CENTRE *for* ECONOMIC
PERFORMANCE

CEP Discussion Paper No 986

June 2010

Currency Unions in Prospect and Retrospect

J. M. C. Santos Silva and Silvana Tenreyro

THE LONDON SCHOOL
OF ECONOMICS AND
POLITICAL SCIENCE ■

E·S·R·C
ECONOMIC
& SOCIAL
RESEARCH
COUNCIL

Abstract
We critically review the recent literature on currency unions, and discuss the methodological challenges posed by the empirical assessment of their costs and benefits. In the process, we provide evidence on the economic effects of the euro. In particular, and in contrast with estimates of the trade effect of other currency unions, we find that the impact of the euro on trade has been close to zero. After reviewing the costs and benefits, we conclude with some open questions on normative and positive aspects of the theory of currency unions, emphasizing the need for a unified welfare-based framework to weigh their costs and gains.

Keywords: Currency union, Integration, Exchange Rage, Trade
JEL Classifications: F00, F02, F15, F31, F42

1 Introduction

What is the appropriate domain of a currency area? Robert Mundell (1961)'s seminal question is today as pertinent as ever. At the turn of the new millennium, twelve Western European countries instituted the euro as legal tender, delegating monetary policy to the European Central Bank (ECB). Cyprus, Malta, Slovakia, and Slovenia formally joined the euro area more recently, and a number of other states, including Andorra, Kosovo, Montenegro, Monaco, San Marino, and Vatican City, unilaterally adopted the euro as their sole currency.[1] Furthermore, a growing group, including Bulgaria, Hungary, and Romania, is currently negotiating accession, while others, among them Britain, Denmark, and Iceland, have maintained ongoing debates on the advisability of adopting the euro, particularly after the onset of the current financial crisis.

Moving South, six Gulf Cooperation Council countries originally planned to introduce a common currency, the Khaleeji, in 2010 but recently postponed its introduction, partly because of the financial crisis. Six members of the Economic Community of West African States have agreed to create a new common currency by the year 2015, and eleven members of the Southern African Development Community have agreed to adopt a common currency by 2018. Finally, and in a less tangible future, the East African Community plans to create a new common currency.[2]

This reshaping of the international monetary arrangement, actual or planned, has reinvigorated the theoretical and empirical debate over the wisdom of currency unions.

---

[1] They differ from the formal members in that they do not have a vote in the ECB.

[2] Details of the countries involved in these prospective currency unions are given in the Supplemental Table 1.

The case for joining a currency union rests on two main benefits. The first is the elimination of currency conversion costs and the disturbances in relative prices coming from nominal exchange rate fluctuations; lower transaction costs and greater predictability encourage deeper integration in goods and capital markets. This is the main benefit emphasized in Mundell (1961), as well as one of the main preoccupations of nineteenth century economists, as famously expressed by John Stuart Mill (1848):

> "So much of barbarism, however, still remains in the transactions of the most civilized nations, that almost all independent countries choose to assert their nationality by having, to their own inconvenience and that of their neighbours, a peculiar currency of their own."

Related to this point, Mundell (1961) also emphasized that a broader currency area reduces the scope for speculation and hence volatility in foreign exchange markets, as in thicker markets single speculators are less likely to affect exchange rates. This increases the value of money as a medium of exchange and likely leads to higher market integration.

The second benefit from joining a currency union is its potential to discipline policies, in particular to combat inflation, insofar as the anchor country (or the union's monetary authority) is better able to commit to monetary rules. The gain from commitment stemming from currency unions was recently emphasized by Alesina & Barro (2002).[3]

The main argument against currency unions, from the perspective of a member country, is the loss of independence to tailor monetary policy to local needs. There are, however,

---

[3]For earlier contributions, see Giavazzi & Giovannini (1989) and Alesina & Grilli (1992), who focused on the Barro & Gordon (1983) trade-off between commitment and flexibility of fixed versus flexible exchange rate regimes in the context of the European Monetary Union.

certain conditions under which this loss is relatively small, typically known as the optimum currency area (OCA) criteria.[4] Specifically, a currency union will tend to be less costly for countries that feature high comovement of economic variables vis-à-vis other countries in the union, as this increases the consensus over the direction of monetary policy (Mundell, 1961).[5] Similarly, a currency union will be less costly if there is a high level of labor mobility within the union, and/or high degrees of wage and price flexibility, as these conditions facilitate full employment, reducing the need for active policy (and, at the same time, they reduce the effectiveness of monetary policy, and thus the value of monetary independence—Mundell, 1961).

Furthermore, the cost of joining a union will tend to decrease with fiscal integration or, more generally, with the availability of public or private mechanisms to smooth out diverse shocks through regional transfers (Kenen, 1969); in the same vein, capital market integration will tend to lower the cost of joining, insofar as it allows countries to smooth consumption in the face of idiosyncratic shocks (Mundell, 1973, and Buiter & Sibert, 2008). A currency union will also tend to be less costly for a country with a high degree of sectoral diversification, as this will provide some insulation against a variety of shocks, avoiding the need for changes in exchange rates (Kenen, 1969). On a different line, joining a currency union may also be less costly for small, open (price-taking) economies—for which the prices of tradeables

---

[4]An "optimum currency area" refers to the geographical area over which it is optimal (in terms of welfare) to have a single or common currency, rather than separate or national currencies. (A long tradition in the literature has equated optimality with the achievement of three goals: full employment, domestic price stability and balance of payments equilibrium.)

[5]Others scholars, most notably Fleming (1971), have argued that ex-ante similarity in inflation rates among union members is also important for the sustainability of the union.

(both imports and exports) are flexible—because nominal exchange rates in this case become ineffective as a mechanism to affect terms of trade, and hence to restore external balance (McKinnon, 1963).

None of the OCA criteria in this non-exhaustive list is necessary or sufficient, and some may even seem mutually contradictory. For example, to achieve stabilization, Mundell (1961) emphasizes the importance of synchronization of shocks within a currency union, as it reduces the cost of the loss of monetary independence; by contrast, Mundell (1973) and Buiter & Sibert (2008) argue that asynchronous shocks can be beneficial in a currency union with integrated capital markets as they increase the scope for risk-diversification within the union. Similarly, while Kenen (1969) suggests that highly diversified (and presumably large) developed economies will be better suited to form a currency union, McKinnon (1963) argues that small, commodity economies will make ideal candidates. Furthermore, while Fleming (1971) argues that similarity in inflation rates is important, Alesina & Barro (2002) make the point that high-inflation countries may gain significantly from joining a currency union with committed low-inflation countries.

Moreover, the OCA criteria are likely to be affected once countries join the union, a point voiced, among others, by Mundell (1961) and Krugman (1993). The point was addressed empirically by Frankel & Rose (1998), who found that trade increases the synchronization of business cycles, and more directly tested by Alesina et al. (2002) and Barro & Tenreyro (2007), who find that currency unions affect the pattern of comovement of price and output shocks across countries.

While the theoretical arguments for and against currency unions are intuitively appealing and fairly well understood, a first limitation of the literature is that, until very recently,

there has been little progress in the empirical assessment of the gains and (particularly) the costs from joining a currency union. A second, perhaps more important, limitation is the regrettable lack of a unifying framework to weigh the various gains and losses from forming a currency union. A demanding critic could well say that the OCA theory is still now little more than an enumeration of non-commensurable criteria.

In the rest of the paper we discuss in more detail the various benefits and costs stemming from currency unions, and critically review recent empirical developments attempting to quantify them. In the process, we highlight some econometric problems in existing empirical work, and propose solutions where possible. A spin-off of this work is to provide a different assessment of the effect of the euro on different economic outcomes. In particular, and in contrast with empirical estimates of the trade effect of other currency unions, we find that the effect of the euro on trade has been close to zero. The differences can be potentially explained by the different characteristics of countries taking part in monetary unions other than the euro, typically very small and low-income economies. Our finding also stands in contrast with previous estimates of the effect of the euro on trade. As we show, these estimates tend to reflect the fact that euro-zone countries historically traded much more intensively than other groups; but there is little evidence that the introduction of the euro had a differential effect on trade among these countries when compared with other developed countries that are not in the euro zone. We conclude with a discussion of some open issues and a possible way forward for the theory of currency unions. Given space constraints, for some important issues pertaining to the gains and costs of currency unions, we will simply provide some of the leading references.

2 The Benefits

2.1 Increased trade

The main benefit from a currency area envisaged by Mundell (1961) was a trade increase stemming from the elimination of currency conversion costs and the possibly greater predictability of prices. Forty years later, Rose (2000) would present the first systematic attempt to quantify the effect of currency unions on trade.[6] Rose (2000) estimated that sharing a common currency increased bilateral trade between countries by over 200 percent. The result raised a not small amount of skepticism, and a large number of papers, including some by Rose, investigated the robustness of the initial finding. The literature spawned by Rose (2000)'s paper is too large for this review to be comprehensive, so we will just highlight the main issues that qualify the initial finding and discuss the conclusions generally drawn from this literature.[7]

2.1.1 The results of Rose and subsequent studies

The empirical work on the effects of currency unions on trade has been framed within the standard "gravity equation" model (for early references on the theoretical foundations of the

---

[6]There were a number of attempts to estimate the effect of exchange rate variability on trade, and the general consensus emerging from that literature is that there is only a small effect. See for example Frankel & Wei (1993), Eichengreen & Irwin (1995), Frankel (1997), Tenreyro (2007), and the references therein. For a more general theoretical investigation of the effects of fixed versus flexible exchange rate regimes, see Obstfeld & Rogoff (1995). Some scholars have argued, however, that currency unions go far beyond the elimination of exchange rate variability and that there should be a big discontinuity going from small variability to the certain and committed absence of exchange rate fluctuations.

