. The higher is the elasticity η^C, the greater is the distortion and hence the lower is the optimal tax rate (because $H(\cdot)$ is concave and the left hand side is decreasing in g and hence in θ).

[9]Equation 4.4 is obtained from the problem of maximizing the sum of the welfare of both consumers, domestic and foreign, with respect to home policies. By symmetry, the first order condition of this problem with respect to θ simplifies to

$$-S + F - F^* + (S - F + F^* + \theta S_\theta)H_g = 0,$$

from which 4.4 and 4.5 follow.

The key determinant of the equilibrium tax rate is thus the elasticity η^C . In a cooperative equilibrium, this elasticity can be written as:

$$\eta^C = S_\theta \theta / s \ . \tag{4.5}$$

Note that the elasticity η^C only reflects the savings elasticity and it neglects the investment elasticity due to the international movements of capital. The reason is that when the two governments cooperate they refrain from exploiting international capital mobility for their own benefit.

This does not happen with non-cooperative policymaking. Specifically, consider the Nash equilibrium, in which both governments maximize the welfare of their own citizens, taking the tax rate in the other country as given. Thus the home government maximizes $v(\theta, \theta^*)$ defined above, given θ^*. Its reaction function is defined by a condition similar to ??, except that the elasticity η^c on the right hand side is now replaced by the following elasticity

$$\eta^N = (S_\theta + 2F^*_\theta)\theta / S \ , \tag{4.6}$$

where the N superscript is a reminder that the elasticity is computed in the Nash equilibrium.[10]

Contrasting 4.5 and 4.6 and recalling that $F^*_\theta > 0$, it follows immediately that $\eta^N > \eta^C$. By (4.4), then, the equilibrium tax rate is higher with cooperation than without it. The intuition is straightforward. In the absence of cooperation, both governments face an incentive to unilaterally reduce taxes, to attract foreign capital and to keep domestic capital within their borders. This incentive is larger the greater is international capital mobility (i.e., the larger is F^*_θ).

Like in section 2, lack of cooperation reduces worldwide welfare. In the Nash equilibrium, there is no capital flight from either country. Tax competition does not pay: it simply distorts governments incentives. In both countries, Nash equilibrium public consumption is too low and private savings too high compared with the (second-best) optimal taxation rule. This distortion is greater (and so is the benefit from cooperation) the larger is international capital mobility. In the limit, if capital is perfectly mobile across countries (if $F_\theta = \infty$), the only Nash equilibrium has zero tax rates and zero public consumption in both countries.

[10]Equation 4.6 is derived from the problem of maximizing the consumer indirect utility function, subject to the government budget constraint and taking the foreign tax rate as given. The first order condition for that problem with respect to θ turns out to be:

$$-S + F + (S - F + F^* + \theta S_\theta - \theta F_\theta + \theta F^*_\theta) H_g = 0$$

which, after some rewriting yields 4.4. To derive 4.6, we have relied on two simplifications. First, by symmetry both governments choose the same equilibrium tax rate. Hence in equilibrium $F = F^* = 0$. Second, by the private optimality conditions discussed in the previous subsection $K_\theta = S_\theta - F_\theta$ *and* $- F_\theta = F^*_\theta < 0$.

4.3. Credibility and cooperation

In section 3 we saw that international cooperation can reduce social welfare in the presence of political distortions, even though it is desirable for the incumbent. We now show that there is another domestic incentive constraint that can make cooperation counterproductive. If the government lacks credibility, then it matters whether cooperation makes government policy more or less credible. Note that here the government maximizes social welfare. Thus, cooperation can be undesirable for society as a whole, as well as for the government that engages in cooperation.

To illustrate this point, suppose that we change the timing of events in the model of the previous section as follows. (1) In period 1 individuals save; (2) In period 2 the governments of both countries choose economic policy; (3) Finally, individuals choose the location of their investment. Thus, savings and investment are temporally separated or, equivalently, capital can be moved across countries after policy choices have been made.

Under this timing, the savings decision anticipates the forthcoming equilibrium tax policy. But when taxes are set, savings are predetermined and thus the perceived elasticity of savings with respect to the tax rate is zero. In this case tax policy suffers from a credibility problem. Governments cannot credibly convince savers that taxes will be low, because they have *ex post* incentives to tax savings a lot. Cooperation can make things worse, because it effectively removes the only remaining check on high capital taxation, namely international mobility.

To make the argument more precise, remove the term S_θ from the elasticities expressions 4.5 and 4.6. With cooperation, the elasticity of the tax base becomes zero, $\eta^C = 0$. In the Nash equilibrium the elasticity η^N remains positive in absolute value, but it is a smaller number than in the previous subsection (because in 4.6 both S_θ and $F^*_\theta < 0$). By 4.4 it then follows that the equilibrium tax rate is higher, both in the non-cooperative and the cooperative regime, when credibility problems are present. Summarizing, lack of credibility always increases the equilibrium tax rate. When there is international cooperation, the equilibrium tax rate is so high that the marginal utility of public spending equals that of private consumption. That is, the governments do not perceive capital taxation to be distorting at all. Without cooperation, the tax competition effect is still operative so that taxes remain lower than with cooperation, even though they are higher than in the Nash equilibrium of the previous section. Tax competition can therefore be socially desirable, by giving credibility to a policy of low capital taxes.

The general insight is similar to that of section 3. Policy coordination can be counterproductive when the international and the domestic incentive constraints pull the equilibrium policy in opposite directions. Tax competition by itself pulls the tax rate below the Ramsey optimum, but lack of credibility pulls it above. Hence the equilibrium in which both incentive constraints are binding may be

superior to that in which only one of them is binding. The same idea also applies to monetary policy, as will be discussed in Part B.

4.4. Notes on the literature

Optimal taxation when tax bases are internationally mobile has been extensively studied. A general analysis can be found in Gordon (1983) and in Razin and Sadka (1991). The book by Frankel, Razin and Sadka (1991) provides a comprehensive summary. Wilson (1987) adds endogenous wage rates to a model similar to that of this section. The idea that lack of credibility can make policy coordination counterproductive is due to Rogoff (1985), who introduced it in the case of monetary policy. Kehoe (1989) has extended it to the capital taxation model of this section. Tax competition has also been studied with much more emphasis or institutional detail. See, for instance, Giovannini, Hubbard and Slemrod (1993) and, with reference to European Integration, Keen (1993) and Sørensen (1992).

5. Domestic institutions in fiscal policy

So far we have discussed whether or not there are *prospective* gains from international cooperation in fiscal policy. But how can cooperative outcomes be implemented? This question is very important, given that each country has incentives to unilaterally deviate from the cooperative equilibrium unless some mechanism enforces it.

In Sections 6 and 10 below we study international institutions, with different degrees of centralization, that enforce fiscal and monetary policy cooperation. In this section, and in Section 9, we show that appropriate domestic political institutions can go some way towards implementing the cooperative outcome. This result is of interest because it demonstrates that better outcomes may be achievable, without any need to enforce international agreements.

To make this point, we once again abandon the world of social planners and representative consumers. The general theme is familiar from section 3 and has also been studied in recent work in political science on two-stage games (Putnam (1988)). When individual citizens are heterogeneous and governments politically motivated, there are more than just two players besides the home and foreign government: there are different domestic policymakers or political actors within each country. In section 3 we viewed international policy coordination as collusion between two incumbents, at the expense of future policymakers, and we argued that cooperation could be socially undesirable. In this section we focus instead on the relationship between voters–the principals–and governments–the agents–in a representative democracy. This relationship is not fixed, but reflects the international policy regime. If international policy spillovers are important, voters elect a government who is fit to "play" the international policy game. Thus, on the one hand, international policy spillovers have domestic political repercussions.

On the other hand, domestic politics plays a role in the international policy equilibrium. In the specific model of this section domestic politics mitigates the adverse consequences of tax competition, and reduces the need for international policy coordination, even though this is not always the case.

The model is identical to that of Section 4.1, except that individuals differ in the weight they attach to the utility of public consumption. Specifically, the preferences of individual i at home are still given by (4.1), except that the term $H(g)$ is replaced by $\alpha^i H(g)$, where the weight α^i differs across individuals and is distributed in the population with mean and median both equal to unity–this implies that the median voter optimum coincides with the utilitarian optimum. To preserve symmetry, the distribution is the same in the two countries.

The sequence of events is as follows: (1) Elections are held simultaneously in both countries; (2) The elected governments simultaneously and non-cooperatively choose tax policy; (3) Savings and investment decisions are made. Thus, we assume away all credibility problems in capital taxation and any international institution enforcing international agreement. An equilibrium is defined by two conditions (in addition to the optimal economic behavior of individuals). It must be a Nash equilibrium among the elected policymakers, who choose the optimal tax rate given foreign policy. It must also be a political equilibrium. That is, the elected policymakers are preferred to any other candidate by a majority of the voters in their own country, given the outcome of foreign elections and given how the policymakers behave once in office.

This definition makes clear that elections are partly driven by a strategic motive. A successful candidate is one who can yield a favorable Nash equilibrium in the subsequent policy game. Thus there is an agency problem. Policymakers behave as Nash players with respect to each other, once in office. But voters do not take the foreign tax rate as given when comparing different candidates, they only take the foreign electoral outcome as given. As shown below, this makes voters wish to elect a policymaker who does not share their own preferences.

5.1. Nash equilibrium of the policy game

Suppose that policymakers of type α^p and α^{*p^*} have been elected in the home and foreign country respectively. The Nash equilibrium among them is obtained exactly like in Section 4.2 above. The optimal tax rate for the home policymaker is therefore defined by a condition like 4.4(reproduced here for convenience):

$$\alpha^p H_g = \frac{1}{1-\eta^N} \,. \tag{5.1}$$

A similar condition holds in the foreign country. The elasticity η^N is still given by 4.6. Equations 5.1 and 4.6 implicitly define the reaction function of the home policymaker, namely a function $\theta = T^p(\theta^*)$, and similarly for the foreign policymaker. These reaction functions are illustrated in Figure 1. Their slope is

ambiguous and turns out to depend on the concavity of the utility function $H(g)$. We assume that H is not very concave, in which case the reaction functions are upward sloping. Their position depend on the government type, as captured by the parameters α^P and α^{*P*}. A higher value of α^P(i.e. more weight given to public consumption) induces higher tax rates and hence shifts the domestic reaction function to the right, towards the dotted line, while a similar argument holds for the foreign government.[11] Intuitively, a larger α^P implies a higher marginal benefit from public consumption. The elected policymaker at home is thus more willing to raise capital taxes for any foreign tax rate. Because the best response of the foreign government is to raise θ^*, the equilibrium tax rates in *both* countries go up as α^P rises. The same argument holds with respect to α^{*P*}.

In summary, the equilibrium tax rate in each country is an increasing function of the policymaker weights α^P and α^{*P*}. It is through this feature of the equilibrium that elections matter for the equilibrium outcome.

