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Should Small Countries Join an Existing Monetary Union ?

George M. von Furstenberg
Fordham University

David P. Teolis
General Motors Corporation

Abstract

We explore the welfare consequences of the alternative monetary and exchange-rate regimes still available to the small country in open international financial markets in view of the optimum monetary policy that the large country adopts for itself. Both economies are based on nominal wage contracts with employment determined by the demand for labor under the contract terms. Reacting to movement in contemporaneously observable price variables, the monetary authorities of the large country, and of the small country under floating, aim to keep labor on its supply curve in the face of IS and LM shocks to aggregate demand, and shocks to aggregate supply. With monetary union, the small country trades discretionary monetary policy for greater stability in real exchange rates and insulation from its own idiosyncratic money supply and demand disturbances. The relative welfare costs of the different regimes for the small country are modeled and deduced from researched parameter values. The result is that there can be a stabilization rationale for accession to a monetary union except at low values of the correlations of like types of shocks for the large and small country.

• **JEL Classifications:** E23, F15, F36

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*Correspondence Address: Graduate School of Business Administration, Fordham University, 113 W 60 St, New York, 10023-7484 USA. Tel. +1-212-636-7953, Fax.: +1-212-765-5573, E-mail: vonfurstenb@fordham.edu. Teolis: General Motors Corporation, 100 Renaissance Center, Detroit, MI 48265-1000, USA.

I. Introduction

Regional economic integration -- a precondition for regional monetary union -- is proceeding in large parts of the world. Well before the completion of European Monetary Union (EMU), economists had begun to question whether there is a need for minor currencies and whether such currencies can survive much longer unprotected in international financial markets.[1] Some now have recommended US-dollarization, initially a unilateral form of monetary union, of much or all of the Western Hemisphere (Hausmann *et al*., 2000). Hence an important policy question that has acquired broad relevance is whether a "small" open economy, still on the outside, would be well-advised to join an existing, inevitably much larger and relatively "closed," monetary union in its region.[2]

We address this question in the welfare-theoretic framework devised by Blinder and Mankiw (1984) for evaluating stabilization policy in a nominal-wage-contracts economy. Since the only alternative to monetary union considered for the small country in the region is floating, our specifications must encompass conditions favorable to each of these two polar regimes to permit balanced evaluation. In the nominal-contracts economy adopted here, workers under contract must supply the amount of labor demanded by employers at money wages that were preset to clear the labor market ex ante. A social loss arises to the extent that amount differs randomly over time from the fixed amount which workers had expected to supply at the market-clearing real wage aimed for in their contract for the period ahead.

Because of money wages being rigid for the duration of the contract, nominal exchange-rate flexibility can be helpful in mitigating the effects of unexpected real disturbances. By contrast, if contracts involved a sufficiently high degree of wage indexation with only short lags, they would provide for real, rather than nominal, wage rigidity. Real-wage rigidity, as in parts of continental Europe, would deprive nominal exchange rate movements of much of their ability to change international competitiveness and relative prices in the small open economy. This would tilt its

[1]It has proved difficult to reconcile freedom of international capital movements with a system of fixed but adjustable exchange rates. Hence Eichengreen and others (see Eichengreen, 2000, p. 2) have concluded that floating and monetary union are the principal alternatives remaining. Even that assessment now may have to be qualified as Cooper (1998, pp. 18-19) and Fischer (1999, pp. 2-3) have suggested. Independently floating currencies of financially small countries increasingly are proving costly and inconvenient to maintain within economically highly integrated regions.

[2]With EMU, "the EU will become more of a large, closed monetary area like the United States" (Eichengreen, 1997, p. 55).

choice of exchange rate regime toward monetary union. It would also be prejudicial for this investigation to assume that countries that have adopted floating exchange rates with regard to their neighbors in the region are inherently less credible than those that target inflation jointly in a monetary union. Switzerland traditionally, and Canada more recently are exceptions to the general rule that nonmember or potential-accession countries have a more inflationary past than the core countries. Both Sweden and the United Kingdom are independent floaters developing a strong attachment to targeting low inflation. Hence the criterion that gives floating exchange rates a chance in the small countries of a region is based on minimizing the deadweight losses of labor under either type of monetary and exchange arrangement and not on systematic differences in inflation levels between them. In fact we will assume that the monetary authorities have "solved" any credibility or time inconsistency problems in their pursuit of price stability. Hence, the price level is reliably trendless while being subject to the effects of short-term shocks and feedbacks everywhere and, in addition, to exchange-rate disturbances in the small open economy under floating.

Having allowed for possible advantages of floating, our specification also must allow for its undeniable drawbacks compared with monetary union. Currencies of financially small developing countries, like Mexico and Turkey, whether floating or made to float by a currency crisis, are buffeted by internal and external shocks. These lead to volatile and generally positive currency risk premiums relative to the key currency of the region and to high variability of real interest and exchange rates. Such risk premiums are precluded in an "irrevocable" monetary union built upon that key currency. However, we assume that the *average level* of the volatile currency risk premium is zero regardless of whether the small country is inside or outside the monetary union so as to retain the superiority of floating as the null hypothesis to be tested under demanding conditions.

Having adopted specifications and rules suitable for the comparative welfare evaluation of the two regimes, we focus on the choice of optimal monetary policy first for the closed economy (Section II) and then for its small neighbor under floating exchange rates (Section III). Under the alternative of monetary union (Section IV) the small economy is subject to the monetary policy chosen by the neighboring large country for its own benefit. In return for surrendering that measure of monetary independence that is given to the small country under floating, monetary union frees it from exposure to disturbances originating in the LM sector and in its exchange relations with the large country. The social loss scores expected for the small country under monetary union then can be compared with the minimum losses achievable under floating against the currency of the large country. This helps determine which of the remaining system alternatives wins out and why (Section V).

All shocks are modeled as temporary because the relevant nominal rigidities that make monetary stabilization policy important are equally short-term (Buiter, 1997). The Bank for International Settlements (1999, p. 29) has suggested that the degree of nominal rigidity is inversely related to the level of inflation. Belke and Kamp (1999) have pointed out that having overcome inflation bias through a strict rule-based monetary policy inside the EMU limits the benefits still available from labor-market reforms to a positive impact on employment. This would reduce the incentive for such reforms inside the euro area compared with living under a more discretionary and hence inflation-prone regime. Calmfors (e.g., 1998) on the other hand has pointed to the loss of exchange-rate flexibility among members of the union as possibly motivating *greater* labor market reforms inside than outside the union to compensate for this loss. Although the realization, that nominal and real rigidities are endogenous, and not maintained irrespective of their costs and benefits, is clearly important, we retain the assumption of nominal wage contracts, fixed for some time ahead, as a realistic feature of a variety of economies.

The information structure subsumed, also rather realistically, is as follows: All agents can observe not only the interest rate (and, under floating, the exchange rate for the small country) but also the consumer price level as it materializes from reported components. These increasingly include “scanner” prices that are reported directly from actual or virtual checkout counters to the statistical agencies so as to reduce sampling, calculation and reporting lags. By contrast, no similar gain in either accuracy or timeliness of aggregate flow data, such as real GDP, is in sight; indeed, “the new economy” has made definition and measurement of real GDP more difficult in some respects. With this information structure and shocks that last just one period each, it is not possible to implement a Taylor rule (see Taylor, 1999) incorporating a reaction to output gaps. Instead the monetary-policy objective of stabilizing employment must be implemented by seeking to infer disturbances to the quantity of labor demanded by employers from the behavior of high-frequency variables. The authorities thus can react at once to not fully revealed shocks to the extent they affect high-frequency price-type variables in a way that detracts from the objective of minimizing the social loss. Data on low-frequency flow quantity measures, such as output, however become available only with a one-period lag, too late to inform policy.[3]

A. Derivation of an Operational Social Loss Function

We conclude this introduction by explaining the social loss functions used in this paper in greater detail. To provide operational help for the monetary authorities, this function ultimately must be linked to price-level variables that they can both observe and influence immediately while nominal wages are sticky. However, equilibrium employment, and not the price level or its stability, is the final target.

As in Blinder and Mankiw (1984), income and substitution effects of real wage changes are assumed to offset each other so that the amount of labor workers would prefer to supply is constant. In economies in which cyclical variations in employment are made less by varying hours per employee than by hiring and lay-offs or firing, the microeconomic bargaining objective of wanting to achieve stable employment is compatible with the traditional macroeconomic objective of not letting the unemployment rate stray from its natural level in the aggregate. However, stabilizing income and output is compatible with the objective of stabilizing employment at its natural level only in the event of monetary (LM) and nonmonetary (IS) shocks to aggregate demand. Supply shocks, by contrast, change output even at given levels of labor input via variations in total factor productivity, and the resulting changes in output should not be resisted since they are based on an efficient level of labor utilization.