[7]For a thorough review, see Baldwin (2006).

gravity equation for trade, see Anderson, 1979, Helpman, 1981, and Helpman & Krugman, 1985). The model states that the bilateral trade flow from country i to country j, denoted by T_{ij}, increases with the sizes of the countries (typically, proxied by their gross domestic product, GDP) denoted by Y_i and Y_j, and decreases with their distance, broadly construed to include all factors that create trade resistance, and collected in the vector x_{ij}.[8] The vector of costs x_{ij} is then augmented with a dummy variable, CU, indicating whether or not the countries share the same currency. To account for deviations from the theory, a multiplicative stochastic term η_{ij} with unit conditional mean, $E(\eta_{ij}|Y_i, Y_j, x_{ij}, CU_{ij}) = 1$, is included in the model, leading to

$$T_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} \exp(x_{ij}\beta + \gamma CU_{ij})\eta_{ij}, \tag{1}$$

where α_0, α_1, α_2, β, and γ are unknown parameters. The factor $\exp(\gamma)$ is the enhancement effect from sharing a common currency and is the main parameter of interest. Following a long tradition in the trade literature, Rose (2000) log-linearized equation (1) and estimated the parameters of interest by least squares using the equation

$$\ln(T_{ij}) = \ln(\alpha_0) + \alpha_1 \ln(Y_i Y_j) + x_{ij}\beta + \gamma CU_{ij} + \ln(\eta_{ij}), \tag{2}$$

which imposes $\alpha_1 = \alpha_2$, as in many theoretical formulations.[9]

To estimate the equation, Rose (2000) put together a large dataset with bilateral trade data for 186 countries for five years spanning 1970 through 1990. Subsequent work by Glick & Rose (2002) extended the coverage to 217 countries from 1948 through 1997.

---

[8] We interpret x_{ij} broadly here, to include (in a more complete specification) multilateral resistance terms, as in Anderson & van Wincoop (2003).

[9] The dependent variable used by Rose (2000) is the average of the two-way bilateral trade flows, instead of the unidirectional trade flows.

This estimation procedure implicitly makes a number of assumptions that have been questioned by subsequent work and which we discuss in turn.

Selection into currency unions There are basically two types of currency unions in Rose's data. One is a client-anchor arrangement in which typically small or poor nations adopt the currency of a large country. The second type of currency unions corresponds to multilateral unions.

As pointed out, among others, by Persson (2001) and Tenreyro (2002), these currency unions were not randomly formed. On the contrary, self-selection into currency unions is strongly hinted at by some distinctive features shared by countries that have been part of common currency areas during the pre-euro period, and included in Rose's dataset. Because of this self-selection, in general, the OLS estimates of γ in (1) cannot be given a causal interpretation. Indeed, in datasets of this nature, there is ample margin for the existence of uncontrolled systematic differences in characteristics between members and non-members of currency unions, which will be picked-up by the OLS estimate of γ.[10] For example, cultural and historical links may increase the propensity to form a currency union as well as strengthen trade links between two countries. Moreover, countries that decide to join a currency union might also be more likely to foster integration through other means, for example, by encouraging the harmonization of standards and by reducing regulatory barriers.[11]

---

[10] Rose (2000) also acknowledged this potential problem, but rejected its quantitative relevance by resorting to an instrumental-variable approach whereby the currency-union indicator was instrumented with inflation rates. These estimates were "implausibly bigger," in his own words, and the overall strategy was not very compelling.

[11] Other unobservable variables, such as market power, may have the opposite effect on the OLS estimates: higher levels of monopoly distortion in the economy may lead to higher inflation rates under discretion and

To address this issue, Persson (2001) employs a matching technique that controls for self-selection.[12] Using Rose (2000)'s data, he finds an increase in trade of between 13 and 66 percent, although the results are not statistically significant. In response to Persson's critique, Rose (2001) shows that a similar technique applied to a broader dataset yields statistically significant results, in the range of 21 to 43 percent.

An alternative strategy used in many studies, including Glick & Rose (2002), is to include country-pair fixed effects in the gravity equation; this inclusion reduced the currency union effect to about 100 percent.[13] These controls, however, may not completely eliminate the problem because a shift at some point in time in trade volumes may be related to a change in the propensity to use a common currency. For example, countries that historically broke with a currency union often saw their trade collapse due to independence wars followed by the deliberate adoption of protectionist policies (Thom & Walsh, 2002). To the extent that these unmeasured (or hard to measure) characteristics affect, or are correlated with, both the propensity to share a common currency and the volume of bilateral trade, OLS estimates of γ will not identify the causal effect of currency unions on trade. Indeed, Thom & Walsh (2002) found no effect in Anglo-Irish trade when Ireland abandoned the sterling peg in 1979;

thereby increase the need to join a currency union as a commitment device to reduce inflation. See Alesina & Barro (2002).

[12] See also Kenen (2002).

[13] Pakko & Wall (2001) also controlled for fixed effects in Rose (2000)'s dataset, finding no significant trade effect. As said, Glick & Rose (2002) use a broader dataset. Estimates of the same order of magnitude of Glick-Rose were found by Rose & van Wincoop (2001), who controlled for (time invariant) country-specific effects; see more below. Nitsch (2002) argued that most of the effect in Glick-Rose came from trade collapses after currency separations, while the effect from joining a currency union on trade was about 8 percent.

they stress that the Anglo-Irish case is a rare example of a long-established currency union breaking up in otherwise stable circumstances.[14]

Different ways of tackling the problems caused by self-selection into the currency unions are explored in Tenreyro (2002), who employs a standard Heckman (1979) selection model that controls for selection on unobservables, and in Alesina et al. (2002) and Barro & Tenreyro (2007), who use a three-step instrumental-variable (IV) approach. The first stage estimates the propensity that a country will enter a currency union with a main anchor; these results are interesting in their own right, as they elucidate part of the reason why countries adopt a foreign currency or join currency unions. The IV is then obtained by computing the joint probability that two countries, independently, adopt the same currency. The underlying assumption in the analysis is that there exist factors driving the decision to adopt a third country's currency that are independent of the bilateral links between any two potential clients. In other words, the basic idea is to isolate the motive that relates to third countries' currencies and use this motivation as an IV for whether two countries do or do not share a common currency. The general message from these regressions is that a currency union is more likely when countries speak the same language, are geographically close, and share former colonial links. In terms of client-anchor arrangements, a union is more likely when the client is poorer and smaller and the anchor is richer. The IV approach generated large estimates of the effect of currency unions on trade, comparable and in some case even bigger

---

[14]Fidrmuc & Fidrmuc (2003) found that the recent break-ups of currency unions in Central and Eastern Europe were followed by dramatic drops in bilateral trade, though they warn that the currency separation cannot be disentangled from the political disintegration, unlike the Anglo-Irish case. Nonetheless, De Sousa & Lamotte (2007) challenge their result and argue that the fall in trade was rather smooth.

than Rose (2000)'s, while the Heckman approach produced estimates in the order of 50 percent, though more imprecisely estimated, more in line with Persson (2001).

One criticism to all these studies, however, is that they do not appropriately control for possibly time-varying "multilateral resistance" terms in the gravity equation, a concept introduced by Anderson & Van Wincoop (2003) and emphasized by Baldwin (2006), who argues that properly controlling for time-varying fixed effects significantly reduces the currency-union effect. Another criticism is that most of these studies averaged two-way bilateral trade flows, instead of using the unidirectional trade flows suggested by theoretical models, thus ignoring bilateral trade imbalances, though it is not obvious in which direction this may affect the results.

Heteroskedasticity and zeroes in trade data   Most of the studies mentioned above resort to the common practice of taking logarithms to linearize the gravity equation as in (2), and estimate its parameters by OLS. Even in the absence of other problems, this procedure can generate substantial biases for two reasons.

First, in trade datasets, it is unlikely that the variance of η_{ij} in (1) will be independent of the countries' sizes and of the various measures of distance, x_{ij}. Since the expected value of the logarithm of a random variable depends both on its mean and on higher-order moments of its distribution, whenever the variance of the error term η_{ij} in equation (1) depends on the regressors, the conditional expectation of $\ln\left(\eta_{ij}\right)$ will also depend on the regressors, violating the condition for consistency of OLS. Santos Silva & Tenreyro (2006) find this to be a serious source of bias in practical applications of the gravity equation.

Second, as a result of the logarithmic transformation, pairs of countries for which bilateral exports are zero have to be dropped from the sample. In a typical dataset, this leads to the loss of over 30 percent of the data points. This massive sample selection, which is particularly problematic when one considers small or poor countries (such as the ones that have been clients in or part of multilateral currency unions in Rose's data), can cause additional biases in the estimation.

These two problems can be addressed by estimating the gravity equation in its multiplicative form. Specifically, Santos Silva & Tenreyro (2006) propose a pseudo-maximum likelihood (PML)[15] technique that is particularly well suited to the estimation of gravity equations, though it has not been applied to estimate the effect of currency unions.[16]

2.1.2 Trade effects of currency unions and the case of the euro

Despite the empirical issues raised in reaction to Rose (2000)'s original estimates, subsequent work by Rose or other scholars still found far from negligible effects on trade from pre-euro currency areas, and a consensus grew that currency unions indeed enhance trade, even if by less than initially estimated. Projections for the euro area were, however, hard to make because the euro zone (EZ) involved relatively richer countries that were already fairly integrated. So, time was needed to gauge the euro effect.

In a first attempt, Micco et al. (2003) conclude that the euro increased trade among EZ members by between 8 and 16 percent, when compared to other European Union (EU) members not using the euro, and by 4 to 10 percent, when compared to a broader sam-

---

[15]See Gourieroux et al. (1984).

