

**Competitiveness Indices for Irish
Manufactured Exports**

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COMPETITIVENESS INDICES FOR IRISH MANUFACTURED EXPORTS

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1. *Introduction*

This paper is devoted primarily to the construction of competitiveness indices for Irish manufactured exports. Our principal motivation in conducting such an exercise is the fact that no satisfactory measures of competitiveness have as yet been developed for Ireland despite which the concept of competitiveness, and the problems associated with declining competitiveness in particular, frequently figure in public discussions of Ireland's economic performance. This concern is exemplified, for instance, by the fact that it is a recurring theme in the Quarterly Bulletins and Annual Reports of the Central Bank.

The content of the paper is organised as follows. Section 2 treats briefly of the conceptual issues pertaining to the notion of competitiveness in general, with particular reference to its applicability under circumstances where the economy is small and open. This section also examines the conceptual soundness of specific types of competitiveness indices. In this connection we offer a critical appraisal of the index employed by the British Central Statistics Office. Section 3 outlines the method used in constructing the indices for Ireland and presents the results at various levels of disaggregation. Section 4 comprises a detailed discussion of these results as they reflect the historical experience of the period covered (1975-1980), and draws some conclusions concerning the implications of these findings for the future under a variety of assumptions about the exchange rate and inflation rate differentials between Ireland and its major competitors. There then follows a brief summary of the paper's findings and a Technical Annex in which the construction of the indices is formally developed and the data employed are presented.

2. *Conceptual Issues*

2.1 Conceptual Issues Relating to Competitiveness in General

It is useful at the outset to distinguish between two broad notions of competitiveness: price competitiveness which is a demand-oriented concept,

*This paper was prompted by working with Joe Durkan on the *Quarterly Economic Commentary* and springs from a suggestion made by him. The author would like to thank the members of the editorial board of the *Commentary* for their helpful remarks. A particular word of gratitude is due to Patrick Honohan of the Central Bank for his painstaking reading of an earlier draft and his detection of a major shortcoming in the weighting system employed therein. Any errors which have survived the careful appraisal of the above are the author's sole responsibility.

and cost competitiveness which is supply-oriented. A measure of competitiveness based on the first concept is concerned with tracking the price of domestic exports against the world price of those goods with which domestic exports compete on international markets. If purchasing power parity were fully operational in tradable goods markets, i.e., if exchange rate movements fully compensated for inflation rate differentials, then an index of price competitiveness would, in fact, degenerate to a constant over time since no divergence would exist between changes in domestic export prices and changes in the world price, expressed in a common currency.

To the extent that such divergences do arise, at least in the short run, the concept of price competitiveness becomes an operational one, provided of course, that the commodity composition of domestic exports and that of the bundle of world tradables which we are examining is the same or, at least, not substantially different. Under such circumstances an increase in domestic export prices relative to the world price is defined as a loss in competitiveness, the inference usually drawn being that there will result a deleterious effect on the trade balance of the country in question, *ceteris paribus*.

The operational significance of the notion of price competitiveness is, we suggest, the same for all economies be they large or small. The theoretical significance of price competitiveness is intimately related to the doctrine of purchasing power parity (PPP): abstracting from compositional changes the existence of divergences between changes in domestic export prices and those obtaining in the rest of the world is evidence of the non-operation of PPP; the corollary of this proposition is that the more protracted the period throughout which such divergences obtain, the greater the temporal violation of PPP. Viewed in this perspective an index of price competitiveness provides us with an indicator of the degree to which a currency is under- or over-valued. In the literature it is commonly referred to as an index of the real exchange rate.

Turning now to the notion of cost competitiveness the following remarks seem appropriate. Cost competitiveness concerns itself with examining the production costs of the domestic economies' exports relative to the costs incurred in the production of those goods with which domestic exports compete on international markets. The significance of this idea may best be apprehended in the event of a uniform price obtaining for tradables on the world market. Under such circumstances, at a particular point in time, the economy which enjoys the lowest unit production costs will enjoy the highest profitability in tradable goods production. However, the operational significance of this concept will differ crucially as between small and large economies in that an increase in exports by the former induced by cost reductions will unambiguously lead to increased profitability for exporters, *ceteris paribus*, since price is exogenously determined (demand for their output being perfectly elastic), whereas for the latter this will not be the case since increased exports from large economies will depress the world price — the consequences for profitability here will depend on the price elasticity of demand. In the event of the law of one price for tradable goods not operating or of PPP being violated, cost competitiveness would not appear to be as neatly workable a concept as the foregoing discussion implies.

There are persuasive reasons to believe that the PPP theory has only very

approximately described the behaviour of price movements and exchange rate variations worldwide over the last decade or so. Frenkel (1981) in a recent paper has marshalled strong evidence in support of the view that PPP has collapsed entirely. In the particular case of Ireland it is not unreasonable to suspect that the change in the currency regime of 1979 has generated significant changes in the real exchange rate, because of, *inter alia*, substantial adjustment lags and imperfect information. These considerations alone would provide prima facie justification for constructing indices of price competitiveness for an economy such as Ireland.

