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TRADE AND EMPLOYMENT: EVIDENCE IN MANUFACTURING OF SELECTED EU COUNTRIES

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Abstract:

This working paper reviews general changes in EU labour markets, with reference to the four major EU countries, France, Germany, Italy and the United Kingdom. It sheds light on the possible links between foreign trade and employment in manufacturing industries, using data for a panel of 40 industries over the period 1970-1995. The estimates do not provide evidence of significant effects of import penetration and export intensity on employment. The exception is for the UK, whereby import penetration is negative and statistically significant. Generally, the responsiveness of employment varies negatively with the degree of import penetration, but not the level of technology.

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1. INTRODUCTION

Between 1975 and 2000 unemployment in the EU had doubled, from 4.1 per cent of the total labour force to 8.2 per cent (Figure 1). By the mid 1980s, the European Community had gained reputation as a high unemployment region, with unemployment reaching double-digit growth during the years 1984-1986 and 1993-1997. The unemployment path of the four major countries, that is France, Germany, Italy and the UK, followed the general unemployment path of EU. The high levels of unemployment in the EU signal an imbalance in the labour market. It had become obvious that Europe's problem was one of jobs, and not wages.

Since the 1980s, the labour markets have been hit by a fundamental shift in the occupational structure of labour demand towards educated and skilled workers and away from less educated and unskilled workers[1]. Several interrelated developments explain the shift of relative labour demand (see Heylen, *et.al*, 1996): the introduction of new technologies requiring more intelligence and less physical strength, and a rise in capital intensity in all industries; and the expansion of trade with developing countries, which includes a growing penetration of imports of manufactured goods that are relative intensive in unskilled labour from low-wage countries, and a rise in exports of manufactured goods that are relatively intensive in skilled labour.

Any change or shock to the demand for a particular type of labour, for example high skilled workers, may alter the market in three distinctive ways:

(a) If the labour market is flexible, an increase in the dispersion of labour earnings will occur, in favour of workers experiencing higher productivity. In other words, the high skilled/low skilled wage differential widens;

(b) If the labour market is rigid, the consequence is not so much an increase in the skill wage differential as an increase in the unemployment differential between skill levels, especially long-term unemployment; and

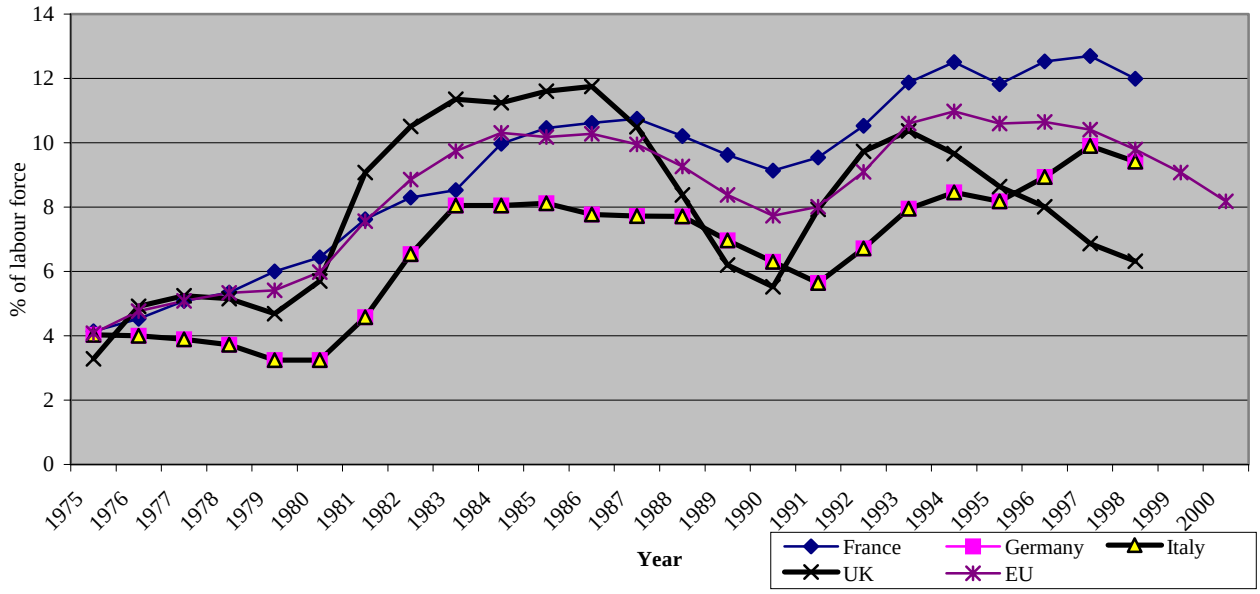
© If the supply of skills which are in greater demand increases, neither the wage nor the unemployment differential need increase.

The EU labour markets' response to the structural changes is claimed to have followed the second way. The structural changes have led to a downward shift of demand for low skilled workers and an upward shift of demand for high skilled workers. However due to relatively rigid wage structure (except for UK[2]), wages remain almost unchanged. The institutional factors that cause this rigidity are union strength, solidarity-based wage setting, government regulation, minimum wages and unemployment benefits. The resulting effect is a widespread and persistent unemployment of unskilled workers (see Table 1) and shortages in skilled labour.

[1] "The rate of growth of employment in the period 1981-96 in advanced countries has usually been highest for professionals and technicians …… In contrast, the rate of growth of employment for the production and related workers category (which contains skilled manual and craft workers but mainly the unskilled and semi-skilled) has been very low, often negative, for developed countries" (World Employment Report 1998-99, p.32).

[2] Wage inequality has increased significantly in the UK.

Figure 1: Unemployment in the EU and selected countries



Note: 1. The unemployment figures for the individual countries refer to civilian unemployment.
2. The statistics for Germany refer to Western Germany (Federal Republic of Germany before the unification of Germany) until 1990 and since 1991, to Germany.

Source: 1. OECD (1993), Labour Force Statistics, 1971-1991
2. OECD (2000), Labour Force Statistics, 1978-1998
3. OECD (2000), Wirtschaftsausblick

Table 1: Unemployment shares by skill groups in selected countries

	Germany				Italy				UK		
Year	WCHS	WCLS	BCHS	BCLS	WCHS	WCLS	BCHS	BCLS	WCHS	WCLS	BC
1996	19.12	21.19	23.67	22.66	5.83	13.14	11.4	16.31	14.21	24.36	46.93
1997	19.92	20.87	25.24	22.49	6.05	13.31	11.87	16.05	11.52	21.46	39.27
1998	20.16	20.84	25.28	22.40	5.65	13.66	11.66	15.92	9.07	19.51	34.67
1999	-	-	-	-	5.92	13.31	10.4	15.79	10.02	18.35	33.51

Note: 1. The major occupation groups have been reclassified based on the ISCO-88 (see Appendix 1a and 1b).
2. For the UK, the sub-groups of blue-collar high skilled and blue-collar low skilled are aggregated into blue collar workers (BC) as the disaggregation of data by occupations are not available within this sub-groups.

Source: Calculations based on ILO, LABORSTA.

The flip side of the rise in unemployment of low skilled workers is the rise in employment shares of high skilled workers (see Table 2). Employment grew fastest over the 1990s in high-skilled white-collar jobs (legislators, senior officials and managers, professionals, technicians and associate professionals) in Germany and the UK and in white-collar low skilled workers (clerks, service workers, shop and market sales workers) in Italy. Conversely, changes in the labour markets have not been favourable for blue-collar workers as jobs in these occupations have either declined or grown slowly in the recent decade.

Table 2: Employment shares by occupation and skill groups in selected countries

	Germany				Italy				UK			
Occupation Category	1996	1997	1998	1999	1996	1997	1998	1999	1996	1997	1998	1999
Major Groups												
1. Legislators, senior officials and managers	5.65	5.80	5.76	5.72	2.86	2.92	3.25	3.34	6.84	5.84	4.35	4.43
2. Professionals	12.02	12.31	12.67	12.60	9.55	9.71	9.93	10.35	2.90	2.15	1.86	2.36
3. Technicians and associate professionals	19.50	19.68	19.69	19.69	14.22	14.75	15.06	15.79	4.47	3.52	2.86	3.23
4. Clerks	12.73	12.78	12.66	12.64	13.36	13.62	13.98	14.12	9.28	8.16	7.17	6.26
5. Service workers and shop and market sales workers	11.17	11.30	11.44	11.58	15.75	15.65	15.68	15.92	15.08	13.30	12.34	12.10
6. Skilled agricultural and fishery workers*	2.18	2.18	2.11	2.15	4.00	3.91	3.74	3.47	21.46	19.06	16.45	15.87
7. Craft and related trade workers	18.89	18.37	18.05	17.74	19.57	19.37	19.13	18.63	13.92	10.77	8.66	8.62
8. Plant and machine operators and assemblers	7.85	7.52	7.47	7.41	9.23	9.06	9.19	9.67	11.56	9.44	9.57	9.03
9. Elementary occupations	7.46	7.62	7.66	8.04	9.23	9.13	9.20	9.07				
0. Armed forces	1.08	1.04	1.01	0.98	1.81	1.89	1.85	1.82				
WCHS	37.17	37.79	38.12	38.01	26.64	27.37	28.24	29.48	14.21	11.52	9.07	10.02
WCLS	23.90	24.08	24.10	24.22	29.11	29.26	29.66	30.04	24.36	21.46	19.51	18.35
BCHS	21.07	20.54	20.16	19.89	23.56	23.28	22.86	22.10	46.93	39.27	34.67	33.51
BCLS	26.74	25.88	25.51	25.14	18.46	18.19	18.39	18.75				

Note: 1. The major occupation groups have been reclassified based on the ISCO-88 (see Appendix 1a and 1b).
2. For the UK, the sub-groups of blue-collar high skilled and blue-collar low skilled are aggregated into blue-collar workers (BC) as the disaggregation of data by occupations are not available within this sub-groups.
* Skilled agricultural and fishery workers include elementary occupations (group 9) for the UK.

Source: Calculations based on ILO, LABORSTA.

The overall picture that emerges from the available evidence concerning unemployment and employment differentials by skill is that there has been a long run decline in demand for low-skilled workers across countries. Nonetheless, the evidence is somewhat mixed concerning the pace of decline over time, though it is cited to have intensified over the 1980s. Though the supply of low-skilled workers has reduced relative to the skilled counterparts in most countries, the existing evidence points to relative demand shifts as a major driving force.