[16]Helpman et al. (2008) offer an alternative way to deal with the presence of zeros. Their method, however, is heavily dependent on incidental distributional assumptions.

ple of developed countries. The authors used the gravity equation framework, estimating their models with data from 1992 through 2002, and including country-pair fixed effects in some specifications. Subsequent work on the euro effect, including Bun & Klaasen (2002, 2007), Flam & Nordstrom (2003, 2006), Baldwin & Taglione (2006), Baldwin et al. (2005), Gil-Pareja et al. (2008), and Baldwin (2006), among many others, have addressed various specification issues in Micco et al. (2003) (e.g., using unidirectional trade flows, post 1993 data,[17] etc.), generally confirming the positive effects of the euro on trade. The range of estimates for the euro effect goes from 2 percent in Baldwin (2006) to more than 70 percent in Gil-Pareja et al. (2008). For a comprehensive survey, see Baldwin (2006).[18] A notable exception to this trend is the work of Berger & Nitsch (2008), who find instead no significant effect.

Given the disparity of results, we think it useful to provide our own estimates of the euro effect. For that, we use a very simple differences-in-differences specification, comparing the exports of the so-called Euro-12 (Austria, Belgium-Luxembourg, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain) to those of similar groups of trading partners. In particular, we consider the following three control groups.

The first group includes only the countries that were part of the EU in 1999, but so far did not adopt the euro: Denmark, Sweden and the United Kingdom. Throughout, this control group will be referred to as EU15. This group of three countries is interesting because it

---

[17]Changes in statistical procedures introduce a break in the series in 1993.

[18]Work by Baldwin & Di Nino (2006), Flam & Nordstrom (2006), and Berthou & Fontagné (2008), investigated in particular the hypothesis that the euro has increased the number of goods that are traded (extensive margin), finding ample confirmation for this hypothesis.

only includes countries that are very similar to those of the Euro-12, but it has the drawback of being quite small.

In the second group, the set of countries is expanded by adding three other members of the European Economic Area (EEA): Iceland, Norway and Switzerland. This control group, which will be referred to as EEA, represents perhaps the best compromise between comparability with the treatment group and sample size.

The final control group sacrifices the degree of homogeneity to allow the use of an even larger sample. This is achieved by including five additional countries that were members of the Organisation for Economic Co-operation and Development (OECD) in 1993: Australia, Canada, Japan, New Zealand and the United States. This group will be labeled OECD93.

Before presenting estimates of the euro effect, it is interesting to graphically study the evolution of trade among the Euro-12 countries, and compare it with that of the countries in the control groups defined above. The data on exports used to construct these graphs are from the International Monetary Fund's Direction of Trade Statistics (IMF DOTS), and the data on GDP are from the OECD STAT database. Given the break mentioned before, our sample runs from 1993 to 2007.

Figure 1 shows the evolution of the exports of the Euro-12 countries to trading partners in the same group (depicted with circles) and to OECD93 countries (depicted with squares), both relative to the total GDP of the Euro-12. Additionally, the Figure also shows the exports from the eleven OECD93 countries to the members of this group (depicted with triangles) and to the Euro-12 countries (depicted with crosses), both relative to the total GDP of the OECD93 countries. All the series are normalized so that they equal 1 for the

first year of the sample. Similar plots for EEA and EU15 are presented as Supplemental Figures 1 and 2, respectively.

These figures suggest that, if there was a euro effect on trade, it was almost certainly small. Yet, applying the same estimation approach followed by Micco et al. (2003) on these data, would yield a strong and statistically significant effect of the euro (these results are available from the authors on request), a finding that at first is hard to reconcile with the graphical evidence.

With this conflicting evidence as a background, we approach the estimation of the euro effect on trade by considering an augmented gravity equation as in (1). However, we depart from previous studies on this topic by including in the model a dummy, labeled EURO-12 DUMMY, which identifies the "treatment group". That is, irrespective of the year, the EURO-12 DUMMY is equal to 1 for the pairs where both countries are part of the Euro-12 group. This dummy is included to control for possible unobservable systematic differences in characteristics between pairs of members of the Euro-12, and other pairs.

As in previous studies, the euro effect is measured by a dummy which is equal to one when, in the relevant year, both partners share the euro as their official currency. As before, this dummy is labeled CU, and is the main regressor of interest.

Finally, the model also contains a standard set of dummies capturing sources of trade resistance. Specifically, the model includes dummies indicating contiguity, common language and colonial ties, as in Santos Silva & Tenreyro (2006); a dummy for the existence of a free trade agreement (FTA) between the countries in the pair, constructed using information

provided by the World Trade Organization webpage;[19] as well as time-varying importer and exporter fixed effects, as suggested by Anderson & van Wincoop (2003). We also control for bilateral distance (computed using the great circle distance algorithm provided by Andrew Gray, 2004). However, rather than just including the log of the distance as a regressor, we allow the distance to have a more flexible effect by dividing it into its four quartiles and interacting the log of distance with dummies for each quartile.

Table 1 presents the main estimation results for the three samples defined by the different control groups. All estimates were obtained using the Poisson PML estimator of Santos Silva & Tenreyro (2006). The results for the standard gravity variables are as expected and the only remark to add is that indeed we find that the effect of log-distance is not linear. More interesting is the fact that we find the effect of the EURO-12 DUMMY, the regressor identifying the treatment group, to be strong and statistically very significant. This indicates that, even before the euro was created, the trade between the Euro-12 was already considerably stronger than between comparable countries, even those that were part of the EU.

As for the main regressor of interest, the estimates obtained for the coefficient of CU are small and not statistically significant at the usual 5% level. For the sample with the OECD93 control group, the coefficient of CU is only marginally insignificant, but the point estimate is actually negative, suggesting that bilateral trade between countries that adopted the euro has increased by less than trade among comparable countries not sharing the common currency.

---

[19]When the comparison groups are EU15 or EEA, the coefficient on this dummy is not identified because all countries are linked by free trade agreements during the period spanned by our sample.

Taken as a whole, the low t-statistics for the coefficient of CU, coupled with the variability of its estimates across the different samples, strongly suggests that the effect of the euro on trade was negligible.

In order to check the adequacy of the specification used, we performed RESET tests (Ramsey, 1969), as described in Santos Silva & Tenreyro (2006). The bottom line of Table 1 reports the p-values of the RESET tests for the three samples, neither of which provides evidence against the null hypothesis of adequate model specification. Although departures from it would have only minor consequences, we also checked the implicit assumption that the conditional variance of T_{ij} is proportional to the conditional mean, and again we were unable to reject the null for the three cases considered.

As a robustness check, we have also estimated models excluding CU, but interacting the Euro-12 dummy with dummies for the different years. These models, which also passed the specification tests described above, lead to results that are remarkably close to those reported in Table 1. In particular, the new dummy variables are generally not statistically significant, therefore providing no significant evidence of a euro effect.

In view of these results we conclude that, after controlling for the fact that the Euro-12 countries already traded much more intensively in the past, there is little evidence that the creation of the euro had an effect on trade. Although the methods used are quite different, our results reinforce those of Berger & Nitsch (2008), who also emphasized the need to account for the fact that the Euro-12 countries were already strongly integrated before the euro was created.

2.2 Increased capital integration

The trade increase from a common currency area envisaged by Mundell (1961) also concerned trade in assets. As many advocates of currency unions have argued, a common currency should foster deeper and more liquid financial markets, and possibly higher levels of cross-border investment (through equities and foreign direct investment, FDI), given lower transaction costs and the elimination of exchange rate risks.[20] More integrated financial markets should, in turn, increase the allocative efficiency of capital, and allow for higher diversification of shocks, mitigating their impact on consumption.

Measuring the effect of monetary unions on capital markets poses similar econometric challenges to those discussed in the previous Section. There have been, however, several recent attempts in the literature, mostly trying to assess the change in capital market integration with the advent of the euro. For a thorough analysis, see Japelli & Pagano (2008) and the comprehensive survey by Lane (2006).[21] The consensual findings are i) a swift integration of the EZ bond market following the introduction of the euro, with a sharp fall in yield differentials across member countries; ii) an increase in cross-border bond and equity holdings, as well as FDI activity among EZ countries. There is, nevertheless, a broad range of estimates of the euro effect. In the interest of space, we do not attempt to summarize the literature, but provide the reader with a set of plots that can give an indication of the magnitudes involved.

---

[20]See, among others, Martin & Rey (2004), Papaioannou & Portes (2008) and Lane (2006).

[21]For another excellent survey see Mongelli & Wylplosz (2008), and for more specific studies on the channels, see Baele et al. (2004), Kalemli-Ozcan et al. (2009), and Spiegel (2008).

Using the same groups defined before, Supplemental Figure 3 shows the holdings by Euro-12 countries of bonds issued by other Euro-12 countries, relative to the total GDP of Euro-12 countries. The series thus describes the holdings by the typical Euro-12 country of other Euro-12 countries' bonds relative to GDP. To provide a benchmark, the Figure also shows the holdings by Euro-12 countries of bonds issued by the eleven countries in the OECD93 group, relative to the total GDP of Euro-12 countries. For completeness, the Figure also displays the total holdings by the OECD93 countries of bonds issued by other countries of the same group, and by the Euro-12 countries, both relative to the total GDP of the OECD93 countries. All series are normalized to 1 for the first year of the sample. Similar plots for EEA and EU15 are presented as Supplemental Figures 4 and 5, respectively.

Supplemental Figures 6 to 8 depict the corresponding holdings of equity, and Supplemental Figures 9 to 11 depict the FDI outflows for the different bilateral combinations. Both for bonds and equity, the data are available in 1997 and then again annually from 2001 to 2007; the data come from the IMF's Coordinated Portfolio Investment Survey (CPIS). The data on FDI come from the OECD STAT database.

