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Two-Country Models of Monetary and Fiscal Policy: What Have We Learned? What More Can We Learn?

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Abstract: This paper surveys the literature that uses two-country models to analyze monetary and fiscal policy issues faced in interdependent economies. We discuss sources of structural interdependence that researchers typically include in these models. We describe many of the types of policy interactions that researchers have considered and summarize the key results that they have obtained. Finally, we briefly explain the limitations of two-country models and outline directions that this literature might usefully be extended.

1. Introduction

Bryant (1980) forcefully argued that macroeconomic policy literature prior to the 1980s had paid insufficient attention to international interdependence. As if in answer to Bryant's call for greater consideration of this issue, there has been an outpouring of work applying two-country models to problems of exchange rate,

monetary, and fiscal policy interdependence and to the possible gains or losses of international coordination of macroeconomic policies. Two-country models are a natural approach to the consideration of open-economy policy issues.

In this paper we survey a wide range of the literature in which such models are employed to examine many problems of monetary and fiscal policy interdependence. We focus on theoretical work, touching only tangentially on empirical applications (for more detail, see Kenen, 1989; Onofri, 1990), and we address the following questions. What issues can researchers usefully examine with two-country models? What conclusions have researchers reached using these models? How and why do these conclusions differ?

In the next section we outline the prototypical two-country policy model. In Section 3 we discuss the types of structural linkages that researchers commonly include in two-country models. In Section 4 we review the types of monetary and fiscal policy interactions considered in the literature and summarize key results that researchers have obtained to date. We discuss topics that we regard as important areas for future research in Section 5.

2. The essential features of two-country models

We begin by outlining the essential elements of the two-country policy problem. This problem was first explored systematically by Hamada (1976). A useful starting point for any discussion of two-country models, however, is the Oudiz and Sachs (1984) model of generic policymakers in structurally identical nations. The policymakers seek to minimize loss functions, $L(M, M^*)$ and $L^*(M^*, M)$, where L and L^* denote domestic and foreign policy losses and M and M^* give the values of domestic and foreign policy instruments. Those who work with two-country models often equate policy loss functions with social loss functions, but doing so is fraught with conceptual problems. One is the well-known debate over the existence of well-defined social welfare functions. Irrespective of this issue, however, is the potential for a policymaker to pursue self-interest rather than the social good, as emphasized in the public choice literature. Nevertheless, both the public-choice approach and the more recent partisan approach to

analysis of policymaking indicate that policy loss functions, under many circumstances, are proportional to social loss functions, if the latter exist. Models of optimal policymaking typically rely on this result as a basis for proposing functions such as L and L^* .

As long as the derivatives of L and L^* with respect to *both* M and M^* are nonzero, so that each policymaker's policy instrument choice affects the loss experienced by the other nation's policymaker, there is *policy interdependence*. For the purpose of illustration, suppose that the policymakers' losses are increasing with respect to their own instrument choices but decreasing in the choice made by the other policymaker, so that $\partial L/\partial M > 0$, $\partial L/\partial M^* < 0$, $\partial L^*/\partial M^* > 0$, and $\partial L^*/\partial M < 0$. In addition, suppose that the loss functions are quadratic in the instrument choices. Horowitz (1987) and Aizenman and Frenkel (1985) provide justifications for viewing quadratic loss functions as reasonable approximations to true measures of losses due to risk aversion or forgone consumer and/or producer surplus. Nevertheless, the overriding reason for the choice of a quadratic form throughout much of the monetary and fiscal policy literature is the gain in expositional simplicity, which is a particular virtue in the context of two-country models.

With quadratic objectives, the policymakers' indifference curves, which are displayed in figure 1, are elliptical. The slope of the domestic indifference curve is equal to $-(\partial L/\partial M^*)/(\partial L/\partial M)$ and the slope of the foreign indifference curve is $-(\partial L^*/\partial M^*)/(\partial L^*/\partial M)$. The area of each ellipse declines with higher values of the other country's instrument, yielding zero-loss bliss points B and B^* .

Noncoordinated policymaking

Under Nash behavior, the domestic policymaker chooses M to minimize its loss, taking M^* as given, while the foreign policymaker chooses M^* to minimize its own loss, taking as predetermined. The domestic first-order condition is $\partial L/\partial M = 0$, which implies setting M at a horizontal tangency to the domestic indifference curve, and the foreign first-order condition is $\partial L^*/\partial M^* = 0$, which entails setting M^* at a vertical tangency to the foreign indifference curve. For each

policymaker, the set of all points at which the first-order condition holds given the other policymaker's instrument choice is its *policy reaction (best-response)* function, denoted by R and R^* , respectively. The noncoordinated policy equilibrium is the crossing point, which has been normalized at the origin. This is the point at which the reaction functions cross, so that each policymaker's actual instrument choice, M^N and M^{*N} , is mutually consistent with the reaction of the other policymaker.

