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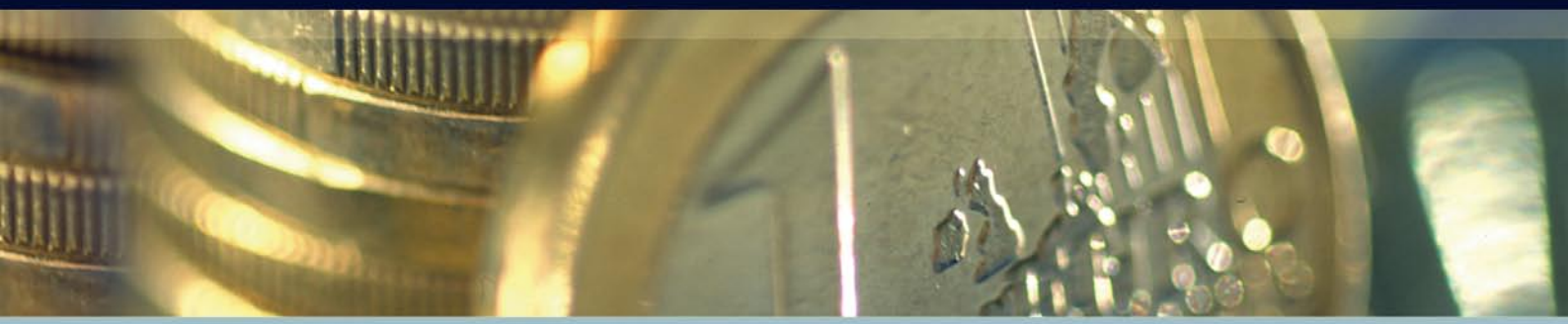

A modern reconsideration of the theory of Optimal Currency Areas

Giancarlo Corsetti

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In May 2008, it will be ten years since the final decision to move to the third and final stage of Economic and Monetary Union (EMU), and the decision on which countries would be the first to introduce the euro. To mark this anniversary, the Commission is undertaking a strategic review of EMU. This paper constitutes part of the research that was either conducted or financed by the Commission as source material for the review.

European Commission
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Publications
B-1049 Brussels
Belgium
E-mail: Ecfin-Info@ec.europa.eu

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A Modern Reconsideration

of the Theory of Optimal Currency Areas

Giancarlo Corsetti

European University Institute, University of Rome III, and CEPR

Abstract:

What can be learnt from revisiting the Optimal Currency Areas (OCA) theory 50 years from its birth, in light of recent advances in open economy macro and monetary theory? This paper presents a stylized micro-founded model of the costs of adopting a common currency, relative to an ideal benchmark in which domestic monetary authorities pursue country-specific efficient stabilization. Costs from (a) limiting monetary autonomy and (b) giving up exchange rate flexibility are examined in turn. These costs will generally be of the same magnitude as the costs of the business cycle. However, to the extent that exchange rates do not perform the stabilizing role envisioned by traditional OCA theory, a common monetary policy can be as efficient as nationally differentiated policies, even when shocks are strongly asymmetric, provided that the composition of aggregate spending tends to be symmetric at union-wide level. Convergence in consumption (and spending) patterns thus emerges as a possible novel attribute of countries participating in an efficient currency area.

Keywords: optimum currency area, optimal monetary policy, costs of business cycle, exchange rate regime, international policy cooperation, new open economy macroeconomics.

JEL classification: E31

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1 Introduction

Economic heterogeneity across regions and countries 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 literature on Optimal Currency Areas (henceforth OCA) has long emphasized that some elements of economic heterogeneity increase the likelihood of a-synchronous business cycle fluctuations at regional level, which interfere with the efficient conduct of stabilization policy in a currency area, and in principle may prevent a single monetary authority from achieving successfully its goals.

The traditional debate pointed out that the likelihood of asymmetric shocks is higher in the presence of national differences in product specialization, and/or sectoral composition of output. Over the years, the list of relevant asymmetries has grown as to include also structural difference which may affect the way a common shock is transmitted across regions — such as different degrees of nominal rigidities and frictions across sectors and regions (arguably reflecting differences in the pace of deregulation and liberalization), or differences in financial structures and labour (and goods) market institutions. Policymakers are obviously interested in understanding the extent to which they should worry about these specific dimensions of heterogeneity, beyond monitoring their role in macroeconomic developments, i.e. in determining the output gap and (core) inflation.[1] The European Central Bank is by no means the only central bank facing this issue — but national differences and the lack of political integration make it more pressing in the euro area than elsewhere.

In this text, I take a step back from the current debate, and reconsider the very foundations of the theory of Optimal Currency Areas (henceforth OCA) drawing on recent contributions to stabilization theory in closed and open economies (see for instance Woodford 2003, Galì 2008 and especially the vast body of contributions to the so-called New Open Economy Macroeconomics after Obstfeld and Rogoff (1995, 1996), as surveyed by Corsetti 2008). The objective is to shed light on what we can (and did) learn about Optimum Currency Areas adopting a new, modern approach to macro stabilization, relative to the body of knowledge already accumulated on the

[1] Recent literature has already provided important insights into this question, for instance by developing the standard closed-economy monetary models (e.g., Woodford (2003)), as to encompass asymmetry in nominal or financial frictions across sectors or regions (see Benigno (2004) among others).

foundations laid out by the classical OCA contributions, and the many later developments.

Relative to the traditional literature, the approach pursued in this paper is different in at least two important respects. First, all the arguments in the text are derived from a stylized micro-founded model in which households maximize expected utility, firms maximize expected profits, monetary authorities maximize national welfare, indexed by the representative household's utility. As in the traditional literature, however, because of frictions in the goods market (which are not modelled explicitly), prices are assumed to be sticky — for simplicity, firms are assumed to preset nominal prices for one production period. Second, the analysis is developed under the assumption that policymakers can credibly commit to policy rules in either exchange rate regimes (currency union, or flexible rates), with the objective of maximizing some average of the consumers' expected utility. Optimal stabilization policy is therefore characterized as optimal rules, rather than discretionary reactions to shocks — the distinction is not treated explicitly in the original OCA theory. I emphasize two main results.

First, as is well understood, in a monetary union inefficient stabilization of national economies is due to (a) insufficient stabilization of domestic marginal costs/output gap, *and* (b) monetary movements unrelated to the fundamentals of a country — in a currency union the common monetary stance can be a source of demand noise for some members of the union, depending on the degree of symmetry of cyclical shocks across countries. An important advantage of a 'micro-founded' framework consists of making it clear that, from the vantage point of the representative national household, the combined welfare cost of insufficient stabilization and monetary shocks unrelated to a country's fundamentals are essentially of the same order of magnitude of the costs of the business cycle. It follows that if one is sceptical about these costs, he/she must also be sceptical about the costs of monetary unification.

This consideration emphasizes an important open issue in OCA theory. According to the stylized model employed in the text, the welfare gap between a monetary union and independent monetary policies is consistent with the assessment of the costs of the business cycle by Lucas (1987, 2003). Many feel that Lucas' calculation severely underestimates the welfare effects of cyclical fluctuations. Yet the literature has so far fallen short of providing a paradigm which radically differs from Lucas' benchmark calculations: much richer models than the one employed in the text end up predicting costs that are only marginally higher. Moreover, by no means a sceptical view of the stabilization costs after monetary unification is a prerogative of the new 'micro-

founded' literature: Buiter (2000) expresses essentially the same view drawing on the IS-LM framework.

A second result sheds new light on an old debate in OCA theory, concerning the extent to which asymmetries in national economic structures and shocks magnify the costs of a single monetary policy. To appreciate this result, recall that arguments in favour of monetary unions typically build on some criticism of the benefits from exchange rate movements as envisioned by the traditional OCA theory. Traditional arguments view currency markets as a source of noise and financial instability. Recent literature instead point out that nominal rigidities in local currency prevent import prices from falling with currency depreciation (see Devereux and Engel 2003 among others): if import prices remain stable in local currency, exchange rate movements cannot foster relative price adjustment. Building on this view, it is indeed possible to produce examples in which a common monetary policy is as efficient as national differentiated policies, irrespective of specialization in production, and independently of the correlation between country-specific shocks.