The Figures show a widening gap of cross-border holdings of bonds between pairs of countries in the Euro-12, vis-à-vis pairs of countries outside this group. There is a perhaps less striking, but still visible, increase in cross-border equity holdings among Euro-12 countries, as shown in Supplemental Figures 6 to 8. Finally, there seem to be relatively small changes in FDI activity among Euro-12 countries, when compared to other bilateral groups. The Figures suggest that there have indeed been important changes in capital markets coinciding with the introduction of the euro. As pointed out by Japelli & Pagano (2008), these changes in financial markets cannot be fully attributed to the use of a common currency;

the introduction of the euro has also triggered a parallel deregulation process that removed important barriers to trade in financial assets; the two effects are hard to disentangle empirically. Indeed, Alesina et al. (2008) argue more generally that common currencies are likely to pave the way to broader structural reforms that foster flexibility and deeper integration.

Somewhat surprisingly, however, the increased financial integration has not led to visible improvements in the diversification of risk, at least not when compared with other countries that are not part of the EZ (Caselli, 2008). This is roughly the conclusion from Supplemental Figure 12 which shows the standard deviation of consumption growth for Euro-12, EU15, EEA, and OECD93, relative to their corresponding values in 1993.[22] The general pattern is almost indistinguishable among these various groups. In terms of changes in allocative efficiency across countries, perhaps a good macroeconomic proxy is the level of GDP per capita. Gauged by this measure, see Supplemental Figure 13, there seems to be a slight jump in 1999 for Euro-12 countries, creating a gap with respect to EU15, but by 2006 the two groups are virtually back to the same relative position as in 1993. In other words, overall growth during 1993-2007 has been almost identical for the countries in the Euro-12 and EU15 groups.[23] The numbers are slightly more encouraging when compared to those in OECD93 or EEA. Judged by these macroeconomic indicators at least, deeper integration does not seem to have materially affected consumption smoothing or labor productivity growth in EZ countries differently than in non-EZ countries.

---

[22]This is measured as the standard deviation of quarterly growth rate over a moving interval of 7 quarters.

[23]Recall that the EU15 control group comprises three countries: Denmark, Sweden and the United Kingdom.

One conjectural explanation for the apparent lack of response of the real economy is that there is little scope for diversification among EZ countries, as their business cycles are highly synchronized; thus, Ingram (1962), Mundell (1973), and Buiter & Sibert (2008), have hypothesized that in terms of seizing the gains from deeper capital market integration, currency unions among highly unsynchronized countries may be more beneficial. A second conjecture is that, because nominal bonds issued by member countries can no longer vary with changes in nominal exchange rates, a common currency eliminates a potentially important source of risk-sharing across borders.[24] To the extent that consumption smoothing and GDP per capita are better indicators of welfare than the various measures of integration, the findings for the EZ do not seem to point to a clear improvement. But it may still be too early to judge.

2.3   Commitment Gains

A potentially important benefit from joining a currency union is a reduction in inflation rates, which is particularly relevant for countries that lack internal discipline and institutions that ensure a low-inflationary environment. In the jargon of Alesina & Barro (2002), by joining a monetary union with a credible anchor-country or set of countries, a client-country eliminates the inflation bias arising from time inconsistency in monetary policy (Barro &

---

[24]See Lane (2006) and Neumeyer (1998).

Gordon, 1983).[25] Countries with a history of high inflation, hence, ceteris paribus, have more to gain from joining a currency union, provided that low-inflation countries act as anchors.[26]

An earlier literature had stressed the need of similarity in inflation rates across countries in the union as one of the OCA conditions. In particular, Fleming (1971) argued that when inflation rates are stable and similar across countries, terms of trade will also remain stable, reducing the incidence of external imbalances and the need for nominal exchange rate adjustment. Indeed, this preoccupation was reflected in one of the conditions for accession established in the Maastricht Treaty: A country could join the union if its inflation rate was no higher than 1.5 percentage points above the three best-performing member states. This rule was supplemented with fiscal rules, given the obvious inflationary threats posed by large fiscal deficits and debts.

Given the Maastricht conditions, EZ countries had therefore narrowed their inflation-rate differentials many years before the actual launching of the euro, with the exception of Greece, which had to wait two more years to meet the criteria to join. After the launching of the euro, however, inflation-rate differentials increased, with Germany at the lower bound of the inflation range and Ireland at the upper bound. This is not surprising, and mostly reflects variation in the prices of less tradeable goods (particularly non-financial services). Differences in productivity growth (to some extent driven by catch-up effects), changes in competition leading to changes in mark-ups, and different exposure to external shocks and international

---

[25]See also Alesina and Stella (2009), who discuss the rules versus discretion arguments as well as other important institutional issues.

[26]Popular concerns in Germany about the loss of Bundesbank independence may suggest the union could bring a loss of commitment to previously stable countries. But at least the early evidence of the euro does not support these concerns.

trade outside the EZ, among others, can in principle explain why some countries within the union experienced higher levels of inflation (a Balassa-Samuelson effect usually the underlying channel). In all, the EZ performed very well. Some skeptics, however, have highlighted that its performance was not unusual for the period: the post 1993 era has witnessed very low inflation rates in all developed countries (Caselli, 2008). This is illustrated in Supplemental Figure 14, which shows that average inflation rates in the three comparison groups (EU15, EEA and OECD93) have been oscillating in a very narrow range since 1993. But one cannot reject the alternative, and more positive, view that the overall good monetary performance in developed countries has been itself an unexpected by-product of the introduction of the euro and its commitment to stability, which left behind beggar-thy-neighbour inflationary policies.

Whether or not similarity in inflation rates was needed as a pre-condition to join the euro is less clear; indeed, the argument in Alesina & Barro (2002) suggests that a key reason for countries with high-inflation records to join a union with credible anchors is the prospect of low inflation after entering the union. In the interest of space, we do not discuss here how the incentives to inflate of the union's monetary authority change as the size of the union increases. We refer the reader to Rogoff (1985), Barro & Tenreyro (2006), and the references therein.[27]

---

[27] We also refrain from discussing the vast literature on the conduct of monetary policy in a currency union (or more generally, under cooperation). Obstfeld & Rogoff (1995) should be an obligatory starting point.

3 The costs

The main cost of joining a currency union is the loss of monetary policy independence, and the consequent inability to react to shocks through exchange rate adjustments. Quantitatively assessing this loss, however, is an extremely difficult task, as there are many factors affecting the need and effectiveness of monetary policy as an adjustment instrument.

In what follows, we discuss the main factors emphasized in the literature. We note that all these factors (or OCA criteria) are endogenous and thus the conditions for optimality should not be the pre-currency union conditions, but rather the ex-post conditions, after the union is formed. We accordingly discuss, where available, the evidence on the effect of currency unions on the factors listed as OCA conditions. We also note that, in practice, even countries that could potentially let their exchange rates adjust to mitigate the impact of shocks (self-declared floaters), often display "fear of floating," and thus do not exploit the automatic stabilization properties of floating exchange rates (Calvo & Reinhart, 2002). This reluctance to use monetary policy in the face of shocks might be linked to its actual effectiveness or the need for it (other mechanisms may facilitate the adjustment and/or render monetary policy less effective) or, possibly, to wider considerations, such as impairing long-term credibility, or triggering beggar-thy-neighbor responses by trading partners, inducing excessive structural volatility in financial markets.

3.1 Similarity of Shocks and Inflation

In his 1961 paper, Mundell highlighted that the pattern of shocks was a critical determinant of the optimal size of a currency union. He defined "optimal" as achieving labor market

and external equilibrium and did away with the presumption that common currencies and national boundaries should coincide. He focused on a particular type of shock, a shift in demand away from the output of one region towards the output of another. (Region, in this case, is an area subject to the same shocks.) If each region had its own currency, a currency depreciation in the region facing the adverse shock vis-à-vis the other currency would restore external balance and prevent unemployment in the first region. If, however, both regions were in monetary union, then unemployment would emerge in one region and inflationary pressure in the other. In other words, monetary policy at the union level would be unable to solve both problems of unemployment and inflation, if capital was mobile and regions were subject to asynchronous shocks. The conclusion thus followed that regions with synchronous shocks make ideal candidates to form currency unions, as there was no need for monetary policy autonomy: A common monetary policy can restore equilibrium in all regions. (There are, of course, many implicit assumptions in Mundell's analysis, e.g., nominal rigidity, which we will discuss later.)

The "similarity of shocks" later became a broader term to capture the incidence of both supply and demand shocks, as well as the structure of the economy, which in turn may affect the nature and speed of adjustment of the economy to shocks.

An empirical literature pioneered by Bayoumi & Eichengreen (1993, 1997) has studied the patterns of correlations of shocks across countries, trying to identify OCA candidates, often using as benchmark the patterns of correlations across US states. The general finding is that European countries have historically faced less correlated shocks than US states, and hence forming a union in Europe may be costly. Alesina et al. (2002) use an alternative sample and method to study the extent of similarity of shocks across countries, focusing on

the covariance of relative shocks (to also capture the relative size of shocks, which is relevant for the appropriateness of monetary policy). In particular, they study the advisability of a dollar, euro, and yen blocs and reach optimistic conclusions about the prospect of a dollar- and euro-area bloc, possibly enlarged by unilateral fixers.

The findings from these exercises should not be viewed as conclusive tests of the OCA criteria. As already said, in principle it is ex-post synchronization of shocks that matters for optimality. To assess ex-post optimality, Alesina et al. (2002) and Barro & Tenreyro (2007) also study the effect of currency unions on the pattern of covariance of shocks, using a broad sample of developing and developed countries that includes existing currency unions. The main result is that, while a common currency increases the comovement of "real" relative price shocks, it tends to decrease the comovement of output shocks.

