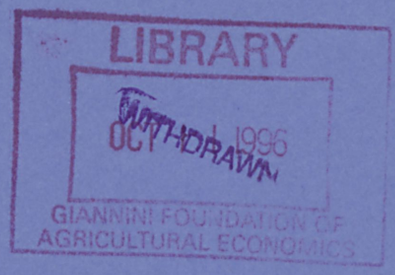

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CENTER FOR INTERNATIONAL AND DEVELOPMENT
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Jeffrey A. Frankel and Andrew K. Rose

August 1996

Department of Economics

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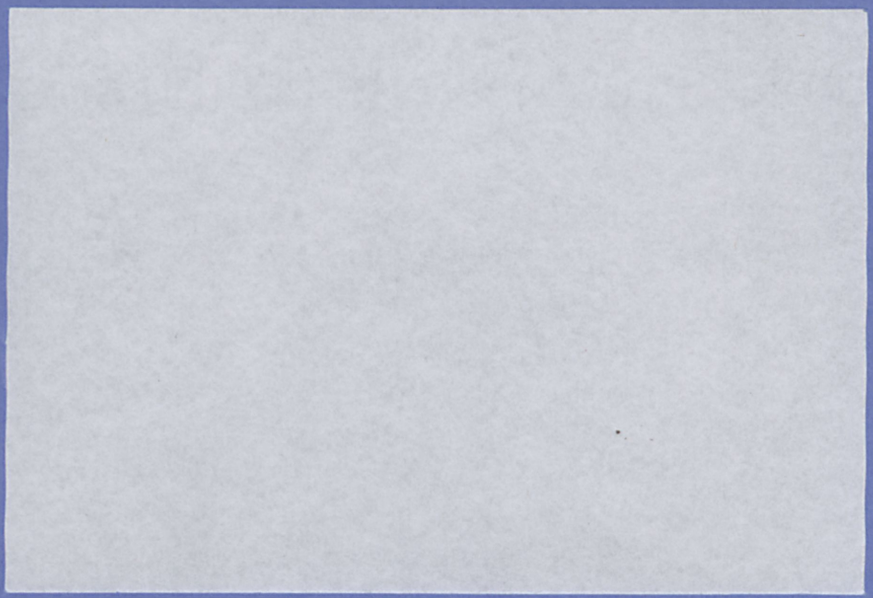

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JEL Classification: F33, F36

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Abstract

Everyone studying EMU cites the theory of Optimum Currency Areas: whether a country like Sweden should join the currency union depends on such parameters as the extent of Swedish trade with other EU members and the correlation of Sweden's income with that of other members. Few economists have focused on what we consider one of the most interesting aspects of this issue. Trade patterns and income correlations are endogenous. Sweden could fail the OCA criterion for membership today, and yet, if it goes ahead and joins anyway, could, as the result of joining, pass the Optimum Currency Area (OCA) criterion in the future. (Further, even if Sweden does not enter EMU quickly, it will be more likely to satisfy the OCA criteria in the future as a result of its recent accession to the EU.)

The few economists who have identified the importance of the endogeneity of trade patterns and income correlation are divided on the nature of the relationship between the two. This is an important empirical question, which may hold the key to the answer regarding whether it is in Sweden's interest to join EMU.

We review the OCA theory, highlighting the role of trade links and income links. Then we discuss and analyze the endogeneity of these parameters. We present econometric evidence suggesting strongly that if trade links between Sweden and the rest of Europe strength in the future, then Sweden's income will become more highly correlated with European income in the future (not less correlated, as some have claimed). This has important implications for the OCA criterion. It means that a naive examination of historical data gives a biased picture of the effects of EMU entry on Sweden. It also means that EMU membership is more likely to make sense for Sweden in the future than it does today.

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Economic Structure and the Decision to Adopt a Common Currency

Some countries are so small that it would make no sense for them to have their own independent currencies. Liechtenstein is an example of a country in this category. It wisely uses the currency of its immediate neighbor, Switzerland. Other countries are so large that it would be highly inadvisable to fix the value of its currency in terms of another, much less to adopt some foreign currency as its own. The United States is in this category.

Sweden, like most countries, is in the middle. The advantages of fixing the exchange rate in terms of its European neighbors, or even of adopting the currency of a new EMU, must be carefully weighed against the disadvantages of doing so. Below, we summarize the pros and cons from the literature and provide new evidence. Our results imply that the deepening Swedish ties to Europe, which should be expected as a result of EU accession, make Sweden a better candidate for EMU entry than the data currently indicate. In addition, Swedish entry into EMU would be expected in and of itself to result in even greater integration with Europe. Both considerations indicate that Sweden may be a better candidate now for EMU entry than commonly thought; and it will certainly be a better candidate for EMU in the future.[1] Nevertheless, our view is that these considerations are still not sufficiently compelling to make a strong case for Swedish entry into EMU now or in 1999.

1. Introduction

[1] A statement of the view that the suitability of European countries for monetary union would increase ex post was presented by the Commission of the European Communities (1990).

In this paper we spell out the advantages and disadvantages of fixing the exchange rate, with particular attention to the relationship between the pattern of economic disturbances and the exchange rate regime. Our framework is the familiar theory of Optimum Currency Areas. The theory recognizes that the decision of a country whether to peg or float vis-à-vis its neighbors should depend on such country characteristics as the extent of trade ties with the neighbors and the extent of correlation of business cycle shocks. The criteria provided by the Optimum Currency Area (OCA) theory for deciding whether a country should peg, essentially boil down to whether its economy is very closely tied to that of its neighbors.

Although the concept is a familiar one, empirical implementation has unfortunately not progressed to the point where we can say with confidence whether a particular country, such as Sweden, currently satisfies the OCA criterion. The best we can do is compare Sweden's fitness to fix its exchange rate with that of other countries, and regions.

Less familiar is the point that the OCA criteria themselves can change over time. The endogeneity of the criteria is a completely open research question. We undertake an econometric analysis of the relationship between the pattern of countries' income correlations and the intensity of their trade links. We conclude that Sweden is more likely to satisfy the OCA criteria in the future than it does now for two reasons. First, the ease of movement of trade and people between Sweden and the rest of Europe will be higher in, say, 2020 than it is now, simply because of Sweden's accession to the EU which has already taken place, but will take some years to reach its full effect. As a result, Sweden's income will be more highly correlated with Europe's income in the future than it is now. Further, if Sweden, despite failing the OCA criterion now, were to go

ahead on political grounds and join the EMU anyway, its trade linkages and hence income correlation with Europe are likely to rise as a consequence of entry into EMU. Thus, it is conceivable that Sweden's participation in EMU would be warranted *ex post*, even if not *ex ante*. This analysis thus offers advocates of EMU some possible grounds for encouragement. Nevertheless, our tentative belief is that Sweden would be best advised to stay out of EMU. The disadvantages outweigh the advantages for the time being, and the risk of a repetition of the 1992 crisis is too great (perhaps in 1999), especially if a large number of countries go ahead despite failing the OCA criteria. The issue could be revisited in ten years or so, to see if Sweden had by then come closer to meeting the OCA criterion.

We begin the paper by reviewing the characteristics of exchange rate regimes, to allow a comparison of the advantages of fixed exchange rates versus the advantages of flexible exchange rates. We next explain how the trade-off between the two regimes depends on country characteristics such as trade links and income correlations. In other words, the choice should depend on the OCA criteria.

The part of the paper that is of original academic interest discusses why the OCA criteria are in fact endogenous. When one country adopts the currency of another, the trade links between the two are subsequently strengthened. The pattern of income correlations is likely to change as well. There are two conflicting views regarding whether the income correlation is likely to go up or down, as the result of linking the currencies. We offer econometric evidence that the positive effect dominates. This implies that a country is more likely to satisfy the OCA criterion *ex post* than *ex ante*. We conclude the paper by offering the reasons for our subjective

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Sweden, like most countries, is in the middle. The advantages of fixing the exchange rate in terms of its European neighbors, or even of adopting the currency of a new EMU, must be carefully weighed against the disadvantages of doing so. Below, we summarize the pros and cons from the literature and provide new evidence. Our results imply that the deepening Swedish ties to Europe, which should be expected as a result of EU accession, make Sweden a better candidate for EMU entry than the data currently indicate. In addition, Swedish entry into EMU would be expected in and of itself to result in even greater integration with Europe. Both considerations indicate that Sweden may be a better candidate now for EMU entry than commonly thought; and it will certainly be a better candidate for EMU in the future.[1] Nevertheless, our view is that these considerations are still not sufficiently compelling to make a strong case for Swedish entry into EMU now or in 1999.

1. Introduction

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If the Swedish kronor depreciates suddenly against the dollar, the kronor price of both oil and housing will go up by the same amount, leaving their ratio unchanged.

This view is wrong. If the Swedish kronor depreciates suddenly against the dollar, the kronor price of oil in fact goes up far more than the price of housing. The increase in the relative price of oil will have real effects (encouraging hotels to conserve on energy, for example).

