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Discussion Paper

THE COMPOSITION OF THE HUMAN CAPITAL STOCK AND ITS RELATION TO INTERNATIONAL TRADE: EVIDENCE FROM THE US AND BRITAIN

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THE COMPOSITION OF THE HUMAN CAPITAL STOCK AND ITS RELATION TO INTERNATIONAL TRADE : EVIDENCE FROM THE US AND BRITAIN

1. Introduction

This paper presents evidence on the factor intensity of British and US trade, using factor content techniques to provide estimates of the implicit trade in factors embodied in net exports. Estimates are reported for a wide range of factors of production at a fairly aggregate level and, for labour, at a disaggregated level involving 74 detailed occupational categories. Results are also produced for each country on the factor intensity of net exports for a sample of different trading partners.

Given the techniques and data that we have employed, our estimates do not represent a formal test of the Heckscher-Ohlin-Vanek (HOV) theorem nor are they formal measures of underlying relative factor abundance. Our approach has been to provide summary estimates on the factor intensity of trade which, we hope, allows a degree of insight that a more formal procedure would deny.

Specifically, this paper examines three issues. Firstly, there is a volume of evidence from both the US and the UK that the composition of the labour force is important in determining trade. In the UK work by Katrak (1982), Hughes (1986), Greenhalgh (1990), Courakis (1991) and Oulton (1993) has provided evidence that skills are important in determining the pattern of international trade. The issue has commanded little attention recently among trade economists examining the US but the importance of labour skills has been clearly recognised since the work of Keesing (1965), Baldwin (1971), and Stern and Maskus (1981). This work generally focuses on levels of skill -- for example, professional or skilled manual labour. Many of the earlier studies also use either discounted wage differentials (eg Stern and Maskus, 1981) or educational attainment (eg Baldwin, 1971). We submit that occupational employment provides a more satisfactory measure of underlying human capital.

This paper examines the hypothesis that specialisation in trade according to differentiated types of labour has two dimensions. As with earlier studies, we examine the extent to which there is specialisation according to broad skill levels such as professsional or skilled manual labour. However, these broad skill categories encompass a wide range of skills that are significantly differentiated from each other whilst demanding a similar level of education and/or training. It is clearly possible that specialisation might also occur within, say, the broad category of professional labour as well as between professional and other types of labour. To date there is almost no available evidence on such effects although Sveikauskas (1983) provides a detailed treatment of technological inputs into US trade and Webster (1993) an anlysis of implicit UK trade in different occupations.

As a by-product of this analysis we provide some evidence on a methodological aspect of factor content techniques. Factors are difficult to define. As Brecher and Choudri (1982) show, unwarranted disaggregation can invalidate the theoretical properties of the factor content model. Equally, excessive aggregation can clearly ignore important sources of specialisation. The appropriate level of (dis)aggregation is, therefore, partially an empirical issue. The evidence that we produce concerning intra-skill category specialisation, therefore, also provides a basis for assessing the extent to which disaggregation is warranted.

Secondly, examination of this second dimension to international specialisation within the labour force also raises questions as to whether the relative importance of inter-skill level and intra-skill level specialisation might vary according to different trading partners. For example, we should expect from the HOV theorem that a country relatively abundant in unskilled labour would tend to export goods intensive in this factor and to import skill intensive goods from a trading partner with a relative skill abundance. If, however, two countries possess identical relative endowments of each broad skill level we should not expect any basis for trade provided that these skill levels are homogeneous. If they are not, then it is still possible that the two countries could specialise within each broad skill category.

It follows, then, that it is possible that the relative importance of inter and intra-category specialisation may vary according to trading partners. To provide evidence on this we calcualte the skill contents of both US and UK trade with (i) all developed countries; (ii) LDC's; (iii) the European Community (EC); and (iv) bilateral trade with each other. The cost to so doing is that our results can not be interpreted as "revealing" comparative advantage (see Leamer, 1980, Maskus, 1985, and Bowen, Leamer and Sveikauskas, 1987).

Finally, this paper is in the HOV tradition in the sense that it focuses on factor markets and trade. To some extent this necessitates ignoring the role of technology in international trade. For example, factor content analysis requires an assumption of identical technology. This, clearly, involves the risk that such estimates could be ignoring an important source of specialisation. By presenting separate estimates on US-UK bilateral trade, based on the factor requirements of production in each country, we are able to provide some limited evidence on the extent to which different production techniques between the two countries have affected net trade in factors.

2. Methodology and Data Sources

Studies of the factor contents of international trade have a long history, stemming from Leontief's (1953) seminal work. As discussed by Leamer (1980), however, Leontief's approach is incapable of accurately revealing underlying factor scarcity in an economy if there exist more than two factors or if there is unbalanced trade, both conditions that are surely true in virtually all applied situations. In such circumstances a simple comparison of the labour and capital contents of exports and imports is inadequate.

The appropriate observation is that, assuming identical and homothetic tastes in all countries, in general equilibrium a nation will consume relatively little (and therefore export on net relatively much) of its abundant factors. Following Leamer and Bowen (1981) let A_i be an (mxn) matrix of interindustry input coefficients for country i (that is, the product of an (mxn) factor-input coefficient matrix and an (nxn) Leontief inverse matrix), Q_i the country's (nx1) vector of commodity production and E_i its (nx1) vector of factor endowments. Then full employment requires that $A_iQ_i = E_i$. Further, let C_i be the (nx1) vector of commodity consumption. Under identical homothetic preferences the country will consume a constant proportion of the world's output of each good: $C_i = Qw_i$, where Q is the world production vector and w_i is the share of the economy's trade-balance-adjusted expenditure in world expenditure. Finally, let T_i be the economy's (nx1) vector of net exports of commodities, with $T_i = Q_i - C_i$ by definition. Under a stringent set of assumptions comprising the HOV Theorem, the following relationship follows immediately:

$$AT_i = E_i - Ew_i \tag{1}$$

where E is the world endowment vector.

Equation (1) may be used as a basis for revealing factor abundance in a country. If elements of the right-hand-side vector are positive, for example, the economy apparently has a relatively large share of the world endowment of those factors. In terms of an internal ranking of endowments a country may be defined to be abundant in one factor relative to a second factor if the country's share of the world endowment of the first factor exceeds its share of the world supply of the second factor. This definition is easily shown to be equivalent to a situation in which the ratio of the total content of the first factor in net exports to its total content in national consumption exceeds the corresponding ratio for the second factor. That is, for any two factors F^1 and F^2, the following ranking is sufficient to demonstrate relative abundance of factor 1:

$$(F_x^1 - F_m^1)/F_c \; > \; (F_x^2 - F_m^2)/F_c \quad . \tag{2}$$

The rankings in inequality (2) are valid across any pair of factors, for an arbitrary number of factors, given the validity of the HOV theorem.

The HOV theorem relies on assumptions of, among other things, factor price equalisation and internationally identical homogeneous technologies. In fact, the model generating inequality (2) holds under less restrictive assumptions. For example, Brecher and Choudhri (1982) showed that the factor-content approach is valid in the absence of factor price equalisation (see also Clifton and Marxsen (1984)). Helpman (1984) demonstrated that if factor prices are not equalised internationally, it is not necessary to assume identical homothetic preferences for the factor-content approach to hold. Thus, factor-content studies are valid under fairly general circumstances.