2.2 Conceptual Issues Relating to Particular Indices of Price Competitiveness

An index of price competitiveness, as stated above, is usually conceived as a measure for tracking the price of domestic exports against the prices of those goods with which domestic exports compete on world markets. As such it is normally constructed as the ratio of some weighted average of competitors' prices to domestic export unit values. The shortcomings of such an index have already received extensive coverage in the literature on competitiveness (see, for example, Bank of England (*Quarterly Bulletin*, 1978), Doggett and Cresswell (1979) and OECD (*Economic Outlook*, 1978). These shortcomings may be usefully divided into those which inhere in the denominator, viz., the fact that unit values change not only with variations in price but also with shifts in the composition of trade, and, those which arise because of the choice of numerator. There is also the additional problem of incomparability between the index of domestic export unit values and whatever index or indices are used to represent world prices, generated either by different measurement methods or differences in the composition of goods covered. The first set of problems alluded to will be of critical importance if the country whose performance is being examined has experienced a systematic movement in export composition towards higher quality, more technically advanced products over time, particularly if the time-span under scrutiny is long. In any event given that we are constrained to using domestic export unit values in the denominator, these problems are inescapable.

The problem of selecting the best numerator in the index reduces to choosing a composite measure of world prices or unit values which most accurately represents and most comprehensively incorporates the prices of those goods with which exports from the home country compete on world markets, subject to the constraints of data availability, standardisation of series between countries and facility of construction. Four methods of constructing such a numerator suggest themselves and we discuss them below in order of increasing conceptual satisfactoriness.

(i) The simplest method would be to weight competitors' export unit values by the importance of each trading partner as a destination for domestic exports. This is, of course, computationally uncomplicated but would appear to have little or no conceptual connection with the idea of competitiveness since the implication here is that the domestic economy competes with the exports of economy A only to the extent that the domestic economy exports to economy A and so on. The adoption of such a method could be rationalised if we could validly appeal to the notion that economy A's export unit values

reflect and move in line with its tradable goods prices in general. The validity of such an appeal is highly questionable.

(ii) Instead of using export unit values as in the above method we could use import unit values and retain the same weighting scheme. The plausibility of such an expedient is not difficult to establish. For any particular foreign market it is imports from "third-party" countries and not exports out of the destination country with which exports from the home country directly compete. Two problems peculiar to this type of index render it less attractive first, import unit values are measured inclusive of carriage, insurance and freight charges, whereas export unit values are measured free-on-board, secondly, the import unit value index for any country of destination will incorporate the prices of the exports of that country whose competitiveness we are examining. Admittedly, the latter problem will not typically be serious if the exporting country is small trade-wise but will involve serious distortions in the eventual index if the small country displays a highly skewed geographical distribution of trade as in the Irish case.

(iii) A complex variant of (i) is the method used by the British CSO amplified in Doggett and Cresswell (1981) and which underlies the specification of the commodity export price equations in Barten, d'Alcantara and Carrin's (1976) medium term macro-model of the EEC. Essentially the procedure involved here is a two-stage one where the weight given to each competitor in the index reflects the importance of that country in each of the domestic economy's overseas markets weighted in turn by the importance of those markets to the home country. Whereas this would appear to be conceptually superior to the first method, it remains an "export price index" in the narrower sense of the expression. Furthermore, and of critical importance to the Irish case, is the problem introduced by using such an index where the country whose competitiveness is being examined directs a large proportion of its exports to a single market. This single market dependence is completely erased from an index of the type used by the British CSO. The importance which this single market should be ascribed is dissipated in the weighting scheme by being distributed amongst the other competing suppliers. We found this index generated extremely perverse results for Ireland. Thus, it seems to be singularly unsuited to tracking the competitiveness of a country with a highly skewed trade pattern.

It should be especially emphasised that none of the above measures of competitiveness includes the price of tradable sector output produced in the destination country and sold there in competition with foreign imports. This constitutes a major shortcoming particularly if the destination country is relatively closed for the following reason: exports to a "closed" economy will compete predominantly with goods produced there rather than "third-party" imports.

(iv) To adequately allow for these considerations we have developed an index of world prices which incorporates the proportion of net supply of manufactured goods accounted for by home production in the individual destination countries for Irish exports, and the price of this home-produced output. Thus, our eventual measure of competitiveness is not merely a "relative export price index" but gives explicit acknowledgement to competition from goods which do not cross international frontiers.

3. *Construction and Results*

In the analysis presented below we have confined ourselves to an examination of manufactured goods only, i.e., those goods which fall within sections 5 to 8 of the SITC classification. The reason for this relatively narrow coverage is that export unit values (XUV) for Ireland are available at only two levels of aggregation: all merchandise trade and manufactured goods. Given the circumstances under which agricultural products are sold abroad it was felt that a more satisfactory focus of attention would be found if they were excluded. Moreover, our discussion relates to indices of price competitiveness only. Although preliminary work has been carried out on cost competitiveness and supply-oriented indices in general, there are thorny theoretical questions to be resolved here as well as some deficiencies in the data.

3.1 Method of Construction

This index, as has been explained in the section on conceptual issues, is essentially the ratio of world tradable goods prices to domestic export prices. For the purposes of the present analysis domestic export prices are represented by the index of export unit values (XUV) for manufactured goods. This is as yet an unpublished monthly series constructed by the CSO to the base 1970 = 100. Its use necessitated some minor adjustments due to the fact that the monthly and annual figures as originally computed were not fully compatible.¹ Furthermore, we have rebased the series to 1975 = 100 for facility of international comparison and estimated quarterly averages since monthly data for the rest of the world are not readily available.

