Monetary policy in heterogeneous currency unions: A micro-founded reconsideration of the Theory of Optimum Currency Areas

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First draft: February 2005
This version: May 2006

Abstract

The adoption of a common currency has fostered European economic integration and given many European countries the benefits of low inflation and financial stability. It is well understood, however, that a single monetary policy cannot deliver efficient business cycle stabilization at national level, relative to an ideal benchmark in which region-specific monetary policy stabilizes domestic output gaps and marginal costs. In this text, I revisit traditional Optimum Currency Area theory in light of recent advances in monetary theory.

Recent literature has stressed efficiency costs of inflation and relative price dispersion in the presence of nominal rigidities. In a single currency area, some inflation dispersion will be the unavoidable cost of relative price adjustment across sectors and regions. In this text, I discuss a related cost of insufficient stabilization, also predicted by the same class of models which highlight the costs of inflation dispersion. This cost consists of a wedge between average output and its efficient level: the adoption of a single currency does not affect the rate of growth of GDP, but may affect the average level of activity. Stabilization gaps at national level exacerbate the adverse implications of monopolistic distortions on prices, output and consumption.

Second, I discuss the thesis that symmetry in national economic structures can contain the costs of a single monetary policy. I identify conditions under which, in spite of specialization in production, a common monetary policy is as efficient as nationally differentiated policies. First, import prices must be constrained by nominal rigidities in local currency. Second, the share of national goods in the representative consumption basket in the union must be close to the (endogenous) share of valued added in production across countries — a novel attribute of optimum currency areas.

[0]This paper develops from a keynote speech delivered during the conference "Monetary policy implications of Heterogeneity in a Currency Area", organized by the European Central Bank in December 2004. I thank the participants in the conference, Luca Dedola and Phil Lane, for comments. Karel Mertens provided excellent research assistance, Lucia Vigna invaluable help with the text. Generous support by the Luxembourg government of the Pierre Werner Chair Programme on Monetary Union at the European University Institute is gratefully acknowledged.

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1 Introduction

Economic heterogeneity is in many ways a vital sign of growing and healthy economies. By the same token, differences in institutions and policies may reflect diversity in preferences and political orientations across communities in a currency area, consistent with the democratic nature of our societies. Nonetheless, the recent debate on European monetary union has motivated a reconsideration of the question as of whether elements of economic 'heterogeneity' may also matter for the design of efficient stabilization policy. A partial list includes sectoral composition of output, the degree of nominal rigidities across sectors and regions, financial structure and labor market institutions, and the degree of liberalization and deregulation. To what extent should a central bank worry about these elements, beyond monitoring their role in macroeconomic developments? The European Central Bank is by no means the only central bank facing this question – but national differences and the lack of political integration make it more pressing in the euro area than elsewhere.

Looking at the recent literature on the topic, it is fair to say that the scope and importance of policy trade-offs raised by heterogeneity is far from clear. In light of recent advances in monetary and macroeconomic theory, recent contributions have reformulated standard closed-economy monetary models (e.g., Woodford (2003)) by allowing for macroeconomic heterogeneity. Optimal stabilization rules have been characterized in relation to specific cross-border differences in financial structure or nominal rigidities,[1] sometimes yielding articulated policy-oriented suggestions (I should note here that robustness of the policy prescriptions to model misspecification is an important open issue that such exercises should thoroughly discuss).

Underlying these contributions, however, there is a basic issue — an issue which is far from new but has not been systematically reconsidered in light of the new monetary and international economic literature. What is the cost of substituting country-specific optimal monetary policies with a single monetary policy? In this brief text, I will address this gap in the literature. Toward this goal, I will reconsider the 'costs of monetary union' in the framework of a stylized choice-theoretic model — representative of the framework commonly adopted by recent contributions to monetary economics. I will discuss the following question: are there differences in the macroeconomic performance of monetary unions relative to economies with an independent monetary policy, under the maintained assumption that in each of these regimes stabilization policies are optimally conducted? In other words, what are the macroeconomic effects of a single welfare-optimizing monetary policy? What is the magnitude of the welfare costs of deviating from an ideal benchmark of nation-specific optimal monetary policy?

It should be emphasized that in my exercise the cost of a single monetary policy will be assessed relatively to an ideal state of efficient domestic stabiliza-

[1] For instance, some contributions in the literature have recently explored policy trade-offs due to heterogeneity in the degree of nominal rigidities (see Benigno (2004) among others), and carried out an analysis of optimal policy rules.

tion. Hence, the exercise will also provide an assessment of the potential gains from activating additional instruments of business cycle stabilization at national or union-wide level, including fiscal policy as well as labor and financial policy.

Similar issues are at the core of the traditional Optimum Currency Area (henceforth OCA) theory. But my arguments will be quite different from those pursued by the traditional literature, in that they are rooted in a stylized micro-founded model in which all agents are rational: households maximize expected utility, firms maximize expected profits, monetary authorities maximize national welfare, indexed by the representative household's utility. As in the traditional model, I will posit that, because of unspecified frictions in the goods market, prices are sticky — I assume that they are preset for one period. Finally, I assume that policymakers can credibly commit to rules, and I will characterize optimal policy as optimal rules, rather than discretionary reaction to shocks — as is the case in the Keynesian model underlying the original OCA theory. As is well understood, an advantage of micro-founded approach is the possibility of carrying out welfare analysis using consumers' expected utility as an indicator of national welfare.

I will discuss two main points. The first emphasizes an important prediction of recent standard monetary models with imperfectly competitive firms and nominal rigidities: insufficient domestic stabilization will result in higher product prices, lower average consumption and lower average output relative to an efficiently stabilized economy. This 'wedge' in average output and consumption has not been widely discussed in the literature, yet it characterizes a large class of models commonly adopted in monetary theory (see Corsetti and Pesenti 2005a). Since, even when optimally conducted, a single monetary policy implies incomplete stabilization at country level, an output and consumption wedge is a cost of monetary unification, independently of the efficiency and effectiveness of the single monetary authority. Some back of the envelope calculations, however, suggest that the magnitude of welfare losses for the representative household is quite small, consistent with the argument about the cost of business cycles by Lucas (1987, 2003).

Regarding my second point, I reconsider recent literature questioning a basic tenet on the benefit of exchange rate flexibility which underlies the traditional OCA theory. This literature points to evidence on the stability in local currency of import prices: to the extent that import price stability is due to nominal rigidities, exchange rate movements do not induce efficient relative price adjustment — a prediction which is clearly at odds with the received wisdom. In light of this observation, some authors have argued that nominal rigidities can actually provide theoretical foundations for the desirability of monetary unions (e.g. Devereux and Engel 2003). I revisit this argument, discussing its weaknesses. However, I also argue that the model underlying it sheds new light on the role of symmetry in national economic structures, in containing the costs of a single monetary policy. Namely, I show that, to the extent that import prices are sticky in local currency, a common monetary policy may be optimal despite specialization in production, provided there is enough symmetry between the composition of consumption and the structure of production at union-wide level.

In other words, the costs of monetary unification are low if the share of national goods in the representative consumption basket in the union corresponds to the (endogenous) share of valued added in production across countries. This is a novel result in optimal currency area theory.

I conclude with a brief discussion of other possible welfare losses in a monetary union, including inflation dispersion, suboptimal level of investment, market segmentation, and inefficient provision of public goods — which provide interesting and potentially important directions for future research.

This paper is organized as follows. Section 2 briefly summarizes the findings of traditional theory of Optimum Currency Areas and lays out a simple model to fix the basic ideas of the analysis. Section 3 introduces a fully-fledged two-country model and analyzes optimal stabilization policy under different policy regimes. Section 4 presents a modern treatment of OCA theory, stressing the macroeconomic and welfare implications of different views of the international transmission of fundamental and policy shocks. Section 5 reconsiders the role of symmetry in economic structures. Section 6 includes some considerations on possible extensions of the model. Section 7 concludes.

2 From the original theory of optimum currency areas to micro-founded analysis

2.1 The classical debate on the costs and benefits of monetary unification

The seminal contributions to the so-called Optimum Currency Area theory, including Mundell (1961), McKinnon (1963), Kenen (1969), Ingram (1973), focus on the costs of exchange rate inflexibility in the presence of asymmetric, country-specific temporary shocks and (by logical extension) asymmetric short-run response to common temporary and permanent shocks — including unexpected components of monetary policy.

As is well known, the argument is that these asymmetries weaken the case for a common currency, as members of monetary union lose the benefits from

1. monetary autonomy;

2. stabilizing movements of the exchange rate.

