

ON THE COSTS OF A MONETARY UNION*

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1. INTRODUCTION

This article revisits the issues in the optimal currency area literature, as in Mundell (1961) and a more recent literature, on the optimal choice of an exchange rate regime. This literature focuses on the following question: what are the costs of a fixed exchange rate regime when there is a role for stabilization policy?

The literature usually suggests that when different shocks hit different countries or when there are differences across countries in the effects of shocks, monetary policy - which has a stabilization role due to the existence of nominal rigidities in the economy, may have to react differently in the different countries. Because of this heterogeneity it is common to infer that there are costs of coordinating monetary policies, either through a fixed exchange rate regime or a monetary union. Building on Mundell (1961) the literature concludes that these costs are higher the stronger are the asymmetries, the more severe are the nominal rigidities, the more pronounced is the incompleteness of international asset markets, the less mobile is labor, and, finally, the less able is fiscal policy in effectively stabilizing the national economies (Corsetti, 2005).

In this article we show that when both fiscal and monetary policies are considered jointly, and assumed to have the same flexibility in response to shocks, the loss of the country specific monetary tool is of no cost.¹ This is true irrespective of the asymmetry in shocks and the transmission mechanisms, in particular the severity of the nominal rigidities. The elements that are crucial in assessing the costs of a single monetary policy are the degree of labor mobility and the effectiveness of fiscal policy, but labor mobility works in the opposite way to the conventional wisdom. In fact only if labor is not mobile across countries is fiscal policy able to eliminate the costs of a monetary union .

These results are derived in a standard two country model. Each country specializes in the production of a set of tradeable goods. The technologies used in the production of these goods are the simpler ones: labor is the only input and productivity does not depend on the scale of production. Labor is not mobile across countries. Money is used by households of every country for transactions of every consumed good: both the goods produced at the country and goods imported from abroad. The government of each country consumes goods produced at home. The expenditure realized in public consumption must be financed by every government with distortionary taxes and seigniorage. The tax instruments are standard linear labor income and consumption taxes. There is non-contingent nominal public debt in each currency that can be traded internationally and private agents issue state-contingent private debt which can be traded inside each country.

* The analyses, opinions and findings of this article are those of the authors and do not necessarily coincide with those of the Banco de Portugal.

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(1) This article is a summary of the results developed in Adão, Correia and Teles (2006).

2. THE METHODOLOGY

As said before we want to be able to answer the question of whether the transition from a monetary regime where the monetary authority has full autonomy to a different regime, namely a monetary union or a specific exchange rate regime, reduces the choices of a decision maker (or of a set of decision makers). This is a particularly interesting question when national monetary policies have a potential stabilization role due to the presence of nominal rigidities. Since we want an answer that is robust to the type of price rigidity we will not derive the result using a particular type of rigidity, like prices set one period in advance, price-setting *à la* Calvo (1983), or any type of state-dependent price setting. Alternatively we will determine the conditions that should be satisfied in an equilibrium where prices were flexible and the exchange rate would also be flexible. We will see the role that fiscal and monetary instruments play in that environment. Namely we will show that there is a strong interaction between any policy instrument, either fiscal or monetary, and between these instruments and the characteristics of the path of equilibrium prices. We are able to show that even if monetary policy is common to both economies and the producer price level does not react to states, or change over time, the same set of equilibrium allocations can be achieved in equilibrium. If this is the case, in an economy with fixed exchange rates and price rigidities those restrictions on price setting will not be active, and the same set of allocations that was derived in the flexible prices and flexible exchange rates economy could be achieved.

3. THE MODEL

The economy has two countries of equal size, the home country and the foreign country (denoted by *). In each country there is a representative household with preferences over the good produced at home, $C_{h,t}$ ($C_{h,t}^*$), the good produced abroad, $C_{f,t}$ ($C_{f,t}^*$) and over hours of labor in the market, N_t (N_t^*). Households need money for transactions of goods.

In each country there is a continuum of firms. Each firm produces a distinct, perishable consumption good with labor only.

Fiscal and monetary policy is undertaken by a government in each country. The aggregate consumption of the public good is exogenous and has to be financed with taxes on the consumption of the home good, $\tau_{h,t}$ ($\tau_{h,t}^*$), taxes on the consumption of the foreign good, $\tau_{f,t}$ ($\tau_{f,t}^*$), taxes on labor income, $\tau_{N,t}$ ($\tau_{N,t}^*$), taxes on profits and seigniorage.