With regard to world tradable goods prices the following procedure was adopted. The 12 countries which together accounted for the greatest proportion of Irish manufactured exports over the period covered (1975 to 1980) were isolated.² This is obviously an arbitrary number but it represents the best compromise between exhaustive coverage on the one hand, and the constraints of time and data availability on the other. The countries selected together accounted for an average of 87 per cent of our manufactured exports over the years 1975 to 1980. This is considered satisfactory coverage. Each of these countries was then assigned a weight designed to reflect the extent to which its exports compete with Irish exports on foreign markets. The sense of this weighting scheme is that the same 12 countries are each given a weight reflecting their individual importance in each of our major export markets.

¹The reason for the incompatibility here is that the annual figures are based on a Fisher index whereas the monthly series are based on a Laspeyres index. Thus, for year t the monthly index of export unit values uses the trade pattern obtaining in year $t - 1$ whereas the trade pattern used for computing the monthly index throughout year $t + 1$ is that obtaining in year t . Consequently, the monthly indices for successive years will not be strictly comparable: discontinuities may occur between the last month of one year and the first month of the next. Furthermore, the annual figure for year t represents the square root of the index based on year $t - 1$ weights by the index based on year t weights and so on. The procedure we have adopted to standardise the index is as follows:

- (a) obtain the average of the monthly figures for year t ;
- (b) divide this into the actual annual figure for year t ;
- (c) factor up/down the monthly figures for year t by the resultant quotient.

²These countries are the UK, France, Belgium-Luxembourg, Germany, The Netherlands, Italy, Denmark, Sweden, Switzerland, Japan, Canada and the USA.

Were we to proceed to weight each of these export markets in turn according to their importance to Ireland as a destination without any further input into the weighting procedure we would be adopting a scheme precisely faithful to that of the British CSO — one of the results of which would be to ascribe a weight to the UK of something in the region of 5 per cent. This would hardly be satisfactory and would yield highly questionable results on competitiveness. What we have done instead is to estimate an “openness factor” for each of the 12 countries involved, which is designed to capture the extent to which each depends on imports of manufactured goods as against domestic production, and to use these “openness factors” to adjust the weights of the trade flow matrix of Table II(b). The weights consequently used in the construction of the competitiveness index are thereby corrected to allow for the degree of “openness” and these appear in Table II(d).

Thus, the index of world tradable goods prices involves a three-stage weighting scheme. The first stage captures inter-country trade in manufactured goods. The second allows for the extent to which manufactured goods requirements in each of Ireland’s major export markets are met out of domestic production in that market, and the third stage involves weighting each of the twelve markets by their importance as destinations for Irish exports. The price measures used are export unit values and that measure of wholesale/output prices which best captures the price of domestically produced manufactured output in the countries concerned. A formal description of the methodology is given in Technical Annexe I and the data on the weighting scheme in Technical Annexe II.

Unfortunately, the procedure outlined above is beset by some unavoidable data problems relating to the estimation of the “openness factor” and the selection of the appropriate output price index for representing the price level of domestically produced output in Ireland’s 12 major destination markets. In the comments relating to Table II(c) in the Technical Annexe we discuss the estimation of the “openness factors”. With regard to the appropriate output price index the ideal series would be the price deflator of manufacturing industry production in each of the countries concerned. Such series are not available. The logical alternative is to use the wholesale price index of manufactured goods instead and this is what we have done in the case of the UK, BLEU, The Netherlands and Italy. For France, Denmark and Switzerland we have used a series entitled WPI of Domestic Goods and for the remaining five countries we have used Producer Prices of Manufactured Goods. There is obviously scope here for increasing precision by obtaining series standardised across countries.

3.2 Presentation of Results

The results are presented in Table 1 below and are reproduced in graphical form in Chart 1. Column (1) of the table sets out the overall competitiveness index for Ireland, i.e., a weighted average of our competitiveness in the 12 markets covered. This is disaggregated in the other three columns: column (2) contains the index of competitiveness on the UK market, column (3) the index of competitiveness on all markets other than the UK and column (4) sets out

the index of our competitiveness *vis-à-vis* the six members of the EMS (Belgium-Luxembourg being counted as one market).³

The overall index suggests that we have gained almost 5.5 per cent in competitiveness relative to 1975 and over 7 per cent since the first quarter of 1979, the time of EMS entry. Prior to this period there was no perceptible trend in the index — it fluctuates for the most part within 2.5 percentage points of 100. There is one fairly pronounced aberration from this pattern, corresponding to the period 1976 III to 1977 II during which the index first increases by roughly four points and subsequently drops by almost 7 points over two quarters. Much of the explanation of this resides in currency fluctuations: the pound depreciated sharply towards the end of 1976, thus improving competitiveness but its subsequent appreciation coupled with the inflationary impulse generated by its loss of value and transmitted to export prices eroded competitiveness substantially over the following two quarters.