The conditions under which such 'equivalence result' holds bear an important lesson for OCA. Namely, what reduces the gap between monetary policy in a common currency area and independent monetary policies is the degree of symmetry in the composition of national consumption. One can show that, if there were only tradable goods, and consumption baskets were identical across countries, monetary unification would not affect the monetary policy stance at national level at all. In light of this consideration, convergence in consumption (and spending) patterns emerges as a candidate novel attribute of countries participating in an efficient currency area.

Before proceeding, it is appropriate to clarify what this paper deals and does not deal with. The main goal of this paper is to analyze the difference at national level between participating in a monetary union and retaining the national currency, treating the two regimes on a level playing field. Consistent with this goal, the costs of a single monetary policy will be assessed relatively to an ideal benchmark of efficient domestic stabilization at country level, and not relative to any historical benchmark. In this respect, the analysis abstracts from a wide variety of inefficiencies and sources of instability — including some which have arguably played a prominent role in the historical process towards the euro, but are not essentially related with the adoption of a common currency. For instance, as shown in Section 4.3, the analysis does lend support to the view that gains from joining a monetary union are potentially sizeable, when participating in the union allows a country to benefit from a better (more disciplined) macroeconomic policy framework. However, the text does not offer an explicit model of the reasons why countries may be unable to adopt a good policy framework on their own. Instead, the exercise provides an assessment of the

potential gains from activating (non-monetary) instruments of business cycle stabilization at national or union-wide level, including fiscal policy (see e.g. the discussion in Adao et al., 2006).

Second, the analysis de facto assumes that consumption risk is perfectly diversified, corresponding to the case of perfect and frictionless financial markets: therefore, the text will not discuss the sensitivity of the welfare gap across regimes to different degrees of financial market integration and development (on this issue, see Sutherland 2004). Financial issues, together with fiscal issues, are briefly touched upon in a final section, while factor mobility is ignored altogether. By no means I regard these issues as secondary in OCA theory. If anything, they define core chapters of a research agenda which has motivated this paper in the first place, and hopefully will attract more research in the near future.

This paper is organized as follows. Section 2 briefly summarizes the findings of traditional theory of Optimal Currency Areas. Section 3 lays out a stylized model of a closed-economy to present the foundations of stabilization theory. Section 4 uses this model to assess the national welfare costs of losing monetary autonomy, and being exposed to monetary policy decisions responding to average fundamentals in the union. Section 5 introduces a two-country model, analyzing the international transmission mechanism and setting the stage for welfare analysis. Section 6 studies optimal stabilization policy under different policy regimes, revisiting the roots of the aversion to monetary union by classical authors. Section 7 revisits the OCA theory in light of non-traditional views of the international transmission of fundamental and policy shocks. Section 8 reconsiders the role of symmetry in economic structures in undermining the viability of currency unions. Section 9 discusses some extensions of the analysis, including fiscal policy and the policy mix. Section 10 concludes.

2 From the original theory of Optimal Currency Areas to micro-founded analyses of the costs and benefits of monetary unification

The seminal contributions to the so-called Optimal Currency Area theory, including Mundell (1961), McKinnon (1963), Kenen (1969), Ingram (1973), analyze the costs of adopting a common currency in the presence of asymmetric, country-specific temporary shocks and (by logical extension) asymmetric short-run response to common temporary and permanent shocks. The well-known argument is that these asymmetries weaken the case for a common currency, as members of monetary union lose the benefits from

(i) monetary autonomy;

(ii) stabilizing movements of the exchange rate.

The same literature then stresses that the benefits from (i) and (ii) 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 — sometimes 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 to the OCA literature, 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 the 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 and a formal derivation. As is well known, the advantage of this model is that it can be solved in closed form. 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).[2]

The main arguments are developed in two steps. The next section introduces the main ideas by using a simplified version of the model, whereas the countries in a monetary union are treated as if they were closed economies, i.e. without trade among them. Thanks to this simplification, the analysis will focus sharply on the costs of losing monetary autonomy, that is, the costs of giving up the possibility of implementing monetary stabilization policies specifically tailored to the need of the domestic economy. The following sections develop a full model of monetary unions

[2] The full specification of the model and its solution are available at www.eui.eu/Personal/corsetti/

with trade and financial links among countries, and complete the analysis contrasting different views on the benefits from exchange rate flexibility.

3 Monetary stabilization: basic ideas from a choice-theoretic model

This section sketches the main principle of macroeconomic stabilization based on a stylized model of an individual country in a monetary union, abstracting from trade in goods and assets. For later reference, the country on which I focus the analysis will be called the Home country; when appropriate Home variables are denoted with the subscript *H*.

3.1 A stylized closed-economy setup

Consider a closed economy populated by many identical households, who derive utility from consumption of goods, and leisure, i.e. their utility is decreasing in labour effort. In the analysis, the expected utility of the national representative household provides a natural index of national welfare.

In the tradition of macroeconomic models, the demand and the supply side of the economy are discussed in turn. Consider the demand side first. The dynamic of aggregate demand is governed by the optimal consumption-saving and investment decisions by Households and firms. For simplicity, as in many modern contributions to monetary theory, posit that the aggregate demand coincides with consumption expenditure, i.e. abstract from investment and government spending. Let C denote domestic aggregate consumption, and P its price (or CPI). Nominal aggregate demand is thus given by PC, and real domestic output Y_H coincides with real consumption expenditure, i.e. $C = Y_H$.

For the purpose of this paper, it is convenient to relate nominal aggregate demand PC to a variable μ, which indexes the stance of monetary policy: a higher μ means that monetary authorities pursue expansionary policies, raising aggregate demand and thus nominal consumption. Provided that there are no asset market frictions, the dynamic of aggregate demand (in nominal terms) reflecting optimal consumption and saving decisions by households can be written as follows

$$\mu_t = \frac{1}{\beta(1+i)} \frac{1}{E\left(\frac{1}{\mu_t + 1}\right)} \tag{1}$$

where β is the discount factor reflecting consumers' impatience, E denotes expectations of future variables, indexed by the subscript +1. The above equation makes it clear that, for given expectations of future prices and future real demand, current spending (corresponding to the current monetary stance) μ is decreasing in the nominal interest rate.

As regards the supply side of the model, output is produced in many varieties by (a continuum of) small firms, each of them with monopoly power on a specific good variety. Production can be written as $Y_H = Z_H \ell$, where Z_H denotes the level of productivity, identical across firms, ℓ denotes employment. Labour productivity Z_H is assumed to vary randomly at business cycle frequency.

Each firm faces a product-specific demand for its output with a constant price elasticity. Taking into account this demand, firms set their monopolistic prices subject to nominal rigidities. Assume for simplicity that firms preset their product prices in nominal terms, and keep them fixed for one production period only (say, one quarter), adjusting the scale of production to meet demand. The general principle is that firms will optimally choose the preset product price which maximizes their market value. Under the assumptions underlying our reference model (utility from consumption is logarithmic, disutility from labour effort is linear), this leads to a very simple and intuitive expression: the optimal preset price results from charging the equilibrium markup over *expected* marginal costs, i.e.

$$P_H = mkp \cdot E\left[MC_H\right] = mkp \cdot E\left[\frac{wage}{Z_H}\right] \tag{2}$$

where the marginal costs MC_H, are given by wage costs per unit of output (i.e. the nominal wage divided by productivity); and, by standard results in micro theory, the equilibrium markup *mkp* is a decreasing function of the elasticity of substitution across domestically produced varieties of the Home goods. As this price is fixed over the production period, the (ex-post) realized markup will obviously vary (inversely) with marginal costs.

To keep the analysis as straightforward as possible, I do not model policy trade-offs stemming from the coexistence of price and wage rigidities (as in e.g. Erceg et al. 2000; see also Galí 2008, chapter 6). I therefore posit that the labour market is competitive, so that the nominal wage rate moves proportionally with nominal consumption, hence with the monetary stance μ. The marginal costs can then be rewritten by linking them directly to our index of monetary stance

$$MC_H = \left(\frac{wage}{Z_H} \right) = \overbrace{\underbrace{\left(\frac{\mu}{Z_H} \right)}_{\text{productivity}}}^{\text{monetary policy stance}} \tag{3}$$

a property that will become central to our discussion of stabilization below.

