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Mundell Revisited: a Simple Approach to the Costs and Benefits of a Single Currency Area

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Abstract

The paper evaluates the costs and benefits of a single currency area within a unified framework. Conventionally, it is argued that a single currency area carries a welfare loss owing to the sacrifice of exchange rate adjustment in the presence of country-specific shocks. But in 1973 Mundell argued that a single currency area offers risk-sharing benefits when capital markets are limited in their ability to facilitate consumption insurance. The authors construct a simple model and compare a system of independent national currencies to a single currency area. The presence of country-specific shocks may either reduce or enhance the benefits of a single currency area, depending on the importance of exchange rate adjustment relative to risk-sharing. In a simple quantitative analysis, we find that either regime may dominate, although the utility differences between the two regimes are very small.

1. Introduction

There has been a wide debate documenting the pros and cons of a single currency area. Broadly speaking, most of the critics of the euro area argued that Europe did not comprise an "optimal currency area." In the sense of Mundell (1961), McKinnon (1963), and Kenen (1969), an optimal currency area is defined as an area in which factor mobility is sufficiently great, or economic shocks are sufficiently common, that there is little need for relative price adjustment between different regions within the area. The proponents, on the other hand, argued for the transactions and efficiency benefits of eliminating national currencies, as well as the "noneconomic" benefits associated with enhancing the European Union. It is fair to say, however, that at an analytical level there has been much more attention paid to the costs of a single currency area, in terms of the absent adjustment role of the exchange rate, and the lack of independent monetary policy, than there has been to the economic benefits of a single currency.[1]

Recently, McKinnon (2002) has highlighted a less well-known contribution by Mundell (1973), who developed an argument for a single currency based on the risk-sharing benefits of using a common means of exchange among regions that are hit by idiosyncratic shocks. Mundell's (1973) perspective is implicitly one where consumption insurance via the use of international private capital markets is difficult or impossible to attain, owing to financial market incompleteness. Then, in a system of independent national currencies, a negative shock has to be absorbed within a country, while under a common currency regime a country can run a balance of payments deficit by running down its holdings of the international currency.

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Although the development of private international capital markets has proceeded dramatically since the time of Mundell's writing, there is still substantial evidence that capital markets do not provide much international consumption insurance (e.g., Lewis, 1998; Crucini, 1999). In addition, when we focus on emerging market economies, capital market constraints seem to be even more binding, as generally these economies find it impossible to issue debt denominated in national currencies (e.g., Eichengreen and Hausmann, 1999).

This paper revisits the analysis of the costs and benefits of a single currency area in a unified model which encompasses both the costs and benefits of a single currency, based on Mundell's two separate arguments. We examine the tradeoff between the adjustment benefits of a flexible exchange rate with independent national currencies, on the one hand, and the risk-sharing benefits of a single currency area on the other hand, within a utility-based general-equilibrium model.

In the model, there are two countries, each of which is hit by separate country-specific shocks. There are also nominal rigidities in the form of sticky wages, which make it desirable to have exchange rate adjustment in face of shocks. A system of independent national currencies under floating exchange rates succeeds fully in undoing the effects of wage rigidities. But this environment is still inefficient because it does not allow any consumption risk-sharing across countries. On the other hand, the establishment of a single currency area allows for a measure of risk-sharing through flows of money from one country to another in response to country-specific shocks, but eliminates the possibility for nominal exchange rate adjustment.

The model therefore encompasses both the costs *and the benefits* of a single currency area, within one framework. In addition, as in Mundell (1961) and (1973), *both* the costs and benefits are related to the presence of country-specific productivity shocks.

In the model, a single currency can offer either net gains or net losses, relative to a system of national currencies. As is to be expected, net losses are more likely, the more important are nominal rigidities. One clear result we note is that *an increase in the variability of country-specific shocks does not necessarily increase the desirability of national currencies with floating exchange rates*. This represents a caution for much of the empirical work that has been conducted in this area.

A calibration exercise of the welfare tradeoff indicates that, in general, the welfare comparison may go either way. For a very high elasticity of labor supply, a single currency area is more desirable. But we also find that the quantitative welfare differences between the two arrangements are very small.

There is one important qualification of the argument, relating to the elasticity of substitution between national goods. Our benchmark model makes the assumption that there is infinite elasticity of substitution (equivalent to a one-good world economy). In this case, national currencies and exchange rate adjustment do not allow for endogenous risk-sharing. But with lower elasticity of substitution, there is endogenous risk-sharing through the terms of trade, as in Cole and Obstfeld (1991). The tradeoff between the single currency area and independent national currencies still applies, however, except in the special case where the elasticity of substitution between goods is unity. In this case, the two regimes are equivalent.

This paper is related to a number of recent papers in the literature which compare alternative international monetary regimes. Bachetta and van Wincoop (2000) compare welfare and trade variability under fixed and floating exchange rate regimes. Their analysis stresses the implications of nonseparability in preferences. Moreover, they do not allow for the risk-sharing implications of a single national currency, which

is the focus of our paper. Here we simplify by maintaining full separability. Obstfeld and Rogoff (2000) also examine optimal monetary rules in a multicountry world economy; they discuss the issue of international monetary coordination. Devereux et al. (2003) examine the welfare consequences of a single currency based on the impact on international pricing decisions.

Section 2 outlines the model. Section 3 lays out a benchmark social planning problem which can be used as a welfare comparison with the other outcomes in the model. Section 4 illustrates the results under independent national currencies. Section 5 describes the effect of a single currency area. Section 6 provides a quantitative comparison of the two arrangements. Section 7 offers some brief conclusions.

