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ABSTRACT

The Theory of Optimum Currency Areas, Trade Adjustment and Trade*

This Paper seeks to integrate more closely the theory of optimum currency areas with the theory of international trade. The currency area is considered as a continuous variable ranging from zero to one: zero if there is no enlargement, and some positive value otherwise, corresponding exactly to the percentage of trade in the enlarged area. The benefits of widening a currency area are then treated in the same way as a reduction in transportation costs. The costs of widening a currency area, in turn, are seen as a drop in the speed of adjustment of the terms of trade to their long-run equilibrium level. On this basis it is shown that the marginal benefits of enlarging a currency area fall, the marginal costs rise, and an optimum size arises. This size, however, depends heavily on the optimal composition of the members.

JEL Classification: F02, F15 and F40
Keywords: exchange rate regime, international trade, optimum currency area and trade adjustment

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The theory of the optimum currency area generally examines the possible monetary union (or disunion) of one country (or region) with some foreign country (or the rest of the union). Events in the European Community and the former Soviet bloc have recently brought this theory into the foreground of attention. Nevertheless, the theory stands largely apart from the main corpus of international economics. The basic purpose of this paper is to permit a closer integration of the theory of the optimum currency area (OCA) with usual thinking about macroeconomics and trade. To do so, I will exploit three ideas: one concerning the benefit of enlarging a currency area, another relating to the cost of such an enlargement, and a third dealing with the measure of the currency area. The benefits of widening a currency area can be likened to a reduction in transportation costs. Thereby a lot of international trade theory immediately comes in. The costs of widening a currency area, in turn, may be seen as a decrease in the speed of adjustment of the terms of trade to their long run equilibrium level. This ties up with a good deal of open economy macroeconomics. Lastly, the size of a currency area can be treated as a continuous variable going from zero to one: zero if there is no enlargement, and some positive value otherwise corresponding exactly to the percentage of trade encompassed in the enlarged area (the percentage depending on the usual system of double-weights serving in constructing multilateral exchange rates). If so, marginal analysis can be brought to bear, and we can keep in mind aggregate trade rather than centering almost exclusively, as is often done, on trade within the area. These possibilities of forging better links between the theory of the OCA and the main body of international economics will be the essential subject-matter.

It is important to keep in mind that the paper refers to a large existing body of literature, whose empirical relevance I take for granted. There are now abundant references to a theory of the OCA, but no such theory has ever been formalized, and any effort to do so would surely incorporate only an aspect of what we know under that name. My basic concern here is to bring together many of the ideas now present in the literature on the OCA -- not all of them -- *in a manner which ties in with international trade theory*. I do not necessarily purport to present a better theory of the OCA or to encompass the whole subject. My major claim is to provide a simple way of linking up a great deal of the *existing* literature on the OCA to standard macroeconomic and microeconomic trade analysis.

The order of topics will be: first, the general theoretical setting; second, the benefits of a wider currency area; third, the costs of a wider area; fourth, the optimum size; and last, concluding observations. These concluding observations will compare the present approach to the OCA with an alternative one focusing on the variance-covariance structure of the shocks in the environment. In principle, these two approaches should be entirely compatible and ultimately, of course, the ideal would be to combine the two.

1. The setting

Consider a world with numerous trading nations of different sizes. Each nation engages in interindustry trade, based on comparative advantage, and in intraindustry trade, based on economies of scale. But foreign trade imposes special trading costs -- costs which do not arise in domestic trade. These costs are partly monetary, partly not. The monetary trading costs come about because of multiple currencies and multiple units of account. In a monetary economy, foreign trade raises separate problems of currency conversion, and over and above, separate problems of calculation. The problems of calculation do not depend on any dislike for the risk of foreign exchange movement (though such dislike would intensify them) but on the sheer difficulty of figuring out costs and returns when the raw data are stated in different accounting units. Thus, the root of the difficulty is bounded rationality: it is simply costly to make profit-maximizing decisions and multiple units of account amplify these costs. The non-monetary costs, in turn, go beyond transportation costs. They also encompass costs of information, distribution, litigation and insurance arising from differences in language, custom and law. Moreover, as cultural differences vary depending on the foreigner, the non-monetary sales costs depend on the nationality of trade partners as well as physical distance and geography.

Differences in country size, comparative costs, and non-monetary sales costs -- all three -- will lead to differences in the volume of trade with individual countries. The same factors, though mostly comparative costs in this case, will foster differences in the ratios of intraindustry trade to total trade with separate countries.

In general, we also know larger countries to be more closed. Thus, nations differing in size will also differ in their openness, or as regards aggregate trade relative to income. The closedness of

larger countries is usually attributed to the opportunity these countries have to produce a wider array of goods profitably and to sell proportionately more of their output at home, thereby avoiding the transportation costs of foreign trade. The same explanation applies here with only the difference that the wider notion of sales costs should be substituted for transportation costs. I will make the additional assumption that the same percentage of total labor is employed in producing tradeables in all countries. This will assure that trade adjustment is of similar importance in relatively closed economies as in relatively open ones. If the same ratio of total employment serves to produce tradeables everywhere, a comparable shock may require as large a trade adjustment relative to output in a fairly closed economy as in a very open one. This assumption basically assures that more closed economies have as much reason for concern about trade adjustment as the rest.

Finally, I will evoke the difficulty of relating the costs and benefits of monetary union to the welfare of the individual. The problem in doing so will come from disparate effects of trade on owners of different factors of production and the resulting need to admit distributional considerations. These difficulties pertain especially to the cost of monetary union, not so much the benefits.

2. The benefits

The benefits of monetary union obviously reside in reductions in monetary sales costs. As the size of the monetary union grows, the monetary sales costs progressively disappear. Let us consider the effect on national trade and national welfare.