With unequal factor prices we cannot expect the equilibrium (observed) A matrix in one country to hold as the equilibrium for all countries, even under invariant technologies. This has represented a significant drawback of most factor-content studies, which take the input-output structure of one country, often the United States, and apply it to other countries or regions. In this regard, using separate A matrices for the United States and the United Kingdom in this paper is a virtue for it allows meaningful examinations of the factor contents of bilateral trade (Brecher and Choudhri, 1988).

Thus, our purpose here is to calculate the rankings in inequality (2) for the trade flows mentioned above. We do this for two definitions of factor inputs. The first includes a series of natural-resource inputs and physical-capital types along with the disaggregated set of 74 occupations. The second incorporates the same non-labour inputs but aggregates the detailed occupations into seven subcategories. This is done both for reasons of descriptive interest in terms of the linkages between broad skill classes and trade and for purposes of testing for the validity of occupational disaggregation.

A word about occupational disaggregation is in order. Our view is that additional insight is to be gained from specifying differential labour skills at a relatively detailed level. From an analytical standpoint, however, such disaggregation is sensible only to the extent that particular skill categories are genuinely distinct from one another. Indeed, Brecher and Choudri (1982) have argued that unwarranted disaggregation can invalidate the factor content model. On the other hand excessive agggregation can also not be valid (Gift and Marxsen, 1984) and can lead to important patterns of specialisation being ignored.

Accordingly, care was taken to select specific categories that plausibly represented skills with two characteristics. First, they likely involve some time and cost for individuals to acquire, ensuring that persons are not freely transferrable between skill categories. Second, the skills have potential uses in the production of a range of goods and services. In cases where such conditions were dubious or clearly unmet the occupation was assigned the relevant residual aggregate. The "unskilled" category was reserved for those workers whose occupational classifications seemed to embody little training and, therefore, rapid potential intersectoral mobility. Whether our aggregation scheme accomplishes these goals in the best way available is an open question.

For comparative purposes it is important that the definition of occupations (labour skills) and other inputs between the two countries be as consistent as possible.[1] We have chosen to use a UK input classification scheme as the benchmark to which comparable US data are concorded. Specifically, non-labour inputs are taken as inputs in comparable categories within the respective input-output tables. Further, occupational categories are adapted from UK census data and we concord US occupations to this basis. Details are provided below.

To this point we have not attempted to standardise the input-output tables of the two countries in terms of sectoral dimensions. Rather, we prefer to use the technological structures provided by the relevant data authorities and not to risk inaccurate aggregation of the tables. Thus, concordances of the industrial classifications for occupational employment to the input-output tables are based on each country's separate data bases.

One final comment of a general nature is in order. There remains some dispute in the literature over whether factor-content calculations should be based on total or gross (direct plus indirect) factor requirements of on direct requirements. Direct requirements may be more appropriate to the extent that a small open economy can trade intermediate inputs freely at world prices (Staiger, 1986). This situation may fairly characterise the United Kingdom, at least in terms of its trade with the EEC. On the other

[1]Indeed, a fully rigorous factor-content comparison would require that the aggregation of factors requires identical weights in both countries, which is a condition that cannot be satisfied in practical terms.

hand, work by Hamilton and Svensson (1983) and Deardorff (1984) favors computation of total requirements in more general circumstances. The latter approach is likely more appropriate for the United States. To save space, we present and compare results based solely on total factor-content computations. As we demonstrate shortly, use of direct versus total requirements makes little empirical difference for either country and the results for direct requirements are available upon request.

2a. US Data

Data required for this study include, for each nation, input-output tables, factor-input technical coefficients, and consumption and net exports for each commodity. For the United States information on the intersectoral economic structure is provided in the 228-sector input-output tables for 1987, the most recent year assembled. These tables were provided on computer tape by the Bureau of Labor Statistics (BLS) of the US Department of Labor. Of these sectors, 111 comprise services, construction, and utilities. We consider these commodities to be nontradeable and set their trade flows to zero.[2] The same approach is used for the UK tables. The remaining 117 industries include raw materials, agricultural products, and manufactured commodities. These are taken to be tradeable goods.

Consumption is defined in this study as apparent consumption, or commodity output by sector less the sectoral trade balance. We assemble data on 1989 commodity outputs and trade flows in order to be consistent with the UK calculations, though they are applied to the 1987 US input-output structure. Commodity output on an input-output basis for 1989 was also provided by BLS.

Unfortunately, no trade data concorded exactly to the input-output sectoral classification exist for

[2]The tables provide data on sectoral total exports and imports and for most of these sectors trade is reported to be zero. For some purposes it would be useful to include trade in services, however available data sources do not break such trade down by region or country. In terms of total trade it seems to make little difference to ignore services trade as the correlation between the total factor contents of US trade in 1987 with and without services trade is 0.92 (the rank correlation is also 0.92), while that for detailed factors is 0.94 (0.92).

1989 and there are none at all for trade with specific countries and regions. This problem forced us to construct a detailed concordance between the Standard International Trade Classification (SITC) and the US input-output structure (details available upon request). This was done initially using 1987 SITC (Revision 2) categories compared to the US sectoral categories. The concordance is evidently successful; the correlations between the input-output data reported by BLS and 1987 SITC-based figures are 0.977 for exports, 0.991 for imports, and 0.988 for net exports across industries. In turn, a careful concordance between the SITC revisions 2 and 3 (the latter in place by 1989) is employed to place the 1989 trade data on an input-output basis.

The largest effort in the data assembly task was to aggregate detailed US data on occupational employment by sector into 74 occupations and the 228 input-output sectors.[3] The data base, again provided on tape by BLS, provides employment in 1990 for 507 occupational titles in 240 industries, comprising some 60,000 records.[4] The industries cover the full spectrum of economic activity, including services. They are reported on the American Standard Industrial Classification (SIC) basis, which BLS has also concorded to its input-output structure. Thus, industry aggregation is straightforward. Within each industry, aggregation of occupational employment is carried out according to the 74 classes taken from the UK 1981 census. Thus, a detailed concordance between these two systems was developed for this purpose. Again, details are available upon request. In total, this aggregation scheme assigned 106.5 million workers (90.3% of civilian employment in 1990) to the occupation-by-industry matrix.

To compute technical coefficients for occupational employment, we calculate the share of sectoral

[3]In fact, only 224 of these sectors employ labour and other inputs as four industries are residual in nature.

[4]Some observations were missing for confidentiality reasons. In most cases missing observations were unreported because occupational employment was less than 50 persons; in these cases we assigned employment levels of 25 people. In other cases it was possible to infer approximate levels of occupational employment from aggregate figures. In each sector the approximated employment total differed from the reported employment total by no more than 0.5%.

employment claimed by each occupation, with these shares adding to unity. Separately, total wage costs as a percentage of industry output are calculated for each input-output sector, with the 1989 wage data coming from various sources, primarily *Employment and Earnings* (BLS) and *Annual Survey of Manufactures* (Department of Labor). Technical coefficients on a value basis, or occupational inputs per dollar of industry output, are then taken as the product of the employment shares and the wage shares.

Technical coefficients for the non-labour categories are taken directly from the input-output "use" matrix. For example, inputs of office machinery are defined as use, per dollar of industry output, of computer equipment and office and accounting machines. Thus, natural resources and physical capital are measured here by flow inputs rather than by existing stocks, as was done by Maskus (1985). There is some danger of misrepresenting endowments in this procedure if utilisation rates differ by country, which would be true to the extent that the UK and the US have different technologies, relative factor prices, or rates of time preference. However, given the apparent success of flow measures in capturing sources of comparative advantage in earlier work (Leamer, 1984; Maskus, 1991) and that there are no practical alternatives available, we consider this problem to be relatively minor.