Of more interest, particularly since the breaking of the sterling link, is an examination of competitiveness at a disaggregated level. With this in mind we focus on our competitiveness on the UK market and on the EMS markets as captured by the indices in columns (2) and (4) respectively. The most salient feature here is the remarkable divergence in these two indices since 1979 I: a

TABLE 1: Price Competitiveness for Irish Manufactured Exports

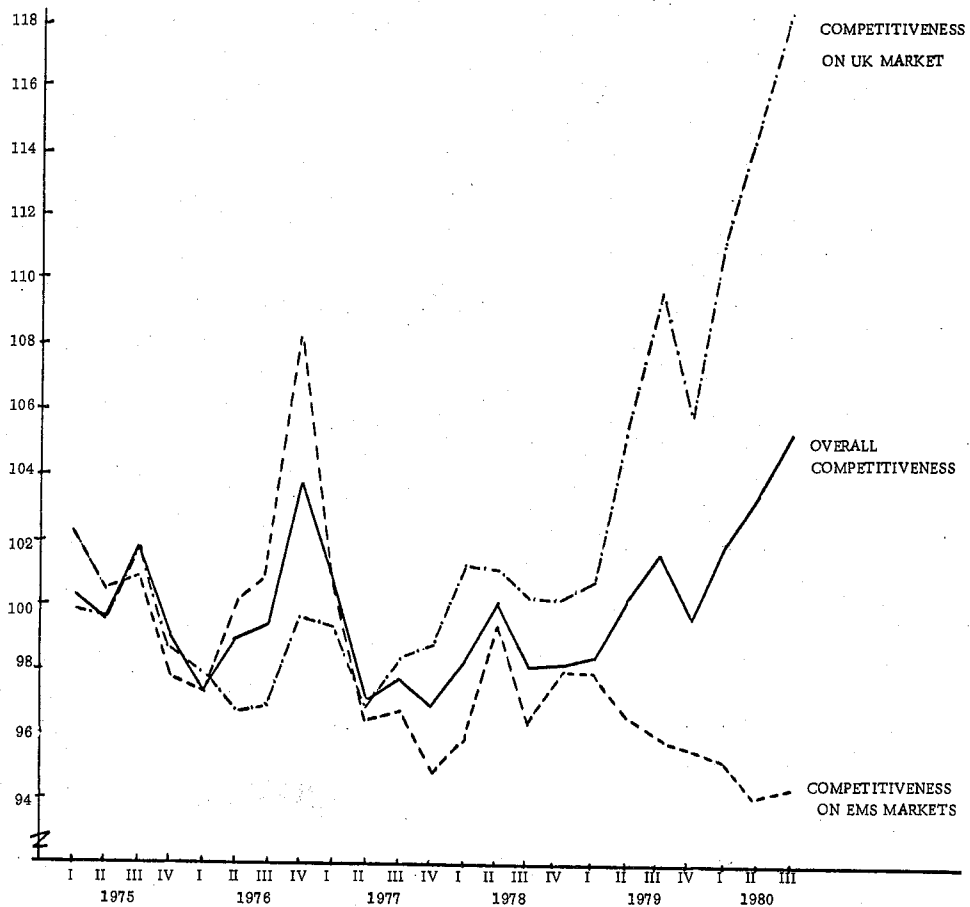
	(1) Overall Index	(2) UK Market Index	(3) Index of all Markets except UK	(4) Index of EMS Markets
1975 I	100.3	99.8	101.1	102.2
II	99.5	99.6	99.4	100.5
III	101.8	101.8	101.8	100.9
IV	98.9	98.9	99.1	97.8
1976 I	97.4	97.9	96.8	95.3
II	99.0	96.7	100.6	100.1
III	99.4	96.9	102.3	101.0
IV	103.9	99.6	108.8	108.3
1977 I	100.8	99.3	102.5	101.7
II	97.0	96.7	97.3	96.5
III	97.7	98.3	97.0	96.7
IV	96.9	98.7	94.8	94.9
1978 I	98.3	101.3	94.9	95.9
II	100.1	101.2	98.8	99.5
III	98.1	100.3	95.6	96.5
IV	98.2	100.2	95.6	97.9
1979 I	98.4	100.8	95.6	97.9
II	100.3	105.3	94.6	96.7
III	101.7	109.7	92.5	96.0
IV	99.6	105.8	92.5	95.7
1980 I	102.0	111.2	91.4	95.3
II	103.5	114.9	90.4	94.3
III	105.4	118.9	89.9	94.5

Notes: Overall index to the base 1975 = 100. Column (3) is a weighted average of Irish competitiveness on the 11 markets other than the UK which enter the overall index.

Column (4) is the same for our 6 EMS markets (Belgium-Luxembourg counted together).

³We actually have figures on competitiveness for each of the 12 markets incorporated in the overall index. How meaningful some of these are is obviously questionable, particularly in the case of Japan and Canada. It makes more sense to examine broad aggregates as we do here.

Chart I:
Competitiveness
Indices by
Destination.



strong upward trend in competitiveness on the UK market on the one hand, interrupted only in 1979 IV by a temporary appreciation in the Irish pound against sterling and, on the other hand, a steady decline in our competitiveness on the markets of our fellow members of the EMS. Specifically, since joining the EMS the gain in competitiveness recorded on the UK market was some 18 per cent by 1980 III, the decline on EMS markets being about 3.5 per cent over the same period.