5.2. Political equilibrium

With this result in mind, let us now turn to stage (1) of the game, when policymakers are elected. Because the voters' preferences are single peaked, the elections are won by the candidate preferred by the median voter. But under the timing spelled out above, the median voters in both countries prefer a candidate other than themselves. They realize that tax competition in the subsequent stage of the game will force the elected governments to keep taxes inefficiently low. By electing a "liberal" policymaker, who is willing to tax and spend a lot *ex post*, the home median voter can induce the *foreign* policymaker to increase his equilibrium tax rate, and this has a positive spillover effect at home. The same argument applies in the foreign country. Hence, in both countries elections are won by a candidate more liberal than the median voter, and the resulting equilibrium policy entails correspondingly higher tax rates.

To illustrate this point more formally, let us compute the tax rate θ that the home median voter would wish to see implemented at home. Under the assumed timing, the home median voter does not take the foreign rate θ^* as given. He instead realizes that the foreign tax rate is determined by the foreign reaction function, $\theta^* = T^{*P}(\theta)$, with α^{*P} taken as given. The home median therefore maximizes his own preferences, subject to the usual government budget constraint and to the additional incentive constraint:
$\theta^* = T^{*P}(\theta)$. The tax rate solving this optimization problem must satisfy the usual optimality condition,

$$H_g = \frac{1}{1 - \hat{\eta}^{NR}} \cdot \tag{5.2}$$

[11]These results can be derived by applying the implicit function theorem to the equation in footnote 10 above, except that on the left hand side of the term H_g is remultiplied by α^P.

Since by assumption the median value of α is 1, the left hand side captures the marginal benefit of public consumption for the median voter. The elasticity η^{NR} is now given by the expression:

$$\eta^{NR} = -(S_\theta + 2\ F^*_\theta(1 - T^*_\theta))\theta/S \tag{5.3}$$

Comparing this new elasticity with the corresponding expression in 4.6, we see that $\eta^{NR} < \eta^N$, because $1 > T^*_\theta > 0$. Hence, at the election stage, the home median voter prefers a higher tax rate than the one that he himself would implement in a Nash equilibrium, but not as high as in the cooperative equilibrium. The reason has been mentioned above. When voting, the median voter does not take the foreign tax rate as given; instead he takes the foreign policymaker and thus the foreign reaction function as given. He thus realizes that the foreign policymaker reacts to a higher tax rate θ (implemented by a more liberal policymaker type) by raising θ^*. This reduces the perceived elasticity of the capital tax base, because it-reduces the danger of capital flight following the election of a liberal government type. The median voter implements his preferred tax rate by electing a more liberal type than himself. [12]

Two general lessons can be drawn from this example. First, political delegation may help relax the international incentive constraint. The political equilibrium tax rates are higher than in the Nash equilibrium of section 4. Tax competition is therefore less damaging than in that simpler model and the benefits of international policy cooperation for the median voters less stark. By delegating policy to a more liberal type, voters manage to raise the equilibrium tax rate even without any international cooperation. Second, domestic politics and international policy spillovers are closely intertwined. The tax competition externality favors left-wing candidates in the political race, because they yield a better international policy equilibrium.

These results, however, are not general, and rely on strategic complimentarily of the policy instruments. If the function H is very concave, then it could happen that the reaction functions are negatively sloped (i.e., we have strategic substitutability). In this case political delegation could make things worse, in that the political equilibrium tax rate would be even lower than in the simple Nash equilibrium. Moreover, the elected government would be more to the right, rather than to the left, of the respective median voters.

5.3. Notes on the literature

Putnam (1989) and the contributions in Evans, Jacobsen and Putnam (1993) view international negotiations as a two-stage game between voters and politicians. Strategic delegation has been studied, among others, by Vickers (1985) with regard to managers and shareholders in oligopolistic firms, and by Fershtman,

[12] This can be verified by comparing equations 5.1 and 5.2, together with $\eta^{NR} < \eta^N$.

Judd, and Kalai (1991) in a more abstract setting. The model and the results in this section are reminiscent of those in Persson and Tabellini (1992), even through their model has heterogenous endowments rather than heterogenous preferences.

6. International institutions in fiscal policy

For some macroeconomic policies, international institutions may sustain commitments to a cooperative outcome. Examples include the European Union, international tax treaties, exchange rate agreements. What are the important features of these institutions? If countries differ from each other, how is disagreement resolved within different institutions? These questions have received more attention in the literature on local public finance than in the literature of international macroeconomics. But some insights concerning federal fiscal institutions are also relevant for the implementation of international policy cooperation. This section highligts some results of the literature on fiscal federalism in the context of the tax competition model of the previous section. We abstract from credibility problems and assume that savings decisions are taken after the policy is in place. We retain the assumption of Section 5, that different voters evaluate public consumption with different weights α^i. However, we only consider voting equilibria over policies, not over people.

6.1. Tax harmonization

Consider first the case discussed in section 5, of two identical economies. Then everyone agrees that the optimal policy, for both countries, is the cooperative outcome defined implicitly by 4.4 and 4.5. Implementing this outcome requires a commitment to refrain from unilaterally reducing taxes in one country. A simple institution that can provide this commitment is an agreement to harmonize taxes–that is, to set $\theta = \theta^*$. Since the two countries are identical, there is no conflict of interest and this agreement can be sustained under a variety of essentially equivalent institutions.

One such institution is full centralization of the policy decision. Concretely, let the equilibrium tax rate be chosen under majority rule with the citizens of both countries eligible to vote, under the constraint that the same tax rate applies in both countries. It is easy to show that, by symmetry, the cooperative outcome of section 4 is the political equilibrium.

But the same outcome can also be implemented under a more decentralized institutional environment. Suppose that, after the "world wide" vote–but before the savings decision–citizens in each country are called to "ratify" the previous common decision, again by majority rule. If both countries ratify the common tax rate, then that rate gets implemented. If one country rejects ratification, then both countries are allowed to reoptimize and select any tax rate they wish, acting non-cooperatively.

To see that cooperation remains an equilibrium, suppose that the cooperative tax rate has been selected by a majority of the voters at stage (1). Then, at the ratification stage (2), the voters essentially have to choose between the cooperative policy in both countries, or the Nash equilibrium policy *in both countries*. Clearly, cooperation is preferred, and the tax harmonization decision ratified. But then, the cooperative tax rate indeed becomes the equilibrium policy selected at stage (1).

The key to this argument is related to that of the previous section. The international institution successfully implements cooperation because it forces the voters to chose *among equilibria*, not among policies. And since the two countries are identical, a majority in both countries agrees that the cooperative equilibrium dominates the non-cooperative one.

If the two countries differ, however, the previous argument can break down, because cooperation is no more uniquely defined and a majority of the voters in one country may prefer the non-cooperative outcome. Specifically, suppose that voters in the home country typically assign a larger weight α^i to public consumption than in the foreign country. In particular, the weight assigned by the domestic median voter is larger than that of the foreign median: $\alpha^m > \alpha^{*m}$. In this case the two medians prefer different common tax rates, and the details of how that common rate is chosen become important. If it is chosen by a "world wide" vote, then the political equilibrium is a tax rate in between those preferred by the home and foreign medians, exactly where depends on the shape of the α distributions. Ratification now potentially matters because it imposes a *participation constraint* on the political equilibrium: not every outcome of the first-stage vote is ratified, but only those that are superior to the Nash equilibrium for a majority of voters in both countries. Clearly, in an equilibrium only outcomes that will subsequently be ratified are candidates for approval at stage (1). Thus, when the participation constraint binds, a common tax rate is still implemented. But this tax rate is now defined by the condition that the median voter in one of the two countries is indifferent between that common rate and the Nash equilibrium. The more qualified is the majority required to approve ratification, the more the participation constraint is likely to bind.

6.2. Bargaining

An alternative procedure for selecting the cooperative policy when countries differ is through bargaining. Ratification implies that reversion to Nash is a natural threat point. We thus consider Nash bargaining among the two median voters, with the non-cooperative Nash equilibrium as the threat point.[13] The bargaining outcome is very different, depending on whether the international institution allows side payments or not.

[13]Naturally there is an issue of strategic delegation here too, similar to that of subsection 5.2. We abstract from it for simplicity (but see the Notes on the Literature section for references).

If side payments are ruled out, the equilibrium is less efficient: cooperation cannot avoid $\theta \neq \theta^*$, and costly international capital movements take place. It is easy to show that the home (high α^m) country sets a higher tax rate: $\theta > \theta^*$, and thus looses capital to the foreign country.

Side payments increase efficiency because they allow government spending to differ in the two countries, even though their tax rates are equal. Side payments may not be relevant if we consider coordination in a single issue. But they may be highly relevant when the coordinating countries are integrated also in other areas of policy, as in Europe today. We therefore consider side payments in more detail. Let t denote a transfer from the foreign to the home government (a negative value of t denotes a transfer in the opposite direction). The indirect utility function of the home median voter now becomes:

$$\begin{array}{c} v(\theta,\theta^*,t) \equiv U(1-S(\theta)) + (1-\theta)S(\theta) + \\ +(\theta-\theta^*)F(\theta,\theta^*) - M(F(\theta,\theta^*)) + \\ +\alpha^m H[t+\theta(S(\theta)-F(\theta,\theta^*)+F^*(\theta,\theta^*))] \end{array} \tag{6.1}$$

The foreign median voter's indirect utility function, $v^*(\theta,\theta^*,t)$, is similarly defined, except that t enters with the opposite sign. Efficient equilibria with side payments solve the following optimization problem:

$$\underset{\theta,\theta^*}{Max}[v(\theta,\theta^*,t) + \delta\, v^*(\theta,\theta^*,t)]$$

for arbitrary values of δ. Going through this optimization problem reveals that, for any δ, $\theta = \theta^*$ must satisfy the optimality conditions previously obtained for a cooperative equilibrium 4.4 and 4.5. Thus, there are no inefficient international capital movements. In addition, the first order condition for t implies:

$$\alpha^m H_g = \delta \alpha^{*m} H_g^*. \tag{6.2}$$

Thus, if the two countries are weighted equally (if $\delta = 1$), the marginal utility of public spending must be equal for the two median voters. By assumption, however, $\alpha^m > \alpha^{*m}$. Hence 6.2 with $\delta = 1$ implies $H_g < H_g^*$: public spending is larger in the home (high α^m) country. Since $\theta = \theta^*$, this requires $t > 0$: the home country receives a lump sum transfer from abroad. This makes intuitive sense. Efficiency requires $\theta = \theta^*$. But since the home country values public consumption more, taxes collected abroad also finance some of its public spending. Naturally, as δ increases above unity (as the foreign country is weighted more), the equilibrium value of t diminishes until it becomes negative. The equilibrium values of θ and θ^* change with δ, but the equality $\theta = \theta^*$ still holds.