The literature stresses that the benefits from (1) and (2) above are low if at least one of the following is true: (a) prices and wages are sufficiently flexible; (b) fiscal policy effectively stabilizes national economies; (c) consumption risk is sufficiently diversified across borders (or international financial markets work smoothly, so that agents can easily smooth consumption); (d) factors are sufficiently mobile also in the short run, at low private and social costs; (e) there are little asymmetries in shocks and in macroeconomic transmission.

The original contributions to this theory abstract from other potentially sizeable benefits of a monetary union, e.g., benefits from policy delegation, gains

from political integration (reflecting the opinion that this is more likely in the presence of monetary union), saving on transaction costs (possibly increasing trade), and so on. These arguments — usually included in modern textbooks as extensions of OCA beyond its original theoretical boundaries — have arguably played an important role in the debate on EMU. For instance, it is well understood that they can explain why some small European countries, whose specific cyclical conditions have a very limited weight in the European Central Bank's decisions, have nonetheless been eager to adopt the euro. However, following the original contributions, I will abstract from these issues altogether.

In my discussion, I will re-visit OCA theory in the framework of a stylized choice theoretical model of currency union. The model in the background of my analysis is specified in Corsetti and Pesenti (2005a, 2005b) and Corsetti (2006) — in this text, I will only use a minimal set of analytical expressions referring the reader to these references for details. The advantage of this model is that it can be solved in closed form. Since the specification of this model is well-known, I only sketch its main features, referring to Corsetti and Pesenti (2005a) for a formal derivation. Relative to its original formulation, I augment the model with a nontradable good sector (as in Obstfeld and Rogoff 2002), and allow for home bias in consumption of tradables (as in Corsetti 2006).

I will proceed in two steps. In this section, I will introduce the main ideas by using a simplified version of the model, whereas I treat the countries in a monetary unions as if they were closed economies, i.e. without trade among them. This simplification will allow me to provide useful insights on the core mechanism driving most of the results in this paper. In the following sections, I will develop a full model of monetary unions with trade links. I will derive the firms' optimal pricing strategies in both the domestic and the export markets, and carry out my analysis of OCA theory in the new framework.

2.2 On the costs of insufficient stabilization (loosing monetary autonomy) in choice-theoretic models: basic ideas

My starting point is a discussion of a potentially important welfare dimension of stabilization, which characterizes a large class of recent models in monetary economics, but is somewhat less well-known than other dimensions (e.g., inflation dispersion). As mentioned above, I will proceed in this section positing countries in a monetary unions are de facto two closed economies.

Let me introduce some basic notation and features of the economy. Define C as domestic consumption in a country I will refer to as Home, and denote with the letter H. To focus sharply on my main point, I will adopt a number of simplifying assumptions. First, there is neither investment nor government spending, so that consumption coincides with domestic output Y_H, i.e. $C = Y_H$. Second, let Z_H denote the level of productivity, identical across firms: output depends linearly on total employment, ℓ, and the productivity level, i.e. $Y_H = Z_H \ell$. Third, productivity is the only source of uncertainty: Z_H varies randomly during a business cycle. Last, national welfare is indexed by the expected utility

of the Home representative household. In each period, this utility is increasing in consumption (in logs), and decreasing in labor effort (linearly).

As in many modern contributions to monetary theory, I posit that output is produced by many small firms, each of them with monopoly power on a specific variety of the Home goods. In the absence of nominal rigidities, firms would optimally set prices charging a markup over marginal costs, MC, measured by wage costs per unit of output (i.e. the nominal wage divided by productivity):

$$P_{\mathrm{H}} = \underbrace{\frac{\theta}{\theta - 1}}_{\text{markup}} \cdot MC_{\mathrm{H}} = \frac{\theta}{\theta - 1} \cdot \frac{wage}{Z_{\mathrm{H}}}. \tag{1}$$

Note that the markup is decreasing in the the elasticity of substitution across domestically produced varieties of the Home goods, denoted by θ. What about optimal pricing in the presence of nominal rigidities? Assume that firms preset their product price in nominal terms, and keeps it fixed for one period only (say, one quarter), adjusting the scale of production to meet demand. In this case, the optimal preset price can be chosen by equating the value of profits in the following period, appropriately discounted, to the value of marginal costs augmented by the equilibrium markup, also appropriately discounted. Under the assumptions specified above (utility from consumption is logarithmic, disutility from labor effort is linear), the expression for optimally preset prices can be written in the following form:

$$P_{\mathrm{H}} = \underbrace{\frac{\theta}{\theta - 1}}_{\text{markup}} \cdot \underbrace{[E_{t-1} MC_{\mathrm{H}}]}_{\text{expected marginal costs}} \tag{2}$$

Namely, the optimal preset price results from charging the equilibrium markup over *expected* marginal costs. As this price is fixed over the production period, the (ex-post) realized markup will obviously vary (inversely) with marginal costs.

Let P denote the price of consumption (CPI), so that nominal aggregate demand is PC. It is convenient to set nominal aggregate demand equal to a variable μ, indexing the stance of monetary policy: a higher μ means that monetary authorities pursue expansionary policies, raising aggregate demand and thus nominal consumption. Now, if the labor market is competitive, the nominal wage rate will be proportional to nominal consumption, hence to μ_t. For this reason, we can conveniently rewrite marginal costs linking them directly to monetary policy

$$MC_{\mathrm{H}} = \left(\frac{wage}{Z_{\mathrm{H}}}\right) = \underbrace{\underbrace{\left(\frac{\mu}{Z_{\mathrm{H}}}\right)}_{\text{productivity}}}_{\text{monetary policy stance}} \tag{3}$$

Intuitively, with a competitive labor market, nominal wages will increase with a monetary expansion.

The above expressions provide all the elements one needs to analyze the macroeconomic implications of random fluctuations in productivity. Holding monetary stance μ (hence nominal wages) fixed, a positive productivity shock (an increase in Z_{H}) lowers marginal costs ex post. But, if prices are preset, firms cannot take advantage of higher productivity to lower prices and raise output: a fixed μ implies that aggregate demand is also fixed in nominal and real terms. As a result, the positive productivity shock opens a positive *output gap*: employment and output fall relative to the equilibrium level if all prices were flexible — commonly referred to as the natural rate of employment and output.

However, in response to an unexpected increase in productivity, monetary authorities *can* improve welfare by expanding aggregate demand: a sufficiently large monetary expansion can close the output gap described above, preventing a fall in employment relative to the flex-price equilibrium. Note that, by raising the monetary stance in response to a positive productivity shock (and contracting it in response to a negative shock, preventing over-heating and excessive employment), the monetary authorities can completely stabilize marginal costs. Provided that they have enough information on current productivity, they should set monetary policy such that the following condition is satisfied:

$$MC = \frac{\mu}{Z_{\mathrm{H}}} = \Gamma \tag{4}$$

where Γ is constant during the period, and indexes the nominal scale of wages and prices. If the above holds, marginal costs are constant over the period, and there is no difference between (1) and (2): this is because optimal prices will remain constant in nominal terms also in the absence of nominal rigidities. By pursuing monetary rules satisfying the above conditions, the monetary authorities make nominal rigidities inconsequential as regards the equilibrium allocation: the sticky price and the flex-price allocation would coincide. Indeed, according to this model, the above condition characterizes the the optimal monetary rules for a welfare-maximizing central bank.

Now, suppose that, for some reason, the central bank does not stabilize marginal costs completely. If stabilization is incomplete, demand does not fall optimally when productivity is low: with preset prices, firms supply too much relative to the flex-price level of output. Conversely, when productivity is high, demand does not rise enough: firms supply too little relative to the flex-price allocation. On average, output will fall short of its flex-price level.

To derive this result formally, set for simplicity $\mu = Z_{\mathrm{H}}^{\xi}$ with $0 < \xi < 1$. As argued above, incomplete stabilization means that demand will vary too little relative to productivity and output gaps would not be completely closed. In the limiting case $\xi = 0$, monetary policy is not contingent on the state of the economy at all — this would be the case if money grows at some predetermined rate between periods. Under this parameterization, it is easy to verify that the expected value of marginal costs will be larger than in the case of complete

stabilization

$$E_{t-1}\left[\frac{\mu_{(\xi<1)}}{Z_H}\right] = \Gamma E_{t-1}\left[Z_H^{\xi-1}\right] > \Gamma. \tag{5}$$

as a straightforward implication of Jensen's inequality. For any given average monetary stance, the lower the extent of stabilization, the higher the preset product prices. Now, since the money stance μ is assumed to be constant in the limiting case $\xi = 0$, it follows that higher prices will translate into lower consumption and output as $C_H = Y_H = \mu/P_H$.