In each period $t = 0, 1, \dots, T$, where T can be made arbitrarily large², the economy experiences shocks. In the particular model analyzed these shocks for the private sector are determined by changes in technologies and by changes in policies.

There are markets for goods, labor, money, state-contingent debt and state non-contingent debt. The labor market is segmented across countries. The state-contingent debt market is segmented across countries and across households and governments. The goods and the state non-contingent debt are tradeable across countries and agents. We assume that firm i sets prices, $P_{h,t}(i)$, $P_{f,t}^*(i)$, every period with contemporaneous information. We also assume that exchange rates, ε_t , are flexible.

The conditions for the optimal decisions on consumption and saving can be described in the following way: the household should be indifferent between using one unity of home money in the consumption of the home good today or saving this unit of money. If the household chooses to save then there are

(2) The assumption of a finite, even if arbitrarily large, time horizon considerably simplifies the analysis and is as reasonable an assumption as the more standard one of an infinite horizon.

two possible alternatives. A first one is to buy the home non-contingent asset whose yield is the gross interest rate (R_t). A second possibility is to convert the unit of the home money into foreign money and then buy the foreign non-contingent asset which pays the gross interest rate (R_t^*). The return of any of these applications can be used to buy consumption of the home good tomorrow. Let us call these optimizing conditions, two for each household, the *intertemporal* conditions.

In addition households have to decide on the total consumption decomposition, into home and foreign good, and on the decision of consuming versus supplying labor. Any of these decision rules equate the marginal rate of substitution of two goods ³ to the relative price of these goods paid by the household. The decision over the consumption of home versus foreign good implies that the marginal rate of substitution has to be equated to their relative price, i.e. the terms of trade, gross of taxes paid on the consumption of every good. In the second decision, of consumption versus labor supply, the relative price is the real wage, net of labor income taxes and gross of the consumption tax. Notice that when deciding on consumption versus labor the nominal interest rate, $R_t, (R_t^*)$, is a price to add to the producer price of the good plus taxes, because transactions of goods for consumption have to be realized with money. As the household has to forgo the interest rate in order to hold money instead of other assets, this is usually described as leisure being a credit good and consumption a cash good. Let us call this set of conditions, two for each household, the *intra-temporal* conditions.

The pricing conditions describe the firms' behavior and imply that firms set prices that are a mark-up over marginal costs. In the special case of flexible prices studied here the mark-up is constant given assumption of a constant elasticity of substitution across goods, and marginal costs are constant due to the choice of a linear production function. Notice that we impose that technology is identical for every good produced in every country. This implies that technological shocks, i.e. a change in the productivity of labor at home or abroad, should be interpreted as sectorial shocks that coincide in this environment with national shocks.

Our purpose in this section is to assert a major result of the paper, that has implications for equilibrium allocations with sticky prices and fixed exchange rates. We show that for any given equilibrium allocation $\{\overline{C}_{h,t}, \overline{C}_{f,t}, \overline{N}_t, \overline{C}_{h,t}^*, \overline{C}_{f,t}^*, \overline{N}_t^*\}$ in the described economy, the equilibrium conditions that characterize the flexible price and the flexible exchange rate environment can be satisfied with different combinations of policies and prices. That is, there is not a unique way to decentralize⁴ a chosen allocation. A particular combination is the one where exchange rates are constants over time as well as producer prices.

The main proposition follows:

PROPOSITION 1:⁵ *Any flexible equilibrium allocation can be implemented with a particular policy such that producer prices are constant across states and over time, for every good, and the exchange rate is fixed.*

Proposition1 $P_{h,t} = P_{h,0}, P_{f,t} = P_{f,0}, \varepsilon_t = \varepsilon_0$ (and $R_t = R_t^*$).

If the allocation $\{\overline{C}_{h,t}, \overline{C}_{f,t}, \overline{N}_t, \overline{C}_{h,t}^*, \overline{C}_{f,t}^*, \overline{N}_t^*\}$ is an equilibrium allocation in the economy above this means that there exist a set of policies and prices that satisfies everyone of the conditions that we described. These prices and policies in general would be time and state dependent. For example, the ex-

(3) A marginal rate of substitution between any two goods describes the maximum amount of one good the household is decided to give up in order to have one additional unity of the other good.

(4) As we are working with market economies the decision maker cannot impose to private agents a chosen allocation. It is called decentralization the way through which that allocation can be chosen voluntarily by private agents in a market economy. Policy makers use policy instrument that affect prices and the value of assets such that free choices through the market coincide with the chosen allocations.