In a Nash bargaining equilibrium, δ is not unity, but reflects the relative bargaining power of the two countries. Specifically, a Nash bargaining equilibrium solves

$$\underset{v,v^*}{Max} \left(v - v^N\right)\left(v^* - v^{*N}\right) \tag{6.3}$$

subject to being on the Pareto frontier (i.e.: subject to $v + \delta v^*$ constant), where v^N and v^{*N} denote welfare in the non-cooperative equilibrium for the home and foreign medians. The first-order conditions for this optimization problem imply that the equilibrium value of δ satisfies:

$$\delta = \frac{v - v^N}{v^* - v^{*N}} \tag{6.4}$$

The right hand side of 6.4 can be shown to exceed unity. Thus, the foreign (low α^{*m}) country has more bargaining power and receives a larger weight. Intuitively, in the non-cooperative equilibrium the home (high α^m) country is forced to set $\theta > \theta^*$. It thus loses capital to the foreign country, with adverse consequences on its tax revenues. Cooperation is therefore more valuable to the home country and it loses bargaining power. We cannot tell, however, in which direction the equilibrium side payments go: even though $\delta > 1$, the equilibrium sign of t can be positive or negative, depending on the properties of the utility functions and on the cost $M(\cdot)$ of capital flight.

Summarizing, when the two countries are equal, cooperation can be enforced by a variety of international institutions. The relevant feature of these institutions is to force policy makers to chose among equilibria rather than among policies. When the countries differ, on the other hand, enforcement is more problematic because the countries disagree over which efficient policy to implement. Disagreement can be resolved in a variety of non-equivalent ways. If a common policy is chosen by majority vote, ratification serves the important role of imposing a participation constraint. If instead a common policy is chosen by bargaining, efficiency requires compensating side payments. Naturally, the equilibrium tax rates implemented under voting *cum* ratification and under bargaining can be very different from each other, since they reflect very different parameters.

6.3. Notes on the literature

The idea that ratification, or rather secession, may impose a relevant constraint in fiscal policy formation originates in local public finance; see for instance Buchanan and Faith (1987) or Bolton and Roland (1992). Piketty (1993) explores a similar idea to the ratification equilibrium above in a model of capital taxation. Tax harmonization in the EEC has been studied by Sinn (1990). Bargaining equilibria have seldom been discussed with reference to international policy coordination. Important exceptions are Chari and Kehoe (1990), who illustrate the relevance of side payments when countries differ, and Gosh and Masson (1994), who discuss private information and the incentives for policymakers to misrepresent information so as to get a more favorable outcome; see also Hughes-Hallet (1986) and Chang (1993). Persson and Tabellini (1994a,b,c) contrast alternative procedures for resolving disagreement over fiscal policy, among different regions of a federal state. They focus precisely on the difference between centralized voting and

bargaining, but consider international risk-sharing rather than capital taxation.

B. MONETARY POLICY

Below we survey the literature since the mid seventies on strategic interactions in monetary policy. Our selective survey highlights the same main themes as in Part A. In Section 7 we formulate a "generic" two country macroeconomic model which we use throughout this part. The model focuses on international spillovers via the real exchange rate and is consistent with the reduced form of the models in Rogoff (1985) and Canzoneri and Henderson (1988, 1991), among others. In Section 8, we illustrate a main theme in the literature: if the two countries do not cooperate, the monetary response to a an adverse symmetric shock, like an oil shock, may be too contractionary. A permanent conflict of interest over the terms of trade, as in Part A (Section 2) generates similar inefficiencies.

Frankel (1988) listed three difficulties in sustaining a coordinated monetary policy outcome in order to eliminate such inefficiencies. One problem pointed out by Rogoff (1985) is that, monetary policy coordination may be counterproductive if governments lack credibility. Subsection 8.3 presents Rogoff's argument, appealing to the same kind of second-best reasoning as in Section 3. The second problem listed by Frankel is uncertainty about initial positions, objective functions, or policy multipliers. This important topic has received considerable attention in the literature. We only deal with it tangentially, and refer the reader to the recent book by Gosh and Masson (1994) for an exhaustive treatment of policy coordination under uncertainty. Finally, Frankel discussed the difficulty of enforcing cooperation, given the incentives for individual countries to unilaterally deviate. The literature has stressed that reputation may relax these incentives when policymakers interact repeatedly over time. The general argument is well known, and its specific application to monetary policy coordination well summarized in Canzoneri and Henderson (1991, Chs. 4-5), and in Gosh and Masson (1994, Ch. 8). Hence, we don't deal with it here. Instead, we follow the approach of Part A, namely to highlight the role of institutions in supporting cooperation. Section 9 starts by discussing domestic institutions, while Section 10 turns to international institutions. Here the institutions take the form of fixed exchange rate arrangements like the Bretton-Woods agreement or the EMS. These institutional arrangements may be interpreted as contracts that implement desirable policy outcomes by strategic delegation.

7. A common framework

The fiscal-policy analysis in part A. rested on simple, yet fully specified, general equilibrium models with choice-theoretic foundations both on the economic and the political side. Our analysis of monetary policy in this part instead relies on social welfare functions defined directly over macroecoonomic outcomes and on

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ABSTRACT

Double-Edged Incentives: Institutions and Policy Coordination*

This paper illustrates some of the most important insights of the literature on international fiscal and monetary policy coordination. It notes that the analysis of international policy interactions is enriched by taking the incentives in the domestic policy process into account. These incentives can either be tied to credibility issues or to political institutions. The paper also focuses on the role of institutions that can enforce and support international cooperation. We discuss alternative task assignments between member countries and the central policy-making level, and alternative processes for collective decision making.

JEL Classification: E5, E61, E62, F00
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Torsten Persson
Institute for International
Economic Studies
University of Stockholm
S–106 91 Stockholm
SWEDEN
Tel: (46 8) 163 066

Guido Tabellini
IGIER
Abbazia di Mirasole
I–20090 Opera (Milano)
ITALY
Tel: (39 2) 5760 6563

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DOUBLE-EDGED INCENTIVES: INSTITUTIONS AND POLICY COORDINATION

Torsten Persson and Guido Tabellini

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Centre for Economic Policy Research
25–28 Old Burlington Street
London W1X 1LB
Tel: (44 71) 734 9110

reduced-form relations between macroeconomic outcomes and policy instruments. This lack of explicit microeconomic underpinnings reflects the state of the art in much of the literature, which relies on linear versions of the Mundell-Fleming model. Working with reduced forms, enables us to avoid the taxonomy of different model specifications that would be necessary to fully capture the argument in each individual contribution..

7.1. A simple model

As before, there are two countries: the home and the foreign country. Each country specializes in the production of a national good, but consumes both goods. The policymaker in the home country has access to a single policy instrument, m, which we identify with money growth. He evaluates the effects of monetary policy according to the following "welfare" function defined over macroeconomic outcomes:

$$W(p,\ x,\ z;\ \theta,\ \epsilon). \tag{7.1}$$

In 7.1, $W(\cdot)$ is a concave function, defined over CPI-inflation, p, output (measured as a deviation from the natural rate) x, and the rate of change of the real exchange rate, z, defined as the relative price of foreign goods in terms of home goods. If z enters the payoff function directly, it is because of real income concerns. As for θ and ϵ, they are symmetrically distributed shocks that may affect macroeconomic outcomes. These shocks enter the payoff function because they may also alter the way the policymaker evaluates specific macroeconomic outcomes, by modifying the partial derivatives W_p, W_x, or W_z. We generally assume that there is a well-defined inflation target, normalized to zero:

$$W_p \gtreqless 0 \quad \text{as} \quad p \lesseqgtr 0. \tag{7.2}$$

The sign patterns of the other partials W_x and W_z will vary somewhat in the different specifications below. Throughout, we assume that the $W(\cdot)$ function is quadratic and separable in the macroeconomic outcomes: the partials in p, x, and z, when non-zero, are linear in these variables and the cross-partials W_{ij} for $i, j = p, x, z$ are zero. However, we maintain the general functional form in 7.1, rather than going to a parametric example, to facilitate the interpretation of the results.

The distinction between θ-shocks and ϵ-shocks has to do with information availability. We follow the literature in assuming that private agents sign nominal contracts for wages (or prices). The policymaker knows the realization of both types of shocks when setting m, but private agents only have information about the θ-shocks. The policymaker's superior information with regard to ϵ-shocks may either reflect a genuine information advantage, or else the relative costs of decision making: monetary policy can be altered at very short notice, whereas

wage contracts cannot. This private information over the ϵ shock provides a role for stabilization policies, as in Fischer (1977).

Following much of the literature, the real exchange rate, z, is the only source of spillovers across countries. Defined as the rate of change in the relative price of foreign goods, we can write z as:

$$z = s + q^* - q, \tag{7.3}$$

where s is the change in the nominal exchange rate and $q(q^*)$ is the own-currency change in the price of home (foreign) country goods. Thus a positive value of z reflects a real depreciation. We represent the macroeconomic outcomes by the following semi-reduced forms:

$$p = P(\underset{+}{m}, \underset{+}{z}; \theta, \epsilon) \tag{7.4}$$

$$x = X(m \underset{+}{-} m^e, z; \theta, \epsilon) \tag{7.5}$$

$$z = Z(m \underset{+}{-} m^e, m^* \underset{+}{-} m^{*e}; \theta, \epsilon, \theta^*, \epsilon^*), \tag{7.6}$$

where the e superscript denotes private expectations, conditional on θ, and where an asterisk "*" denotes a foreign variable. A sign under a variable denotes an assumption about the corresponding partial derivative that will be maintained throughout.

The CPI-inflation rate p in 7.4 increases with money growth, as well as with a real depreciation. This reduced form follows from (i) the definition of CPI-inflation

$$p = P(q, z), \tag{7.7}$$

where $P(\cdot)$ is increasing in both arguments, and (ii) an assumption that the rise in home-goods prices depends on θ-shocks and ϵ-shocks and is an increasing function of domestic money growth:

$$q = Q(m; \theta, \epsilon). \tag{7.8}$$

In keeping with the rational-expectations surprise-supply literature, domestic output (employment) x is only affected by monetary surprises. The $Z(\cdot)$ function can be thought of as the inverse of a relative demand function, where the relative demand for home goods, $d - d^*$, is a decreasing function of the relative price of foreign goods: $D(z; \theta, \theta^*, \epsilon, \epsilon^*)$ with $D_z(\cdot) > 0$. If so, we can write the equilibrium condition $(d - d^*) = (x - x^*)$ as $z = D^{-1}((x - x^*); \theta, \theta^*, \epsilon, \epsilon^*)$, which together with 7.5 and its foreign counterpart defines 7.6.

We normalize the model by assuming

$$p = 0 \quad \text{when} \quad m = m^e = z = \theta = \epsilon = 0, \tag{7.9}$$

$$x = 0 \quad \text{when} \quad m = m^e, \quad \text{and} \quad z = \theta = \epsilon = 0,$$

$$z = 0 \quad \text{when} \quad m = m^e, \; m* = m*^e, \quad \text{and} \quad \theta = \epsilon = \theta* = \epsilon* = 0.$$

The policy objective and macroeconomic outcomes of the foreign country are specified in a completely analogous way. Finally, we assume that all the macroeconomic outcome functions are linear in their arguments, but, again, maintain the general form for ease of interpretation. Together with the assumption that objective functions are quadratic, this makes our model a linear-quadratic one.