The inappropriateness of the equilibrium view is evident in a comparison of exchange rate behavior across different regimes. Currencies that are officially stabilized show low variability in the nominal exchange rate, compared to those that are allowed to float more or less freely; one would expect this, virtually by definition. But such currencies also show lower variability in the *real exchange rate*, that is, in the nominal exchange rate adjusted for domestic and foreign prices. When nominal exchange rate variability rose sharply with the advent of generalized floating in 1973, real exchange rate variability rose in tandem. Figure 1 illustrates the case of the DM/dollar rate. The pre-1973 vs. post-1973 comparisons suggest strongly that fluctuations in the nominal exchange rate may be a cause of fluctuations in the real exchange rate.

An alternative possible explanation for Figure 1 is that the greater variability in real exchange rates after 1973 was due to the greater magnitude of real worldwide disturbances, such as oil shocks, and would have happened even under a regime of fixed exchange rates (in which case the variability would have shown up in the price levels). This alternative view holds that changes in the nominal exchange rate do not cause changes in the real exchange rate, but that

both occur in response to exogenous real disturbances such as productivity changes.[2] One problem with this view is that no one has identified what these real shocks are; see Flood and Rose (1995).

One way to check if the comparison of the fixed-rate and floating-rate periods might be contaminated by larger supply shocks after 1973 than before is to look at Canada, the one country to have a floating exchange rate in the 1950s. The real exchange rate in Canada was highly variable at the time, while those in fixed-rate countries were much less so.

Another piece of evidence is offered by the case of Ireland. From 1957 to 1970 the Irish currency was pegged to the pound, and thereby to the dollar and deutschemark as well, until the major currencies began to float against each other. From 1973 to 1978 the Irish currency was again pegged to the pound, which meant it floated against the dollar and mark. Then from 1979 onward Ireland was in the European Exchange Rate Mechanism, and the currency—the punt—was thereby tied to the mark, which meant it floated against the dollar and pound (except when the latter was a member of the ERM as well, during 1990-1992). In each of the three periods, the choice of nominal exchange rate regime for the punt corresponds very well with the observed degree of *real* exchange rate variability vis-à-vis each of the three trading partners. Exchange rate variability in the presence of sticky goods prices explains the pattern. Otherwise it would be quite a coincidence that real variability vis-à-vis the mark, say, should fall, and vis-à-vis the pound rise, at precisely the same moment that the nominal variabilities, respectively, fall and rise as well.

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[2] Such theories have been constructed, for example, by Stockman (1987). Other relevant works include Persson and Svensson (1989).

A third way of evaluating whether real exchange rate variability is related to the exchange rate regime is to consider earlier historical experience. History demonstrates that the variability of real exchange rates was larger under floating-rate regimes than under fixed-rate regimes, not just during the period after World War II, but before the war as well; Eichengreen (1988).

2.2. Are Floating Exchange Rates Excessively Volatile?

Having disposed of the equilibrium view, we accept that the choice of exchange rate regime has real effects. The next question is whether exchange rate fluctuations arise solely from monetary policy and other economic fundamentals, or whether there is an extra, speculative, component.

Some have concluded that the foreign exchange market is not working as it is supposed to, that speculation destabilizes the exchange rate. The conclusion is fed by recent developments in international financial markets, on the one hand, and by a number of academic findings on the other.

In the 1970s, the majority view among economists was that floating exchange rates were the right way to avoid misalignments, such as the overvaluation to which the dollar had become increasingly subject in the 1960s: the market knows the appropriate value of the currency better than the government. Most economists had become persuaded by the argument of Milton Friedman (1953), namely that speculators would be stabilizing rather than destabilizing, because any speculator who increased the magnitude of exchange rate fluctuations could only do so by

buying high and selling low, a recipe for going out of business quickly.

The pendulum began to swing back in the 1980s. Concerns about floating rates became much more widespread with the dollar bubble in 1984-85. The market, it seemed, sometimes gets things wrong. The notion that financial markets might suffer from excessive volatility has been boosted by the theory of rational speculative bubbles. The initial motivation for the theory was purely as a mathematical curiosum. But it turned out to be a demonstration that speculators could be destabilizing without losing money. In a rational speculative bubble, the price goes up each period because traders expect it to go up further the next period. Even though the price becomes increasingly far removed from the value justified by economic fundamentals, each individual trader knows that he would lose money if he tried to buck the trend on his own. These rational speculative bubbles are an effective answer to Friedman's point that destabilizing speculators would lose money.

Everyone describes floating exchange rates as highly volatile. But volatile compared to what? They are more volatile than they were expected to be before the 1973 move to floating rates, more volatile than the prices of goods and services, and more volatile than apparent monetary fundamentals. This is not the same, however, as saying that they are excessively volatile. Even if foreign exchange markets are functioning properly, fundamental economic determinants, such as monetary policy, should produce a lot of variability in the exchange rate. Dornbusch's (1976) famous "overshooting theory" of exchange rate determination, for example, predicts that a relatively small increase in the money supply will cause a relatively large increase in the price of foreign exchange. The important question is whether volatility is higher than

necessary.

Econometric research has failed to explain most exchange rate movements by fundamentals, especially on a short-term basis.[3] Logically, this failure leaves two possible explanations: 1) unobservable fundamentals, or 2) bubbles, defined as exchange rate movements not based on fundamentals. In the first case, we would still be subject to the standard presumption of neoclassical economics that if volatility were somehow suppressed in the foreign exchange market, it would simply show up elsewhere. Imagine, for example, that the fundamental origin of the appreciation of the dollar in the first half of the 1980s were an increase in worldwide demand for U.S. goods, and therefore an increase in demand for U.S. currency to buy those goods (a real appreciation). An attempt on the part of the U.S. monetary authorities to suppress the appreciation would consist of purchases of foreign currencies, putting more dollars in the hands of the public. This increase in the U.S. money supply would have been inflationary. The increase in U.S. relative prices (the real appreciation) would have occurred anyway, but it would simply have taken the undesirable form of inflation. Can we judge that exchange rate movements are due to unobservable fundamentals, rather than bubbles?

Arguing against the unobservable fundamentals explanation is the pattern noted in the preceding section; nominal and real exchange rate variability increases upon a shift from a fixed to a floating regime. Furthermore, there is no reduction in the variability of monetary fundamentals necessary to keep the exchange rate in line, when moving from floating rate regimes to target

[3] Frankel and Rose (1995) survey the empirical literature on exchange rate determination.

zone regimes, or to fixed rate regimes.[4] This seems to leave speculative bubbles as the remaining explanation for much of the short-term variation in exchange rates. It would likely follow that exchange rates are unnecessarily volatile.

2.3. The Advantages of a Fixed Rate vs. the Advantages of Floating

The two big advantages of fixing the exchange rate are 1) to reduce transactions costs and exchange rate risk, which can discourage trade and investment, and 2) to provide a credible nominal anchor for monetary policy. The big advantage of a floating exchange rate is the ability to pursue an independent monetary policy.[5] In this section we elaborate on these conflicting advantages, before seeing how they depend on characteristics of the country in question, specifically the strength of its economic links to its neighbors.

Twenty or thirty years ago, the argument most often made against floating currencies was that higher exchange rate variability would create uncertainty; this risk would in turn discourage international trade and investment. Fixing the exchange rate in terms of a large neighbor would eliminate exchange rate risk, and so encourage international trade and investment. Going one step farther, and actually adopting the neighbor's currency as one's own, would eliminate transactions costs as well, and thus promote trade and investment still more.

Most academic economists tend to downplay this argument today. It is not that exchange

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[4] Flood and Rose (1995) and Rose (1994).

[5] To be sure, other factors enter as well. Another advantage of fixed exchange rates, for example, is that it prevents competitive depreciation or competitive appreciation. Another advantage of having an independent currency is that the government retains seigniorage. Most of the important factors, however, can be lumped into the major arguments presented in the text.

rate uncertainty has been small. On the contrary, variability has been very high, as already noted. But the *effect* of this variability is thought to be relatively low. One reason is that exchange rate risk can be hedged, through the use of the forward exchange market and other instruments. (There are costs to hedging, both in terms of bid-ask spread and in terms of a possible exchange risk premium. These are generally thought to be small, however, especially the bid-ask spread.) Another reason is that there have been quite a few empirical studies of the effect of exchange rate volatility on trade, and some on investment; most of them find small adverse effects, if they find any at all.[6]

Nevertheless, this argument still carries some weight. It looms large in the minds of European policy-makers and business-people. Promoting trade and investment in Europe was certainly a prime motivation for the European Monetary System, and for the planned EMU. The importance of exchange rate risk and transactions costs in this regard was emphasized by the European Commission (1990). Furthermore, there has not been satisfactory testing of the proposition that trade and investment are substantially boosted by full monetary union. In the case of monetary union, even the *possibility* of a future change in the exchange rate is eliminated, along with all transactions costs. Some recent tests of economic geography suggest that Canadian provinces are far more closely linked to each other than they are to nearby states of the U.S., whether the links are measured by prices or quantities of trade. High on the list of possible reasons why trade seems to be so much higher between provinces within a federation such as

[6] Surveys of the literature are included in Edison and Melvin (1990) and Goldstein (1995). Recent cross-section research that finds statistically significant effects of bilateral exchange rate variability on bilateral trade in the 1960s and 1970s is Frankel and Wei (1995a,b, 1997). The negative effect disappears, however, after 1980. The increasing use of hedging techniques is a possible explanation.