The remainder of the paper is organized as follows. Section 2 illustrates the changes in skill composition of the manufacturing sector in the UK, France, Germany and Italy.

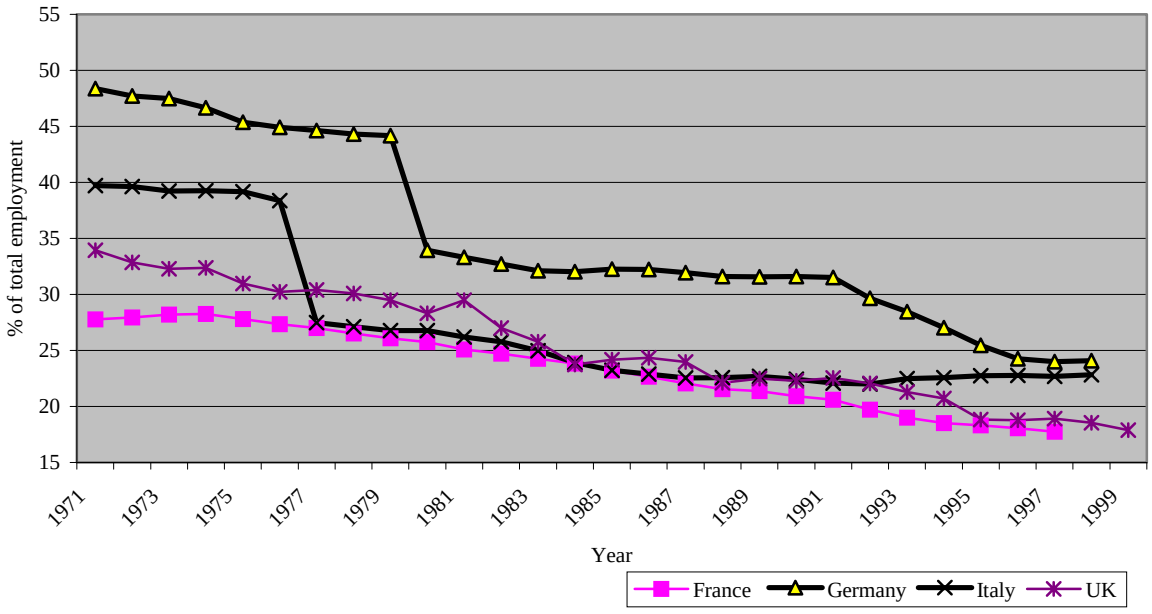
Section 3 reviews the links between international trade with employment and wages, and draws upon several studies that have attempted to quantify the effects of the former on the latter. This section gives an account of the trade-wage and trade-employment literature. Section 4 presents an empirical exercise on the employment effects of trade in the four major European countries. The data set used, the methodology and estimation techniques employed and the results and their significance are reported in this section. Section 5 concludes this paper.

2. EMPLOYMENT AND SKILL COMPOSITION IN MANUFACTURING

2.1 Employment Trends in Manufacturing

Europe recorded significant job losses in the manufacturing sector. Figure 2 presents the share of manufacturing employment in total employment in the four major European countries. The employment shares of manufacturing either declined or barely increased over the past three decades. The declining share in manufacturing employment has been attributed to structural shifts (from manufacturing to a growing services industry), technology and trade.

Figure 2: Employment shares of manufacturing in selected countries



Note: The manufacturing employment figures used are average annual estimates for all countries, except for the UK, where manufacturing employment figures are mid-year estimates.

Source: 1. OECD (1993), Labour Force Statistics, 1971-1991.
2. OECD (2000), Labour Force Statistics, 1978-1998.
3. OECD (1998), OECD STAN Database for Industrial Analysis, 1978-1997.

2.2 Skill Composition in Manufacturing

The decomposition analysis[3] of Berman, Bound and Griliches (1994) is used to shed light on the changing workforce structure in the manufacturing sector for both the "within" industry and "between" industry components over a given time period. The "within" effect (a movement towards more skilled workers in both growing and declining sectors) is interpreted as a measure of the extent of skill biased technological change, and the "between" effect" (low skilled industries have shrunk in size relative to high skilled industries) is interpreted as a reflection of trade effects.

The demand for skilled labour can be reflected as the share of skilled workers in both employment and wages. However only the former would be considered in the following:

$$\Delta Sn = \sum_i \overleftarrow{\Delta W_i} Sn_i + \sum_i \Delta Sn_i \overleftarrow{W_i} \qquad i = 1,\ldots\ldots\ldots\ldots\ldots\ldots N \text{ industries}$$

between within

Note: An overstrike indicates a simple average over time.
The weights are the industry employment shares in manufacturing employment.

ΔSn = share of skill level n in total employment (skill mix)

Sn_i = skill level n employment in industry i/total employment in industry i

$\{Sn_i = S/(S+U)\}$

W_i = industry i employment/ manufacturing employment $\{W_i = E_i/\sum_i E_i\}$

S = skilled workers

U = unskilled workers

E = employment

The results reveal that most of the change in the share of employment of high skilled workers in total manufacturing employment is due to within industry changes. Since trade's main impact is assumed to fall on between industry factor allocation, this finding suggests that trade has only played a very limited role in labour market inequality. The evidence obtained is similar to other industrial countries, suggesting the dominant role of skill-biased technological change.

The decomposition results should only be regarded as preliminary evidence due to the inherent weaknesses in this method. First, the analysis assumes trade and technology as two separate sources for the increase in skilled labour, but the two factors could be mutually reinforcing, as international competition can induce faster technological adoption. Another important note is that to the extent that industrial countries specialize in sectors that are relatively intensive in skilled labour, exports of these products should raise the relative demand for the skilled, whilst imports of goods that are relatively intensive in unskilled labour could reduce the demand for the unskilled. Therefore the possibility of trade contributing to labour market shifts (changes in relative wages or relative demand or both), cannot be excluded on *a priori* grounds.

[3] The decomposition analysis is a useful indicator of the source of changes in labour demand.

Table 3: Decomposition of changes in high skilled manufacturing employment

Country	Period	Between	Within	% Contribution of "within" effect
Italy	1981-1991	0.004	0.060	93.75
France	1981-1991	0.005	0.081	94.19
Germany	1980-1990	0.021	0.049	70.00
UK	1981-1991	0.119	0.928	88.63

Note: 1. High skilled refers to white-collar high skilled workers.
2. The method employed to calculate the "between" and "within" effects is based on Berman, Bound and Griliches (1994).
3. The sample of countries selected was dictated by better data coverage in terms of both industry and period. These countries include France, Germany, Italy and the UK.

Source: Calculations based on data obtained from the OECD (DSTI/EAS Division).

3. TRADE, WAGES AND EMPLOYMENT

In this section, I will review the arguments and some of the literature regarding trade-related studies. Issues of both methodology and substance will be drawn upon from the lively debate. All these methods are not devoid of criticisms, and some of them are mentioned in the following.

3.1 Theoretical Exposition

There are three arguments of trade effects on labour markets that involve different empirical approaches. The first adopts the Hecksher-Ohlin (HO) perspective that advanced countries are likely to import unskilled labour intensive goods and export labour intensive goods. Therefore, trade with LDCs will reduce the relative price of unskilled intensive goods in advanced countries and subsequently lead to downward pressure on unskilled wages. This pressure will equalize factor rewards among trading nations under specific conditions.

Adherents to this model predict that the effects of trade are filtered through to the labour market *via* declines in relative prices of unskilled labour intensive goods, and therefore relate product price changes to changes in relative factor prices. Slaughter (1998) points out that what matters in these product-price studies (or sometimes referred as mandated wage equations due to its closer relationship to theory) is how international trade is related to product price changes. The missing link however involves exogenous forces attributable to trade and product price changes, such as international differences in tastes, technology, endowments and barriers to trade that have to be identified. Prices and quantities of both

primary factors and intermediate inputs should also be accounted for in the empirical work by redefining zero profit conditions *a la* Samuelson.

It has been frequently argued (in contrast to the HO view) that changing trade patterns may cause large adjustments to the labour market. Some notable changes that have been identified in the literature to be of non-HOS predictions include: unemployment arising from adjustment changes to competitive pressure, reduction in industry specific wages (even if the industry is small relative to the aggregate) due to imperfect mobility of workers, reskilling of the existing workforce with an increase in inter-industry trade, or changes of processes within the industry with growing intra-industry trade[4].

The second (labour market) approach focuses on trade flows. The arguments involve the displacement of workers particularly in labour intensive import competing sectors due to trade with LDCs. It is expected that rising import penetration in some industries (or industry groupings) will cause declines in employment due to declines in industry product demand or higher productivity gains. An extension of this argument is that rising export intensity may have a positive bearing on employment or a negative coefficient. Larre (1995) exudes 2 possibilities for the latter outcome of export intensity: (i) declining local production due to relocation of production processes abroad; and (ii) rationalizing labour usage to improve competitive position internationally.

The labour market approach which seeks to uncover the displacement effect of imports on wages and employment, and subsequently to the economy at large, is very much dependent on the size of the traded goods sector. The generalization of the impact on the traded sector which is used to mediate the effects of displacement in the non-traded sector, is based on the prediction that trade effects depend on the size of the former sector and on demand/cost parameters.

The third (Ricardian) approach is based on differences in labour productivity/cost across countries. A rise in LDCs productivity results in a loss in domestic comparative advantage and a trade deficit. To regain trade balance, domestic wages will fall relative to foreign wages. The magnitude of the reduction in wages depends on the size of the sectors on the margin of the comparative advantage ladder, differences in labour productivity among them, and the elasticity of product demand for output. This approach has not been tested extensively due to the high demands on data.

The connection between trade, wages and employment is not a simple one as discussed above, as various deviations from principles can be expected. Thus it would be incorrect to generalize industries that face sharp import growths or severe decline in import prices will suffer sharp declines in wages and/or employment. The general evidence on linking trade volumes or trade prices with labour market outcomes[5] is that trade has played a very small role in industrial countries. The consensus is that technology is more important than trade.