Coordinating policymaking

Under policy coordination, each policymaker sets its instrument to minimize a weighted sum of losses for *both* nations. Each policymaker seeks to minimize the simple sum $L + L^*$, so that coordination gains are equally shared. For the domestic policymaker, the first-order condition for the choice of M is, $\partial L/\partial M + \partial L^*/\partial M = 0$, or $-(\partial L/\partial M)/(\partial L^*/\partial M) = 1$, and for the foreign policymaker, the first-order condition for M^* is, $\partial L/\partial M^* + \partial L^*/\partial M^* = 0$, or $-(\partial L^*/\partial M^*)/(\partial L/\partial M^*) = 1$. These first-order conditions imply that the mutually consistent instrument choices must satisfy the equality, $-(\partial L/\partial M^*)/(\partial L/\partial M) = -(\partial L^*/\partial M^*)/(\partial L^*/\partial M)$. The left-hand side of this condition is the slope of the domestic policymaker's indifference curve, and the right-hand side is the slope of the foreign policymaker's indifference curve. Hence there is a tangency of the indifference curves at a coordinated policy equilibrium, point E in figure 1. The settings M^E and M^{*E} comprise the Pareto-efficient set, illustrating Oudiz and Sachs' key point: *Other things equal, policy coordination, if it can be implemented, is the Pareto-efficient policy regime.* Note that we follow Branson, Frenkel, and Goldstein (1990) and Kenen (1989) by reserving the term "coordination" to refer to mutual policymaker commitments to concrete policy actions intended to attain either insular or common objectives. Although policymakers can "cooperate" or "consult" by exchanging information, such efforts entail no precommitment to use shared information to avoid policy miscalculations or harmful beggar-thy-neighbor effects.

As we discuss in Section 5, *implementability* is an important issue. Suppose that the foreign policymaker feels bound to honor a coordination agreement but the domestic policymaker does not. Then

the domestic policymaker clearly has an incentive to renege, or "cheat," on its commitment to coordinated policymaking and choose the instrument setting MC , which yields a lower domestic loss while saddling the foreign authority with a larger loss than anticipated. In a multiperiod game the likely result would be a collapse of the coordination agreement, which would yield a discounted stream of losses to the domestic authority due to lost efficiencies in future periods. This reputational consideration support the view that coordination regimes can be implemented.

A leader-follower regime

A third behavioral mode for international policy-making is Stackelberg behavior, in which one (say, the domestic) policymaker leads and the other (foreign) policymaker follows in choice of policy instruments. Under this behavioral approach, the domestic leader chooses M taking into account the foreign policymaker's reaction function R^* . Given this choice, denoted M^S , the foreign follower's choice then is equal to M^{*S} . This mode of preconditioned behavior is preferable to purely noncoordinated policymaking but is inferior to the policy-coordination regime for both authorities. For this reason, in most contexts, particularly when it is assumed that the countries are identical, it is difficult to provide a rationale for the existence of a Stackelberg policy regime. As we discuss in Section 5, appeals to structural or institutional features germane to a specific policy problem typically are required.

A fixed exchange rate

Another type of scheme for policy interaction entails a mutual agreement for one nation's policymaker to fix its policy instrument setting as a function of the instrument setting of the other policymaker. The foreign policymaker, for instance, may M^* fix as a function of M and let the domestic policymaker choose M optimally. A specific example of this approach to coordinated policymaking is a fixed-exchange-rate regime, in which the foreign policymaker M^* varies as required to maintain an exchange-rate target, leaving the domestic policymaker to determine the level and growth of M and,

consequently, trend inflation for both nations. This is not the same as the Stackelberg game, because the foreign policymaker in this instance does not choose an optimal reaction, most notably in the face of disturbances that may affect national losses asymmetrically. In the presence of symmetric shocks and given the identical-nation assumption, this type of fixed-exchange-rate regime yields the coordination outcome illustrated in figure 1, as does an alternative regime in which *both* nations coordinate variations in their money stocks to maintain a fixed exchange rate.

The Oudiz-Sachs analysis is an application of theory of one-shot games. Nevertheless, it illustrates the fundamental issues that arise in two-country policy environments. All that is needed to extend this approach to analyses of real-world policy problems is pinning down the explicit structure of the policy objective functions and more formal modeling of the international environment that the policymakers face.