2b. UK Data

British data were collected with the intention of achieving the closest possible match with that or the United States. Definitions of both factors and occupations were based on a UK classification but constructed to be identical to those for the US for all practical purposes. As with the US, 3 digit SITC data on commodity trade (United Nations) were employed.

Data on the factor requirements of production were taken from : *Input-Output Balance for the United Kingdom 1989, Economic Trends, Central Statistical Office, 1992, London : HMSO.* Requirements for all factors other than labour were, therefore, treated as current expenditures and taken directly from this input-output table. The 1989 input-output table simply reports total value added for each activity and does not separately identify income from employment. To allow total labour requirements to be calculated, data on industry wage bills for each input-output category were calculated from *Census of Production 1989, Business Statistics Office, 1990, London : HMSO.*

Having identified labour requirements per unit of output for each non-service activity these were further decomposed into labour according to the same eight skill levels and the same 74 occupational categories as for the analysis of US net exports. Data for this disaggregation of labour requirements were taken from *Census 1981: Qualified Manpower, Office of Population Censuses and Surveys, 1984, London : HMSO.* Disaggregation was performed by head count. This procedure has been used by a number of authors previously such as Baldwin (1971) and Leamer (1980) and has been shown to be a legitimate basis for calculation by Gift and Marxsen (1984).

By construction it is assumed that the share of each skill or occupational category in total labour requirements was unchanged between 1981 and 1989. Total labour requirements, however, are those recorded for 1989. It is, therefore, a constant composition of the workforce between 1981 and 1989 that is assumed, not unchanged labour requirements. Apparent consumption figures were directly computed from the UK input-output table as production less net exports.

3. US Results

This section presents calculations of the total factor contents of US net exports, relative to aggregate consumption, using first a broad aggregation of productive factors and second the detailed set of occupational endowments. The initial analysis is useful for providing context on the broad factoral determinants of trade performance, including non-labour inputs. The subsequent analysis attempts to refine our picture of labour skills as determinants of trade performance.

3a. Factor Requirements of US Trade

Table 3.1 lists the total scaled factor contents of net exports with the developed economies as a group, the developing countries as a group, the UK, and the EEC.[5] These are broad aggregates of 17 factors, including 5 natural resources, four types of physical capital, and eight skill classifications for labour. We report only the total factor requirements because of their close similarity to direct factor requirements.[6] The computations yield the following insights. Among the natural resources the United States finds its greatest relative abundance in forestry and fishing, particularly with respect to trading with the developed nations, including Europe. Oil and gas and metal ores are among the most scarce factors as revealed through factor contents. In terms of capital, the strongest net export positions are for the services of office machinery (computing, office and accounting machines) and electrical and telecommunications equipment. The single exception lies in the strong net imports of office-machinery services from developing countries, which likely reflects the US deficit positions in trade in semiconductors and simple office machines. This deficit is reflected in the low ranking of this factor in factor trade with developing economies but these imported inputs then are used in other sectors with strong net export positions, especially with the industrial countries. Indeed, this picture is reversed in the context of the machinery factor (largely industrial machinery), the services of which are prominent in net exports to the developing nations.

Turning to the labour categories, the classification used here is similar to that used in Keesing's (1965) classic article. The figures reveal an interesting difference between trade with the UK and the EEC, on the one hand, and the developing countries, on the other. The labour skills contributing most strongly to positive net exports to the UK and the EEC are those in the professional, skilled nonmanual

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[5]We also computed factor contents of trade with the world as a whole but do not report these because they are virtually identical to factor contents of trade with the developed countries (rank correlations for the US are 0.82 for the limited set of factors and 0.92 for the detailed set of factors and occupations).

[6]Rank correlations between total and direct factor requirements are 0.63 (trade with developed countries), 0.68 (trade with LDCs), 0.97 (trade with UK) and 0.92 (trade with EC). All are significantly positive at the 95% confidence level.

(eg, draughtsmen and technicians), and managerial occupations.[7] In contrast, these skills are ranked considerably lower in the determination of net exports with the developing countries. Higher-ranked categories include semiskilled nonmanual (eg, sales representatives), unskilled workers, and clericals. In a sense these results are surprising in that the United States is presumably relatively scarce in these factors.[8] Further, the sectors with relatively strong commodity net-export positions relative to the developing countries tend to embody more-advanced technologies and, presumably, skills (eg, industrial machinery, aircraft, instruments, and chemicals). On the other hand, the occupations at issue here are disproportionatly employed in the service (here, nontraded) sectors. It may be that the results are picking up some kind of intrasectoral differences in the use of labour skills for producing for, and importing from, various international markets. This issue requires further examination.

It is worth noting separately that the category of skilled manual workers (eg, skilled textile workers, construction workers, and printers) is ranked low in its contribution to net exports in all trade flows. In this sense it appears quite strongly that skilled tradespersons have become relatively scarce in the United States.

In total it seems that more-advanced skills contribute to net-export strength for the United States, at least in relation to trade with Europe and the developed countries. Nonetheless, the relationship is weak, suggesting that a sharper delineation of skills could provide greater insights into the skill-based determinants of international trade. That is the task of the next subsection.

3b. Occupational Requirements of US Trade

Table 3.2 lists the rankings of natural resources, capital, and occupational gross contents in net

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[7]See Table 3.3 below for lists of the subcategories in each skill class.

[8]Without further analysis we are unwilling to make this claim very strongly. For example, it may well be that the US is well endowed with sales representatives in comparison with other economic structures.

exports over consumption for 1989.[9] There appear to be considerable differences in the factor-content rankings between the developing countries, on the one hand, and the UK and the EEC, on the other hand.[10] For example, medical occupations (doctors, dentists, and nurses; pharmacists) are ranked highly in the factor contents of net exports to the former group and much lower in net exports to the latter areas. Conversely, many of the engineering professions are more prominent in determinint net exports with the UK and the EEC than with the LDCs, where they are ranked lower. An extreme difference arises in the category "repetitive assemblers," which is ranked first among occupations in trade with Europe and the UK and close to last otherwise. Again, this dichotomy in a category with limited skills is curious. Overall, these differences in rankings suggest that considering trade with different areas separately may be sensible.

The results indicate that certain professional and managerial categories are strong contributors to net exports with the UK and the EEC. Such categories include primarily engineering, economists and computer professionals, writers, production managers, and farm managers. Somewhat less important are the services of architects, lawyers, scientists, and transportation managers. The averages of these rankings in these categories are 32.4 (UK) and 25.0 (EEC) in professional occupations and 29.2 (UK) and 27.2 (EEC) in managerial occupations. These advanced labour skills are the most important types of labour explaining positive US trade performance with Europe.

Moving down the skill ladder into other categories, the average ranking rises almost continuously (suggesting greater scarcity for these factors) through the skilled manual trades in trade with the UK and the EEC. Thus, despite the importance of isolated labour skills, such as technicians, agricultural supervisors, motor mechanics, telecommunications fitters, and horticultural workers, it appears that US

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[9]Rank correlations between gross and net factor and occupational requirements are 0.87 (developed countries), 0.85 (LDCs), 0.91 (UK), and 0.90 (EC).