Not only is the magnitude of this divergence impressive but the nature of the underlying trends in the two measures of competitiveness is noteworthy. Prior to 1979 I, the two indices *fluctuated* more or less together (again the period 1976 III to 1977 II is aberrant) without showing either pronounced divergences or a marked underlying trend in a particular direction. This pattern underwent a radical change in all respects after 1979 I. Sustained and substantial depreciation of the currency against sterling in the face of small inflation-rate differentials between the two countries is responsible for the enormous gain in competitiveness on the UK market. While a more or less fixed exchange rate versus EMS currencies in the face of relatively large differentials in inflation rates in favour of our EMS partners explains the loss in competitiveness on that particular front.

Furthermore, as one might have expected, the change in the currency regime reflects itself in the comparative variability of the two indices as between the period to 1979 I and the period after that. Prior to 1979 I competitiveness on the UK market showed less variability (the UK index shows a standard deviation of 1.61 as against 3.42 for the EMS index where the means are 99.2 and 99.1 respectively). Subsequent to 1979 I the position is reversed with the UK index showing more variability (an SD of 5.93 against one of 1.26 with means of 109.4 and 95.8 respectively).

4. Interpretation and Conclusions

In the sections of the paper dealing with conceptual problems and index construction we have alluded to some of the shortcomings embodied in the competitiveness indices. It is useful at this stage to recapitulate on the most important of these to provide a counterpoint to our interpretation and conclusions: (a) our employment of unit value indices means that our measures of competitiveness will be sensitive to changes in export composition as well as changes in price; (b) our construction is such that substantial differences in composition may exist between Irish exports on the one hand, and those goods which Irish exports are deemed to compete with abroad on the other; (c) because of data deficiencies the index which we have used to represent the price of tradable goods which do not cross national frontiers has not always been the most appropriate one.

The first shortcoming is an important one since changes in the composition of exports may occur in direct response to what we are attempting to measure. Intersectoral differences in competitiveness trends may over time result in resources being redeployed towards those sectors which are enjoying relatively high competitiveness gains. The indices which we have constructed conceal this resource re-allocation and mask the employment and output implications arising therefrom. This problem is obviously one which increases in magnitude with the time-span of the analysis. It is outside the scope of the present paper to ascertain the extent to which such resource movements have occurred during the 5-6 year period which we have examined.

It is extremely unlikely that the imperfections discussed above account for the salient features of the behaviour of the indices we have presented in Table 1. Nevertheless, their presence does not allow any unequivocal or conclusive interpretation of the results. Interpretation must be conducted with some caution.

The evidence suggests that sharp and protracted divergences have occurred between the domestic and foreign price of tradable goods, particularly striking in this regard being the evidence from the disaggregated results. These findings are contrary to even the weakest formulation of the purchasing power parity theory. The fact that the results pertain to an economy which is widely regarded as fulfilling to a large extent the assumptions of the SOE theory may be construed as a disturbing reflection on the applicability of the theory itself in the short run. It is also notable that the divergences have only acquired appreciable magnitude in the period following Ireland's accession to EMS membership. It is equally notable that these divergences are particularly marked in the case of the UK index. This feature of the results would suggest

that the breaking of one-for-one parity with sterling has introduced significant real disturbances into the system which vitiate at least some of the assumptions which underlie both the PPP theory and that of the Small Open Economy.

With regard to future developments it seems reasonable to suppose that our competitiveness on EMS markets will continue to decline. This outcome appears to be inevitable if we eschew the option of devaluation within the EMS. The maintenance of existing inflation rate differentials between Ireland and other EMS member countries and *a fortiori* the widening of such differentials, in what is essentially a fixed rate regime, is not compatible with the improvement of our competitiveness nor is it compatible with the maintenance of the fixed rate regime. Predicting developments on the UK market is problematical. Since 1980 III, the last observation in our series, there has been further depreciation of the Irish pound against sterling, of the order of 10 per cent. Meanwhile, inflation has started to fall quite dramatically in the UK. Taking both these factors into account, it seems likely that the improvement in competitiveness on the UK market slowed down over the quarters 1980 IV and 1981 I — the index may have reached 123-124 by the first quarter of this year. The current position (May 1981) is that our exchange rate has stabilised *vis-à-vis* sterling, and precluding the possibility of devaluation within the EMS, the probability of significant further depreciation is not very strong. Given this and the likely prospect of our inflation rate outstripping that of the UK by about 8 per cent this year and by, perhaps, 5 per cent in 1982,⁴ it seems that the competitiveness of Irish exports on the UK market will decline significantly over the next 7-8 quarters. Of course, other factors enter into competitiveness on the UK market, in particular the export prices of other suppliers. However, given the relatively closed nature of the UK market for manufactured goods, consideration of likely trends in the Irish pound-sterling exchange rate and inflation rate differentials between the two countries is sufficient to provide a rough indication of future developments in competitiveness.