Unless we make explicit assumptions to the contrary, we assume the following timing: (1) The values of θ and θ^* are observed by everyone; (2) Private agents form expectations: m^e and m^{*e}; (3) The values of ϵ and ϵ^* are observed by the policymakers; (4) Money growth rates, m and m^*, are chosen simultaneously; (5) Macroeconomic outcomes are realized. That is, we study a "discretionary" policy environment, where there is some scope for stabilization policy due to the policymakers' information advantage.

The major contributions that we survey below can each be described within this common framework, or slight variant with alternative assumptions about the signs of partials in the objective function 7.1 and the reduced forms 7.4 - 7.6.

7.2. Notes on the literature

The model in this section is essentially the reduced form of the static models in Canzoneri and Henderson (1988, 1991). It also encompasses other models, like those in Canzoneri and Gray (1985) and Rogoff (1985), among others.

8. International externalities and domestic incentives

8.1. Conflict over stabilization

After the experience of the two oil shocks, the literature in the early to mid eighties focused on a particular aspect of decentralized and uncoordinated policymaking: inefficiencies may arise because individual countries try–in vain–to export some of the necessary adjustment to a common stagflationary shock to other countries. We illustrate the main idea in a first specialized version of our common framework, which is essentially the one suggested by Canzoneri and Henderson (1988).

In this version the two countries are completely symmetric. Neither the objective functions nor the output levels are directly affected by the real exchange rate which, however, directly affects CPI-inflation through import prices. Thus we assume:

$$W_z = W_z^* = X_z = X_z^* = 0. \tag{8.1}$$

Further, policymakers evaluate output realizations according to

$$W_x,\ W_x^* \gtrless 0 \quad \text{as} \quad x,\ x^* \lessgtr 0. \tag{8.2}$$

Thus, there are no shocks of the common-information type giving rise to domestic incentive problems:

$$\theta = \theta^* = 0. \tag{8.3}$$

The remaining shock is common to both countries:

$$\epsilon = \epsilon^*, \tag{8.4}$$

and has the character of a supply shock, in that

$$X_\epsilon = X_\epsilon^* < 0,\ P_\epsilon = P_\epsilon^* > 0, \text{ and } \quad Z_\epsilon = 0. \tag{8.5}$$

Cooperative policy. What would happen in a cooperative equilibrium? As usual, we assume in this regime that the two countries choose monetary policies so as to maximize the sum of their objective functions. For any ϵ, the optimal value for home money growth must satisfy the first-order condition:

$$W_p P_m + W_x X_m + (W_p P_z - W_{p^*}^* P_z) Z_m = W_p P_m + W_x X_m = 0, \tag{8.6}$$

where the first equality follows from the symmetry of the model (which makes $P_z^* = -P_z$). Taking expectations of 8.6 over ϵ, we can solve for equilibrium expectations, m^e. Plugging m^e back into 8.6 , we obtain the cooperative equilibrium value of m, conditional on ϵ. We label this value $m^C = M^C(\epsilon, \epsilon^*)$. By symmetry of structure and shocks, we have $m^{*C} = m^C = M^C(\epsilon, \epsilon)$.

We make four observations about the cooperative equilibrium defined by 8.6: First, if there is no supply shock, so that $\epsilon = 0$, each country reaches its first-best macroeconomic outcome at $m^C = M^C(0,0) = 0$. (This follows by P_m and X_m both being positive and by $W_p = W_x = p = x = z = 0$ at $m = m^e = m^* = m^{*e} = 0$.) Second, at non-zero values of ϵ, higher output has to be optimally traded off against higher inflation. (By 7.3 and 8.1, $sgn\ [x] = -sgn[p]$ at $m = m^e = 0$ for $\epsilon \neq 0$; it follows that $sgn[W_p] = -sgn[W_x]$ at $M^C(\epsilon, \epsilon)$.) Whether the home policymaker in fact chooses to expand or contract money growth depends on the relative weight he imposes on inflation relative to output and on the properties of the $P(\cdot)$ and $X(\cdot)$ functions. Hence, $M^C(\epsilon, \epsilon)$ can be positive or negative. Third, the effects of monetary policy that go through the real exchange rate are effectively ignored in the optimum solution. This is because the indirect effects of home monetary policy on the foreign inflation rate are internalized, and because of the symmetry–both in shocks and economic structure; formally, the third term in the leftmost expression in 8.2 is equal to zero. This is, of course, a precise analog to the results on intertemporal terms of trade effects in fiscal policy of

Section 2. Finally, due to the symmetry, the implied equilibrium real exchange rate change is independent of $\epsilon : z = Z^C(\epsilon, \epsilon) = 0$ all ϵ.

Non-Cooperative Policy. Suppose that the two policymakers instead make decentralized and independent monetary policy decisions. As in Part A, we study the Nash equilibrium associated with such non-cooperative behavior. The home country's policymaker thus sets m to maximize his objective, taking m^*, as well as m^e and m^{*e}, as given. This yields the first-order condition:

$$W_p P_m + W_x X_m = -W_p P_z Z_m. \tag{8.7}$$

Taking expectations of 8.7 over ϵ defines equilibrium expectations, m^e. Inserting them back into 8.7 yields the state-dependent non-cooperative equilibrium policy, $m^N = M^N(\epsilon, \epsilon^*)$.

How does this solution compare to the cooperative optimum? When there is no supply shock, $\epsilon = 0$, m^N like m^C implements the first best at $m = m^e = 0$. (The P, X and Z-partials are all non zero, whereas $W_p = W_x = p = x = 0$ at this point.) But when a non-zero symmetric supply shock is realized m^N is different from m^C. As can be seen from 8.6 and 8.7, the difference between the policies is proportional *to* $-W_p P_z Z_m$, an expression which has the same sign as ϵ at the cooperative optimum (as W_p has the opposite sign of ϵ and $P_z Z_m$ is always positive). Because the left-hand side of 8.6 and 8.7 is decreasing in m by concavity, we have

$$M^N(\epsilon, \epsilon) \underset{>}{\overset{<}{=}} M^C(\epsilon, \epsilon) \quad \text{as} \quad \epsilon \underset{<}{\overset{>}{=}} 0. \tag{8.8}$$

In other words, monetary policy is distorted in the absence of cooperation: here it is too contractionary when there is a stagflationary shock ($\epsilon > 0$), and too expansionary in the opposite case.

To see the intuition, consider a positive realization of ϵ. The home policymaker, who is optimally trading off high CPI-inflation against low output, has an additional incentive to contract money growth: to generate a negative value of z real appreciation–so as to lower CPI inflation via lower prices of imported goods. Hence, m^N is lower than m^C. But because the foreign policymaker has an analogous incentive, and because of symmetry, the effect on the real exchange rate is nullified in equilibrium. That is to say, $Z^N(\epsilon, \epsilon) = Z^C(\epsilon, \epsilon) = 0$. All that remains relative to the cooperative optimum is a contractionary bias in both countries. If both countries jointly expanded their money growth rates from m^N , their payoffs would improve: by 8.7 the increase in m would, by itself, have a zero (first-order) effect on W, but the accompanying increase in m^* would raise W by preventing a real depreciation and thereby limit the increase in home inflation. With a favorable supply shock, ($\epsilon < 0$), the non-cooperative equilibrium instead has an expansionary bias. The general result in this version of the model is thus that non-cooperative policymaking induces "overactivism" by policymakers.

How the bias depends on the supply shock is clearly affected by the specification of the macroeconomic model. Canzoneri and Gray (1985) also discuss policy

coordination in the context of supply shocks in a similar symmetric two-country world. But (in one version) their model has $P_z = 0$, $X_z > 0$. This leads to an expansionary bias as $\epsilon > 0$. Policymaking is thus still distorted, albeit in a different direction.

8.2. Conflict over real income

The international conflict in the previous section is only temporary. We have already seen that the cooperative and non-cooperative solutions coincide if $\epsilon = 0$. A temporary supply shock thus causes only a temporary conflict over stabilization. In a richer, dynamic model the conflict would still only be temporary, even if the ϵ-shock was permanent. The policymaker's *incentive* to export inflation to the foreign country, by decreasing domestic output via a surprise monetary contraction, would certainly remain. But his *ability* to do so goes away once the original wage contracts are rewritten (formally, the ϵ-shock would become a θ-shock). Suppose, however, that we amend the model in Section 8.1 with real income objectives for policymakers. That is, the model is exactly the same except that the home country policymaker values an improvement in its terms of trade, a decrease in z

$$W_z = -W_z^* < 0. \tag{8.9}$$

This adds a permanent source of conflict between the countries, which is really the same as in Section 2 above.

Cooperative Policy. The first-order condition for home money growth in this amended version of the model becomes:

$$\begin{aligned} W_p P_m + W_z X_m + [(W_p - W_{p^*}^*)P_z + (W_z + W_z^*)]Z_m = \\ W_p P_m + W_z X_m = 0, \end{aligned} \tag{8.10}$$

where we have used 8.9 to arrive at the second equality. Comparing 8.10 and 8.6, the optimal cooperative policy is exactly as before. This is a pretty obvious result: internalizing the spill-over effects on the foreign country in a symmetric model is effectively identical to removing the international real income conflict.

Non-Cooperative Policy. With non-cooperative monetary policymaking, the corresponding first-order condition is

$$W_p P_m + W_z X_m = -(W_p P_z + W_z) Z_m. \tag{8.11}$$

The home country policymaker now has an incentive to improve the terms of trade via contractionary monetary policy once wage contracts have been written. This incentive is captured by the new term $-W_z Z_m$ on the right hand side of 8.11. This term is always positive, independently of ϵ, which adds a permanent contractionary bias to monetary policy. But this incentive will be frustrated in equilibrium; by a similar contractionary incentive abroad, we still have $Z^N(\epsilon, \epsilon) = 0$.

We can make two observations about the associated non-cooperative equilibrium: Unlike in the stabilization example, non-cooperative policy no longer corroborates the cooperative optimum in the absence of supply shocks. This, of course, reflects the presence of a permanent conflict over the terms of trade. Also, the conflict over real income may either reinforce or weaken the conflict over stabilization. If we have an adverse supply shock, $\epsilon > 0$, the stabilization and real income incentives pull in the same direction, namely towards a more contractionary policy than in the cooperative optimum ($W_p P_z$ and W_z have the same sign). But when $\epsilon < 0$, they pull in different directions. Indeed, by continuity (of P_z and W_p), there must be a negative value of ϵ such that the non-cooperative and cooperative policies coincide (for this value, W_p is precisely equal $to - P_z/W_z$, at the point $M^C(\epsilon, \epsilon)$).

8.3. Domestic credibility problems

In the two examples above, the only prospective source of inefficiency is the lack of cooperation between the two governments. To say this in another way: the cooperative optimum is an *ex post* Pareto optimal outcome from the viewpoint of the two policymakers. But as we have already seen in the analysis of part A, the result changes when we add binding domestic incentive constraints. The recent macroeconomic literature has stressed how lack of commitment in monetary policy may generate an inflation bias. In a perceptive and early contribution, Rogoff (1985) pointed out how such domestic incentive problems may render international cooperation undesirable. We now illustrate his argument in a specialized version of the model. The thrust of the analysis closely resembles our treatment of credibility problems in capital taxation in Section 4.