[10]This observation is confirmed by the rank correlations in Table 3.4.

comparative disadvantage relative to Europe comes in the areas with more limited skills. The highest averages lie in the skilled manual occupations (this is true also of US trade with all developed countries), amounting to 48.2 (UK) and 56.4 (EEC). Thus, the characterisation here of the skill basis of US trade with Europe would suggest that the US has the relative advantage in services of professional and managerial occupations and the relative disadvantage in services of skilled manual trades. The other categories, including semiskilled manual and unskilled workers, occupy an intermediate position.

The situation is rather different with respect to the developing countries. Again, while there are substantial occupational variations within categories, such as the low rankings of physical scientists and civil engineers in contrast with the high ranking of mechanical engineers, it seems that, relative to Europe, US net export strength with the developing countries lies rather more in the skilled manual areas (average ranking 43.0) and rather less in the prfoessional and managerial categories (average rankings 39.1 and 37.5, respectively). In the skilled manual area, categories of particular strength include agricultural supervisors, engineering machine operators, sheet metal workers, steel erectors, tool and instrument makers, and welders. Agricultural supervisors, along with farm managers and horticultural workers, likely serve as proxies for the large American land endowments and resulting comparative advantage in agriculture, rather than as a distinctive source of comparative advantage. Otherwise, the picture that emerges that the US has a comparative advantage relative to the LDCs in occupations that are intensively used in heavy manufacturing sectors.

4. UK Results

4a. Factor Requirements of UK Trade

Factor requirements of UK net exports per dollar of consumption are reported in Table 4.1 on a total basis. Again, the choice of direct or total factor requirements can be shown to be of little relevance for the UK.[11]

There are several important areas in which the factor content of the UK's net trade with developed countries differs from that with LDC's. The most obvious of these is oil and natural gas. Many significant oil producers are LDC's whereas few developed countries are major oil producers. It is not, therefore, surprising that the UK exhibits a strong tendency to export goods intensive in crude oil to developed countries but not to LDC's.

That the results for LDC's and developed countries correspond to what one might expect from casual observation of factor endowments is also shown by other factors. The UK is generally "revealed" by the analysis to be specialised in capital-intensive activities in relation to LDC's but not in relation to developed countries. Similarly, the UK is not generally revealed to be abundant in non-energy resources with respect to any group of trading partners. However, the rankings do suggest a specialisation in metallic ores compared to LDC's. This is much more likely to be the consequence of complementarities than underlying endowments of such resources. Since the production of metals is as capital-intensive as it is resource-intensive it is likely that this is a consequence of the UK's relative capital endowment rather than its resource endowment.

With respect to the different skill levels of labour the pattern of the UK's revealed specialisation by factor is broadly consistent between trade with LDC's and that with developed countries. In general, the UK is revealed to be relatively specialised in almost all types of nonmanual labour but to be relatively scarce in manual labour.

Concerning bilateral net exports with the US, the UK is again shown to be a significant net exporter of energy, as with developed countries in general, but also relatively specialised in capital-intensive activities (other than for office machinery in which it is revealed to be relatively scarce), as with

[11]Rank correlations between total and direct factor requirements are 0.78 (developed countries), 0.97 (LDCs), 0.97 (US), and 0.73 (EEC).

UK trade with LDC's. Unlike UK trade with other developed countries, Britain is generally revealed to be scarce in most types of labour except, in particular, skilled manual labour. The highest skill levels (professional and managerial labour) tend to be the strongest sources of imports of any labour category. These results accord well with the rankings noted above for the United States.

The pattern of revealed factor abundance in UK-EC net exports is broadly similar to that of trade with all developed countries. This should not be surprising given the dominance of the EC in the UK's trade with developed countries. Energy is revealed to be abundant and capital scarce. Nonmanual labour is again a relatively weak source of advantage.

Table 4.3 reports rank correlation coefficients between the gross factor contents of UK net exports with the different trading partners. Correlations are reported with UK/Developed country trade for completeness and for consistency with the analysis of US trade. Since the EC dominates UK trade with developed countries, however, we shall confine discussion to UK trade with the other three partners. The factor content of UK net trade with the different partners exhibits a common pattern. The rank correlation between the factor contents of UK net exports (relative to consumption) with the EC and for net exports to LDC's is negative and generally statistically insignificant. Rank correlations between UK trade with the EC and the US are also generally negative and statistically insignifiant. On the other hand, rank correlations between British net trade with the US and LDC's are positive and statistically significant.

It would seem, therefore, that the evidence from UK trade is that the pattern of net exports by factor and by occupation is consistent between trade with LDC's and with the US but not between either LDC's or the US and British trade with the EC. There are two possible explanations for this, which are not mutually exclusive. Detailed net-export ratios by industry for the UK show that intra-industry trade is, on balance, far more important in British trade with the EC than with either LDC's or the US.[12] This may mean that specialisation according to comparative advantage is simply of less relevance to UK-EC trade than for other trading partners. However, while this could explain the absence of a statistically significant relationship it is unlikely to account for the negative results.

The second possibility is impediments to trade. An obvious difference between UK trade with the EC and British trade with LDC's and the US is potentially less trade "friction". Geographical proximity means lower transport costs and, clearly, policy impediments to trade are less. This would, therefore, mean that the lack of trade friction between the EC and the UK has induced a significantly different trade pattern. For the UK, then, our results suggest that specialisation in different factors and different occupations has been profoundly affected by integration.

4b. Occupational Requirements of UK Trade

Table 4.2 reports estimates of the gross occupational contents of UK net exports for the nonlabour categories and the same 74 occupations as for the analysis of US trade. As with the more aggregated factor requirements, it is possible to demonstrate a positive, statistically significant rank correlation between direct and total estimates.[13]

Within the broad category of professional labour it is clear that there is considerable variation in the revealed abundance of different professions. For example, civil/mining engineers, pharmacists, and physical scientists are revealed to be relatively abundant for the UK in comparison to almost all of the identified trading partners. Conversely, artists/designers and architects/surveyors are fairly persistently sources of disadvantage. Thus, for each of the trading partners, the broad category of professional labour encompasses some of the occupations revealed to be most abundant and some of those revealed to be least

[12]These ratios for the UK and the US are available upon request.

[13]These rank correlations are 0.59 (developed countries), 0.94 (LDCs), 0.95 (US), and 0.80 (EEC).

abundant. This offers strong support to the hypothesis that it is not only the UK's endowment of professional labour but also the composition of the professional labour force that affects its specialisation in trade. Again, this observation is consistent with the US findings.

Similarly, considerable variation in the rankings according to the content on net exports relative to consumption can be found between the different occupations comprising managerial labour, skilled manual labour and semiskilled manual labour. This variation within broad skill levels applies to all British trading partners. The other broad categories - skilled and semiskilled nonmanual labour - tend to be more homogeneous.

The conclusion from this must be that there are grounds to believe that specialisation according to labour endowments has two dimensions. There is a clear pattern in which (see Table 4.1) the UK is specialised in certain skill levels. For example, the UK is fairly consistently revealed to be relatively more abundant in professional labour and skilled manual labour than it is in managerial or semiskilled manual labour. On the other hand, there is also a clear pattern of specialisation within each broad skill category, as Table 4.2 shows. This means that the composition of the labour endowment is likely to affect specialisation in trade by two means. Firstly, there is specialisation according to the level of skill involved. Secondly, there is also a strong tendency for the UK to be specialised in some occupations but not others sharing a common skill level.