3. Structural interdependence in two-country models

When evaluating how to include potential sources of interdependence in two-country models, a model-builder always faces a tradeoff between realism and tractability, because solution problems typically arise as a result of policy interdependence and resulting feedback effects. A common feature of game-theoretic models of strategic interaction among economic agents or policymakers is the potential for multiple solutions. Of course, in a number of contexts there may be multiple theoretical solutions, but only one economically feasible solution to a two-country policy problem (see, for instance, Bryson, Chen, and VanHoose, 1998). In other contexts, however, it could be true that coordination failures and multiple solutions lie at the heart of the policy problem (for instance, see Lane, 1990). As discussed by Cooper and John (1988), the slopes and shapes of players' response (reaction) functions determine whether players' choices are strategic complements or substitutes, thereby pinning down the number of stable equilibria in game-theoretic models.

Demand-side linkages

Within any two-country model of monetary and fiscal policy, the nature of strategic interactions among policymakers depends largely on the sources of structural interdependence that one builds into the model. To consider structural interdependence from the *demand side*, most researchers allow for a dependence of home output demand on the real exchange rate. Many also include a role for financial-market interdependence.

Uncovered interest parity (UIP) is a common assumption in models that include a central role for interest rates, either in the endogenous determination of other key variables or in the conduct of monetary and/or fiscal policies. In the absence of perfect capital mobility, balance-of-payments or wealth constraints, together with bond-market equilibrium conditions, are needed to structurally link two countries' models economies (e.g., a two-country version of Benavie, 1983, or Canzoneri, 1982).

Supply-side linkages

In fact, *real* interest rates influence investment decisions, so model-builders often must consider the fact that consumers or firms care about consumer price indexes (CPIs). If the CPI is relevant for consumption and investment decisions, however, it also should be relevant for valuing workers' real wages and input prices. Consequently, another way to motivate structural interdependence in a two-country framework is through real-exchange-rate effects in the nations' aggregate supply functions.

Purely from a modeling perspective, the drawback from including supply-side inter-relationships is that they introduce a number of additional complications. For instance, should wage setting be atomistic, in that workers and firms are small enough that they perceive that their individual choices cannot influence the CPI and, consequently, incentives faced by policymakers? Or should wage setting be treated as a centralized undertaking in which national trade unions or governmentally managed coordination mechanisms establish an aggregate wage bargaining process that helps to determine the CPI

and policy incentives directly? Clearly, as Bruno and Sachs (1985) and Calmfors and Driffill (1988) have documented, there are significant differences among wage-setting institutions throughout the world, and so the answer must depend on the countries under consideration. Although little work has explored these issues, VanGompel (1994) discusses the importance of pursuing such work, and Bryson et al. (1986) have done initial work on supply-side interactions with atomistic wage setters. Likewise, Jensen (1993) has explored centralized wage setting in a two-country context.

With either demand- or supply-side linkages, the determination of the real exchange rate pins down solutions for the nominal exchange rate and nations' CPIs. As a simplification, many authors adopt the ex ante PPP assumption, which states that PPP holds on average, though unexpected deviations can occur. This assumption simplifies solutions of expectational models by tying down agents' expectations via the *anticipation* that PPP will hold in equilibrium, while permitting national policymakers to attempt to influence the terms of trade ex ante.

The two-country framework has its roots in typical closed-economy structures. The international linkage is how the closed-economy model is "opened" to allow for international dimensions. The linkage that opens the model determines the extent to which each economy is affected by a foreign policy action, a policy reverberation or policy spill-over, or the effectiveness of policy and practicality of coordination under various monetary and exchange rate regimes. The linkage, therefore, preconditions certain outcomes and eliminates specific policy options. For example, in a typical theoretical model, UIP renders fully sterilized exchange-rate intervention useless.

4. Modeling policy-interactions in two-country models

In many practical contexts, including explicit linkages among the policy procedures of the nations' policymakers is appropriate. This situation arises most often when the domestic policy instrument is conditioned upon the exchange rate or upon a variable of the foreign economy, such as the foreign interest rate or money stock. For

instance, if responses of a foreign authority are not fully and immediately sterilized by the domestic authority, then nations' money supplies are linearly dependent, which results in nonunique solutions (Lane, 1990). This problem can be circumvented by assuming that foreign intervention is not reflected in the domestic money rule. This assumption requires that foreign intervention is immediately and fully sterilized by the domestic authority (see Gros and Lane, 1992, Note 9), so that money supply rules are asymmetric and unique solutions follow. Another approach, which Lane (1989) and Daniels (1997) follow, is to specify the exchange rate regime of one economy and then derive policy solutions for the other economy. This "ties down" the value of one authority's instrument, allowing a unique solution for the other authority's instrument and permitting comparison of optimal policy responses across regimes. Explicit policy linkages also arise when a domestic policy instrument is conditioned on foreign variables. Daniels and VanHoose (1995a) show that lagged foreign monetary innovations can provide important intertemporal policy information for the domestic authority. In this context, the policy linkage gives the domestic authority an additional degree of freedom in its policy decision.