The property of recent monetary models just discussed cannot be overemphasized: with nominal rigidities and monopoly power in production, incomplete stabilization affects average prices, consumption and output in equilibrium. For standard parametrization, given demand, average prices will be too high, average output and consumption of Home goods will be too low relative to the flex-price benchmark.

I should stress here that the growth rate of the economy is not affected: in the long run the economy will expand at the same rate of productivity growth, independently of the monetary regime. Yet, there will be a gap between potential and current output on average, depending on the monetary regime.

2.3 Insufficient stabilization and the costs of cyclical fluctuations

What are the aggregate welfare costs of inefficient stabilization? To provide an estimate, suppose that Z_{H} is lognormally distributed. Since we have assumed that utility from consumption is in log form, i.e. $\ln C_t$, the loss in expected log consumption due to incomplete stabilization — denoted $\Delta\mathcal{W}$ — can be written as follows

$$\Delta\mathcal{W} = \frac{1}{2}(\xi - 1)^2 \, Var_{t-1} Z_{\mathrm{H}} \tag{6}$$

When $\xi = 1$ the economy is fully stabilized: the variance of the shock does not affect expected utility from consumption, and the above expression is identical equal to zero. If $\xi < 1$, instead, expected utility will be decreasing in the variance of the shock.

Observe the parallel between (6) and the formula expressing the costs of business cycles in the seminal contributions by Lucas (1987, 2003). While being consistent with Lucas' analysis,[2] in this text the analysis is carried out from a different angle. In standard monetary models, the goal of stabilization is not to eliminate consumption variability around a smooth trend. Rather, the goal of stabilization is to reduce the gap between consumption and its efficient level — which may well be time varying depending on the state of the economy. In the model underlying my calculations above, full stabilization completely closes the output gap, ensures that employment is at its flex-price rate, and lets

[2] I should note that in Lucas' calculation, the goal is to assess the benefit from 'further stabilization', relative to what is already reflected in the data. In the example given in the text, the exercise is to assess the gains in going from no stabilization to full stabilization of marginal costs and output gaps.

consumption fluctuate optimally with the state of the economy. Conversely, a constant μ (or μ growing at a deterministic rate) will imply that consumption is constant, but at a lower average relative to a perfectly stabilized economy. Paradoxically, incomplete stabilization makes consumption 'smoother' relative to a flex-price economy, but suboptimally so. At the same time, it induces excessive volatility of employment.

A back-of-the-envelope calculation of the order of magnitude of the welfare costs of insufficient stabilization is as follows. Let the standard deviation of productivity be 1 percent per period. Moving from no stabilization $\xi = 0$ to full stabilization $\xi = 1$ is worth approximately one half of a hundredth of a percent of consumption per quarter. The order of magnitude of this assessment is fully consistent with Lucas' point on the small costs from business cycle.[3]

There is a need for empirical studies testing the link between stabilization, the price level and average output. In principle, the impact of insufficient stabilization may be stronger than suggested by the model used in my calculations. For instance, with a more general utility function, the average price level and consumption will also respond to monetary noise. In this case, there are welfare gains from reducing monetary noise, as central banks pursue systematic monetary rules of the type suggested by modern monetary theory.

2.4 The costs of heterogenous monetary union vs. the costs of business cycles

What are the implications of the above analysis for monetary union? It is well understood that a welfare-optimizing central bank in a monetary union should react to the average cyclical conditions of common currency area. While there could be different views on the weighting scheme used in building area-wide averages, a single (optimal) monetary policy will not be able to stabilize fully output gaps and producers' marginal costs at national level — as crudely captured by the slogan 'one size cannot fit all'. In the framework of the model above, a single monetary policy would correspond to some ξ strictly below one – depending on the weight of the region/country in the union-wide aggregates.

As shown above, a lesson from microfounded models with nominal rigidities and monopolistic power in production is that incomplete stabilization of marginal costs and output gap (i.e., $\xi < 1$) results into optimally preset prices that are on average too high, reducing average consumption and welfare. Yet, we have seen above that the magnitude of this welfare loss may be quite small on average. There are reasons to believe that it will be even smaller in a monetary union. Shocks in the union may be correlated: what counts in the above analysis are country-specific innovations in Z, not its union-wide component. Obviously, the cost of a single currency will be decreasing in the degree of symmetry of productivity shocks hitting the different regions of the monetary union.

[3] In Bergin and Corsetti (2005), we also allow for product diversification and love for variety. In such a model, business fluctuations reduce product variety available to consumers. The costs of insufficient stabilization is higher, depending on preferences for variety.

However, the cost of joining a currency area will not be symmetric: it will tend to be higher for smaller countries, i.e. countries whose macroeconomic conditions have a small weight in the union-wide aggregates used by the central bank to assess the macroeconomic conditions of the area as a whole. Actually, if the business cycle in a small country is not synchronized with the rest of the union, a common monetary policy may turn out to be destabilizing — a much worse case than providing incomplete stabilization.

The main policy conclusions of the traditional OCA theory are that monetary union challenges domestic policy makers to find alternative instruments of business cycle stabilization, or implement reforms that reduce the magnitude of frictions and distortions creating a stabilization problem. These conclusions are still valid in the above analysis – it is indeed desirable to use additional policy instruments (such as fiscal policy). However, a micro-founded model of currency area suggests a clear parallel between the magnitude of welfare gains from stabilizing the business cycle, and the magnitude of welfare costs due to a single monetary policy. If one is skeptical about the former, he/she must be skeptical about the latter.

It is worth noting, here, that similarly skeptical views of the welfare costs of monetary union had been expressed early on by critics of the OCA theory using the same theoretical model underlying the original contributions to this theory, most notably by Willem Buiter (see for instance Buiter (2000)).

3 A reconsideration of the theory of optimum currency areas: a stylized micro-founded model

3.1 Model set up

Having clarified some basic ideas about the costs of insufficient stabilization in a monetary union, and its relation with business cycle costs, I will now generalize them, and discuss new results, using a fully-fledged model allowing for international trade. In what follows, I will describe the main elements of a general equilibrium, two-country, choice-theoretic stochastic model with nominal rigidities and imperfect competition in production. Since the model is well known and relatively easy to work with, I only provide a small set of analytical details, but do not include the derivation of the solution in closed form. This can be characterized by following the steps in the appendix of Corsetti and Pesenti (2005b).

The model consists of two country, Home and Foreign, denoted by H and F, each perfectly specialized the production of a tradable good (in many varieties), and a nontradable good (also in many varieties). The Home representative household combines these goods in a consumption basket in the form:

$$C = \left[C_{\mathrm{H}}^{\alpha} C_{\mathrm{F}}^{1-\alpha}\right]^{\gamma} C_{\mathrm{N}}^{1-\gamma} \tag{7}$$

where C_{H}, C_{F} and C_{N} denote consumption of Home tradables, Foreign tradables and Home nontradables, respectively. Note that tradable and nontradable

goods have unit elasticity of substitution in consumption, i.e. the consumption aggregator is Cobb-Douglas. The weight of nontraded goods is $1-\gamma$, so that γ is the weight on the basket of traded goods. Within this basket, also Home and Foreign traded goods have unit elasticity, with weights α and $1-\alpha$. Foreign consumption is similarly defined

$$C^* = \left[\left(C^*_{\mathrm{H}} \right)^{\alpha} \left(C^*_{\mathrm{F}} \right)^{1-\alpha} \right]^{\gamma} \left(C^*_{\mathrm{N}} \right)^{1-\gamma} \tag{8}$$

where an asterisk denotes foreign real variables, as well as nominal variables expressed in Foreign currency. Observe that the preferences over tradable goods are symmetric across countries: national representative consumers assign the same weights γ and $1-\gamma$ to the goods H and F, respectively.

As in the previous section, preferences for consumption are in log form and additive separable in labor — the disutility from labor effort is linear. I again abstract from investment and government consumption. Production is linear in labor only — employment is denoted by ℓ. Labor productivity is now subject to shocks that are both country- and sector specific. So we have four possible shocks: $Z_{\mathrm{H}},\ Z_{\mathrm{N}},\ Z_{\mathrm{F}},\ Z^*_{\mathrm{N}}$, denoting shocks to productivity in the Home tradable sector, the Home nontradable sector, the Foreign tradable sector, the Foreign nontradable sector, respectively. Labor is immobile across borders.