These specialisations within each skill band are observable for each of the identified trading partners. In this sense, then, the results are robust. However, it is also clear that the rankings of some individual occupations vary according to trading partners. To provide an indication of how far the results vary, Table 4.4 reports rank correlations across trading partners.

A very similar picture emerges as that for the factor content of UK gross trade. The occupational content of UK gross trade with the US is positively correlated with that of UK gross trade with LDC's. This relationship is statistically significant, though it barely reaches that status. In contrast, the occupational content of UK trade with both the US and with LDC's is negatively correlated with that for UK-EC trade. This confirms the insight that there is a behavioural difference between UK-EC trade and UK trade with non-EC partners.

5. Further Analysis of the Results

The results for both the US and the UK are strongly suggestive of a pattern of specialisation according to broad skill levels accompanied by a secondary pattern of specialisation in different skills at essentially the same level of education and/or training. This section seeks further to investigate this possibility.

Firstly, the results we have presented take no account of technological differences between the US and the UK. To provide some assessment of the validity of this approach rank correlations between UK and US estimates of the total factor and occupational content of net bilateral trade were calculated. If differences in production techniques are irrelevant and there is no measurement error we should expect perfect negative correlations. On the other hand, if only differences in production techniques matter, rankings by factor intensity are purely arbitrary. In this case we should expect to observe no statistically significant relationship between US and UK estimates. More realistically, we should expect both technology and factor endowments to have influenced patterns of specialisation. In any case, unknown measurement errors would almost certainly have affected the results. We should, therefore, expect to find a statistically significant but imperfect negative correlation between US and UK estimates.

In fact, the rank correlations between US and UK estimates for factor contents is -0.72 and for occupational contents is -0.43. Both figures are statistically significant at 95% confidence levels. Our results, therefore, suggest that the underlying relationship between factor and occupational endowments is not unduly disturbed by international differences in production techniques.

Secondly, it is possible to test the hypotheses as to whether within-skill category variations or between-category variations in the contents of net trade are more important in explaining UK and US factor trade. A standard analysis of variance of the occupational content of US and UK trade provides a formal test of such a hypothesis. In this case the null hypothesis of the standard ANOVA test is, in effect, that between-category variations are insignificant in relation to within-category variations. Since we are equally interested in the alternative hypothesis -- that within-category differences might equally be insignificant -- we also report the inverse of the standard F test. This inverse this will also have an F distribution but with the degrees of freedom inverted.

The analysis of variance of the occupational content of US net trade is reported in Table 5.1. For the UK comparable results are reported in Table 5.2. For the US there is no instance where either the standard null hypothesis or the inverted null hypothesis can be rejected at 95% confidence levels. For the UK the standard null hypothesis (that between-category variation is statistically insignificant) cannot be rejected in any instance at 95% confidence levels. Only for UK-US trade can the inverted hypothesis (that within-category variation is statistically insignificant) be rejected.

There are two possible interpretations of these results. It may be that the test statistic is a poor discriminator between the hypotheses. It is clearly possible that the ANOVA tests have low power. However, there are three reasons for supposing this not to be so. Firstly, inverting the test and, hence, reversing the nature of Type I and Type II errors has little impact on the conclusions. Secondly, reducing confidence levels could be expected to reduce the risk of a Type II error. For each trading partner, for both US and UK results, reducing the confidence level to 90% only affects the decision in one instance. Finally, casual observation of the occupational content of both countries' net trade would suggest that both within-category and between-category specialisations are important. Thus, we argue that the second interpration, that both within-category and between-category variations are of approximately equal significance, is correct. The evidence is that both types of specialisation are important to both countries.

6. Conclusions

The evidence of this paper is that both the US and Britain are specialised in international trade in differentiated types of labour. This specialisation is, in part, according to different levels of education and/or training. There are also firm grounds for supposing that there is also specialisation according to different types of skill at approximately the same level of education/training.

This study provides evidence that the US exhibits a consistent pattern of specialisation by both factor and by detailed occupation across different trading partners. The UK pattern of specialisation, however, varies between net trade with the EC on the one hand and with the US and LDC's on the other. While a study of this type cannot offer a conclusive explanation, the latter result does suggest that the relationship between trade impediments and factor markets is worthy of further exploration.

Finally, our results offer some methodological implications for further work. They suggest that international differences in production techniques, unsurprisingly, can affect factor content calculations but do not necessarily invalidate them. Analysis of variance testing provides a basis for assessing whether disaggregation is warranted or not. The results of this paper suggest that, properly defined, highly disaggregated labour categories need not result in problems of unwarranted disaggregation.

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TABLE 3.1: US TOTAL FACTOR REQUIREMENTS, 1989 (NET EXPORTS/CONSUMPTION)

	Developed		Developing		UK		EEC	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
NATURAL RESOURCES:								
Forestry & fishing	0.0058	2	-0.0056	7	0.0012	3	0.0069	3
Coal	-0.0102	9	-0.0036	4	0.0001	9	0.0013	6
Oil & natural gas	-0.0167	12	-0.0244	16	-0.0015	16	-0.0052	14
Metal ores	-0.0509	17	-0.0108	15	-0.0017	17	-0.0092	16
Nonmetallic minerals	-0.0118	10	0.0024	2	-0.0005	13	-0.0030	13
CAPITAL:								
Industrial plant & steel	-0.0487	16	-0.0066	8	-0.0012	15	-0.0105	17
Machinery	-0.0363	15	0.0004	3	-0.0008	14	-0.0058	15
Office machinery	0.0362	1	-0.0535	17	0.0229	1	0.0816	1
Elec & telecoms equip	0.0000	3	0.0093	1	0.0057	2	0.0161	2
LABOUR:								
Professional	-0.0079	5	-0.0073	10	0.0005	5	0.0017	5
Managerial	-0.0102	8	-0.0075	11	0.0002	7	-0.0000	7
Clerical	-0.0088	6	-0.0068	9	0.0001	8	-0.0005	8
Skilled nonmanual	-0.0130	11	-0.0086	12	0.0007	4	0.0018	4
Semiskilled nonmanual	-0.0068	4	-0.0040	5	0.0000	11	-0.0008	10
Skilled manual	-0.0201	14	-0.0107	14	-0.0002	12	-0.0030	12
Semiskilled manual	-0.0193	13	-0.0107	13	0.0004	6	-0.0006	9
Unskilled	-0.0088	7	-0.0050	6	0.0001	10	-0.0008	11

TABLE 3.2 US TOTAL FACTOR AND OCCUPATIONAL REQUIREMENTS, 1989 (NET EXPORTS/CONSUMPTION)

	Developed		Developing		UK		EEC	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
NATURAL RESOURCES:								
Forestry & fishing	0.0058	5	-0.0056	52	0.0012	10	0.0069	7
Coal	-0.0102	51	-0.0036	36	0.0001	54	0.0013	17
Oil & natural nas	-0.0167	63	-0.0244	76	-0.0015	80	-0.0052	74
Metal ores	-0.0509	81	-0.0108	68	-0.0017	81	-0.0092	77
Nonmetallic minerals	-0.0118	55	0.0024	7	-0.0005	68	-0.0030	70
CAPITAL:								
Industrial plant & steel	-0.0487	80	-0.0066	61	-0.0012	77	-0.0105	79

TABLE 3.2 (CONTINUED)