Hence a signal extraction problem arises both in the monetary union and in the small country before it decides to join that union. The monetary authorities have to decide what movements in the price variables that are immediately observable reveal about the composition of the temporary shocks that currently are affecting the economy. If the price level unexpectedly goes up, should the money supply be reduced to counter what is presumed to be a positive shock to aggregate demand? Alternatively, should the money supply be kept unchanged or even be raised to support a rise in the price level sufficient to reduce real wages so as to maintain employment in the face of a negative supply shock? Striking an optimal balance

[3]In developing optimal feedback rules for monetary policy under forward-looking rational expectations with potentially persistent disturbances, Taylor (e.g., 1986) has demonstrated the importance of assuming that the price level is contemporaneously observable to all agents. Goodfriend (1992) has explained that the aggregate level of output *not* being contemporaneously observable is critically important for the time-series properties of aggregate consumption data resulting from the sum of decisions by rationally optimizing agents.

between these conflicting pressures so as to minimize the expected squared deviations of employment is the objective of monetary policy, yet aggregate employment, like output, is not immediately observable. But because the price level is the variable that is critical to demand-determined employment given the preset money wage level, this objective can be pursued by minimizing the expected social loss, S. The loss function involves a number of variances and shock co-variances of the price level relevant for the large closed and small open economies, when the former is a materials-input supplier to the latter.

The basic logic of the derivation is most easily explained for the simplest case of the large closed economy. In that economy, minimizing the expected squared deviation of the amount of labor demanded by employers from the fixed amount workers would prefer to supply implies minimizing the variance of $(p+\sigma)$. As derived in von Furstenberg and Teolis (2002), the expected social loss score is $S = [s/(1-\beta)]^2[var(p)+2covar(p,\sigma)+var(\sigma)]$ with minimization focusing on the first two terms inside the last pair of brackets. In this expression, s is the elasticity of factor substitution in production, β is the share of labor, p is the price level with log-index mean of 0, and σ is the supply shock with zero mean and fixed variance, $var(\sigma)$.

If supply shocks were absent, minimizing S simply would require an active monetary policy that would eliminate incipient deviations of the price level from its stationary path so as to keep p and $var(p)$ at 0. However, if $var(\sigma)>0$, some negative covariance between p and σ clearly is helpful to minimize the expected value of the social loss function. Hence price-level variations would contribute to protecting the optimal "Walrasian" employment outcome against shocks. Such price-level variability that is helpful is not what Barro and Gordon's, (1983, p. 595) familiar dual-objectives-squared function has in mind when it casts deviations of the inflation and unemployment rates from their respective policy targets as a social loss. If supply shocks were guaranteed to be the only shocks affecting the economy and therefore inferable from price behavior, they should be fully matched by price changes in the opposite direction so as to produce procyclical behavior of real wages to stabilize employment. With $covar(p,\sigma)=-var(s)$ and $var(p)=var(s)$, the social loss score, S, would be zero according to equation (1). However, when the economy is afflicted by both aggregate demand and supply shocks, the minimum S is positive.

In the small open economy, whose variables are distinguished by asterisk (*), changes in the terms of trade, or in the cost of imported materials relative to the

Table 1. The Closed-Economy Union Model and Its Policy Solution

The Variables and Coefficients: See Glossary in the Appendix.		
The Social Objective (S) without Penalty for Instrument Use		
(1)	Min. $E_t\,S=var(p)+2covar(p,\sigma)+var(\sigma)$.	
The System Constraints		
(2)	$y_t=a_1(p_t-E_{t-1}p_t)+a_2\sigma_t; a_1=2,\ a_2=3,\ \sigma\sim N[0,\ var(\sigma)]$.	(Aggregate Supply)
(3)	$y_t=-b_1\,(i_t-E_t\,p_{t+1}+p_t)+\delta_t$; $b_1=0.68,\ \delta\sim N[0,\ var(\delta)]$.	(Aggregate Demand)
(4)	$m_t-p_t=-c_1i_t+c_2\,y_t+\eta_t; c_1=0.8,\ c_2=0.5,\ \eta\sim N[0,\ var(\eta)]$.	(Real-Balance Demand)
(5)	$m_t=-wp_t+vi_t+g\sigma_t+\varepsilon_t; g=0.15,\ \varepsilon\sim N[0,\ var(\varepsilon)]$.	(Money-Supply Policy)
Partially Reduced Solutions for p, y, i, m and S containing the Feedback Parameters w and v		
(6)	$p_t=\Delta^{-1}\{(c_1+v)\delta_t+b_1(\varepsilon_t-\eta_t)-[b_1(a_2c_2-g)+a_2(c_1+v)]\sigma_t\}$;	
(7)	$y_t=\Delta^{-1}\{a_1(c_1+v)\delta_t+a_1b_1(\varepsilon_t-\eta_t)+[b_1(a_1g+a_2(1+w+c_1+v))]\sigma_t\}$;	
(8)	$i_t=\Delta^{-1}\{(1+w+a_1c_2)\delta_t-(a_1+b_1)(\varepsilon_t-\eta_t)-[(a_1+b_1)g+a_2(1+w-b_1c_2)]\sigma_t\}$;	
(9)	$m_t=\Delta^{-1}\{(v+va_1c_2-wc_1)\delta_t+[c_1(a_1+b_1)+b_1(1+a_1c_2)]\varepsilon_t+(v(a_1+b_1)+wb_1)\eta_t+[g(c_1(a_1+b_1)+b_1(1+a_1c_2))+wa_2(b_1c_2+c_1)-va_2(1-b_1c_2)]\sigma_t\}$;	
	$S=\Delta^{-2}\{(c_1+v)^2var(\delta)+b_1^2[var(\varepsilon)+var(\eta)]+A^2var(\sigma)\}$;	
(10)	$\Delta\equiv(a_1+b_1)(c_1+v)+b_1(1+w+a_1c_2)>0$.	
	$A=b_1(1+w+a_1c_2)+(a_1-a_2+b_1)(c_1+v)+b_1(g-a_2c_2)$.	

price level of domestic value added also impact the demand for labor. This makes minimization of S^* more complex than that of S. Derivation and calibration of all the social loss functions used for scoring the different policy cases later in this paper are presented in von Furstenberg and Teolis (2002).

II. Optimal Monetary Policy for Stabilization of the Large Self-Contained Economy

The model of the monetary and economic union, given in Table 1, is the familiar closed-economy AS-AD model stated in deviation form. Its transitory logarithmic or multiplicative shocks are an IS shock to aggregate demand, δ, two types of LM shocks, ε and η, referring to random flutter in real money supply and money demand respectively, and an aggregate supply shock, σ. All Greek-letter disturbances are uncorrelated and the money supply measure that matters for economic activity is assumed to be sufficiently broad to be available to the authorities with a satisfactory degree of accuracy and completeness only with a lag. Hence ε is the orthogonal part of the money-supply shock not subject to immediate detection and correction.

In addition, aggregate supply shocks, σ, have an endogenous immediate nonpolicy effect on the money supply. As has been noted in a number of recent crises (see, for instance, Furman and Stiglitz, 1998; Mishkin, 1999) and as emphasized by "the new credit view," a negative supply shock (σ<0), by undermining the quality of existing loans, weakening bank balance sheets, and lowering capital adequacy, will induce money-supply contraction without any official acts by the monetary authorities. Although conceptually important, we put relatively little numerical weight on this still unconventional element, $g\sigma$, in the money supply function by making g equal to 0.15.[4] This chosen value is a mere 10% of the combined effect, a_2, of σ on output and the effect, c_2, of that change in output on the demand for real balances by the public, and for loan assets by banks.

The forward-looking model of Table 1 is solved by the method of undetermined coefficients for the nominal interest rate, *i*, and the relative deviations of output, *y*, and price level, *p*, from their respective stationary *ex* ante equilibrium values. As shown in Table 1, these variables are functions of the four disturbances and the as yet undetermined feedback policy coefficients, *w* and *v*, which appear in equation (5). Using the solution for *p* to derive $var(p)$ and $covar(p,\sigma)$, as required for minimizing expected deviations of employment from the level aimed at in prior wage negotiations if only price-type variables are observable on a current basis, then yields the expression for the remaining social loss, *S*, given as equation (10).