Canada than between countries, is the fact that the provinces share a common currency.[7]

Of the advantages of fixed exchange rates, academic economists tend to focus most on the nominal anchor for monetary policy. The argument is that a central bank that wants to fight inflation can commit more credibly by fixing the exchange rate, or even giving up its currency altogether. Workers, firm managers, and others who set wages and prices then perceive that inflation will be low in the future, because the currency peg will prevent the central bank from expanding even if it wanted to (without rapidly jeopardizing the viability of the exchange rate peg). When workers and firm managers have low expectations of inflation, they set their wages and prices accordingly. The result is that the country is able to attain a lower level of inflation (for any given level of output). This is an argument why countries like Italy, Spain, and Portugal, which had high inflation rates in the 1970s, were eager to tie their currencies to those of Germany and the rest of the EMS countries. In essence, they hoped to import the inflation-fighting credibility of the Bundesbank. Svensson (1994) provides a cogent evaluation of this argument.

The advantages of a flexible exchange rate can mostly be grouped under one major aspect: it allows the country to pursue independent monetary policy. The argument in favor of monetary independence, as opposed to constraining monetary policy by the fixed exchange rate, is the classic argument for discretion, as opposed to rules. When the economy is hit by a disturbance, such as a shift in worldwide demand away from the goods it produces, the government would like to be able to respond, so that the country does not go into recession. When the exchange rates in managed, monetary policy is always diverted, at least to some extent, to dealing with the balance

[7] See McCallum (1995) for trade and Engel and Rogers (1994, 1997) for prices.

of payments. Under the combination of perfectly fixed exchange rates *and complete integration of financial markets*, which characterizes the plans for EMU, monetary policy becomes completely powerless. Under these conditions, the domestic interest rate is tied to the foreign interest rate. An expansion in the money supply has no effect: the new money flows out of the country, via a balance of payments deficit, just as quickly as it is created. In the face of an adverse disturbance, the country must simply live with the effects. After the fall in demand, the recession will last until wages and prices are bid down, or until some other automatic mechanism of adjustment takes hold.

By freeing up the exchange rate, on the other hand, the country can respond to a recession by monetary expansion and a depreciation of the currency. This stimulates demand for domestic products and returns the economy to desired levels of employment and output more rapidly than would the case under the automatic mechanisms of adjustment.

Which factors are likely to dominate, the advantages of fixed exchange rates or the advantages of floating? The answer must depend, in large part, on characteristics of the country in question. For example, if the country is subject to many external disturbances, such as fluctuations in foreigners' eagerness to buy domestic goods and domestic assets (perhaps arising from business cycle fluctuations among the country's neighbors), then it is more likely to want to float its currency. In this way it can insulate itself from the foreign disturbances, to some degree. On the other hand, if the country is subject to many internal disturbances, such as fluctuations in the construction industry, then it is more likely to want to peg its currency. However, the optimum exchange rate regime chosen also depends on the nature of the disturbances, i.e.,

whether they are real or monetary in nature.

Many of the country characteristics that are most important in this context are closely related to the size and openness of the country. This observation brings us to the theory of the Optimum Currency Area.

3. Optimum Currency Areas

We begin this section by reviewing the OCA theory, highlighting the role of integration and income correlations. Then we discuss the endogeneity of these parameters.

3.1. The Traditional Theory of Optimum Currency Areas

Countries that are highly integrated with each other, with respect to trade and other economic relationships, are more likely to constitute an optimum currency area. An optimum currency area is a region for which it is optimal to have its own currency and its own monetary policy. This definition can be given some more content by assuming that smaller units tend to be more open and integrated than larger units. Then an OCA can be defined as *a region that is neither so small and open that it would be better off pegging its currency to a neighbor, nor so large that it would be better off splitting into sub-regions with different currencies.*[8]

Why does the OCA criterion depend on openness? The advantages of fixed exchange rates increase with the degree of economic integration, while the advantages of flexible exchange

[8] The classic references are Mundell (1961) and McKinnon (1963). A recent survey is Tavlas (1992). The issues are also

rates diminish. Recall the two big advantages of fixing the exchange rate that we identified above: 1) to reduce transactions costs and exchange rate risk that can discourage trade and investment, and 2) to provide a credible nominal anchor for monetary policy. If traded goods constitute a large proportion of the economy, then exchange rate uncertainty is a more serious issue for the country in the aggregate. Such an economy may be too small and too open to have an independently floating currency. In the limit, imagine that the regions within Sweden, or even individual neighborhoods of Stockholm, each had their own currency. Then every time someone wished to cross from one neighborhood to another, he or she would have to consult the listings for the day's exchange rate, and go to a bank to exchange currency. Clearly the transactions costs would be prohibitive. At the same time, because fixing the exchange rate in a small open country goes further toward fixing the entire price level, an exchange rate peg is more likely to be credible, and thus more likely to succeed in reducing inflationary expectations.[9]

Furthermore, the chief advantage of a floating exchange rate, the ability to pursue an independent monetary policy, is in many ways weaker for an economy that is highly integrated with its neighbors. This is because there are ways that such a country or region can cope with an adverse shock even in the absence of discretionary changes in macroeconomic policy. Consider first, as the criterion for openness, the marginal propensity to import. Variability in output under a fixed exchange rate is relatively low when the marginal propensity to import is high; openness acts as an automatic stabilizer, dampening the effect of domestic disturbances.

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reviewed by Bayoumi and Eichengreen (1994).

[9] Romer (1993).

Consider next, as the criterion of openness the ease of labor movement between the country in question and its neighbors. If the economy is highly integrated with its neighbors by this criterion, then workers may be able to respond to a local recession by moving across the border to get jobs, so there is less need for a local monetary expansion or devaluation. Of course the neighbor may be in recession too. *To the extent that business in the two economies are correlated,* however, *monetary independence is not needed in any case: the two can share a monetary expansion in tandem.* There is less need for a flexible exchange rate between them to accommodate differences.

Consider, finally, a rather special kind of integration: the existence of a federal fiscal system to transfer funds to regions that suffer adverse shocks. The existence of such a system, like the existence of high labor mobility or high correlation of business cycles, makes monetary independence less necessary.[10]

In the remainder of this study, we will focus particularly on two of these OCA criteria: the extent of trade among members of a given grouping, and the correlation of their incomes. The two axes in Figure 2 represent these two parameters. The OCA line is downward-sloping: the advantages of adopting a common currency depend positively on trade integration and the disadvantages of abandoning monetary independence (which is the same thing) depend negatively

[10] Stretching the definition of integration even further, another kind of integration, more political in nature, can help reduce the need for monetary independence: to the extent that domestic residents have economic priorities, especially on fighting inflation versus unemployment, that are similar to those of their neighbors their will be less need for a differentiated response to common shocks. (Corden, 1972; and Alesina and Grilli, 1991.) Finally, to the extent that individuals think of themselves as citizens of Europe more than citizens of their own county, they may be willing on political grounds to forego discretionary monetary responses even to disturbances that are so large that a national policy response would be in their economic advantage.

on income correlation.[11] Points high up and to the right represent groupings that should adopt a common currency among themselves; those down and to the left represent groupings that should float.

3.2. A Contrary View

The logic that integration counts favorably in the decision to peg one's currency to a neighbor (even holding constant patterns of economic activity and income correlation) was challenged early on by Peter Kenen (1969). He argued that regions that are highly diversified in production economically are better off (which is clearly true), and that such regions are better candidates to fix their currencies to those of neighbors than regions that are more specialized in production (which we think questionable).

We note here an apparent drawback to the Kenen view that diversification is a good OCA criterion. The drawback derives merely from the logic of drawing boundaries around ever-larger geographical areas. Stipulate that the joining of two or more regions forms a larger unit that tends to be more highly diversified as a whole than are the regions considered individually. Then if an individual region is sufficiently diversified to pass the Kenen test for pegging its currency to a neighbor, it follows that the larger (more diversified) unit that is thereby created will pass the test by an even wider margin. It thus will want to peg to other neighbors, forming still larger units, and so forth. The process will continue until the entire world is on one currency.

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[11] We assume in this project that effective capital controls are not an option. Thus fixing the exchange rate is the same thing as abandoning monetary independence.

What if the individual regions are not sufficiently diversified to pass the Kenen criterion to begin with? Then, under the OCA logic, they should break up into smaller currency units (say, provinces) that float against each other. But these smaller units will be even less diversified, and thus will fail the Kenen criterion by a wider margin, and will thus decide to break up into still smaller units (say counties). The process of dissolution will continue until the world is down to the level of the (fully-specialized) individual.

In other words, the system is unstable. No interior solution is an equilibrium. Admittedly, governments might not in practice use the OCA criterion in choosing their regime. But it is disturbing to think that if governments did follow the "correct" OCA criterion, the outcome must be either a world of one currency or a world of 5 billion.

The world seems, rather, to consist of intermediate-sized units. They occasionally join together in attempts to form larger currency areas, or split apart into smaller ones. The world, however, is steadily pushed away from either the extreme of a system of overly small, open, specialized currency units, or the extreme of a system of overly large, closed, diversified units. This suggests that regions are better candidates for an OCA when they are specialized, not worse.