The description of the model is completed with the characterization of the natural rate of employment (or output), that is, the employment (output) rate if all prices were flexible. In the absence of nominal rigidities, each firm would maximize current profits by charging the equilibrium markup over current marginal costs:

$$P_H^{flex} = mkp \cdot MC_H = mkp \cdot \frac{\mu}{Z_H} \cdot \tag{4}$$

This expression differs from the case of nominal rigidities because all fluctuations of nominal marginal costs affect prices ex-post. Substituting the definition of μ, the production function $Y_H = Z_H \ell$, and re-arranging, yields the result that the natural level of employment, ℓ^{nr}, is constant:

$$\ell^{nr} = \frac{1}{mkp} \tag{5}$$

In the long run, ℓ^{nr} is decreasing in the degree of monopoly power of domestic firms. As goods become better substitutes, or regulation and competition policy reduces average markups in the economy, the natural rate of employment and output rise. At business cycle frequencies, the natural rate of output obviously fluctuates with productivity, i.e. $Y_H^{nr} = Z_H \ell^{nr}$.

3.2 Efficient monetary stabilization

The above expressions provide the key elements to analyze, in a stylized way, the macroeconomic implications of random fluctuations in current and future productivity, and the optimal policy response to stabilize the economy. Consider how current productivity shocks are transmitted to the economy (demand shocks will be discussed below). 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 the 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, firms satisfy the current demand using less productive inputs. The positive productivity shock opens a positive *output gap*: employment and output fall short of their natural rate, i.e. their equilibrium value in a flexible price allocation.

In response to an unexpected increase in productivity, however, monetary authorities *can* improve welfare by expanding aggregate demand, up to the level of output if prices were flexible. In other words, at given prices, a sufficiently large monetary expansion can close the output gap described above, preventing any fall in employment relative to the flex-price equilibrium. Observe that, by raising the monetary stance in response to a positive productivity shock (and contracting it in response to a negative shock, as to rule out over-heating and excessive employment), a country's monetary authorities can completely stabilize marginal costs in nominal terms. Provided that they have enough information on current productivity, they can do so by setting monetary policy such that nominal marginal costs are constant during the period:

$$MC = \frac{\mu}{Z_H} = \Gamma \tag{6}$$

If the above holds, i.e. if private agents expect the central bank to credibly pursue rules such that $\mu = Z_H \Gamma$, optimal prices would remain constant in nominal terms also in the absence of nominal rigidities, as there would be no difference between the expressions (4) and (2). By pursuing monetary rules satisfying the above condition, the monetary authorities make nominal rigidities inconsequential as regards the equilibrium allocation, in the sense that in each period the sticky price allocation coincides with the flex-price allocation. The economy operates at the natural rate.

Observe that (6) requires a central bank to commit to (a) align aggregate demand with productivity, responding within each period to current productivity fluctuations; and (b) keep the price level along a predetermined path, indexed by Γ. By way of example: a credible inflation target of 2 percent would translate into a growth rate of prices at the constant rate $\frac{\Gamma_{+1}}{\Gamma} = 1.02$ (see Adao et al. 2005 for an analysis of determinacy).

For the simple economy specified above, it is easy to show that policies implementing the flex-price allocation also maximize welfare, i.e. the expected utility

of the representative agent. While this result does not hold in more general models, the literature has nonetheless produced several examples of economies where a natural-rate policy would not produce appreciable losses relative to the optimal policy.

3.3 Interest rates and demand stabilization

In the language of traditional models of stabilization, the optimal policy condition characterized above prescribes central banks to 'lean against the wind of excess demand (opening output gaps).' This section elaborates on this point. Specifically, after substituting the optimal policy condition (6) into the dynamic demand equation, that is,

$$\frac{1}{\Gamma Z_H} = \beta(1+i)E\left(\frac{1}{\Gamma_{+1} Z_{H,+1}}\right), \tag{7}$$

one can derive the interest rate corresponding to the implementation of the optimal stabilization policy[3]

$$i = -\ln\beta + \ln\frac{\Gamma_{+1}}{\Gamma} + E\ln Z_{H,+1} - \ln Z_H + \frac{1}{2}Var\ln Z_{H,+1} \tag{8}$$

This expression suggests a different way to state the main conclusion of the analysis in the previous subsection. Namely, given the path of price levels Γ to which the central bank commits when it defines inflation targets at different horizons, and holding expectation of future productivity constant, the natural rate of interest falls with current productivity gains — which, in the absence of a contingent optimal reaction by monetary authorities, would open a positive output gap. It raises with anticipated productivity growth.

It is important to understand that condition (6) prescribes monetary authorities to respond efficiently not only to current productivity shocks, but also to current

[3] Taking logs of the expression in the text and rearranging, yields the nominal interest rate implicitly defined by the optimal policy condition:

$$i = -\ln\beta + \ln\frac{\Gamma_{+1}}{\Gamma} + \ln\frac{1}{Z_H} - \ln E\left(\frac{1}{Z_{H,+1}}\right).$$

The expression in the text follows from assuming that shocks are log-normally distributed.

aggregate demand disturbances. To see this point most clearly, suppose that in some periods private agents become more optimistic, or pessimistic, about the future state of the economy. Specifically, they receive an informative signal about the level of productivity one period ahead, which can be expected to be either high or low. This is a type of expectations shocks which is reminiscent of traditional Keynesian theory, where movements in the so-called autonomous components of spending for consumption and investment are driving forces of business cycle fluctuations.

For a given path of prices (the *Γ's*) and interest rates over time, the expressions (1) and (7) make it apparent that fluctuations in expectations of future productivity translate into fluctuations in future incomes and consumption demand C_{+1}; in turn (holding current interest rate fixed) this moves current real aggregate demand *C* away from the natural rate. For instance, given Γ_{+1} and *i*, optimistic expectations raise demand above natural output, opening a positive output gap.

A central bank implementing optimal rules $\left(\mu = \Gamma Z_H\right)$ however would systematically and completely stem any excess demand on current resources, including those driven by anticipation of future growth. Under the optimal monetary regime, the nominal rate indeed rises with $E \ln Z_{H,+1}$, causing households to postpone optimally the spending plans they would have pursued in response to optimistic expectations, had the nominal rate been left constant. Without investment and international borrowing, whether or not private expectations turn out to be correct ex post is utterly inconsequential for the evolution of the economy. Given the optimal rule, in the next period the policy stance will be such that households again consume the efficient level of output.[4]

Note that, in addition to signals about future average productivity, current demand would also fluctuate inefficiently with uncertainty about future productivity, i.e. with changes in the variance term in (8). Monetary authorities are obviously required to stabilize fluctuations in demand also when these are driven by perceived uncertainty.

An observation on the so-called zero bound problem is in order before closing this section. As is well known, according to (8) the implementation of optimal stabilization policy may at times require that nominal interest rate be negative, if the economy is hit by a sufficiently large negative shock to, say, expected productivity growth. In such circumstances, the implementation of optimal stabilization rules would be constrained by the fact that nominal rates cannot fall below zero. Holding

[4] The presence of capital as productive input and investment shocks do not necessarily modify this conclusion — see for instance Bergin and Corsetti (2005).

the price level target constant, monetary authorities would not be able to keep efficient control of aggregate demand.

4 The costs of losing monetary autonomy

It is well understood that a welfare-optimizing central bank in a monetary union should react to the average cyclical conditions of the 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'. To the extent that it translates into insufficient stabilization, the costs of monetary union are clearly akin to the costs of the business cycle.

Since insufficient stabilization of national cycles is a dimension of the cost from monetary unification which has received a very large share of attention in the debate, it is useful to start our analysis by focusing sharply on it, before moving to other dimensions.