Machinery	-0.0363	77	0.0004	9	-0.0008	75	-0.0058	75
Office machinery	-0.0033	21	-0.0535	78	0.0229	1	0.0816	1
Elec & telecoms equip	0.0000	6	0.0093	2	0.0057	2	0.0161	2
PROFESSIONAL:								
Accountants etc	-0.0085	46	-0.0065	59	0.0002	34	0.0001	32
Architects, surveyors	-0.0027	17	-0.0022	25	0.0001	46	0.0003	27
Artists, designers	-0.0070	36	-0.0052	48	0.0003	23	-0.0000	35
Civil, mining engineers	-0.0089	47	-0.0211	74	-0.0007	72	-0.0011	61
Doctors/dentists/nurses	-0.0006	7	-0.0005	11	0.0000	58	-0.0000	36
Economists,stat,comp	-0.0056	29	-0.0062	57	0.0014	9	0.0044	9
Elec/electronic engin	-0.0075	39	-0.0069	62	0.0036	4	0.0119	4
Lawyers	-0.0029	18	-0.0027	29	0.0009	52	0.0001	31
Mech, aero engineers	-0.0031	20	0.0091	3	0.0025	6	0.0088	6
Other engineers	-0.0129	57	-0.0037	39	0.0030	5	0.0100	5
Personnel managers	-0.0074	38	-0.0058	55	0.0007	15	0.0021	15
Pharmacists etc	-0.0009	8	-0.0005	12	0.0000	57	-0.0001	38
Physical scientists	-0.0076	40	-0.0147	72	-0.0006	70	-0.0006	50
Vocational trainers	-0.0037	24	-0.0027	28	0.0003	29	0.0075	20
Writers, journalists	-0.0031	19	-0.0028	30	0.0008	11	0.0026	12
Other professional	-0.0023	13	-0.0016	22	0.0003	27	0.0008	19
MANAGERIAL:								
Farm managers	0.0188	2	0.0104	1	0.0008	13	0.0038	11
Marketing, sales execs	-0.0108	52	-0.0044	42	0.0006	16	0.0009	18
Office managers	-0.0033	21	-0.0023	26	0.0001	47	0.0001	34
Production/works mngrs	-0.0238	72	-0.0091	67	0.0017	8	0.0022	14
Transp/distrib mngrs	-0.0072	37	-0.0032	33	-0.0000	63	-0.0009	60
Other managers	-0.0079	43	-0.0062	56	0.0003	28	0.0003	26
CLERICAL:								
Clerks	-0.0079	42	-0.0053	50	0.0002	33	-0.0003	45
Office machine operator	-0.0066	35	-0.0055	51	0.0004	22	0.0006	22
Secretaries, typists etc	-0.0057	31	-0.0043	41	0.0002	35	0.0002	29
Telephonists, reception	-0.0063	34	-0.0044	43	0.0001	44	-0.0003	48
SKILLED NONMANUAL:								
Draughtsmen	-0.0128	56	-0.0042	40	0.0004	21	0.0001	33
Lab technicians	-0.0054	27	-0.0045	45	-0.0002	66	-0.0002	42
Other technicians	-0.0111	53	-0.0045	45	0.0022	7	0.0067	8
Photographers etc	-0.0036	23	-0.0025	27	0.0000	56	-0.0003	47
Other skilled nonmanual	-0.0018	12	-0.0010	16	-0.0000	60	-0.0002	40
SEMISKILLED NONMANUAL:								
Sales reps & agents	-0.0090	48	-0.0048	46	0.0001	45	-0.0008	55
Security guards etc	-0.0062	33	-0.0029	32	0.0003	30	0.0005	23
Other semiskilled nonm	-0.0034	22	-0.0022	24	0.0001	56	-0.0002	41
SKILLED MANUAL:								
Ag/forest/fish supervs	0.0152	3	0.0089	4	0.0008	12	0.0038	10
Chefs, cooks	-0.0018	11	-0.0013	18	0.0001	49	0.0002	30
Electricians	-0.0135	59	-0.0033	34	0.0001	51	-0.0007	52
Engineering mach ops	-0.0387	78	0.0013	8	0.0002	32	-0.0052	73

TABLE 3.2 (CONTINUED)

Furnacemen, forgemen	-0.0423	79	-0.0057	54	-0.0005	69	-0.0071	76
Goldsmiths, silversmiths	-0.0988	83	-0.0797	80	-0.0064	83	-0.0617	82
Metal working fitters	-0.0162	62	-0.0057	53	0.0002	38	-0.0009	56
Motor & aero mechanics	-0.0055	28	-0.0006	14	0.0003	24	0.0007	21
Office mach mechanics	-0.0093	49	-0.0050	47	0.0002	43	-0.0007	53
Other drivers	-0.0182	65	-0.0045	44	-0.0000	65	-0.0020	65
Painters etc	-0.0224	70	-0.0079	65	0.0003	26	-0.0027	69
Plumbers etc	-0.0080	45	-0.0013	19	0.0001	53	-0.0000	37
Printers	-0.0057	32	-0.0062	58	0.0002	40	-0.0006	51
Service supervisors	-0.0016	9	-0.0014	20	0.0002	41	0.0004	24
Sheet metal workers	-0.0228	71	0.0031	6	0.0005	20	-0.0020	66
Skilled construc workers	-0.0051	26	-0.0018	23	-0.0000	64	-0.0007	54
Skilled food process	-0.0079	41	-0.0132	71	0.0001	50	-0.0019	63
Skilled leather workers	-0.0803	82	-0.2994	83	-0.0018	82	-0.0764	83
Skilled materials worker	-0.0218	69	-0.0212	75	0.0002	37	-0.0034	71
Skilled paper, book	-0.0024	15	-0.0036	37	0.0002	42	-0.0003	44
Skilled textile workers	-0.0179	64	-0.0699	79	-0.0008	73	-0.0102	78
Skilled wood workers	-0.0133	58	-0.0076	64	0.0005	17	-0.0001	58
Slingers etc	-0.0113	54	-0.0203	73	-0.0007	71	-0.0009	59
Steel erectors	-0.0026	16	-0.0012	17	-0.0000	62	-0.0003	46
Tailors, dressmakers	-0.0256	73	-0.1450	81	-0.0014	79	-0.0154	81
Telecom fitters	-0.0050	25	-0.0034	35	0.0002	31	0.0002	28
Tool/instrum. makers	-0.0359	76	-0.0006	13	0.0005	18	-0.0026	68
Vehicle drivers	-0.0079	44	-0.0036	38	-0.0000	59	-0.0009	57
Welders	-0.0342	75	-0.0001	10	-0.0003	67	-0.0049	72
Other skilled manual	-0.0184	66	-0.0088	66	0.0001	48	-0.0019	64
SEMISKILLED MANUAL:								
Chem, petrol proc work	-0.0161	61	-0.0071	63	-0.0008	74	-0.0026	67
Horticultural workers	0.0109	4	0.0052	5	0.0005	19	0.0023	13
Metal press operators	-0.0200	68	-0.1477	82	-0.0014	78	-0.0148	80
Miners	-0.0100	50	-0.0353	77	-0.0009	76	0.0019	16
Packers & bottlers	-0.0187	67	-0.0119	70	0.0007	14	-0.0004	49
Semiskilled const work	-0.0017	10	-0.0001	15	-0.0000	61	-0.0002	39
Semiskilled porters	-0.0024	14	-0.0015	21	0.0002	39	0.0003	25
Repetitive assemblers	-0.0315	74	-0.0116	69	0.0055	3	0.0143	3
Other semiskilled man	-0.0159	60	-0.0052	49	0.0003	25	-0.0013	62
UNSKILLED:								
Unskilled workers	-0.0056	30	-0.0028	31	0.0002	36	-0.0003	43

TABLE 3.3 RANK CORRELATIONS AMONG TOTAL FACTOR REQUIREMENTS OF US TRADE WITH DIFFERENT AREAS, 1989 (N=17)

	Developed	Developing	UK	EEC
Developed	1.000			
Developing	0.206	1.000		
UK	0.762*	0.015	1.000	
EEC	0.814*	0.015	0.963*	1.000

*indicates significantly greater than zero at 95% confidence level.