However, Wood (1994) challenged the basic results obtained saying that the role of trade was underestimated in these studies. The core of Wood's study is a factor-content analysis adjusted for the presence of non-competing goods between northern and southern

[4] This particular trade is advocated by the so-called "new trade theory" which has recently shown that with the presence of economies of scale, product differentiation and imperfect competition, intra-industry trade can take place between similar countries.

[5] It is noted that these studies are criticized for lacking a solid analytical basis in standard trade theory. Conventional trade theories framework do not provide grounds for the mentioned link. However, there are some leading studies that have made major inroads in explaining wages inequality by non-HOS predictions (see Feenstra and Hanson 1996). The ongoing research makes clear that the simple HOS-based models are ill suited to explain trade impacts on labour markets.

economies. The effect of such goods results in some of the largest estimates of labour market impacts of trade in the literature. The controversial findings led to a number of second-wave studies, focusing on methodology.

A dichotomy between the modeling strategy of trade and labour economists in considering the impact of trade on wages and employment is obvious in the literature. The methodologies adopted vary significantly between these groups and can be divided into the following categories: factor content calculations, the growth accounting framework, and the recent regression technique. Factor content studies emerges from the labour theorists' traditional approach and involve estimations of the amount of labour required to produce a given amount of exports or being displaced by a given amount of imports. The growth accounting technique, which has been widely used in the past, involves an accounting procedure to decompose the contributions of domestic demand, imports, exports and productivity change on employment. The final category is also referred to as model-based studies, which utilize an economic behavioural mode. These models are generally partial equilibrium and stress the impact of trade on labour market outcomes.

The following section will draw upon several empirical studies that attempt to assess the potential magnitude of trade effects, grounded on the different approaches mentioned above.

3.2 Related Research

Hine and Wright (1997) utilize the growth accounting procedure for UK manufacturing between 1979-1991. Their results indicate that productivity growth is the main factor for the declining employment over the long term (though fluctuations in domestic demand over the short term had more prominent effects) whilst trade factors only played a secondary and generally negative role. The limitation is that the effects of the latter on the former are not captured. However, it is expected that growth in imports and exports will be positively correlated to productivity growth at the industry level. Similarly, their econometric analysis based on a labour demand function suggests that trade has a stimulating effect on labour productivity, and the latter is the principal source of labour displacement.

Larre (1995) in a similar spirit quantifies the impact of trade on *relative* employment and *relative* wages in several OECD countries. Relative import penetration is found to be negatively associated with relative employment changes, particularly in the low-manual industrial grouping. Similarly, export intensity also reveals a negative impact, dominant in high-manual industrial grouping. These results imply a shift of employment away from high manual towards low manual industries. On a more disaggregated form, statistically significant negative coefficients on the import variable are identified in four industries, namely metal products, office and computing machinery, radio - television and communication, shipbuilding and repair). The evidence on exports are somewhat mixed.

The usual industrial groupings employed in the literature are based on skill intensity and technology. However, Oliveira-Martins (1993) introduces market structure, comprising product differentiation and concentration, as a basis of industrial classification. His study reveals that import penetration is associated with reduced relative wages in industries producing relatively standardized products. In industries with high product differentiation, there is no evidence of a negative impact of increased openness.

Greenaway *et.al* (1998) modifies the demand model employed by Hine and Wright (1997) by introducing a lagged employment explanatory variable into the demand function, to account for deviation of the employment level from its steady state equilibrium due to

adjustment costs. This model is then referred to as a dynamic demand function and applied to a panel of 167 manufacturing industries over the period 1979 to 1991 in the UK. Both the signs of imports and exports are negative, implying the existence of trade-induced efficiencies. The impact however varies based on UK's trade with different regions. The surprising result is that the effects of trade with East Asia and Japan are less marked than the import effects from the EU. An extension of this analysis is done in another paper (1999) to assess the impact of trade on wages in a bargaining framework. The results imply that foreign competition has a significant disciplining effect on wages in the UK. The result also qualifies the findings on employment in the earlier paper, which is the impact of imports from the EU appears to be largest among the trading regions. However trade with East Asia seems to affect those in the lower skilled categories and therefore generating some form of wage inequality.

The above studies are mainly concerned with the links between trade with wages and employment. Revenga (1995) addresses the issue of *trade liberalization* instead of trade *per se*, particularly changes in trade protection, on employment and wages in Mexico. Her study shows that reductions in quota coverage and in tariff levels are associated with moderate reductions in firm-level employment. On the wage front, changes in quota coverage have no impact while tariff reductions are associated with wage increases.

Greenaway (2000) points out that much of the above literature ignores the labour market adjustment between equilibrium levels, and the costs involved. Most of the studies do not distinguish the long-run from the short-run impacts of trade on labour markets. He summarizes a few studies that have attempted to establish causal connections between trade expansion and labour market adjustments. The investigations reveal that the degree of labour market flexibility and the form of trade expansion (intra or inter-industry trade) matters. However the hypotheses in these empirical investigations have yet to be theoretically justified.

An interesting complement to econometric analysis (some of which have been iterated above) is computational analysis using low dimensional and large-scale computational general equilibrium (CGE) models. The CGE models are considered more appropriate to as it strings together partial equilibria to describe the long-term evolution of labour outcomes. The juxtaposition for this approach is that the relationship between trade, wages and employment has extended over longer periods and concern input markets that serve a multiplicity of output markets.

The literature gleaned above describes different explanations toward the trade-wage and trade-employment debate. The results obtained vary for different countries, for different model specifications and different methods of estimation.

4. EMPIRICAL ASSESSMENT OF TRADE EFFECTS ON MANUFACTURING EMPLOYMENT IN THE UK, FRANCE, GERMANY AND ITALY

4.1 Introduction

The countries selected for this study comprise the four large EU countries, France, Germany, Italy and the UK. These countries have experienced expansions in industrial production, but with a considerably reduced workforce. For the UK, employment declined by 41 per cent between 1990 and 1997 and output in real terms expanded by 23 per cent. Similarly, manufacturing employment declined by 29, 27 and 17 per cent for France,

Germany and Italy respectively, with corresponding expansions of 69, 35 and 137 per cent in real output for the same period (Figure 3).

The above outcome can be attributed to a combination of supply and demand factors that change over time in a market economy. This paper however focuses on a reduced form equation to capture one aspect of the demand shift explanation offered in the literature, that is international trade, without discrediting the other demand determinants and supply side issues. The general consensus is that the trend fall in employment is associated with structural factors while year-on-year changes in trend are influenced by a host of factors, including changes in import penetration and export intensity. An important issue therefore is the possible link between greater exposure to trade and labour market adjustments in Europe.

It is thus first useful to graphically depict the movements in the key candidate explanatory variables. Figure 4 shows that the four countries have become increasingly integrated into the international economy through increasing trade over time. Between 1970 and 1996, import penetration rose from 14 per cent to 39 per cent for UK, while export intensity rose from 16 per cent to 37 per cent. Similarly, import penetration and export intensity had more than doubled for all the other countries during the same period. The import penetration and export intensity rates seem to move closely together in most cases. Generally the export intensities of all countries are higher than their import penetration rates, with the exception of the UK since 1982. The trade intensities in these countries may have moved in response to changes in the business cycles of the individual countries and their corresponding trading partners, changes in relative competitiveness, in tastes and preferences, incomes or technology.

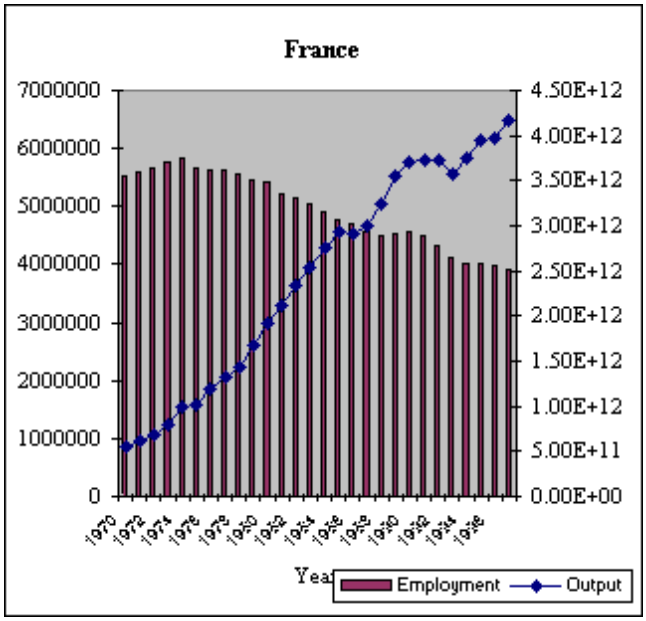
Within Europe, it is expected that there would be some variance across countries in the relative magnitudes of employment effects of trade, depending on the degree of wage flexibility that dominates wage-setting institutions. The research will focus on the role of trade (excluding non-trade factors), to assess the quantitative significance of changing trade patterns on the labour market. The purpose of this study is to consider the *absolute* (and not relative impacts) impact of trade on employment, based on the idea that trade may in fact be labour saving and may imply an absolute reduction in the overall employment, of both skilled and unskilled labour. The *labour market approach* is taken, and extends Larre's (1995) analyses of OECD countries, but with the following changes:

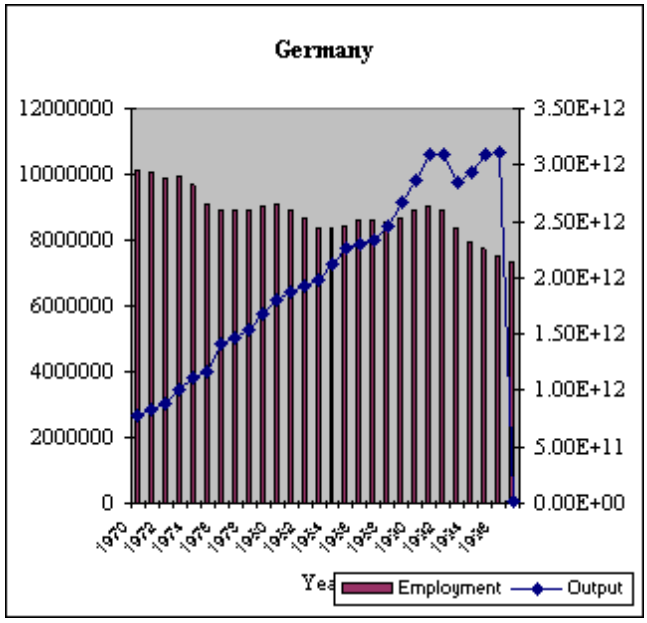
- The period of analyses is extended for an additional six years until 1995;
- Data are pooled together for a larger number of industries for a few selected countries, that is France, Germany, Italy and the UK, and are estimated country by country; and
- An alternative grouping of industries is formed based on (i) technological capacity, identified by the investment intensity of industries (Appendix 2); and (ii) import competing or export competing sectors, identified by the ratio of import penetration to export intensity (Appendix 3).