The decline in output comovement may reflect Krugman's (1993) conjecture that integration leads to more specialization and thus less synchronization of shocks. Frankel & Rose (1998), on the other hand, find in a sample of 21 industrialized countries that trade significantly increases the cross-country synchronization of shocks. If, indeed, currency unions lead to more trade, then the two sets of results contradict each other. To complete the taxonomy of possibilities, Giannone & Reichlin (2006) find that the euro has had no detectable effect on the synchronization of shocks among EZ countries. The contradictions between the conclusions of these studies may arise from differences in the period covered, samples of countries, and methods used, as well as differences in the actual measures of synchronization. The conclusion to draw is that there is ample scope for more work to shed light on the issue.

A second open question on this matter is whether synchronization (either ex-ante or ex-post) is indeed needed. In his 1973 paper, Mundell argued that, because currency unions

lead to deep integration in financial markets, countries with asynchronous shocks make ideal candidates, as there are further benefits from risk diversification. The argument has been more recently revived by Buiter & Sibert (2008) and formalized by Ching & Devereux (2003) in a model that encompasses both the advantages and disadvantages of similarity of shocks in a currency union; the model finds that there are neither substantial nor unambiguous effects on welfare, as the diversification motive and the similarity argument for common policy tend to cancel each other. The results make intuitive sense, given the model.

In reality, however, adjustment costs are important and the idea that financial diversification will be enough to smooth the shocks to consumption, and hence leave welfare unaltered, misses the potentially important losses in human capital from a spell of high unemployment, the costly work relations and information needed to transact in domestic and foreign markets, the fixed costs of closing and reopening plants, etc. Considering adjustment costs may untie the results in favor of similarity. There is, on the other hand, of course, the question of whether monetary policy is used as an adjustment tool, the premise that Calvo and Reinhart (2000) questioned. We think these are extremely relevant questions that have not yet received compelling answers.

With regards to the need for ex-ante similarity in inflation rates, often listed as an OCA criteria, we refer the reader to the discussion on inflation in Section 2.3.

3.2 Factor Mobility

Mundell (1961) pointed out that labor mobility can be an alternative adjustment mechanism to restore equilibrium in regions subject to asymmetric shocks. If labor was mobile across different regions, then the unemployed in the adversely affected regions could move

to the boom regions without the need for active monetary policy. Whilst Mundell's labor mobility criterion has not gone without criticism,[28] it remains one of the key concepts of an undergraduate course in International Economics.

There is no consensus as to whether labor mobility can effectively attenuate the cost of a multi-country monetary union. Many have argued that labor mobility is unlikely to operate at the high frequency with which demand shocks take place and is hence unlikely to be an effective substitute for active monetary policy. Furthermore, the high costs of migration may entail larger welfare losses. In the context of the European Monetary Union (EMU), Bayoumi & Prasad (1997) find that cross-country labor mobility is significantly lower than across comparable US regions, where labor mobility tends to be an important equilibrating force in the face of disturbances (Blanchard & Katz, 1992).[29] In Europe, instead, the main equilibrating mechanism appears to be changes in labor force participation (Decressin & Fatas, 1995).

The lack of mobility may partly be a reflection of the vast heterogeneity in languages and other cultural characteristics, as well as various other institutional or policy constraints, including the lack of integration in pension systems and in educational and qualification standards, the higher contractual costs of hiring and firing, and the generous unemployment benefits in many European countries. Alesina et al. (2008), argue, however, that many of these constraints may be affected by the introduction of the euro, as countries find ways to substitute for the lack of exchange-rate mechanism adjustment. They find that the introduc-

---

[28]Kenen (1969) suggests that it is only under very special circumstances that labor mobility solves both labor market and trade balance. Moreover, inter-regional labor mobility requires occupational mobility, which is rare. See also Ingram (1962).

[29]See also Eichengreen (1990) and Obstfeld & Peri (1998).

tion of the euro has indeed affected labor markets, although in complex ways. In particular, they find that while there is no indication that the adoption of the euro has accelerated labor market reforms in the primary labor markets, in several countries a "secondary" market with temporary and much more flexible contracts has emerged. The authors also find smaller "second-round" inflationary effects, that is, a smaller adjustment of nominal wages to past inflation and, accordingly, more real-wage flexibility in various countries. Furthermore, Alesina et al. (2008) find significant reforms in product markets, which as Blanchard & Giavazzi (2003) argue, may be an important pre-condition to trigger labor-market reforms that foster flexibility.[30]

In terms of capital mobility, we refer the reader to the discussion in Sections 2.1 and 2.2; in the interest of space, we do not attempt to distinguish between trade in capital and non-capital goods, nor the extent to which trade in product markets itself substitutes for the relative lack of mobility in factor markets. These are important empirical matters that need further investigation.

3.3   Openness

McKinnon (1963) suggested size and openness of an economy as key determinants of the decision to join a currency union. He argued that, rather than involving a loss of policy autonomy, irrevocably fixing the nominal exchange rate could be a benefit for small, open economies. This is because in a small, open economy, a large portion of consumption and intermediate goods are imported and prices are given by international markets (perhaps we should add here, following Engel (2000)'s insight, that in McKinnon's analysis, which is

---

[30]Obligatory references on this topic are Saint-Paul (2000) and Saint Paul & Bentolila (2000).

pertinent for small open economies, prices are set in the producer—or at least not local—currency). In the limit—when all goods are tradable—a small economy is unable to influence its real exchange rate by intervening in the foreign exchange market, and hence cannot use its nominal exchange rate to influence competitiveness (Purchasing Power Parity holds). In other words, fluctuations in the nominal exchange rate merely result in fluctuations in the domestic price level for small, open economies via the effect on import prices. Since the currencies of small, open economies inherently suffer from shocks (due to specialization and currency speculation), domestic prices would fluctuate in accordance. Therefore, giving up monetary policy autonomy is no big loss.

McKinnon's openness criterion has been criticized because his analysis is valid only when the foreign price level is stable (Ishiyama, 1975). This is why, as stressed by Alesina & Barro (2002), having a credibly stable anchor is critical. A perhaps repetitive point at this stage is that if the degree of openness increases with the formation of the currency union as found by the literature started by Rose (2000), whether due to the elimination of exchange risk, transaction costs, or more generally because of other parallel reforms triggered by the union, then the ex-ante OCA criterion is not the right metric and any cost-benefit analysis should be based on the post-unification degree of openness.

3.4 Economic Diversification

Kenen (1969) proposed product diversification (in domestic production and exports) as an OCA criterion. His argument rested on two reasons. First, the likelihood of asymmetric shocks and their impact in the economy are small when exports are diversified. Second, export diversity will help to stabilize investment, thereby requiring a smaller adjustment in

prices and employment than would otherwise be required after an industry-specific export shock. Kenen acknowledged the conflict that his first point gives rise to. Product diversification is not sufficient to guarantee internal stability even when external shocks tend to average out. To achieve labor market equilibrium, there needs to be sufficient occupational mobility so that the unemployed resources in the adversely hit sectors are re-employed in the growing sectors. At the empirical level, and in the context of the EMU, Bayoumi & Prasad (1997) provide a comparative study of industrial diversification in European countries and US regions. The main finding is that, on this criterion, there do not seem to be significant differences between Europe and the US.

Because more developed and bigger economies tend to be more diversified (Koren & Tenreyro, 2007), Kenen (1969)'s OCA criterion points to a completely different set of ideal candidates for unification than McKinnon (1963)'s. Put differently, the list of countries that do not satisfy either of these two criteria for OCA (or the list of countries that satisfy both) is nearly empty. To our knowledge, there is no work trying to clearly assess the comparative welfare or output losses from relinquishing monetary policy independence in diversified economies vis-à-vis small, open (and typically specialized) economies, and hence the relevance of these two opposing OCA criteria. We think this deserves further study.

3.5   Price and Wage flexibility

In a seminal paper, Friedman (1953) makes the case for flexible exchange rates given the intrinsic nominal rigidity that impairs the adjustment of the economy in the face of shocks. The case depends critically on the extent of nominal rigidity. In the extreme of perfect nominal flexibility, monetary policy is neutral and hence the choice of exchange rate regime

becomes irrelevant. This was also pointed out by Mundell (1961) and is one important OCA criterion—and to some extent underpins McKinnon (1963)'s criterion, as small, open economies face, from their perspective, flexible prices.

A more recent literature, largely inspired by Devereux & Engel (1998) and Engel (2000), has argued that price rigidity is not sufficient to advocate a flexible exchange rate regime, all else equal. In particular, this literature shows that if there is pricing-to-market and prices are rigid in the local (destination) currency, there is low pass-through from exchange rate changes. In this case, exchange rate changes do not affect export prices in destination countries and hence do not induce changes in the demand for exports. Various empirical studies by Engel and coauthors also present empirical evidence on the low extent of pass-through, supporting his case. The argument is challenged, to some extent, by the usual surges in political pressure for depreciation amidst recessions, which typically invoke the need to increase firms' competitiveness in foreign markets. The issue has spawned a large and growing literature exploring the extent of pass-through and its determinants. Given space constraints, we refrain from reviewing this work. (For a different perspective, see, for example, Imbs et al., 2005, and the references therein.)

3.6   Fiscal Transfers

Kenen (1969) also argues that the provision of fiscal transfers can significantly mitigate the cost of relinquishing monetary policy autonomy, as it can cushion the effects of economic disturbances. For the US economy, a number of papers, including Sala-i-Martin & Sachs (1992), von Hagen (1992), and Bayoumi & Masson (1995), empirically studied the mechanism and its quantitative relevance. Whether or not cross-country fiscal transfers are needed and,

in particular, whether financial integration can be a substitute for them (either through well diversified sovereign funds held by national governments, or directly through private capital markets), is part of an ongoing debate.