Prior to our membership of the EMS it was widely thought that this move, given the UK's decision to remain outside, would result in an accelerated diminution of our export dependence on the UK market. Such a prediction was based, among other things, on an incorrect anticipation of subsequent exchange rate developments and consequently of competitiveness trends too. The evidence since 1979 is somewhat confused by the fact that the UK economy has experienced a very sharp recession: the 11 months to November 1980 saw 42.25 per cent of our manufactured exports directed to the UK market compared to 43.65 per cent the previous year and 44.5 per cent in 1978. In 1974 the corresponding proportion was 54 per cent. Clearly, the process of redirecting exports to markets other than the UK has not accelerated — if anything it has slowed down. The extent to which trends in competitiveness have played a role here is not readily quantifiable. It is at least reasonable to suggest that they have not been helpful in this regard.

⁴These forecasts are based on the assumption that the rate of inflation in the UK will be about 10 per cent for each of the years 1981 and 1982. The corresponding projections for Ireland being 18 per cent and 15 per cent respectively.

5. Summary

Not surprisingly, our analysis points to a significant gain in overall price competitiveness since Ireland joined the EMS — the gain being in the region of 7 per cent. This conclusion, however important, is overshadowed by the remarkable difference in competitiveness trends when the overall index is disaggregated by destination market. Irish exports of manufactured goods recorded a gain in price competitiveness of roughly 18 per cent on the UK market and a loss of some 3.5 per cent on EMS markets from the first quarter of 1979 to the third quarter of 1980, suggesting a substantial undervaluation of the Irish pound *vis-à-vis* sterling and an overvaluation of considerably smaller magnitude relative to EMS currencies. This difference in experience can be ascribed largely to exchange rate developments.

It is hard to see how continued gains in competitiveness can be made on the UK market, given the likely behaviour of the UK price level in the coming year or so, and, the assumption of no devaluation of the Irish pound in the EMS. At the same time, anticipating price developments in the economies of our fellow EMS members, it seems unlikely that we can avoid further deterioration of our competitive position in those markets (again assuming that the option of devaluation is eschewed). All things considered, however, it does seem improbable that the competitive advantage Ireland has gleaned since early 1979 on the UK market by virtue of sterling's phenomenal upsurge will be eroded rapidly enough in the near future to reverse the current position whereby we are more price competitive on UK than on EMS markets. This scenario has important implications for the geographical distribution of our exports which, we suggest, have not heretofore been acknowledged.

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TECHNICAL ANNEXE

I. Construction of Price Competitiveness Index

The construction of this index may be formally described as follows:

Let $i = 1, 2, \dots, m$ represent the importers of manufactured goods.

Let $j = 1, 2, \dots, n$ represent the exporters of same.

Imports of i from j are indicated by a_{ij} and $\sum_{j=1}^n a_{ij}$ gives total imports of manufactured goods by i .

Therefore $\frac{a_{ij}}{\sum_{j=1}^n a_{ij}} = \alpha_{ij}$ will be the proportion of i 's imports

$$\sum_{j=1}^n a_{ij}$$

of manufactured goods accounted for by exporter j .

Furthermore, if we describe an "openness factor" $\pi_i = \frac{\sum_{j=1}^n a_{ij}}{Q_i}$,

as the proportion of net manufactured goods supply in i accounted for by imports, where Q_i represents "consumption" of manufactured goods in country i , then, $\pi_i \alpha_{ij}$ will be the proportion of net manufactured goods supply in i accounted for by imports from country j and $(1 - \pi_i)$ the proportion accounted for by domestic production.

Finally, let P_i (where $i = 1, 2, \dots, m$) represent the price of domestically produced output and XUV_j ($j = 1, 2, \dots, n$) represent the export unit values of manufactured goods, both vectors of prices being expressed in a common currency for each country and over all countries.

The price competitiveness index may be represented as follows in matrix form.

$$\begin{bmatrix} 1-\pi_1 & 0 & \dots & 0 \\ 0 & 1-\pi_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & 1-\pi_m \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ \vdots \\ P_m \end{bmatrix} + \begin{bmatrix} \pi_1 & 0 & \dots & 0 \\ 0 & \pi_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \pi_m \end{bmatrix} \begin{bmatrix} 0 & \alpha_{12} & \dots & \alpha_{1n} \\ \alpha_{21} & 0 & \dots & \alpha_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{m1} & \alpha_{m2} & \dots & 0 \end{bmatrix} \begin{bmatrix} XUV_1 \\ XUV_2 \\ \vdots \\ XUV_n \end{bmatrix} = \begin{bmatrix} PC_1 \\ PC_2 \\ \vdots \\ PC_m \end{bmatrix}$$

which is an $m \times 1$ dimensioned vector of "prevailing" prices in the m markets for exporters each element of which is a weighted average of the prices of domestically produced output in market i and exports to market i from all j ($i \neq j$) or in summation form:

$$PC_i = (1 - \pi_i) P_i + \pi_i \sum_{j=1}^n \alpha_{ij} XUV_j$$

where $\alpha_{ij} = 0$ if $i = j$ multiplying the above vector by $1/XUV_{IRL}$, where XUV_{IRL} is the export unit value index for Irish manufactured goods, yields a vector of competitiveness indices for Ireland each element of which corresponds to the export markets (importers) $i = 1, 2, \dots, m$ which if pre-multiplied by the row-vector

$$\begin{bmatrix} COMP_1 \\ COMP_2 \\ \vdots \\ COMP_m \end{bmatrix} \quad \begin{bmatrix} \beta_1 & \beta_2 & \dots & \beta_m \end{bmatrix}$$

yields the overall price competitiveness index for Ireland where the β_i s represent the proportion of Irish manufactured exports going to each market i .