That social-loss equation contains the variances of the four multiplicative disturbances, $var(\delta)$, $var(\varepsilon)$, $var(\eta)$ and $var(\sigma)$. Values were assigned to these four shock variances so as to match the actual variances of *p* (December to December percentage change in the SA CPI), *i* (average annual 3-month Treasury bill rate), *y* (fourth-quarter to fourth-quarter percentage change in real GDP index), and *m* (December to December percentage change in SA M2) in U.S. (and German) annual data for the low-inflation period 1982-1998. These variables' variances, several of comparable size for Germany and the United States, are given in Appendix Table 1A. As explained below, matching them through the shock variances had to be done in an iterative solution process because obtaining the fully-reduced solutions shown in lines (b) of Table 2 requires the use of optimal values of the feedback parameters *v* and *w* which, in turn, depend on the size of the shock variances. The latter are expressed relative to $var(\sigma)$ which is the numeraire used for social loss throughout, given that the information conveyed by *S* is unaffected by scaling.

S is highly nonlinear in *w* and *v* given that the determinant of the coefficient

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[4]It is likely that the higher *g*, the greater the "signal confusion" and hence the lower the effectiveness and use of reactive monetary policy.

Table 2. How Shocks Affect the Endogenous Variables in the Closed-Economy Union (a) with no feedback policy, (b) with policy optimal for $var(\delta, \varepsilon, \eta)=(2,5,5)var(\sigma)$

Equations for Variable:	IS-Shock	LM-Shock		Supply Sk.
		Money-Supply Sk.	Money-Demand Sk	
Money Supply (ln) with:				
(a) v=0, w=0		ε		$+0.150\sigma$
(b) v=6.8, w=10.4	0.183δ	$+0.122\varepsilon$	$+0.878\eta$	$+0.786\sigma$
Nom. Interest (rate) with:				
(a) v=0, w=0	0.571δ	-0.765ε	$+0.765\eta$	-0.680σ
(b) v=6.8, w=10.4	0.431δ	-0.093ε	$+0.093\eta$	-1.166σ
Price Level (ln) with:				
(a) v=0, w=0	0.228δ	$+0.194\varepsilon$	-0.194η	-0.947σ
(b) v=6.8, w=10.4	0.264δ	$+0.024\varepsilon$	-0.024η	-0.824σ
Real Interest (rate) with:				
(a) v=0, w=0	0.799δ	-0.571ε	$+0.571\eta$	-1.627σ
(b) v=6.8, w=10.4	0.694δ	-0.069ε	$+0.069\eta$	-1.990σ
Output (ln) with:				
(a) v=0, w=0	0.457δ	$+0.388\varepsilon$	-0.388η	$+1.106\sigma$
(b) v=6.8, w=10.4	0.528δ	$+0.047\varepsilon$	-0.047η	$+1.353\sigma$

Source: Table 1, equations (6) through (9) solved with the coefficient values shown in that table and with the feedback policy parameters v and w shown in lines (a) and (b) above. The resulting fully-reduced solutions for the endogenous variables of interest are functions only of some or all of the shocks δ, ε, η, and σ as shown above.

Notes: The real interest rate, $i_t-(E_tp_{t+1}-p_t)$ is equal to i_t+p_t in this model of strictly temporary disturbances where $E_tp_{t+1}=0$ for all t.

For lines (b), the optimal values of v and w were found from equation (10) with $var(\delta)=2var(\sigma)$, and $var(\varepsilon)=var(\eta)=5var(\sigma)$. This relation between the shock variances was found by trial and error, proceeding in round multiples of $var(\sigma)$ from an initial assumption of all four shock variances being equal. It yielded optimal policy feedback parameters of v=6.8 and w=10.4, with the set of shock variances being chosen so as to yield values close to the actual variances of annual rates of change in m (M2), p (CPI), y (real GDP) and i (T-Bill Rate) during the most recent period of low inflation in the United States, 1982-1998, with $var(\sigma)$ set equal to 2 percent. The fit with the actual *past* variances for Germany is not as close as with its likely *prospective* variances which may not differ greatly from the past U.S. pattern. Data and details of the fit are provided and discussed in Appendix Table 1A.

matrix, Δ, also contains both of these variables. The "Maple V" program, using the Newton-Raphson procedure, was used to solve for the minimum value of S obtainable for shock variance ratios tentatively identified as consistent with U.S. data. We then searched for the combination of v and w that yields this minimum value to a four-places-of-decimals approximation and substituted the resulting values into the semi-reduced forms in Table 1 to obtain complete solutions for the dependent variables in terms of the exogenous shocks (Table 2). We then calculated the variances of p, i, y, and m from the fully-reduced-form equations to

Table 3. The Expected Social Loss and the Relative Importance of Its Components when the shock variances are var(δ, ε, η)=(2,5,5)$var(\sigma)$

	No Feedback v=0, w=0	Price Level Fdbk. v=0, w=2.3	Interest Rate Fdbk. v=3.2, w=0	Price and Interest Fdbk. v=6.8, w=10.4
$var(\delta)$	21.6	14.3	85.7	79.1
$var(\varepsilon)$	38.9	25.8	6.2	1.6
$var(\eta)$	38.9	25.8	6.2	1.6
$var(\sigma)$	0.6	34.2	1.9	17.7
Total:	100	100	100	100
SocialLoss(S)	0.4837var(σ)	0.3491var(σ)	0.2558var(σ)	0.1760var(σ)
--Index Form	100	72	53	36

Note: Percentage contributions of the shock variances to S may not add to 100 due to rounding. The numeraire used for S is var(σ) throughout.

recheck the fit with U.S. data, proceeding iteratively until a consistent match was found. The combination of values of v=6.8, w=10.4 and $var(\delta)=2var(\sigma)$, $var(\varepsilon)=var(\eta)=5var(\sigma)$ yielded an acceptably close match.

Without re-estimating the shock variance ratios so found in the unconstrained optimal program, we also searched for the constrained-optimal values of w given v=0 and of v given w=0 to see how much would be lost by basing the feedback policy on either the price level or the interest rate alone, rather than on both of these high-frequency variables. The results are $w=2.3|v=0$ and $v=3.2|w=0$ for these one-dimensional optima (Table 3). In addition we derived the solutions for the four basic variables of the system (Table 2) and for S and its variance decomposition (Table 3) when there is no feedback policy at all (v=0, w=0). The last line of Table 3 shows that a feedback policy that is fully optimized subject to the specifications of the model would reduce S by almost two-thirds from its no-feedback value. Such a reduction is undoubtedly much greater than what can be achieved in practice where various lags and model uncertainty would dampen the optimal degree of policy activism. The results also show that interest-rate smoothing, as attributed to U.S. policymakers (Goodfriend, 1987), by itself, can go much of the theoretically available distance. It reduces S by almost half from its no-feedback value, while optimally reacting to price level deviations alone achieves a reduction of one quarter.

A. Interpretation of Policy Results for the Large Country

The fact that the optimal values found for v and w are both positive for the large country has important implications for the economic system's remaining exposure to shock's A positive but finite value of w implies that the money supply is reduced to counter temporary price increases (p>0) to some extent while a positive but finite value of v indicates that the money supply reacts positively to, and thus dampens, interest rate increases according to the specification of the money supply function, equation (5) in Table 1. In other words, the optimal monetary policy is found to be one of smoothing: it reduces, but does not eliminate, nominal-interest-rate and price-level variability.[5] Hence any temporary shock that tends to move goods prices and interest rates in *opposite* directions is met by a double-barreled money-supply response. LM shocks ε and η have this characteristic, with a positive real-balance demand shock η, or a negative money-supply shock ε, for instance, tending to move interest rates up and the price level down. Hence a feedback policy in which the optimal values of both w and v are found to be positive necessarily helps reduce the social loss arising from LM shocks compared with no feedback.

By the same reasoning, since both IS shocks (δ) and aggregate-supply shocks (σ) move interest rates and the price level in the *same* direction, the optimal money-supply response is ambiguous. With v, w>0, the two barrels then point in opposite directions, being at cross-purposes, and it is not clear a priori whether the impulse to expand or to contract the money supply wins out in response to any realization of such shocks. It is even possible that the cost of achieving reduced exposure to LM shocks (ε and η) is an increase in exposure to the social loss arising from IS and/or aggregate-supply shocks (δ and σ).