With lower unit sales costs, aggregate trade expands, thereby increasing the openness of the country. Moreover, trade expands within the union relative to the outside. The trade-creation occurs over all relevant dimensions: quantities of currently traded goods, kinds of traded goods, and varieties of differentiated traded goods. Traditional Ricardian analysis would explain the rise in the volume of existing trade. The model of Dornbusch-Fischer-Samuelson (1977) with a continuum of goods is better suited to explain the widening of the range of tradeables entering into trade. As regards the increase in the varieties of differentiated goods, the approach of Krugman (1979, 1980), involving decreasing costs and monopolistic competition, is probably essential. But as no exact breakdown of the rise in trade between volumes, kinds and varieties is really required, we will disregard this aspect. As a result, relatively simple modelling is possible.

The following formalization, concerning all individual nations, will serve us:

$$mO = X_h + X_s \tag{1}$$

$$\frac{X_s}{O} = c(N) \qquad c'(N) < 0 \tag{2}$$

$$X = X_s[1 - m - t] \tag{3}$$

$$Y = O + X_s[\underline{\bar{S}}\,\Omega - m - t] \qquad \underline{\bar{S}}\,\Omega - m - t > 0 \tag{4}$$

$$V = V(Y/N) \qquad V'(Y/N) > 0 \qquad V''(Y/N) < 0 \tag{5}$$

Parentheses are used to indicate functional relations and brackets to signify multiplication instead.

m = tradeables as a percentage of output O

X_h = tradeables supplied at home

X_s = tradeables shipped abroad

X = trade[1]

m = the ratio of monetary sales costs to trade shipments

t = the ratio of non-monetary sales costs to trade shipments

Y = income

$\underline{\bar{S}}$ = the real equilibrium multilateral exchange rate

Ω = the fraction of $X_s\underline{\bar{S}}$ which would represent the consumer surplus resulting from trade except for sales costs.

V = social welfare (per capita).

Equation (1) supposes that tradeables ($X_h + X_s$) are exogenously given as a percentage of total home output. I thereby limit myself to the case of no substitutibility in consumption between tradeables and non-tradeables. According to equation (2), larger nations ship a lower percentage of their production of tradeables to foreign customers. For the moment, nothing besides the size of the nation affects trade shipments, which are therefore exogenous. (But this next assumption will be loosened later on). Equation (3) introduces the popular iceberg model of transportation costs. This

model says that only a portion of any goods dispatched reach their foreign destinations. The difference here is that the model applies more generally to sales costs. Accordingly, sales costs consist of differences between shipments and arrivals, or losses en route. In line with our broad conception of sales costs (as depending on many things besides distance), we might wish to think of damages incurred at international frontiers rather than, or in addition to, the evaporation of goods into thin air. Equation (4) defines the right concept of income, *Y*, in analyzing welfare. This concept naturally requires imputing the consumer surplus resulting from trade, as otherwise trade would be inexplicable in light of the sales costs entailed. This surplus (signified by the coefficient *W*) has been related to the equilibrium price $\underline{\bar{S}}$ and thereby to the situation under balanced trade. Underlying the determination of *W* is necessarily a process of utility maximization in distributing consumption between home and foreign goods, and the value of *W* therefore must be seen as hinging on the trade opportunities. That is, X_s must correspond precisely to the level which maximises the consumer surplus net of unit sales costs $\underline{\bar{S}\Omega - m - t.}$ The second derivative of *Y* in the welfare function, equation (5), expresses diminishing marginal utility of per capita income. (We shall be modifying this last function when we come to the costs of monetary union).

Let us assume that individual nations vary greatly by size, *N*, and that every individual nation trades with numerous others to varying degrees, ranging from low to high. We can then designate the size of monetary union as *u (0 £ u £ 1)*:

$$u = \frac{\sum_{i=1}^{r} X_{s,i}[1 - m - t_i]}{\sum_{i=1}^{n} X_{s,i}[1 - m - t_i]} = \frac{\sum_{i=1}^{r} X_i}{\sum_{i=1}^{n} X_i} \qquad r < n \qquad (6)$$

where *r* in these equations is any specific subset of foreign countries out of all the possible subsets of *n* foreign countries (*n* very large) and the summation in the numerator is strictly over the subset r.[2] The index *i* notably attaches to *t* since the non-monetary sales costs vary by individual country *i*. In the event of monetary union, the new regime would be:

$$X = X_s[1 - m[1 - u] - t] \qquad (7)$$

$$Y = O + X_s[\underline{\bar{S}}\Omega - m[1 - u] - t] \qquad (8)$$

$$t = \frac{\sum_{i=1}^{n} t_i X_{s,i}}{\sum_{i=1}^{n} X_{s,i}} \qquad (9)$$

The variable t will be treated as exogenous in this section. This effectively assumes not only that trade shipments stay the same when u moves, but that these shipments do so by individual country (i.e., $X_{s,i}$ is exogenous too). The main reason to proceed thusly is to avoid complicating the analysis with changing shipments to different countries while we still retain the simplifying assumption that the division of tradeables between home and foreign sales stays the same (in accord with equation (2)). We will introduce changes in the division of tradeables between foreign countries and between the home country and foreigners both together in a separate appendix. As shall be seen, neither of these two refinements affects the essential results.