4.1 Heterogeneous monetary union and the welfare costs of the business cycle

The main inefficiencies from insufficient stabilization can be characterized in terms of relative price distortions, translating into a suboptimal level of output and consumption. According to the model discussed above, if the central bank does not stabilize marginal costs completely, at national level demand does not fall optimally when productivity is low: with preset prices, these turn out to be too high relative to factor costs, and firms supply too much relative to the flex-price level of output. Conversely, when productivity is high, demand does not rise enough: product prices are too low relative to factor costs, and firms supply too little relative to the flex-price allocation. It follows that, with insufficient stabilization, average output will fall short of its flex-price counterpart.

To derive these results formally, set for simplicity $\Gamma=1$ and

$$\mu = Z_H^{\xi}, \qquad 0 \leq \xi \leq 1 \tag{9}$$

When $\xi<1$, stabilization is incomplete: demand varies too little relative to productivity, translating into positive or negative output gaps. 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[5]

$$E\left[\frac{\mu_{(\xi<1)}}{Z_H}\right]=\Gamma E\left[Z_H^{\xi-1}\right]>\Gamma. \tag{10}$$

For any given average monetary stance, the lower the extent of stabilization, the higher the preset product prices. Now consider the limiting case ξ=0, when 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. Holding μ constant, it is easy to see that higher prices translate into a lower constant level of consumption and output as $C_H = Y_H = \mu / P_H$ (see also the discussion in Section 9 on related results when price setting is staggered).

The property of recent monetary models just discussed should be properly emphasized: with nominal rigidities, incomplete stabilization affects average prices, consumption and output in equilibrium. For standard parameterization, average prices will be too high, average output and consumption of Home goods (as well as average wages) will be too low relative to the flex-price benchmark. Observe, however, 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.[6]

[5] Technically, the inequality above follows as a straightforward implication of Jensen's inequality.

[6] In joint work with Bergin, I show that models including both firms' entry and nominal price rigidities confirm the main result of this section, namely, 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.

What is the cost of inefficient stabilization in terms of welfare? As already mentioned, this will simply coincide with the cost of inefficient business cycle movements. To see this most clearly, assume that Z_H is lognormally distributed. In our model, with utility from consumption being in log form, i.e. $\ln C = \ln \frac{\mu}{p}$, the loss in expected log consumption due to incomplete stabilization — denoted ΔW — can be written as follows: [7]

$$\Delta W = \frac{1}{2}(1-\xi)^2 Var \ln Z_H \tag{11}$$

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 identically equal to zero. If $\xi < 1$, instead, expected utility will be decreasing in the variance of the shock.

Not surprisingly, expression (11) is very close to the formula expressing the costs of business cycles in the seminal contributions by Lucas (1987, 2003).[8] Indeed, many

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[7] Define welfare with flexible prices (or in a fully stabilized economy) W^{flex} as

$$W^{flex} = E \ln \mu - E \ln P^{flex}$$

$$= E \ln \mu - E \ln \frac{\mu}{Z_H} + \text{constant.} = \text{E} \ln Z_H + \text{constant}$$

Consider now the case of sticky prices under the assumption $\mu = Z_H^{\xi}$

$$W^{sticky} = E \ln Z_H^{\xi} - E \ln E\left(\frac{Z_H^{\xi}}{Z_H}\right)$$

$$= \xi E \ln Z_H - (\xi - 1) E \ln Z_H - (\xi - 1)^2 * 0.5 * Var \ln Z_H$$

$$= E \ln Z_H - (\xi - 1)^2 * 0.5 * Var \ln Z_H$$

The expression in the text is the difference between the two.

[8] 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 the calculations above, full stabilization completely closes the output gap, ensures that employment is at its flex-price rate, and lets 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. Somewhat

models currently used in the design and assessment of monetary stabilization policy share this very feature. As in Lucas, back-of-the-envelope calculations of the order of magnitude of the welfare costs of insufficient stabilization lead to very small estimates. To wit: 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.[9] Adding some preference shocks to the model may marginally raise this estimate, but not substantially so.

Not only these numbers are strikingly low: remarkably, the above estimates actually provide an upper bound to the welfare losses due to insufficient stabilization in a common currency, derived for the case in which domestic productivity shocks have no common component across countries, i.e. they are purely idiosyncratic.[10] The parameter ξ above can be interpreted as the weight assigned by a common central bank to the stabilization of the output gap in country *H*.

Sure enough, the issue of assessing the (welfare) costs of the business cycle is far from being settled. The literature provides examples of frictions and inefficiencies which can raise their assessment relative to Lucas' estimates. In addition, low aggregate welfare losses may correspond to large losses for some group in the society. Yet, the main message of this section is apparent.

The analysis suggests a close link 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 sceptical about the former, he/she must be sceptical about the latter.[11] It is worth noting, here, that similarly sceptical views of the welfare costs

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paradoxically, it is incomplete stabilization which makes consumption 'smoother' relative to a flex-price economy, but suboptimally so. At the same time, it induces excessive volatility of employment.

[9] 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 (see Ghironi and Melitz 2005, Corsetti, Martin and Pesenti 2005, among others).

[10] 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. Similarly, it is well understood that the cost of joining a currency area will not be symmetric. For instance, ceteris paribus, it will 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.

[11] In the discussion of this paper during the conference EMU@10, many voiced the widespread opinion according to which the costs of the business cycle is larger than predicted by most standard models — a concern that has motivated quite a bit of theoretical and empirical work. Unfortunately, none of the contributions mentioned in the discussion succeeds in accounting for more than a marginal upward revision of the standard calculation. The literature may eventually provide convincing models

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)).

4.2 Country-specific monetary 'noise'

So far, we have discussed the implications of a single monetary policy in terms of insufficient domestic stabilization. However, from the vantage point of a country whose business cycle is not synchronized with the rest of the union, a common monetary policy also generates destabilizing 'monetary noise'.

For this reason, a common currency could potentially be more consequential for national welfare than suggested above. Accounting for monetary noise, rewrite expression (9) as follows

$$\mu = \Gamma Z_H^{\xi} \Omega_H$$

where Ω_H indexes changes in the union-wide monetary stance which are unrelated to the Home country's fundamental Z_H. This new variable captures policy decisions by the common central bank, in response to average fundamentals in the currency union. If Z_H and Ω_H are independently lognormally distributed, the welfare costs of joining a monetary union become[12]

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predicting large average welfare losses from the business cycle. It is worth stressing that, in this case, it would still be important to verify that the welfare gap between monetary union and national currencies is correspondingly large.

[12] To wit:

$$\begin{aligned} W^{sticky} &= E\ln\mu - E\ln E\left(\frac{\mu}{Z_H}\right) = \\ &= E\ln\Omega_H + \xi\ln Z_H - E\ln\left(\Omega_H Z_H^{\xi-1}\right) - 0.5\cdot Var\left(\ln\Omega_H + (\xi-1)\ln Z_H\right) \\ &= E\ln\Omega_H + \xi\ln Z_H - E\ln\Omega_H - (\xi-1)E\ln Z_H \\ &\quad - 0.5\cdot\left[Var\ln\Omega_H + (\xi-1)^2 Var\ln Z_H\right] \\ &= E\ln Z_H - 0.5\cdot\left[Var\ln\Omega_H + (\xi-1)^2 Var\ln Z_H\right] \end{aligned}$$

$$\Delta W = 0.5.\left[Var \ln \Omega_H + \left(1-\xi\right)^2 Var \ln Z_H \right] \quad (12)$$

Welfare losses are obviously higher than (11). However, to the extent that monetary authorities follow optimal rules, Ω_H reflects some weighted average of country-specific domestic productivity shocks in the union as a whole. Thus, in the expression above, the magnitude of the two terms in square brackets cannot be very different. It follows that 'monetary noise' due to lack of business cycle synchronization in a monetary union can hardly raise the order of country-specific welfare losses, relative to our assessment of the costs from incomplete stabilization.

4.3 Monetary instability and the advantages of joining a disciplined monetary union

An important observation suggested by expression (12) is that a highly unstable monetary policy could potentially produce large welfare losses, up to dwarfing the costs of insufficient stabilization. The point is that the variance of Ω_H can rise substantially in the presence of noisy behaviour by central bankers, and/or monetary instability due to fiscal or financial instability.— in more general specification of the model, the size of welfare losses will be sensitive to the degree of risk aversion of the representative agents, which magnifies the effects of non-fundamental nominal volatility.[13]

The strong welfare implications of an unstable monetary policy back a well-known argument which, historically, has played an important role in the political process towards the creation of the European monetary union. Namely, countries that are unable to adopt a stable monetary framework (for a variety of reasons) are bound to gain the most from joining a union that guarantees monetary and fiscal discipline.