The first block of equations in Table 2, for the logarithm of the money supply, shows that, compared with no feedback (v=0, w=0), 88 percent of any money-supply shock, ε, is offset and 88 percent of any money demand shock, η, is accommodated. In other words, if the money supply function is geared for optimal response to feedback from p and i, only 12 percent of the respective unidentified shock, if it occurs, is left to affect the economic system. By contrast, the respective optimal combinations of v and w *raise* the sensitivity of both the price level and output to IS shocks in Table 2, and this effect contributes to boosting the importance of the variance of δ in the minimum expected social loss, relative to no feedback, by a factor of about 3.6 from 21.6 in the first column to 79.1 percent in the last column of Table 3. Since the size of S at the same time declines to 36 percent of its no-feedback value as shown on the last line of Table 3, the *absolute* contribution

[5]According to Goodfriend (1987), central banks utilize monetary policy to stabilize both the financial markets and the economy in this way. Although he highlighted internal tensions, such a policy turns out to be optimal in the present model with full credibility and temporary shocks.

of $var(\delta)$ to the social loss S increases only modestly. However,it is evident from comparing the results in the first and last column of Table 3 that both the absolute and relative contributions of $var(\sigma)$ to S are raised greatly by the optimal policy.

Hence achieving a very large reduction, of over 98 percent, in exposure to the variance of LM shocks through adoption of that policy comes at the cost of increasing vulnerability to other shocks, particularly supply shocks: Their expected contribution to the social loss rises by a factor of more than 10. If supply shocks could be identified as soon as they occur and σ happened to be positive at some rate, the desired stabilization of employment would be achieved if the price level would fall and the real wage rise at that same rate. The optimal feedback policy, however, does not let this happen. Rather it is designed to dampen price movements since they are due mostly to causes other than supply shocks. At the same time, extinguishing *all* price-level variability by setting w to infinity is not the optimal feedback rule for monetary policy even though fixity of p (at its log-index value of 0) could be achieved mathematically since w appears only in the denominator (Δ) of the solution for p (eq. (6), Table 1). Not surprisingly, with a Walrasian-equilibrium rather than a Barro-Gordon welfare norm, some amount of aggregate price level variability is desirable because it is part of the most efficient real-wage adjustment to shocks.

Once the large closed economy that represents the monetary union has implemented its optimal feedback policy, it will confront the neighboring small country with the economic input data that greatly concern it. These data -- in particular, p, i, and y -- are determined by the, not immediately identifiable, shocks δ, ε, η, and σ, as shown in the set of equations (b) of Table 2. The small country shares these types of exogenous shocks, and not just their spillover effects, to some degree with the large country. It also experiences random shocks, χ, in the uncovered interest parity (UIP) relation with the large country under floating exchange rates. As already indicated, we use UIP without making any provision for a systematic positive risk premium against claims denominated in a financially small countrys currency to avoid anything that would favor the case for monetary union by assumption.[6]

[6]By specifying that the exchange rate is expected to be in equilibrium in all future periods we are assuming away bubbles and peso problems and ignore that exchange rates rarely have been found to have a stable relationship to macroeconomic fundamentals. For an analysis of the behavior of the exchange rates of the principal international currencies with the U.S. dollar see Meese (1990), for that of the Mexican peso see Teolis and von Furstenberg (1993), and for intra-European exchange rates see Canzoneri, Vallés and Viñals (1997) and Belke and Gros (1997).

Table 4. The Small-Open-Economy Model and its Policy Solution under Floating

The Variables and Coefficients: See Glossary in the Appendix.		
The Social Objective (S^*) without Penalty for Instrument Use		
(1)	Min. $E_t S^* = var(p^*) + var(\sigma^*) + \gamma^2 var(e) + \gamma^2 var(p) + 2covar(p^*, \sigma^*) - 2\gamma covar(p^*, e) - 2\gamma covar(p^*, p) - 2\gamma covar(\sigma^*, e) - 2\gamma covar(\sigma^*, p) + 2\gamma^2 covar(e, p)$, $\gamma = 0.25$.	
The System Constraints		
(2)	$y_t^* = a_1^*(p_t^* - E_{t-1}p_t^*) + a_2^*\sigma_t^* - a_3^*[e_t + p_t - E_{t-1}(e_t + p_t)]$; $a_1^* = 2.25$; $a_2^* = 4$; $a_3^* = 0.25$; $\sigma^* \sim N[0, var(\sigma^*) = var(\sigma)]$, $\sigma_t^* = \rho_{\sigma^*\sigma}\sigma_t + s_t$.	(Aggregate Supply)
(3)	$y_t^* = -b_1^*(i_t^* - E_t p_{t+1}^* + p_t^*) + b_2^*(e_t + p_t - p_t^*) + b_3^* y_t + \delta_t^*$; $b_1^* = 0.22$; $b_2^* = b_3^* = 0.5625$; $\delta^* \sim N[0, var(\delta^*) = 0.118 var(\delta)]$, $\delta_t^* = 0.344\rho_{\delta^*\delta}\delta_t + d_t$.	(Aggregate Demand)
(4)	$m_t^* - p_t^* - 0.3125(e_t + p_t - p_t^*) = -c_1 i_t^* + c_2 y_t^* + \eta_t^*$; $c_1 = 0.8$; $c_2 = 0.5$; $\eta^* \sim N[0, var(\eta^*) = var(\eta)]$, $\eta_t^* = \rho_{\eta^*\eta}\eta_t + n_t$.	(Real-Balance Demand)
(5)	$m_t^* = -w^* p_t^* + v^* i_t^* + g^*\sigma_t^* + \varepsilon_t^*$; $g^* = 0.2$; $\varepsilon^* \sim N[0, var(\varepsilon^*) = var(\varepsilon)]$, $\varepsilon_t^* = \rho_{\varepsilon^*\varepsilon}\varepsilon_t + h_t$.	(Money-Supply Policy)
(6)	$e_t = -E_t(e_{t+1} - e_t) = i_t - i_t^* + \chi_t$; $\chi_t \sim N[0, var(\chi)]$.	(Uncovered Interest Parity with Noise)
Solution for S^* with $v=6.8$ and $w=10.4$ and Small Country's Feedback Parameters v^* and w^*		
(7)	$S^* = \Delta^{*-2}\{[0.496\rho_{\delta^*\delta} + 0.360 + (0.344\rho_{\delta^*\delta} + 0.334)v^* + (0.086\rho_{\delta^*\delta} + 0.036)w^*]^2 var(\delta) + 0.118(1.441 + v^* + 0.25w^*)^2(1 - \rho_{\delta^*\delta}^2)var(\delta) + (0.045 + 0.274\rho_{\varepsilon^*\varepsilon} + 0.023v^* + 0.011w^*)^2 var(\varepsilon) + 0.274^2(1 - \rho_{\varepsilon^*\varepsilon}^2)var(\varepsilon) + (0.045 + 0.274\rho_{\eta^*\eta} + 0.023v^* + 0.011w^*)^2 var(\eta) + 0.274^2(1 - \rho_{\eta^*\eta}^2)var(\eta) + [1.290 - 1.390\rho_{\sigma^*\sigma} + (0.653 - 0.968\rho_{\sigma^*\sigma})v^* + (0.300 + 0.033\rho_{\sigma^*\sigma})w^*]^2 var(\sigma) + (-1.391 - 0.968v^* + 0.033w^*)^2(1 - \rho_{\sigma^*\sigma}^2)var(\sigma) + (-0.097 + 0.054v^* - 0.055w^*)^2 var(\chi)\}$;	
	$\Delta^* = 4.866 + 3.0325v^* + 1.0325w^*$.	

III. The Model of the Small Open Economy and its Policy Solution under Floating

Going from a model of the large and closed economy to a model of the small and open economy requires much more than re-labeling the country of application. Although financially small countries in Latin America and East of Euroland which might consider joining an existing monetary union are at lower levels of economic and financial development than that union, it is desirable to establish a baseline by specifying that the large and small country are as much as possible alike. But even when no change in basic economic behavior and in the disturbance-generating process is intended, many of the coefficients and reduced-form relations must change to take account of essential characteristics of the small open economy. This will be demonstrated with regard to the specification of aggregate demand shocks.[7] Hence the starred values for the small economy under floating in Table 4 usually differ from the corresponding coefficient values for the large closed economy in Table 1. An asterisk is attached whenever variables or coefficients already familiar from the model for the large country apply to the small country.