TABLE 3.4 RANK CORRELATIONS AMONG TOTAL FACTOR AND OCCUPATIONAL REQUIREMENTS OF US TRADE WITH DIFFERENT AREAS, 1989 (n=83)

	Developed	Developing	UK	EEC
Developed	1.000			
Developing	0.512*	1.000		
UK	0.301*	0.201*	1.000	
EEC	0.658*	0.288*	0.723*	1.000

*indicates significantly greater than zero at 95% confidence level.

TABLE 4.1 : UK TOTAL FACTOR REQUIREMENTS, 1989 (NET EXPORTS / CONSUMPTION)

	Developed		Developing		USA		EEC	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
NATURAL RESOURCES :								
Forestry & fishing	-0.1088	16	-0.0235	17	-0.0080	16	-0.0544	15
Coal	-0.0404	9	0.0069	7	0.0009	7	-0.0268	12
Oil and natural gas	0.0082	1	-0.0061	15	0.0064	2	0.0114	1
Metal Ores	-0.0486	12	0.0152	3	0.0032	5	-0.0259	11
Non-metallic minerals	-0.0671	14	0.0091	5	0.0015	6	-0.0238	9
CAPITAL :								
Industrial plant and steel	-0.0178	3	0.0117	4	0.0053	4	-0.0151	6
Machinery	-0.0731	15	0.0223	1	0.0111	1	-0.0565	16
Office machinery	-0.0573	13	-0.0136	16	-0.0467	17	0.0068	2
Elec & telecoms equip	-0.1114	17	0.0216	2	0.0059	3	-0.0872	17
LABOUR :								
Professional	-0.0222	5	0.0031	8	-0.0012	14	-0.0127	4
Managerial	-0.0277	6	0.0011	12	-0.0011	13	-0.0171	7
Clerical	-0.0210	4	0.0019	10	-0.0005	10	-0.0131	5
Skilled nonmanual	-0.0296	7	0.0078	6	-0.0007	12	-0.0173	8
Semiskilled nonmanual	-0.0170	2	-0.0003	14	-0.0005	9	-0.0112	3
Skilled manual	-0.0447	11	0.0016	11	0.0008	8	-0.0316	14
Semiskilled manual	-0.0403	8	0.0027	9	-0.0012	15	-0.0240	10
Unskilled	-0.0407	10	0.0007	13	-0.0006	11	-0.0286	13

TABLE 4.2: UK TOTAL FACTOR AND OCCUPATIONAL REQUIREMENTS, 1989 (NET EXPORTS/ CONSUMPTION)

	Developed Value	Developed Rank	Developing Value	Developing Rank	USA Value	USA Rank	EEC Value	EEC Rank
NATURAL RESOURCES :								
Forestry & fishing	-0.1088	82	-0.0235	80	-0.0080	78	-0.0544	81
Coal	-0.0404	59	0.0069	25	0.0009	24	-0.0268	60
Oil and natural gas	0.0082	1	-0.0061	72	0.0064	4	0.0114	1
Metal Ores	-0.0486	66	0.0152	8	0.0032	9	-0.0259	58
Non-metallic minerals	-0.0671	78	0.0091	19	0.0015	17	-0.0238	53
CAPITAL :								
Industrial plant and steel	-0.0178	25	0.0117	15	0.0053	6	-0.0151	39
Machinery	-0.0731	80	0.0223	3	0.0111	1	-0.0565	82
Office machinery	-0.0573	75	-0.0136	78	-0.0467	83	0.0068	2
Elec & telecoms equip	-0.1114	83	0.0216	5	0.0059	5	-0.0872	83
PROFESSIONAL :								
Accountants etc	-0.0139	17	0.0018	48	-0.0006	47	-0.0098	24
Architects, surveyors	-0.0098	10	0.0007	55	-0.0006	46	-0.0065	13
Artists,designers	-0.0232	34	-0.0018	68	-0.0010	53	-0.0159	40
Civil,mining engineers	-0.0092	6	0.0010	54	0.0011	22	-0.0043	10
Doctors/dentists/nurses	-0.0266	37	0.0049	31	0.0000	34	-0.0200	49
Economists, stat, comp	-0.0228	33	0.0020	45	-0.0073	77	-0.0081	19
Elec/electronic engin	-0.0311	48	0.0023	42	-0.0099	79	-0.0084	21
Lawyers	-0.0089	5	0.0005	59	-0.0006	48	-0.0065	14
Mech, aero engineers	-0.0300	45	0.0119	14	-0.0002	40	-0.0199	48
Other engineers	-0.0400	58	0.0125	13	-0.0012	56	-0.0276	61
Personnel managers	-0.0289	43	0.0041	34	-0.0011	55	-0.0192	46
Pharmacists etc	-0.0147	18	0.0095	17	-0.0019	64	-0.0101	25
Physical scientists	-0.0121	13	0.0080	22	0.0009	23	-0.0079	17
Vocational trainers	-0.0276	39	0.0036	36	-0.0024	68	-0.0187	45
Writers, journalists	-0.0322	50	0.0028	38	-0.0030	72	-0.0136	35
Other professional	-0.0092	7	0.0001	60	-0.0001	37	-0.0057	11
MANAGERIAL :								
Farm managers	-0.0672	79	-0.0122	77	-0.0063	76	-0.0484	78
Marketing,sales execs	-0.0311	47	0.0033	37	-0.0025	69	-0.0201	50
Office managers	-0.0131	16	0.0006	57	-0.0007	51	-0.0083	20
Production/works mngrs	-0.0462	65	0.0038	35	-0.0027	70	-0.0321	67
Transpt/distrib mngrs	-0.0298	44	0.0012	52	0.0006	27	-0.0127	33
Other managers	-0.0068	4	-0.0005	64	-0.0003	42	-0.0041	8
CLERICAL :								
Clerks	-0.0182	27	0.0019	47	-0.0007	50	-0.0122	30
Office machine operator	-0.0233	35	0.0025	41	-0.0019	62	-0.0144	37
Secretaries, typists etc	-0.0170	24	0.0020	46	-0.0009	52	-0.0113	29
Telephonists,reception	-0.0148	19	0.0012	53	-0.0005	45	-0.0094	23
SKILLED NONMANUAL :								
Draughtsmen	-0.0277	40	0.0126	12	0.0005	28	-0.0193	47
Lab technicians	-0.0285	42	0.0097	16	-0.0023	66	-0.0165	41
Other technicians	-0.0205	30	0.0042	32	-0.0016	60	-0.0111	28
Photographers etc	-0.0165	22	-0.0002	62	-0.0024	67	-0.0080	18
Other skilled nonmanual	-0.0222	31	0.0086	21	0.0027	11	-0.0176	43
SEMISKILLED NONMANUAL :								
Sales reps & agents	-0.0225	32	0.0020	44	-0.0017	61	-0.0146	38
Security guards etc	-0.0186	28	0.0027	40	-0.0003	41	-0.0136	34
Other semiskilled non-m	-0.0095	8	-0.0023	69	-0.0001	39	-0.0073	16
SKILLED MANUAL :								
Ag/forest/fishing supervs	-0.0247	36	-0.0084	75	-0.0016	58	-0.0035	6
Chefs, cooks	-0.0063	3	0.0000	61	0.0001	32	-0.0043	9
Electricians	-0.0323	51	0.0072	23	-0.0022	65	-0.0186	44
Engineering mach ops	-0.0569	74	0.0220	4	0.0028	10	-0.0472	77
Furnacemen, forgemen	-0.0508	68	0.0132	10	0.0013	20	-0.0428	73
Goldsmiths, silversmiths	-0.0343	52	-0.0226	79	-0.0149	81	-0.0234	52
Metal working fitters	-0.0396	57	0.0150	9	0.0019	15	-0.0297	64
Motor & aero mechanics	-0.0316	49	0.0050	30	0.0022	13	-0.0239	54
Office mach mechanics	-0.0449	63	-0.0091	76	-0.0361	82	0.0048	3
Other drivers	-0.0420	62	0.0070	24	0.0014	18	-0.0253	57
Painters etc	-0.0275	38	0.0042	33	0.0011	21	-0.0220	51
Plumbers etc	-0.0154	20	0.0088	20	0.0021	14	-0.0125	32
Printers	-0.0562	73	0.0023	43	-0.0047	74	-0.0243	56
Service supervisors	-0.0165	21	0.0005	58	-0.0004	43	-0.0124	31
Sheet metal workers	-0.0374	54	0.0327	1	0.0082	2	-0.0375	71
Skilled construc workers	-0.0097	9	0.0014	50	0.0001	31	-0.0060	12