As monetary instability plausibly reflects a weak macroeconomic and/or political framework, however, assessing these gains requires a careful specification of what prevents national monetary authorities from following optimal rules consistent with the analysis in Sections 3 — a task beyond the goal of this text.

[13] It is worth noting here that the assumptions underlying the baseline model above actually rule out costs of monetary shocks via mispricing of goods and services: optimally preset prices do not depend on the variance of monetary policy. For more general specifications of preferences and technology, however, a noisy conduct of monetary policy would also affect average prices.

5 Adding the costs of giving up exchange rate flexibility

Having clarified some basic ideas about the costs of losing monetary autonomy, the next step consists of reconsidering the second element of OCA theory — the consequences of giving up exchange rate flexibility — using a fully-fledged model of international macroeconomic interdependence. What follows will briefly describe the main elements of a general equilibrium, two-country, choice-theoretic stochastic model with nominal rigidities and imperfect competition in production.

5.1 A model with trade and international interdependence

Consider a model of macroeconomic interdependence consisting of two countries, Home and Foreign, denoted by *H* and *F*, each perfectly specialized in 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, which may take the following form:

$$C = C\left[C_H, C_F, C_N\right] = \left[C_H^{\alpha} C_F^{1-\alpha}\right]^{\gamma} C_N^{1-\gamma} \tag{13}$$

where C_H, C_F and C_N denote consumption of Home tradables, Foreign tradables and Home nontradables, respectively. Note that, in the model I use to develop my arguments, 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 - γ, 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 - α. Foreign consumption is similarly defined

$$C^* = C^*\left[C_H^*, C_F^*, C_N^*\right] = \left[\left(C_H^*\right)^{1-\alpha}\left(C_F^*\right)^{\alpha}\right]^{\gamma}\left(C_N^*\right)^{1-\gamma} \tag{14}$$

where an asterisk denotes foreign variables. Comparing the two expressions above shows that preferences over tradable goods are assumed to be asymmetric across countries: national representative consumers assign the same weight α to the goods produced in the country where they live. If α > 1/2, preferences for tradables have a 'home bias'. Preferences for consumption are in log form and additive separable in labour — the disutility from labour effort ℓ is linear (as in the previous section). I again abstract from investment and government consumption.

In the economy, labour is employed in the production of tradables and nontradables. We therefore have four measure of labour productivity, each subject to shocks that are country- as well as sector- specific: Z_H, Z_N, Z_F, Z_N^* denoting productivity in the Home tradable sector, the Home nontradable sector, the Foreign tradable sector, the Foreign nontradable sector, respectively. Labour is immobile across borders.

Let P_N, P_H and P_F denote the Home prices of nontraded goods, Home produced traded goods, and Foreign produced traded goods; P_N^*, P_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) combine the prices of domestic goods and imports

$$P = P\left[P_H, P_F, P_N\right] \qquad P^* = P\left[P_H^*, P_F^*, P_N^*\right] \tag{15}$$

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.[14] As mentioned above, this means that the model leaves no room for improvements in welfare through the development of financial markets — an issue often discussed in reference to Optimal Currency Areas.

With efficient consumption risk sharing, exchange rate determination is straightforward. As is well known, perfect consumption insurance implies that the growth rates of marginal utilities are equalized across countries in Purchasing Power Parity (PPP) terms. As our two countries are perfectly symmetric ex ante, in the stylized model I am using in this paper this condition means that wealth and consumption are always equalized in nominal terms across countries:

$$PC = \mathcal{E}P^*C^*. \tag{16}$$

As explained above, it is convenient to define nominal demand as a synthetic indicator of domestic monetary stance — whatever the instruments used by the

[14] 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.

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

$$\varepsilon_t = \frac{\mu}{\mu^*} \tag{17}$$

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

5.2 Nominal rigidities and the local currency price stability of imports

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. The literature has emphasized that the macroeconomic allocation will depend crucially on this elasticity (e.g. see Corsetti and Pesenti 2005a).

Several contributions have emphasized the radically different macroeconomic implications of two alternative hypotheses, 'Producer Currency Pricing' (PCP) versus 'Local Currency Pricing' (LCP). 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:

$$\begin{aligned} P_F^* &= mkp \cdot E\left(MC_F^*\right) \\ P_F &= P_F^* \cdot \varepsilon \end{aligned} \tag{18}$$

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. Nominal rigidities do not prevent flexibility of import prices, in response to shocks which appreciate or depreciate the currency. Observe that the law of one price holds exactly, because of the assumption that demand elasticities are identical in the two national markets.

'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:

$$\begin{aligned} P_F^* &= mkp \cdot E\left(MC_F^*\right) \\ P_F &= mkp \cdot E\left(MC_F^* \cdot \varepsilon\right) \end{aligned} \tag{19}$$

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 $P_F \neq \varepsilon P_F^*$.[15]

The macroeconomic effects of a given monetary policy rule vastly differ depending on export pricing behaviour. To see this most clearly, rewrite the prices of Foreign goods in the home market expressing marginal costs in terms of the two indicators of monetary stance μ and μ^*, and productivity. In the case of PCP, we have:

$$\frac{P_F}{\varepsilon} = mkp \cdot E\left[MC^*\right] = mkp \cdot E\left[\frac{\mu^*}{Z^*}\right]. \tag{20}$$

In each period, Home import prices in the Home currency vary one-to-one with movements in the exchange rate induced by Home monetary policy. A domestic monetary expansion results into a higher nominal price of Foreign goods in the Home market (and a correspondingly lower nominal price of Home goods in the Foreign market). These price movements redirect global demand towards Home goods, and away from Foreign goods: exchange rate movements have 'expenditure switching effects'. Yet, as apparent from the above expression, when expressed in *Foreign*

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

currency Foreign prices are totally independent of Home monetary policy. Indeed, under PCP, perfect pass-through implies that Foreign firms' unit revenue and marginal costs are completely insulated from the Home monetary stance.

Policy trade-offs are potentially different in the LCP model. In this case, a Home nominal depreciation following a Home monetary expansion has no expenditure switching effects: relative prices faced by consumers are preset. It does however lower the revenues Foreign firms earn on each unit of goods sold in the Home market: a Home currency depreciation worsens the Foreign country's terms of trade. Thus, it is not surprising that preset import prices in Home currency do depend on Home monetary policy.

$$P_F = mkp \cdot E\left[MC_F^* \cdot \varepsilon \right] = mkp \cdot E\left[\frac{\mu}{Z^*} \right] \tag{21}$$

In other words, the policy pursued by Home monetary authorities directly affects optimal export pricing by Foreign firms. For the very reason studied in the previous section, exchange rate volatility that is unrelated to Foreign productivity fluctuations will translate into higher import prices in the Home country.

5.3 From macroeconomic analysis to policy assessment and design

One of the most appealing features of the model is its tractability for welfare analysis. Thanks to well-educated assumption on preferences and technology, in a rational expectations equilibrium the expected utility in any given period can be approximated by looking at expected log consumption only:

$$W = E \ln\left[C \right] \tag{22}$$

This is clearly not general. However, the model captures essential policy trade-offs at the core of the stabilization debate, as well as the focus of this contribution. 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:

$$
\begin{aligned}
W &= E\{\ln \mu - \ln P\} \\
&= E\{\ln \mu - (1-\gamma)\ln P_N - \gamma\alpha \ln P_H - \gamma(1-\alpha)\ln P_F\} + \text{t.i.p.}
\end{aligned}
\tag{23}
$$

where t.i.p. stands for terms independent of policy. The corresponding expression for the Foreign country is:

$$
\begin{aligned}
W^* &= E\ln\left[C^*\right] = E\{\ln \mu^* - \ln P^*\} \\
&= E\{\ln \mu^* - (1-\gamma)\ln P_N^* - \gamma(1-\alpha)\ln P_H^* - \gamma\alpha \ln P_F^*\} + t.i.p.*
\end{aligned}
\tag{24}
$$

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).[16]

Optimal stabilization policies are fully characterized by solving the problem of two national monetary authorities whose objective is to maximize domestic welfare, assuming that these authorities can commit to policy rules and these are perfectly credible. I comment on these conditions below. As the optimal policy varies depending on the international arrangements between the two authorities, I consider three regimes. The first is the *Nash equilibrium*: the two authorities act independently of each other, each setting the domestic monetary stance taking the monetary stance abroad as given; the second is *international policy coordination*: the two authorities maximize a joint welfare function; the third is *monetary union*, which is different from coordination in that there is only one monetary instrument, so that $\mu = \mu^*$.[17] To characterize optimal policies, I will study which monetary stance μ and μ^* maximizes the objective function given by (23) and (24).