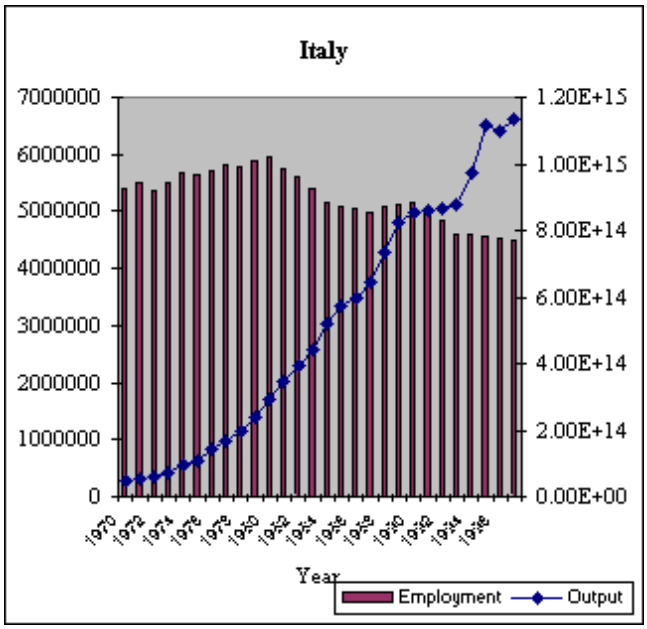
Regression analysis technique is used to elucidate the impact of foreign trade on industry level employment. The questions that would be addressed are:

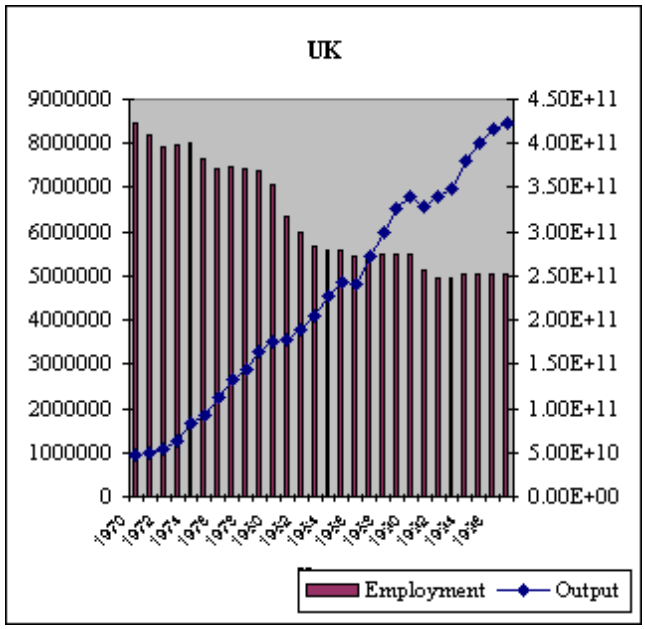
1. Are changes in employment of industries associated with changes in import penetration and export intensity over time?
2. Are the findings consistent with the view that increased openness increases the efficiency of labour usage?
3. Are there significant differences across industrial groupings in the impact of import penetration and export intensity on employment?

Figure 3: Output and employment in manufacturing



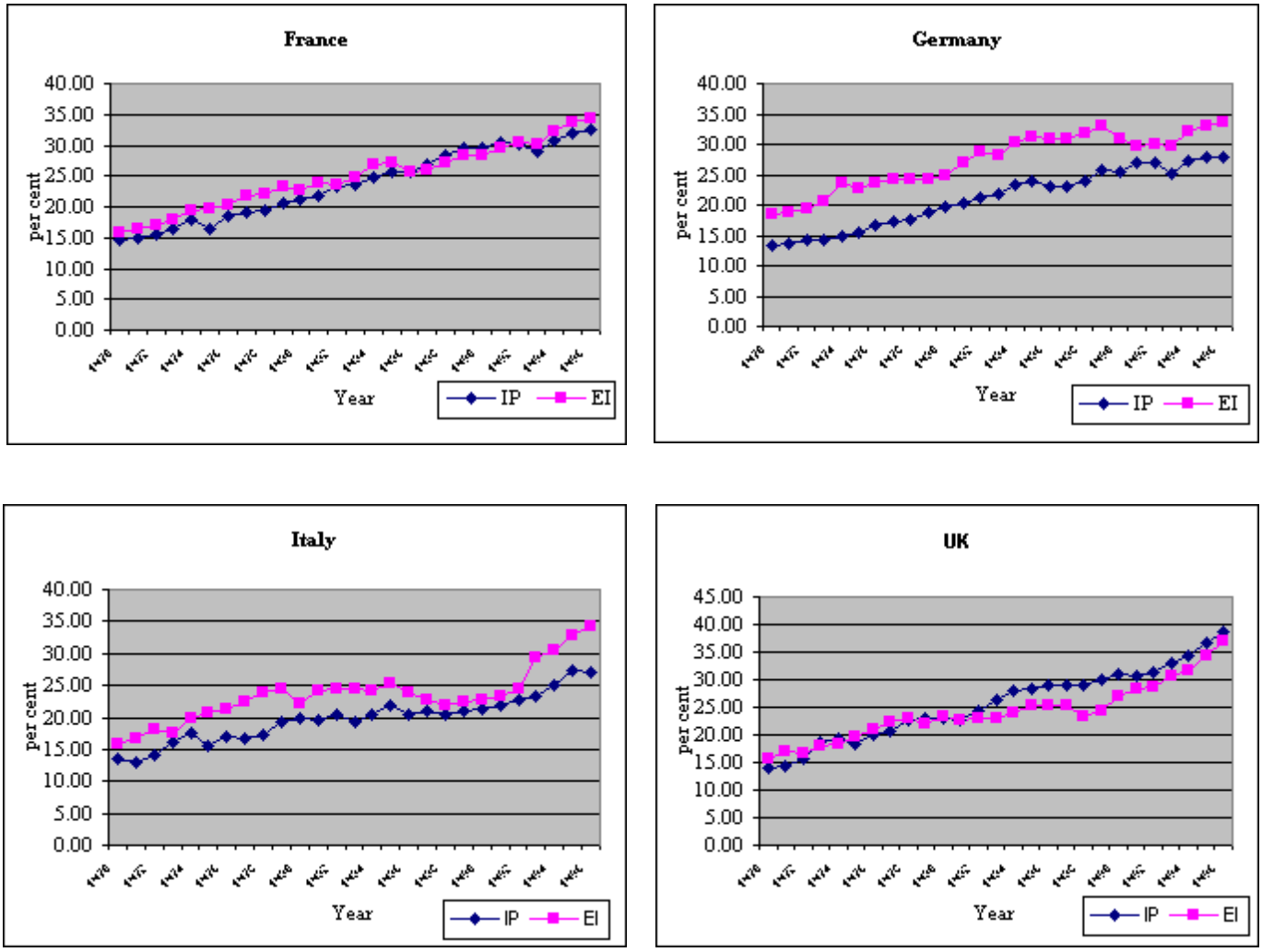






Source: OECD STAN Database.

Figure 4: Trade Flows in manufacturing



Note: IP - import penetration; EI - export intensity.

Source: OECD STAN Database.

This study would test the following:

(a) Increases in trade volumes (both in terms of exports and imports) cause reductions in the level of derived labour demand;

(b) The responsiveness of employment to changes in import penetration would vary inversely with the level of technology; and

© The responsiveness of employment to changes in import penetration would vary inversely with the degree of import penetration;

4.2 Data Sources and Definition of Variables

The analysis is based primarily on the OECD STAN database for industry and trade data (see Data Appendix). They cover 40 manufacturing industries (Appendix 2) at the three-digit level, consistently defined across years, and countries for international comparison. Definitions are drawn from the OECD STAN database and the classification of industry is taken from the International Standard Industrial Classification (ISIC – Rev.2, 1968). With information both cross-section and through time, I have a panel of 40 manufacturing industries, corresponding to a three digit ISIC level of aggregation, from 1970 to 1995.

The key data consists of: total employment, exports and imports, production and labour compensation. The variables used in the framework of analysis are constructed from the key data on individual industries for the four countries, as explained in the Data Appendix.

4.3 Estimation Method

The employment effects of trade (see Appendix 4 for modeling this approach) are examined using the basic labour demand equation, with all variables expressed in logarithms as follows:

$$\ln N_{i,t} = \lambda_i + \mu_{1j} \ln M_{i,t} + \mu_{2j} \ln X_{i,t} + \mu_{3j} \ln w_{it} + \mu_{4j} \ln Q_{it} + \varepsilon_{it} \qquad (1)$$

where

i = 1,……40 industries (depending on the country j)

t = 1970 - 1994/5 (depending on the country j)

N_{it} = total employment in industry i in time t

λ_i = industry specific effect (to allow for unaccounted differences between sectors which are constant over time)

M_{it} = import penetration

X_{it} = export intensity

w_{it} = labour compensation per employee in industry i in time t

Q_{it} = output in industry i in time t

The estimation technique used is a simple pooling of cross-section/time-series data, which connotes a common intercept for all industries, followed by standard fixed effects linear models for panel data. The pooling method does not allow for parameter heterogeneity among industries over time, but offers the advantage of drawing on all sources of variation – cross section and time series – in the data. Alternatively, the fixed effects model which captures the differences across industries, by using industry specific constants, is also used. The results of the fixed effects model are considered more reflective of the data when there are substantial variations in industries.