Models of exchange-rate intervention

A common issue concerning direct policy interactions in two-country models is the appropriate degree of exchange-rate intervention when nations are structurally interdependent. Typically, analyses of this issue are based on models that include policy rules for the monetary authorities, with a floating-rate regime (no interventions) lying at one extreme and a pure exchange-rate peg lying at the other. Although Benavie (1983) considers only a single, small open economy, this is a useful paper for understanding models of optimal intervention policies, which have similar structures in most two-country frameworks.

Good examples of two-country exchange-rate intervention models are Canzoneri (1982), Lane (1989), and Gros and Lane (1992). Canzoneri derives Poole (1970)-type results from a two-country framework and generalizes to a three-country world. Lane considers the common view that exchange-rate policy unpredictability should be

minimized and reaches the interesting conclusion that one country may desire to achieve an optimal degree of unpredictability in order to influence the policy regime chosen by the other nation's authority.

Gros and Lane provide a very lucid discussion of the strategic interactions that arise when two nation's monetary authorities condition their policies on exchange-rate innovations. They show that the nature of these strategic interactions depends on the sources of disturbances, a point often neglected in models that focus solely on strategic issues and abstract from stabilization goals that policymakers typically pursue.

4.1. Models of monetary and exchange-rate coordination

Whether nations could gain from coordinating their exchange-rate and monetary policies has been a long-standing debate. Two-country models have proven useful in evaluating the pros and cons of policy coordination. Particularly influential models have been those developed by Canzoneri-Henderson (1988) and Rogoff (1985a). The structural frameworks proposed by these authors share three key features. First, they include standard "IS" (income-expenditure equilibrium) and "LM" (real-money-market clearing) relationships, in which both the real exchange rate and foreign income affect desired spending on home goods. Second, both have a supply-side structure in which nominal wages are contracted in advance of labor- and goods-market clearing. Third, both models follow the bulk of the policy literature by exploring policies aimed at stabilizing employment and CPI inflation around target values.

Canzoneri and Henderson essentially imbed a structural macroeconomic framework into the Oudiz-Sachs game-theoretic analysis. Among other things, they consider how monetary policy coordination could be welfare-improving for two nations that face common disturbances, and they discuss potential mechanisms to remove the incentive for a nation to "fink" on a commitment to a policy agreement, an intertemporal version of their basic one-shot policy game. One problem with the Canzoneri-Henderson (1988) analysis, which carries over to Canzoneri-Henderson (1991), is that

their analysis focuses primarily on optimal stabilization games involving strategic interactions only among the policymakers. In these games, private agents view policymaker commitments to either insular or coordinated policymaking as credible. Furthermore, their macroeconomic framework is highly stylized. In one respect, this is a virtue. The stylized model is readily amenable to analysis of one-shot games. This makes their framework a very useful pedagogical tool. Nevertheless, the model does not readily lend itself to standard aggregate demand-aggregate supply interpretations, and results from the model are not always easily comparable to those that are more broadly structured.

Rogoff (1985a) builds directly on the preceding macroeconomic literature by constructing a two-country model based on a more complete rational-expectations framework that, in contrast with Canzoneri—Henderson (1988), includes a role for interest rates. Although Rogoff's model is somewhat more unwieldy, it, along with Oudiz and Sachs, is very useful for learning how to construct two-country models of monetary policy. In addition, Rogoff considers a combined credibility-stabilization game by broadening the scope for strategic interactions among both policymakers and private agents. Rogoff's paper makes one of the most fundamental points about policy coordination: In the presence of time inconsistencies, monetary policy coordination is not necessarily welfare improving. As emphasized by Canzoneri and Henderson, coordination has stabilization benefits, but Rogoff shows that noncoordinated policymaking tends to reduce the extent of the discretionary inflation bias that exists when coordinating monetary authorities internalize a desire to achieve short-run output and employment expansions via unexpected inflation. Accounting for time inconsistency problems thereby can overturn the basic Oudiz-Sachs result that coordination yields efficiency in two-country policy games.