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[16] It should be stressed here that, for simplicity, the analysis ignores utility or other gains from liquidity services. The analysis thus abstracts from considerations that could make it optimal to follow the Friedman rule (see Adao, Correia and Teles 2003).

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

$$Max_{\mu} EW$$

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

$$Max_{\mu^*} EW^*$$

taking μ as given. With international policy coordination, the joint problem is

$$Max_{\mu,\mu^*}\left[EW + EW^*\right].$$

In a monetary union, the problem is the same as above, subject to the constraint $\mu = \mu^*$.

6 At the root of the aversion to currency unions

A first set of results from our analysis sheds light on 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, when nominal rigidities prevent price flexibility in domestic currency. If exchange rates regulate international relative prices, giving up flexibility is obviously costly.

To revisit this fundamental critique of monetary unification, consider the model under the assumption of '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: $P_F = \mathcal{E} P_F^*$. In this case, the objective functions of monetary authorities are obtained by substituting (18) into the price index (15).

Nash equilibrium Consider first the case of two national authorities acting independently (the case of a Nash equilibrium). In this economy, each of them will find it optimal to stabilize a weighted average of marginal costs in the two production sectors of the economy (nontradable and tradable). As we have seen above that, with PCP, average import prices do not depend on domestic monetary policy, the optimal stabilization policy rules under commitment in the Home and Foreign country will take the form[18]

[18] Optimal policy stances satisfy:

$$1 = \frac{1-\gamma}{1-\gamma(1-\alpha)} \frac{\frac{\mu_{PCP,Nash}}{Z_N}}{E_{t-1}\left(\frac{\mu_{PCP,Nash}}{Z_N}\right)} + \frac{\gamma\alpha}{1-\gamma(1-\alpha)} \frac{\frac{\mu_{PCP,Nash}}{Z_H}}{E_{t-1}\left(\frac{\mu_{PCP,Nash}}{Z_H}\right)}$$

$$1 = \frac{1-\gamma}{1-\gamma(1-\alpha)} \frac{\frac{\mu^*_{PCP,Nash}}{Z^*_N}}{E_{t-1}\left(\frac{\mu^*_{PCP,Nash}}{Z^*_N}\right)} + \frac{\gamma\alpha}{1-\gamma(1-\alpha)} \frac{\frac{\mu^*_{PCP,Nash}}{Z_F}}{E_{t-1}\left(\frac{\mu^*_{PCP,Nash}}{Z_F}\right)}$$

$$\mu_{PCP,Nash} = \mu\left[Z_H, Z_N\right] \qquad \mu^*_{PCP,Nash} = \mu^*\left[Z^*_H, Z^*_N\right]. \tag{25}$$

This states that the optimal monetary policy is a function of domestic shocks only. 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). National central banks are only concerned with domestic policy trade-offs (Home monetary authorities do not respond to Z^*_N or Z_F): there is no 'international dimension' in monetary policymaking. The reason why with PCP policymakers are not concerned with foreign shocks is that, once optimal monetary rules are in place, the implied exchange rates fluctuations automatically move relative prices in the right direction, at no cost. For instance, any positive supply shock to tradables in the Foreign economy is matched by a foreign expansion, appreciating the Home currency. The exchange rate response lowers the relative price of Foreign tradables in the global economy, switching domestic and world demand towards Foreign output. This is exactly what would happen in a flex-price (efficient) equilibrium.

A common currency $\left(\mu = \mu^*\right)$ cannot be optimal in this environment. To see this, combine the expressions above, as to derive the equilibrium exchange rate conditional on implementing optimal monetary rules:

$$\frac{\mu_{PCP,Nash}}{\mu^*_{PCP,Nash}} = \mathcal{E} = \frac{\mu\left[Z_H, Z_N\right]}{\mu^*\left[Z_F, Z^*_N\right]}. \tag{26}$$

In general, there is no solution for $\mu = \mu^*$. The exception is the (obviously implausible) case of two identical economies where shocks are also perfectly symmetric 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. These costs are arguably falling in the correlation among shocks.

Observe that, because of sectoral asymmetries, similar considerations also apply 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.

Coordination If policy rules are jointly determined as to maximize the sum of welfare in the two countries, the fact that import prices in a country do not depend on the monetary stance in that country implies that 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. Yet optimal monetary policies will generally differ from the case of the Nash equilibrium, implying that there are gains from international policy coordination. Indeed, it can be shown that, in comparison with the non-coordinated case, monetary authorities react relatively 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 worsens the country's terms of trade, thus favouring consumers abroad: hence, the international spillovers from monetary policy are positive. In the Nash equilibrium, the Home monetary authorities ignore these spillovers when solving the policy problem: they react too little to shocks to nontradables. For this reason, it follows that, in general, gains from coordination do not provide an argument in favour of limiting exchange rate flexibility.

Monetary union As discussed in Section 4, a common currency imposes losses in national welfare, due to both insufficient domestic stabilization, and destabilizing monetary shocks. The fully-fledged model provides a better analytical characterization of 'monetary noise.' Consider a common central bank interested in maximizing an equally weighted average of Home and Foreign welfare. With a common currency the optimal monetary policy rule becomes a function of all shocks in the area:

$$\mu_{MU} = \mu\left[Z_H, Z_N, Z_F, Z_N^*\right] = \mu\left[\underbrace{\overbrace{Z_H, Z_N,}^{\text{Home output-gap stabilization}}}_{\text{Monetary noise in the Foreign country}} \quad \underbrace{\overbrace{Z_F, Z_N^*,}^{\text{Monetary noise in the Home country}}}_{\text{Home output-gap stabilization}}\right] \tag{27}$$

From the vantage point of the Home country, the common monetary policy stabilizes domestic output and marginal costs only to the extent that is driven by the first two terms on the right-hand side of this expression. Systematic policy responses to the last two terms translate into monetary noise — as already anticipated discussing (12). The opposite is true from the vantage point of the Foreign country.

7 Are there benefits from monetary autonomy when exchange rate movements do not stabilize international prices?

In the previous section, we have seen that at the root of the classical aversion to monetary union is a positive view of exchange rate movements, according to which exchange rate adjustment is driven by changes in economic fundamentals (in the model above, exchange rates move with relative productivity shocks), and regulates the global demand for a country's products (inducing expenditure switching effects).

However, the traditional view of international transmission has been strongly questioned by authors who cast doubts on the stabilization properties of the exchange rate. Namely, an important strand of the literature stresses 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 (see Corsetti 2008 for a survey). The observed local currency price stability of imports arguably reflects both real factors and nominal rigidities.[19] But 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 (they have no 'expenditure switching effect'). Actually, they tend to make the international transmission of monetary policy harmful ex-post: a Home depreciation worsens the Foreign terms of trade, raising equilibrium foreign labour for every level of Foreign consumption.