(5) See the proof in Adão, Correia and Teles (2006).

change rate would change with the state of the economy and prices would fluctuate over time. Let us give some intuition on how the same allocation can be supported by different policies that guarantee constant prices and exchange rates. In order to do this, we would evaluate whether the clearing and optimizing conditions of households and firms in the economy are satisfied for a given allocation and two different sets of policies and prices, set Λ (which is not constrained) and set Θ where producer prices and exchange rates are constant over time.

The clearing conditions for every good, and for labor in every country, are trivially satisfied since the allocation is the same. Therefore we have to check how every agent can choose the same quantities and firms set constant prices, for the fixed exchange rate.

Let us begin by the price setting conditions. It is easy to verify that a constant price level can be the outcome of firms' choice once the nominal wage rate in every country reacts to the country technological shocks. To see this, note that a constant producer price level implies a constant marginal cost and this can be achieved if the wage rate in every country reacts completely to changes in productivity.

When the exchange rate is fixed the *intertemporal* conditions of the households in every country imply that $R_t = R_t^*$. Let us take a particular path for this common interest rate. Using the *intra-temporal* conditions we can verify that the choice of labor and of consumption of the local good can be the same if the real wage net of taxes is the same in the set Λ and in the set Θ . We can use the tax on labor income to guarantee that, in every date and state, this is true. The choice over the two aggregate goods, home and foreign consumption, is determined by the terms of trade, again gross of consumption taxes. This choice would be the same if, in every country, the tax on the imported good is adjusted to maintain the terms of trade gross of taxes constant across set Λ and set Θ .

We still have to verify that the common nominal interest rate is identical to the expected real interest rate plus the expected inflation of consumer prices. Since we are maintaining the real interest rate constant, because the allocation is the same, the choice of a common interest rate and of constant producer prices has to be adjusted by the expected tax on the consumption of the home good, in every country. This tax on every state will be chosen to guarantee the private budget constraint. As we constrain the environment to the non-existence of state contingent assets,⁶ the change of the tax on the home consumption good across states, allows for a consumer price that is state dependent, even when the producer price is constant over time. This state-dependent consumer price allows for deflated nominal assets to be also state-dependent, and can therefore satisfy the private budget constraint, for every state and date.

Finally, we just have to verify the home budget constraint, or national solvency, that guarantees that the amount of real external assets can finance the flow of future trade balance deficits, for every date and state. These are the conditions that, given the allocations and the new path for the producer prices, would determine the interest rate path, which as said before, is common to both countries.

This exercise can be repeated for any allocation that is an equilibrium for the case where prices and exchange rates are flexible.

We have thus shown that for any equilibrium allocation, $\{\overline{C_{h,t}}, \overline{C_{f,t}}, \overline{N_t}, \overline{C_{h,t}^*}, \overline{C_{f,t}^*}, \overline{N_t^*}\}$, the equilibrium conditions can be satisfied by asset positions, prices and policies such that producer prices and exchange rates are arbitrary constants, $P_{h,t} = P_{h,0}$, $P_{f,t}^* = P_{f,0}^*$, $\varepsilon_t = \varepsilon_0$. This means that the full set of equilibrium allocations can be implemented under fixed exchange rates with producer prices in both countries that are constant over time. It is important to highlight the particular role played by taxes in

(6) Although there exist state-contingent assets traded between households in every country, in equilibrium the net supply of these assets for the representative household in every country is zero.

the equilibrium with constant producer prices and exchange rates. In general different shocks in different countries lead to changes in relative prices. If producer prices and the exchange rate are constant then such relative price changes can only be achieved by changes in the consumption taxes in one good relative to the other. Consumption taxes play another role, when public debt is non-contingent, which is that of replicating state-contingent real debt. We have assumed, as is standard in this literature, that internationally traded assets are state non-contingent. Nominal interest rates, that in a fixed exchange rate regime are common across countries, can play the role of replicating state-contingent international debt. Consumption taxes also affect the households decisions between consumption and labor. Labor income taxes will have to adjust for those effects. Since prices are constant and technological shocks in the two countries can be different, the nominal wages will have to move in response to shocks and move differently in different countries. Money supply will also have to move to respond to shocks to satisfy the transactions role of money. A fixed exchange rate, which should be equal to one in the case of a monetary union, leads to the result that nominal interest rates are equalized but money could be distributed across countries in a very asymmetric way.