We go back to the setup of Section 3.1 above, where there are no direct effects of the real exchange rate on policy objectives or outputs, so that 8.2 holds.[14] To simplify the argument, we initially assume that there are no ϵ-shocks. On the other hand, there is a common θ-shock. We let θ measure the distance between the home policymaker's preferred level of output and the natural rate.[15] All realizations of θ are assumed to be positive. In summary, we thus make the following assumptions:

$$W_z = W_z^* = X_z = X_z^* = 0, \tag{8.12}$$

[14]Rogoff's model actually has the property that the a real exchange rate depreciation has a negative effects on output: X_z, $X_z^* < 0$. This may be because nominal wages are (partly) indexed to the CPI, or because domestic production requires foreign intermediate inputs. None of our qualitative results below hinge on ignoring this effect, however.

[15]We could think about this shock either as fluctuations in the natural rate for a given target level of output, or as fluctuations in the policy objective for a given natural rate. As it stands, our model has the latter interpretation, in that we keep the natural rate of output fixed at zero, but this is really only a matter of normalization.

$$W_x,\ W_{x^*}^* \gtrless 0 \text{ as } \quad x,\ x^* \lessgtr \theta, \tag{8.13}$$

$$W_{x\theta} > 0, \tag{8.14}$$

$$\theta = \theta^*, \tag{8.15}$$

$$\epsilon = \epsilon^* = 0. \tag{8.16}$$

We continue to assume that the two countries are symmetric also in all other respects.

Cooperative Policy. Assume as before that the two policymakers agree to set their money growth rates so as to maximize the sum of their objectives, given the realization of θ and the private expectations $m^e(\theta,\theta)$ and $m^{*e}(\theta,\theta)$. The optimum condition for m becomes

$$W_p P_m + W_x X_m + (W_p P_z - W_{p^*}^* P_z) Z_m = W_p P_m + W_x X_m = 0. \tag{8.17}$$

This first-order condition is identical to 8.6, with which it shares the property that the real exchange rate effect of domestic monetary expansion is effectively ignored in the cooperative optimum. Yet it does not produce the same solution. Consider the hypothetical solution $m = m^e = 0$, which would produce $p = x = 0$. Whereas the marginal cost of inflation W_p is zero at that point, by 7.2, the marginal benefit of output W_x is positive, by 8.13. There is evidently an incentive to expand monetary policy, given that X_m is positive. This incentive keeps on biting up to the point where W_p has become sufficiently negative to deter further expansion. How far m and p have to rise depends on θ. We thus have $M^C(\theta,\theta) > 0$, with $M_\theta^C > 0$. But because θ is public information (and there are no other shocks), the policy is completely anticipated, so that $m^e(\theta,\theta) = M^C(\theta,\theta)$.

To summarize, we end up with positive inflation $p > 0$, but with output at the natural rate, $x = 0$. The policymaker would like to announce the policy $m = 0$ *ex ante*. In the absence of a commitment technology such an announcement is not credible, however, because it is not incentive compatible *ex post*. Of course, this is nothing but the well known Kydland-Prescott *cum* Barro-Gordon inflation bias as it appears in our particular model. Since monetary policies are perfectly anticipated, the real exchange rate is equal to its natural value $Z(\theta,\theta) = 0$, for all θ.

Non-Cooperative Policy. In the absence of cooperation, policymakers no longer ignore the real exchange rate effects of monetary policy. Equilibrium monetary policy in the home country has to satisfy the same condition as in section 8.1, which we can rewrite as

$$W_p(P_m + P_z Z_m) + W_x X_m = 0. \tag{8.18}$$

The equilibrium choice of m still involves trading off the marginal cost of higher inflation against the marginal benefit of higher output. Hence, m continues to be an increasing function of θ, $M^N(\theta,\theta)$. But the policymaker now perceives an

additional marginal cost when considering an expansion of m : for given foreign monetary policy, a expansion generates a real depreciation, whereby higher prices of imported goods add further to CPI-inflation (this corresponds to the term $W_p P_z Z_m$ on the left hand side of 8.18). Clearly then, $M^N(\theta,\theta) < M^C(\theta,\theta)$ for any θ. Again, policy is perfectly anticipated such that $m^c(\theta,\theta) = M^N(\theta,\theta)$ and $x = 0$, for all θ. And, again, we have an identical outcome in the foreign country, such that the equilibrium has $z = 0$. Clearly then p is always higher in the cooperative regime, which makes the outcome strictly worse than in the non-cooperative regime.

Perceived exchange rate effects thus provide a disincentive to inflate, which by itself creates a contractionary bias in monetary policy. This contractionary bias is a vice in a setup with only international conflict–as in Sections 8.2-3. But it becomes a virtue when coupled with a domestic incentive problem, which tends to give too much rationally expected inflation without any gains in employment. The parallels with the second-best arguments in sections 3 and 4 should be obvious.

If we reintroduce the supply shocks from Sections 3.1-2, we clearly get a trade-off: cooperation is helpful in promoting more efficient stabilization, but unhelpful in not putting a check on the domestic incentive problem. Whether the benefits outweigh the cost depends on whether the coordination problem is more serious than the credibility problem. An *ex ante* assessment of which regime would be preferable would have to rely on comparing the expected value of the objective 2.1 under specific assumptions about the distributions for θ and ϵ. Rogoff takes this to imply that gains form cooperation can be ensured only when appropriate domestic institutions are in place. We leave the discussion of this and other institutional issues to Section 9 below.

Discussion. The second-best logic of two incentive constraints pulling in different directions also helps to understand other "paradoxes" in the literature on monetary policy coordination. One example is the result due to Oudiz and Sachs (1985), who showed that when policymakers do not cooperate, having access to commitment in monetary policy may reduce each country's payoff. A similar result holds with regard to the exchange of information. The informal literature often argues that the international exchange of information always produces better outcomes, even in the absence of joint policy choice. But, drawing on the IO-literature on information sharing, Gosh and Masson show (1994, Ch. 7), that information exchange can sometimes produce worse outcomes. The reason, in their model, is that policymakers who ignore the realization of foreign shocks pursue underactivist policies. Exchange of information may or may not lead to better outcome, depending on whether there is underactivism or overactivism in the Nash equilibrium without information exchange.[16]

[16]Edison and Henderson (1990) also distinguish between cooperation and coordination and conclude that information exchange (*i.e.* cooperation) generally helps. Their argument is different, however, and relies on the insight that policy coordination games often have multiple equlibria, because of mutliple instruments, or reputational effects, for instance. Then commu-

When discussing Rogoff's paradoxical result, Canzoneri and Henderson (1988) stress an interpretation in terms of coalitions: cooperation between a subset of the players in a game (here, the two governments, but not private agents forming expectations) does not necessarily produce better outcomes for these players, even though cooperation by the grand coalition of all the players would. The same logic helps understand why, as in Canzoneri and Henderson (1991, Ch. 3), cooperation by two countries separately in a three-country world may actually reduce the equilibrium payoff to the cooperating countries.

8.4. Notes on the literature

Several of the papers in Bryant et. al (1988) discuss the empirical importance of international policy spillovers. Horne and Masson (1988) and Fischer (1988) survey a number of studies that attempt to measure empirically the gains from coordination. Most studies seem to find relatively modest gains from coordination, a fact that Canzoneri and Henderson (1991) attribute to the nature of the exercise: the studies allow for gains from joint stabilization, but not from eliminating permanent conflicts. Perhaps one may speculate that allowing in empirical studies for domestic incentive problems may give rise to larger prospective gains from coordination, but only to the extent that coordination serves to eliminate first-order losses due to these domestic incentive problems.

Miller and Salmon (1985) derived a Rogoff-type result in a dynamic policy game, based on a two-country version of the sticky-price Dornbusch overshooting model, whereas van der Ploeg (1988) demonstrated it in a model where the private sector in each country is modeled as a forward-looking and intertemporally maximizing representative agent. A related paradox can be found in Frenkel and Rockett (1989), who demonstrate that coordination of monetary policies may lead to worse outcomes if policymaker's disagree over how the world economy works. The Oudiz-Sachs result mentioned in the text relies on a truly forward looking private sector; it is exposited in a two-period model by Canzoneri and Henderson (1991, ch 5). Similar results can also be found in Levine and Currie (1987) and in Currie, Levine, and Vidalis (1987).

9. Domestic institutions in monetary policy

Suppose the international environment indeed implies important international spillover effects in monetary policy. So far, we have only discussed prospective gains from policy cooperation, arising from the joint choice of policy instruments to maximize the worldwide payoff. Which mechanisms can decentralize the cooperative outcome to policymakers who set their policy instruments to maximize

nication, may allow the countries to coordinate on a favorable Nash equilibrium, which could produce gains without any need for outside enforcement.

their individual payoffs? One answer in the literature is that cooperative outcomes in a non-cooperative setting can be enforced by "reputational mechanisms" when policymakers interact repeatedly over time. We do not pursue that line of argument here. The main reason is that it is already well-known: applications of the "folk theorem" of repeated games abound in many branches of the recent economics literature dealing with strategic interaction. All the drawbacks of the argument–like its lack of predictive power because of multiple equilibria–are well known, too. The recent book by Canzoneri and Henderson (1991, Chs. 4-5) discusses reputational forces in a strategic international monetary setting at length.

Instead, we discuss implementation by contractual mechanisms. Specifically, we borrow freely from the microeconomic literature on contracts and principal-agent relations. In our view, the role that central banks play in the design of monetary policy throughout the developed world supports the idea that an analysis of optimal delegation can yield important insights. This is the approach taken by Persson and Tabellini (1993) and Walsh (1994), who have studied how to tackle domestic incentive problems in monetary policy by institution design. As we shall see, a contractual approach can also be used to reinterpret some of the existing literature on institutions and international policy cooperation. In this section we look at decentralized policymaking without any international institutional arrangements in place. But in the next section we introduce more centralized arrangements, to end up in full monetary union with centralized policymaking.

9.1. One-sided exchange rate pegs

The paper by Canzoneri and Gray (1985) also studies a fixed exchange rate regime in the context of international conflict over stabilization. In their perceptive approach, a fixed exchange rate regime is modeled as a particular non-cooperative game, where one country makes a one-sided commitment to a specific monetary policy "reaction function", while the other country chooses its policy freely. This regime implements the cooperative optimum in a symmetric setting like the one in Section 8 above. In this subsection we first demonstrate how the Canzoneri-Gray result can be interpreted as a contractual arrangement. But we also show that the result is not robust and discuss its underpinnings.