Let $P_{\mathrm{N}}, P_{\mathrm{H}}$ and P_{F} denote the Home prices of nontraded goods, Home produced traded goods, and Foreign produced traded goods; $P^*_{\mathrm{N}}, P^*_{\mathrm{H}}$ and P^*_{F} are the corresponding prices in foreign currency. The welfare-based consumer price indexes P (in Home currency for the Home country) and P^* (in Foreign currency for the Foreign country) are

$$P = \frac{\left[P^{\alpha}_{\mathrm{H}} P^{1-\alpha}_{\mathrm{F}} \right]^{\gamma} P^{1-\gamma}_{\mathrm{N}}}{\gamma^{\gamma} \left(1-\gamma \right)^{1-\gamma}} \qquad P^* = \frac{\left[\left(P^*_{\mathrm{H}} \right)^{\alpha} \left(P^*_{\mathrm{F}} \right)^{1-\alpha} \right]^{\gamma} \left(P^*_{\mathrm{N}} \right)^{1-\gamma}}{\gamma^{\gamma} \left(1-\gamma \right)^{1-\gamma}} \tag{9}$$

Let $\mathcal{E}$ denote the nominal exchange rate between the Home and the Foreign currency (measured in units of Home currency per unit of Foreign currency). To the sake of analytical tractability, I assume that households can perfectly insure consumption risks across countries.[4] Exchange rate determination is then straightforward. As is well known, perfect consumption insurance implies that the growth rates of marginal utilities are equalized across countries in PPP terms. As our two countries are perfectly symmetric ex ante, in our model this condition can be written as:

$$P_t C_t = \mathcal{E}_t P^*_t C^*_t .$$

[4] In the Corsetti-Pesenti model (as in Cole and Obstfeld 1991) equilibrium terms of trade movements are such that, independently of whether asset markets are complete (but provided there is no outstanding net debt), cross-border consumption risk sharing is efficient. So the solution in the text would also characterize financial autarky.

Note that, because of this property, the model leaves no room for improvements in welfare through the development of financial markets – an item often discussed in reference to Optimum Currency Areas.

Once expressed in the same currency, nominal consumption is equalized across countries. As explained above, it is convenient to define nominal demand as a synthetic indicator of domestic monetary stance — whatever the instruments used by the central bank. Abstracting from government spending and investment, nominal demand coincides with nominal consumption

$$\mu = PC, \qquad \mu^* = P^*C^*$$

An increase in μ (μ^*) corresponds to Home (Foreign) monetary policy expansion. Using the definition of μ and μ^*, it follows that the exchange rate depends on Home and Foreign monetary stances

$$\mathcal{E}_t = \frac{\mu}{\mu^*}$$

If the two countries adopt a fixed exchange rate regime, then $\mu = \mu^*$.

3.2 Nominal rigidities and export pricing

In our stylized model, domestic firms selling in the domestic market optimally preset prices by charging a constant mark-up over expected marginal costs, according to (2). This will be true both in the Home and in the Foreign country. However, modelling nominal rigidities in the export markets requires additional assumptions about the elasticity of prices to exchange rate movements. Recent literature has emphasized that the macroeconomic allocation will depend crucially on this elasticity (e.g. see Corsetti and Pesenti 2005a).

Many contributions have discussed in detail the difference between 'Producer Currency Pricing' and 'Local Currency Pricing' hypothesis. According to the former hypothesis, foreign firms preset prices in their own currency, and let the Home currency price of their goods move one-to-one with the exchange rate. The prices that maximize the value of the firm under PCP are:

$$\begin{aligned} P^*_{\mathrm{F},t} &= \frac{\theta}{\theta-1} E_{t-1}\left(MC^*_{\mathrm{F},t}\right) \\ P_{\mathrm{F},t} &= P^*_{\mathrm{F},t} \cdot \mathcal{E}_t \end{aligned} \tag{10}$$

where MC^*_{F} denotes foreign marginal costs (in foreign currency). In this case, the exchange rate pass-through into Home import prices is clearly 100 percent.

'Local Currency Pricing' instead corresponds to the case in which exports prices are preset in the currency of the destination markets. Foreign firms thus preset two prices, one in the local market, one in their exports' market. These two prices are:

$$\begin{aligned} P^*_{\mathrm{F},t} &= \left[\frac{\theta}{\theta-1} E_{t-1}\left(MC^*_{\mathrm{F},t}\right)\right] \\ P_{\mathrm{F},t} &= \left[\frac{\theta}{\theta-1} E_{t-1}\left(MC^*_{\mathrm{F},t} \cdot \mathcal{E}_t\right)\right] \end{aligned} \tag{11}$$

As Foreign goods prices are preset in local currency, exchange rate pass-through is zero. Exchange rate movements translate into deviations from the law of one price, since in general $P_{\mathrm{F},t} \neq \mathcal{E}_t P^*_{\mathrm{F},t}$.[5]

The macroeconomic effects of a given monetary policy rule vastly differ depending on the degree of pass-through. To show this most clearly, I rewrite import prices above expressing marginal costs in terms of the two indicators of monetary stance μ and μ^*, and productivity. In the case of complete pass through, we have:

$$\frac{P_{\mathrm{F},t}}{\mathcal{E}_t} = \frac{\theta}{\theta - 1} E_{t-1}\left[MC^*_t\right] = \frac{\theta}{\theta - 1} E_{t-1}\left[\frac{\mu^*}{Z^*}\right]. \tag{12}$$

Import prices in *foreign* currency are clearly independent of domestic monetary policy. While in each period Home import prices in the Home currency will vary one-to-one with the exchange rate, exchange rate movements induced by Home monetary policy will have no impact on their *expected* level. This is because foreign marginal costs are not directly affected by μ: with perfect pass-through, Foreign firms' revenues are insulated from Home monetary shocks. Home monetary authorities can thus focus on stabilizing domestic marginal costs/output gap and let exchange rate movements adjust international prices. The ex-ante level of import prices will only depend on Foreign monetary policy and Foreign shocks: also the Foreign central bank can focus on stabilizing domestic firms' marginal costs, expressed in its own currency.

Things are quite different if pass-through is not complete. In the case of zero pass-through we have

$$P_{\mathrm{F},t} = \frac{\theta}{\theta - 1} E_{t-1}\left[MC^*_{\mathrm{F},t} \cdot \mathcal{E}_t\right] = \frac{\theta}{\theta - 1} E_{t-1}\left[\frac{\mu}{Z^*}\right]$$

Average import prices will now depend on domestic monetary policy. In such case, stabilizing *only* domestic marginal costs may not be optimal for the Home authorities. This is because Foreign firms' revenues and profits in Foreign currency fluctuate with the exchange rate. To the extent that exchange rate volatility is unrelated to Foreign productivity shocks, imperfect stabilization of imports demand and marginal costs will translate into higher average import prices — for the very reason studied in the previous section. At the margin, it is rational for monetary authorities to weight the benefits of stabilizing domestic marginal costs completely, against the costs of high import prices. Namely, welfare can be improved by stabilizing a weighted average of marginal costs in both the domestic and the import sector. I will formally derive the implications of these considerations for the design of optimal monetary rules in the next section.

3.3 Welfare and policy objectives

One of the most appealing features of the Corsetti-Pesenti model is its tractability for welfare analysis. Given the above specification of preferences and tech-

[5] Note the difference in the currency denomination of the marginal costs in the above expressions. In the case of $P_{\mathrm{F},t}$, the Foreign marginal costs are expressed in Home currency.

nology, in a rational expectations equilibrium the expected utility in any given period can be approximated by looking at expected log consumption only. Define

$$\mathcal{W} = E \ln [C] \tag{13}$$

Now, recall that consumption can be written as the ratio between the monetary stance for the economy μ (i.e. the level of aggregate nominal spending) and the price level. Hence we can also write:

$$\begin{aligned} \mathcal{W} &= E \{\ln \mu - \ln P\} \\ &= E \{\ln \mu - (1-\gamma) \ln P_{\mathrm{N}} - \gamma\alpha \ln P_{\mathrm{H}} - \gamma (1-\alpha) \ln P_{\mathrm{F}}\} + \text{constant} \end{aligned}$$

The corresponding expression for the Foreign country is:

$$\begin{aligned} \mathcal{W}^* &= E \ln [C^*] = E \{\ln \mu^* - \ln P^*\} \\ &= E \{\ln \mu^* - (1-\gamma) \ln P^*_{\mathrm{N}} - \gamma\alpha \ln P^*_{\mathrm{H}} - \gamma (1-\alpha) \ln P^*_{\mathrm{F}}\} + \text{constant} \end{aligned}$$

Observe that all we need to know to characterize optimal policies is the equilibrium expression for the optimal preset prices (shown in the previous subsection). I should stress here that, for simplicity, throughout the analysis I ignore utility or other gains from liquidity services.[6]

To study optimal stabilization policies, I solve the problem of two national monetary authorities whose objective is to maximize domestic welfare, assuming that these authorities can commit to policy rules and are perfectly credible. I characterize optimal rules under three regimes: the first is a Nash equilibrium, that is, the case of two independent authorities, each choosing the domestic monetary stance taking the monetary stance abroad as given; the second is the case of international policy coordination, whereas the two authorities maximize a joint welfare function; the third is the case of an optimal monetary union, which different from co-ordination in that there is only one monetary instrument, so that $\mu = \mu^*$. I will then analyze under which conditions the solution for the first two cases coincides with the solution for the latter, i.e. under what conditions optimal stabilization could be achieved under a common monetary policy (i.e., with a fixed exchange rate).