If X_s and t are both independent of u, then based on equation (7), a rise in u will simply increase trade by $m X_s$, that is, the additional goods reaching their final destination. It consequently follows from equation (8) that the rise in trade will also represent the improvement in income if only the terms of trade, $\underline{\bar{S}}$, stay the same. I will assume this to be true as an approximation. The approximation will be fully correct in certain cases. One such case is where home suppliers can sell all the additional $m X_s$ goods without making any price concessions abroad, and correspondingly foreign suppliers in the union need to make no price concessions on their added sales at home. In this event, $m X_s$ will represent producer profits. Another example is where home suppliers must concede the entire benefit of their extra sales to buyers through price reductions, but foreign suppliers must do the same on behalf of home importers. In this case, $\underline{\bar{S}}$ will once again stay constant and $m X_s$ will represent consumer gains at home. In between these two extremes, the accuracy of the measure will depend on perfectly offsetting effects of price changes on producer and consumer surpluses at home (implying a constant weighted-average $\underline{\bar{S}}$, or at least a constant product term $\underline{\bar{S}}\Omega$). Generally speaking, $m X_s$ will be a proper approximation to the rise in income (or the sum of producer and consumer gains) if there is a certain symmetry between home and foreign effects inside the union.

In this model, the per capita welfare value of the trade creation ($m X_s/N$) is the per capita rise in income (also $m X_s/N$) times $V'(Y/N)$. In addition, the marginal benefit of monetary union

declines because of diminishing social marginal utility of per capita income *(V''(Y/N) < 0)*. When we come to the more general case where total shipments rise with falling monetary sales costs, we will find these basic results to be little altered.

3. The costs

On the cost side, I will suppose the costs of monetary union to relate strictly to the path toward equilibrium and not the equilibrium itself. This conforms to the main tendency in the literature on the OCA.[3] One fundamental postulate, therefore, is that the desire for permanent inflation is identical everywhere.[4] Another assumption is that prices in goods and factor markets are sticky, as otherwise the terms of trade could adapt just as smoothly with a fixed as with a flexible exchange rate. Under perfectly flexible prices, the nominal exchange rate would not affect the terms of trade, even momentarily. Ever since McKinnon (1963), the literature has also insisted on the tendency of openness to reduce the costs of monetary union. There are two strong empirical grounds for this view. First, more open economies have a higher marginal propensity to import. As a result, these economies can obtain more trade adjustment through expansions and contractions of output, apart from any changes in the terms of trade. Second, more open economies cannot secure as large a change in terms of trade through a movement in the exchange rate. Nominal import prices and wages there respond too quickly to the nominal exchange rate. For a survey of the evidence, see Goldstein and Khan (1985).

The relation between trade adjustment and social welfare has never been the subject of much preoccupation in the literature on the OCA. It would indeed prove very difficult to construct a firm microeconomic foundation for the adverse welfare effect of trade adjustment. Problems of trade adjustment alter the constraints on the individual household and firm: the relative prices they face and their incomes. On a general plane, some nationals will benefit from disequilibrium values of the constraints during trade adjustment and others will suffer from them, regardless which direction trade moves in the aggregate. Those who are hurt will notably include the temporarily unemployed. Only the superior welfare weight of the adverse effects of the adjustment will justify the idea that difficulties of trade reduce social welfare.

I shall not probe further into these postulates but will accept all of them -- the previous ones regarding the sources of the costs of trade adjustment and the last one regarding the negative effect of trade adjustment on social welfare. My efforts will center on two aspects. The first is the translation of the problem of trade adjustment in terms of speed of movement in the real exchange rate to its long run equilibrium level. This will obviously link up the analysis of the OCA with conventional open-economy macroeconomics, and in particular, with the usual consideration of exchange rate misalignment as the result of the slowness of adjustment of trade. The other aspect is the treatment of the size of the monetary union as a variable. This next treatment will prove to be particularly revealing.

Let β be the speed of adjustment of the terms of trade S toward the equilibrium value $\underline{\bar{S}}$. Thus

$$\frac{S_t - S_{t+1}}{S_t} = b\frac{S_t - \bar{S}}{\bar{S}} \qquad 0<b<<1 \qquad (10)$$

Suppose next that the fraction of the contribution of the real exchange rate to the adjustment of trade, based on usual current account equations (exports minus imports), is α. The greater marginal propensity to import in more open countries means that α falls with openness. The higher indexation of money wages and prices to the exchange rate in more open economies means that the adjustment of the terms of trade depends more heavily on sticky relative prices in these economies. Therefore, β will be lower there as well. Both of these considerations can be brought together into a single equation saying:

$$ab = A(x) \qquad A'(x)<0 \qquad 0<a<1 \qquad (11)$$

where x is the openness of the country, or the ratio of its trade to income X/Y, and ab is the speed of trade adjustment which is ascribable to the real exchange rate.

The fundamental proposition of the literature on the OCA about costs of monetary union can next be stated as follows:

$$\frac{b(u>0)}{b(u=0)} = f \qquad 0 < f < 1 \qquad (12)$$

$b(u>0)$ refers to b in case of monetary union with some specific trade partner (or partners), $b(u=0)$ to b with u = 0, and f is a parameter. According to equation (12), in case of monetary union, relative price adjustment slows down. Following shocks, the stabilizing influence of relative prices lessens per unit of time. If we next substitute equation (12) for b in equation (11), where b had obviously stood for $b(u=0)$, we get:

$$a\,b(u>0) = fA(x) \qquad A'(x)<0 \qquad (13)$$

The combination of equations (11) and (13) conveys an essential part of the message. Because of higher values of *A(x)* with lower x values, the negative impact of positive u on $a\,b$ is all the greater when x is lower. Stated simply: more closed economies suffer greater slowdowns in trade adjustment from monetary union.