Fiscal transfers, and more generally, fiscal policy under monetary unions, are part of a vast literature that we do not attempt to review in this short survey. A non-exhaustive list of references that can serve as guidance are von Hagen & Eichengreen (1996), Beetsma & Uhlig (1999), Dixit & Lambertini (2001), Uhlig (2003), Cooper & Kempf (2004), and Chari & Kehoe (2007, 2008).[31]

4 Summary and open issues on normative and positive aspects of currency unions

Before Mundell (1961)'s pathbreaking contribution, currency areas were inextricably bounded by country borders. Unsurprisingly, then, previous work had concentrated on the pros and cons of flexible versus fixed exchange rate regimes across countries. Mundell broke the conceptual constraint, and used the insights from the early literature to build the theory of currency unions.[32] Mundell (1961) pointed out that monetary unification could lead to increased integration in goods and capital markets and that this gain should be weighed against the loss of monetary policy independence. He also noted that three conditions— similarity of shocks, nominal flexibility, and factor mobility—would reduce the cost of the

---

[31]See also earlier work by De Grauwe (1994), Canzonieri & Diba (1991), Aizenman (1992), Sibert (1992), and Buiter et al. (1993).

[32]In particular, Mundell's work has been greatly influenced by his advisor James Meade (see, for example, Meade, 1957).

loss of monetary independence, and hence balance the choice of regime in favor of monetary unification. Mundell's contribution inspired a vast normative literature establishing additional conditions under which relinquishing monetary policy independence would be less disadvantageous; these additional conditions—together with Mundell's—are known as the OCA criteria.

A first wave of empirical work tried to quantitatively assess the various OCA conditions, particularly in the context of EMU countries, using as a benchmark comparable regions in the US. The results of these exercises were qualified by the likely possibility that once countries entered or formed the union, many of the original conditions (e.g., synchronization of shocks, openness, etc.) might change. It was not until Rose (2000), however, that the empirical literature really surged. Rose's provocative paper (and his novel dataset) stimulated a large and growing literature trying to empirically assess the economic effects of currency unions. The advent of the euro, in turn, provided yet another ground to test the impact of a common currency. While the jury is still out on the actual magnitudes, some consensus is emerging.

With regard to trade gains, for the small and relatively less developed economies in Rose's historical data, currency unions are associated with large increases in the volume of international trade. For countries in the EZ, the effect appears more elusive: In particular, we could not find statistically significant effects on trade among EZ members following the introduction of the euro, though previous work has found positive, yet generally small, effects. In terms of financial integration, important changes in trends are observed with the introduction of the euro, particularly for cross-border holdings of bonds and equity. Concerning inflation, variability of consumption, and output growth, changes stemming from

the introduction of the euro are less visible, particularly when compared to other developed countries in the EU.

There are, in general, less conclusive results on the costs of currency unions (that is, the various OCA criteria) and the extent to which they endogenously change with the use of a common currency. Empirical work exploiting the timing of the euro will shed more light on the question. Notably, Alesina et al. (2008) and Bugamelli et al. (2008) find evidence that the euro has forced significant structural reforms and firm restructuring; this should facilitate the response of national economies to shocks, thus substituting at least partly for the traditional exchange-rate mechanism of adjustment. There is also a growing branch of the literature studying both theoretically and empirically fiscal aspects of currency unions, as well as the extent of price and wage rigidity, currency choice, labor market frictions, and diversification patterns, the results of which may affect the current view on the relevant OCA criteria.

While significant progress on the empirical assessment of the various gains and costs is under way, the theory of currency unions begs for a unified framework that can incorporate the various relevant factors determining optimality. Important starting points are Alesina & Barro (2002) and Ching & Devereux (2003).[33] The first weights trade and credibility gains against the cost of asynchronous shocks, in the absence of financial markets. The second, by contrast, stresses the gain from integration in financial markets facilitated by currency unions. Not surprisingly, the extent of dissimilarity of shocks weighs very differently in the

---

[33]See Carre & Collard (2003), Faia (2007), and Christoffel et al. (2009), who also analyze specific gains and costs from a monetary union. More broadly, on welfare-based analysis of different aspects of monetary interdependence, see Corsetti & Pesenti (2001) and Obstfeld & Rogoff (1995).

two analyses. In Alesina & Barro (2002), dissimilarity of shocks is a key determinant of the cost of joining a currency union, as in Mundell (1961); in Ching & Devereux (2003), dissimilarity can rather act as a benefit, fostering diversification of shocks and a smoother path for consumption, as suggested by Mundell (1973).

A unified welfare-based framework should resolve the seeming contradiction in the roles played by these and the various other criteria that we discuss, and thus help move the theory of currency union beyond a narrative enumeration of gains and costs. It should also clarify the implicit assumptions about the economy underlying the various OCA criteria. Guidance from recent empirical developments, in turn, should help operationalize the theoretical framework, and turn it into a quantitative model for policy evaluation.

5   Literature Cited

Aizenman J. 1992. Competitive externalities and the optimal seigniorage. *Journal of Money, Credit and Banking* 24: 61-71

Alesina A, Ardagna S, Galasso V. 2008. The euro and structural reforms. In *Europe and the Euro*, ed. A Alesina, F Giavazzi, in press. Chicago: University of Chicago Press

Alesina A, Barro RJ. 2002. Currency unions. *Quarterly Journal of Economics* 117:409-36

Alesina A, Barro RJ, Tenreyro S. 2002. Optimal currency areas. In *NBER Macroeconomics Annual*, ed. M Gertler, K Rogoff 17:301-345. Cambridge(MA): MIT Press

Alesina A, Grilli V. 1992. The European Central Bank: reshaping monetary politics in Europe. In *Establishing a Central Bank: Issues in Europe and Lessons from the U.S.*, ed. M Canzoneri, V Grilli, P Masson, pp 49-78. Cambridge: Cambridge University Press

Alesina A, Stella A. 2009. *The politics of monetary policy.* Harvard University, manuscript.

Anderson JE. 1979. A theoretical foundation for the gravity equation. *American Economic Review* 69:106-16

Anderson J, van Wincoop E. 2003. Gravity with gravitas: a solution to the border puzzle. *American Economic Review* 93:170-92

Baele L, Ferrando A, Hördahl P, Krylova E, Monnet C. 2004. Measuring financial integration in the euro area. *European Central Bank occasional paper series*, no. 14, European Central Bank, Frankfurt am Main

Baldwin RE. 2006. *In or out: does it make a difference? An evidence-based analysis of the trade effects of the euro.* London: Center for Economic Policy Research

Baldwin R, Di Nino V. 2006. Euros and zeros: the common currency effect on trade in new goods**.** NBER Working Papers 12673, National Bureau of Economic Research, Inc. Cambridge(MA)

Baldwin RE, Taglioni D. 2006. Gravity for dummies and dummies for gravity equations. *NBER Working Papers* 12516, National Bureau of Economic Research, Inc. Cambridge(MA)

Baldwin RE, Skudelny F, and Taglioni D. 2005. Trade effects of the euro: evidence from sectoral data. *European Central Bank Working Paper Series* 446, European Central Bank, Frankfurt am Main

Barro R, Gordon D. 1983. Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics* 21:101-21

Barro R, Tenreyro S. 2006. Closed and open economy models of business cycles with marked-up and sticky prices. *The Economic Journal* 116:434-56

Barro R, Tenreyro S. 2007. Economic effects of currency unions. *Economic Enquiry* 45:1-197

Bayoumi T, Eichengreen B. 1993. Shocking aspects of European economic unification. In *Adjustment and Growth in the European Monetary Union*, ed. F Torres, F Giavazzi, pp. 193-229. Cambridge: Cambridge University Press

Bayoumi T, Eichengreen B. 1997. Ever closer to heaven? An optimum-currency–area index for European countries. *European Economic Review* 41:761–770

Bayoumi T, Masson PR. 1995. Fiscal flows in the United States and Canada: lessons for monetary union in Europe. *European Economic Review* 39:253-274

Bayoumi T, Prasad E. 1997. Currency unions, economic fluctuations, and adjustment: some new empirical evidence. *IMF Staff Papers* 44:36-58

Beetsma R, Harald U. 1999. An analysis of the stability and growth pact. *Economic Journal* 109:546–71

Berger H, Nitsch V. 2008. Zooming out: the trade effect of the euro in historical perspective. *Journal of International Money and Finance* 27:1244-60

Berthou A, Fontagné L. 2008. The euro effects on the firm and product-level trade margins: evidence from France. CEPII, Working Paper No 2008 – 21, Centre d'Etudes Prospectives et d'Informations Internationales, Paris

Blanchard O, Giavazzi F. 2003. The Macroeconomic effects of labor and product market deregulation. *Quarterly Journal of Economics* 118:879-909

Blanchard O, Katz L. 1992. Regional evolutions. *Brookings Papers on Economic Activity* 23:1-75.