4 Revisiting OCA theory

4.1 At the Root of Aversion to Monetary Unions

I begin by reconsidering the root of the aversion to currency unions expressed by economists who share the classical view of international transmission — as exemplified by Friedman (1953). According to such view, exchange rate movements are efficient substitutes for international relative price adjustment. If exchange rates regulate international relative prices, giving up flexibility is obviously costly.

[6] The analysis thus abstracts from considerations that could make it optimal to follow the Friedman rule (see Adao, Correia and Teles 2003).

To revisit this fundamental critique of monetary unification, consider the model above assuming 'producer currency pricing,' whereas P_{F}^{*} is sticky, but the price of imports in Home currency P_{F} moves one-to-one with the exchange rate: $P_{\mathrm{F}} = \mathcal{E}P_{\mathrm{F}}^{*}$. Substituting (10) into the price index (9), the Home welfare can be written as follows

$$\begin{aligned}
\mathcal{W} &= E\ln[C] \\
&= E\left\{\ln\mu - (1-\gamma)\ln E_{t-1}P_{\mathrm{N}} - \gamma\alpha\ln E_{t-1}P_{\mathrm{H}} - \gamma(1-\alpha)\left[\ln\mathcal{E} + \ln E_{t-1}P_{\mathrm{F}}^{*}\right]\right\} \\
&= E\left\{\ln\mu - (1-\gamma)\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right) - \gamma\alpha\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)\right. \\
&\quad \left. -\gamma(1-\alpha)\left[\ln\mu - \ln\mu^{*} + \ln E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{F}}}\right)\right] + \text{ constant}\right\}
\end{aligned}$$

A similar expression can be derived for the Foreign country. To characterize optimal policies, I just look at the first order condition of these expressions with respect to the monetary stance indices.[7] I comment on the results below.

Nash equilibrium If the two authorities act independently (the case of a Nash equilibrium), each of them will find it optimal to stabilize a weighted average of marginal costs in the two production sector of the economy (non-tradable and tradable). Namely, the optimal stabilization policy rules under commitment in the Home and Foreign country will satisfy

$$(1-\gamma(1-\alpha)) = (1-\gamma)\frac{\frac{\mu}{Z_{\mathrm{N}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right)} + \gamma\alpha\frac{\frac{\mu}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)}$$

$$(1-\gamma\alpha) = (1-\gamma)\frac{\frac{\mu^{*}}{Z_{\mathrm{N}}^{*}}}{E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{N}}^{*}}\right)} + \gamma(1-\alpha)\frac{\frac{\mu^{*}}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{F}}}\right)}$$

So, Home monetary authorities optimally choose an expansionary stance (raising μ) in response to positive productivity shocks in either sector of the domestic economy (either Z_{N} or Z_{H}).

[7] In a Nash equilibrium, the Home policymaker problem is

$$Max_{\mu}E\mathcal{W}$$

taking μ^{*} as given. The corresponding problem for the Foreign policymaker is

$$Max_{\mu^{*}}E\mathcal{W}^{*}$$

taking μ as given.

With international policy coordination, the joint problem is

$$Max_{\mu,\mu^{*}}[E\mathcal{W} + E\mathcal{W}^{*}].$$

In a monetary union, the problem is the same as above, subject to the constraint $\mu = \mu^{*}$. In solving these problems, it is useful to recall the following differentiation rule:

$$\frac{df\left[E\left(g\left(X\right)\right)\right]}{dX} = f'\left[E\left(g(X)\right)\right]g'(X).$$

Observe that central banks are only concerned with domestic policy trade-offs (they do not respond to $Z^*_{\rm N}$ or $Z_{\rm F}$): there is no 'international dimension' in monetary policymaking. As explained above, the reason why policymakers are not concerned with foreign shocks is that, once optimal monetary rules are in place, the implied exchange rates fluctuations move relative prices in the 'right direction.' Namely, a positive supply shock in the Foreign economy is matched by a foreign expansion, appreciating the Home currency. The exchange rate response lowers the relative price of Foreign goods, switching domestic and world demand towards Foreign output. This is what would happen in a flex-price equilibrium.

Are there conditions under which fixing the exchange rate would not be consequential for efficient domestic stabilization? Hardly so. It is apparent that, in general, the above conditions will not be solved by symmetric monetary stances ($\mu = \mu^*$). Combining the expressions above, we can derive the equilibrium exchange rate conditional on implementing optimal monetary rules:

$$\frac{\mu}{\mu^*} = \mathcal{E} = \frac{(1-\gamma)\,\frac{\frac{1}{Z^*_{\rm N}}}{E_{t-1}\left(\frac{\mu^*}{Z^*_{\rm N}}\right)} + \gamma\,(1-\alpha)\,\frac{\frac{1}{Z_{\rm F}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\rm F}}\right)}}{(1-\gamma)\,\frac{\frac{1}{Z_{\rm N}}}{E_{t-1}\left(\frac{\mu}{Z_{\rm N}}\right)} + \gamma\alpha\frac{\frac{1}{Z_{\rm H}}}{E_{t-1}\left(\frac{\mu}{Z_{\rm H}}\right)}}.$$

In general, there is no solution for $\mu = \mu^*$. The exception is the (obviously implausible) case of perfect symmetry of shocks both *across countries* and *across sectors*. Clearly, adopting fixed exchange rates has a cost in terms of stabilization: in a monetary union the central bank cannot stabilize four marginal costs with a single instrument.

One could actually extend similar consideration to domestic stabilization. Unless the sectoral shocks are perfectly correlated at domestic level, the central bank will not be able to stabilize both aggregate demand and the relative demand for the tradables and nontradables with a single instrument. Benevolent policy makers will maximize over the resulting policy trade-offs, reacting more to shocks hitting the largest sector, and de facto placing more weight on the sector with the highest variance of shocks.[8]

Coordination With flexible exchange rates, the presence of nontraded goods imply that there are potential gains from coordination. If policy rules are jointly determined as to maximize the sum of welfare in the two countries, they satisfy:

$$[(1-\gamma(1-2\alpha)] = (1-\gamma)\,\frac{\frac{\mu}{Z_{\rm N}}}{E_{t-1}\left(\frac{\mu}{Z_{\rm N}}\right)} + 2\alpha\gamma\frac{\frac{\mu}{Z_{\rm H}}}{E_{t-1}\left(\frac{\mu}{Z_{\rm H}}\right)}$$

[8] In our economy, there is no trade-off between inflation and unemployment. This is so because we assume that all prices are fixed for one period. The above trade-off can be easily accounted for by allowing for some degree of flexibility (e.g. Corsetti and Pesenti 2005).

$$(1+\gamma(1-2\alpha)) = (1-\gamma)\frac{\frac{\mu^*}{Z_{\mathrm{N}}^*}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{N}}^*}\right)} + 2\gamma(1-\alpha)\frac{\frac{\mu^*}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{F}}}\right)}$$

Under coordination, monetary authorities are still completely inward looking, in the sense that they only stabilize the marginal costs in the two sectors of the domestic economy. However, relative to the non coordinated case, they react more to shocks in the non-traded-good sector. This is because, according to the classical view of the international transmission mechanisms, a monetary expansion in one country tends to favour consumers abroad by improving their terms of trade: hence, the international spillovers from monetary policy are positive. In a Nash equilibrium, the Home monetary authorities ignore these spillovers when solving the policy problem. Gains from coordination however disappears if $\gamma \to 1$, i.e. all goods are tradables.