The next problem is to analyze the response of f to different values of u. Evidently f must vary with u, since the value of u affects the extent to which sticky prices alone must do the work of adjusting the terms of trade with the rest of the countries in the monetary union. But u cannot be the whole story since many different compositions of union partners are consistent with the same u. Thus, the composition will matter greatly. One important aspect of this composition is the degree of intraindustry trade with the other members. High ratios of intraindustry trade inside the union would signify that the other countries in the union possess an industrial structure which resembles one's own.[5] Consequently, fewer changes in the terms of trade with the other members would be required, and union would cause less impairment of trade adjustment: f would be higher. Another important feature of the composition is the ratio of non-monetary sales costs to total trade with the other union partners. Low ratios of sales costs would mean that the other members are closer geographically, culturally and juridically. This too would facilitate trade adjustment and reduce the costs of monetary union. Last, the difference between the equilibrium real exchange rate of the union currency, $\underline{\bar{S}_u}$, and the national currency, $\underline{\bar{S}}$, is a factor. In case of monetary union, the exchange rate of the national currency will respond to differences between $\underline{\bar{S}_u}$ and $\underline{S_u}$ rather than $\underline{\bar{S}}$ and S. This must slow down the speed of adjustment to discrepancies between $\underline{\bar{S}}$ and S (to say nothing of the possibility of exchange rate pressures stemming from fundamentals elsewhere in the union rather than at home and thereby the possibility of wider values of $|\underline{\bar{S}}-S|$).

These considerations would suggest the following hypothesis:

$$f = g\left(u, \frac{I_u}{I}, \frac{t_u}{t}, [1-u]m, [1-u]\left|\frac{\bar{S}_u - \bar{S}}{\bar{S}}\right| \right) \qquad (14)$$

(+ over I_u/I; − over t_u/t, $[1-u]m$, and $[1-u]\left|\frac{\bar{S}_u - \bar{S}}{\bar{S}}\right|$)

where I = the ratio of intraindustry trade shipments to trade shipments[6]

$I = uI_u + [1-u]I_{nu}$ $\quad I_u = I$ within the union $\quad I_{nu} = I$ outside the union

t_u = the ratio of non-monetary sales costs to trade shipments (t) within the union

$t = ut_u + [1-u]t_{nu}$ $\quad t_{nu} = t$ outside the union

and the signs above the variables indicate the direction of the influences. None of the terms on the right require any special discussion (beyond the one in the previous paragraph) except the last two. The $[1-u]m$ term is essential since m necessarily slows down trade adjustment, just as the non-monetary trading costs do. Consequently, a higher value of u hastens the speed of adjustment by lowering the monetary sales costs. The negative impact of u coming through the other channels, as indicated by the separate u term, however, must be supposed to dominate. The $1-u$ weight on the variable $[\bar{S}_u - \bar{S}]/\bar{S}|$ recognizes the fact that the exchange rate of the union currency pertains exclusively to trade outside the union. Given this weight, as u goes to one, the relevance of the $\bar{S}_u - \bar{S}$ term disappears, in line with the fact that the pertinence of S_u vanishes as well. It may be noted, in addition, that the condition $f = 1$ when $u = 0$ simply requires an appropriate constant term (a constant whose value plus that of the m term sums to one).

Suppose next that we know the exact I_i and t_i associated with every country i, and that for any set of union members, we know the resulting $\bar{S}_u$. In that case, equation (14) will yield f and, given all the possible f values for any u, we will know the combination of union members at any u that would maximize f. This combination will then define the optimum composition of the union.

Let the maximized value of f based on the optimal composition of union partners at any u be shown by:

$$f = \hat{g}(u) \qquad (15)$$

In this case, the function $\hat{g}(u)$ is simply a restricted form of the righthandside of equation (14) in which all the variables except u can be suppressed since they are implicit in u.

Based on equation (15), the question of the impact of u on f may now be raised anew. The fundamental difference is that the second derivative of u can be clearly considered negative: the marginal cost of u must rise. The reason lies in the fact that the optimum choice of union members consists of picking the better partners first. Broadly speaking, at low values of u, the ideal composition consists of union partners yielding higher values of I_u/I and lower ones of t_u/t and $|\overline{S}_u - \overline{S}|$. Increasing the size of the union will therefore mean having recourse to worse and worse candidates for admission and larger and larger falls in β.[7] As we see, the optimum currency area will depend on the best composition of the membership.

Must f fall uniformly with rises in u? In other words, is the first derivative of u in equation (15) (as well as the second) necessarily negative throughout? There is an excellent reason to think otherwise. But it only emerges from a previous approach that I adopted to the question rather than the current one (Mélitz (1995)). I had focused earlier on the expected covariance of the terms of trade with different sets of national trade partners. Some reflexion will show why if the covariance of the terms of trade with some sets of foreigners and the rest happens to be negative, f may rise for low values of u. The terms of trade can be written as:

$$S = u\frac{P_u}{P} + [1-u]\frac{E_u P^*_{nu}}{P} \qquad (16)$$

where P_u is the (weighted-average) price of traded goods of union partners, P^*_{nu} is the price of these goods of non-union trade partners, and E_u is the exchange rate of the union currency ($E_u P^*_{nu}/P$ is also S_u, and for $u = 0$, $S = S_u$ and $E = E_u$). As u goes from zero to one, the basic problem is the inability to adjust P_u/P with the union partners through exchange rate movement. But suppose that the expected covariance between P_u/P and $E_u P^*_{nu}/P$ is negative. Then ex ante, any adjustment of the terms of trade with these union partners through the exchange rate would be expected to alter the terms of trade with the rest of the world the wrong way. Monetary union with these partners, consequently, must increase the usefulness of the exchange rate as an adjustment tool.

We observe here for the first time in this paper the fact that the across-the-board movements in all individual terms of trade that are generated by the exchange rate can be a liability. In the present analysis, this point has been accommodated -- the only way we can -- by imposing no restrictions

whatever on the relative influences of I_u/I, t_u/t and $[\overline{S}_u - \overline{S}]/\overline{S}$, on the one hand, and that of u, on the other, on the coefficient f in equation (14). Thereby we have allowed for the possibility that f will rise with rising u through the right choice of trade partners over a low range of values of u.