3.3. Is Europe an Optimum Currency Area? The Comparison With the U.S.

Plans for eventual monetary union, agreed upon at Maastricht in 1991, ran into serious difficulty in the crises of 1992 and 1993. Since then, the membership of the European Community has expanded into an even larger European Union, with the accession of Austria, Finland, and

Sweden. Is this too large or diverse a collection of countries to constitute an optimum currency area?

The discussion of optimum currency areas above noted several economic criteria, generally falling under the rubric of the degree of economic integration. We have seen that regional units are more likely to benefit, on net, from joining together to form a monetary union if: 1) there is high degree of labor mobility among them, 2) there exists a federal fiscal system to transfer funds to regions that suffer adverse shocks, 3) they trade a lot with each other, or 4) the business cycles they face are highly correlated.[12]

Each of these criteria can be quantified, but it is very difficult to know what is the critical level of integration at which the advantages of belonging to a currency area outweigh the disadvantages. The states of the United States constitute a possible standard of comparison. It seems quite clear that the degree of openness of the states, and the degree of economic integration among them, are sufficiently high to justify their use of a common currency. How do the members of the European Union compare to the states in this regard? US states appear to be more open than European countries, by both the trade and labor mobility criteria. It appears that when an adverse shock hits a region of the US such as New England or the oil states of the South, out-migration of workers is the most important mechanism whereby unemployment rates and wages are eventually re-equilibrated across regions.[13] Labor mobility among European countries is much lower than in the United States.

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[12] The phrase "symmetric" has become standard to refer to shocks shared in common by two or more countries. We believe that the word "correlated" is preferable, reserving symmetric to describe a group of countries that have the same correlations with each other (and with others), regardless whether the correlations within the group are 1.

When disparities in income do arise in the United States, federal fiscal policy helps to narrow them. Estimates suggest that when a region's per capita income falls by one dollar, the final reduction in its disposable income is only 60 cents. The difference consists of an automatic decrease in federal tax receipts of 34 cents plus an automatic increase in unemployment compensation and other transfers of 6 cents. Neither the fiscal transfer mechanisms that are already in place within the European Union nor those that are contemplated under EMU (so-called "structural funds" or "cohesion funds") are as large as those in the U.S. federal fiscal system.[14]

Finally, disturbances across U.S. regions have a relatively high correlation, compared to members of the European Union.[15]

Judged by these optimum currency area criteria, the European Union is not as good a candidate for a monetary union as is the United States. This helps account for the troubles that the Maastricht plan has encountered. In Figure 2, we have drawn the U.S. states as lying well into the OCA zone, and the Germany-Netherlands-Luxembourg-Belgium grouping as a little over the OCA line. We have represented the wider group of European countries that includes the UK, Italy and Spain as featuring degrees of trade integration and income correlation that are too small to warrant currency union. We have not explicitly placed other northern European countries, such as France, Denmark, and Sweden on the graph, as we believe that their position is sufficiently unclear that it must await empirical analysis.

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[13] Blanchard and Katz (1992).
[14] Sala-i-Martin and Sachs (1991). Lower estimates of the coefficients are suggested by some others.
[15] Bayoumi and Eichengreen (1993).

4. The Degree of Integration—and Therefore the OCA Criterion—is Endogenous

The extent of European integration is increasing over time, partly as a result of such steps as the single market program of 1992, which removed barriers to trade and labor mobility. Even if EU members such as Italy and the UK in 1992 did not satisfy the criteria for joining the optimum currency area in the 1990s, perhaps they will in the future. This point is especially acute for new members such as Sweden. The effect of EU accession in 1995 will be to promote Sweden's trade with other European countries. Statistical estimates using the gravity model of bilateral trade suggest that membership in the EU increases trade with its members by roughly 50 percent.[16] The effect of Sweden's EU accession may well be smaller, since trade with the EU countries was already relatively free. Nevertheless, Sweden is moving rightward in the Figure, making it more likely that it will satisfy the OCA criterion in the future than in the past.

Some residents of Sweden are under the impression that trade has already expanded so much, particularly with its European neighbors, that no further increase in trade is to be expected in the future. In this respect, Swedes are like Americans, Japanese, and everyone else. Over the last fifty years, trade as a share of income has increased sharply all over the world, typically doubling or more. People thus imagine that they have achieved perfect integration, that they trade as much with residents across the continent or across the globe as they do with residents across town. We hear that distance and borders no longer matter. But this is not the case.

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[16] The Frankel and Wei papers cited above provide estimates, and other citations to the literature. Parenthetically, the estimated effects of EFTA are much less strong than those of the EC or EU. We also provide new results consistent with this estimate in table 2 below.

Sweden's international trade (either exports or imports) is about a third of its GDP. Over two-thirds of this trade is with members of the EU. These numbers are high, and much higher than they were 50 years ago. But they do not represent complete integration. To see this, note that Sweden's share of Gross World Product is less than one percent.[17] If Swedes indeed traded with foreigners as easily as with each other, then Swedish goods would occupy the same tiny share of Swedish consumption as they occupy of world consumption: slightly over .5%. Instead, domestic goods are at least one hundred times more important than that.[18] Sweden's share of EC income (the 12) is just over 3% (3.13%=.0058/.1851). If Swedes indeed traded with other Europeans as easily as with each other, then Swedish goods would occupy the same share of Swedish consumption as they occupy of European consumption: 3.13 %. Instead, domestic goods are over an order of magnitude more important than that in domestic consumption.[19]

Sweden (like all countries) has a long way to go before it achieves perfect integration. If it follows the pattern that other countries follow, it will continue in the future to become gradually more integrated with the rest of the world, and especially so with the rest of Europe, as a result of policy programs such as the European Economic Area agreement of 1993 and the 1995 accession to the EU.

What about the other parameter, the degree of income correlation among members? We come now to a key point. *Income correlation surely depends on trade integration.*

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[17] On a PPP basis using 1991 numbers, it is .58 percent; $148 billion/(5710$ billion/.2247).

[18] Since in 1994, Swedish exports were 557 bn kronor, imports were 492 bn kronor, private consumption was 820 bn kronor, and GDP was 1516 bn kronor.

[19] Of course some, but not all, of this apparent bias for domestic goods stems from the intrinsically non-tradable nature of some goods and services.

Our hypothesis is that this relationship is positive: the more Sweden trades with the EU, the more will Swedish income be correlated with EU income. We think it evident that the incomes of U.S. states, for example, are highly correlated with each other because their economies are highly integrated. The result would be immediate in a demand-driven model (where the correlation of income depends in a simple way on the marginal propensities of the two countries to import from each other), but it could also follow in a variety of other models (e.g., productivity shocks spilling over via trade). Thus we have drawn the correlation function as upward sloping in Figure 3.

Consider what happens when Sweden joins the EU. Not only does trade integration increase, but so does income correlation. We move up and to the right. The advantages of pegging rise and the disadvantages fall. On both scores, the country comes closer to meeting the OCA criterion than before.

4.1. The OCA Criterion Might Be Satisfied *Ex Post*, Even if not *Ex Ante*

Now consider what happens when Sweden decides to join EMU (European Economic *and Monetary* Union). The elimination of exchange rate uncertainty and currency transaction costs stimulates trade with other EU members. Integration and correlation rise further. Based on the statistical evidence, we believe that the stimulus to trade from stabilizing the exchange rate is rather small, but still positive. The advantages to eliminating different currencies altogether probably adds something more, above and beyond the elimination of exchange rate variability

(although this amount is much more difficult to quantify, given the lack of historical evidence). The way we have drawn Figure 4, even though Sweden fails the OCA criterion given its current structure of trade, a decision to go ahead and join anyway could promote trade and raise the income correlation enough to put it over the line. That is, Sweden could satisfy the OCA criterion *ex post*, even though it fails *ex ante*.[20]

The relationship that we have pictured corresponds to the view of the Commission of the European Communities (1990). But it is not universally accepted among those who have considered the endogeneity of trade patterns and income correlations. Several authors have pointed out (correctly, in our view) that as trade becomes more highly integrated, countries specialize more in production; they have then gone on to argue (probably incorrectly, in our view) that this greater specialization will *reduce* the correlation of incomes. Their logic is apparently that only supply shocks matter, and that these will become less correlated due to specialization. If Sweden specializes now in Volvos and timber, and imports all its motorcycles and milk, shocks such as paper gluts and bovine diseases will have increasingly different impacts on Sweden's economy as compared to Europe's. The correlation function would in that case slope downward, as we have drawn it in Figure 4. An increase in integration would actually move Sweden *away* from the OCA region.[21] These authors claim that *the country might fail the OCA criterion ex*

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[20] This is essentially an application of the celebrated Lucas (1976) critique of inappropriate policy analysis based on a naïve view of the historical evidence. Here we focus on changes in international trade and international correlations of business cycles which might result from Swedish entry into EMU. However, this sort of analysis can be applied much more broadly. For instance, Swedish monetary policy and therefore the nature of Swedish business cycles is likely to change as a result of EMU, whether Sweden enters or not; international investment patterns are also likely to change radically.