Yet gains from coordination are not an argument in favor of limiting exchange rate flexibility. Country-specific shocks still drive the optimal conduct of domestic monetary authorities, who see no reasons to react to cyclical conditions abroad.

Monetary union Optimal monetary policy in a monetary union is clearly sub-optimal. Maximizing an equally weighted average of Home and Foreign welfare, optimal policy rules with a common currency satisfy the following:

$$1 = (1-\gamma)\left[\frac{\frac{\mu}{Z_{\mathrm{N}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right)} + \frac{\frac{\mu}{Z_{\mathrm{N}}^*}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}^*}\right)}\right] + 2\alpha\gamma\frac{\frac{\mu}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)} - 2\gamma(1-\alpha)\frac{\frac{\mu}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{F}}}\right)}$$

Note that a large α — a proxy for the economic weight of the Home country in the union — raises the importance of stabilizing Home marginal costs in the eye of the single monetary authority. By the same token, a country with more pronounced exogenous shocks to fundamentals will acquire a larger weight in the implementation of optimal stabilization rules.

4.2 Local currency price stability of imports as an argument in favor of monetary unions

The traditional view of international transmission has been recently questioned by authors stressing the empirical evidence on the local currency price stability of imports, i.e., on the fact that the price in domestic currency of Foreign goods tends to move very little with the exchange rate. To the extent that this is due to nominal rigidities, we have seen above that exchange rate movements do not help correcting international relative prices. Actually, they tend to make the international transmission of monetary policy harmful ex-post: a Home expansion worsens Foreign terms of trade, raising foreign labor for every level of Foreign consumption.

While there is a considerable debate on the relative importance of real and nominal factors in determining the local currency price stability of imports,[9] let me consider the extreme case in which this is due exclusively to nominal frictions. If both domestic and import prices are sticky (preset), we can use (11) and (9) to write Home welfare as

$$\begin{aligned}\mathcal{W} &= E\left\{\ln\mu-(1-\gamma)\ln P_{\mathrm{N}}-\gamma\alpha\ln P_{\mathrm{H}}-\gamma(1-\alpha)\ln P_{\mathrm{F}}\right\}\\ &= E\left\{\ln\mu-(1-\gamma)\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right)-\gamma\alpha\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)\right.\\ &\qquad\left.-\gamma(1-\alpha)\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{F}}}\right)+\text{constant}\right\}\end{aligned}$$

By the same token, Foreign welfare is

$$\begin{aligned}\mathcal{W}^{*} = E\left\{\ln\mu^{*}-(1-\gamma)\ln E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{N}}}\right)-\gamma\alpha\ln E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{H}}}\right)\right.\\ \left.-\gamma(1-\alpha)\ln E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{F}}}\right)+\text{constant}\right\}\end{aligned}$$

With benevolent and credible monetary authorities, policy rules in an non-coordinated world equilibrium will satisfy the following conditions:

$$1=(1-\gamma)\frac{\frac{\mu}{Z_{\mathrm{N}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right)}+\gamma\left[\alpha\frac{\frac{\mu}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)}+(1-\alpha)\frac{\frac{\mu}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{F}}}\right)}\right]$$

$$1=(1-\gamma)\frac{\frac{\mu^{*}}{Z^{*}_{\mathrm{N}}}}{E_{t-1}\left(\frac{\mu^{*}}{Z^{*}_{\mathrm{N}}}\right)}+\gamma\left[\alpha\frac{\frac{\mu^{*}}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{H}}}\right)}+(1-\alpha)\frac{\frac{\mu^{*}}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^{*}}{Z_{\mathrm{F}}}\right)}\right]$$

Optimal monetary policies are no longer 'inward-looking'. They respond to an average of shocks hitting the world economy, weighting them depending on the importance of each type of goods in consumption. As discussed in Corsetti and Pesenti (2005b), nominal frictions in local currency are an argument in favor of an 'international dimension' in the optimal design of monetary policy rules. It turns out that the optimality conditions above are the same with international policy cooperation, a result that extends the finding by Corsetti and Pesenti (2005a) to an economy including nontradable goods.

Are there conditions under which the two equations can be solved by the same monetary stance? The answer is positive. Observe that the two equations above are identical, either if productivity shocks in the nontraded good sector

[9] Real factors include distributive trade, difference in preferences generating differences in elasticities across markets, vertical and horizontal interactions in non-competitive markets, or other factors creating scope for optimal price discrimination.

are symmetric, or if tradables are the only goods delivering utility ($\gamma \to 1$), i.e.

$$\lim_{\gamma \to 1} \frac{\mu}{\mu^*} = \mathcal{E} = \frac{\alpha \frac{\frac{1}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{H}}}\right)} + (1-\alpha) \frac{\frac{1}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{F}}}\right)}}{\alpha \frac{\frac{1}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)} + (1-\alpha) \frac{\frac{1}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{F}}}\right)}} = 1$$

In either case, optimal stabilization implies $\mu = \mu^*$, hence a fixed exchange rate is by no means an impediment to optimal stabilization.

The result that a regime of fixed exchange rates does not constrain the optimal conduct of stabilization policy is not robust. It only holds under two sets of conditions. The first is that stabilizing domestic and foreign costs in the tradable sector is the only relevant policy trade-off faced by monetary authorities (i.e. either there are asymmetries in the nontradable sector, or the nontradable sector is very small). Second, the structure of tradable consumption is identical across countries. The latter is the crucial reason why national central banks find it optimal to stabilize the same weighted average of Home and Foreign marginal costs: even though the two monetary authorities act independently, monetary stances are symmetric, ruling out exchange rate variability altogether — a point stressed by Devereux and Engel (2003) and Corsetti and Pesenti (2005a).

In general, however, giving up domestic currencies does impose a binding constraint on stabilization policy. Even if the tradable consumption basket is symmetric (I will relax this assumption in the next section), shocks to the non-tradable sector will break the symmetry in optimal policy — this is the essence of the critique of Devereux and Engel (2003) by Duarte and Obstfeld (2004). While nominal price rigidities in local currency tend to down-play the gains from exchange rate flexibility, they are hardly an argument for embracing fixed exchange rates, i.e. they cannot provide new theoretical foundations to optimum currency areas.

5 A novel result: specialization and symmetry in economic structures

In the literature on OCA, some authors (most notably, Krugman 1993) stress that the scope and likelihood of asymmetric shocks are linked to the degree of production specialization across areas. With specialization, the argument goes, any industry-specific shocks will also be region-specific, raising the costs of monetary unification in terms of stabilization. If the economic structure is instead symmetric across countries, industry-specific shocks will affect all regions in the union in the same way, reducing the strain on the Central Bank.[10]

[10] Of course, there could other sources of idiosyncratic shocks — for instance, policy-related shocks. One issue raised by the literature is that, to the extent that a single currency affect trade costs and the policy regime, the pattern of national economic specialization when monetary union is created, may change over time. Even if an area is not an OCA at that point, it may then become so over time.

Now, in the previous section we have presented an (admittedly extreme) example at odds with Krugman's argument, that complete specialization raises the costs of monetary unification because of its influence on the scope and likelihood of asymmetric shocks. Namely, consider the model with tradable goods only (for $\gamma \to 1$). Even if countries are perfectly specialized and shocks are asymmetric, to the extent that import prices are sticky in local currency, Home and Foreign optimal monetary policy tends to react to some average of domestic and foreign shocks. As the optimal monetary stance becomes symmetric across borders, optimal stabilization policy implies complete stability of the exchange rate: relative to a regime with monetary autonomy, there is no cost in renouncing national currencies. The example suggests that complete specialization and asymmetries in economic structures are not necessarily inconsistent with a common currency, in the sense that optimal monetary policy in a monetary union does no worse than country-specific optimal monetary policy. In light of this result, it is interesting to reconsider Krugman's argument using a slightly different specification of the model.

For the purpose of my analysis, I again assume that, absent a monetary union, imports are sticky in local currency. Different from the previous section, however, I now introduce some home bias in the consumption of tradables. Instead of weighting Home and Foreign tradables with identical parameters α and $1-\alpha$ in both C and C^*, I redefine these consumption baskets as follows

$$\begin{aligned} C &= \left[C_{\mathrm{H}}^{\beta} C_{\mathrm{F}}^{1-\beta}\right]^{\gamma} C_{\mathrm{N}}^{1-\gamma} \\ C^* &= \left[\left(C_{\mathrm{H}}^*\right)^{1-\beta}\left(C_{\mathrm{F}}^*\right)^{\beta}\right]^{\gamma}\left(C_{\mathrm{N}}^*\right)^{1-\gamma} \end{aligned}$$

where $\beta > 1/2$ now indexes the degree of home bias in tradables. As long as the degree of home bias is symmetric across countries, the model can still be solved in closed form (see Corsetti 2006).