This may be expressed in summation form as follows:

$$\frac{1}{XUV_{IRL}} \left[\sum_{i=1}^m \beta_i (1 - \pi_i) P_i + \sum_{i=1}^m \beta_i \pi_i \sum_{j=1}^n \alpha_{ij} XUV_j \right]$$

where $\alpha_{ij} = 0$ if $i = j$.

II Data for Derivation of Weighting Scheme

Table II (a) is a trade-flow matrix for 1977 covering imports and exports of manufactured goods between the 12 countries incorporated in our index. The importers are arranged by column and the exporters by row. The figures are in value terms and are expressed in millions of US dollars. Thus the UK, for instance, imported \$3,328m worth of manufactured goods from France in 1977 out of a total bill of \$37,169m for manufactured imports. Ireland's exports of manufactured goods are entered in the last column purely for reference purposes. Note that the figures appearing in the row entitled "total" represent the sum of manufactured imports from all sources and not merely from the countries listed. The elements of this matrix correspond to the a_{ij} s referred to in the formal exposition of the construction method.

Table II (b) is simply the previous table in proportion form: thus the UK in 1977 imported 8.95 per cent of its total manufactured import requirements from France, and so on. These proportions do not sum to one for any one importer as they would do if coverage of exporters were exhaustive. The extent to which they fall short of one is indicated in the row labelled "Total (Above)" and varies from 63 per cent in the case of Japan to 94 per cent for Canada. The simple average here is in fact about 80 per cent which is adequate for our

TABLE II(a): Trade Flow Table for Manufactured Goods — 1977 (Importers by Column, Exporters by Row)
Millions of US \$s

	UK	FRA	BLEU	NETH	GER	ITALY	DEN	SWE	SWITZ	USA	CAN	JAP
UK	—	2808	2729	2248	3381	1418	997	1515	1233	3880	994	740
FRA	3328	—	4596	2353	8922	4032	420	666	1536	2515	370	473
BLEU	2225	5217	—	4245	6825	1283	347	485	553	1309	188	156
NETH	2209	2230	3874	—	5808	978	375	543	403	869	114	213
GER	5587	10397	7326	9629	—	6040	2190	3466	4639	6876	815	1355
ITALY	2065	5610	1384	2164	7209	—	313	451	1277	2496	327	600
DEN	478	241	108	227	720	93	—	883	100	251	51	72
SWE	1565	878	455	555	1465	371	1399	—	295	923	233	184
SWITZ	2249	1343	447	461	2668	757	215	378	—	981	180	429
USA	4710	3634	1457	1863	2199	1754	439	1185	979	—	23777	4661
CAN	928	157	79	99	238	96	18	72	45	18902	—	249
JAP	1790	1353	620	864	2717	589	402	774	526	18416	1613	—
TOTAL	37169	40752	26291	26839	57406	21052	8618	13993	13457	78613	30896	14649
Ireland	1113	113	51	92	240	35	46	46	23	168	31	26

Source: OECD "Statistics of Foreign Trade" — Monthly Bulletin Series C (1977)

TABLE II (b): Trade Flow Matrix — Proportions α_{ij}

	UK	FRA	BLEU	NETH	GER	ITALY	DK	SWE	SWITZ	USA	CAN	JAP
UK	—	.0689	.1038	.0836	.0589	.0674	.1157	.1083	.0916	.0494	.0327	.050
FR.	.0895	—	.1748	.0875	.1554	.1915	.0487	.0476	.1141	.0320	.0122	.0323
BLEU	.0599	.1280	—	.1578	.1189	.0609	.0403	.0347	.0411	.0167	.0045	.0106
NETH	.0594	.0547	.1474	—	.1012	.0465	.0435	.0388	.0299	.0111	.0038	.0145
GER	.1503	.2551	.2787	.3580	—	.2869	.2541	.2477	.3447	.0875	.0268	.0825
ITALY	.0556	.1377	.0526	.0805	.1256	—	.0363	.0322	.0949	.0318	.0108	.0410
DEN	.0129	.0059	.0041	.0084	.0125	.0044	—	.0631	.0074	.0032	.0018	.0049
SWE	.0421	.0215	.0173	.0206	.0255	.0176	.1623	—	.0218	.0177	.0077	.0126
SWITZ	.0605	.0330	.0170	.0170	.0465	.0360	.0249	.0270	—	.0125	.0059	.0293
USA	.1267	.0892	.0554	.0693	.0383	.0833	.0509	.0847	.0728	—	.7822	.3182
CAN	.0250	.0038	.0030	.0037	.0041	.0046	.0022	.0051	.0033	.2404	—	.0170
JAP	.0482	.0332	.0236	.0321	.0473	.0280	.0466	.0553	.0391	.2343	.0531	—
Total												
(Above)	.7301	.8310	.8777	.9185	.7342	.8271	.8255	.7445	.8607	.7306	.9415	.6252
Ireland	.0299	.0028	.0019	.0027	.0042	.0017	.0053	.0033	.0017	.0021	.0010	.0018
Ireland's Exports (1977 Weights)	.5342	.0683	.0393	.0424	.1247	.0219	.0218	.0211	.0108	.0836	.0185	.0134

Note: This table is based on Table II(a).

purposes. Note that for the purposes of constructing the index these proportions are normalised to sum to unity. The elements of this table correspond to the α_{ijs} defined above. In the last row of Table II (b) we present the proportions of Ireland's manufactured exports going to each of the countries tabulated — these correspond to the β_{is} of the formal discussion.

