
CENTRE FOR RESEARCH ON GLOBALISATION AND LABOUR MARKETS



Research Paper 99/11

**Further Evidence on the Effect of
Foreign Competition on Industry
Level Wages**

by

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The Centre acknowledges financial support from The Leverhulme Trust under
Programme Grant F114/BF

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Acknowledgements

The authors gratefully acknowledge financial support from the ESRC under its Asia-Pacific Programme Grant number L324253045 and from the Leverhulme Trust under Programme Grant F114/BF. They are also grateful for comments from participants at a CEPR European Research Workshop in International Trade in Helsinki, an IESG Annual Conference at Nottingham, and a Leverhulme Programme Conference at Nottingham. Amanda Greenwood provided excellent research assistance.

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Abstract

This paper examines the impact of trade changes on industry level wage outcomes. Using a specially constructed (and possibly unique) panel combining trade, industrial structure and labour market data we estimate wage equations across a large number of UK industries. The results suggest that on average increases in trade, whether emanating from imports or exports, serve to decrease wages. This evidence is consistent with the view that foreign trade acts to moderate the demand for an industry's output and hence to discipline wage setting. The data set is such that in addition to testing for the impact of trade expansion in the aggregate, we can also investigate the effects of increased imports from (exports to) particular groups of trading partners. This analysis suggests that trade with the East Asian Economies has disproportionately affected the wages of those at the lower end of the income distribution and therefore served to increase wage inequality.

Outline

1. Introduction
2. Trade, Bargaining and Wages
3. Modelling Wage Effects
4. Results
5. Conclusions

1 Introduction

In a recent paper in *Weltwirtschaftliches Archiv*, Konings and Vandenbussche (1995) investigated the effects of foreign competition on wages and employment in the United Kingdom. Using a firm level panel of data they searched for wage effects, noting that Stolper-Samuelson effects should result in a negative impact on wages whilst modern (intra-industry) trade theory suggests a positive effect. In fact they found both – a positive effect for their full sample and a negative effect when they restricted themselves to the manufacturing sector. They also found that both domestic competition and unionisation have wage effects.

The focus of this paper is also on foreign competition and wages. Like Konings and Vandenbussche (1995) we adopt a panel framework. However, our analysis is industry based. Moreover, it also disentangles import and export competition and disaggregates UK imports by origin and UK exports by destination. Using a specially constructed (and possibly unique) panel combining trade, industrial structure and labour market data we estimate wage equations across 167 UK industries. Within a bargaining framework we construct a model to identify directly the impact of increased import penetration and improved export performance on relative wage growth across industries, after allowing for other determinants of differential wage growth, such as unionisation, growth in output and so on. The data set is such that, in addition to testing for the impact of trade expansion in the aggregate, we also investigate the effects of increased imports from (exports to) particular groups of trading partners. Among other things we find that foreign competition has a significant disciplining effect on wages.

The remainder of the paper is organised as follows. Section II reviews the literature on international trade and wage determination in a bargaining framework, including recent empirical evidence. Section III sets out the framework for our analysis, providing details of our data set, the methodology employed, the variables incorporated and the estimation techniques deployed. Section IV reports our results and discusses their significance. We also consider their policy implications. Finally Section V concludes.

2. Trade, Bargaining and Wages

In considering the impact of trade changes on wage levels, a dichotomy exists between the modelling strategy of trade and labour economists. For trade theorists the natural starting point is the Heckscher-Ohlin-Samuelson model. In the simple 2x2x2 case this predicts that

trade alters relative prices and in turn relative factor rewards. Specifically rewards to a country's relatively abundant factor will increase whilst those to its scarce factor will decline. The reasoning is well known: the abundant factor is used intensively in the export industry and the scarce factor in the import substitute sector. As demand for the former increases and the latter declines, derived demands for factors of production alter and factor rewards change. Moreover, the basic intuition carries over to higher dimensions in goods. One can therefore think of a continuum of commodities with differing degrees of labour intensity. This intuition also carries through to a world with differing qualities of labour; thus one can think of high skill and low skill intensive activities. In an industrialised economy it would be widely assumed that exports are intensive in high skill labour and imports intensive in low skill labour with trade expansion increasing rewards to the former relative to the latter. Again the driver is changes in demand for the different types of labour. This perspective is a useful one from the standpoint of thinking about long run relative factor rewards. It is not so helpful however when thinking about short run wage adjustment, nor the impact of industrial structure or bargaining on wage adjustment.