Nash equilibrium and coordination When both domestic and import prices are sticky (and preset in local currency), expected utility should be evaluated using import prices given by expression (20). As apparent from this expression, under LCP import prices depend on the domestic monetary regime. The behaviour of domestic monetary authorities influences expected marginal costs, thus average prices, charged by foreign exporters in the local market. It follows that the optimal domestic monetary policy will react also to productivity shocks abroad, in addition to domestic shocks, with an intensity that is increasing in the weight of imports in the national consumption basket:

[19] 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.

$$\mu_{LCP,Nash} = \mu\left[Z_H, Z_F, Z_N\right] \qquad \mu^*_{LCP,Nash} = \mu^*\left[Z_H, Z_F, Z^*_N\right] \qquad (28)$$

Relative to the PCP case,[20] optimal monetary policies are no longer 'inward-looking'. In this sense, as discussed in previous work with Pesenti (Corsetti and Pesenti 2005b), nominal frictions in local currency provide an argument in favour of an 'international dimension' in the optimal design of monetary policy rules. Also, relative to the PCP case, the fact that optimal policies now depend on shocks abroad make national monetary stances more symmetric. Symmetry in monetary stance in turn implies a lower volatility of the nominal exchange rate. This result is hardly surprising, given that with LCP exchange rate movements do not have any desirable effects on international relative prices, i.e. they are not associated with the 'expenditure switching effects' described in the previous section.

An important example As an extreme example, the literature has long noted that the policy reaction functions (28) actually become identical, if tradables are the only goods delivering utility (i.e., $\gamma \to 1$), *and* national consumers demand an equally weighted basked of domestic and foreign- produced goods, i.e. $\alpha = 1/2$ (see Devereux and Engel 2003 and Corsetti and Pesenti 2005a). Under these conditions, it can be shown that optimal stabilization implies no movement in exchange rates ($\mu = \mu^*$) for *any* distribution of the shocks, and irrespective of international policy coordination:

[20] To wit, optimal policy stances satisfy

$$1 = (1-\gamma)\frac{\frac{\mu_{LCP,Nash}}{Z_N}}{E_{t-1}\left(\frac{\mu_{LCP,Nash}}{Z_N}\right)} + \gamma\left[\alpha\frac{\frac{\mu_{LCP,Nash}}{Z_H}}{E_{t-1}\left(\frac{\mu_{LCP,Nash}}{Z_H}\right)} + (1-\alpha)\frac{\frac{\mu_{LCP,Nash}}{Z_F}}{E_{t-1}\left(\frac{\mu_{LCP,Nash}}{Z_F}\right)}\right]$$

$$1 = (1-\gamma)\frac{\frac{\mu^*_{LCP,Nash}}{Z^*_N}}{E_{t-1}\left(\frac{\mu^*_{LCP,Nash}}{Z^*_N}\right)} + \gamma\left[(1-\alpha)\frac{\frac{\mu^*_{LCP,Nash}}{Z_H}}{E_{t-1}\left(\frac{\mu^*_{LCP,Nash}}{Z_H}\right)} + \alpha\frac{\frac{\mu^*_{LCP,Nash}}{Z_F}}{E_{t-1}\left(\frac{\mu^*_{LCP,Nash}}{Z_F}\right)}\right]$$

$$\lim_{\gamma \to 1, \alpha \to 1/2} \varepsilon = \frac{\mu_{LCP,Nash}}{\mu^*_{LCP,Nash}} = \frac{\mu\left[Z_H, Z_F\right]}{\mu\left[Z_H, Z_F\right]} = 1 \tag{29}$$

In other words, under the conditions spelled out above, a fixed exchange rate is by no means an impediment to optimal stabilization. Whether or not the two monetary authorities act independently, monetary stances are symmetric, ruling out exchange rate variability altogether.

The main lesson to draw from the above example is that the stability of import prices in local currency in the form of LCP generally causes monetary authorities to dampen exchange rate volatility in equilibrium. Since exchange rate movements are not useful to correct relative prices, one can even build examples of economies in which these movements can be shut down altogether at no cost.

Conversely, a lesson which should *not* be drawn from the above example is that local currency pricing (and the implied absence of expenditure switching effects from exchange rate movements) provide a case against monetary autonomy and exchange rate flexibility. The stability of import prices in local currency *per se* does not imply that national central banks would find it optimal to stabilize the same weighted average of Home and Foreign marginal costs (thus prices), as to make optimal monetary policies symmetric.

First, stabilizing domestic and foreign costs in the tradable sector are not the only relevant policy trade-off faced by monetary authorities: a large share of domestic output consists of nontradables. Even if the consumption baskets of tradables were identical across border ($\alpha = 1/2$), shocks to the nontradable sector would break the symmetry in optimal policy — this is the essence of the critique of Devereux and Engel (2003) by Duarte and Obstfeld (2004).[21]

Second, and perhaps more fundamentally, many empirical contributions taking a microeconomic perspective on exporters' behaviour emphasize price discrimination and distribution over nominal rigidities, as the main determinants of the observed low elasticity of retail prices to the exchange rate (see Golberg and Verboven 2001). If low exchange rate pass-through cannot be attributed to nominal rigidities, the above results do not apply (Corsetti and Dedola 2005). Whether or not consumption baskets are identical, a fixed exchange rate would unduly constrain on the optimal conduct of stabilization policy.

[21] By the same token, in models with capital accumulation symmetry breaks down when shocks generate nation-specific investment dynamics.

8 A new perspective on an old debate: asymmetric shocks and the relative efficiency of a common monetary policy

In the literature on OCA, some authors (most notably, Krugman 1993) have argued 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 shock will also be region-specific, raising the stabilization costs of monetary unification. 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 (see the text after expression (26) above).

Now, the previous section has presented an admittedly extreme example at odds with Krugman's argument, that complete specialization raises the costs of monetary unification because of its implications for the scope and likelihood of asymmetric shocks. If (a) all goods are tradable, (b) tradable goods have the same weight in the consumption basket in the union, and (c) before monetary unification import prices are sticky in local currency, the exchange rate remains optimally fixed, even if countries are perfectly specialized and shocks are asymmetric. This is so, because Home and the Foreign monetary authority react to the same average of domestic and foreign shocks: optimal monetary policy in the union will do no worse than independent monetary policy at national level. In this sense, there is no cost in renouncing national currencies.

Which symmetry matters? On logical ground, these considerations show that production specialization and asymmetries in economic structures are not necessarily inconsistent with the comparative efficiency of a common currency. Observe that without nontradables and with symmetry in tradable consumption ($\gamma \to 1$ and $\alpha = 1/2$), 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. By way of example, setting the *value* of the union GDP equal to 1, each country produces half of it. 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. Under LCP, it is the breaking down of *this* symmetry that makes exchange rate flexibility an essential prerequisite for optimal stabilization policy.

Implications for endogenous OCA On empirical and historical ground, however, the above considerations also provide a new perspective on OCA. Building on the maintained hypothesis of 'local-currency pricing', the idea is that the relative performance of a currency union may improve with the emergence of similar consumption patterns across countries joining the union.

In a well-known contribution, Frankel and Rose (1998) build a case for 'endogenous currency areas' stressing that, even if countries joining a monetary union do not satisfy the conditions for an OCA, they may do so over time, as economic integration fosters intra-industry over inter-industry trade, reducing the extent of specialization in production. Taking the logic of the argument above a step further, one could build a totally different argument. Namely, countries joining a common currency lose nothing in terms of stabilization efficiency relative to a regime with independent monetary policies, even if a common currency leads to specialization in production and inter-industry trade. The key point is that economic monetary and economic integration must foster convergence in consumption patterns in the countries of the union.

Observe that this argument could shed some light on a long-lasting question in European monetary study, regarding the reasons why European policy leaders have traditionally shown a preference for fixed exchange rates at regional level. Based on the results above, a possible answer lies in a sceptical view about the role of exchange rates in adjusting relative prices among relatively open European countries, coupled with the observation that production and consumption patterns for Europe as a whole are not too different.

9 Extensions of the analysis and directions for future research

To conclude this text, it is appropriate to discuss briefly the implications for our analysis of different assumptions about nominal price rigidities, fiscal and monetary policy interactions, and the degree of development of financial markets.

9.1 Policy trade-offs when price adjustment is staggered

In the baseline model adopted in this text, prices are assumed to be predetermined and fixed during each production period, and simultaneously updated between periods. 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, to the extent that price adjustment is staggered, a correction of international relative price can only materialize over time, at the costs of price dispersion, which is well known to have important negative implications on efficiency. With staggered adjustment, positive inflation means that 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 fostering relative price adjustment *across types of goods (e.g. domestic versus foreign goods, and tradables versus nontradables)*, and its costs in terms of relative price distortions *within each category of goods* (see Corsetti et al. 2007).