General setting. In one of the countries–the home country for concreteness–we now distinguish explicitly between two public authorities: "society" (that is, a benevolent government or a social planner) is the principal that delegates the conduct of monetary policy to its agent, "the central bank". Society has the objective function identified by 7.2 and writes a "performance contract" with its home central bank. The central bank shares society's overall objective, but also cares about a transfer, T, provided under the contract. This transfer can be thought of either as direct performance related pay, or as indirect rewards

and punishments. The central bank thus maximizes $(W + T)$. Unlike in the literature on contracts and regulatory design, we assume that the transfer is not costly to the principal, because the budgetary or non-pecuniary consequences of the transfer to the central bank are likely to be negligible relative to the macroeconomic outcomes at stake. However, we do assume the agent requires a specific minimum (and positive) expected payoff to participate in the game.

Symmetric shocks. Consider the symmetric supply shock model of section 8.1. Before any other event takes place, the home country imposes a non-linear performance contract on its central bank. The contract is defined over the change in the nominal exchange rate, s :

$$T^s(s;\epsilon,\epsilon*) = \begin{matrix}\alpha \text{ if } s=0\\ \alpha - c \text{ otherwise,}\end{matrix} \tag{9.1}$$

where c is a positive number and α is chosen so as to fulfill the agent's participation constraint. Thus, if the home central bank abandons the pegged exchange rate, it faces a prohibitive cost, provided that c is high enough (it exceeds the value of W for all realizations of policies and shocks).[17] The rest of the model is as before, except that we adopt the following timing: (1) Society commits to a contract in the home country; (2) Expectations m^e and m^{*e} are formed; (3) The shock ϵ is realized; (4) The foreign policymaker chooses m^*; (5) The home central bank chooses m; (6) Macroeconomic outcomes are realized.

Clearly, this performance contract will make the home central bank choose the same money growth as the foreign policymaker, to keep the exchange rate fixed. This follows, because the nominal exchange rate change

$$s = z + q - q^*,$$

is zero if and only if $m = m^*$, given that the equilibrium in this regime will again have the property that $m^e = m^{*e} = 0$.[18] Faced with this reaction function, when choosing m^* at stage (4), the foreign policymaker realizes that $z = 0$ whichever policy he sets. His optimal policy choice therefore ignores any effects on z and is thus defined by the first-order condition:

$$W^*_{p*}P^*_{m*} + W^*_{x*}X^*_{m*} = 0. \tag{9.2}$$

[17]This way of modeling a fixed exchange rate regime is related to the approach in Obstfeld (1992), who does not use the contractual language explicitly, but nevertheless assumes that a central bank faces a lump sum cost for breaking its promise to peg the exchange rate. The structure of the game is also somewhat reminiscent of the setup studied in Lohman (1992) where a central banker is choosen *ex ante* together with a lump-sum penalty to society for firing him *ex post*.

[18]Using 7.1 we can write s as:

$$s = Z(m - m^e, m^* - m^{*e}; \epsilon, \epsilon) + Q(m;\epsilon) - Q^*(m^* * \epsilon^*).$$

From $m^e = m^{*e} = 0$, and symmetry plus linearity of the reduced forms, it follows that s is zero if and only if $m = m^*$.

But this, as we know, is exactly the condition that produces the cooperative optimum. Thus, we have a Nash equilibrium which implements the cooperative solution with $m = m^* = M^C(\epsilon, \epsilon)$.

The lesson is thus that, in this symmetric setting, there is no need for any cooperative agreement. The cooperative solution can be self-enforced in a decentralized non-cooperative setting by a one-sided exchange rate peg. What is necessary is that the home government's contract with its central bank includes strong enough sanctions for giving up the fixed exchange rate. Notice also that this arrangement presupposes a certain independence of the central bank in the pegging country, such that a de facto delegation of monetary policy is feasible. It is tempting to think of the examples of the successful one-sided peg of the Austrian schilling against the Deutschmark during the last ten to fifteen years along these lines. The Austrian central bank has a very independent position by its statute from 1984, and an explicit legislated target to protect the internal and external value of the schilling. Also, the Austrian and German economies are integrated enough that the symmetry assumption seems to make sense.

Asymmetric shocks. Clearly, the result that a contract inducing the home country policymaker to keep the exchange rate fixed is not robust to natural extensions of the model. An important proviso is the symmetry assumption. Specifically, when the two countries have asymmetric economic structures or face less than perfectly positively correlated shocks, the cooperative optimum entails an asymmetric policy response. To fix ideas, consider the opposite case of perfectly negatively correlated shocks

$$\epsilon^* = -\epsilon. \tag{9.3}$$

so that

$$X_\epsilon = -X^*_\epsilon < 0,\ P_\epsilon = -P^*_\epsilon > 0, \text{ and } \quad Z_\epsilon < 0. \tag{9.4}$$

In this case the *cooperative* optimum policies (under hypothetical joint decision making) will be mirror images of each other. The two policies have to satisfy

$$W_p P_m + W_x X_m = -2W_p P_z Z_m, \tag{9.5}$$

$$W^*_{p^*} P^*_{m^*} + W^*_{x^*} X^*_{\cdot} = -2W^*_p P^*_z Z^*_{m^*} = 2W_p P_z Z_m, \tag{9.6}$$

where we have used the fact that $W_p = -W^*_p$ by $\epsilon^* = -\epsilon$, and that $P_z = -P^*_z$, and $Z_m = -Z^*_{m^*}$ by symmetry. From 9.4 it follows that $M^C(\epsilon, -\epsilon) = -M^{*C}(\epsilon, -\epsilon)$. The equilibrium real exchange rate change has the opposite sign of ϵ in this cooperative optimum

$$sgn[Z^C(\epsilon, -\epsilon)] = -sgn[\epsilon]. \tag{9.7}$$

In words, a negative supply shock at home together with a positive supply shock abroad calls for a real appreciation of the home currency under the assumptions of the model.

It is easy to show that the bias in the *non-cooperative* simultaneous move equilibrium goes in the opposite direction to the symmetric-shock case. For example, if $\epsilon = -\epsilon^* > 0$, the home country expands its money growth rate too much if it fails to internalize that the foreign country–having suffered a positive supply shock–desires higher inflation, something which would be helped by a further fall in z.

Suppose that the home country government has written a performance contract with its central bank, which like 9.1 penalizes any failure to keep the exchange rate fixed. If the penalty is stiff enough, so that the home central bank complies for all realizations (ϵ, ϵ^*), then the resulting policy is not only worse than the cooperative optimum, but even worse than the simultaneous move non-cooperative equilibrium. The reason is that, given $\epsilon = -\epsilon^*$, there is only one difference $m - m^*$ that keeps s constant at 0. Thus, the home central bank still reacts one-for-one to changes in m^*.[19] This means that the foreign policymaker again effectively ignores the effect of his policy on z, and sets policy so as to fulfill 9.2. But as we have seen, in 9.4, the cooperative optimum requires not only that he take this effect into account, but that he give it double weight!

Discussion. A fixed exchange rate contract is thus only beneficial for both countries in the case of extreme symmetry. Suppose we are willing to make the symmetry assumption. Two further problems with the Canzoneri-Gray result are revealed by thinking about it in contracting terms. One is the rationale for the fixed exchange rate contract. So far we have taken the existence and form of the contract as exogenous. In the contracting framework it becomes natural to ask whether it is indeed in the interest of the central bank's principal–society–to write the contract in this particular way. The solution is admittedly Pareto optimal, but if the principal has the ability to impose a binding contract on its agent, it can likely achieve a strategic advantage by giving contractual incentives to its central bank to act in a more aggressive way, so as to impose a larger burden of the adjustment on the foreign country. Put differently, if we endogenize contract formation in the framework of this section, the fixed exchange rate contract is unlikely to be credible in the sense that it survives as a subgame perfect equilibrium.[20] A related problem is the asymmetric roles of the two countries. The home country can commit to a contract, whereas the foreign country cannot. But the foreign central bank can commit to a policy, whereas the home central bank cannot. The result would perhaps be more convincing if the roles of the two countries were more symmetric.

[19]The reaction function for the home central bank can be found from the requirement that $s = z + q - q^*$ is kept constant, which implies

$$dm/dm^* = (Q^*_{m^*} - Z_{m^*})/(Q_m + Z_m) = 1,$$

where the last equality follows from symmetry.

[20]See Giavazzi and Giovannini (1989) for a discussion about how such incentives may break up a fixed exchange rate arrangemant.

The next section shows that these difficulties are not necessarily insurmountable. There we study a different, and more symmetric institutional setup, where the cooperative optimum can be implemented as a subgame perfect equilibrium with decentralized delegation of monetary policy and endogenous contract formation in both countries, even with asymmetries in shocks or structure.

9.2. Decentralized contracting and policymaking

Suppose now that the government in each of the two countries delegates monetary policy to its central bank in the same stabilization context as above. As before this is done by a state-dependent non-linear performance contract, which is written before anything else happens. Importantly, both contracts are publicly observable. Under these conditions, the general results on delegation games in Fershtman, Judd and Kalai (1991) apply, which means that the cooperative optimum is indeed a subgame perfect equilibrium. As far as we know, this recent idea has not yet been applied to international policy coordination. We argue below that the underlying logic may have particular appeal in the case at hand, even though it cannot handle interesting extensions.

Implementation. The underlying economic assumptions are as in Section 4.1, but the supply shocks can have any correlation structure. The timing instead is more symmetric, namely: (1) The two governments simultaneously impose performance contracts on their central banks, which are observed by everyone; (2) Expectations are formed; (3) Supply shocks are realized; (4) The two central bankers simultaneously choose monetary policies; (5) Macroeconomic outcomes are realized.

Suppose that at stage (1) the home government writes a contract with its central bank of the following form

$$T^W(W, W^*; \epsilon, \epsilon^*) = \begin{array}{l} \alpha \text{ if } W(m,m^*;\epsilon,\epsilon^*),\, W^*(m^*,m;\epsilon,\epsilon^*) \geq W^C(\epsilon,\epsilon^*), W^{*C}(\epsilon,\epsilon^*) \\ \alpha - c \text{ otherwise} \end{array} \tag{9.8}$$

and that the foreign government writes an analogous contract. $W(m, m^*; \epsilon, \epsilon^*)$ is the reduced form expression for the home government's payoff given m and m^* and $W^C(\epsilon, \epsilon^*)$ is the home country's payoff at the cooperative optimum in state ϵ, ϵ^*. The contract in 9.8–and its foreign counterpart–is again on target compensation form. But rather than over the exchange rate, it is defined directly over government payoffs, and hence indirectly over monetary policies. Note that the *home* contract is contingent on the payoff of *both* countries. The home central banker is rewarded if the cooperative payoffs are reached by both countries, but not otherwise.

Key to the implementation result is that the strategy of each central banker is made conditional on the contracts in both countries. Specifically, assume that

the home central bank's strategy is:

$$m(\epsilon,\epsilon^*) = \begin{matrix} M^C(\epsilon,\epsilon^*) \text{ iff } [T^W(W,W^*;\epsilon,\epsilon^*),\ T^{*W}(W^*,W;\epsilon,\epsilon^*)] \geq (\alpha,\alpha) \\ M^N(\epsilon,\epsilon^*) \text{ otherwise} \end{matrix} \tag{9.9}$$

and that the foreign central bank chooses $m^*(\epsilon,\epsilon^*)$ in an analogous way.