Much of the subsequent literature on monetary policy coordination has applied the fundamental points of these pathbreaking papers to examine coordination of policies by central banks in two nations with separate currencies or by a supranational monetary authority that determines the money stock within a two-country monetary union. For instance, Canzoneri and Henderson (1991)

extend their original analysis by contemplating asymmetric disturbances. Lewis (1989) adapts Rogoff's model to evaluate circumstances that would induce occasional, but temporary, efforts to coordinate policies.

Collins (1988) and Melitz (1988) are examples of early efforts to apply concepts both from Canzoneri and Henderson and Rogoff to issues concerning European Monetary Union (EMU). Considerable work on this latter topic has followed; for more detailed overviews of EMU issues, see Fratianni, von Hagen, and Waller (1992), De Grauwe (1994), and Bayoumi, Eichengreen, and von Hagen (1997). Laskar (1989), Currie, Levine, and Pearlman (1996), and Dolado, Griffiths, and Padilla (1994) have extended the framework of Rogoff (1985b) and evaluate how the appointment of conservative central bankers might have contrasting welfare implications depending on asymmetries of disturbances, the extent of coordination, and the nature of cross-country monetary policy spillovers.

Most two-country-based analyses of monetary policy coordination consider a world in which nations might coordinate variations in their money stocks (or money growth rates). Nevertheless, another type of international monetary coordination setting that one might consider is a Bretton-Woods-type system in which one, perhaps "dominant", nation pins down the underlying inflation rate for participating nations and coordinates this choice with exchange-rate target setting(s) of the other member nation(s). Canzoneri and Gray (1985) examine this version of the two-country policy problem, which some have also argued may be applied to the European Monetary System (EMS). (For differing interpretations on the issue of German dominance in the EMS see Giavazzi and Giovannini, 1989; Fratianni and von Hagen, 1990 ; Hafer and Kutan, 1994; Camen, Genberg and Salemi, 1991; Kutan, 1991.)

Under this perspective on a fixed-exchange-rate system, in contrast to the Rogoff and Lewis approach in which monetary authorities coordinate to fix the exchange rate, the exchange rate itself is a strategic choice variable for one nation in a two-country model, while the other nation chooses its money stock or growth rate. van der Ploeg (1989), VanHoose (1992), and Bryson Chen, and

VanHoose (1998) are examples of recent two-country interpretations of such fixed-exchange-rate systems. von Hagen (1992) examines a version of this approach in which one country delegates complete monetary policy responsibility to the other nation's central bank and shows that in a repeated game this institutional structure could, in principle, yield credibility gains for both nations' authorities.

The instrument choice problem, nonstationarities, and currency substitution

Considering money stocks/growth rates or exchange rates as policy instruments simplifies the two-country policy problem but obscures the fact that monetary policymakers typically use bank reserves or money market interest rates as their policy instruments. In the context of Poole (1970)-type analyses of the monetary instrument choice problem, Turnovsky and d'Orey (1986, 1989), Turnovsky, Basar, and d'Orey (1988), and Henderson and Zhu (1990) have explored the nature of the strategic problem that monetary authorities face. In particular, Henderson and Zhu consider a "battle-of-the-sexes" game in which multiple equilibria arise from the interaction of policymaker instrument-choice problems in which a policymaker's payoff depends on the other policymaker's instrument choice rather than its own. They show that the introduction of additive uncertainty can reduce the number of equilibria and that under some circumstances unique noncoordinated equilibria can entail Pareto-inferior policy instrument choices. In addition, Daniels and VanHoose (1995, 1998) have built on Goodfriend's (1987) extension of the basic Poole framework and Sephton's (1989) small-open-economy elaboration of Goodfriend's model to show how international interdependence can make base drift and price-level non-trend-stationarities optimal central bank policies with and without policy coordination.

Seigniorage, optimal settings for bank reserve requirements, and currency substitution have recently received considerable attention in the context of two-country models. Most models apply the cash-flow definition to seigniorage (see Klein and Neumann, 1990; Gros, 1993, for more on cash-flow versus opportunity-cost concepts of seigniorage) to evaluate how optimal seigniorage would change in

settings with coordinated monetary policies. Drazen (1989) highlighted the importance of bank reserve requirements in relation to the seigniorage issue, and Bacchetta and Caminal (1992) and Daniels and VanHoose (1996) have explored this topic in two-country settings.

Until recently, most two-country models of monetary and fiscal policy abstracted from complications introduced by consideration of currency substitution. Canzoneri and Diba (1992, 1993) are important exceptions. In particular, Canzoneri and Diba (1992) show how currency substitution and seigniorage concerns interact to influence the potential gains from monetary policy coordination. Proposed benefits of competing currencies, they argue, are overstated when fiscal authorities face tax collection costs.