This possible rise in f over a low range, of course, does not interfere with the rising *marginal* cost of u. Even if the marginal cost should be negative over a range -- because of a certain honing of the exchange rate instrument as an adjustment tool at first -- this cost will still rise (i.e., become less negative) as worse partners are admitted. In addition, the marginal cost must eventually turn positive. The values of I_u/I and t_u/t begin to move toward one beyond a certain point as u rises. Moreover, they must do so very rapidly at a certain point relative to u, since they move asymptotically toward one. Thus, I_u/I and t_u/t will exert waning influences relative to u as u approaches one. The same is true of $[\overline{S}_u - \overline{S}]/\overline{S}$, though for a different reason: namely, the 1-u term going to zero. In a word, the decreasing flexibility in the terms of trade will eventually dominate the outcome.

4. The optimum currency area

In order to determine the optimum currency area, it is necessary to go further. We must introduce the smoothness of trade adjustment into the social utility function. Since the only relevant aspect of this smoothness is the part of the speed of the adjustment attributable to the real exchange rate, we may simplify and introduce ab directly in the utility function. Consequently, we have:

$$V = V(Y/N, ab) \qquad V'(Y/N) > 0 \qquad V''(Y/N) < 0$$
$$V'(ab) > 0 \qquad V''(ab) = 0 \tag{17}$$

This next equation supposes, quite apart from the welfare issues we have raised earlier, that there is a certain variance-covariance structure of trade disturbances. That is, $V'(ab)$ must depend partly on the amplitude of trade shocks in the environment.

Given equation (17), the rest is straightforward. We need to maximize V with respect to u.

$$\frac{dV}{du} = \frac{d(Y/N)}{du} V'(Y/N) + \frac{d(ab)}{du} V'(ab) \tag{18}$$

Upon solving, we find:

$$\frac{dV}{du}=\frac{X_s m}{N}V'(Y/N)+\left[\hat{g}'(u)a\,b_0+X_s m\frac{Y-X}{Y^2}\,fA'(X/Y)\right]V'(a\,b) \qquad (19)$$

where $[X_s m/N]V'(Y/N)$ is the improvement resulting from greater trade, $\hat{g}'(u)a\,b_0V'(a\,b)$ is the degradation coming from lower adjustment speed, the $A'(X/Y)$ term reflects the amplification of this previous slowdown in adjustment speed resulting from the induced rise in openness through greater trade. b_0 equals b (0) and X and Y could be replaced.

The second derivative of V with respect to u must be negative because of the diminishing social marginal utility of per capita income ($V''(Y/N) < 0$) and the worsening quality of the set of trade partners in the monetary union as u rises ($\hat{g}''(u)<0$). Specifically:

$$\frac{d^2V}{du^2}=\frac{X_s m}{N^2}V''(Y/N)+\hat{g}''(u)a\,b_0V'(a\,b)<0 \qquad (20)$$

Figure 1 illustrates the result. The intersection of marginal benefit (the $V'(Y/N)$ term of equation (19)) and marginal cost (the $V'(a\,b)$ term of this equation) determines the OCA, $\hat{u}$ (where $dV/du = 0$). In the case of a smaller (N lower) and more open country (x higher), trade per capita (X_s/N) would rise (see equation (2)). Therefore, the marginal benefit would be higher. Further, the value of $a\,b_0$ would drop (equation (11)), and therefore the marginal cost would be lower. Thus $\hat{u}$ would go up. The diagram overlooks the possibility of a section of negative marginal cost over a low range of u values. In addition, the figure supposes that the rest of the world can be carved up into every possible trade size. This has been explicit all along, but one aspect of the possible discontinuity may have evaded us. At low values of u, only poor trading partners may be available. Thus, the graph should possibly be understood as beginning at a point where the best trading partners are already available. To eliminate this problem, we would have had to assume throughout that all possible qualities of trade partners are available for membership at low values of u.

5. Concluding observations

In an earlier treatment of the issue of the OCA based on the same general ideas, I rested the costs of u exclusively on the covariance of relative prices that would be lost by widening the monetary union. More precisely, I viewed the cost of monetary union as the loss of some of the potential use of the exchange rate in exploiting positive covariance in the terms of trade between different sets of foreign

trade partners. Correspondingly I considered the optimization exercise involved in choosing union partners as one of keeping as much positive covariance between relative prices (with different foreign countries) outside the union as possible. In this way, monetary union would sacrifice the least degree of real exchange rate flexibility. Fundamentally, this view is highly complementary with the present one. Comparison with the previous approach would show that the same factors which lower the extent of positive covariance of relative prices outside the union will also slow down the speed of adjustment of trade. Yet the two approaches sometimes differ, and where they do, neither always dominates the other: sometimes one is superior, sometimes the other is, and generally both have something to say.

Apart from the closer tie of the present approach to traditional trade theory, which I have emphasized throughout, the superiority of this approach arises principally in two connections. One regards the time horizon. Emphasis on the stochastic environment tends to leave open considerable ambiguity about the relevant time frequency of the stochastic properties. This ambiguity, in fact, has hounded previous attempts to concentrate wholly on the stochastic environment in analyzing the OCA.[8] Focus on the speed of adjustment clearly brings the whole path toward equilibrium into view. Furthermore, it does so without requiring our simplifying assumption of a constant adjustment speed. The other advantage of the present treatment pertains to the stability of parameters. The effort to relate the OCA to international trade theory has led us here, as we have seen, to try to ascertain the changes in parameters that monetary union would bring. This focus squares with our intuition that monetary union would mean a different regime. One difficulty with the alternative focus on the stochastic properties is that the alteration of these properties under monetary union -- and therefore the general change in regime -- may remain largely behind the scene.[9]

Yet in certain other regards, the alternative approach is preferable. The speed of adjustment of the terms of trade does not adequately face up to the question of the size and nature of the likely shocks to trade. Indeed, at one critical juncture in this article, we were forced to consider the sign of the covariance of relative prices in order to settle a problem. Conformably, a large part of the empirical discussion of the OCA has been rightly preoccupied with the sources and the variance-covariance of shocks.[10] It should be mentioned nonetheless that in the last decade or so, this literature has often relied heavily on the inadequate distinction between symmetric and asymmetric

shocks or the mere question whether some changes in terms of trade would be required for trade adjustment or not. The shortcomings of this distinction should be clear, since the distinction leaves open the whole issue what the exchange rate can do about the changes in relative prices that may be required and how much the ability to cope with the required changes would diminish in case of a limited enlargement of the currency area.