Bugamelli M, Schivardi F, Zizza R. 2008. The euro and firm restructuring. In *Europe and the Euro*, ed. A Alesina, F Giavazzi, in press. Chicago(Il): University of Chicago Press

Buiter WH, Corsetti G, Roubini N. 1993. Excessive deficits: sense and nonsense in the treaty of Maastricht. *Economic Policy* 8:57–100

Buiter WH, Sibert A. 2008. *New theories of optimal currency areas and their application to Poland's adoption of the euro: the asymmetric-shocks-on-its-head and the lender-of-last-resort theories of optimal currency areas.*
http://www.nbp.pl/konferencje/bise_2008/bin/buiterp.pdf

Bun MJG, Klaassen FJGM. 2002. Has the euro increased trade? *Tinbergen Institute Discussion Papers* 108/2, Tinbergen Institute, Amsterdam

Bun MJG, Klaassen FJGM. 2007. The euro effect on trade is not as large as commonly thought. *Oxford Bulletin of Economics and Statistics* 69:473-496

Calvo GA, Reinhart CM. 2002. Fear of floating. *Quarterly Journal of Economics* 117:379-408

Canzoneri MB, Diba BT. 1991. Fiscal deficits, financial integration, and a central bank for Europe. *Journal of the Japanese and International Economy* 5:381–403

Carre M. Collard F. 2003. Monetary union: a welfare-based approach. *European Economic Review* 47:521–52

Caselli F. 2008. Discussion of Paper by Mongelli and Wyplosz ECB "Euro at 10" Conference.
http://personal.lse.ac.uk/CASELLIF/papers/EMU10.pdf

Chari VV, Kehoe P. 2007. On the need for fiscal constraints in a monetary union. *Journal of Monetary Economics* 54:2399–408

Chari VV, Kehoe P. 2008. Time Inconsistency and Free-Riding in a Monetary Union. *Journal of Money, Credit and Banking* 40:1329-56

Ching S, Devereux MB. 2003. Mundell revisited: a simple approach to the costs and benefits of a single currency area. *Review of International Economics* 11:674-91

Christoffel K, Kuester K, Linzert T. 2009. The role of labor markets for euro area monetary policy. *European Economic Review* in press

Cooper RW, Kempf H. 2004. Overturning Mundell: fiscal policy in a monetary union. *Review of Economic Studies* 71:371–96

Corsetti G, Pesenti P. 2001. Welfare and macroeconomic interdependence. *Quarterly Journal of Economics* 116:421-445

Decressin J, Fatás A. 1995. Regional labor market dynamics in Europe. *European Economic Review* 39:1627-55

de Grauwe P. 1994. *The Economics of Monetary Integration*, 2nd ed. Oxford: Oxford University Press

de Sousa J, Lamotte O. 2007. Does political disintegration lead to trade disintegration? Evidence from transition countries. *Economics of Transition* 15:825-43

Devereux MB, Engel C. 1998. Fixed vs. floating exchange rates: how price setting affects the optimal choice of exchange-rate regime. NBER Working Papers 6867, National Bureau of Economic Research, Inc. Cambridge(MA)

Dixit A, Lambertini L. 2001. Monetary-fiscal policy interactions and commitment versus discretion in a monetary union. *European Economic Review* 45:977–87

Eichengreen B. 1990. One money for Europe? Lessons from the US currency union. *Economic Policy* 5:117-87.

Eichengreen B, Irwin D. 1995. Trade blocs, currency blocs, and the reorientation of world trade in the 1930s. *Journal of International Economics* 38:1–24

Engel C. 2000. Local-currency pricing and the choice of exchange-rate regime. *European Economic Review* 44: 1449-72

Faia E. 2007. Financial differences and business cycle co-movements in a currency area. *Journal of Money, Credit and Banking* 39:151-185

Fidrmuc J, Fidrmuc J. 2003. Disintegration and trade. *Review of International Economics* 11:811-29

Flam H, Nordström H. 2003. Trade volume effects of the euro: aggregate and sector estimates. *IIES Seminar Paper* No. 746, Institute for International Economic Studies, Stockholm

Flam H, Nordström H. 2006. Euro effects on the intensive and extensive margins of trade. *IIES Seminar Paper* No. 750, Institute for International Economic Studies, Stockholm

Fleming JM. 1971. On exchange rate unification. *The Economic Journal* 81:467-88

Frankel JA, Rose A. 1998. The endogeneity of the optimum currency area criteria. *The Economic Journal* 108:1009-25

Frankel JA. 1997. *Regional Trading Blocs in the World Economic System*, Washington DC: Institute for International Economics

Frankel JA, Rose A. 2002. An estimate of the effect of currency unions on trade and income. *Quarterly Journal of Economics* 117:437-66

Frankel J, Wei S-j. 1993. Trade blocs and currency blocs. *NBER Working Papers* 4335, National Bureau of Economic Research, Inc. Cambridge(MA)

Friedman M. 1953. The case for flexible exchange rates. In *Essays in Positive Economics*, pp 157–203. Chicago(Il): University of Chicago Press

Giannone D, Reichlin L. 2006. Trends and cycles in the euro area: how much heterogeneity and should we worry about it? *European Central Bank Working Paper Series* 595, European Central Bank, Frankfurt am Main

Giavazzi F, Giovannini A. 1989. Monetary policy interactions under managed exchange rates. *Economica*, 56:199-213

Gil-Pareja S, Llorca-Vivero R, Martínez-Serrano JA. 2008. Trade effects of monetary agreements: evidence for OECD countries. *European Economic Review* 52:733-55

Glick R, Rose A. 2002. Does a currency union affect trade? The time series evidence. *European Economic Review* 46:1125-51

Gourieroux C, Monfort A, Trognon A. 1984. Pseudo maximum likelihood methods: applications to Poisson models. *Econometrica* 52:701–20

Gray A. 2004. Great Circle Calculator. http://andrew-gray.com/dist/

Heckman JJ. 1979. Sample Selection Bias as a Specification Error. *Econometrica* 47:153-61

Helpman E. 1981. International trade in the presence of product differentiation, economies of scale, and monopolistic competition: a Chamberlin-Heckscher-Ohlin approach. *Journal of International Economics* 11:305-40

Helpman E, Krugman P. 1985. *Market Structure and Foreign Trade.* Cambridge(MA): MIT Press

Helpman E, Melitz M, Rubinstein Y. 2008. Estimating trade flows: trading partners and trading volumes. *Quarterly Journal of Economics* 123:441-487

Imbs J, Mumtaz H, Ravn M, Rey H. 2005. PPP strikes back: aggregation and the real exchange rate. *Quarterly Journal of Economics* 120:1-43

Ingram JC. 1962. *Regional Payments Mechanisms: The Case of Puerto Rico.* Chapel Hill(NC): University of North Carolina Press

Ishiyama Y. 1975. The theory of optimum currency areas: a survey. *IMF Staff Papers* 22:344-83

Japelli T, Pagano M. 2008. Financial market integration under EMU. *European Commission Economic Papers* 312, European Commission, Brussels

Kalemli-Ozcan S, Papaioannou E, Peydró J-L. 2009. What lies beneath the euro's effect on financial integration? Currency risk, legal harmonization, or trade? *NBER Working Papers* 15034, National Bureau of Economic Research, Inc. Cambridge(MA)

Kenen PB. 1969. The theory of optimum currency areas: an eclectic view. In *Monetary Problems of the International Economy*, ed. R Mundell, A Swoboda pp. 41-60. Chicago(Il): University of Chicago Press

Kenen PB. 2002. Currency unions and trade: variations on themes by Rose and Persson. *Reserve Bank of New Zealand Discussion Paper Series* DP2002/08, Wellington: Reserve Bank of New Zealand

Koren M, Tenreyro S. 2007. Volatility and development. *Quarterly Journal of Economics* 122:243-87

Krugman P. 1993. Lessons of Massachusetts for EMU. In *Adjustment and Growth in the European Monetary Union*, ed. F Torres, F Giavazzi pp.241-60. Cambridge: Cambridge University Press

Lane P. 2006. The Real Effects of European Monetary Union. *Journal of Economic Perspectives* 20:47-66

Martin P, Rey H. 2004. Financial super-markets: size matters for asset trade. *Journal of International Economics* 64:335-61

Meade, J, 1957. The balance of payments problems of a free trade area. *Economic Journal* 67:379-96

Micco A, Stein E, Ordoñez G. 2003. The currency union effect on trade: early evidence from EMU. *Economic Policy* 18:315-56

Mill JS. 1848. *Principles of Political Economy with some of their Applications to Social Philosophy.* London: John W. Parker

McKinnon RI. 1963. Optimum currency areas. *American Economic Review* 53:717-25

Mongelli FP, Wyplosz C. 2008. *The euro at ten: unfulfilled threats and unexpected challenges.* In The euro at ten: lessons and challenges, ECB Central Banking Conference, 5th, Frankfurt

Mundell RA. 1961. A theory of optimum currency areas. *American Economic Review* 51:657-65

Mundell RA. 1973. Uncommon arguments for common currencies. In *The Economics of Common Currencies*, ed. HG Johnson, AK Swoboda pp 114-32. Cambridge(MA): Harvard Univiersity Press

Neumeyer PA. 1998. Currencies and the allocation of risk: the welfare effects of a monetary union. *American Economic Review* 88:246-59

Nitsch V. 2002. Honey I shrunk the currency union effect on trade. *World Economy* 25:457-474

Obstfeld M, Peri G. 1998. Regional non-adjustment and fiscal policy. *Economic Policy* 13:205-59

Obstfeld M, Rogoff K. 1996. *Foundations of International Macroeconomics.* Cambridge(MA): MIT Press

Pakko MR, Wall HJ. 2001 Reconsidering the trade-creating effects of a currency union. *Federal Reserve Board of St. Louis Review* 83:37-45

Papaioannou E, Portes R. 2008. Costs and benefits of running an international currency. *European Commission Economic Papers* 348, European Commission, Brussels

Persson T. (2001). "Currency union and trade: how large is the treatment effect?" *Economic Policy*, 16:433-62

Ramsey JB. 1969. Tests for specification errors in classical linear least squares regression analysis. *Journal of the Royal Statistical Society B* 31:350-71

Rogoff K. 1985. Can international monetary policy cooperation be counterproductive? *Journal of International Economics* 18:199-217

Rose A. 2000. One money one market: estimating the effects of common currencies on trade. *Economic Policy* 15:9-48

Rose A. 2001. Currency union and trade: the effect is large. *Economic Policy* 16:433–62

Rose A, van Wincoop E. 2001. National money as a barrier to international trade: the real case for currency union. *American Economic Review (Papers and Proceedings)* 91:386–90

Saint-Paul G. 2000. *The Political Economy of Labour Market Institutions.* Oxford: Oxford University Press

Saint-Paul G, Bentolila S. 2000. Will EMU increase eurosclerosis?" *CEPR Discussion Paper* No. 2423, Center for Economic and Policy Research, Washington DC

Sala-i-Martin X, Sachs J. 1992. Fiscal federalism and optimum currency areas: evidence for Europe from the United States. In *Establishing a Central Bank: Issues in Europe and Lessons*

from the U.S., ed. M Canzoneri, V Grilli, P Masson pp 195-219. Cambridge: Cambridge University Press

Santos Silva JMC, Tenreyro S. 2006. The log of gravity. *The Review of Economics and Statistics* 88:641-58

Sibert A. 1992. Government finance in a common currency area. *Journal of International Money and Finance*, 11:567–78

Spiegel M. 2008. Monetary and financial integration in the EMU: push or pull? *Federal Reserve Bank of San Francisco Working Paper* 2008-11. Federal Reserve Bank of San Francisco, San Francisco(CA)

Tenreyro S. 2002. *On the Causes and Consequences of Currency Unions*. Phd Thesis. Harvard University.