2. The Model

Take a model of two countries, called "home" and "foreign." Preferences are identical across countries. In addition, there is only one period. Wages must be set in advance before the state of the world is known. This is a starkly simplified environment, but it suffices to draw out clearly the tradeoff between costs and benefits of a single currency area relative to a system of independent national moneys.

Firms

The final good is produced by firms in each country.[2] The final-good firm in the home country uses labor to produce output. Labor is differentiated across households. Define the composite labor supply as H, where

$$H = \left(\int_0^1 h_i^{\frac{(\rho-1)}{\rho}} di \right)^{\frac{\rho}{(\rho-1)}}.$$

The final-good firm has the production function

$$Y = \theta H^{(1-\alpha)}, \tag{1}$$

where θ represents a home-country-specific productivity shock. The firm chooses employment to maximize profits, given by $P(1+s)Y - \int_0^1 W_i H_i di$. We assume that the firm receives an employment subsidy, s, from the government.[3] This implies an implicit labor demand schedule

$$P(1-\alpha)(1+s)\frac{Y}{H}\left(\frac{H_i}{H}\right)^{-\frac{1}{\rho}} = W_i. \tag{2}$$

Households

Within each country, there is a unit measure of households. A household supplies labor to a final-good firm, and receives profits from ownership of a firm. In addition, the individual consumes some of the final good, and holds real balances. Home country consumer i maximizes the following utility function:

$$\mathrm{E}U = \mathrm{E}\left[\ln(C_i) + \chi \ln\left(\frac{M_i}{P}\right) - \eta \frac{H_i^{1+\psi}}{1+\psi} \right] \tag{3}$$

subject to the budget constraint

$$PC_i + M_i = W_i H_i + \Pi_i + M_{i0} + T_i, \tag{4}$$

where C_i is consumption of the final good, P is the final-good price, M_i is the quantity of domestic money held, with M_{i0} being initial money holdings and T_i a money transfer from the government/central bank, W_i is the preset wage for individual i, H_i is total hours worked, and Π_i is profit income. As in the *differentiated labor* model of Obstfeld and Rogoff (2000), we assume that each household has some market power in the control of its own labor supply. The household sets the wage in advance, and then chooses consumption and money balances after the state of the world has been revealed.

Wage Setting

Each worker i faces a downward-sloping labor demand curve, given by (2). The worker chooses the wage to maximize expected utility as given in (3) subject to (4). This gives the resulting wage:

$$W_i = \tilde{\rho}\eta \frac{\mathrm{E}H_i^{1+\psi}}{\mathrm{E}\left(\frac{H_i}{PC_i}\right)}, \tag{5}$$

where $\tilde{\rho} = \rho/(\rho - 1)$. In the case where wages are flexible, this equation would imply that the nominal wage is given by a markup factor ($\tilde{\rho} > 1$) multiplied by the disutility cost of labor, divided by the marginal utility of money (i.e., $W_i = \tilde{\rho}\eta PC_i H_i^{\psi}$). When wages are set in advance, the worker chooses the wage so that the expected utility cost from working more is matched by the expected benefit due to the higher wage earnings.

Given the wage, employment is determined by the demand for labor (2). Since each individual within a country is alike, we can dispense with the individual-specific subscripts, and thus, we must have $H = H_i$.

Consumption and Real Balances

After the state of the world has been revealed, the home household chooses consumption and money balances to maximize *ex post* utility, taking the wage and employment as given. Thus we have

$$C = \frac{1}{1+\chi}\frac{Wh + \Pi + M_0 + T}{P}, \tag{6}$$

$$\frac{M}{P} = \gamma C. \tag{7}$$

The conditions pertaining to the foreign economy are analogous. The foreign firm has production function for good 2 identical to (1), except that foreign productivity disturbances may differ from those in the domestic economy. In addition, we assume that the domestic and foreign productivity disturbances are independent and identically distributed.[4]

Equilibrium

Under all international monetary arrangements, an equilibrium in the world economy must involve (a) profit maximization by the home and foreign firms as in (2), (b)

optimal wage determination by home and foreign workers as described in (5), (c) utility maximization subject to budget constraints by home and foreign households (giving (6) and (7)), and (d) market clearing in the final-good and money markets. The goods-market clearing is represented by the equation

$$\theta H^{1-\alpha} + \theta^* H^{1-\alpha} = C + C^*. \tag{8}$$

The money-market clearing conditions depend on the international currency arrangement being followed.

The Appendix spells out in detail how the solution of the model is derived, under each international currency arrangement. In the discussion in the text below, we give an intuitive account of the properties of the solution. First, however, it is insightful to examine a *social planning solution*. This represents an outcome of the world economy where a global social planner maximizes an equally weighted sum of the utility functions of home and foreign countries, unencumbered by nominal rigidities or imperfect competition. This offers a welfare benchmark with which to compare the outcome under separate national currencies, and a single world currency.