Several variants of the model are considered:

- (1) basic model, without trade effects;
- (2) augmentation of the basic model with trade factors;

The expected signs on both changes in import penetration and changes in export intensity are negative. The underlying reason is that the changing competitive position of the industrial countries may act as an incentive to rationalize on the use of resources and therefore increased import penetration will cause a decrease in labour usage and increased export intensity would force the industry to be more efficient. Increases in the industry's output and increases in wages would increase demand for labour in the former and vice versa in the latter.

4.4 Results

It is suspect that the variables could be non-stationary in their levels. However, some researchers pursue the analyses in levels and test whether the relevant variables share common stochastic trends, using cointegration tests. The concern of some researchers is that differencing the data means analyzing variations in year-to-year growth rates, which defeats the purpose of analyzing the trend movements.

The approach taken here is to perform the unit root panel tests both on the levels and first differences before estimating the employment equations further. Two tests are taken into account, the panel unit root tests proposed by Im, Pesaran and Shin (IPS, 1997) and the Levin Lin (LL, 1993) test. The IPS is considered a more appropriate procedure than the LL test as the former allows for a higher degree of heterogeneity in cross-section dynamics and also has a higher power than the latter. The results in Table 4 clearly confirm that all variables are stationary in their first difference.

Table 4: Unit root panel tests (first differences)

Variable	France		Germany		Italy		UK	
	IPS	LL	IPS	LL	IPS	LL	IPS	LL
Employment	-8.487	145.063	-9.786	178.241	-15.554	81.176	-13.259	119.813
Import penetration	-20.869	39.404	-18.422	36.387	-23.207	17.980	-21.123	28.407
Export Intensity	-17.470	32.284	-17.041	31.667	-19.037	3.663	-18.849	31.692
Labour Compensation	-14.631	5.994	-20.451	41.807	-17.276	16.572	-17.557	15.078
Output	-10.037	89.510	-17.827	58.866	-14.529	87.292	-11.684	86.887

Note: 1. The above tests assume a constant but without trend. One lag is assumed for all cases.

2. 5% level one-tailed critical value is -1.65.

The regression is then estimated in first differences using the pooling method and the fixed effects model to check for the consistency and robustness of the results. The estimation results reported in Table 5 presents the basic model, without the trade variables and the augmented model. The estimations are also given for two different specifications for the fixed effects model, with and without the introduction of industry and year dummies.

Some very clear results emerge from Table 5. First, the inclusion of industry and year dummies into the equations does not improve the quality of fit of the fixed effects model for all cases. Second, the results obtained *via* the pooling method are similar to the results from the fixed effects model with the inclusion of industry and year dummies (specification 2). The following explanation would therefore emphasize the results of the second specification of the fixed effects model since it is common in the literature to include period and cross sectional dummies in panel estimation.

For the basic specification, wage and production variables explain a substantial proportion of employment in all countries. The basic equation produces results as expected, the increases in industry output increases the demand for labour while increases in labour compensation per employee cause labour demand to fall. The wage elasticity coefficient is greatest in the UK as compared to the other three countries, reflecting a more flexible labour market.

When the basic model is augmented with trade variables, they reduce the overall goodness of fit of the basic equation in all countries marginally (with the exception of Germany). The trade coefficients are statistically insignificant in most countries and the elasticity estimates across countries are by no means uniform. As for the UK, the significant negative elasticity of import penetration seems to suggest a redistribution of employment from the import sector to the export sector.

Table 5: Employment equations across manufacturing industries by pooling and fixed effects (first differences)

Country	Import Penetration	Export Intensity	Wage	Production	R-squared overall	Number of Observations
France						
Pooling Method	-	-	-0.141* (-3.380)	0.173* (8.188)	0.196	675
	-0.079 (-0.488)	-0.142 (-0.641)	-0.832 (-1.759)	0.148 (1.384)	0.119	675
Fixed Effects	-	-	-0.132* (-3.466)	0.148* (7.815)	0.349	675
(1)	-0.078* (-2.150)	-0.147* (-3.037)	-0.819* (-8.148)	0.142* (5.371)	0.119	675
(2)	-0.078 (-0.498)	-0.147 (-0.683)	-0.819 (-1.803)	0.142 (1.377)	0.114	675
Germany						
Pooling Method	-	-	-0.138 (-0.899)	0.029* (2.173)	0.026	824
	-0.325 (-1.149)	0.045 (0.154)	-0.716 (-0.894)	0.414* (4.521)	0.307	824
Fixed Effects	-	-	-0.141 (-0.893)	0.022 (1.879)	0.209	824
(1)	-0.326* (-5.531)	0.042 (0.664)	-0.702* (-4.387)	0.404* (16.872)	0.307	824
(2)	-0.326 (-1.203)	0.042 (0.152)	-0.702 (-0.898)	0.404* (4.581)	0.300	824
Italy						
Pooling Method	-	-	-0.308* (-3.993)	0.019 (1.580)	0.087	999
	0.141 (0.952)	0.019 (0.190)	-0.862* (-2.975)	0.063 (1.804)	0.150	999
Fixed Effects	-	-	-0.269* (-3.570)	0.017 (1.705)	0.188	999
(1)	0.142* (5.014)	0.017 (0.503)	-0.854* (-8.810)	0.060* (4.460)	0.150	999
(2)	0.142 (1.002)	0.017 (0.176)	-0.854* (-3.037)	0.060 (1.765)	0.148	999

Table 7 - continued

Country	Import Penetration	Export Intensity	Wage	Production	R-squared overall	Number of observations
UK						
Pooling Method	-	-	-0.258*	0.085	0.111	899
			(-5.172)	(2.669)		
	-0.359*	0.036	-1.469*	0.225*	0.179	899
	(-2.053)	(0.214)	(-1.994)	(3.457)		
Fixed Effects	-	-	-0.236*	0.074	0.210	999
			(-4.995)	(2.634)		
(1)	-0.352*	0.032	-1.433*	0.231*	0.178	899
	(-8.605)	(0.709)	(-10.151)	(9.708)		
(2)	-0.352*	0.032	-1.433*	0.213*	0.171	899
	(-2.066)	(0.200)	(-2.001)	(3.434)		

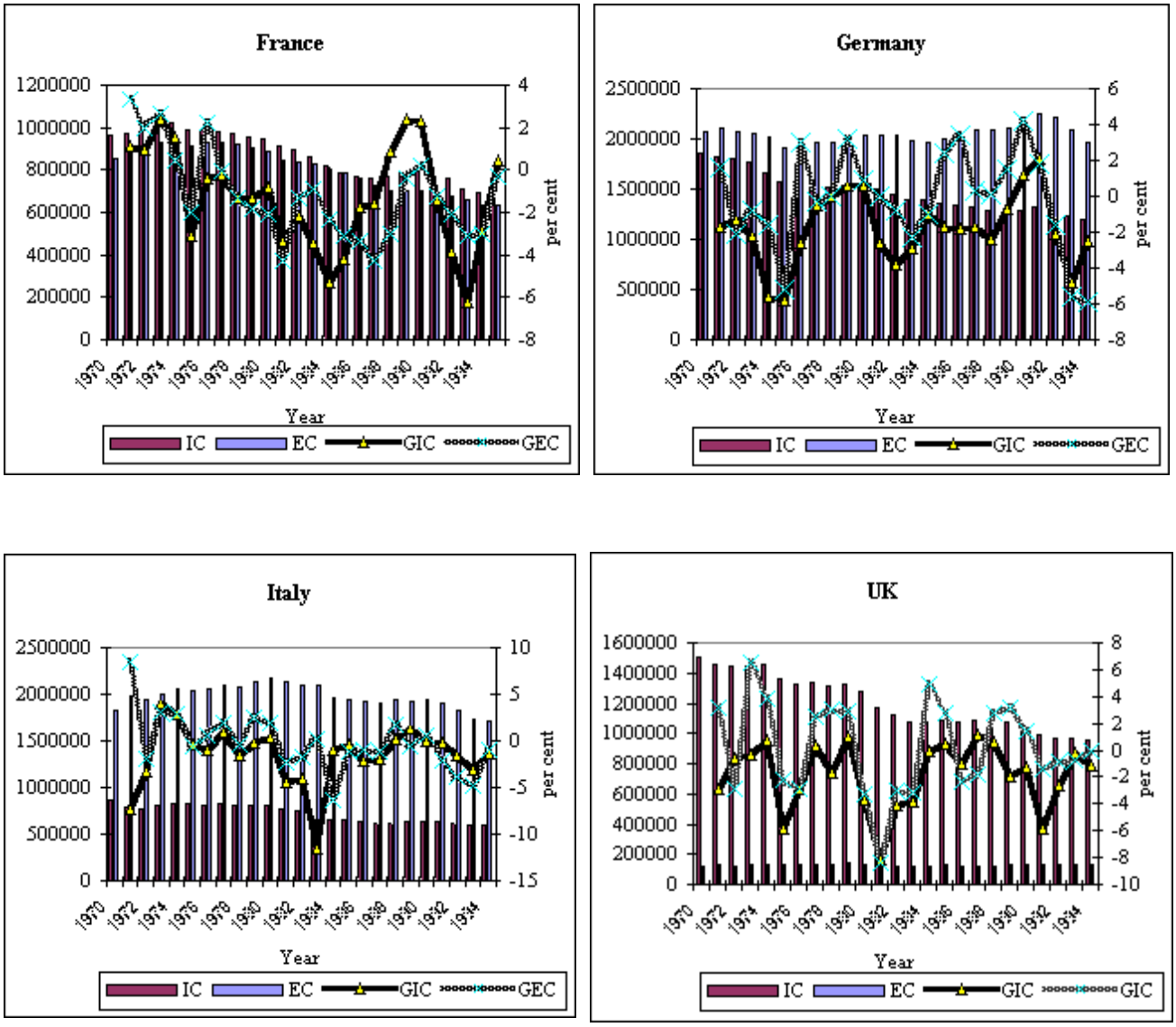
Note: 1. Inclusion of industry and year dummies in specification (2).
2. Figures in brackets indicate robust standard errors consistent t-statistics.
3. * Indicate coefficients are significantly different from zero at the 5% level.

The analyses in first differences are extended for different industrial groupings. The motivation for this is the observed variation in industries classified under the OECD STAN database. Although total manufacturing employment declined over the years, the decline is not spread uniformly across individual industries. Therefore it is necessary to capture any significant disparities between industries by grouping them into broad industrial groups. The patterns in employment levels of the two groupings considered, the ratio of import penetration to export intensity and the level of technology, are illustrated in Figures 5 and 6.