[21] We have drawn the correlation function as steeper than the OCA line, on the grounds that if economists disagree about whether the slope is positive or negative, then the line must be relatively steep. Obviously this logic is far from airtight.

post, even if it passes it ex ante. (This outcome would hold regardless whether the increase in integration were due to exogenous forces such as falling transport costs, a deliberate trade policy decision such as joining the EU, or a deliberate monetary policy decision such as joining EMU. At present, we focus on the last source of increased integration: if exchange rate risk and transactions costs matter for trade patterns, then trade integration is endogenous with respect to the currency regime.)

The authors to whom we refer are not minor figures. Examples include Barry Eichengreen (Eichengreen, 1992, pp.14-16; Bayoumi and Eichengreen, 1994, pp.4-5) and Paul Krugman (1993).[22] Their view that specialization works against common currencies, and that diversification of the economy works in favor of it, goes back to Kenen. While casual empiricism leads us to the view that integration leads to higher correlations, it is certainly possible that the Eichengreen-Kenen-Krugman view is the right one. There is no substitute for formal empiricism. We now turn to that task.

5. Econometric Analysis

In this section, we present some empirical evidence on the relationship between bilateral income correlations and bilateral trade intensity. The evidence is consistent with a strong positive effect of trade intensity on income correlations.

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[22] "Theory and the experience of the US suggest that EC regions will become increasingly specialized, and that as they become more specialized they will become more vulnerable to region-specific shocks. Regions will, of course, be unable to respond with counter-cyclical monetary or exchange rate policy" (Krugman, 1993, p.260).

5.1. Introduction

The main goal of our empirical work is to ascertain whether income correlation depends positively on trade integration or negatively, i.e., whether Figure 4 or Figure 5 best represent the world. To do this, we examine the historical experience of a variety of countries.

It is not enough to estimate income correlations and measures of trade integration, and to see whether the two are positively related. Countries are likely deliberately to link their currencies to those of some of their most important trading partners, in order to reduce exchange rate risk and partake of the other advantages of exchange rate stability outlined above. In doing so, they lose the ability to set monetary policy independently of those neighbors. The fact that their monetary policy will be closely tied to that of their neighbors could result in an observed positive association between trade links and income links. In other words, the association could be the *result* of countries' application of the OCA criterion, rather than an aspect of economic structure that is invariant to exchange rate regimes.

To identify the effect of bilateral trade patterns on income correlations, we need exogenous determinants of bilateral trade patterns. We use the exogenous variables of the gravity model, such as distance, and variables representing a common border or language. In this way we hope to see whether an exogenous increase in trade between two countries raises or lowers the correlation between their incomes.

5.2. Related Results from the Literature

Cohen and Wyplosz (1989) examined the correlation of output growth rates for Germany and France, while Weber (1991) did so for other members of the European Community. Bayoumi and Eichengreen (1993a,b,c, 1994) argue that these studies conflate information on the incidence of disturbances and on economies' responses; thus they use a structural vector auto-regression approach to distinguish underlying aggregate demand and aggregate supply disturbances from the subsequent dynamic response. One grouping that they find a plausible candidate for monetary unification is a northern European collection comprising Germany, France, the Netherlands, Belgium, Denmark, Austria, and perhaps Switzerland (but excluding other European countries).[23]

De Grauwe and Vanhaverbeke (1993) find that "asymmetric" or idiosyncratic shocks tend to be more prevalent at the level of regions within a country than at the level of nations within Europe. This seems to support the pessimistic Eichengreen-Krugman view that as countries become more integrated (more like regions within each country are now), their incomes will become less closely tied together. De Grauwe-Vanhaverbeke do not measure income links by correlations, however. Instead of taking the correlations of percentage changes in income between two regions, they take *the standard deviation of the difference* in percentage changes in income between the two regions. This is a less useful measure of income links. There is every reason to think that the variance of income at the regional level is much higher than the variance of income at the national level: because national income is the sum of regional income, some of the local variation will cancel out (despite a correlation). But if regional variances are larger than national variances, then some simple algebra can show that the variance of regional differences

[23] Sweden -- but not Norway, Iceland or Finland -- appears to belong in the core group, in estimates in Bayoumi and

can appear larger than the variance of national differences, even though regional incomes are in fact more highly correlated than national variances.[24]

Close in spirit to our view is a recent paper by Artis and Zhang (1995), which finds that most European countries' incomes were more highly correlated with the U.S. during 1961-79, but (with the exception of the UK) have become more highly correlated with Germany since joining the ERM. (Of course the Eichengreen point applies: the correlation may be the result of the loss of monetary independence, rather than of the increased trade.) Evidence in Honkapohja and Pikkarainen (1992) supports our idea that countries with a high degree of specialization are more likely to find it desirable to peg their exchange rate.

5.3. Measuring Trade and Income Links

Our empirical analysis relies on two key variables: bilateral trade intensity; and bilateral correlations of real economic activity. We discuss these in turn.[25]

We are interested in the bilateral intensity of international trade between two countries, i and j at a point in time t. We use three different proxies for bilateral trade intensity. The first uses export data exclusively; the second uses only imports, and the final and preferred measure uses both exports and imports:

Eichengreen (1993b).

[24] The reason is that the correlation coefficient is defined as the covariance divided by the product of the square root of the respective variances.

[25] The STATA 4.0 data set and programs are available during 1996 upon receipt of two formatted 3.5" diskettes and a self-addressed, stamped mailer.

$$wx_{ijt} = X_{ijt}/(X_{i.t} + X_{j.t})$$

$$wm_{ijt} = M_{ijt}/(M_{i.t} + M_{j.t})$$

$$wt_{ijt} = (X_{ijt} + M_{ijt})/(X_{i.t} + X_{j.t} + M_{i.t} + M_{j.t})$$

where: X_{ijt} denotes total nominal exports from country i to country j during period t; $X_{i.t}$ denotes total global exports from country i; and M denotes imports. In practice we take natural logarithms of all three ratios.

There are a variety of problems associated with bilateral trade data (e.g., $X_{ijt} \neq M_{jit}$). Our data measure actual trade rather than potential trade which would exist if conditions were slightly different. Further, from a theoretical point of view, it is unclear which set of weights is optimal; some countries may have specialized exports or imports. Thus we conduct our tests with all three measures of trade intensity. Reassuringly, our answers appear to be insensitive to the exact way that we measure trade intensity.

The bilateral trade data are taken from the International Monetary Fund's *Direction of Trade* data set.[26] The data are annual and cover twenty-one industrial countries from 1959 through 1993.[27]

Our other important variable is the bilateral correlation between real activity in country i and country j at time t. Again, it is difficult to figure out the optimal empirical analogue to the theoretical concept. We therefore use a variety of different proxies.

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[26] Much of the data set was kindly provided by Tam Bayoumi.

[27] The countries are: Australia; Austria; Belgium; Canada; Denmark; Finland; France; Germany; Greece; Ireland; Italy; Japan; Norway; Netherlands; New Zealand; Portugal; Spain; Sweden; Switzerland; the UK; and the US. In future work, we hope to include developing countries.

Two of our four real variables are taken from the International Monetary Fund's *International Financial Statistics*; the other pair are taken from the OECD's *Main Economic Indicators*. All the data are quarterly, covering (with gaps) the same sample of countries and years as the trade data.

We use four different measures of real economic activity: real GDP (typically IFS line 99); an index of industrial production (line 66); total employment (OECD mnemonic "et"); and the unemployment rate ("unr").

We transform our variables in two different ways. First, we take natural logarithms of each variable except the unemployment rate. Second, we de-trend the variables. Given the importance of different de-trending procedures, and the lack of consensus about optimal de-trending techniques, we employ four different de-trending methodologies.

First, we take simple fourth-differences of the (logs of the) variables (i.e., we subtract the fourth lag of e.g., real GDP from the current value), multiplying by 100 (so that the resulting variable can be interpreted as a growth rate). Second, we de-trend the variables by examining the residual from a regression of the variable on a linear time trend, a quadratic time trend, and three quarterly dummies. Third, we de-trend the variables using the well-known Hodrick-Prescott ("HP") filter (using the traditional smoothing parameter of 1600). Finally, we apply the HP filter to the residual of a regression of the variable on a constant and quarterly dummies.

(We have also constructed a fifth transformation of our dependent variable. This is similar to our second variant in that we de-trend the variables by examining the residual from a regression of the variable on a set of controls. But we add a control which is meant to account for the

dependency of the economy to imported oil price shocks. In particular, we take the real price of oil (the price of oil in dollars per barrel, divided by the CPI for industrial countries), and multiply it by net exports of fuel, expressed as a percentage of nominal GDP. This variable, meant to measure the degree of dependency on imported oil, is then added to our other control variables including linear and quadratic time trends, and quarterly dummies.)

After appropriately transforming our variables, we are able to compute correlations for real activity. These correlations are estimated (for a given concept of real economic activity), *between* two countries *over* a given span of time. Thus, for instance, we estimate the correlation between real GDP de-trended with the HP filter for two countries I and j over the first part of our sample period. We begin by splitting our sample into four equally-size parts: the beginning of the sample through 1967Q3; 1967Q4 through 1976Q2; 1976Q3 through 1985Q1; and 1985Q2 through the end of the sample. To check for robustness, we also split our sample into only two parts, before and after (the end of 1974).