In Table II (c) we present the estimates of the "openness factors" used for each importer. Ideally, these should represent the proportion of net manufactured goods supply accounted for by imports of manufactures in the respective countries. In practice reliable data for the derivation of π (as the openness factor is designated in the formal discussion) are available for the UK only. Although gross manufacturing output figures are given in the *UN Yearbook of National Accounts* for some other countries, it was felt that the problems relating to cross-country comparability of such data were inimical to their use. Instead, for all countries except the UK we have used an approximation for π viz. the ratio of imports to domestic final demand — $M/(C + I + G)$. Obviously this will overstate the true π in the case of countries which rely relatively heavily on agricultural imports, for instance, and will understate true π in the event of a country being relatively self-sufficient in agricultural produce. Notwithstanding this shortcoming it is felt that the net result will not involve major inaccuracies.

TABLE II(c) Openness Factors (π_{is}) (Based on 1977 data)

UK	.2093
France	.2162
Bleu	.5271
The Netherlands	.4915
Germany	.2414
Italy	.2772
Denmark	.3142
Sweden	.2960
Switzerland	.3498
USA	.0926
Canada	.2398
Japan	.0309

Sources: UK-CSO *Annual Abstract of Statistics (1981)* Other countries — *UN Yearbook of National Accounts Statistics (1979)*, Table 12.

Finally in Table II(d) we reproduce a matrix entitled "Origin of Net Manufactured Goods Supply". This combines the α_{ijs} and the π_{is} such that along the diagonal are displayed the $(1 - \pi_{is})$, i.e., the proportion of manufactured goods consumption in i originating in domestic production and, the off-diagonal elements are $\pi_{ij} \alpha_{ij}$, i.e., the proportion of manufactured goods consumption in i imported from country j . From this table it is possible to calculate the weight implicitly ascribed to each of the 12 competitors in the eventual index. This is only an implicit weight, however, since the index as constructed is based on a weighted average of *markets* and not a weighted average of competitors. Nevertheless, it is of some interest to know the implicit weight given to each competitor, particularly as it was on this very point that

TABLE II (d): Origin of Net Manufactured Goods Supply

	UK	FRA	BLEU	NETH	GER	ITALY	DEN	SWE	SWITZ	USA	CAN	JAP
UK	.7907											
FR	.0257	.7838	.0623	.0447	.0194	.0226	.0440	.0431	.0372	.0063	.0083	.002
BLEU	.0172	.0333	.1050	.0468	.0511	.0642	.0185	.0189	.0464	.0041	.0031	.001
NETH	.0170	.0142	.0885	.0844	.0391	.0204	.0153	.0138	.0167	.0021	.0011	.000
GER	.0431	.0664	.1674	.5085	.0333	.0156	.0166	.0154	.0122	.0014	.0010	.000
ITALY	.0159	.0385	.0316	.1916	.7586	.0961	.0967	.0985	.1401	.0111	.0068	.004
DEN	.0037	.0015	.0025	.0431	.0413	.7228	.0138	.0128	.0386	.0040	.0028	.002
SWE	.0121	.0056	.0104	.0045	.0041	.0015	.6858	.0251	.0030	.0004	.0005	.000
SWITZ	.0173	.0086	.0102	.0110	.0084	.0059	.0618	.7040	.0089	.0015	.0020	.000
USA	.0363	.0232	.0333	.0091	.0153	.0121	.0095	.0107	.6502	.0016	.0015	.001
CAN	.0072	.0010	.0018	.0371	.0126	.0279	.0194	.0337	.0296	.9702	.1992	.015
JAP	.0138	.0086	.0142	.0020	.0013	.0015	.0008	.0020	.0013	.0305	.7602	.000
				.0172	.0156	.0094	.0177	.0220	.0159	.0298	.0135	.969

the British CSO-type index was unsatisfactory. The formula for arriving at these implicit weights is

$$\beta_j (1 - \pi_j) + \sum_{i=1}^m \beta_i \alpha_{ij}$$

where $\alpha_{ij} = 0$ if $i = j$. They are reproduced in Table II (e) along with the weights obtained in constructing the relative Export Price Index discussed in the main body of the paper.

TABLE II (e): Weights Implicit in Price Competitiveness Index (PCI) and Weights used in Relative Export Price Index (RXPI)

	PCI Weights	RXPI Weights
UK	.4842	.0424
FRANCE	.0829	.1159
BLEU	.0400	.0879
THE NETHERLANDS	.0405	.0761
W. GERMANY	.1456	.2010
ITALY	.0364	.0866
DENMARK	.0184	.0191
SWEDEN	.0254	.0446
SWITZERLAND	.0203	.0591
USA	.1072	.1418
CANADA	.0210	.0470
JAPAN	.0281	.0785
SUM	1.0000	1.0000