A. What Are "Like" Aggregate Demand Shocks in the Large Closed and Small Open Economies?

For the large closed economy, we have entered δ_t as an IS shock in equation (3) of Table 1. However, an equal distribution of exogenous non-monetary shocks to aggregate demand does not yield the same IS shocks in the closed and open economies[8] because exposure of domestic aggregate demand to the original shocks, and the extent to which they are propagated domestically, differ greatly between them. We will proceed to implement the ceteris paribus assumption by taking the variance of percentage (i.e., logarithmic) shocks to *domestic absorption* to be the same in the large closed and the small open economy. Then the shock δ_t* that would be recorded in equation (3) of Table 4 would still have a much smaller variance than the aggregate demand shock for the large country, δ_t. The reason is that a consistent set of assumptions suitable, by degree of openness, for countries like the Netherlands and Mexico, point to only 68.75 percent of any shock to domestic absorption affecting the demand for domestically produced goods in the small open economy directly.[9] This autonomous change is processed with an IS-multiplier that is half of that in the large country. Hence $var(\delta^*)= (0.6875/2)^2 var(\delta)=0.118164\ var(\delta)$. However, additional dependence on var(δ) is communicated through dependence of the small-country model equations of Table 4 on the large country's log income y_t, log price level p_t, and interest rate i_t,

[7]Coefficient Relations Between Large Closed and Small Open Economies are derived in von Furstenberg and Teolis (1999).

[8]Differences in the propagation mechanism can lead to asymmetry in the shock exposure of countries even if the shocks themselves are perfectly symmetric so that ρ equals1. This point has been emphasized and fully developed in Hughes Hallett and Warmedinger (1998).

[9]As indicated by γ=0.25 in the first equation of Table 4, the share of imported inputs in the gross value of domestic supply, defined as domestic value added plus imports of intermediate goods used to produce it, is one quarter. However, for countries like Mexico and the Netherlands, intermediate goods imports account for 80 percent of total imports (and exports, assuming balanced trade). Hence the ratio of total imports and exports to gross supply is 25/0.8=31.25 percent, meaning that domestic cost factors affect only 68.75 percent of the consumer price level (in the money demand function) of the small open economy, and exports are 31.25 percent of total aggregate demand for domestically produced goods, including intermediate import content.

variables which in turn contain δ_t (Table 2).

Next we must further allow that δ_t^* and δ_t, like all the other types of shocks between the large and the small country, are most likely positively correlated, rather than independent. Whatever is responsible for the shock in the large country may also be a factor in the shock to the neighboring small country through shared expectations, markets, production, information, or technology. Hence for demand shocks we specify that $\delta_t^*=0.34375\rho_{\delta^*\delta}\delta_t+d_t$, where the small country's idiosyncratic disturbance, d_t, is d_t~$N[0, var(d)]$. In the equation above, the coefficient on δ_t is $[var(\delta^*)/var(\delta)]^{0.5}\rho_{\delta^*\delta}$, with $var(\delta^*)/var(\delta)=0.118164$ and with $\rho_{\delta^*\delta}$ being the coefficient of correlation between aggregate demand shock δ for the large country and δ^* for the small country. Hence the variance of the idiosyncratic aggregate demand disturbance, d, is $var(d)=(1-\rho_{\delta^*\delta}^2)\ var(\delta^*)=0.118(1-\rho_{\delta^*\delta}^2)\ var(\delta)$. Clearly if $\rho_{\delta^*\delta}=1$, $var(d)$ equals zero and d must always stay at its mean value of zero also. By contrast, if $\rho_{\delta^*\delta}=0$, $var(d)$ equals $var(\delta^*)$, and the idiosyncratic element in the small country's aggregate demand disturbance, d, accounts for the entire disturbance, δ^*.

Matters are simpler for the three other pairs of multiplicative shocks where the shock variances for large and small country can be set equal to each other in each pair. It then follows from the specification of the supply shocks for the small country, $\sigma_t^*=\rho_{\sigma^*\sigma}\ \sigma_t+s_t$, that the variance of the small-countrys idiosyncratic supply shock component is $var(s)=(1-\rho_{\sigma^*\sigma}^2)var(\sigma^*)=(1-\rho_{\sigma^*\sigma}^2)var(\sigma)$. Analogous sub-stitutions are used for the variances of the idiosyncratic component of small-country money supply and money demand shocks, $var(h)$ and $var(n)$. Throughout we will consider four values of ρ ranging from independence, or absence of symmetry ($\rho=0$), to complete symmetry ($\rho=1$). We ignore negative correlations between like shocks of the four different kinds as having no empirical support for economically closely integrated neighboring countries, large and small.

B. The Disturbance in the Uncovered Interest Parity Relation and the Policy Solution

One new disturbance arises in the small open economy under floating which is unique to that economy since the large country is virtually unaffected by its exchange relations with the small country. This asymmetric disturbance, χ, arises in the uncovered interest parity (UIP) relation, equation (6) in Table 4. In that equation the exchange rate is always expected to return to the disturbance-free equilibrium in the next period, so that its current deviation from an equilibrium value of 0, e_t, equals the reverse of the temporary international interest differential of the small country, $i_t^*-i_t$, plus the iid disturbance, χ. Because e_t thus is controllable through the domestic interest rate, i_t^*, the exchange rate does not appear together with i_t^* and with the price index of domestic value added, p_t^*, in the monetary authority's feedback function which is equation (5) in Table 4.[10]

Equation (6) is used to substitute for e_t in the prior equations of the model and in the social objective function, S^*, whose expected value the central bank seeks to minimize. The central bank of the small country, like that of the large country, would do so by optimally selecting the policy feedback parameters to be attached to price and interest rate deviations that are currently revealed. These parameters, v^* and w^*, are determined from equation (7) of Table 4 by using the same shock variance ratios for $var(\delta)=2var(\sigma)$, $var(\varepsilon)=5var(\sigma)$, and $var(\eta)=5var(\sigma)$ in relation to $var(\sigma)$ and the same sets of correlation coefficients, ρ, as before, as well as a suitable value next derived for $var(\chi)$.

The variance of χ differs from the variances of δ, ε, η, and σ, and of their small-country matches, δ^*, ε^*, η^*, and σ^*, by several orders of magnitude because only $var(\chi)$ refers to changes in prices (interest and exchange rates) rather than changes in stock or flow quantities (of goods and services or real balances). $Var(\chi)$ is related closely to the variance of percentage changes in the exchange rate because changes in that rate are not well explained by changes in the international interest differential. If the small country and its large neighbor were at similar levels of industrial development and highly integrated economically, the variance of the real exchange rate and of χ would not get very large. If, however, one considers, say, Mexico in relation to the United States, the variance of χ is found to be many

[10]The semi-reduced solutions for all the variables with v^* and w^* -- presented as "Partially Reduced Solutions for the Small Open Economy under Floating" -- are available upon request.

[11]For the United States, McCallum (1989, p. 28) attributes a standard deviation of 2.95 percent (variance of 8.7 percent), equal to the standard deviation of multifactor productivity, to supply shocks. However, to match the variance of p, i, y, and m for the United States, 1982-1998, we required a variance of supply shocks, $var(\sigma)$, of only 2 percent because we distinguished three other sources of disturbances. For comparison, the variance of the real exchange rate, calculated for the period 1980-1998 with annual data reported by Banco de México (1998, p. 276; 1999, pp. 106, 241), is 318 percent based on unit labor costs in manufacturing and 256 percent based on consumer prices. The solution of equation (6) in Table 4, after substituting the value of i_t corresponding to the feedback parameters v=6.8 and w=10.4 for the large country and the value of i_t^* corresponding to v^*=1.76 associated with an optimal interest rate policy for the small country when ρ=0.75 (Table 6) shows that 99 percent of the variance of e is due to (0.64 times) the variance of χ and not to the variance of the international interest rate differential. Hence, with $0.64var(\chi)=0.99(318/2)var(\sigma)$, the variance of χ *relative* to $var(\sigma)$ is 246 by the first measure. It is 198 by the second. We choose $var(\chi)=150var(\sigma)$ to be conservative in our appraisal of the advantage, over floating, of monetary union which necessarily eliminates the disturbance χ.