3. A Social Planning Outcome

Assume that the social planner maximizes the utility function

$$V = \ln(C) - \frac{\eta}{1+\psi} H^{(1+\psi)} + \ln(C^*) - \frac{\eta}{1+\psi} H^{*(1+\psi)}$$

subject to the world resource constraint (8).[5] The social planner's choice is particularly simple. The social planner would wish to achieve full risk-sharing, and so equalizes consumption across countries, so that $C = C^* = \frac{1}{2}(\theta H^{(1-\alpha)} + \theta^* H^{*(1-\alpha)})$, and to set employment according to the rule

$$H = \left[\frac{(1-\alpha)}{\eta} \frac{2\theta^\sigma}{\theta^\sigma + \theta^{*\sigma}} \right]^{\frac{1}{1+\psi}}, \tag{9}$$

where $\sigma = (1+\psi)/(\alpha+\psi)$. The social planner would lead home employment to respond positively to home-country productivity shocks, but negatively to foreign-country productivity shocks. Intuitively, when there is risk-sharing across countries, a home productivity shock raises the marginal product of home employment more than it reduces the marginal utility of consumption, so that home employment should rise. But because the marginal utility of consumption falls relative to the marginal product of *foreign* employment, foreign employment should fall.

4. Independent National Currencies

How does the social planning outcome compare to the market outcome? This depends critically on the international monetary regime. When each country issues its own currency, which is held by domestic residents, then money holdings of the home-country household must equal the outstanding money supply, $M = M_0 + T$, and there are no transfers across countries. Then consumption must equal national output in each country, so from (2) we have

$$C = \theta H^{(1-\alpha)}. \tag{10}$$

Note from the money market equilibrium that $M = \chi PC$. Combining this and (10) with the firm's profit-maximizing decision $P(1 - \alpha)\theta H^{-\alpha} = W$, we find employment is given by

$$H = \frac{M}{W}\frac{(1-\alpha)}{\chi}. \tag{11}$$

Under separate national currencies, employment is positively related to the home-country money supply, and negatively related to the wage. Holding the money supply constant, however, employment does not depend on domestic (or foreign) productivity shocks. A domestic productivity shock will cause a fall in the home-country price so that optimal employment for each firm is unchanged:

$$P = \frac{W^{(1-\alpha)}M^{\alpha}}{\theta}(1-\alpha)^{-(1-\alpha)}\chi^{-\alpha}. \tag{12}$$

The determination of employment and output in the foreign country is identical. Then, from the PPP relationship, we have the exchange rate given by

$$S = \frac{\theta^*}{\theta}\left(\frac{W}{W^*}\right)^{1-\alpha}\left(\frac{M}{M^*}\right)^{\alpha}. \tag{13}$$

The characteristics of the world economy with independent national currencies will obviously depend on the monetary policy being followed. If the money supply in each country is held constant, then the exchange rate must adjust to domestic and foreign productivity shocks. A domestic productivity shock, lowering the home country price, requires a nominal exchange rate appreciation for the home country. This represents a system of floating exchange rates, where the exchange rate is a key part of the adjustment process.

As we noted, holding the money supply constant, employment is constant, by (11). But since employment is constant, this must mean that it doesn't matter whether wages are predetermined or not. A constant money supply stabilizes aggregate demand, and as long as the preset wage is chosen optimally, employment is equal to the rate that it attains in a flexible wage economy even without wage flexibility.[6]

Given constant money supplies, and floating exchange rates, it is easy to establish that nominal preset wages are proportional to the money supply in each country. As a result, the equilibrium exchange rate becomes $S = (\theta^*/\theta)(M/M^*)$.

This offers an illustration of the benefits of exchange rate adjustment under independent national currencies, as in Mundell (1961). Although in the Mundell argument, terms-of-trade movements were stressed, the logic carries over to this environment, where goods are perfect substitutes. The possibility for nominal exchange rate adjustment is important, owing to the presence of nominal wage rigidities. We find that if countries follow a constant money supply policy, then the exchange rate adjusts so as to completely eliminate the impacts of nominal rigidities. Consumption and output respond as they would in a flexible wage economy.

But note that there is a difference between the consumption and employment outcome under independent national currencies and the outcome implied by the social planner's solution. This is because the economy with independent national currencies precludes international risk-sharing. Home consumption responds only to domestic productivity shocks, and not to foreign shocks. Moreover, employment is constant. Intuitively, when home consumption fully absorbs the impact of home productivity

shocks, the substitution and income effects of the shock exactly cancel out, so home employment is unaffected by the shock.[7]

We have described the outcome of the economy under independent national currencies only in the special case where the home and foreign money stocks are held constant. How do the results change if monetary policies are set in different ways? One possibility is that money supplies are adjusted to maintain a fixed exchange rate. Looking at (13), it is clear that if the monetary authorities in each country follow a rule given by $M = \tilde{M}\theta^{1/\alpha}$, $M = \tilde{M}^*\theta^{*1/\alpha}$, where $\tilde{M}$ and $\tilde{M}^*$ are known in advance, then the exchange rate will be fixed. But then from (11), employment is no longer constant. Now, domestic output responds positively to a domestic productivity expansion, as in the social planning outcome. But there is still no consumption risk-sharing, since national output and consumption must be the same, as in (10). In fact, we may show that the constant-money-supply floating exchange rate is the optimal policy for each monetary authority, under the environment of separate national currencies.

Proposition 1. *With separate national currencies, the optimal monetary rule for each country is a constant money supply (see the Appendix).*

Corollary. *Under separate national currencies, welfare is higher under floating exchange rates than under fixed exchange rates.*

The intuition behind this result is that, with separate national currencies, there is no international risk-sharing. Each country's consumption equals its income. Conditional on this, it is optimal to maintain a constant employment level. Any nonconstant money supply rule would destabilize employment, thereby leading output to deviate from the flexible wage equilibrium, without any gains in terms of international risk-sharing. As a byproduct, the proposition says that exchange rate flexibility is a key ingredient of an optimal monetary policy under separate national currencies.