From Figure 5, it is obvious that in the UK, the import competing sector is significantly larger than the export competing sector based on the employment levels, but *vice versa* for Italy. The employment levels have been decreasing in the import competing sectors of all countries, except for Italy. In terms of technological groupings, employment levels of low technology industries have been gradually declining over the period 1970-1994, while employment levels of high technology industries have been relatively stable (Figure 6). The large employment levels in the low technology industries arise from the large number of industries classified in this category, as opposed to the small number of industries classified as higher end technology industries.

Dummy variables are incorporated to represent the various classifications, taking the value 1 if it belongs to the particular group and 0 otherwise. In the first group, the intercept dummies represent import competing (DUMIC) and export competing (DUMEC) sectors respectively. The second classification includes dummies for low technology (DUMLT) and high technology sectors (DUMHT). The results are as shown in Table 6.

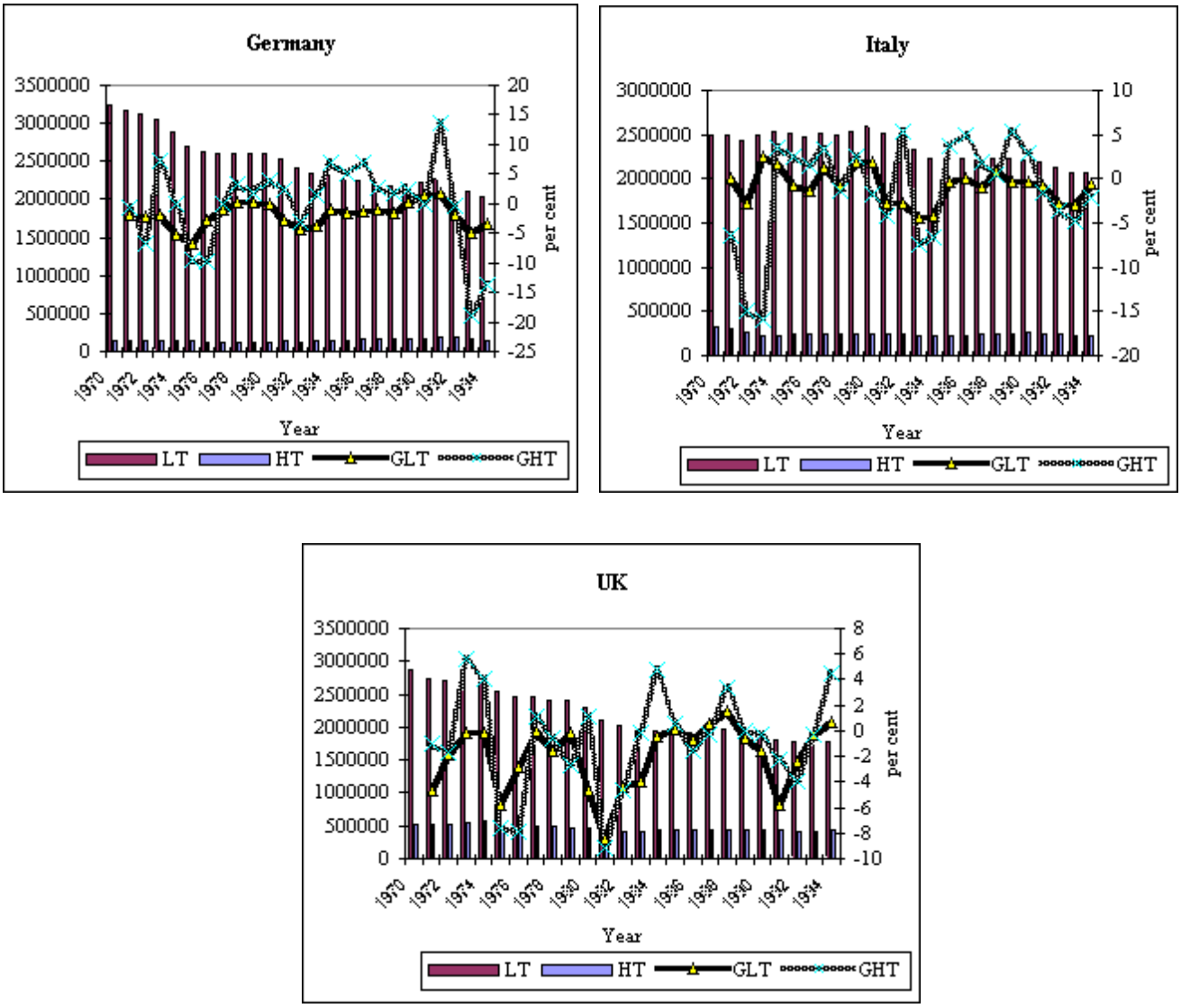
Figure 5: Employment levels and growth rates in import competing and export competing sectors



Note: IC and EC represent employment in import competing and export competing sectors, while GIC and GEC represent the growth rates of the sectors respectively.

Source: Calculations based on the OECD STAN database with corresponding definition of sectoral classification in Appendix 3.

Figure 6: Employment levels and growth rates of low technology and high technology sectors



Note: 1. LT and HT represent low technology and high technology sectors, while GLT and GHT refer to the growth rates respectively.

2. France is not included in the above because there are no high technology sectors as defined in Appendix 2 based on the OECD STAN database.

Source: Calculations based on the OECD STAN database with corresponding definition of technological groupings in Appendix 2.

Table 6: Employment equations across manufacturing industries, first differences (with industry group dummies)

Country	Import Penetration	Export Intensity	Wage	Production	DUMIC	DUMEC	R-squared	Number of Observations
France	-0.031 (-1.870)	0.030 (1.617)	-0.143* (-3.403)	0.175* (8.223)	0.001 (0.183)	0.004 (1.500)	0.205	675
Germany	0.000 (0.005)	-0.044* (-2.012)	-0.159 (-1.054)	0.027* (2.091)	-0.016* (-3.891)	0.001 (0.158)	0.059	824
Italy	-0.030 (-1.540)	-0.041* (-2.316)	-0.304* (-4.081)	0.014 (1.444)	-0.008 (-1.484)	0.005 (1.122)	0.118	999
UK	0.012 (1.072)	-0.038* (-2.202)	-0.273* (-5.655)	0.082* (2.657)	0.004 (1.020)	0.021* (3.097)	0.128	899
Country	Import Penetration	Export Intensity	Wage	Production	DUMLT	DUMHT	R-squared	No. of Observations
Germany	0.004 (0.233)	-0.040 (-1.803)	-0.154 (-0.970)	0.026* (2.046)	-0.016* (-5.439)	0.012 (0.917)	0.078	824
Italy	-0.029 (1.504)	-0.042* (-2.409)	-0.304* (-4.089)	0.014 (1.418)	0.001 (0.206)	0.003 (0.227)	0.115	999
UK	0.013 (1.102)	-0.040* (-2.283)	-0.277* (-5.672)	0.081* (2.650)	0.001 (0.211)	0.025* (3.195)	0.136	899

Note 1. Figures in brackets indicate robust standard errors consistent t-statistics.
2. * Indicate coefficients are significantly different from zero at the 5% level.

The results reveal negative significant intercepts for import competing and low technology sectors in Germany. Contrasting results are observed for the UK, with positive significant intercepts for export competing and high technology sectors. To gauge the responsiveness of employment to the different industrial groups, I regress the employment equations with import penetration interacted with industry groups. Table 7 presents the coefficients obtained.

Table 7: Employment equations, first differences
(Imports interacted with industry groups)

Variable	France	Germany	Italy	UK
Import Penetration*IC	-0.029	-0.059	-0.002	-0.021
Import Penetration*EC	0.050*	0.048	-0.109	-0.048
Import Penetration*LT	-	-0.006	-0.024	0.006
Import Penetration*HT	-	-0.050	-0.080	-0.151

Note: 1. The equations are identical to those presented in Table 8, but include the import penetration interacted with the import competing (IC) and export competing (EC) sectors and the low technology (LT) and high technology (HT) groups.
2. * Indicate coefficients are significantly different from zero at the 5% level.

The set of estimates suggests that the responsiveness of employment to changes in import penetration varies negatively with the degree of import penetration in France and Germany. This implies that industries with high import penetration rates (import competing sectors) are likely to face reductions in employment. Conversely, the responsiveness of employment to changes in import penetration varies negatively in all technological groupings, except for the low technological group in the UK. Therefore there is no clear evidence that employment varies negatively with high technology groups, with the exception of the UK.

The evidence based on the pooling method and the fixed effects model suggests that there is some form of displacement effects of import penetration on employment in total manufacturing only for the UK. On the contrary, both import penetration and export intensity are not statistically significant in France, Germany and Italy. The results do not reveal a general evidence of more efficient usage of labour in these countries. This would suggest that trade pressures alone do not explain Europe's dismal employment performance in manufacturing since the 1970s.

4.5 Shortcomings and Limitations

There are some caveats to the above analyses that are worth mentioning. The availability of data based on the degree of disaggregation in the STAN database does not allow the detection of all effects[6], and therefore the above results merely indicate some preliminary findings that warrant further analyses. The following are some important issues that should be considered in studies pertaining to labour market impacts of trade.

First, the quantitative impact on relative employment would, depend on the elasticities of demand for and supply of different categories of labour and the importance and evolution of the type of trade *vis-à-vis* the rest of the world. The displacement effect of international

[6] A reasonable consequence of falling manufacturing employment is a decrease in employment of less-skilled labour with increased competition. Such disaggregated data on labour composition of manufacturing employment by industries is not available in the database used for this study.

trade would very much depend if the trade is of the intra-industrial[7] or inter industrial type. The effects on demand for labour in the former type of trade are more likely to affect particular firms while the latter would have an impact on particular industries.

Second, changes in trade intensities would normally lead to changes in the demand for labour, for as long as markets have responded to changes in the prices of imported[8] and exported goods. From a trade theorist view, the behaviour of traded goods price[9] indices play a determinant role in the labour market impact as changes in relative prices affect factor demands directly, followed by factor rewards and finally trade volumes. It is also noted that trade prices, and not trade volumes or import penetration ratios, are exogenous while the other variables are not. Trade effects may be conveyed through other channels too, such as "outsourcing[10]" and "delocalisation."