4. STICKY PRICES

One first implication of the result in the Proposition is that fixed exchange rates do not restrict the set of allocations under flexible prices. This is an interesting result in itself, in particular, as in our model, when asset markets are incomplete. However, the issue of whether there are costs of a fixed exchange rate regime is typically associated with the presence of some type of price rigidity, as argued by Friedman (1953). If there are restrictions on how producer prices are set, and exchange rates are fixed, it may be the case that there will be restrictions on the relative prices of the goods produced in the different countries.

It is particularly surprising that fixed exchange rates do not restrict the set of allocations also when producer prices are constant over time. Can both producer prices and exchange rates be constant over time? Yes, as long as taxes can change so that the terms of trade, real wages, and debt levels can move with the shocks.

We now assume that prices are sticky in some or in all goods produced. We assume that firms set prices as in Calvo (1983) staggered price setting,⁷ which is a commonly used assumption in the sticky price literature. We assume that firms set prices in the currency of their country. In each country, starting from an historical common price, at every date, each firm can optimally set its price with some probability less than one, that can differ across countries. As there is a continuum of firms, this probability is also the share of firms that optimally revise the price in each period. In general, staggered price setting leads to inefficient differences in prices across firms. Although in a given country firms are otherwise identical, have the same linear technology and face identical demand functions, they may charge different prices. Thus, the relative price of the goods they produce may be different from one. The only case in which this will not occur is when firms that in each period have the opportunity of choosing a new price decide to maintain the same price. The price setting restrictions in this case will not be binding and the producer price level in each country will be constant. The equilibrium conditions will be identical to the equilibrium conditions of the flexible price economy when producer prices are constant across periods.

(7) Calvo (1983) price setting assumes that there is a probability that a particular firm can choose optimally its price. This probability is identical across firms and non correlated over time. Therefore the probability that a particular firm can decide on its price does not depend on how long ago she got the opportunity to do it. Once the firm gets this opportunity she will decide setting a price that is a constant mark-up on the weighted sum of future marginal costs.

Since, as stated in Proposition 1, it is possible under flexible prices to implement the full set of equilibrium allocations with constant prices and fixed exchange rates, it follows that under sticky prices it is also possible to implement that same set, also with fixed exchange rates.

The proposition follows.

PROPOSITION 2: *In a world economy with non-contingent bond markets and Calvo (1983) staggered price setting there is no cost of a fixed exchange rate regime, independently of the degree of price rigidity.*

In Proposition 1 we showed that the set of allocations under flexible prices is implemented with policies that generate constant prices and exchange rates, equal to arbitrary numbers. For the policies that induce prices to be equal to the historical initial prices of the Calvo firms, $P_{h,0}$ and $P_{f,0}^*$, and exchange rates equal to any constant,⁸ the equilibrium conditions under Calvo (1983) will be exactly the ones under flexible prices. This establishes that the flexible price set of allocations is feasible with Calvo price setting and fixed exchange rates. This set is also the optimal, in the sense that for every allocation in the set under sticky prices, there is one in the set under flexible prices, that is a potential Pareto improvement.⁹

The result in Proposition 2 can be extended to any other form of price stickiness, such as prices set in advance, Taylor (1980) staggered prices, or Rotemberg (1982) adjustment costs of changing prices. For the case where prices are set in advance, let the initial prices $P_{h,0}$ and $P_{f,0}^*$ be exogenously given and the other period prices $P_{h,t}$ and $P_{f,t}^*$ be set in advance for k periods, for a finite k . Proposition 1 implies that adding those restrictions to the flexible price economy still allows to implement the set of allocations under flexible prices, in a fixed exchange rate regime. The argument of welfare dominance of the flexible price set also applies here.

We have analyzed flexible versus fixed exchange rate regimes. The analysis clearly follows through in a monetary union. The interest rate will be common as under fixed exchange rates and equal to one. The money supply in each country obviously does not have to be the same.

We have assumed that prices are set in the currency of the producer. We could alternatively have assumed local currency pricing. The results would follow through. For the policies that support constant producer prices and constant exchange rates, local currency price setting restrictions would not have any impact. Contrary to what is argued extensively in the literature that does not allow for fiscal policy instruments, it does not make a difference whether prices are set in the currency of the producer or the consumer.

5. LABOR MOBILITY

In the literature of optimal currency areas the lack of labor mobility is one of the justifications for the costs of a monetary union with asymmetric member countries. A result of this paper is that the opposite is true. Labor immobility is a necessary condition for the irrelevance of the exchange regime.