5. A Single Currency Area

A single currency area differs from a pegged exchange rate in one critical way; there are implicit transfers of money between countries. The single currency is acceptable in exchange in both the home and foreign country. A unit exchange rate holds by definition, and there is no need for monetary policy to be actively used to support an exchange rate peg.[8] There is a single central bank, and home and foreign country residents receive transfer payments from the bank (T and T^*) that are not contingent on the realization of θ.[9] If home-country residents desire an increase in their money balances, they can achieve this by running a surplus in trade with the foreign country, and obtaining more of the international currency in exchange. In this way, the common currency introduces the possibility of transfers of goods for money across countries; consumption no longer need necessarily be equal to income for each country. This is the feature of the single currency area stressed in Mundell (1973). This feature allows for some international risk-sharing that did exist under national currency regimes. But against this risk-sharing gain, there is a loss arising from the inability of the exchange rate to adjust to shocks. We now examine this tradeoff.

Although, in the presence of a single currency, consumption no longer need equal income for each country, consumption demand is given by (6) and money demand by (7), as before. But with just one money held by households in both the home and foreign economies, money market clearing is

$$\overline{M} = M_0 + M_0^* + T + T^* = \chi P(C + C^*). \tag{14}$$

Given the goods-market clearing equation (8), the common world price level under the single currency area is

$$P = \frac{1}{\chi}\frac{\overline{M}}{\theta H^{(1-\alpha)} + \theta^* H^{*(1-\alpha)}}. \tag{15}$$

Now note from (6) that home-country consumption is a function of real GDP and the real value of money balances:

$$C = \frac{\theta H^{(1-\alpha)}}{1+\chi} + \frac{1}{1+\chi}\frac{M_0 + T}{P}.$$

To maintain symmetry, assume that each country has an equal initial share of the world money supply, so that

$$\frac{M_0 + T}{\overline{M}} = \frac{M_0^* + T^*}{\overline{M}} = \frac{1}{2}.$$

Then, substituting for the world price level from (15) gives

$$C = \omega\theta H^{(1-\alpha)} + (1-\omega)\theta^* H^{*(1-\alpha)}, \tag{16}$$

where $\omega = \left(1 + \frac{\chi}{2}\right) \Big/ (1+\chi)$. Likewise, foreign-country consumption is

$$C^* = \omega\theta^* H^{*(1-\alpha)} + (1-\omega)\theta H^{(1-\alpha)}. \tag{17}$$

Equations (16) and (17) establish that the presence of a single currency establishes a measure of consumption risk-sharing that does not exist in the case of separate national currencies. Consumption is now a weighted sum of GDP in each country. The weights depend on the importance of real balances in utility, and the share of the world money supply held by the country. But even for relatively small values of χ, the single currency area could allow for a substantial amount of risk-sharing. For instance, for $\chi = 2$, we obtain $\omega = 0.67$.

The risk-sharing possibilities of a single currency arise from the ability of the country to run balance of payments deficits or surpluses, drawing on their reserve holdings of the region-wide currency. Under independent national currencies, if the home country has a positive productivity shock that raises home GDP, it would increase both its consumption and real balances. Consumption would increase by the full amount of the increase in income, and a fall in the home price level would let real balances rise by the same proportion. But in the single currency area, the fall in the world price level is *less than* proportional to the home country productivity shock. In order to increase its holdings of real balances, the home country runs a balance of payments surplus; consumption rises by less than the increase in home GDP. As a result, foreign consumption will also rise.

In a dynamic model, this risk-sharing role could be played by trade in nominal bonds. But under separate national currencies, there is a risk with nominal bond trade that one country might resort to surprise inflation to reduce the real value of outstanding asset claims.[10]

This description of the single currency area is only partial, however, since employment and output are endogenous. Unlike the example of independent national currencies, in a single currency area there is no equivalence between the equilibrium with preset wages and the flexible wage equilibrium (to be shown below). Hence in order

to explore the behavior of output, it is useful to set out as a benchmark the case where wage rates are flexible, *ex post*.

The Single Currency Area with Flexible Wages

First, we may state the following proposition.

PROPOSITION 2. *In an economy with flexible wages, welfare is higher with a single currency than with independent national currencies (see the Appendix).*

The intuition behind Proposition 2 is straightforward. There are two potential efficiency losses in the global economy, relative to the social planning outcome. The first comes from sticky wages, and the second is due to the failure of risk-sharing. When wage rates are flexible, the only remaining distortion is the failure of full risk-sharing. But the single currency area sustains greater risk-sharing than does the equilibrium with independent national currencies, which allows for no risk-sharing. Thus, without nominal rigidities, the single currency environment allows for higher welfare.

To determine employment in the single currency area with flexible wages, note that the marginal product of labor must be equal to the *ex post* marginal rate of substitution between consumption and labor; i.e., $P(1-\alpha)\theta H^{-\alpha} = \eta PCH^{\psi}$. This implies that employment is

$$H = \left[\frac{(1-\alpha)}{\eta}\frac{\theta}{C}\right]^{\frac{1}{\psi+\alpha}}. \tag{18}$$

Employment depends positively on the domestic productivity shock, and negatively on domestic consumption. Now use equation (18) and the analogous condition for the foreign economy to write

$$\frac{H}{H^*} = \left[\frac{\theta}{\theta^*}\right]^{\frac{1}{\psi+\alpha}}\left[\frac{C^*}{C}\right]^{\frac{1}{\psi+\alpha}}. \tag{19}$$

We may compare expression (19) with the social planning outcome. From equation (9), the social planning outcome would imply

$$\frac{H}{H^*} = \left[\frac{\theta}{\theta^*}\right]^{\frac{1}{\psi+\alpha}}.$$

The relative employment response in the single currency area (with flexible wages) approaches that of a social planner, the greater is the risk-sharing facilitated by the single currency area. But in general, risk-sharing under the single currency area is imperfect, so the employment response with flexible wages differs from the social planning outcome. Effectively, this will mean that employment is not sufficiently responsive (positively) to domestic productivity shocks, or (negatively) to foreign productivity shocks.