Elaborating on this trade-off, recent contributions have elaborated on the principle that central banks should target inflation in those sectors/countries that have the highest degree of nominal rigidities. The reason is apparent. 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.[22]

The implementation of this principle is however more controversial than appears. Suppose that one can provide empirical evidence that the degree of nominal price or wage rigidity is higher in a particular country. Unless there are fundamental reasons to expect these rigidities to persist over time and be extremely costly to remove, increasing the weight of this country in union-wide policy making would possibly reduce the incentive to implement reforms that could in principle bring this economy in line with the rest of the union.

9.2 Fiscal and monetary policy interactions

An important policy conclusion from the traditional OCA theory is that monetary union challenges domestic policy makers to find alternative instruments of business cycle stabilization, or implement reforms that attenuate the adverse effects of cyclical

[22] Observe that the analysis of the Nash equilibrium in Section 6 (where import prices are flexible in local currency) and Section 7 (where import prices are sticky in local currency) can be interpreted as an application of the same principle.

shocks. These conclusions are still valid in the above analysis — it is indeed desirable to use additional policy instruments, such as fiscal policy.

In general, the stabilization properties of fiscal policy will depend on the fiscal instruments available to the government, the distortionary nature of taxation, and financial and nominal frictions affecting the transmission of demand and tax shocks. The macro literature has moved some steps towards more realistic and articulated models of fiscal stabilization, accounting for distortionary taxes and spending on useful public goods, and/or introducing liquidity constrained agents in general equilibrium models.

A key contribution to OCA theory in this respect is provided by Adao et al. (2006), a paper which, to a large extent, can be interpreted as a micro-founded reconsideration of the OCA literature, where the traditional focus on monetary policy is replaced by a novel focus on fiscal measures. These authors show that, if the government has enough tax instruments, including income and consumption taxes, there exists a fiscal regime with state contingent tax rates which support a flexible-price equilibrium independently of nominal rigidities and the exchange rate (monetary policy) regime. Intuitively, with enough instruments to affect all the relevant decisions margins for households and firms, fiscal policy can ensure that relative prices across countries and sectors, and the level of aggregate demand, are the same as in the (Pareto-efficient) allocation.[23] There is no meaningful monetary-fiscal interaction.

This paper thus provides an important benchmark for virtually all other studies on the subject, which typically proceed by (realistically) constraining the set of fiscal instruments available to the policymakers. In the same vein, in the rest of this section I briefly sketch an analysis of fiscal policy in a monetary union abstracting from state-contingent taxes on income and consumption, as an extension of the framework adopted in the text above (see Beetsma and Jensen 2005 and Galì and Monacelli (2005) among others). Suppose domestic government spending falls on useful public goods which provide utility to the representative consumer in the country, and that such spending is financed through lump-sum taxation. In a Pareto-efficient allocation, government spending should be higher in periods when productivity is also high, since it is efficient to produce more (private and public) goods in those periods. 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

[23] Interestingly, Adao et al. (2006) build an economy where lack of labour mobility across the border is by no means an impediment to optimal stabilization. Rather, it is a prerequisite to it, since optimal labour income and consumption taxes are not efficient if workers can arbitrage net wages across markets.

expansionary when productivity is high. These considerations suggest that monetary policy and fiscal policy should both be expansionary in response to a positive productivity shock.

In a monetary union, however, it is reasonable to expect that the correlation between these two policies be lower than in a regime of flexible exchange rates. Specifically, consider the optimal single monetary response to a positive productivity shock in the Home country. As this shock raises average productivity in the union as a whole, 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 a monetary union, therefore, the optimal policy mix differs at national level, requiring fiscal policy to be anti-cyclical depending on domestic conditions. In the countries experiencing positive productivity shocks, fiscal and monetary policy will both be expansionary. In the countries not experiencing these shocks, 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.

9.3 Financial issues

The analysis of fiscal policy sketched above is based on a model which abstracts from liquidity and/or borrowing constraints. In their presence, Ricardian equivalence no longer holds: spending and taxation policy can also have a direct effect on private consumption through disposable income. The analysis also abstracts from issues related to fiscal solvency and loss of seigniorage revenue, as well as from noisy behaviour in financial markets. Including these elements in a formal model would clearly enhance our understanding of the macroeconomic policy trade-offs in a currency union.

However, when focusing on fiscal and monetary interactions, it is important to keep in mind that increasing participation in financial markets and market

development has arguably relaxed the frictions underlying the traditional output multiplier process, stressed by the conventional analysis of budget policy. Deregulation and liberalization of financial markets may be expected to undermine the effectiveness of fiscal policy as a stabilization tool, consistent with the evidence provided by Perotti 2005, that multipliers tend to be lower after 1980s than before. The unwelcome implication is that, to the extent that monetary union enhances financial integration and development, fiscal stabilization correspondingly becomes less appealing as a substitute for monetary policy from an aggregate perspective[24] --- while of course it may still be quite powerful in correcting market distortions, or providing insurance for specific groups of agents with limited or no access to financial markets.[25]

In light of these considerations, a research agenda on the role of financial market development in monetary unions appears the most promising, and high-priority, area where to concentrate theoretical and empirical analyses on OCA. By eliminating currency risk and reducing transaction costs within the euro area, the introduction of the new European currency has arguably boosted European financial market integration. A core question is the extent to which enhanced opportunities to borrow and share risk through portfolio diversification achievable in a currency union can contribute to reduce the welfare consequences of the stabilization deficits (see e.g. Kalemli-Ozcan et al. 2005). A second related core question is the extent to which monetary and financial authorities in a common currency area can foster financial stability. The answer to these questions is particularly intriguing, as it is well understood that the transmission of shocks across countries and sectors can be fundamentally different across economies with different structures of financial markets (see Sutherland 2004).

Appropriately developed, these are chapters of the OCA theory which could provide substantial contributions to institutional and policy design.

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[24] As a caveat, even with integrated financial markets, financial turmoil and liquidity crises could cause temporary exacerbations of borrowing constraints, arguably improving the effectiveness of fiscal policy as an instrument of output stabilization. The social value of spending and taxation measures rises when cyclical fluctuations are rooted in financial stress which interferes with the normal functioning of credit markets.

[25] Another reason for scepticism on the role of fiscal policy is that countries have become much more open to trade, and monetary union is expected to foster trade integration even above global trends --- a point amply debated in the empirically controversy after Rose (2000), and also discussed in the text in relation to the convergence of consumption patterns. According to the received wisdom, increasing openness raises the magnitude of international spillovers from fiscal policy, while muting its effects on the demand for domestic output.

10 Conclusions

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.

The analysis in this paper reconsidered the foundations of traditional OCA theory in light of recent advances in monetary theory. The exercise sheds new light on two fundamental principles which shape conventional wisdom. First, aggregate welfare losses from monetary unification are found to be small — arguably smaller than the benefits from joining a disciplined currency area for countries without a stable and efficient macroeconomic policy framework. Current and future advances in the literature may of course refine our understanding of the transmission of shocks causing cyclical fluctuations, perhaps challenging the current conventional wisdom on welfare losses from lack of stabilization. Even so, it will still be necessary to verify the extent to which stabilization issues can outweigh other benefits from monetary unification.

Second, specialization in production and asymmetric cyclical shocks do not necessarily make a common monetary policy less efficient than nationally differentiated policies, for two reasons. First, exchange rate movements do not necessarily perform the stabilizing role envisioned by the traditional theory — this is the case when import prices are preset in local currency. In this respect, it is worth stressing that, historically, supporters of a European currency union have often shared a high degree of scepticism on the benefits from exchange rate flexibility. Second, and most importantly, monetary unification may foster processes of convergence in the composition of spending at national level. Convergence in spending patterns tends to make the policy stance which is optimal at regional level more symmetric across different regions in the union, even if regional shocks are uncorrelated and local production is specialized. Convergence of spending patterns emerges as a potential novel attribute of successful monetary unions.

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