The strategies specified in 9.8-9.9 constitute a subgame perfect equilibrium that implements the cooperative optimum policies for each realization of $(\epsilon,\ \epsilon^*)$. Clearly, once the performance contracts 9.8 are in place, it becomes optimal for the central banks to respond with the cooperative policies.[21] What about the incentives for the two societies to write the contracts in this way? Suppose home society contemplates a deviation. Because the suggested equilibrium is *ex post* Pareto optimal, writing another contract that alters the home central bank's policy must either lower the home country's payoff, which can never be optimal, or else increase its payoff at the expense of the foreign country. But in the latter case the foreign central bank can not achieve the target payoff prescribed in its contract. Consequently it chooses the policy $M^{*N}(\epsilon,\epsilon^*)$, to which the home central bank optimally responds by setting $M^N(\epsilon,\epsilon^*)$. This is clearly worse than achieving the cooperative outcome in both countries. Note that on important role of the contract in each country is to induce good behavior of the central bank *abroad*. This is a nice analog to our earlier delegation result in Section 5, where the median voter in each country had incentives to elect a policymaker with distorted preferences precisely to induce a better tax policy abroad.

This is not the unique subgame perfect equilibrium contract implementing the optimum: any payoff for cooperative behavior for the agents that satisfy their participation constraints will do the same trick. However, these equilibria are all equivalent in policy outcomes. If the transfers were indeed costly to the two principals, setting the rewards such that each agent received a net payoff that just satisfied his participation constraint would be the unique subgame perfect equilibrium–see however footnote.

Discussion. Applying the Fershtman-Judd-Kalai argument to policy coordination games may seem a little contrived to some readers. We will spell out some of the obvious weaknesses below, but we still think there are some interesting insights. One is that the implementation here is entirely decentralized and does not require any international agreements. The government in each country *de facto* commits to following the cooperative monetary policies, but only through the contracts with their own central banks. Implementation, of course, requires that these rather elaborate domestic contracts are enforceable. At a general level, however, an ability to commit through *domestic* institutional arrangements seems

[21]This is not the only equilibrium: $(M^N,\ M^{*N})$ is also an equilibrium of the agents game. Fershtman, Judd and Kalai (1991) discuss how to redefine the delegation game so as to get rid of equilibria that are Pareto dominated for both agents. When the agents are communicating, as is certainly the case in international policy coordination, Pareto dominated equilibria are clearly implausible. See also the distinction in Footnoote 16 between cooperation and coordination.

eminently more plausible than being able to commit to an international contract, at least if we think of the suggested cooperation as applying to discretionary deals in response to ongoing shocks in the world economy. We basically agree with Feldstein's (1988) claim that it is probably unrealistic to expect real-world policymakers to pursue policies that run against their domestic interests. Therefore, it is interesting that strong domestic institutions may lead to internationally cooperative outcomes purely as a result of self interested choices.

But the implementation scheme we have studied also has severe drawbacks. One is that it relies heavily on the very sharp "take-it-or-leave-it" incentives embodied in our non-linear and state-dependent contracts. A second drawback is that the contracts are defined over payoffs, rather than over policies that may be easier to observe. And a third is that *ex post* Pareto optimality of the underlying cooperative policies is a necessary condition for the scheme to work. This means that the argument can be extended to policy environments with a permanent conflict over the terms of trade, as in Section 8.2. But it need not apply to a policy environment with domestic incentive problems, such as the credibility problems studied in Section 8.3. Some of these drawbacks are addressed in the next section, which deals with a contractual approach to rules-based prospective cooperation within the context of institutionalized and multilateral international monetary arrangements.

9.3. Notes on the literature

After Canzoneri and Gray, several authors have studied how alternative rules-like policy assignments to central banks might help improve on non-cooperative equilibria. Giavazzi and Giovannini (1989) study exchange rate arrangements and show that it makes a difference whether the pegging country's policy instrument is the exchange rate rather than the money supply. Frankel (1991) considers a more symmetric arrangement and argues that symmetric nominal income targeting may overcome some of the obstacles to policy coordination.

The analogy between the central banks as agents to their political principals and managers as agents to their firms' owners, or natural monopolies as agents to their government regulators has been noted for a long time, but it is only recently that it has entered the formalized literature. Vickers (1985) is an early contribution to the industrial organization literature on strategic vertical delegation, which is usefully surveyed by Caillaud and Rey (1994). The central reference to the modern literature on regulation and contracts is Laffont and Tirole (1993).

10. International institutions in monetary policy

10.1. Multilateral pegs

We remain in the stabilization model of Sections 8-9 without a direct conflict over the terms of trade. However, we now allow for both ex ante observable (to wage setters) θ-shocks and unobservable ϵ-shocks, and for an arbitrary correlation structure between these shocks. As before, the countries are completely symmetric in all other respects. We now show that international institutions may help resolve credibility problems, as well as international coordination problems. This result squares with the observation that many countries seem reluctant to find domestic solutions to their credibility problems and resort instead to international arrangements.

To get some perspective on this question, we first consider a single *international* principal trying to provide the two central banks with the appropriate incentives for their decentralized policymaking via a pair of contracts. These contracts can be thought of as being written at an initial "institution design stage", when negotiators from the two symmetric countries get together and form a binding international agreement. At this point in time the objective function is the sum of the two countries expected payoffs:

$$E[W(p, x, z; \theta, \epsilon) + W^*(p^*, x^*, z; \theta^*, \epsilon^*)], \tag{10.1}$$

where E denotes the unconditional expectations operator, taken over $(\theta, \theta^*, \epsilon, \epsilon^*)$.

We assume the following sequence of events: (1) An international principal imposes a performance contract on each central bank, observed by everyone; (2) θ and θ^* are realized; (3) Expectations about m^c and m^{*c} are formed; (4) ϵ and ϵ^* are realized; (5) The two central banks simultaneously choose monetary policies; (6) Macroeconomic outcomes are realized.

To get a handle on what contracts the principal would like to write, consider the hypothetical problem of finding the state-contingent policies $m(\theta, \theta^*, \epsilon, \epsilon^*)$ and $m^*(\theta, \theta^*, \epsilon, \epsilon^*)$ that maximize 10.1, under the constraint that private expectations are formed rationally:

$$m^c(\theta, \theta^*) = E_{\epsilon,\epsilon^*}[m(\theta, \theta^*, \epsilon, \epsilon^*)],\ m^{*c}(\theta, \theta^*) = E_{\epsilon,\epsilon^*}[m^*(\theta, \theta^*, \epsilon, \epsilon^*)]. \tag{10.2}$$

Here, E_{ϵ,ϵ^*} denotes the conditional expectations operator, that is the expectation taken over (ϵ, ϵ^*), given the realization (θ, θ^*). The solution to this problem gives the *ex ante* optimal policies from the point of view of the international principal.

Eliminating the multipliers on the constraints in 10.2, and exploiting symmetry, the first-order conditions for the optimal choices of $m(\theta, \theta^*, \epsilon, \epsilon^*)$ and $m^*(\theta, \theta^*, \epsilon, \epsilon^*)$ can be written as:

$$W_p P_m + (W_x - E_{\epsilon,\epsilon^*} W_x) \cdot X_m + (W_p - W_{p^*}^*) \cdot P_z Z_m = 0, \tag{10.3}$$

$$W^*_{p^*} P_m + (W^*_{x^*} - E_{\epsilon,\epsilon^*} W^*_{x^*}) \cdot X_m - (W^*_{p^*} - W_p) \cdot P_z Z_m = 0. \qquad (10.4)$$

Recall that the derivatives of W and W^* are linear in the macroeconomic outcomes, which themselves are linear functions of m, m^*, m^e, and m^{*e}. For each state, these two conditions are therefore linear functions of $m(\theta, \theta^*, \epsilon, \epsilon^*)$, $m*(\theta, \theta^*, \epsilon, \epsilon^*)$ and of the expectations $m^e(\theta, \theta^*)$ and $m^{*e}(\theta, \theta^*)$. We can find the latter by taking expectations (over ϵ and ϵ^*) of 10.3 and 10.4. Plugging the resulting expressions into 10.3 and 10.4, we have two equations in two unknowns and we can solve for the *ex ante* optimal state-contingent policies under cooperation.

The tradeoffs expressed in 10.3 involve terms that are all familiar from the above analysis, with one exception. The third term in 10.3, $-E_{\epsilon,\epsilon^*} W_x X_m$, measures the marginal cost of higher expected money growth (inflation), which it is appropriate to internalize at stage (1), before private agents have formed their expectations. Note that this term depends on θ, because W_x is increasing in θ, but not on θ^*. Similarly, the third term in 10.4, $-E_{\epsilon,\epsilon^*} W^*_x X_m$, depends on θ^* but not on θ. For future reference, we note an important property of the optimal state-contingent policies: it is possible to show that they are not dependent on the realizations of θ and θ^*. The optimal policies under hypothetical commitment thus do not respond to observable shocks. Intuitively, this is because (i) agents have rational expectations, (ii) real variables are only affected by monetary surprises, and (iii) the cost of expected inflation does not depend directly on θ and θ^*. We refer to the resulting policies as $M^{CC}(\epsilon, \epsilon^*)$ and $M^{*CC}(\epsilon, \epsilon^*)$, where CC stands for cooperation and (hypothetical) commitment.

We now show that the central-bank contracts can be structured to implement the *ex ante cooperative* optimum. Consider the incentives faced by the home central bank when it chooses policy *ex post* and in a decentralized fashion, without any contracts in place at stage (3). The partial derivatives of W and W^* with respect to m and m^*, taking $m^e(\theta, \theta^*)$ and $m*^e(\theta, \theta^*)$ as given, are:

$$\partial W / \partial m = W_p P_m + W_x X_m + W_p P_z Z_m \,. \qquad (10.5)$$

$$\partial W^* / \partial m* = W^*_p P_{m^*} + W^*_p X_{m^*} - W^*_p P_z Z_m \,. \qquad (10.6)$$

Compared to the expressions in 10.3 and 10.4, two terms are missing from each expression. The missing terms reflect the incentive constraints faced by the individual agents setting policy *ex post* at stage (3), namely credibility and individual, rather than joint, optimality. Unlike the common international principal setting policy *ex ante* at stage (1), the two central banks take expectations as given, and thus neglect the effect of equilibrium policy on expectations–the third term in 10.3 and 10.4. Similarly, they neglect the spillover effects of domestic policy on inflation abroad–the fifth term in 10.3 and 10.4. The role of a useful contract is thus to implement the policies $M^{CC}(\epsilon, \epsilon^*)$ and $M^{*CC}(\epsilon, \epsilon^*)$, by making the central banks at stage (3) internalize the effects of policy on expectations and foreign payoffs, and hence correct the distortions induced by *ex post*, decentralized

policymaking. (As we have seen in Section 8.3, these two incentive constraint may well pull in opposite directions, so it is unclear exactly how distorted equilibrium outcomes would be.)