In contrast to the above, which is framed in a general equilibrium context and hence emphasises the long run, labour economists have generally been interested in modelling the microeconomics of the wage bargaining process and short run adjustment. The models are generally partial equilibrium and stress the impact of unemployment and labour/product market imperfections on wage outcomes. This modelling of the bargaining process considers how a surplus arising from production is divided between the firm and the union, though authors differ in their detailed specification¹. Despite these differences, the majority of standard theoretical models give rise to an implicit wage function of the form:

$$w = f(\gamma, \bar{w}, b, U, prod) \quad (1)$$

where:

- γ = relative bargaining power of the union to the firm
- \bar{w} = alternative wage available to union members
- b = unemployment benefit level
- U = unemployment rate
- $prod$ = productivity of the firm.

¹ For a recent theoretical survey see Booth (1995). For a review of the 'trade' and 'labour' perspectives see Slaughter (1999).

Wages would be expected to be increasing in the relative bargaining power of the union, the productivity of the firm and those factors which improve the outside opportunities of the union members (increases in unemployment benefits/alternative wages and decreases in the unemployment rate).

A number of authors have recently sought to adapt union bargaining to an open economy context. Lawrence and Lawrence (1985) develop a monopoly union model of wage setting in which the impact of increased foreign competition is introduced via a reduction in the demand for domestic goods. In their basic model the firm is assumed to face a constant elasticity of substitution (CES) function:

$$Y = [\alpha L^\rho + (1-\alpha)K^\rho]^{1/\rho} \quad (2)$$

which, since it is assumed to maximise profits gives rise to the following first order condition for each firm:

$$\frac{w}{r} = \left(\frac{\alpha}{1-\alpha} \right) \left(\frac{L}{K} \right)^{1-\rho} \quad (3)$$

This firm is then assumed to bargain with a monopoly union which maximises the sum of individual union members expected utilities. The union will therefore choose the level of wages and employment, bearing in mind the subsequent profit maximising behaviour of the firm, to maximise its utility function:

$$L(U(w) - U(\bar{w})) \quad (4)$$

This will lead it to set a wage level that equates the gain in utility from employment with respect to the wage rate equal to the elasticity of derived labour demand (η):

$$\frac{U'(w)w}{U(w) - \bar{U}} = \eta \quad (5)$$

Lawrence and Lawrence (1985) then model the negative demand shock caused by an increase in imports as an inward shift of the labour demand curve. However since the elasticity of derived labour demand is independent of demand shocks, their model predicts that increased import pressure leads to a reduction in employment whilst leaving the bargained wage unchanged. This is simply a generalisation of the result of McDonald and

Solow (1981) that iso-elastic shifts of the labour demand curve do not alter wage levels. However, as Lawrence and Lawrence (1985) note, more general functional forms for the production or utility functions which allow the elasticity of derived labour demand to be altered by increased import competition will lead to simultaneous declines in both wages and employment.

Grossman (1984) also considers the impact of changes in trade patterns on wage outcomes, though his model is framed in terms of a median voter bargaining model in which membership is also variable. He incorporates the impact of foreign competition on wage and employment outcomes by assuming the presence of a traded good which is a perfect substitute for domestic output. Increased competition therefore reduces the price of the firm's product in the domestic market. This has two principal effects: first the median voter will prefer a higher wage to compensate for the higher probability of job loss; second, workers will leave the unionised sector as the probability of getting a job decreases. Falling union membership however serves to increase wage demands as the average seniority of the union rises. The overall impact of increased competition on wages will therefore depend on the relative balance between these effects.

This ambiguity in the predicted impact of increased international competition on the wage level is also reflected in a more recent literature which has examined the impact of increased economic integration on labour markets. Danthine and Hunt (1994) point out that, whilst Marshallian pressures would be expected to decrease wages as competition in the product market increases, increased integration will also effectively reduce the degree of centralisation of bargaining. As in the seminal paper by Calmfors and Driffill (1988), this can lead to either increases or decreases in union wage demands depending on the initial bargaining structure of the country concerned. Naylor (1995) focuses on intra-industry trade. He adopts a partial equilibrium framework in which two firms, one in each of two countries, produce identical products and engage in Cournot competition. Each firm also bargains with a domestic monopoly union. He finds that increased economic integration leads to the union demanding higher rather than lower wages as, in an oligopoly context, reductions in trade costs effectively lower the elasticity of demand facing the firm. Similar results are found by Huizinga (1993) and Sorensen (1993).