Simple scatter-plots of bilateral activity correlations against bilateral trade intensity reveal very little; the data appear to be clouds. Figure 6 is a set of sixteen scatter-plots (four measures of activity, each de-trended four ways) of bilateral activity correlations against the log of total trade intensity; Figures 7 and 8 are the analogues for import and exports weights. Finally, Figure 9 focuses on Swedish data. It provides only four scatter-plots (corresponding to the four different measures of economic activity), all de-trended with fourth-differencing, and all simply graphed against the log of total bilateral trade intensity. The Swedish observations are highlighted with diamonds. Again, no simple relationship is apparent.

5.4. Methodology

The regressions we estimate take the form:

$$Corr(v,s)_{i,j,\tau} = \alpha + \beta Trade(w)_{i,j,\tau} + \varepsilon_{i,j,\tau}.$$

$Corr(v,s)_{i,j,\tau}$ denotes the correlation between *country i* and *country j* over *time span* τ for *activity concept v* (corresponding to: real GDP (y); industrial production (i); employment (e); or the unemployment rate (u)), *de-trended with method s* (corresponding to: fourth-differencing (d); quadratic de-trending (t); HP-filtering (h); HP-filtering on the SA residual (s); or quadratic de-trending with the oil control (o)). $Trade(w)_{i,j,\tau}$ denotes the natural logarithm of the average bilateral trade intensity between country i and country j over time span τ using *trade intensity concept w* (corresponding to: export weights (x); import weights (m); or total trade weights (t)). Finally, $\varepsilon_{i,j,\tau}$ represents the myriad influences on bilateral real activity correlations above and beyond the influences of international trade, while α and β are the regression coefficients to be estimated.

We have sixteen versions of the regressand (as we consider four activity concepts and four de-trending methods) and three versions of the regressor (since we have three sets of trade weights).

The object of interest to us is the slope coefficient β. We are interested in both the sign and the size of the coefficient. The *sign* of the slope tells us whether the Eichengreen-Krugman

specialization dominates (in which case we would expect a negative β, since more intense trading relations would be expect to lead to more idiosyncratic business cycles and hence a lower correlations of economic activity) or the expected traditional effect prevails (in which case β would be expected to be positive). The *size* of the coefficient allows us to quantify the economic importance of this effect.

Parenthetically, estimation of β is potentially complicated by a number of issues that we ignore in our first pass through the data. The observations are not truly independent since the French-Belgian observation for the first quarter of the sample is likely to be dependent both on e.g., the French-Belgian observation for the second quarter and the French-Dutch observation for the first quarter. We initially ignore such cross-sectional dependence in computing our covariance matrices, and instead try simply not to take their precise size too seriously (it turns out there is no need to do so). A second problem with interpreting the covariance matrix is that the regressor is generated. We plan to address these problems directly in future work.

5.5. Results

Ordinary least squares (OLS) estimates of β are tabulated in Table 1. The estimates (along with their standard errors) are presented in three columns, corresponding to the three different measures of bilateral trade intensity. For each measure, sixteen estimates (four measures of economic activity each de-trended in four different ways) are presented in the rows.

The estimates indicate that a closer trade linkage between two countries is strongly and consistently associated with more tightly correlated economic activity between the two countries.

The size of this effect depends on the exact measure of economic activity (as is expected), but does not depend very sensitively on the exact method of de-trending the data or the measure of bilateral trade intensity. Parenthetically, the adjustment for the oil price reduces the size of the coefficients slightly, although they remain positive and significant.

We have checked these results in a number of different ways, and they seem to be robust. For instance, a consistently positive estimate of β appears whether or not the trade intensity measure is transformed by natural logarithms, and whether or not the observations are weighted by country size. More importantly, the results do not appear to be very sensitive to the exact sample chosen. The data from the last quarter of the sample show more evidence of a strongly positive estimate of β than does that from the first quarter, but the exact choice of countries does not matter. We have also tested for the importance of important non-linearities in the relationship between trade intensity and activity correlations by estimating the equation with a non-parametric data smoother (similar to locally weighted regression but without neighborhood weighting); the non-linear effects are typically statistically insignificant and the strong positive effect of trade intensity on business cycle correlations is not affected. Adding either time-specific or country-specific "fixed effect" controls (or both) also does not affect the sign or statistical significance of β. Finally, we have split our data set into two sub-periods across time (instead of four), and re-estimated our equations. The resulting point-estimates of β remain quite similar to those recorded in Table 1.

The issue of simultaneous causation is potentially serious. For this reason, we take instrumental variable (IV) estimates of β more seriously than our OLS estimates. We use three

instrumental variables: the natural logarithm of the distance between the business centers of the relevant pair of countries; a dummy variable for geographic adjacency; and a dummy variable which indicates if the pair of countries share a common language. Each of these variables is expected to be correlated with bilateral trade intensity, but can reasonably be expected to be unaffected by other conditions which affect the bilateral correlation of economic activity.

Direct evidence on the "first-stage" linear projections of (the natural logarithm of) bilateral period-average trade intensity on our three favored instrumental variables is presented in Table 2. Distance (more precisely, the natural log thereof) is strongly negatively associated with trade intensity, as predicted by standard "gravity" models of international trade. Countries that share either a common border or a common language also have significantly more trade than others. The first-stage equations appear to fit relatively well.

Also included in Table 2 is a minor perturbation to our standard first-stage equation, namely the "default equation" augmented by a variable registering membership in a regional trade agreement. There are two relevant agreements: 1) the US/Canada FTA, and its successor, NAFTA; and 2) the EEC/EC.[28] Membership in a regional trading agreement is strongly associated with more intense international trade in both an economic and statistical sense. Entry into a regional trade agreement appears to raise bilateral trade intensity by almost 50%. While the variable appears to be approximately orthogonal to our three default instrumental variables, we do not use it as one of our default instrumental variables since it is potentially associated with tighter

[28] We compute this variable by taking a pair-specific indicator variable (e.g., unity for UK/France in 1975, zero for the US/Japan in 1975) and estimating sub-period averages over time (e.g., the sub-period for the last quarter of the sample is non-zero for all EC-Spanish observations but the observations are not unity since Spain was not in the EC for the entire sub-sample; earlier Spanish observations are all zero).

income correlations directly (e.g., through exchange rate arrangements; there is a high correlation between EC and EMS membership). Happily, our β estimates are insensitive to inclusion or exclusion of the extra instrumental variable.

Instrumental variable estimates of β (estimated with our three default instrumental variables) are tabulated in Table 3, which is a direct analogue to Table 1. As expected, the results are consistent with the OLS results of Table 1, but they are somewhat stronger in both economic and statistical significance. The effect of greater intensity of international trade on the correlation of economic activity remains strongly positive and statistically significant, but is larger than the simple OLS estimates indicate. The oil-adjusted results are now slightly large than the other coefficients.

As with the OLS results, our IV estimates of β are robust to a wide range of perturbations to our basic econometric methodology. We have performed all the experiments mentioned in conjunction with Table 1 without disturbing our central results. We have also changed the list of instrumental variables in a number of different ways without changing our results. For instance, adding dummy variables for membership in GATT or regional trade arrangements as extra instrumental variables does not change our results, as does adding country population and output.

We have augment our relationship by adding a dummy variable that is unity if the two countries shared a bilateral fixed exchange rate throughout the sample. This is an important test. The Bayoumi-Eichengreen view is that the high correlation among European incomes is a result not of trade links, but of Europeans' decision to relinquish monetary independence vis-à-vis their neighbors. If this is correct, putting the exchange regime variable explicitly on the right-hand side

should show the effect, and the apparent effect of the trade and geography variables should disappear. Instead, the addition of this exchange rate variable does not significantly alter β. The actual estimates are provided in Table 4, which is an analogue of Table 3 (with the same instrumental variables) when the equation is augmented by an indicator variable which is unity if the pair of countries maintained a mutually fixed exchange rate during the relevant sample period. For simplicity, only the results with total trade weights are reported. The positive β coefficient still appears quite strong; indeed its sign and magnitude is essentially unchanged from Table 3. By way of contrast, the effect of a fixed exchange rate regime *per se* is not well determined. The coefficients vary in sign and magnitude depending on the exact measure of economic activity and de-trending method used to compute the bilateral activity correlation.[29]

We have also performed a more direct check for the importance of oil price shocks by augmenting our relationship with a variable meant to measure the degree of dependency on imported oil. This variable (the same used to adjust the oil-adjusted regressands tabulated in Tables 1 and 3) is the product of the real price of oil (the price of oil in dollars per barrel, divided by the CPI for industrial countries), and net exports of fuel, expressed as a percentage of nominal GDP. We add this variable to our default regression and estimate the coefficients with instrumental variables. The results are presented in Table 5. There are two sets of columns. The second is a minor perturbation, in that the extra regressor is the *percentage change* of the real oil price multiplied by next exports of fuel. Again, as in Table 4, the same instrumental variables as in Table 3 are used, and for simplicity, only the results with total trade weights are reported.

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[29] Results are not changed substantively if the actual bilateral exchange rate volatility is substituted for our indicator variable.