Table 5. Expected Social Loss (S^*) for the Small Country Under Floating (v=6.8, w=10.4) Compared with Monetary Union

ρ=0	No Feedback	Price Level Fdbk.	Interest Rate Fdbk.	Price and Interest Fdk.
	$v^*=0, w^*=0$	$v^*=0, w^*=0.38$	$v^*=2.15, w^*=0$	Unconstr. Min. S*
S*	0.2703$var(\sigma)$	0.2686$var(\sigma)$	0.1883$var(\sigma)$	0.1104$var(\sigma)$
-- Index Form	100	99	70	41
Social Loss under Monetary Union with ρ=0 is 0.2431$var(\sigma)$ and appreciably higher than under floating in half the number of cases.				
ρ=0.5	No Feedback	Price Level Fdbk.	Interest Rate Fdbk.	Price and Interest Fdk.
	$v^*=0, w^*=0$	$v^*=0, w^*=-0.1$	$v^*=1.84, w^*=0$	Unconstr. Min. S*
S*	0.2204$var(\sigma)$	0.2203$var(\sigma)$	0.1473$var(\sigma)$	0.1015$var(\sigma)$
-- Index Form	100	100	67	46
Social Loss under Monetary Union with ρ=0.5 is 0.1570$var(\sigma)$ and appreciably lower than under floating in half the number of cases.				
ρ=0.75	No Feedback	Price Level Fdbk.	Interest Rate Fdbk.	Price and Interest Fdk.
	$v^*=0, w^*=0$	$v^*=0, w^*=-0.3$	v*=1.76, w*=0	Unconstr. Min. S*
S*	0.1926$var(\sigma)$	0.1913$var(\sigma)$	0.1223$var(\sigma)$	0.0900$var(\sigma)$
-- Index Form	100	99	63	47
Social Loss under Monetary Union with ρ=0.75 is 0.1139var(s) and lower than under floating in 3 out of 4 cases.				
ρ=1	No Feedback	Price Level Fdbk.	Interest Rate Fdbk.	Price and Interest Fdk.
	$v^*=0, w^*=0$	$v^*=0, w^*=-0.5$	v*=0.168, w*=0	Unconstr. Min. S*
S*	0.1649$var(\sigma)$	0.1608$var(\sigma)$	0.0972$var(\sigma)$	0.0763$var(\sigma)$
-- Index Form	100	98	59	46

Social Loss under Monetary Union with ρ=1 is 0.0709$var(\sigma)$ and lower than under floating in all cases.

Sources: Floating : Equation (7), Table 4. Monetary Union: Equation (6), Table 6, for different values of ρ. Correlations between like shocks in the large and small country are all ρ=0, 0.5, 0.75, or 1.
Shock variances in the numeraire $var(\sigma)$ are $var(\delta)=2var(\sigma)$, $var(\varepsilon)=5var(\sigma)$, $var(\eta)=5var(\sigma)$, and $var(\chi)=150var(\sigma)$, with only the relation of $var(\delta)$ to $var(\sigma)$ relevant under Monetary Union.

times as large as that of the other four shocks, with 150 $var(\sigma)$ being a conservative estimate.[11] For instance, giving the same weighting to their respective trading partners, mostly the United States, the variance of the real exchange rate over the past two decades has been 15 times larger for Mexico than Canada with annual data.

C. The Expected Social Loss for the Small Country Under Floating

Any advocacy of floating is motivated by the desire of the small country to continue to engage in active monetary feedback policies. Even though that small country is overshadowed by its large neighbor, it will try to mitigate its exposure both to the foreign spillovers and to any idiosyncratic shocks which arise internally. Table 5 is therefore designed in part to compare the social welfare loss of the small country under floating in the absence of any feedback policy with what it would be if feedback to both price and interest rate developments were instantaneous and completely unrestricted, being accurately deployed and calibrated to minimize the expected social welfare loss. In between we consider the welfare loss under a constrained-optimal modus operandi in which monetary policy either reacts only to temporary innovations in the price level (column 2) or in the interest rate (column 3).

The results in Table 5 show that an independent monetary policy is less valuable to the small country the greater the correlation of its shocks, ρ, with the corresponding shocks of the large country. For instance, the indexes and social loss numbers in Table 5 reveal that the maximum policy-induced decline in S compared with no feedback is little more than half as large if ρ=1 than if ρ=0 absolutely, though the percentage differences in stabilization success relative to no feedback, revealed by the index numbers, are less dramatic. Price-level feedback,

Table 6. The Small-Open-Economy Model under Monetary Union

The Variables and Coefficients: See Glossary in the Appendix.

Arbitrage Condition: Arbitrage assures that the interest rate in the small country (i^*) is equal to that in the large country (i) with which it is in monetary union. However, on account of nontraded goods and different specializations in production, the price level of the small country (p^*) may deviate from that in the large country (p) although any such deviations are temporary in the present model.

The Expected Social Welfare Level (S*)

(1) $E_tS^*=var(p^*)+var(\sigma^*)+\gamma^2var(p)+2covar(p^*,\sigma^*)-2\gamma covar(p^*,p)-2\gamma covar(\sigma^*,p)$, $\gamma=0.25$.

The System Constraints

(2) $y_t^*=a_1^*(p_t^*-E_{t-1}p_t^*)+a_2^*\sigma_t^*-a_3^*[p_t-E_{t-1}(p_t)]$; $a_1^*=2.25$; $a_2^*=4$; $a_3^*=0.25$; $\sigma^*\sim N[0, var(\sigma^*)=var(\sigma)]$, $\sigma_t^*=\rho_{\sigma^*\sigma}\sigma_t+s_t$. (Aggregate Supply)

(3) $y_t^*=-b_1^*(i_t-E_tp_{t+1}^*+p_t^*)+b_2^*(p_t-p_t^*)+b_3^*y_t+\delta_t^*$; $b_1^*=0.22$; $b_2^*=b_3^*=0.5625$; $\delta^*\sim N[0, var(\delta^*)=0.118var(\delta)]$, $\delta_t^*=0.344\rho_{\delta^*\delta}\delta_t+d_t$. (Aggregate Demand)

Solutions with Policy-Feedback Parameters v=6.8 and w=10.4 applied in the Large Country and with the Money Supply to the Small Country Perfectly Elastic Within the Monetary Union

(4) $y_t^*=(1.0322\rho_{\delta^*\delta}+0.4643)\sigma_t+(0.2552\rho_{\delta^*\delta}+0.2432)\delta_t+0.0433(\varepsilon_t-\eta_t)+1.0322s_t+0.742d_t$.

(5) $p_t^*=-(1.319\rho_{\sigma^*\sigma}-0.1148)\sigma_t+(0.1134\rho_{\delta^*\delta}+0.1374)\delta_t+0.0219(\varepsilon_t-\eta_t)-1.319s_t+0.3298d_t$.

(6) $S^*=(0.11344\rho_{\delta^*\delta}+0.0714)^2var(\delta)+(-0.31904\rho_{\delta^*\delta}+0.32078)^2var(\sigma)+0.00025var(\varepsilon)+0.00025var(\eta)+0.10179(1-\rho_{\sigma^*\sigma}^2)var(\sigma)+0.01283(1-\rho_{\delta^*\delta}^2)var(\delta)$.

on top of what the large country is doing on its own behalf, is practically useless for the small country and may not involve dampening but rather mild reinforcement, since $w^*|v^*=0$ takes on small negative values in some cases. An interest-rate feedback policy, however, is highly effective, achieving from 51 percent (30/59) of the maximum theoretical reduction in S when $\rho=0$ to 76 percent (41/54) when $\rho=1$.

When either the price or interest-rate feedback mechanism is deactivated, the middle columns of Table 5 show the constrained-optimal values of v^* (s.t. $w^*=0$) or w^* (s.t. $v^*=0$) to be lower the higher ρ. Thus, the higher the correlation between like kinds of shocks affecting the large and small country, the less active any one-dimensional feedback policy should be, and the less such a policy has to contribute to reducing the social loss from employment instability.