One further, general limitation of the present argument, which regards the rest of the literature on the OCA as well, is the attempt to reduce the value of independent monetary policy entirely to one of the impact of this policy on trade. Countries clearly may value their monetary independence quite apart from trade because of the effect of the interest rate on industrial sectors such as construction. In this respect, the optimum currency area is smaller than the present analysis would suggest.

I would like to defend another limitation of the present analysis, however, pertaining to the strict definition of the optimum currency area with reference to the welfare of the individual nation rather than the entire group. Any potential entrant in a currency area must consider entry from the perspective of its own welfare. If a country's desired partners in a currency area do not wish to join this country in such an arrangement, there is a genuine problem. Reconciliation will depend on tradeoffs and bargaining and no solution may emerge. Moreover, there is every reason to anticipate conflicting national assessments of optimum currency areas in some cases, if only because of differences in country size. Joining the United States in a currency union is a totally different proposition for Canada than the same action is for the United States. The value of u is of a radically different order in the two cases. The same point applies to monetary union between Germany and Denmark. Though we may frequently ask whether a set of countries is an optimum currency area, this can only be regarded as the proper question if we are willing to pursue the analysis far enough to admit side-payments and bargaining. In defining the optimal currency area with respect to the welfare of the individual country, I have focused the discussion on the logically prior question of the country's best interests, apart from any subsequent bargaining and compensations.

Notes

1. Whether to use gross or net trade in measuring trade raises the basic question whether to regard trade as inclusive or exclusive of the import-content of exports. In analyzing the benefit side of monetary union, sales costs would seem to be best regarded as proportional to gross trade. But in analyzing the cost side, the macroeconomic problems of trade adjustment (which will be treated later) are probably best seen as related to net trade, or the contribution of trade to income and employment. It would complicate matters unduly, however, to use both measures of trade here. I will therefore simplify by supposing the same measure -- either one -- to apply in dealing with costs and benefits.

2. Note that if the numerator in this definition had been written instead as $\sum_{i=1}^{r} X_{s,i}[1-t_i]$, then u would not have equalled one when r equalled n, and therefore u would have been bounded below one. Our choice of definition merely simplifies the exposition.

3. See, for example, Krugman (1990).

4. A number of recent authors have emphasized problems of time-consistency in official promises of inflation in analyzing the OCA. See, for example, Bofinger (1993), De Grauwe (1992) and Tavlas (1993, 1994). On this view, the OCA will sometimes be an area where the monetary authorities can credibly promise lower inflation than the national authorities could. One can question this interpretation. It may seem rather drastic to give up a separate currency so as to cure a problem of time-inconsistency in the promises of central bankers. Less far-reaching measures could be envisaged, such as strengthening central bank independence at home.

5. Kenen (1969) deserves credit for first underlining this point.

6. For a measure of intraindustry trade, see, for example, Hufbauer and Chilas (1974).

7. The language in the text, of course, supposes that the optimum composition of union members requires adding new members rather than substituting new ones for old ones as u rises. But even if some substitution were sometimes involved, we would still have $\hat{g}''(u) < 0$: collectively speaking, the quality of the membership would decline. *Grosso modo*, the simple language in the text is also correct: with increases in u, worse members will be added for the most part.

8. Vaubel (1978) and von Hagen and Neumann (1994) all recognize the difficulty.

9. Mundell (1961) managed somehow to raise both sorts of problems in his seminal article.

10. See, for example, Cohen and Wyplosz (1989) and Bayoumi and Eichengreen (1992).

Appendix

The OCA if trade shipments vary with sales costs

Consider the difference if sales costs affect the proportion of tradeables which are shipped abroad and if exporters accordingly favor destinations where sales costs are lower. Under these conditions, equation (2) must be replaced with:

$$\frac{X_s}{O} = c(N, m+t) \qquad c'(N) < 0 \qquad c'(m+t) < 0 \qquad (A1)$$

where the first derivative $c'(m+t) < 0$ expresses the negative effect of a rise in sales costs operating through lower demand abroad (as a result of higher prices) and lower supply to foreigners (as a result of higher costs). Let us next restate equation (4), regarding income, as:

$$Y = O + X_{s,o}[\,\bar{S}\,\Omega - m - t_o\,] \qquad (A2)$$

where $X_{s,o}$ is the current X_s and t_o is the current t. In the event of monetary union, the corresponding restatement of this equation will be, not equation (8), but:

$$Y = O + X_{s,o}[\,\bar{S}\,\Omega - m[1-u] - t] + [X_s - X_{s,o}]m \qquad (A3)$$

u should be measured independently of differences between X_s and $X_{s,o}$ in order to avoid purely semantic issues. Thus, the $X_{s,i}$ terms in the definition of u, equation (6), must now be explicitly understood as pertaining strictly to initial (country) values.

Attention may center on the new $X_s - X_{s,o}$ term in equation (A3), concerning the rise in trade shipments attributable to the fall in unit sales costs from $m+t_o$ to $m[1-u]+t$ under monetary union. The logic is really no different than before concerning $X_{s,o}$. In the absence of any price concessions from existing levels, $[X_s - X_{s,o}]m$ would represent producer profits (since the goods would still be priced at $1+m+t_o$ times home prices, as they were before); in the presence of the maximum price concessions, this value would be consumer gains; in between the two there would be a mixture of producer and consumer gains and $[X_s - X_{s,o}]m$ would represent an approximation to

the resulting blend. The rise in X_s will affect *t*, which we have treated as a constant before, since t_i varies by individual country *i* and the extra shipments go toward union members. Most important, the change in *t* associated with any *u* will now depend on the exact composition of the union. Thus, the optimal composition of the union will be affected.