The positive β coefficient still appears quite strong; indeed its sign and magnitude is essentially unchanged from Tables 3 and 4. By way of contrast, the effect of oil price dependency is not firmly established. The coefficients vary in sign and magnitude when the level of the oil price is used. When the percentage change of the oil price is used, the oil price regressor has a consistently positive (though not always significant) coefficient. But the durable sign and significance of β is unaffected.

6. Conclusion: Should Sweden Join?

We have argued that the OCA criteria of trade links and income links are appropriate for evaluating the appropriateness of monetary union, while emphasizing that these "parameters" will change over time. Where does Sweden lie with respect to these criteria?

The trade intensity data show that, while Sweden trades somewhat more with European countries than it does with other parts of the world, it still has a long way to go before its trade with EU countries is as large as their trade with each other. The intensity of Sweden's total trade with the rest of the world is .019 (the average of exports and imports over the entire sample period). The intensity of Sweden's trade with EU partners is .021. By contrast, the average intensity of members of the original EC 12 with each other is .042. While geographical proximity explains a bit of the difference, the results of the gravity model suggest that length of membership in the EU explains some of the difference as well.[30] The implication is that Sweden's trade links with Europe will grow over time.

There is every reason to expect that deepening trade links between Sweden and the EU will result in Sweden's income becoming more highly correlated with European income. Swedish income is not especially highly correlated with EU income, and this relationship can be expected to develop over time as our regression analysis indicates. For instance, over the entire sample, the average correlation of (the fourth-difference of real) Swedish GDP with GDP in the rest of the world was .21. It was only .22 with EU members. By way of contrast, the comparable intra-EU GDP correlation averaged .31.

The OCA theory has certainly not developed far enough for us to be able to say what are the critical levels of trade links and income links, above which it is optimal for a country to peg its currency. Our analysis of OECD data is too limited to shed much empirical light on this issue. But the actual behavior of a wider cross-section of countries with respect to their choice of exchange rate regime provides a useful benchmark.

To accept that the OCA framework is the right one to use in making an optimal choice of exchange rate regime, is not the same as saying that most countries in fact use the OCA framework to make their choice. It has been argued that the theory has little explanatory power (Goodhart, 1995, p.452). But it clearly has *some* explanatory power. Very small and open countries are far more likely to have fixed exchange rates than large, less open, countries. Several researchers have shown that size, and other variables from the OCA theory, are significant determinants of the choice of exchange rate regime. Heller (1978) is an early example. Honkapohja and Pikkarainen (1992) also find that small countries are more likely to peg, as are

[30] The tendency of EU residents to buy from firms in other EU countries, rather than their own country, doubled

those with low diversification of exports (contradicting the Kenen hypothesis). Bayoumi and Eichengreen (1996) find that three OCA variables are helpful in explaining bilateral exchange rate variability among industrialized countries in the 1970s and 1980s: country size (measured by real GDP), the "symmetry of disturbances" (measured by the standard deviation in the difference in log output), and the magnitude of bilateral trade (measured relative to GDP).

To shed a little more light on this issue, we separated the 124 IMF member countries for which we have the relevant data into two simple categories of exchange rate regime: members of currency unions and countries with fixed exchange rates; and members with flexible exchange rates or intermediate exchange rate arrangements (using IMF "Exchange Rate Arrangement" Classifications). We then computed the mean level of openness (imports plus exports over income) in each category. The 33 countries with fixed exchange rates have an (unweighted) average level of openness which is 112% of GDP, much more open than the 91 floaters whose openness ratio is 42%. Sweden (like many European countries) is larger and less open than most of those in the fixed exchange rate category. If countries are acting intelligently, even on average, such numbers suggest that Sweden's trade links are not yet strong enough to justify fixing its exchange rate, let alone entering into a monetary union.

Why should a major industrialized country like Sweden be guided by the policy choices of mini-states like Panama and Swaziland? The key point here is that many larger countries have repeatedly tried to stabilize their exchange rates and have failed to sustain a peg, or even a band. One has only to recall the December 1994 peso crisis in Mexico, the January 1994 realignment of

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between 1982 and 1994 (holding income and other variables constant); Wei (1996).

the CFA franc in Africa, the August 1993 crisis of the French franc in the ERM, 1992 crises in the lira and pound (not to mention Sweden itself!), as well as many more failed attempts to stabilize currency values in the past.

The gravity model literature suggested that membership in the EU might eventually boost a country's trade by roughly 50 per cent, holding constant for other determinants of trade such as income, proximity, and so forth. Such numbers are estimated without complete precision. Moreover, the effect from Sweden's 1995 accession to the EU may well be much smaller, since free trade agreements were already in effect.[31] As imperfect as this basis of judgment is, we think that it is giving the right answer, qualitatively if not quantitatively: Sweden does not currently satisfy the OCA criterion. The advantages of tying its currency to that of the EMU would currently be outweighed by the disadvantages. One should take into account that the effect of joining a currency union would be to boost bilateral trade and income correlations somewhat. This means that Sweden might be ready for currency union even at a time when the trade and links fall a little short of the critical OCA threshold. Nevertheless, it would be unwise to exaggerate the magnitude of this effect, or the speed with which it operates. To peg prematurely would be to invite a crisis. A speculative attack might force a realignment on the occasion of the first major economic disturbance requiring adjustment, or even the first time that speculators perceive a need for adjustment. Sweden may come closer to satisfying the OCA criterion in 20 or 30 years. For the near-term future, we are skeptical.

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[31] The fact that there is a serious possibility that Swedish trade will *not* become much more EU-intensive and therefore Swedish business cycles will not become more highly synchronized with those of EMU members is an extra reason not to enter EMU immediately. This is especially true, given the rising importance of trade with

Table 1: Ordinary Least Squares Estimates of Effect of Trade Intensity on Income Correlation

Activity	De-Trending	Total Trade Weights	Import Weights	Export Weights
GDP	**Differencing**	7.1 (.88)	6.2 (.79)	6.7 (.85)
Ind Prod	**Differencing**	6.9 (.95)	5.5 (.83)	6.9 (.95)
Employ	**Differencing**	5.7 (1.1)	4.8 (1.0)	5.3 (1.1)
Unemp	**Differencing**	3.3 (.97)	2.5 (.87)	3.1 (.95)
GDP	**Quadratic**	7.2 (1.1)	6.3 (.99)	6.4 (1.1)
Ind Prod	**Quadratic**	8.3 (1.2)	7.2 (1.0)	7.6 (1.2)
Employ	**Quadratic**	6.2 (1.4)	6.1 (1.3)	4.8 (1.5)
Unemp	**Quadratic**	7.0 (1.4)	6.1 (1.3)	6.4 (1.5)
GDP	**HP-filter**	5.7 (.92)	4.2 (.85)	5.9 (.88)
Ind Prod	**HP-filter**	5.6 (1.0)	4.5 (.88)	5.5 (1.0)
Employ	**HP-filter**	6.6 (1.1)	5.7 (.99)	6.2 (1.0)
Unemp	**HP-filter**	3.4 (1.1)	2.6 (.95)	3.2 (1.0)
GDP	**HP-SA**	4.8 (.84)	3.9 (.78)	4.7 (.81)
Ind Prod	**HP-SA**	4.9 (.94)	3.9 (.81)	4.8 (.94)
Employ	**HP-SA**	6.5 (1.0)	5.7 (.92)	5.9 (.94)
Unemp	**HP-SA**	3.2 (1.0)	2.4 (.94)	5.9 (.98)
GDP	**Oil Adjusted**	4.7 (1.2)	3.8 (1.1)	4.7 (1.2)
Ind Prod	**Oil Adjusted**	6.3 (1.3)	5.3 (1.1)	5.9 (1.3)
Employ	**Oil Adjusted**	7.9 (1.5)	6.5 (1.4)	7.6 (1.4)
Unemp	**Oil Adjusted**	4.7 (1.5)	4.3 (1.3)	4.1 (1.4)

OLS estimate of β (multiplied by 100) from

$$Corr(v,s)_{i,j,\tau} = \alpha + \beta Trade(w)_{i,j,\tau} + \varepsilon_{i,j,\tau}.$$

South-East Asia and Central Europe.

Huber standard errors in parentheses. Intercepts not reported.

Bilateral quarterly data from 21 industrialized countries, 1959 through 1993 split into four sub-periods.

Maximum sample size = 840.

Table 2: First-Stage Estimates of Determinants of Bilateral Trade

	Total Trade Weights	Total Trade Weights	Import Weights	Import Weights	Export Weights	Export Weights
Log of Distance	-.45 (.03)	-.40 (.03)	-.52 (.03)	-.48 (.04)	-.43 (.04)	-.37 (.04)
Adjacency Dummy	1.03 (.14)	1.01 (.14)	.83 (.14)	.81 (.14)	1.21 (.16)	1.19 (.16)
Common Language	.51 (.11)	.51 (.11)	.58 (.11)	.58 (.11)	.48 (.13)	.48 (.13)
Regional Trade Member		.44 (.11)		.35 (.12)		.54 (.13)
N	840	840	839	839	840	840
RMSE	.98	.97	1.01	1.01	1.14	1.13
R^2	.39	.40	.40	.40	.33	.34

OLS estimates from

$$\text{Trade}(w)_{i,j,\tau} = \varphi_0 + \varphi_1 \text{Log(Distance)}_{i,j} + \varphi_2 \text{Adjacent}_{i,j} + \varphi_3 \text{Language}_{i,j} + \varphi_4 \text{Regional}_{i,j,\tau} + \nu_{i,j,\tau}.$$

Standard errors in parentheses. Intercepts not reported.