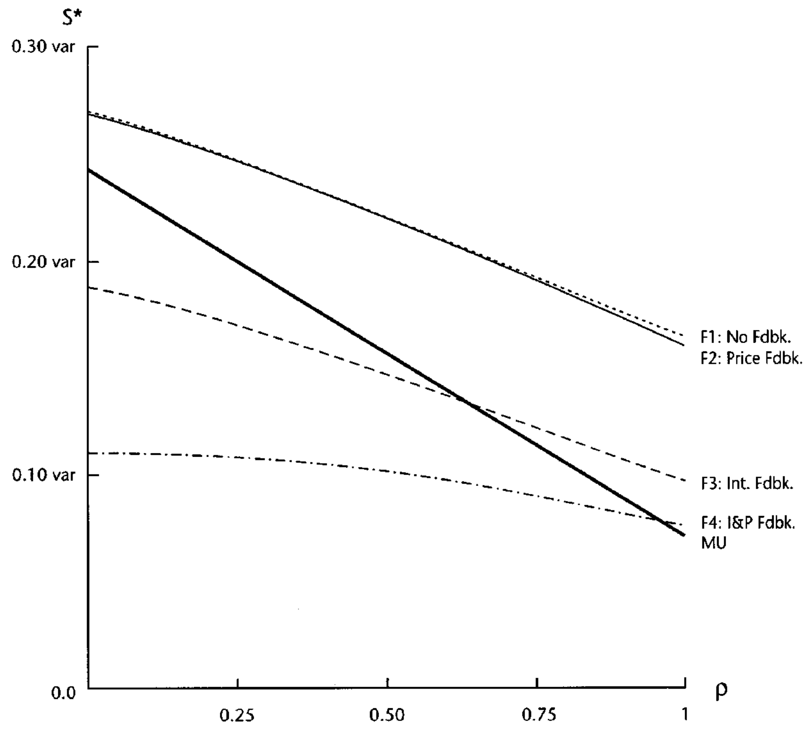
IV. The Social Loss for the Small Country Under Floating Compared with Monetary Union

In monetary union with the large country, the small country sheds exposure to $var(\varepsilon)$ and to the LM disturbances with variance $var(\varepsilon)$ and $var(\chi)$. The reason is that the money supply to the small country becomes infinitely elastic at the interest rate, i, shared with the large country if financial integration is so complete as to provide no substance for policy-based or other differences in country risk. Hence money-demand disturbances originating in the small country have no effect on prices, interest rates, or income in that country, and the monetary sector equations do not appear in the model for the small country under monetary union in Table 6. There remains, of course, indirect exposure to all the disturbances, including the LM disturbances, affecting the large country because that country's i, p, and y, and hence the full set of its contemporaneous disturbances, appear in the AS-AD sector equations of the small country.

Under monetary union, the small country is not able to modify the effects of this exposure to the shocks of the large country nor is it able to react to the idiosyncratic part of the IS and AS shocks to which it remains exposed. It also will lose its ability to adjust its aggregate barter terms immediately through changes in its nominal exchange rates -an adjustment otherwise possible provided the small country's trade composition differs from that of the large country.

Figure 1, based on Table 5 which includes italicized identification of the social loss under monetary union, shows that this sacrifice of monetary and exchange-

Figure 1. The small country's social loss (S^*) with specified monetary feedback policies under floating (F), compared with monetary union (MU), at different degrees of large- and small-country shock correlations (ρ).



rate autonomy may be rewarding. For these welfare costs can be outweighed by the benefits of shedding exposure to monetary and exchange rate disturbances through monetary union, provided the value of like error correlations between the two countries is sufficiently high. For instance, if ρ exceeds 0.95, the social loss under monetary union will be less than under floating even when the feedback policy process is unconstrained and applied with perfect precision. In reality, there may be an appreciable reaction lag or friction in the implementation of monetary policy, for instance because a policy-making committee or governing council first must act. There could also be a question about the quality of some of the price data when first reported and of their immediate processing with an agreed model on which the optimal policy rests. Any such imperfections would raise the likelihood of monetary union, at any given value of ρ, being less costly than floating.

A. Additional Welfare Comparisons Between Floating and Monetary Union

It is useful to compare the welfare results under floating with those under monetary union further for a small developing country for which $var(\chi)$ is assumed to be $150var(\sigma)$. As ρ rises from 0 to 1, the welfare loss under monetary union falls by about 70 percent from $0.24var(\sigma)$ to $0.07var(\sigma)$ (line MU in Figure 1). With no feedback (curve F1), or with "price level feedback only" which does little better (curve F2), the welfare loss under floating (F) declines from $0.27var(\sigma)$ to $0.16var(\sigma)$ under the same circumstances, falling by only about 40 percent. If the small country instead optimizes its feedback policy under floating (curve F4), the social loss, while starting out much lower than in the case of the two alternatives discussed, also falls much less as ρ increases: S^* now declines by less than one-third from $0.11var(\sigma)$ for ρ=0 to $0.08var(\sigma)$ for ρ=1. The upshot is that forgoing an optimal monetary policy under floating is relatively less costly, compared not only with a "no feedback" policy under floating but with monetary union, the higher the degree of paired shock correlation, ρ, among the large and the small country, given that the large country optimizes for its own sake.

Even if like kinds of shocks to the large and the small country are perfectly correlated, the difference in openness and hence in their propagation mechanisms means that the small country can still benefit by having its own active feedback policy under floating. Indeed, looking down the principal diagonal of Table 5, of the entire $0.194var(\sigma)$ reduction in welfare loss that is associated with moving from a situation where ρ=0 and there is no policy feedback to one where ρ=1 and the optimal two-dimensional feedback policy is in effect, 54 percent is due to the increase in ρ and the remaining 46 percent to the feedback policy. Not surprisingly, the first effect, the reduction in the welfare loss due to the increase in ρ, is so much more powerful under monetary union that it starts to beat even the rather successful "interest-rate feedback only" policy under floating at ρ>0.62 and the unconstrained mathematically perfect policy at ρ>0.95. Figure 1 shows the crossover points of the solid MU line with F3 and F4, respectively. Having "no feedback" and "price-level feedback only" are conditions trumped by monetary union from the start (of ρ=0). The last conclusion is of interest if "price-level feedback only" is identified with inflation targeting as currently practiced by a number of monetary authorities.

Monetary union thus need not represent a disturbing triumph of a drive toward political integration over economic logic, as Feldstein (1997, 2000) and Krugman (1997) have held against Europe and the Euro. On the contrary: For financially small neighboring countries that have already experienced deep economic integration of the kind a common market, and to a lesser extent an FTA, brings, monetary union may be an important step toward a lower social welfare loss from any applicable set of random disturbances than realistically expected under floating.

V. Conclusion and Evaluation

In this paper, the large economy representing an existing monetary union and the potential joiner at its periphery have much in common even though there is a fundamental asymmetry in their degree of influence. Both entities have already "converged" in their economic structure and also in their policy goals. Hence both have just one welfare-based objective for monetary policy in a nominal-wage-contracts economy: to minimize unintended employment fluctuations. This in turn implies that output should optimally fluctuate by the exact amount of any multiplicative supply shock, with price-level variability needed to promote this "Walrasian" outcome.

To help achieve this, price-type variables, such as the consumer price level and interest rates, and not more slowly emerging quantity variables like aggregate output or employment, here could be acted upon immediately. It turns out that the monetary feedback policy of the large closed economy and of the small open economy under floating that is optimal to minimize the variance of labor-demand-determined employment around the fixed desired labor supply is a feedback policy that dampens both the price and interest rate movements resulting from temporary shocks. Such a policy is most consistent and effective when a shock, like an LM shock to aggregate demand, moves prices and interest rates in opposite directions, and not in the same direction as would be expected from an IS shock or a shock to aggregate supply. It is also quite effective in countering the effects of disturbances in the international interest-parity relationship, which, unlike all other shocks, are fully identified contemporaneously.

The optimal rules-based monetary policy thus turns out to be most apt at diminishing the economy's exposure precisely to those disturbances which monetary union eliminates by its very nature if it achieves complete integration of the monetary and financial systems of the member countries. Indeed, monetary union partly substitutes for the optimal monetary policy under floating, leaving a similar structure of welfare results and remaining shock exposure. Monetary union is more beneficial, and giving up the optimal monetary policy available under floating is less costly, the higher ρ. Since economic union raises ρ, and monetary union as the capstone of economic union may do so even more, as Frankel and Rose (1998), Rose (1999), Fontagné and Freudenberg (1999), Frankel and Rose (2000), and Rose and van Wincoop (2001) have documented, the case for monetary union grows with the intensity of regional integration to which it itself contributes.[12]

However, monetary union should not precede such deep integration: If ρ is zero, the welfare loss under monetary union is over twice as great as the minimum loss under floating combined with the two-dimensional and numerically unconstrained mathematically optimal feedback policy. Even though that policy is probably utopian,[13] being severely affected by what Buiter (2000, p. 3) has called the "fine tuning delusion," a more practical, "interest rate feedback only," policy with floating exchange rates also leads to a better outcome than monetary union if the paired international shock correlations are small. Thus, economically as yet not deeply integrated faraway countries, such as Argentina and the United States, should not aim for bilateral monetary union or its inferior substitute, complete unilateral dollarization. Hemisphere-wide monetary arrangements may become optimal eventually, but only after economic integration has spread, for instance by means of the Free Trade Area of the Americas (FTAA), to the entire chain of countries that trade mostly with each other.