Suppose we go back to equation (14) for *f*. This equation must now be expanded to incorporate induced changes in the aggregate ratios of intra-industry trade and non-monetary sales costs. We need some new notation. For any specific combination *r* of union members, let us say:

$$t_u = \frac{\sum_{i=1}^{r} t_i X_{s,i}}{\sum_{i=1}^{r} X_{s,i}} \qquad (A4)$$

$$t(u) = ut_u + [1-u]t_{nu} \qquad (A5)$$

$$I_u = \frac{\sum_{i=1}^{r} I_i X_{s,i}}{\sum_{i=1}^{r} X_{s,i}} \qquad (A6)$$

$$I(u) = uI_u + [1-u]I_{nu} \qquad (A7)$$

Thus, the new version of equation (14) will be:

$$f = g\left(u, I(u) - I_o, \frac{I_u}{I_o}, t(u) - t_o, \frac{t_u}{t_o}, [1-u]m, [1-u]\left|\frac{\bar{S}_u - \bar{S}}{\bar{S}}\right|\right) \qquad (A8)$$

$\quad -\quad +\quad +\quad -\quad -\quad -\quad -$

where I_o and t_o pertain to $u = 0$. To know *f* based on any combination *r* of union members now requires more information than before, since the trade shipments differ from $X_{s,o}$. But for any given *r* combination, if we know X_s for all countries, and we also have our previous information about t_i, I_i, and $\bar{S}_u$, then (A8) will yield *f* and (A3) will yield *Y*. Let us designate all the possible *r* combinations of countries giving rise to the same *u* as R_u. Then finding the optimal *r* subset of R_u will simply require determining the specific membership yielding the highest value of *V* (*V* = *V*(*Y*/*N*, *a b*)).

Evidently, the basic difference in the case of this new derivation of the optimal composition $\hat{R}_u$ is that the non-monetary sales costs acquire greater significance than before (as they influence *Y/N* as well as ab).

Let the values of t and f resulting from the preceding maximization of V at every u be given by:

$$t = \bar{t}(u) \qquad (A9)$$

$$f = \bar{g}(u) \qquad (A10)$$

Before proceeding, a few remarks should be added about the signs of u in these last two equations.

As u rises, the incorporation of the better trade partners at first will mean raising the overall ratio of intraindustry trade I and lowering the overall ratio of non-monetary sales costs t. Consequently, the fall in f will be smaller than previously, but only up to a point. As u increases, worse-than-average partners will be included in the optimal membership at some stage and subsequently I will begin to fall and t will begin to rise. Further, though we cannot be precise about the differences between $\bar{g}(u)$ and the earlier function $\hat{g}(u)$, we can still affirm that $\bar{g}'(u)$ is negative based on the same problems of price stickiness as before, and $\bar{g}''(u)$ is negative based on the same problem of worsening membership as previously. Similarly, while we know $\bar{t}'(u) < 0$ over a low range and $\bar{t}'(u) > 0$ over a high range, the inclusion of increasingly poor partners will mean a tendency toward $\bar{t}''(u) > 0$. Yet a bit of vagueness enters about the second derivatives $\bar{g}''(u)$ and $\bar{t}''(u)$ because the diminishing quality of union partners as u rises can now be reflected entirely in one of these second derivatives and not the other. For example, sharply accelerating reductions in b may mean non-diminishing increases in Y over a stretch.

The rest is straightforward. Based on equations (A7) and (A8), $\hat{u}$ can be derived. Solving for *dV/du*, we get

$$\frac{dV}{du} = \frac{1}{N}\frac{dY}{du}V'(Y/N) + \left\{\bar{g}'(u)ab_o + \left[\frac{dX}{du}Y - \frac{dY}{du}X\right]\frac{f}{Y^2}A'(X/Y)\right\}V'(ab) \qquad (A11)$$

and

$$\frac{dY}{du} = [m - \bar{t}'(u)][X_{s,o} - mOc'(m+t)] \qquad (A12)$$

$$\frac{dX}{du} = [m - \bar{t}'(u)]\,\{X_{s,o} - [1 - m[1-u] - t]Oc'(m+t)\} \qquad (A13)$$

Comparison with the previous solution for *dV/du*, equation (19), yields clear results. Previously *dV/du* had been simply $mX_{s,o}$. But $[m - \bar{t}'(u)]\,X_{s,o}$ alone is larger than $mX_{s,o}$ in equations (A11)-(A12) for low u values since $\bar{t}'(u)$ is negative. Further, the additional $c'(m+t)$ term in these equations, concerning the new trade shipments resulting from lower sales costs, is also positive (since $c'(m+t)$ is negative). Further still, the trade creation *dX/du* had previously simply equalled the income creation *dY/du*. But now *dX/du* (equation (A13)) exceeds *dY/du* (equation (A12)) because of the new shipments ($1 - m[1-u] - t > m$). Hence openness rises more. The net result, of course, is a higher social marginal utility of u.

As regards the second derivative of V with respect to u, if we disregard higher-order effects on openness, we get

$$\frac{d^2V}{du^2} = \frac{1}{N^2}\frac{dY}{du}V''(Y/N) - \bar{t}''(u)[X_{s,o} - mOc'(m+t)]\,V'(Y/N) + \bar{g}''(u)\,a\,b_0\,V'(a\,b) \quad > 0 \qquad (A14)$$

All three terms on the righthandside are negative. With *dY/du* greater than before, the effect of the falling social marginal utility of per capita income is stronger. The additional $\bar{t}''(u)$ term, concerning the declining ability of u to lower t ($\bar{t}''(u) > 0$), means more rapidly diminishing increases in trade shipments and trade. Even though the $V'(a\,b)$ term is difficult to compare with the preceding one, on the whole, the fall in marginal utility looks sharper. With d^2V/du^2 negative, $\hat{u}$ should be less than one.