Tenreyro S. 2007. On the trade impact of nominal exchange rate volatility. *Journal of Development Economics* 82:485-508

Thom R, Walsh B. 2002. The effect of a currency union on trade: lessons from the Irish experience. *European Economic Review* 46:1111-23

Uhlig H. 2003. One money, but many fiscal policies in Europe: what are the consequences? In *Monetary and Fiscal Policies in EMU: Interactions and Coordination*, ed. M Buti pp 29–56. Cambridge(MA): Cambridge University Press

von Hagen J. 1992. Policy-delegation and fixed exchange rates. *International Economic Review* 33:849-70

von Hagen J, Eichengreen B. 1996. Federalism, fiscal restraints, and European monetary union. *American Economic Review* 86:134–38

Table 1: Estimates of the euro effect (CU)
for three different control groups[a]

	OECD93	EEA	EU15
CU	−0.084	−0.006	0.065
	(1.958)	(0.107)	(0.578)
EURO-12 DUMMY	0.356	0.398	0.227
	(3.385)	(2.929)	(1.207)
FTA	0.886	−	−
	(7.123)	−	−
LOG-DISTANCE (1st Quartile)	−0.494	−0.639	−0.696
	(4.537)	(7.039)	(5.962)
LOG-DISTANCE (2nd Quartile)	−0.513	−0.642	−0.709
	(5.008)	(7.225)	(6.055)
LOG-DISTANCE (3rd Quartile)	−0.552	−0.663	−0.723
	(5.654)	(7.986)	(6.717)
LOG-DISTANCE (4th Quartile)	−0.581	−0.714	−0.764
	(6.041)	(8.615)	(6.866)
CONTIGUITY DUMMY	0.279	0.101	0.030
	(3.039)	(1.154)	(0.282)
COMMON-LANGUAGE DUMMY	0.468	0.621	0.630
	(4.888)	(8.402)	(6.961)
COLONIAL-TIE DUMMY	−0.147	0.113	0.113
	(1.029)	(0.721)	(0.678)
Sample Size	6930	4080	2730
R^2	0.979	0.978	0.981
RESET test p-values	0.264	0.990	0.407

a) All regressions are performed by Poisson PML and include time-varying importer and exporter fixed effects; robust (clustered by country-pair) t-ratios in parentheses.
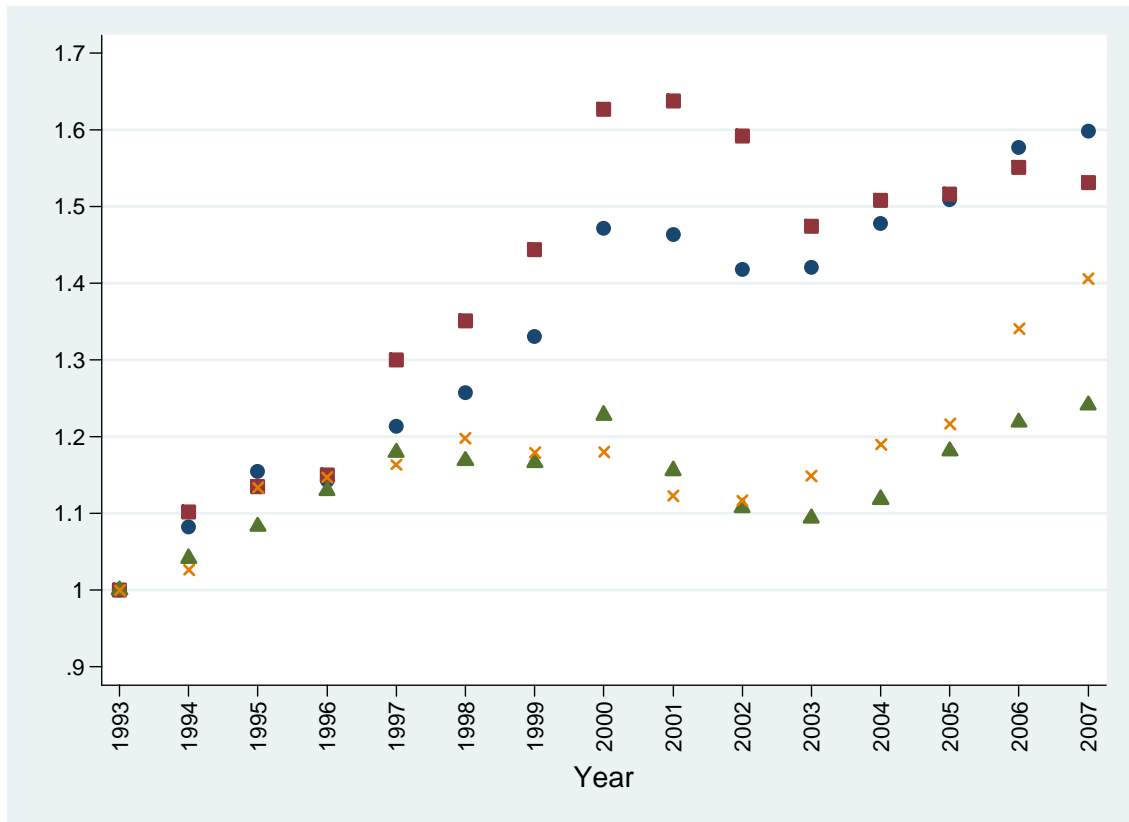
FIGURE 1: Bilateral Trade Relative to GDP for Different Bilateral Groups (OECD93): exports of the Euro-12 countries to trading partners of the same group (circles) and to OECD93 countries (squares), both relative to the total GDP of the Euro-12; exports from the eleven OECD93 countries to the members of this group (triangles) and to the Euro-12 countries (crosses), both relative to the total GDP of the OECD93 countries. All series are normalized to 1 in 1993.

985	Fabian Waldinger	Quality Matters – The Expulsion of Professors and Ph.D. Student Outcomes in Nazi Germany
984	Brian Bell Stephen Machin Francesco Fasani	Crime and Immigration: Evidence from Large Immigrant Waves
983	Nicholas Bloom Carol Propper Stephan Seiler John Van Reenen	The Impact of Competition on Management Quality: Evidence from Public Hospitals
982	Nicholas Bloom John Van Reenen	Human Resource Management and Productivity
981	Alan Manning	Imperfect Competition in the Labour Market
980	Ana Fernandes Heiwai Tang	The Determinants of Vertical Integration in Export Processing: Theory and Evidence from China
979	Stephen Machin Olivier Marie Sunčica Vujić	The Crime Reducing Effect of Education
978	Andrew B. Bernard J. Bradford Jensen Stephen Redding Peter K. Schott	Intra-Firm Trade and Product Contractibility (Long Version)
977	Albrecht Ritschl Samad Sarferaz	Crisis? What Crisis? Currency vs Banking in the Financial Crisis of 1931
976	Joshua D. Angrist Jörn-Steffen Pischke	The Credibility Revolution in Empirical Economics: How Better Research Design is taking the Con out of Econometrics
975	Holger Breinlich Alejandro Cuñat	Trade Liberalization and Heterogeneous Firm Models: An Evaluation Using the Canada – US Free Trade Agreement
974	Facundo Albornoz Hector Calvo-Pardo Gregory Corcos Emanuel Ornelas	Sequential Exporting
973	Marco Fugazza Frédéric Robert-Nicoud	The 'Emulator Effect' of the Uruguay Round on US Regionalism

972	Andreas Georgiadis Christos N. Pitelis	The Interrelationship between HR, Strategy and Profitability in Service SMEs: Empirical Evidence from the UK Tourism Hospitality and Leisure Sector
971	John T. Addison Alex Bryson Paulino Teixeira André Pahnke	Slip Sliding Away: Further Union Decline in Germany and Britain
970	Nicholas Bloom Raffaella Sadun John Van Reenen	Recent Advances in the Empirics of Organizational Economics
969	Nicholas Bloom John Van Reenen	New Approaches to Measuring Management and Firm Organiz\ation
968	Andrew B. Bernard J. Bradford Jensen Stephen J. Redding Peter K. Schott	Wholesalers and Retailers in U.S. Trade (Long Version)
967	Pooyan Amir Ahmadi Albrecht Ritschl	Depression Econometrics: A FAVAR Model of Monetary Policy During the Great Depression
966	Nicholas Bloom Raffaella Sadun John Van Reenen	Does Product Market Competition Lead Firms to Decentralize?
965	Ralf Martin	Why is the US so Energy Intensive? Evidence from Multinationals in the UK
964	Christian A. L. Hilber Frédéric Robert-Nicoud	Origins of Land Use Regulations: Theory and Evidence from US Metro Areas
963	Maria Bas Juan Carluccio	Wage Bargaining and the Boundaries of the Multinational Firm
962	L. Rachel Ngai Christopher A. Pissarides	Welfare Policy and the Distribution of Hours of Work
961	Caroline Freund Emanuel Ornelas	Regional Trade Agreements
960	Francesco Caselli Guy Michaels	Do Oil Windfalls Improve Living Standards? Evidence from Brazil