Qualitatively there are no surprises from working through this simultaneous and yet asymmetric model in which the small country acts in view of what the large country chooses as its own best policy. The higher ρ and the greater the variance of the noise (χ) in the UIP relation relative to the variance of the IS, LM, and AS

[12]Fontagné and Freudenberg (1999) estimate that EMU, through the elimination of exchange-rate variability *expectations*, increases horizontal intra-industry trade, which raises the symmetry of shocks, empirically much more than vertical differentiation that does not necessarily do so. Carré, Levasseur and Portier (2000) also emphasize the endogenous modification of shock correlations during the process of economic and monetary integration, but they expect growing specialization and an increasingly asymmetric impact of given sectoral shocks. OECD (1999, p. 15) notes that each of the three key forces which promote closer integration, (i) trade interdependence, (ii) the degree of intra-industry trade, and (iii) closer income linkages, such as increased foreign direct investment or closer financial market interactions, has risen sharply over the past 20 years, and all of these factors are likely to be raised further by monetary union.

[13]The mathematically optimal feedback rule can be found by policymakers in the small open economy only if they know their own economic structure *and* that of the large foreign economy. Hence it may be utopian to expect the small country to obtain the same degree of optimality as expected from policymakers in the large country, particularly if the small country is at a lower level of economic and financial development. In Frankel's (1999, p. 4) judgment, "emerging economies" are "not really able to use the tool of independent monetary policy effectively."

[14]The two-player model exaggerates the extent to which joining a regional monetary union eliminates exchange risk but on the other hand handicaps monetary union by not allowing the small country's fiscal policy to confront IS and AS shocks when it loses its own monetary policy.

disturbances, the more likely it is that monetary union offers a net improvement.[14] If so, what the small country gives up by moving from floating to monetary union-a monetary policy that deals by optimal rules-with any undesirable spillovers from the large country and with its own idiosyncratic shocks-will be surpassed by what it gains from such a step-deactivating exposure to its own LM shocks and to exchange-rate shocks and capital-account disturbances.

Before closing it needs to be noted that, for the most likely accession countries, the case for or against monetary union cannot be based on short-run stabilization considerations alone.[15] For instance, depending on their level of financial development, they may be subject to consistently adverse country and currency risk premiums prior to joining in monetary union with a large country or group of countries. By failing to credit deep monetary union with the elimination of such premiums, we have ignored the allocative benefits of lower expected costs of capital and of increased capital formation and long-run economic growth that financial integration achieved by joining a multilateral monetary union would bring.

For countries that are financially less developed and less credibly administered than the core countries of the region, economic and monetary union also would banish currency and financial crises and provide some consumption insurance by allowing their credit markets to become integrated to such an extent in the region that temporary adversity readily could be financed at prevailing interest rates. To assume that systematic currency risk premiums, effects on economic growth, and opportunities for consumption insurance can be left out of consideration in choosing between floating and monetary union could be fitting for financially highly developed, but otherwise “small,” countries in a region like Canada, or Sweden, Switzerland, and the United Kingdom. It would not be appropriate for Latin American countries and accession countries to the East of Euroland. Hausmann *et al.* (2000) and Calvo and Reinhart (2000) have explained why acceding to an existing monetary union conferring a first-rate international currency and financial system is much more attractive for financially small developing countries than for highly advanced countries. All considered therefore, the case for monetary union is stronger for the former class of countries than was demonstrated in this paper by considering short-term stabilization effects alone. On the other hand, it may be weaker for the latter class of countries to the extent they face, on average,

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[15]A more complete list of the benefits to be expected from monetary union is given in (Chabot , 1999). Calmfors *et al.* (1997) provide a comprehensive and balanced assessment of the case for monetary union versus floating for an advanced economy (Sweden).

zero or even negative currency risk premiums that are not nearly as volatile as was here realistically assumed for the financially small countries.

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Appendix

Glossary, Variance Data for the United States and Germany and their Model Counterparts
Glossary of Variables and Coefficients

Large Closed Economy

y, p, m	: Logarithm (ln) of output, of the price level, and of the money supply.
i, E	: Nominal interest rate (natural units, not %), expectations operator.
g	: The endogenous effect of a positive supply shock on the strength of bank balance sheets and hence the supply of money.
t	: Time subscript.
-w, v	: Instantaneous monetary-policy feedback policy parameters to movements in p and i. These parameters are to be set to minimize the expected social loss, S.
σ	: Multiplicative (ln-additive) aggregate supply (AS) shock.
δ	: Multiplicative aggregate demand (IS) shock.
η	: Money demand (LM) shock.
ε	: Money supply (LM) shock.
S	: Social welfare loss score.

Small Open Economy

y, p*, m**	: Logarithm (ln) of output, of the price level, and of the money supply.
*e, i**	: Ln of small country’s exchange rate with large country, the nominal interest rate.
E	: Expectations operator.
g	: The endogenous effect of a positive supply shock on the strength of bank balance sheets and hence the supply of money.

t	: Time subscript.
$-w^*$, v^*	: Instantaneous monetary-policy feedback policy parameters to movements in p* and *i**. These policy parameters apply only under floating (i* = i under monetary union).
σ, σ^*	: Multiplicative supply shock in the large and small country with correlation coeff. $\rho_{\sigma^*\sigma}$.
δ, δ^*	: Multiplicative demand shock in the large and small country with correlation coeff. $\rho_{\delta^*\delta}$.
η, η^*	: Money demand shock in the large and small country with correlation coeff. $\rho_{\eta^*\eta}$.
ε, ε^*	: Money supply shock in the large and small country with correlation coeff. $\rho_{\varepsilon^*\varepsilon}$.
s	: Idiosyncratic component of aggregate supply (AS) shock for the small country.
d	: Idiosyncratic component of aggregate demand (AD) shock for the small country.
n	: Idiosyncratic component of money demand (LM) shock for the small country.
h	: Idiosyncratic component of money supply (LM) shock for the small country.
*S**	: Social welfare loss score.
*	: Distinguishes variables and coefficients that were already introduced in the model for the large closed economy when they apply to the small country.

Table 1A. Variances of Annual Percentage Rates of Change: Actual or Implied in Model Assuming the Estimated Optimal Monetary Policy is applied by the Large Country

Column:	1982-1998 United States (1)	1982-1998 Germany (2)	Var(δ, ε, η, σ) = 4,10,10,2 v=6.8, w=10.4 (3)
December to December % Change in SA M2	9.36 (5.60)	17.22 (5.60)	9.23
Average Annual 3-Month Treasury Bill Rate (%)	4.24 (6.30)	3.42 (5.42)	3.63
December to December % Change in the SA CPI	1.51 (3.34)	2.25 (2.46)	1.65
Fourth Quarter to Fourth Quarter % Change in Real GDP Index	3.92 (2.96)	2.95 (2.28)	4.82

Notes: Mean percentage rates of change or levels (T-bill rate) are shown in parentheses in the first two columns referring to actual data. When the demand shock variance is twice var(σ) and the money supply and money demand variances are five times var(σ), the pattern of all implied variances in column (3) is close to that in column (1). Specifically, the entries in column (1) are at least 80 percent and not more than 120 percent of the corresponding entries in column (3). The implied pattern of the variances of the growth rates of m, *p*, and y and of *i*, in this last column, also roughly matches some features of the data for Germany in column (2). Interestingly, the variance of real GDP growth exceeds that of inflation during this low-inflation period in all three columns, and the variance of the T-bill rate is about the same as that of real GDP growth but much less than the variance of money growth.

For Germany, the growth rates of seasonally adjusted M2 are between yearends (IFS), and the growth rates of both the CPI and real GDP are year-over-year. Data prior to 1991 refer to Western Germany, and the growth rate of the M2 money supply during 1991 was dropped from the above calculations to eliminate outlier effects of the July 1, 1990, German monetary union. Nevertheless, unusually erratic annual rates of money supply growth during the period 1992-1995, including one episode of significant *negative* growth far away from the sample mean of 5.6% growth per annum raised the sample variance of money growth for Germany above the population variance to be expected for a continuing, rather than newly configured, entity.

The opposite bias is likely to affect both the German and the U.S. real GDP growth data, as both sample variances are depressed by going from a trough in 1982 to the advanced stages of a long expansion in 1998, rather than to another trough. Hence we are inclined to settle for the present calibration of all the shock variances in the model with round multiples of *var*(s).