Seigniorage and fiscal policies

Because seigniorage is a tax, it automatically relates monetary and fiscal policy issues. Such issues have been of particular interest in light of the Maastricht Treaty's explicit fiscal constraints and of broader discussions of achieving greater fiscal coordination and convergence in Europe.

Several papers have used two-country models to evaluate the fiscal policy implications of seigniorage with and without monetary policy coordination and with and without a common currency. For instance, Canzoneri and Rogers (1990) apply a cash-in-advance approach to investigate the interplay between seigniorage and direct taxes in a two-country setting. This leads them to conclude that the ability to spread taxes across the two funding sources is a crucial determinant, along with the magnitude of currency conversion costs, of the desirability of a common currency. In addition, Sibert (1992, 1994) has imbedded an overlapping-generations framework to explore the allocation of seigniorage shares between two nations with a common central bank and the coordination of taxation and government expenditures in a common-currency environment and concludes that the gains from fiscal policy coordination are enhanced in a monetary union. Jensen (1996) examines analogous issues in a two-country extension of Alesina and Tabellini (1987) but which does not include a time-inconsistency problem for policymakers vis à vis

their private sectors. Sheen (1992) has conducted a simulation study indicating that the case favoring fiscal policy coordination actually is stronger than the case for monetary policy coordination.

Of course, one difficulty is that analyzing fiscal policy issues can require attention to a number of problems, irrespective of the seigniorage and other monetary and financial interactions. As Frenkel and Razin (1987) have emphasized, failing to account for intertemporal tradeoffs that fiscal authorities and private agents face can lead to incomplete or even misguided results. In addition, Tanzi (1991) has discussed key issues that proponents of fiscal coordination must face, such as the inevitable asymmetries that create wedges among the fiscal policy responses of national governments. Indeed, Bryson (1994b) develops and conducts policy simulations within a two-country framework and finds that fiscal coordination can increase the extent of fiscal flexibility required for governments to deal with asymmetric disturbances.

Levine and Brociner (1994) find that the case for fiscal coordination is stronger when relative prices can change in a two-good, two-country setting, because without coordination, governments have a greater incentive to improve their nations' terms of trade. Again the Levine-Brociner analysis abstracts from time inconsistency issues that give rise to broader strategic interactions. More generally, as Tabellini (1990) has shown, fiscal policy coordination can internalize incentives that governments have to run inflationary deficits, and so fiscal coordination potentially can, like monetary coordination, be counterproductive.

The Maastricht Treaty places explicit limits on fiscal authorities of nations that ultimately may choose to join the proposed EMU. Bryson (1994a), like Jensen (1996) and Bryson, Jansen, and VanHoose (1993), uses a two-country extension of the Alesina-Tabellini (1987) model to show that fiscal policy coordination requires a sufficient degree of fiscal-policy flexibility and thereby could be hindered by such constraints. This buttresses analogous conclusions that Masson and Melitz (1991) reach in a simulation study of fiscal interactions among Germany, France, and the rest of the world.

Some have argued, nevertheless, that a monetary union promotes greater fiscal convergence even without formal constraints on fiscal policy. Glick and Hutchison (1993) apply a two-country model to evaluate the extent to which formation of a monetary union constrains the discounted present values of government expenditures. They find that although a monetary union tends to bring about long-run convergence in discounted spending flows, considerable cross-country variability nevertheless can arise. Jensen (1996) concludes that the case for fiscal coordination is strengthened by formation of a monetary union.

Taking into account various combinations of potential channels of interactions among monetary and fiscal authorities, however, considerably muddies the waters concerning the desirability of either monetary or fiscal policy coordination. Jensen reaches this conclusion under the assumption that policymakers can honor commitments to private agents. Bryson Jensen, and VanHoose (1993) examine situations of committed or discretionary policymaking with respect to private agents with either monetary coordination alone or combined cross-coordination (but not within-country coordination) of both monetary and fiscal policies. They do so in a model with no disturbances and hence no stabilization concerns, yet they find that the theoretical case for either monetary coordination alone or for combined monetary and fiscal coordination is unclear.

5. Issues for further research

What more can we learn from two-country models of monetary and fiscal policy? We conclude by evaluating this question.

Asymmetries

A key assumption in most two-country models is that nations are symmetrically structured. There is an important advantage of using this assumption, which is that it greatly simplifies the solution of a two-country model while nonetheless permitting authors to make key points about the likely effects of policy actions or regime changes. An obvious and important drawback of the structural symmetry assumption is that gains and losses in monetary or fiscal unions can

vary based on a nation's relative size (see, for instance, Cassella, 1992).