The Single Currency Area with Sticky Wages

With sticky wages, there is a tradeoff between the adjustment benefits offered by independent national currencies, and the risk-sharing benefits offered by the single cur-

rency area. Note that the expressions (16) and (17) hold whether wages are flexible or not. But to determine employment with sticky nominal wages, use equation (2) to get

$$H = \left(\frac{W}{P\theta(1-\alpha)} \right)^{-\frac{1}{\alpha}} \tag{20}$$

in the home economy. Now substitute for the world price level into (20), and using the equivalent to (20) for the foreign economy, we may obtain the solution for employment as

$$H = \frac{\overline{M}(1-\alpha)}{W\chi} \frac{\theta^{\frac{1}{\alpha}}}{\left(\theta^{\frac{1}{a}} + \theta^{*\frac{1}{a}} \right)}, \tag{21}$$

where the nominal wage is determined by condition (8), given the distribution of consumption and employment facing workers.

Holding the money supply constant, employment again depends positively on home-country productivity, and negatively on foreign productivity. A rise in home productivity will reduce the world price level, but less than in proportion to the productivity increase itself. Given a fixed nominal wage, equilibrium employment will rise. Likewise, a foreign productivity expansion will reduce both the world price level and home employment.

The response of employment is not identical to that under the social planning outcome, or to the single currency area with flexible wages. In contrast to the case of flexible wages and a single currency, here relative employment across countries will respond to productivity shocks *by more* than is efficient, because nominal wage rates are fixed. And because of this, there is in general a gap between the *ex post* marginal product of labor and the marginal rate of substitution between consumption and labor.

Hence, there is a tradeoff between the risk-sharing benefits of the single currency area on the one hand, and the adjustment benefits of the exchange rate in a system of independent national currencies, on the other. With a single currency area, some risk-sharing is facilitated, but the labor market is not in equilibrium (i.e., equivalence between the marginal product of labor and the marginal rate of substitution between consumption and labor). With independent national currencies, there is no risk-sharing at all, but the adjustment of the exchange rate ensures that the labor market is always in equilibrium. The welfare comparison between the two international monetary arrangements then becomes an empirical one.

One key insight to note is that the *sole difference between the two international monetary arrangements arises from the presence of country-specific productivity shocks*. If productivity shocks were identical, then consumption, employment and welfare would be the same across both regimes. Thus, *both* the costs and benefits of a single currency area are related to country-specific shocks, as in Mundell (1961) and (1973). Therefore, *it will not be true to say that country-specific productivity shocks enhance the benefits of independent national currencies*.

In order to provide a quantitative welfare comparison between the single currency area and independent national currencies, we must discuss the stance of monetary policy in the single currency area. Recall from Proposition 1 that an optimal monetary policy rule under independent national currencies was for each country to maintain a constant (noncontingent) money supply. We can establish an analogous result under the single currency area.

PROPOSITION 3. *An optimal monetary rule in the symmetric outcome of a single currency area is to maintain a constant level of the area money supply* (*see the Appendix*).

At first glance this proposition may seem puzzling since, unlike in the economy with independent national currencies, here there is an inefficiency associated with sticky nominal wages. Thus it would seem that monetary policy could be used actively to alleviate these inefficiencies. But the explanation lies in the fact that the labor market inefficiencies are not associated with productivity shocks per se, but the *differential* shocks across countries. If the home and foreign productivity shocks were identical, then the world economy would behave like the individual economies under separate national currencies. Employment would be independent of the productivity shocks, there would be no welfare loss from nominal wage stickiness, and thus no need for monetary policy. It is only when the productivity shocks are country-specific that the failure of wages to adjust has real consequences. But this is precisely the case where aggregate, area-wide monetary policy is ineffective. The presence of sticky wages means that employment does not respond efficiently to productivity shocks in the home or foreign country. An optimal policy would require that home and foreign employment respond efficiently, in different directions to a home productivity shock. But an area-wide monetary policy rule can only move *ex post* employment in both countries in the same direction. Thus, in face of differential productivity shocks, an activist area-wide monetary rule is neither useful nor desirable.

6. A Quantitative Comparison

With the highly stylized model that we use, it is difficult to provide a robust quantitative welfare comparison of the single currency area relative to independent national currencies. But to the greatest extent possible, we calibrate to empirical observations.