Proposition 1 was stated for the case where labor cannot move across countries. It does not apply when labor is mobile. To see this we assume that workers can choose to work in foreign firms and re-

(8) The exchange rate could be equal to one for the case of a monetary union.

(9) It is clear that under sticky prices there are allocations that are not implementable under flexible prices. That is the case whenever otherwise identical firms set different prices. It turns out, as we show in Adão, Correia and Teles (2006), that the set of flexible price allocations dominates in terms of welfare the set of allocations under sticky prices. Since agents are heterogeneous across countries, the meaning of welfare dominance is the usual one, of a potential Pareto movement where lump sum transfers between agents are implicitly assumed.

main being taxed at home. They consume at home. This is one way of modelling labor mobility. There are alternative ways but the same arguments go through.

For the home households, total labor N_t is split between work at home $N_{h,t}$ and work abroad $N_{f,t}$,

$$N_t = N_{h,t} + N_{f,t}. \quad (1)$$

Similarly for the foreign country, N_t^* is split between $N_{h,t}^*$, which is labor in the home country, and $N_{f,t}^*$, which is labor in the foreign country,

$$N_t^* = N_{h,t}^* + N_{f,t}^*. \quad (2)$$

The market clearing conditions in the goods market is:

$$C_{h,t} + C_{h,t}^* + G_t = A_t [N_{h,t} + N_{h,t}^*] \quad (3)$$

$$C_{f,t} + C_{f,t}^* + G_t = A_t^* [N_{f,t} + N_{f,t}^*] \quad (4)$$

where A_t and A_t^* represent, respectively, the productivity at home and at the foreign country. Therefore $A_t N_t$ ($A_t^* N_t^*$) is total production at home (the foreign country) when prices are flexible. The conditions of the households problem are the same except for an additional arbitrage condition on where to work, that equates the two wages

$$W_t = \varepsilon_t W_t^* \quad (5)$$

Notice that full labor mobility implies one additional constraint per state to the equilibrium conditions. The wage in the same currency must be equal across countries. As shown in the proof of Proposition 1, there are multiple policies that support each allocation under flexible prices with constant prices and exchange rates. These degrees of freedom were used to maintain prices and exchange rates constant over time. They are not enough to satisfy the additional equilibrium restrictions, described in conditions (5), which are as many as the number of states in every period.

When labor is mobile, and prices are sticky, the exchange rate regime matters. In particular, while with flexible exchange rates it is possible to implement the set of allocations under flexible prices, that is not the case in a fixed exchange rate regime.

Notice that when we say that with labor mobility there are costs of a fixed exchange rate regime, while there are no such costs when labor is immobile, we are not claiming that labor mobility is undesirable. We are not comparing environments with and without labor mobility, but rather environments with and without fixed exchange rates, when labor is immobile or when it is mobile.

6. CONCLUDING REMARKS

Under a flexible exchange rate regime, monetary policy in each country can freely respond to shocks, may respond to country specific shocks or may respond differently from other countries to common shocks. Instead, in a monetary union there is a unique monetary policy for the members of the union. This implies restrictions in the use of policy; the exchange rate must be constant over time and the nominal interest rate must be equal across countries. Are these restrictions relevant to achieve the optimal equilibrium allocations? Does the answer to this question change with the introduction of nominal rigidities, like staggered price setting?

The conventional wisdom is that there are costs of a fixed exchange rate regime, or a monetary union, resulting from the loss in ability to use policy for stabilization purposes. The costs are taken to be higher the stronger are the asymmetries across countries in shocks and their transmission, and the stronger are the nominal rigidities. Instead, we show that in an environment with nominal rigidities, the type of price setting (producer currency pricing or local currency pricing) and the exchange rate regime (whether flexible or fixed exchange rates) are irrelevant once fiscal policy instruments are taken into account. This is the main result of the paper. We also show that in order for the costs of the monetary union to be zero labor cannot be mobile.

One possible objection to our analysis, as well as to the related literature that uses both fiscal and monetary policy instruments, is that we do not incorporate informational restrictions in the policy choice and also do not take into account lack of ability to commit. The assumptions of private information on the part of the government and inability to commit in the presence of a time inconsistency problem may justify policy that does not respond to contingencies, such as illustrated with the inflation cap in the analysis in Athey, Atkeson and Kehoe (2005). But once we want to take into account these considerations for the use of fiscal instruments there is no reason why the same arguments should be exclusively for those and not extended to monetary instruments.

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