There are, of course, various ways that countries may be asymmetric. As noted above, they may have divergent wage-setting structures. As in Canzoneri-Rogers (1990), they may possess differing fiscal structures and tax-collection technologies. They also may have access to differing policy commitment technologies. Asymmetries can also exist because of the size and leadership role of a particular nation. For example, Germany's monetary policy leadership position represents an asymmetry in the EMS, in that the Bundesbank may conduct independent monetary policy while other member nation's surrender policy autonomy (von Hagen, 1993). This view has come to be known as the German Dominance Hypothesis.

The most common means of introducing asymmetries into two-country models, however, is through consideration of asymmetric disturbances (see Fratianni and von Hagen, 1990b; Canzoneri and Henderson, 1991; Bryson, 1994). A typical type of asymmetric shock examined in two-country models is one that entails a shift in demand from one country to another. This is the easiest form of asymmetric shock to consider because it involves analyzing shocks that have the same absolute sizes.

It is arguable that we may have learned as much as we can from symmetrically two-country frameworks. Furthermore, resolving most issues concerning coordination of monetary, exchange-rate, or fiscal policies realistically require considering asymmetries that countries face. Researchers may need to begin sacrificing simplicity for greater realism in two-country frameworks.

Implementability of coordination schemes

Most initial research on mechanisms for implementing international policy coordination focused attention on the potential for supranational institutions to promote both policy cooperation or coordination. As Cooper (1985) points out, supranational institutions can negotiate the "burden-sharing" of coordinated policy schemes, reducing free-rider problems. This can be particularly important when

there is a large difference between the size of nations. Third-party organizations can also make possible the attainment of national goals that are in direct conflict with each other. For example, the International Monetary Fund can provide sufficient reserves to allow two nations to enjoy payments surpluses at the same time. Supranational organizations are particularly well-suited forums for policymakers to share information and ideas about the structure of individual economies, forecasts, objectives, and intended policy actions. Hence, policy cooperation can reduce the "harm" of noncoordinated regimes. Furthermore, supranational organizations can provide a leadership role when policymakers of the leading nation find it politically impossible or unwise to do so.

Finally, and perhaps most important, these third-party organizations potentially can perform an important monitoring function. To the extent that these institutions can observe and report on the behavior of policymakers, supranational institutions can reduce the potential for policymakers to "cheat" on coordination agreements when the social and private gains from coordination do not coincide. Asymmetries change the distribution of the gains from coordination and can inhibit attempts to act collectively. Structural or goal-driven asymmetries, therefore, raise the issue of side payments and benefits from establishing third-party referees, such as supranational institutions including the International Monetary Fund and the World Bank.

Supranational organizations are unlikely to be privy to all the private information possessed by national policymakers, however. As pointed out by Canzoneri and Gray (1985), policy processes are complex and economic measurements can be ambiguous, making cheating relatively easy in an international context. This has led many researchers to focus attention on coordination schemes based on highly visible coordination targets. von Hagen (1993) concludes that because the exchange rate is a particularly visible target, a fixed-exchange-rate regime can serve as a useful "surrogate" for coordination.

Policy timing issues

An important feature of any policy analysis is the timing of a national authority's policy choice relative to observations of disturbances and the choices of other policymakers. If authorities must act before they observe shocks, then there is little scope for stabilization policies, aside from, say, choosing an optimal instrument given knowledge of variances of shocks, as in Poole (1970). If authorities can wait to determine optimal choices after shocks occur, however, then they can affect the choices of private agents. This will be so even if private agents cannot themselves observe the shocks, since the agents recognize that authorities will partially offset disturbances (see VanHoose and Waller, 1991).

A key implication of a game theoretic approach common to two-country policy modeling is that the timing of players' moves is a key determinant of the behavioral interactions among players. Consequently, the timing of policy decisions has a significant bearing on the equilibrium outcomes that emerge in two-country policy games. To this point, the literature has paid insufficient attention to this issue.

Three- and many-country models

In a global economy composed of more than 175 recognized political entities, there are some obvious limitations to policy analyses conducted via two-country models. As Canzoneri and Henderson (1991, Chapter 3) demonstrate, even in the absence of time inconsistency problems, policy coordination among two countries may reduce their residents' welfare when the nations have a third major trading partner that is not part of the policy-coordination arrangement. An earlier version of this same basic point is made by Canzoneri (1982), who points out that a key issue in evaluating monetary unions is how the formation of a union between two nations exposes one member of the union to interactions between the other member and a third nation.