TABLE 4.2 (CONTINUED)

Skilled food process	-0.0304	46	-0.0074	74	0.0017	16	-0.0302	66
Skilled leather workers	-0.0203	29	-0.0679	83	0.0066	3	-0.0343	69
Skilled material worker	-0.0388	56	-0.0048	71	0.0003	29	-0.0355	70
Skilled paper, book	-0.0593	76	0.0028	39	-0.0049	75	-0.0241	55
Skilled textile workers	-0.0517	71	-0.0276	81	0.0006	26	-0.0538	80
Skilled wood workers	-0.0544	72	-0.0064	73	-0.0016	59	-0.0300	65
Slingers etc	-0.0419	61	0.0055	29	-0.0000	35	-0.0290	62
Steel erectors	-0.0129	15	0.0093	18	0.0032	8	-0.0106	26
Tailors, dressmakers	-0.0417	60	-0.0557	82	0.0024	12	-0.0436	75
Telecom fitters	-0.0123	14	-0.0004	63	-0.0045	73	-0.0038	7
Tool/instrum. makers	-0.0505	67	0.0183	7	-0.0001	38	-0.0383	72
Vehicle drivers	-0.0280	41	0.0013	51	0.0000	33	-0.0169	42
Welders	-0.0511	69	0.0207	6	0.0047	7	-0.0433	74
Other skilled manual	-0.0383	55	-0.0010	66	-0.0012	57	-0.0293	63
SEMISKILLED MANUAL :								
Chemical,petrol proc work	-0.0114	12	0.0260	2	0.0013	19	-0.0138	36
Horticultural workers	-0.0104	11	-0.0010	65	-0.0006	49	-0.0072	15
Metal press operators	-0.0614	77	0.0127	11	0.0002	30	-0.0532	79
Miners	-0.0517	70	0.0067	26	-0.0029	71	-0.0001	4
Packers & bottlers	-0.0458	64	0.0056	28	-0.0019	63	-0.0341	68
Semiskilled const work	-0.0167	23	0.0015	49	-0.0000	36	-0.0092	22
Semiskilled porters	-0.0035	2	-0.0010	67	0.0009	25	-0.0015	5
Repetitive assemblers	-0.0766	81	0.0061	27	-0.0109	80	-0.0442	76
Other semiskilled man	-0.0180	26	-0.0039	70	-0.0005	44	-0.0111	27
UNSKILLED :								
Unskilled workers	-0.0356	53	0.0007	56	-0.0011	54	-0.0261	59

TABLE 4.3: RANK CORRELATIONS AMONG TOTAL FACTOR REQUIREMENTS OF UK TRADE WITH DIFFERENT AREAS, 1989 (n=17)

	Developed	Developing	US	EEC
Developed	1.000			
Developing	-0.262	1.000		
US	-0.012	0.603*	1.000	
EEC	0.762*	-0.417	-0.225	1.000

* indicates significantly different from zero at 95% confidence

TABLE 4.4: RANK CORRELATIONS AMONG TOTAL FACTOR AND OCCUPATIONAL REQUIREMENTS OF UK TRADE WITH DIFFERENT AREAS, 1989 (n=83)

	Developed	Developing	US	EEC
Developed	1.000			
Developing	-0.256*	1.000		
US	0.119	0.343*	1.000	
EEC	0.764*	-0.330*	-0.234*	1.000

* indicates significantly different from zero at 95% confidence

TABLE 5.1: ANALYSIS OF VARIANCE OF US TOTAL OCCUPATIONAL REQUIREMENTS, 1989

a. US Trade with Developed Countries

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.002908	6	0.000485	
Within category	0.017484	66	0.000265	
TOTAL/F	0.020392	72	1.829558	2.25
Inverse F			0.54658	3.67

b. US Trade with Developing Countries

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.007074	6	0.001179	
Within category	0.125717	66	0.001905	
TOTAL/F	0.132791	72	0.618962	2.25
Inverse F			1.615609	3.67

c. US Trade with UK

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.000012	6	0.000002	
Within category	0.000108	66	0.0000016	
TOTAL/F	0.000119	72	1.222222	2.25
Inverse F			0.818182	3.67

d. US Trade with EEC

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.001134	6	0.000189	
Within Category	0.009569	66	0.000145	
TOTAL/F	0.010703	72	1.303584	2.25
Inverse F			0.767116	3.67

TABLE 5.2: ANALYSIS OF VARIANCE OF UK TOTAL OCCUPATIONAL REQUIREMENTS, 1989

a. UK Trade with Developed Countries

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.003403	6	0.000567	
Within category	0.016641	66	0.000252	
TOTAL/F	0.020044	72	2.248918	2.25
Inverse F			0.444658	3.67

b. UK Trade with Developing Countries

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.000656	6	0.000109	
Within category	0.013522	66	0.000205	
TOTAL/F	0.014178	72	0.533443	2.25
Inverse F			1.874613	3.67

c. UK Trade with US

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.000013	6	0.000002	
Within category	0.002038	66	0.000031	
TOTAL/F	0.002051	72	0.067962	2.25
Inverse F			14.71409	3.67

d. UK Trade with EEC

Source of Variation	Sum of Squares	Degrees of Freedom	Mean SS/F	Critical Values (95%)
Between category	0.002221	6	0.00037	
Within category	0.011422	66	0.000173	
TOTAL/F	0.013643	72	2.139137	2.25
Inverse F			0.467478	3.67