The expressions for welfare are remarkably closed to the ones derived above: a crucial difference is the weight on the tradable goods. Namely, welfare in the Home country is

$$\begin{aligned} \mathcal{W} &= E\left\{\ln \mu - (1-\gamma)\ln P_{\mathrm{N}} - \gamma\beta \ln P_{\mathrm{H}} - \gamma(1-\beta)\ln P_{\mathrm{F}}\right\} = \\ &= E_{t-1}\ln \mu - (1-\gamma)\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right) - \gamma\beta \ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right) \\ &\quad -\gamma(1-\beta)\ln E_{t-1}\left(\frac{\mu}{Z_{\mathrm{F}}}\right) + \text{constant} \end{aligned}$$

For the Foreign country we have

$$\begin{aligned} \mathcal{W}^* &= E\left\{\ln \mu^* - (1-\gamma)\ln P_{\mathrm{N}}^* - \gamma(1-\beta)\ln P_{\mathrm{H}}^* - \gamma\beta \ln P_{\mathrm{F}}^*\right\} = \\ &= E_{t-1}\ln \mu^* - (1-\gamma)\ln E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{N}}}\right) - \gamma\beta \ln E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{F}}}\right) \\ &\quad -\gamma(1-\beta)\ln E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{H}}}\right) + \text{constant} \end{aligned}$$

Consistently, the optimal policy rules in a Nash equilibrium now satisfy the following conditions:

$$\frac{1}{\mu} = (1-\gamma)\frac{\frac{1}{Z_{\mathrm{N}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{N}}}\right)} + \gamma\beta\frac{\frac{1}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)} + \gamma(1-\beta)\frac{\frac{1}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{F}}}\right)}$$

$$\frac{1}{\mu^*} = (1-\gamma)\frac{\frac{1}{Z^*_{\mathrm{N}}}}{E_{t-1}\left(\frac{\mu^*}{Z^*_{\mathrm{N}}}\right)} + \gamma(1-\beta)\frac{\frac{1}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{H}}}\right)} + \gamma\beta\frac{\frac{1}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{F}}}\right)}$$

As before, optimal monetary stances stabilize a weighted average of domestic and foreign marginal costs — with weights given by the CPI weights of domestic and import good prices.

Home bias in tradable consumption — indexed by β — is obviously relevant for policy design. Consider the limiting case in which all goods are tradables, i.e. $\gamma \to 1$. The ratio of Home to Foreign optimal monetary policy is

$$\lim_{\gamma\to 1}\frac{\mu}{\mu^*} = \mathcal{E} = \frac{(1-\beta)\frac{\frac{1}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{H}}}\right)} - \beta\frac{\frac{1}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu^*}{Z_{\mathrm{F}}}\right)}}{\beta\frac{\frac{1}{Z_{\mathrm{H}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{H}}}\right)} - (1-\beta)\frac{\frac{1}{Z_{\mathrm{F}}}}{E_{t-1}\left(\frac{\mu}{Z_{\mathrm{F}}}\right)}}$$

This expression makes it clear that, for a given stochastic process driving productivity shocks in the two countries, the degree of symmetry in monetary policy falls with home bias in consumption. The monetary stance is identical across the two countries when there is no bias, i.e. when $\beta = 1/2$. It is easy to verify that this is a special case of the analysis in the previous section, for $\alpha = \beta = 1/2$. Increasing the degree of home bias, i.e. raising β, makes the two national economies less open. The larger β, the less suitable a common monetary policy for stabilization.

What are the main lessons for OCA? Observe that, when $\beta = 1/2$, the share of consumption expenditure on each national good is identical to the share of each good in the total value added produced by the two countries. This leads me to conclude that a symmetry between consumption and the (endogenous) value of production is essential for the strong result of optimality of fixed exchange rates derived in the previous section. For a relatively stable exchange rate to be an attribute of optimal monetary policy, there must be substantial cross-border symmetry in consumption and production structures.

Second, one may conjecture that limiting exchange rate flexibility is desirable in relatively open economies, less so in relatively closed economies. Indeed it is easy to verify that lowering β towards $1/2$ raises the symmetry of optimal national monetary stances. However, such conjecture does not hold for economies with a very high degree of openness. Suppose we decrease β below $1/2$, as to induce a bias towards Foreign goods. Stabilization in this case will again require asymmetry in the optimal monetary stances: a fixed exchange rate cannot be optimal.

A long-lasting question in European monetary study is why European policy leaders have traditionally shown a preference for fixed exchange rates. Based on the result above, a possible answer lies in a skeptical view about the role of exchange rate in adjusting relative prices among relatively open European countries, characterized by symmetry between production and consumption patterns.

Observe that, taking the logic of the argument a step further, one could build a case for 'endogenous currency areas' symmetrically different from the argument in Frankel and Rose (1998): even if countries joining a common currency do not satisfy the criteria for an optimal currency area, they may do so over time, to the extent that a common currency favors specialization in production, and the emergence of symmetry in consumption patterns. However, if monetary union and further market integration raise the degree of production specialization, but also makes these economies very open and break symmetry in consumption patterns, the costs of giving up flexibility would correspondingly rise. A common monetary policy may lose its appeal over time.

6 More costs of insufficient stabilization and monetary unions

In this section, I briefly sketch a small set of issues that could be modelled in extensions of the framework above. The list is partial and incomplete: I do not comment on financial issues, or issues related to fiscal solvency and loss of seigniorage revenue; by the same token, I make no reference to possible implications of monetary union for the labor market or international trade.

6.1 Inflation dispersion

It is well understood that in models with partial price adjustment, incomplete stabilization of output gaps generates inflation variability and inflation dispersion. Differences in inflation rates across countries (or sectors) may reflect desirable adjustment in international relative prices — and therefore be welfare-enhancing. However, in models with staggered price adjustment, inflation dispersion has also negative implications on efficiency, as inflation distorts relative prices (to wit: with staggered adjustment, the market price of ex-ante symmetric goods in preferences and production is not necessarily symmetric). Hence, the design of optimal monetary policy in a currency union must address the trade-off between the benefit of inflation in fostering relative price adjustment *across types of goods*, and its costs in terms of relative price distortions *within categories of goods*.

Elaborating on this trade-off, recent contributions have argued that central banks should target inflation in those sectors/countries that have the highest degree of inflation persistence. The reason is straightforward. Suppose some fundamental shock creates the need for adjustment in relative prices across different types of goods, or across countries. In response to these shocks, it is highly inefficient to place the burden of price adjustment on sectors/countries

that have high and persistent nominal rigidities. If policy makers try to do so, adjustment will take time, and it will be costly due to distortions in relative prices of similar goods – since some firms will happen to adjust prices early on, others will happen to adjust prices at a later time. Conversely, it is efficient to pursue policies that target desired relative price adjustment via nominal price changes in the most flexible sectors or countries of the union. Clearly, adjustment will be faster and less costly.

An important relative price affecting the dispersion of national inflation rates in a monetary union is that between traded and nontraded goods. As is well known, these sectors could potentially have different inflation rates reflecting fundamentals such as productivity growth differentials between manufacturing and services. But they could also respond differently to demand shocks. A crucial empirical issue is to what extent inflation differentials in a monetary union are driven by nontraded price variability.

6.2 Investment and firms' entry

There are a number of possible directions of theoretical research developing along the lines sketched in Section 3 above. For instance, recent literature has developed models with entry and exit of firms (see Ghironi and Melitz (2005), Corsetti, Martin and Pesenti (2005), among others), with very promising results. In joint work with Bergin, I show that models including both firms' entry and nominal price rigidities confirm the main result of Section 3: lack of stabilization raises the price level (Bergin and Corsetti 2005). In addition, the model suggests that insufficient stabilization at national level reduces the number of firms created in equilibrium, depressing the level of investment relative to the flex-price allocation benchmark.

Some of these models also introduce yet another dimension to the costs of business cycle. Since firms produce differentiated goods, the welfare implications of fluctuations in economic activity that expand or contract the array of goods available to consumers are magnified by the degree of households' 'love of variety.'