Canzoneri and Henderson make this point in the context of a stylized framework in which two identical economies in combination are identical in size and structure to a third economy. In contrast,

Laufer and Sundararajan (1994) consider a three-nation model with a "mixed-exchange-rate" regime in which two nations maintain a fixed exchange rate vis à vis one another but permit the exchange rate vis à vis the third nation to float. They find that the use of such a mixed-exchange-rate regime reduces the extent to which shocks originating in the third nation can influence outcomes in the nations with the fixed-exchange-rate agreement.

Several authors have considered settings in which the "world economy" described by their models includes a large number of nations. For instance, Aizenman (1992) and von Hagen and Süppel (1994) have developed many-country frameworks to analyze policy problems faced by member states of a monetary union. Aizenman focuses on the inflation tax competition within a common-currency union, while von Hagen and Süppel apply their model to an analysis of the appropriate degree of policymaking centralization within such a union. Kehoe (1987) has provided a many-country model of fiscal policy interactions, which he uses to illustrate how increasing the number of countries pushes equilibrium fiscal policy choices further from coordinated outcomes. Sorensen (1996) applies a monopolistic competition framework to help explain why a subset of countries that produce similar goods and desire to embark on fiscal expansions might wish to coordinate their fiscal policies.

In all of these multicountry models, the authors obtain tractable solutions by assuming that countries are small and identically structured, although they allow for country-specific disturbances. One possible direction for future work would be to try to develop many-country models that permit some degree of "lumpiness" in the distribution of country sizes, perhaps by considering a world composed of groups of nations that follow into one of two basic size categories: small or large. Such an approach likely would lend itself to tractability while enabling a model to focus on issues arising from differences in countries' relative sizes.

Dynamics and informational issues

Most two-country policy models are static, one-period frameworks. Of the papers discussed above, Kehoe (1987) is a notable

exception. Likewise, real-business-cycle frameworks such as the one proposed by Backus, Kehoe, and Kydland (1994) contain dynamic elements, although most of these latter models have not yet proved readily amenable to policy analysis.

One simple way to take into account intertemporal aspects of monetary and fiscal policy issues would be to follow Bini-Smaghi and Del Giovane (1996) by considering multiperiod problems in policymaking and coordination. These authors provide a simple two-period version of a standard two-country framework to evaluate policy criteria that might contribute to convergence among nations that join the European monetary union.

Another useful extension of two-country models would be to consider the potential importance of imperfect information. Frankel and Rockett (1988), for instance, have provided a static framework for evaluating a specific type of policy uncertainty—policymaker uncertainty about the true economic model—and its potential implications for the desirability of policy coordination. They show that such uncertainty can significantly reduce the likelihood of sizable ex post gains from policy coordination. Ghosh and Masson (1991) show that this result hinges on the assumption that policymakers are so dogmatic that they give no credence to the possibility that the models used by their counterparts might be correct. Once individual policymakers allow for the possibility that the model used by another policymaker may be the correct model and evaluate this possibility based on observations of macroeconomic variables, coordinated policymaking dominates alternative uncoordinated regimes.

To our knowledge, only two papers have considered both dynamic *and* informational issues in the context of a two-country policy model. Neck and Dockner (1995) evaluate a noncooperative open-loop setting, in which policymakers choose their strategies given information only about initial states, thereby committing themselves to particular strategies. They contrast this setting with one characterized by a noncooperative feedback equilibrium that assumes policy-makers choose their strategies given information about the *current* state. This is analogous to the standard, time-consistent discretionary policy commonly analyzed in a static framework. In addition, Neck and

Dockner consider a cooperative equilibrium in their dynamic two-country policy game, which, because they assume that private-sector agents do not act strategically with respect to policymakers, yields Pareto efficiency. van Aarle, Bovenberg, and Raith (1997) examine both open-loop strategies and feedback strategies that do not presume precommitment in their analysis of a dynamic game between two national fiscal authorities and a central bank in a two-country monetary union. They conclude that feedback strategies, which arguably are a more realistic depiction of dynamic behavior of discretionary policymakers, lead to slower debt stabilization by fiscal authorities within a two-country monetary union.

These recent contributions point toward at least one route that two-country policy models might be taken, which is to evaluate equilibria arising from dynamic policy games with alternative information sets. Another potentially fruitful avenue, which (to our knowledge) has not yet been investigated, would be to examine two-country policy interactions in environments with asymmetric information. Any nation's policymakers realistically possess private information that is not available to policymakers in another nation or to their own nation's private sector (see, for instance, Cukierman, 1992). Considering this type of policy environment could yield important implications about the credibility of international policy coordination, which is the key determinant of the potential for any welfare gains to arise from such arrangements.

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Appendix Figure 1