Bilateral quarterly data from 21 industrialized countries, 1959 through 1993 split into four sub-periods.

Maximum sample size = 840.

Table 3: Instrumental Variable Estimates of Effect of Trade Intensity on Income Correlation

Activity	De-Trending	Total Trade Weights	Import Weights	Export Weights
GDP	Differencing	10.3 (1.5)	10.2 (1.4)	9.7 (1.4)
Ind Prod	Differencing	10.1 (1.5)	9.8 (1.5)	9.8 (1.5)
Employ	Differencing	8.6 (1.8)	8.4 (1.8)	8.2 (1.8)
Unemp	Differencing	7.8 (1.6)	7.6 (1.6)	7.5 (1.6)
GDP	Quadratic	11.3 (1.9)	11.1 (1.9)	10.7 (1.8)
Ind Prod	Quadratic	9.3 (2.1)	9.0 (2.0)	9.0 (2.0)
Employ	Quadratic	8.6 (2.5)	8.6 (2.4)	7.9 (2.4)
Unemp	Quadratic	10.8 (2.4)	10.5 (2.4)	10.6 (2.3)
GDP	HP-filter	8.6 (1.5)	8.4 (1.5)	8.2 (1.4)
Ind Prod	HP-filter	9.8 (1.7)	9.4 (1.6)	9.4 (1.6)
Employ	HP-filter	10.1 (1.8)	9.8 (1.8)	9.7 (1.8)
Unemp	HP-filter	7.8 (1.7)	7.5 (1.7)	7.6 (1.6)
GDP	HP-SA	7.3 (1.5)	7.2 (1.4)	6.9 (1.4)
Ind Prod	HP-SA	9.1 (1.5)	8.7 (1.5)	8.8 (1.5)
Employ	HP-SA	8.6 (1.7)	8.4 (1.7)	8.2 (1.7)
Unemp	HP-SA	8.1 (1.7)	7.8 (1.7)	7.8 (1.6)
GDP	Oil Adjusted	14.3 (2.0)	13.9 (2.0)	13.8 (1.9)
Ind Prod	Oil Adjusted	14.0 (2.2)	13.5 (2.1)	13.6 (2.1)
Employ	Oil Adjusted	13.7 (2.4)	13.4 (2.4)	12.9 (2.3)
Unemp	Oil Adjusted	8.4 (2.4)	8.1 (2.4)	8.3 (2.3)

IV estimate of β (multiplied by 100) from

$$Corr(v,s)_{i,j,\tau} = \alpha + \beta Trade(w)_{i,j,\tau} + \varepsilon_{i,j,\tau}.$$

Instrumental Variables for trade intensity are: 1) log of distance; 2) dummy variable for common border; and 3) dummy variable for common language.

Standard errors in parentheses. Intercepts not reported. Bilateral quarterly data from 21 industrialized countries, 1959 through 1993 split into four sub-periods. Maximum sample size = 840.

Table 4: IV Estimates of Effect of Fixed Rate Regime

(Total Trade Weights)

Activity	De-Trending	β	γ
GDP	Differencing	11.5 (1.5)	-13.0 (2.9)
Ind Prod	Differencing	10.7 (1.6)	-5.1 (2.9)
Employ	Differencing	8.9 (1.9)	-2.7 (3.6)
Unemp	Differencing	7.3 (1.7)	5.1 (3.2)
GDP	Quadratic	12.6 (2.0)	-15.2 (3.7)
Ind Prod	Quadratic	11.3 (2.2)	-17.2 (3.9)
Employ	Quadratic	9.4 (2.6)	-6.8 (4.9)
Unemp	Quadratic	12.1 (2.5)	-13.2 (4.8)
GDP	HP-filter	8.6 (1.6)	.0 (3.0)
Ind Prod	HP-filter	10.8 (1.7)	-8.7 (3.1)
Employ	HP-filter	10.4 (1.9)	-1.7 (3.6)
Unemp	HP-filter	7.7 (1.8)	1.1 (3.4)
GDP	HP-SA	6.5 (1.5)	10.8 (2.8)
Ind Prod	HP-SA	9.9 (1.6)	-7.1 (2.9)
Employ	HP-SA	8.6 (1.8)	.5 (3.4)
Unemp	HP-SA	7.6 (1.8)	4.7 (3.3)

IV estimates of β and γ (multiplied by 100) from

$$Corr(v,s)_{i,j,\tau} = \alpha + \beta Trade(w)_{i,j,\tau} + \gamma FIX_{i,j,\tau} + \varepsilon_{i,j,\tau},$$

where $FIX_{i,j,\tau}$ is the (period-average of a) dummy variable which is unity if i and j had a mutually fixed exchange rate during the period.

Instrumental Variables for trade intensity are: 1) log of distance; 2) dummy variable for common border; and 3) dummy variable for common language.

Standard errors in parentheses. Intercepts not reported.

Bilateral quarterly data from 21 industrialized countries, 1959 through 1993 split into four sub-periods.

Maximum sample size = 840.

Table 5: IV Estimates of Effect of Oil Price Shock

(Total Trade Weights)

		Price of Oil		Change in Oil Price	
Activity	**De-Trending**	β	δ	β	δ
GDP	**Differencing**	10.3 (1.5)	.4 (.5)	9.8 (1.4)	6.2 (1.1)
Ind Prod	**Differencing**	10.1 (1.5)	.8 (.5)	9.0 (1.4)	9.3 (1.1)
Employ	**Differencing**	8.6 (1.8)	-.8 (.6)	8.4 (1.8)	2.5 (1.4)
Unemp	**Differencing**	7.9 (1.6)	-2.5 (.6)	7.3 (1.6)	5.5 (1.2)
GDP	**Quadratic**	11.2 (1.9)	2.5 (.7)	10.9 (1.9)	4.6 (1.5)
Ind Prod	**Quadratic**	9.2 (2.1)	6.5 (1.8)	8.6 (2.1)	6.2 (1.6)
Employ	**Quadratic**	8.6 (2.5)	-.6 (.8)	8.5 (2.5)	.7 (1.9)
Unemp	**Quadratic**	10.8 (2.4)	.5 (.8)	10.3 (2.4)	6.2 (1.9)
GDP	**HP-filter**	8.6 (1.5)	.2 (.5)	8.2 (1.5)	4.6 (1.2)
Ind Prod	**HP-filter**	9.7 (1.6)	4.3 (1.5)	8.7 (1.6)	9.2 (1.2)
Employ	**HP-filter**	10.1 (1.8)	-1.0 (.6)	9.8 (1.8)	3.3 (1.4)
Unemp	**HP-filter**	7.8 (1.7)	-.5 (.6)	7.3 (1.7)	5.6 (1.3)
GDP	**HP-SA**	7.3 (1.4)	-.4 (.5)	6.9 (1.4)	4.6 (1.1)
Ind Prod	**HP-SA**	9.0 (1.5)	4.2 (1.3)	8.2 (1.4)	7.3 (1.1)
Employ	**HP-SA**	8.6 (1.7)	-1.3 (.6)	8.4 (1.7)	1.9 (1.3)
Unemp	**HP-SA**	8.1 (1.7)	-.6 (.6)	7.6 (1.7)	5.1 (1.3)

IV estimates of β and γ (multiplied by 100) from

$$Corr(v,s)_{i,j,\tau} = \alpha + \beta Trade(w)_{i,j,\tau} + \delta(POIL*\{[(X^{Fuel}-M^{Fuel})/Y]_i[(X^{Fuel}-M^{Fuel})/Y]_j\})_\tau + \varepsilon_{i,j,\tau},$$

where $(POIL*\{[(X^{Fuel}-M^{Fuel})/Y]_i[(X^{Fuel}-M^{Fuel})/Y]_j\})_\tau$ is the (period-average of) the product of the nominal price of oil (in $/bbl, deflated by the global CPI), net fuel exports normalized by nominal GDP in country i and the latter variable for country j.

Instrumental Variables for trade intensity are : 1) log of distance; 2) dummy variable for common border; and 3)

dummy variable for common language.

Standard errors in parentheses. Intercepts not reported.

Bilateral quarterly data from 21 industrialized countries, 1959 through 1993 split into four sub-periods.

Maximum sample size = 840.

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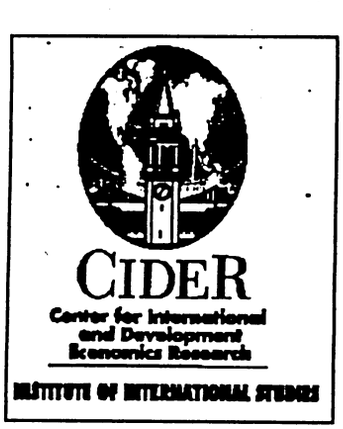

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