Third, changes in trade in manufactured goods are likely to result in changes in the demand for particular types of labour (skilled vs. unskilled). Empirical evidence from the literature suggests that the trade-price effect, albeit small, has a somewhat larger impact on wages and employment of the unskilled.

Ideally, a quantitative analysis on the impact of international trade would therefore have to be disaggregated to take into account the following: the type of trade (intra-industrial or inter-industrial); the direction of trade; the state of business cycle of the country in question; the impact of *changes in trade* and the impact of *changes in trade balances*[11] in the tradeables sector.

5. CONCLUSION

The study looks into the adjustments in labour markets, particularly the employment trends in manufacturing composition in four countries in Europe. Based on these observed trends, an attempt is made to uncover any links between trade (one dimension of globalization) and employment in general.

Two pieces of evidence are assembled. The first is the shift-share analysis that implies an almost negligible role of trade based on the small share of between effects as opposed to within effects. The results provide prima facie evidence for further analyses on trade impacts. The second piece of evidence involves a simple econometric exercise in which

[7] This sort of trade has increased over the past few decades in most OECD countries.

[8] However in the case of France, Germany, Italy and the UK, Neven and Wyplosz (1999) show that changes in import prices had little to do with the level of skills during the period 1975-1990. However there is evidence of industrial restructuring in unskilled labour intensive sectors in terms of downsizing and skill upgrading.

[9] This approach is gaining fast consensus in the literature (see Bhagwati 1994, Hakura 1997). However, lower trade prices do not necessarily imply lower wages. When there is complete specialization, lower import prices will in fact improve real wages of *all* workers. However in the case of incomplete specialization, lower import prices will exert downward pressure on wages or employment of a particular type of labour. Though trade prices, and not trade *per se* or quantities of trade are considered as a key channel of transmission, it may reflect other forces such as trade liberalization and growth of developing countries (see Deardorff, 1998).

[10] "Outsourcing " involves the possibility of fragmenting the production processes into geographically separate steps, such as importing labour-intensive inputs from low wage countries. Whilst "delocalisation" involves the relocation of production to low wage countries, via foreign direct investment. These two channels reflect trade effects on labour market in the absence of trade price changes.

[11] If the employment content of exports and imports is approximately equal, the impact of rising trade intensity on employment in the tradeables sector, when measured over a period during which the current account balance deteriorates for domestic macroeconomic reasons, will almost certainly reveal declining employment in that sector, and *vice versa*.

a demand function for manufacturing employment is estimated. From this second exercise, there is no evidence that employment is sensitive to import penetration or export intensity. The exception is the UK, whereby the coefficient of import penetration is negative and statistically significant. It is however noted that testing such a general proposition is bound to be fraught with difficulties, therefore conclusions can only be tentative.

These two pieces of evidence tend to reinforce one another. Both uncover symptoms of competition pressures (in this case *via* trade volumes) on employment, which is probably insignificant and therefore not overwhelming. Notwithstanding the above evidence, further research in this area should be more refined to account for two major issues: endogeneity in wages[12]; and a *dynamic* labour demand equation for panel estimation adapted and redefined by Greenaway and *et.al* (1998) by using instrumental variables, that is the generalized method of moments (GMM) technique posited by Arellano and Bond (1991). More work is also needed to elucidate other forces at work in Europe, ranging from industrial structures, labour market institutions and technology.

[12] The failure to consider the potential endogeneity of wages in the employment equations may explain in part the weakness of the results reported in the above analyses.

DATA APPENDIX

This appendix contains details of data sources used. In addition, it presents an explanation of how the various series are constructed.

A.1 Data on Trade and Industry

Trade data used for the four countries measures imports (IMPO) and exports (EXPO) in current prices for manufacturing only. This data is used in concordance with industry data of the manufacturing subdivisions of Appendix 2. The data obtained are as defined below:

Production (PROD) – national accounts compatible production (gross output) in current prices;

Employment (EMPN) – includes number of employees as well as self-employed, owner proprietors and unpaid family workers;

Labour compensation (LABR) – current price national accounts compatible labour costs which include wages as well as the costs of supplements such as employer's compulsory pension or medical payments;

Gross fixed capital formation (GFCF) – national accounts compatible gross fixed capital formation (land, buildings, machinery and equipment) in current prices;

Value added (VALU and VALUK) – contribution of each industry to national GDP in both current and constant (1990) prices. The valuation of national accounts value added by activity is based on basic prices for France and Germany, market prices for Italy and factor costs for the UK.

For Germany, the industry data (as iterated above) are for the western Germany only (Federal Republic of Germany before the unification of Germany, including West Berlin), but the trade data (EXPO and IMPO) refer to western Germany up to and including 1990. From 1991, the trade data include eastern Germany.

The availability of the above data for the detailed industrial sectors varies across countries. Therefore the empirical exercise for the 4 countries differ in terms of the industries selected for the analysis as iterated below:

France – Includes 29 industries (excluding industry: 3522, 352X, 3825, 382X, 3832, 383X, 3841, 3842, 3843, 3844, 3845) from1970-1995; 676 observations.

Germany – Includes 33 industries (excluding industry: 3522, 352X, 3832, 383X, 3842, 3844, 3849) from 1970-1994; 825 observations.

Italy – Includes all 40 industries from 1990-1994; 1000 observations.

UK – Includes 36 industries (excluding industry: 3842, 3844, 3845, 3849) from 1990-1994;

900 observations.

The other online databases include the following:

ITCS International Trade by Commodities – Germany, France, Italy and UK (SITC, Rev.2, Vol.2000, release 01)

International Trade & Competitiveness Indicators, Vol.2001, release 01

A.2 Data on Technology

R&D intensity is used as a proxy for technology. The data obtained on business expenditure on R&D are limited for the period 1981 – 1987, from the following online database: Basic Science & Technology Indicators - Business expenditure on research and development by industry and source of funds (ISIC Rev.2, Table 10, Vol.2001, release 01)

A.3 Data on Skills

The data used to represent skilled labour is the share of total R&D personnel in individual industries to total manufacturing employment. The data on total R&D personnel is also limited to the period 1981-1987, for the following online database: Basic Science & Technology Indicators – Total research and development personnel in business enterprise sector by industry (ISIC Rev.2, Tables 12 &13, Vol.2001, release 01).

A.4 Variables Constructed

A number of derived variables are constructed by industry (i). The variables are all in nominal terms:

- Labour compensation per employee (w);
  $w_i = (LABR_i/EMPN_i) /(LABR_m/EMPN_m)$ where m = total manufacturing

- Import penetration (M);
  $M_i = IMPO_i/(PROD_i+IMPO_i-EXPO_i)$

- Export intensity (X);
  $X_i = EXPO_i/PROD_i$

- R&D intensity
  $RD_i = (\text{R\&D Business Expenditure})_i/PROD_i$

- Investment intensity; and
  $INV_i = GFCF_i/PROD_i$

- Skill intensity
  $SI_i = (\text{Total R\&D Enterprise Personnel})_i/EMPN_i$

- Labour productivity
  $LP_i = VA_i/EMPN_i$

APPENDIX 1a: OCCUPATIONAL CLASSIFICATION (based on the ISCO-88[i])

Occupational Group	Major Group	
I. WHITE COLLAR WORKERS		
(a)Fourth Skill Level		
Professionals	2	
(b)Third Skill Level		
Technicians and associate professionals	3	
© Second Skill Level		
Clerks	4	
Service workers and shop and market sales workers	5	
Skill agricultural and fishery workers	6	
Craft and related workers	7	BLUE-COLLAR
Plant and machine operators and assemblers	8	
(d) First Skill Level		
Elementary occupations	9	→ Unskilled

Note: 1. Skill is defined in ISC0-88 as "the ability to carry out tasks and duties of a particular job." There are 4 ISCO skill levels, and they are related to eight major groups.
2. For Group 1 (legislators, senior officials and managers), the range of tasks which can constitute a managerial occupation was deemed too large to link directly with a particular skill level. For Group 10 (armed forces), many countries had indicated that the information required to categorize occupations within their armed forces would not be available for statistical classification.
3. Occupations ca n be broadly aggregated in the following manner:
White-collar high skill (WCHS) – Groups 1, 2 and 3
White-collar low skill (WCLS) – Groups 4 and 5
Blue-collar high skill (BCHS) – Groups 6 and 7
Blue-collar low skill (BCLS) – Groups 8 and 9

Source: Elias, 1998.
OECD, 1998.

APPENDIX 1b: SUB-MAJOR GROUPS OF ISCO-88 (at the 2 digit level)

11	Legislators and senior officials
12	Corporate managers
13	General managers
21	Physical, mathematical and engineering science professionals
22	Life science and health professionals
23	Teaching professionals
24	Other professionals
31	Physical and engineering science associate professionals
32	Life science and health associate professionals
33	Teaching associate professionals
34	Other associate professionals
41	Office clerks
42	Customer services clerks
51	Personal and protective service workers
52	Models, salespersons and demonstrators
61	Market-oriented skilled agricultural and fishery workers
62	Subsistence agricultural and fishery workers
71	Extraction and building trades workers
72	Metal, machinery and related workers
73	Precision, handicraft, printing and related trades workers
74	Other craft and related trades workers
81	Stationary-plant and related operators
82	Machine operators and assemblers
83	Drivers and mobile-plant operators
91	Sales and services elementary occupations
92	Agricultural, fishery and related labourers
93	Labourers in mining, construction, manufacturing and transport

Note: WCHS – 10+20+30
WCLS – 40+50
BCHS – 60+70
BCLS – 80+90

APPENDIX 2: INDUSTRY CLASSIFICATION (based on ISIC Revision 2)