We let the joint distribution of productivity shocks be symmetric and have standard deviation δ.[11] Following the literature on the international measurement of Solow residual shocks (e.g., Zimmerman, 1994), we set $\delta = 0.03$. The value of ψ determines the consumption-constant elasticity of labor supply (i.e., $1/(1 + \psi)$). Since it is the elasticity of labor supply that substantially determines the effective welfare loss from fixed nominal wages, this is a critical parameter for the model. There is a wide variety of estimates of this parameter. Christiano et al. (1997) set this elasticity at unity, implying $\psi = 0$. But we also allow for a lower elasticity of half, implying that $\psi = 1$. Since the monopoly markup in wage setting is eliminated by an optimal subsidy, we need not specify the elasticity of substitution between differentiated labor. The parameter χ is important, because it controls the degree to which the single currency area facilitates risk-sharing through flows of money across regions. In the model, this parameter is equivalent to the ratio of money in nominal consumption. The equivalent value in the data depends on the measure of money used. We use IMF international financial statistics data, calculating the average value of "money" (representing M1 or extended M1 for most countries) relative to quarterly nominal consumption, for a sample of OECD economies for the 1980–2000 period. The average value of this estimate is 2. But because the estimates vary so much, we also report the results for values of 0.5, 1, and 3.5. Finally, we set the share of labor in GDP equal to 0.64, roughly the measure used in RBC theory (thus setting $\alpha = 0.36$).

Table 1 provides a welfare comparison between the single currency area and the equilibrium with independent national currencies. Welfare is evaluated using expected utility. The value in each cell measures the proportion of consumption under the

Table 1. Welfare Evaluation in the Benchmark Model[a]

	$\chi = 0.5$	$\chi = 1$	$\chi = 2$	$\chi = 3.5$	$\chi = 2$ (*flexible wage*)
$\psi = 0$	0.015	–0.02	–0.04	–0.054	–0.1
$\psi = 1$	0.12	0.09	0.07	0.06	–0.13

[a] Measures the proportion of consumption under the single currency area that a resident of either country would need to be equally as well off as under independent national currencies.

single currency area that a resident of either country would need to make her equally as well off as under independent national currencies. If the value is positive, then separate currencies dominate. But if it is negative, the single currency area welfare-dominates.

The table indicates that, for the high estimate of labor supply, the single currency area is marginally preferable to the system of independent national currencies, in the baseline case. Note, however, that the welfare differences are extremely small. Residents of the single currency area would desire only 4 hundredths of one percent of consumption to be willing to move to a system with independent currencies. For a lower labor supply elasticity, the comparison switches, and residents marginally prefer independent national currencies. As the importance of money relative to nominal consumption falls ($\chi = 0.5$), the welfare comparison switches in favor of independent national currencies, even with a high labor supply elasticity. This is intuitively understandable, since we've seen that as χ falls, the risk-sharing benefits of the single currency area fall. On the other hand, as χ rises, the benefits of independent currencies fall. Finally, the last column compares the two systems under flexible wages. As established by Proposition 1, in this case the single currency area is preferable. While the welfare differences are still small, it is notable that in this case they are substantially larger than the baseline case under sticky wages.

7. Conclusions

We have developed a framework within which to evaluate the costs and benefits of a single currency area as compared with a system of independent national currencies. The costs of a single currency area are related to the sacrifice of nominal exchange rate adjustment in an environment of nominal rigidities. The benefits of a single currency area are related to the enhanced risk-sharing possibilities offered by flows of money across borders. The costs of sacrificing nominal exchange rate adjustment were identified by Mundell (1961) and many other writers since then. The risk-sharing benefits of a single currency were first identified by Mundell (1973). The contribution of our paper is to bring these costs and benefits together within a unified framework, and moreover, to analyze the single currency area question within a utility-based model. The paper also shows that a single currency area may be desirable quite apart from any microeconomic benefits in terms of reduced international transactions costs. From a quantitative point of view, we find that either currency arrangement may dominate in welfare terms, but the welfare differences are very small. One of the central messages to come from the paper is that, in contrast to the prevailing consensus in the literature, the presence of country-specific productivity shocks does not necessarily enhance the case for independent national currencies.

Appendix

Model Solution under Independent National Currencies

We may describe the full model by the following set of equations:

$$W = \frac{\rho}{\rho - 1}\eta \frac{\mathrm{E}H^{1+\psi}}{\mathrm{E}\left(\frac{H}{PC}\right)}, \tag{A1}$$

$$W^* = \frac{\rho}{\rho - 1}\eta \frac{\mathrm{E}H^{*1+\psi}}{\mathrm{E}\left(\frac{H^*}{P^*C^*}\right)}, \tag{A2}$$

$$P(1+s)\theta(1-\alpha)H^{-\alpha} = W, \tag{A3}$$

$$P^*(1+s)\theta^*(1-\alpha)H^{*-\alpha} = W^*, \tag{A4}$$

$$\theta H^{1-\alpha} + \theta^* H^{*1-\alpha} = C + C^*, \tag{A5}$$

$$C = \theta H^{1-\alpha}, \tag{A6}$$

$$\frac{M}{P} = \chi C, \tag{A7}$$

$$\frac{M^*}{P^*} = \chi C^*. \tag{A8}$$

This equation system solves for W, W^*, C, C^*, H, H^*, P, and P^*. From that we may recover the exchange rate from the PPP condition. By using (A3), (A6), and (A7), we obtain (11) of the text. Then using (11) and (A3) again, we obtain (12). Finally, using (12) and the analogous equation for the foreign country in the PPP condition, we obtain the exchange rate equation (13).