References

Bayoumi, Tamim and Barry Eichengreen (1992). "Shocking Aspects of European Monetary Unification," CEPR Working Paper no. 643.

Bofinger, Peter (1993). "Is Europe an Optimum Currency Area?" CEPR Discussion Paper no. 915, February.

Cohen, Daniel and Charles Wyplosz (1989). "The European Monetary Union: An Agnostic Evaluation," in Ralph Bryant, David Currie, Jacob Frenkel, Paul Masson, and Richard Portes, eds., *Macroeconomic Policies in an Interdependent World*, Washington D. C.: International Monetary Fund.

De Grauwe, Paul (1992). *The Economics of Monetary Integration*, Oxford University Press.

Dornbusch, Rudiger, Stanley Fischer and Paul Samuelson (1977). "Comparative Advantage, Trade and Payments in a Ricardian Model with a Continuum of Goods," *American Economic Review*, 67 (December), 823-839.

Goldstein, Morris and Mohsin Khan (1985). "Income and Price Elasticities of Foreign Trade," in Ronald Jones and Peter Kenen, eds., *Handbook of International Economics*, vol. 2, pp. 1041-1105.

Hufbauer, Gary and J. G. Chilas (1974). "Specialization by Industrial Countries: Extent and Consequences," in Herbert Giersch, ed., *The International Division of Labour: Problems and Perspectives*, Kiel: Institut für Weltwirtschaft.

von Hagen, Jürgen and Manfred J. M. Neumann (1994). "Real Exchange Rates Within and Between Currency Areas: How far away is EMU?" *Review of Economics and Statistics*, 76 (May), 236-44.

Kenen, Peter (1969). "The Theory of Optimum Currency Areas: An Eclectic View," in Mundell and Swoboda, eds., *Monetary Problems of the International Economy*, University of Chicago Press, pp. 42-60.

Krugman, Paul (1979). "Increasing Returns, Monopolistic Competition and International Trade," *Journal of International Economics*, 9 (November), 469-479.

Krugman, Paul (1980). "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 70 (December), 950-959.

Krugman, Paul (1990). "Policy Problems of a Monetary Union," Paul De Grauwe and Lucas Papademos, eds. *The European Monetary System in the 1990's*, London and New York : Longman, CEPS and Bank of Greece, pp. 48-64.

McKinnon, Ronald (1963). "Optimum Currency Areas," *American Economic Review*, 53 (September), 717-725.

Mélitz, Jacques (1995). "A Suggested Reformulation of the Theory of Optimal Currency Areas," *Open Economies Review* 6, 281-298.

Mundell, Robert (1961). "A Theory of Optimum Currency Areas," *American Economic Review*, 51 (September), 657-665.

Tavlas, George (1993). "The 'New' Theory of Optimum Currency Areas," *The World Economy*, 16 (November), 663-85.

Tavlas, George (1994). "The Theory of Monetary Integration," *Open Economies Review* 5, 211-30.

Vaubel, Roland (1978). "Real Exchange-Rate Changes in the European Community: A New Approach to the Determination of Optimum Currency Areas," *Journal of International Economics* 8, 319-339.

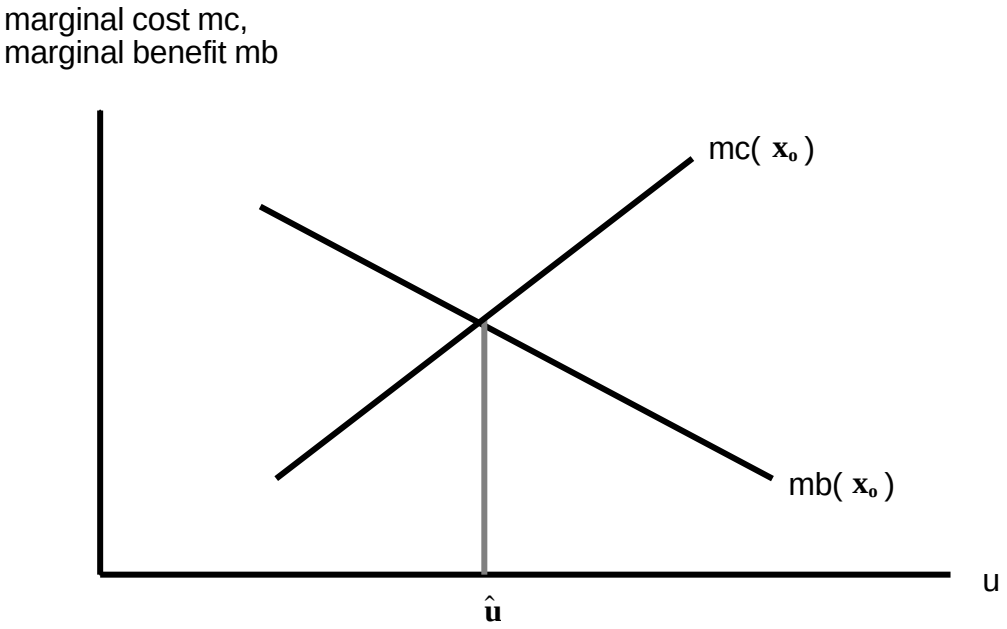
marginal cost mc,
marginal benefit mb
mc($\mathbf{x}_o$)
mb($\mathbf{x}_o$)
u
$\hat{\mathbf{u}}$

Figure 1