Industry Group	*Codes*
Food, beverages & tobacco	**3100 (LOTECH)**
Food	*311.2*
Beverages	313
Tobacco	*314*
Textiles, apparel & leather	**3200 (LOTECH)**
Textiles	*321*
Wearing apparel	*322*
Leather & products	*323*
Footwear	*324*
Wood products & furniture	**3300 (LOTECH)**
Wood products	331
Furniture & fixtures	*332*
Paper, paper products and printing	**3400 (LOTECH)**
Paper & products	*341*
Printing & publishing	*342*
Chemical products	**3500**
Industrial chemicals	*351(MHTECH)*
Other chemicals	*352(MHITECH)*
Drugs and medicines	*3522 (HITECH)*
Chemical products nec	*352X(MHTECH)*
Petroleum refineries	*353 (MLTECH)*
Petroleum & coal products	*354*
Rubber products	*355*
Plastic products nec	*356*
Non-metallic mineral products	**3600 (MLTECH)**
Pottery, china, etc.	361
Glass & products	*362*
Non-metallic products, nec	*369*
Basic metal industries	**3700 (MLTECH)**
Iron & steel	*371*
Non-ferrous metals	*372*
Fabricated metal products	**3800**
Metal products	*381 (MLTECH)*
Non-electrical machinery	*382 (MHTECH)*
Office & computing machinery	*3825 (HITECH)*
Machinery & equipment nec	*382X (MHTECH)*
Electrical machinery	*383 (MLTECH)*
Radio, TV & communication equipment	*3832 (HITECH)*
Electrical apparatus nec	*383X (MHTECH)*
Transport equipment	*384 (MHTECH)*
Shipbuilding & repairing	*3841 (MLTECH)*
Railroad equipment	*3842*
Motor vehicles	*3843 (MHTECH)*
Aircraft	*3845 (HITECH)*
Transport equipment nec	*3849 (MHTECH)*
Professional goods	*385 (MHTECH)*
Other manufacturing	3900 (MLTECH)

Note: The industries are categorized into 4 technology groups based on R&D as follows:
HITECH – High technology industries (3522+3825+3832+3845)
MHTECH - Medium-high technology industries (3512X+382X+383X+3842A+3843+3850)
MLTECH – Medium-low technology industries (3534A+3556A+3600+3710+3720+3810+3841+3900)
LOTECH – Low technology industries (3100+3200+3300+3400)

APPENDIX 3: INDUSTRY CHARACTERISTICS (based on the ratio of import penetration to export intensity)

Code	Industry	IP/EI	Code	Industry	IP/EI
	I. FRANCE			**2. GERMANY**	
	Import-Competing Sectors			Import-Competing Sectors	
314	Tobacco	3.776	311.2	Food	1.553
331	Wood products	1.590	313	Beverages	1.861
332	Furniture & fixtures	1.934	322	Wearing apparel	1.981
341	Paper & products	1.592	324	Footwear	2.442
381	Metal products	4.038	331	Wood products	2.120
39	Other manufacturing	1.820	353	Petroleum refineries	3.262
	Export-Competing Sectors			Export-Competing Sectors	
313	Beverages	0.346	342	Printing & publishing	0.449
382	Non-electrical machinery	0.385	382X	Machinery & equipment nec	0.425
384	Transport equipment	0.280	3841	Shipbuilding & repairing	0.467
385	Professional goods	0.006	3843	Motor vehicles	0.447
	Two-Way Trade Sectors			Two-Way Trade Sectors	
311.2	Food	1.073	314	Tobacco	0.745
321	Textiles	1.068	321	Textiles	1.135
322	Wearing apparel	1.056	323	Leather & products	1.237
323	Leather & products	1.034	332	Furniture & fixtures	0.849
324	Footwear	1.377	341	Paper & products	1.429
342	Printing & publishing	1.177	351	Industrial chemicals	0.720
351	Industrial chemicals	1.027	352	Other chemicals	0.627
352	Other chemicals	0.698	354	Petroleum & coal products	0.615
353	Petroleum refineries	1.362	355	Rubber products	0.854
355	Rubber products	0.660	356	Plastic products, nec	0.756
356	Plastic products nec	1.236	361	Pottery, china, etc	0.700
361	Pottery, china, etc.	1.295	362	Glass & products	0.796
362	Glass & products	0.719	369	Non-metallic products, nec	0.903
369	Non-metallic products, nec	1.166	371	Iron & steel	0.689
371	Iron & steel	0.822	372	Non-ferrous metals	1.271
372	Non-ferrous metals	1.491	381	Metal products	0.530
383	Electrical machinery	1.183	382	Non-electrical machinery	0.530
			3825	Office & computing machinery	1.033
			383	Electrical machinery	0.692
			384	Transport equipment	0.537
			3845	Aircraft	1.144
			385	Professional goods	0.873
			39	Other manufacturing	0.993

Note: 1. The ratios of import penetration to export intensity (IP/EI) reported are averages for the period 1970-1994/5, for each individual sector.

2. IP/EI > 1.5 is classified as import competing; IP/EI < 0.5 is classified as export competing; All others are classified as two way trade sectors.

Appendix 3 – continued

Code	Industry	IP/EI	Code	Industry	IP/EI
	3. ITALY			**4. UK**	
	Import-Competing Sectors			Import-Competing Sectors	
311.2	Food	2.591	311.2	Food	2.767
314	Tobacco	46.514	322	Wearing apparel	1.578
331	Wood products	2.638	324	Footwear	2.263
341	Paper & products	1.976	331	Wood products	12.261
352X	Petroleum refineries	1.600	341	Paper & products	3.165
372	Non-ferrous metals	2.067			
				Export-Competing Sectors	
	Export-Competing Sectors		3522	Drugs and medicines	0.499
313	Beverages	0.410	361	Pottery, china, etc.	0.455
322	Wearing apparel	0.269			
324	Footwear	0.121		Two-Way Trade Sectors	
332	Furniture & fixtures	0.103	313	Beverages	0.625
342	Printing & publishing	0.376	314	Tobacco	0.619
356	Plastic products, nec	0.367	321	Textiles	1.228
369	Non-metallic products, nec	0.213	323	Leather & products	1.054
381	Metal products	0.426	332	Furniture & fixtures	1.490
3849	Transport equipment, nec	1.147	342	Printing & publishing	0.654
39	Other manufacturing	0.475	351	Industrial chemicals	0.921
			352	Other chemicals	0.637
	Two-Way Trade Sectors		352X	Chemical products, nec	0.721
321	Textiles	0.620	353	Petroleum refineries	1.016
323	Leather & products	0.669	354	Petroelum & coal products	0.865
351	Industrial chemicals	1.228	355	Rubber products	0.795
352	Other chemicals	1.303	356	Plastic products, nec	1.406
3522	Drugs and medicines	1.078	362	Glass & products	1.191
352X	Chemical products, nec	1.600	369	Non-metallic products, nec	0.795
353	Petroleum refineries	1.007	371	Iron & steel	0.952
354	Petroleum & coal products	1.376	372	Non-ferrous metals	1.284
355	Rubber products	0.686	381	Metal products	0.796
361	Pottery, china, etc	0.520	382	Non-electrical machinery	0.851
362	Glass & products	0.744	3825	Office & computing machinery	1.066
371	Iron & steel	0.985	382X	Machinery & equipment, nec	0.756
382	Non-electrical machinery	0.666	383	Electrical machinery	1.030
3825	Office & computing machinery	1.026	3832	Radio, TV & communication equipment	1.145
382X	Machinery & equipment, nec	0.589	383X	Electrical apparatus, nec	0.931
383	Electrical machinery	0.936	384	Transport equipment	0.908
3832	Radio, TV and communcation equipment	1.273	3841	Shipbuilding & repairing	0.659
383X	Electrical apparatus, nec	0.707	3843	Motor vehicles	1.036
384	Transport equipment	0.937	385	Professional goods	0.959
3841	Shipbuilding & repairing	0.801	39	Other manufacturing	0.992
3842	Railroad equipment	0.659			
3843	Motor vehicles	0.995			
3845	Transport equipment, nec	0.987			
385	Professional goods	1.445			

Source: Calculations based on the OECD STAN Database.

APPENDIX 4: MODELLING EMPLOYMENT EFFECTS

The analysis is conducted within the framework of a fairly simple static profit-maximizing model of firm behaviour (based upon Greenaway *et al*., 1999). A Cobb-Douglas production function is assumed for the representative firm in industry i in period t:

$$Q_{it} = A^{\gamma}K_{it}^{\alpha}N_{it}^{\beta}$$

where
Q = real output
K = capital stock
N = units of labour utilized
and α, β represent the factor share coefficients and γ allows for factors changing the efficiency of the production process. A profit-maximizing firm will employ labour and capital at such levels that the marginal product of labour equals the wage (w) and the marginal product of capital equals the user cost ©. Thus, solving this system simultaneously to eliminate capital from the expression for firm output gives the following expression:

$$Q_{it} = A^{\gamma}[\alpha L_{it}/\beta \text{ x } w_i/c]N_{it}^{\beta}$$

Taking logarithms and rearranging the above equation provides the derivation of the firm's, and therefore the industry's derived demand for labour:

$$\ln N_{it} = \mu_0 + \mu_1 \ln(w_i/c) + \mu_2 \ln Q_{it}$$

where
$\mu_0 = -(\gamma \ln A + \alpha \ln\alpha - \alpha \ln\beta)/(\alpha + \beta)$
$\mu_1 = -\alpha/(\alpha + \beta)$
$\mu_2 = 1/(\alpha + \beta)$

If the technical efficiency of the production process increases over time and the rate of technology adoption and increases in x-efficiency is correlated with trade changes, then parameter A in the production function varies with time in the following manner:

$$A_{it} = e^{\delta 0 Ti}M_{it}^{\delta 1}X_{it}^{\delta 2}, \quad \delta_0, \delta_1, \delta_2 > 0$$

where T = time trend
M = import penetration
X = export intensity

which implies

$$\ln N_{it} = \varphi^*_0 - \mu_0 T - \mu_1 \ln Mit - \mu_2 \ln Xit + \varphi_1 \ln(w_i/c) + \varphi_2 \ln Q_{it}$$

with
$\varphi^*_0 = -(\alpha \ln\alpha - \alpha \ln\beta)/(\alpha + \beta)$
$\mu_1 = \mu\delta_1$
$\mu_2 = \mu\delta_2$
$\mu = \gamma/(\alpha + \beta)$

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[i] The ISCO-88 was developed during the mid 1980s. Most countries of the EU have reached the point where their classification of national occupational statistics to a schema based upon ISCO-88 is considered useable for comparative analyses at the level of 2-digits sub-major groups. The comparability between national classifications and ISCO-88 is good for Germany, average for France and poor for Italy and the United Kingdom.