With constant national money supplies, under floating exchange rates, we have employment and PC constant, so that the nominal wage is given by $W = [\rho\eta/(\rho - 1)]PCH^{\psi}$. Using this with (A3), and noting that $s = 1/(\rho - 1)$, we find that employment is

$$H = \left[\frac{(1-\alpha)}{\eta}\right]^{\frac{1}{1+\psi}}. \tag{A9}$$

Proof of Proposition 1

An optimal monetary policy with commitment involves the central bank choosing a state contingent money rule, taking into account the impact of the rule on private sector expectations and *ex ante* wage setting. The objective function for a national government is

$$\mathrm{E}U = \mathrm{E}\ln C - \mathrm{E}\frac{1}{1+\psi}H^{1+\psi}. \tag{A10}$$

Without loss of generality, assume that there is a finite number of states of the world, Z, and the monetary authority chooses the money supply for each state, $z \in Z$; i.e., $M(z)$. Each state has probability $\pi(z)$. From (A1), using (A3), (A6), and (A7):

$$W = \frac{\Theta}{\chi}\sum_{z\in Z}\pi(z)\left(M(z)^{1+\psi}\right)^{\frac{1}{1+\psi}}, \tag{A11}$$

where

$$\Theta = \left[\frac{\rho\eta}{\rho-1}(1-\alpha)^{\psi}\right]^{\frac{1}{1+\psi}}.$$

Now substitute this wage-setting equation into (11) of the text, and using (A6), substitute into the objective function (A10). We obtain

$$\mathrm{E}U = \sum_{z\in Z}\pi(z)\ln\theta(z) + (1-\alpha)\left[\sum_{z\in Z}\pi(z)\ln M(z) - \frac{1}{1+\psi}\ln\sum_{z\in Z}\pi(z)M(z)^{1+\psi}\right] + \Psi, \tag{A12}$$

where Ψ denotes a function of parameters which do not depend on money or productivity shocks. The first-order conditions from (A12) give

$$\frac{\pi(z)}{M(z)} - \frac{\pi(z)M(z)^{\psi}}{\sum_{z\in Z}\pi(z)M(z)^{1+\psi}} = 0 \tag{A13}$$

for each z. This does not depend on $\theta(z)$, so it is clear that the optimal money supply under independent national currencies should be state independent. □

Model Solution under a Single Currency Area

Under a single currency area, (A1)–(A5) are the same as before. But equations (A6)–(A8) now become

$$C = \frac{P\theta H^{1-\alpha} + M_0 + T_0}{P(1+\chi)}, \tag{A14}$$

$$\overline{M} = \chi P(C = C^*). \tag{A15}$$

Using (A14) and (A5), we obtain an initial solution for the world price level ((15) of the text). Substituting back into (A14), we obtain (16) of the text. Equation (17) of the text is obtained analogously. □

Proof of Proposition 2

In a single currency area, home and foreign consumption can be written as

$$C = \omega\theta H^{1-\alpha} + (1-\omega)\theta^* H^{(1-\alpha)}, \quad C^* = (1-\omega)\theta H^{1-\alpha} + \omega\theta^* H^{(1-\alpha)}.$$

Holding employment at the level appropriate for the economy with separate national currencies, expected utility for each country is higher under a single currency area than with individual national currencies, because the former allows some cross-country consumption risk-sharing, while the latter does not. That is

$$\mathrm{E}\ln\left(\omega\theta H_I^{(1-\alpha)} + (1-\omega)\theta^* H_I^{*(1-\alpha)}\right) - \mathrm{E}\frac{\eta}{1+\psi}H_I^{1+\psi} \geq \mathrm{E}\ln\left(\theta H_I^{(1-\alpha)}\right) - \mathrm{E}\frac{\eta}{1+\psi}H_I^{1+\psi},$$

where H_I represents the (constant) employment level under separate national currencies. But since, under flexible wages, equilibrium employment in a single currency area is chosen optimally to maximize *ex post* utility, it must be that in any state of the world,

utility is higher with employment chosen optimally than it would be with employment determined at the level implied by individual national currencies. Hence, in an overall sense, expected utility must be higher in a single currency area with flexible wages than in the equilibrium with individual national currencies. □

Proof of Proposition 3

First we derive the expression for the nominal wage under the single currency area. Given the money-market clearing condition (14) and the home-country budget constraint, we may write

$$PC = \left[\frac{\omega WH}{(1-\alpha)} + (1-\omega)\frac{(W^*H^*)}{(1-\alpha)}\right]. \tag{A16}$$

(This follows from the fact that the nominal wage is equal across countries in a symmetric currency area, and total GDP in the currency area is the total wage bill divided by $(1 - \alpha)$.) Then from (20) (and its analogue for the foreign country) we have

$$\frac{H}{H^*} = \left[\frac{\theta}{\theta^*}\right]^{\frac{1}{\alpha}}. \tag{A17}$$

From the wage-setting equation, (A16), and (A17), and again assuming a finite state probability distribution, we may obtain an implicit solution for the nominal wage under the single currency area as

$$W = \Theta\frac{1}{\chi}\left(\sum_{z\in Z}\pi(z)\left(M(z)\frac{\theta(z)^{\frac{1}{\alpha}}}{\theta(z)^{\frac{1}{a}} + \theta(z)^{*\frac{1}{a}}}\right)^{1+\psi}\right)^{\frac{1}{1+\psi}}$$
$$\times\left(\sum_{z\in Z}\pi(z)\frac{W^{\vartheta}\theta(z)^{\frac{1}{a}}}{\omega W^{\vartheta}\theta(z)^{\frac{1}{\alpha}} + (1-\omega)W^{*\vartheta}\theta(z)^{*\frac{1}{\alpha}}}\right)^{\frac{1}{1+\psi}}, \tag{A18}$$

where $\vartheta = -(1 - \alpha)/\alpha$. Using (A18), and the analogous expression for the foreign nominal wage, it is apparent that (a) the home and foreign nominal wage rates are equal if the money supply is state independent, and (b) the home nominal wage exceeds (falls short of) the foreign nominal wage if

$$\operatorname{cov}\left[M, \frac{\theta^{\frac{1}{\alpha}}}{\theta^{\frac{1}{\alpha}} + \theta^{*\frac{1}{\alpha}}}\right] > 0, \quad \operatorname{cov}\left[M, \frac{\theta^{*\frac{1}{\alpha}}}{\theta^{\frac{1}{\alpha}} + \theta^{*\frac{1}{\alpha}}}\right] > 0.$$