6.3 Market segmentation and pricing to market

Recent models have focused on the macroeconomic aspects of optimal pricing-to-market in models allowing for distribution services intensive in local input. Because of these services, the consumer price of goods has a sizeable component in local costs. Previous joint work with Luca Dedola suggests that, to the extent that incomplete stabilization at national level raises the price for nontradables including distribution services, distribution margins will tend to be higher in a monetary union, relative to a regime of flexible rates. Larger distribution margins may create further opportunities of market segmentation and price discrimination, running counter other desirable effects of a single currency on price dispersion.

6.4 Fiscal policy and the provision of public goods

As is well known, stabilization properties of fiscal policy will in general depend on the fiscal instrument that the government uses (taxation, government spending on consumption or investment), the distortionary nature of taxation, and financial and nominal frictions affecting the transmission of demand and tax shocks. The analysis of fiscal policy thus raises the issue of choosing among different possible specifications of instruments and economic structure. The macro literature has moved some steps towards a more realistic treatment of this issue, accounting for distortionary taxes and spending on useful public goods, and/or introducing liquidity constrained agents in general equilibrium models. In this text, I will limit my analysis to a simple example that is somewhat useful to explore the attributes of an optimal policy mix (see Galì and Monacelli (2004)).

Assume that taxes are lump sum and government spending falls on useful public goods which provide utility to the representative national consumers. Observe first that, in a Pareto-efficient allocation, government spending should be higher in states of nature where productivity is high, since it is efficient to produce more (private and public) goods in these states of nature. To characterize an equilibrium allocation with an optimal policy mix, recall the main result of the previous section: with nominal rigidities, monetary policy should be expansionary when productivity is high. In an optimal float, then, we may expect that optimal monetary policy and fiscal policy should both be expansionary in response to a positive productivity shock. Indeed, in an Optimal Float, private and public consumption will be highly correlated: they both increase with positive productivity shocks.

In an optimal monetary union, however, it is reasonable to expect that the correlation between these two policies be lower. Specifically, consider the optimal single monetary response to a positive productivity shock in the Home country. As average productivity is higher in the union, monetary policy will be expansionary, raising both domestic and foreign private consumption. But since by assumption productivity has not changed in the Foreign country, the single monetary policy will move output gaps in different directions: output will be too low in the Home country (since the shock is not fully stabilized); it will be too high in the Foreign country. What about fiscal policy? Clearly, it will be optimal to expand government spending on public goods in the Home country, where productivity is high. It will not be optimal to raise public spending in the Foreign country, where productivity has not changed. Actually, welfare could be improved by reducing, at the margin, public activity, to compensate (at least partially) for the high employment rates driven by monetary policy.

In an optimal monetary union, therefore, the optimal policy mix differs at national level, requiring fiscal policy to be anticyclical depending on domestic conditions. Government spending should always move to close output gaps. In some countries this will require both fiscal and monetary policy to be expansionary. In others, fiscal policy should be used to cool down the national economy response to a monetary shock motivated by cyclical conditions elsewhere in the union. This is clearly not optimal, relative to the benchmark case of complete

stabilization and efficient provision of public goods.

Note that this simple model abstracts from liquidity-constrained households ('rule of thumb' consumers). In their presence, spending and taxation policy can also have a direct effect on private consumption through disposable income, breaking Ricardian equivalence.

7 Conclusion

In this paper, I have reconsidered a set of questions at the heart of the theory of Optimum Currency Areas. A first question concerns possible stabilization costs from giving up exchange rate flexibility and monetary autonomy; a second question is whether symmetry in economic structure across countries can help a single monetary authority pursue its goal of efficient union-wide stabilization. Relative to traditional theory, I have adopted a stylized choice-theoretic model whereas all economic agents (households, firms and the government) are maximizing their objective functions (utility, profits and social welfare as proxied by the expected utility of the national representative consumer).

The analysis sheds light on the costs of insufficient domestic stabilization in a currency area in terms of a wedge between the fixed-price and the flexible price consumption level. This result points to the need for further theoretical and empirical analysis of the macroeconomic implications of monetary unification on average prices and output. By the same token, asymmetries in economic structure are not necessarily an argument against monetary union. What is crucial is the symmetry across consumption basket and production shares of different national goods manufactured within the union.

References

[1] Adao, Bernardino, Isabel Correia and Pedro Teles (2003). "Gaps and Triangles", *Review of Economic Studies*, 70(4), pp. 699-713.

[2] Benigno, Pierpaolo (2004). "Optimal Monetary Policy in a Currency Area." *Journal of International Economics* 63 (2), pp. 293-320

[3] Bergin, Paul, and Giancarlo Corsetti (2005). "Towards a theory of firm entry and stabilization policy", NBER wp 11821, CEPR dp 537.

[4] Buiter Willem (2000). "Optimal Currency Areas: Why does the Exchange Rate Regime Matter? With an application to UK Membership in EMU. *Scottish Journal of Political Economy*, 47(3), pp. 213-250.

[5] Cole, Harold L., and Maurice Obstfeld (1991). "Commodity Trade and International Risk Sharing: How Much Do Finacial Markets Matter?" *Journal of Monetary Economics* 28, pp. 3-24.

[6] Corsetti, Giancarlo (2006). "Openness and the case for flexible exchange rates", Research and Economics, Forthcoming

[7] Corsetti, Giancarlo, Philippe Martin and Paolo Pesenti (2005). "Productivity spillovers, terms of trade and the 'home market effect'." NBER WP 11165.

[8] Corsetti, Giancarlo, and Paolo Pesenti (2005a). "International Dimensions of Optimal Monetary Policy.", *Journal of Monetary Economics*, 52(2) 281-305.

[9] Corsetti, Giancarlo, and Paolo Pesenti (2005b). "The simple geometry of transmission and stabilization in closed and open economy", NBER working paper no. 11341.

[10] Corsetti, Giancarlo, and Luca Dedola (2005). "A Macroeconomic model of price discrimination." *Journal of International Economics.* 67(1), 129-156.

[11] Devereux, Michael B., and Charles Engel (2003). "Monetary Policy in the Open Economy Revisited: Price Setting and Exchange Rate Flexibility." *Review of Economic Studies* 70, pp. 765-783.

[12] Duarte, Margarita, and M. Obstfeld (2004). "Monetary Policy in Open Economy Rivisited: The Case for Exchange-Rate Flexibility Restored", mimeo, University of California, Berkeley

[13] Frankel, Jeffrey A., and Andrew K. Rose (1998). "The Endogeneity of the Optimum Currency Area Criteria." *Economic Journal* 108 (449), July, pp. 1009-25.

[14] Friedman, Milton (1953). "The Case for Flexible Exchange Rates," reprinted in *Essays in Positive Economics*, Chicago, IL: University of Chicago Press, pp. 157-203.

[15] Galì Jordi and Tommaso Monacelli (2004). "Optimal Fiscal Policy in a Monetary Union", mimeo.

[16] Ghironi, F. and M. Melitz, 2005. International Trade and Macroeconomics Dynamics with Heterogenous Firms, International Trade and Macroeconomic Dynamics with Heterogeneous Firms", *Quarterly Journal of Economics*, (120), 865-915.

[17] Ingram, J. (1973). *The Case for European Monetary Integration.* Princeton Essays in International Finance No.98, Princeton NJ, Princeton University, International Finance Section.

[18] Kenen, Peter (1969). "The Theory of Optimum Currency Areas: An Eclectic View," reprinted in *Exchange Rates and the Monetary System: Selected Essays of Peter B. Kenen*, Aldershot: Elgar, 1994, pp. 3-22.

[19] Krugman , Paul (1993). "Integration, Specialization and Regional Growth: Notes on 1992." In Torres, Francisco and Francesco Giavazzi, eds. *Adjustment and growth in the European Monetary Union*, Cambridge: Cambridge University Press.

[20] Lucas, Robert E., Jr. (1987). *Model of Business Cycles*, Basil Blackwell

[21] Lucas, Robert E., Jr. (2003). "Macroeconomic Priorities". *American Economic Review*. March, pp. 1-14.

[22] McKinnon, Ronald (1963). "Optimum Currency Areas." *American Economic Review* 53, September, pp. 717-724.

[23] Mundell, Robert (1961). "A Theory of Optimum Currency Areas." *American Economic Review* 51, September, pp. 657-664.

[24] Obstfeld, Maurice, and Kenneth Rogoff (2002). "Global Implications of Self-Oriented National Monetary Rules." *Quarterly Journal of Economics*, 117 (2), May, pp. 503 - 535.

[25] Woodford, Michael (2003). *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press.