Optimal contracts. In the model at hand, there are multiple performance contracts the principal could impose on the two central banks at stage (1), to implement $M^{CC}(\epsilon, \epsilon^*)$ and $M^{*CC}(\epsilon, \epsilon^*)$ at stage (3). By assumption, the change in the nominal exchange rate s and the two CPI's p and p^* are linear functions of m and m^*. This means that the right incentives can be embodied in performance contracts over any combinations of these variables, provided that state-contingent contracts can be written. In particular, a feasible way to implement the optimum is a policy assignment where–say–the foreign country's central bank has a performance contract tied to m^* (or p^*), whereas the home central bank has an exchange-rate contract tied to s. These contracts could clearly be written on the same non-linear, take-it-or-leave-it form as in Section 9. But the principal could also impose the right marginal incentives for $M^{CC}(\epsilon, \epsilon^*)$ and $M^{*CC}(\epsilon, \epsilon^*)$ by two *linear* performance contracts, in close analogy with the linear contracts in the closed economy models of Persson and Tabellini (1993) and Walsh (1994). Such linear performance contracts embody less stark and perhaps more intuitive incentive mechanisms. In particular, the following pair of contracts would work:

$$T^s(s;\, \theta, \epsilon, \epsilon^*) = \alpha - t^s(\theta, \epsilon, \epsilon^*) \cdot s \tag{10.7}$$

$$T^{m^*}(m^*;\, \theta^*, \epsilon, \epsilon^*) = \alpha - t^{m^*}(\theta^*, \epsilon, \epsilon^*) \cdot m^*. \tag{10.8}$$

Thus, both central banks face performance contracts that are linear in the exchange rate and the money growth rate, respectively. The state-contingent slope coefficients are given by $t^s(\theta, \epsilon, \epsilon^*) \equiv (E_{\epsilon,\epsilon^*} W_x X_m + W_p^* P_z Z_m)/(Z_m + Q_m)$ and $t^{m^*}(\theta^*, \epsilon, \epsilon^*) \equiv E_{\epsilon,\epsilon^*} W_{x^*}^* X_m - W_p P_z Z_m$, where it is understood that the derivatives are evaluated at the *ex ante* optimal policies $M^{CC}(\epsilon, \epsilon^*)$ and $M^{*CC}(\epsilon, \epsilon^*)$.

The contract for the foreign central bank is easiest to interpret. As is apparent from 10.4, 10.6 and 10.8, the contract confronts the foreign central bank with the appropriate corrective incentives. First, it makes the foreign central bank internalize the costs of higher money growth in terms of higher expected inflation; because the *ex post* incentive to inflate depends on θ^*, the optimal contract has to be stiffer–the slope coefficient larger–the higher is θ^*. Second, it makes the foreign central bank internalize the spillover effect on inflation in the home country, via the real exchange rate; the importance of this effect is governed by ϵ and ϵ^*. The exchange rate contract faced by the home central bank has a similar interpretation, except for the denominator, which is there because the contract is a performance contract in the exchange rate. Hence, it controls the incentives to set m only indirectly, via s : at stage (3) the marginal effect of m on T is given by, $T_s S_m = -t^s(\theta, \epsilon, \epsilon^*) \cdot (Z_m + Q_m)$, as $s = z + q - q^*$.

The international principal can thus implement the *ex ante* cooperative optimum by a careful choice of linear contracts. The proviso is that the slope coeffi-

cients have to be state contingent, in θ and θ^* to relax the credibility constraints, and in ϵ and ϵ^* to relax the individual optimality constraints.

Multilateral exchange rate regimes. The theoretical framework sketched above clearly bears some resemblance to the history and operation of the most important international exchange-rate arrangements of the post-war period. Both the Bretton-Woods system and the EMS did indeed grow out of an initial and lengthy period of multilateral negotiations–like the institution design stage of the model. Also, both arrangements had a codified set of prospective rewards and sanctions tied to the behavior of central banks–like the contractual transfers in the model.[22] Finally, both arrangements amounted–like in the model–to an explicit or implicit policy assignment among the member countries. The US Fed and the German Bundesbank would direct their policies towards a domestic monetary target providing a nominal anchor to the system. The other central banks instead would have an adjustable exchange rate target vis-a-vis the central currency, whereby they would capture some credibility from the anchor country.

But why would these real-world international monetary arrangements involve the exchange rate as a key intermediate target, rather than a more symmetric arrangement? Some would argue that the exchange rate is used as a target because it is so easy to monitor. It is also hard to find an analog to the explicit state-contingency of the contractual mechanism supporting the optimal policy in the model. The reason may be that it is very difficult to foresee, monitor and verify the macroeconomic events that would potentially trigger state-contingent international sanctions or rewards for specific monetary policies. Allowing only non-state contingent contracts, we would have to insist on the slope coefficients in 10.7 and 10.8 being constant, which would clearly induce some inefficiency.[23]

In fact, the Bretton Woods system and the EMS–together with the domestic monetary institutions in the central currency country–are perhaps best described as mechanisms for implementing a simple rule with an "escape clause": in normal circumstances the central-currency country would pursue a restrictive monetary policy and the exchange rate against the central currency would remain pegged. But temporary slippage of the monetary anchor and realignments would be allowed under exceptional circumstances.[24] In the model above, at stage (1), the international principal could implement such an escape-clause equilibrium by re-

[22]Examples were the obligation to inform and consult with the IMF or with other countries before exchange rate changes; the conditional rights to draw on SDR's to finance balance of payments deficits and the possibility of IMF conditionality in the case of the Bretton-Woods system; the short-run credit facilities, the the ties to other EC institutions like the CAP, and the practice not to allow full restoration to parity of overvalued currencies at realignments, in the case of the EMS.

[23]Gosh and Masson (1994, Ch. 9) discuss the incentives for policymakers to actively distort information to gain a strategic advantage in international coordination games.

[24]The classic formulation in Article IV of the Bretton Woods agreement about allowing devaluations only in situations of "fundamantal disequilibrium" reminds precisely about the notion of a rule with an escape clause.

placing the contracts in 10.7 and 10.8 by a pair of non-linear, state-independent contracts. Deviations from a fixed exchange rate and a specific foreign money growth rate m^* would be punished by a pair of non-contingent negative transfers (c^s, c^m). How often the escape clause would be triggered would depend on (c^s, c^m) : the lower their value, the more realizations of θ, θ^*, ϵ, and ϵ^* would induce the central banks at stage (3) to break the contract and pursue a decentralized, discretionary policy.

Such a multilateral peg system would also be suboptimal, relative to the hypothetical benchmark of the *ex ante* cooperative optimum. Just how suboptimal depends on the properties of the shocks. Frequent realizations of high values of θ and θ^* and low or negative correlation between ϵ and ϵ^* would lead to frequent breach of the simple rule. But with limited credibility problems of monetary policy–or a central country with a great deal of credibility–and relatively parallel macroeconomic development in the participating countries, the incentives to deviate from the simple rule would be small. Perhaps it is not too far-fetched to describe the fifties and (most of) the sixties under the Bretton Woods system, as well as the eighties under the EMS, just in those terms.

As we have seen in Section 9.2, however, in the wake of asymmetric ϵ-shocks it is worse to have a monetary arrangement that creates strong incentives for convergent monetary policies than to have no arrangement at all. Asymmetric shocks are therefore especially likely to put strain on the simple rule and potentially on the whole mechanism. It is interesting to note that the eventual breakdown of the Bretton Woods system and the EMS were indeed both preceded by asymmetric shocks to the central currency country: the US fiscal shock in connection with the Vietnam war and Johnson's great society program, and German unification, respectively.

10.2. Monetary union

The complete form of monetary policy cooperation would be full monetary union, with a single money managed by a *single* central bank. The previous discussion suggests that full monetary union would be a suboptimal arrangement if there are asymmetric shocks. But if the cooperative optimum under commitment is infeasible, we face a second-best institution design problem, namely a choice between different suboptimal alternatives. Furthermore, our simple model abstracts from a number of complicating factors. For one, it has no room for speculative attacks, or more generally, speculation-induced volatility of capital movements and asset prices. The 1992-1994 turmoil in world asset markets, with the effective breakup of the EMS, suggests that the relevant choice may be between floating rates (and appropriate domestic institutions) versus full monetary union.[25] Moreover, we have confined our analysis to stabilization policies. But other prospective gains,

[25]Peter Garber and Lars E.O. Svensson's chapter in this *Volume* discusses the literature on speculative attacks.

such as savings on transactions costs (Casella (1992)) or microeconomic benefits in other areas of integration (Basevi, Delbono, and Denicolo (1992)), may only be reaped with full monetary union.

Whatever its motivation, monetary union raises several interesting questions. First, under which circumstances should a single country join a monetary union? To the list that starts with Mundell's (1961) high factor mobility, and includes the predominant type of macroeconomic shocks, the recent literature on "optimum currency areas" has added large domestic incentive problems in monetary policy. But there is also an interesting systemic question: how does the design of the common central bank resolve conflicting interests of member countries and shape the union's monetary policy? Keeping with our approach in this chapter, these positive and normative questions could be productively analyzed, by drawing on principal-agent theory and contract theory. A common central bank is an instance of common agency: this common agent serves multiple principals (the member countries) with partly common, partly conflicting interests.[26] The themes would be the same as in our analysis of fiscal policy: participation constraints have to be respected, particularly with asymmetric countries, and the specific collective decision-making mechanism shapes the policy outcome, as well as the distributions of costs and benefits. Even though they use a different language, the recent papers by Casella and Feinstein (1989), Alesina and Grilli (1992) and Von Hagen and Süppel (1994) effectively address these problems. They all suggest that one cannot analyze the question of how to design a common central bank without paying close attention to the broader political and institutional framework in which the member countries interact.

An interesting issue for further work would be how alternative international monetary arrangements could handle the incentives for individual policymakers to conceal or distort information about the state of their economies. The contract theory approach would seemingly be very valuable here, given that it has essentially been developed to deal with incentive problems and conflicting interests in the presence of asymmetric information.

10.3. Notes on the literature

The literature on the Bretton Woods system is too voluminous to be surveyed here. The recent volume edited by Bordo and Eichengreen (1993) contains many useful studies, analytical as well as descriptive. Likewise there is a large literature on the EMS and on monetary union in Europe. Useful collections of articles can be found in de Cecco (1989) and Canzoneri, Grilli and Masson (1992). Martin (1992) compares optimal monetary policy delegation in monetary union and under flexible exchange rates. Giavazzi and Pagano (1988) discuss the EMS and

[26]Bernheim and Whinston (1986) formulate a general model of common agency. This approach has recently been applied to the study of trade policy by Grossman and Helpman. (See their (1994) paper, and Dani Rodrik's chapter in this *Volume*.)

the incentives created by the practice of not allowing full compensation of inflation differentials at EMS realignments. Cohen and Wyplosz (1989) specifically emphasize the role of the EMS as a coordination device.

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