We may write home-country consumption under the single currency area as

$$C = \left(\omega\theta(z) + (1-\omega)\theta^*(z)\left[\frac{H(z)^*}{H(z)}\right]^{(1-\alpha)}\right)H(z)^{1-\alpha}$$
$$= \left(\omega\theta(z) + (1-\omega)\theta(z)^*\left[\frac{\theta(z)^*}{\theta(z)}\right]^{\frac{(1-\alpha)}{\alpha}}\right)\left[\frac{M(z)(1-\alpha)}{W\chi}\frac{\theta(z)^{\frac{1}{\alpha}}}{\theta(z)^{\frac{1}{\alpha}} + \theta(z)^{*\frac{1}{\alpha}}}\right]^{1-\alpha}. \tag{A19}$$

Now write the welfare objective function for the single currency area's central bank as

$$\mathrm{E}U = \mathrm{E}(\ln C + \ln C^*) - \mathrm{E}\frac{1}{1+\psi}H^{1+\psi} - \mathrm{E}\frac{1}{1+\psi}H^{*1+\psi}.$$

Using (A18) and (A19), we see that if the monetary policy of the single currency area is such that

$$\mathrm{cov}\left[M, \frac{\theta^{\frac{1}{\alpha}}}{\theta^{\frac{1}{\alpha}} + \theta^{*\frac{1}{\alpha}}}\right] > 0,$$

then this will raise $\mathrm{E}\ln(C)$ relative to $\mathrm{E}\ln(C^*)$, and reduce $\mathrm{E}H^{1+\psi}$ relative to $\mathrm{E}H^{1+\psi}$, thus raising welfare of the home-country residents at the expense of foreign-country residents. On the other hand, if

$$\mathrm{cov}\left[M, \frac{\theta^{*\frac{1}{\alpha}}}{\theta^{\frac{1}{\alpha}} + \theta^{*\frac{1}{\alpha}}}\right] > 0,$$

then the reverse logic applies, and foreign welfare is higher. Since home and foreign welfare are equally weighted by the objective function, it must be that neither inequality is desirable. Hence the optimal monetary rule implies

$$\mathrm{cov}\left[M, \frac{\theta^{\frac{1}{\alpha}}}{\theta^{\frac{1}{\alpha}} + \theta^{*\frac{1}{\alpha}}}\right] = \mathrm{cov}\left[M, \frac{\theta^{*\frac{1}{\alpha}}}{\theta^{\frac{1}{\alpha}} + \theta^{*\frac{1}{\alpha}}}\right] = 0.$$

Thus, as in the case of independent national currencies, the optimal monetary rule should be state independent. □

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Notes

1. See, however, Voss (1998) for a notable exception. Voss identifies a risk-sharing benefit of a single currency area similar to that of Mundell (1973) (see below), the key difference being that in Voss's mechanism a single currency area's central bank plays an active contingent redistributive role through its use of seigniorage revenue.
2. We assume that there is a single final good produced in both countries. In Ching and Devereux (2001) we show that the results extend naturally to the case of imperfect substitution in preferences between the home and foreign goods.
3. The employment subsidy is used to offset the downward bias in average employment due to monopoly power of workers.
4. This assumption is not necessary, but allows for a more simple discussion of the results of section 3.
5. Following the recent literature (Obstfeld and Rogoff, 2000; Corsetti and Pesenti, 2001), we ignore the utility of real balances in the welfare calculations. This has no effect on the results of the paper.
6. From the wage-setting equation (5), employment is constant, and (if the money stock is constant) PC is constant, so the variables inside the expectations operators are known with certainty. Then substituting from (5) into (11) gives the employment level

$$H = \left[\frac{(1-\alpha)}{\eta}\right]^{1/(1+\psi)}.$$

7. This of course is dependent on the absence of dynamics. Nevertheless, allowing for endogenous capital accumulation and borrowing is unlikely to have a significant effect on the results.
8. In this sense, there is a critical difference between a single currency area and a system of pegged exchange rates with separate national currencies. In the latter, there are no money flows across borders (balance of payments surpluses or deficits), whereas in the former there are.
9. Voss (1998) shows how risk-sharing can be achieved in a single currency area by state-contingent seigniorage distribution.
10. Empirically, only a few countries can issue bonds denominated in their own currencies, as documented by Eichengreen and Hausmann (1999). Moreover McKinnon (2002) suggests that

the establishment of the euro as a single currency for Europe may enhance the development of capital markets and facilitate risk-sharing that would not take place within a system of national currencies and floating exchange rates. Thus, according to this perspective, the risk-sharing benefits of a single currency area might even be underestimated by our analysis.

11. The states are $\{(1+\delta),(1-\delta)\}, \{(1+\delta),(1+\delta)\}, \{(1-\delta),(1-\delta)\}, \{(1-\delta),(1+\delta)\}$, each with probability 0.25.