Econometric studies which have directly examined the impact of trade on bargained wage outcomes are rare, with the majority based on U.S. data². As noted at the outset Konings and Vandebussche (1995) provides a unique study for the UK. They find that increased competition affects wages, with the sign of the effect depending upon whether or not one estimates the model for all industries or only the manufacturing sector.

3. Modelling Wage Effects

In this section we measure the impact of changing international competition on wage outcomes by incorporating import and export intensity variables into empirical wage functions of the type suggested by equation (1). When this is implemented empirically however it is important to adopt a dynamic specification in order to allow for the possibility of sticky wage adjustment through time.

$$\ln W_{it} = \lambda_i + \beta_0 X_{it} + \beta_1 \ln W_{i,t-1} + u_{it} \quad (6)$$

where, for industry i at time t :

W = wage rate

X = explanatory variables

λ_i = industry specific fixed effect

X denotes a vector of variables which may be internal or external to individual firms within a given industry, and which are treated as being engaged in a common wage-setting process. For our purposes, the key influences which moderate the ability of firms to pay, and the union to obtain, large wage increases are: foreign competition as expressed through trade; the level of union density; labour productivity; human capital effects and other variables whose aim is to reflect the structure of the labour market. The outside opportunities available to union members, which depend on the unemployment rate and the alternative wage available, are assumed identical across industries, and are captured by the time specific fixed effects. In practice a number of authors have also found it important to include the growth of employment in the wage equation³ to capture insider hysteresis and dynamic monopsony effects (Nickell and Wadhvani 1989, 1990).

² Abowd (1987) for example examines the impact of import competition on wage and employment outcomes in the U.S., with Abowd and Lemieux (1990) and Caves (1990) providing a comparison with Canada.

³ See for example Wulfsberg (1997)

The data set we use has been specially assembled, to investigate the effects of international trade alongside other influences. We draw on a diversity of sources and construct an integrated database of industrial, labour market and trade statistics. Thus we have a panel of 167 manufacturing industries (corresponding approximately to a four digit SIC level of aggregation) from 1979 to 1991⁴. The data set is therefore highly disaggregated at the industry level. Our trade data are disaggregated by country and country grouping, thereby creating the potential for evaluating the impact on wages of trade with different types of partner.

For purposes of estimation, equation (6) is differenced to remove industry specific fixed effects and then instrumental variables techniques are applied to the first differenced equation, which leads to consistent estimates of the parameters of interest (Anderson and Hsiao (1982)). For this purpose the generalised method of moments estimator of Arellano and Bond (1991) is adopted. This relies upon the use of lags of the endogenous variables dated $t-2$ and earlier as instruments, but is efficient since it expands the instrument set as the panel progresses and the number of potential lags increases. Consistency of the estimates requires that the differenced equation is free of second and higher order serial correlation, thus test statistics, which are distributed normally under the null of no serial correlation, are calculated and presented. The validity of the instrument set is also checked using a Sargan test based on the correlation between the instruments and the residuals from the model. This is asymptotically distributed as chi-squared under the null.

4. Results

Results from a variety of specifications of wage equations are presented in Table 1. The basic functional form is presented in the first column. Subsequent columns present augmentations. In other words, column 1 reports the results of modelling wages as a function of lagged wages, productivity, employment growth and industrial concentration. Column 2 brings in labour market characteristics and human capital indicators. Column 3 introduces import and export shares (in levels and lags). Finally, column 4 reports results when import shares from different trading partners are introduced.

Overall the wage equation is well behaved and stable. The lagged wage is positive and highly significant in all specifications, with the coefficient of 0.19 indicating persistence in

⁴ Details of the data sources used are set out in Appendix A.

wage rates. As expected, labour productivity impacts positively on the wage rate in both the short and long run. The coefficient on employment growth is more fragile however, a finding which is common in the empirical literature (Nickell and Wadhvani 1990; Denny and Machin 1991). Although lagged employment growth consistently impacts positively on wage levels, contemporaneous effects are significant at the 95% level in specification two only.⁵ None of the specifications exhibit second order serial correlation and in all cases the null of instrumental validity cannot be rejected.

Column Two shows the impact of introducing labour market characteristics. As expected, increases in unionisation have a positive and statistically significant impact on wage changes, reflecting the mark-up of union over non-union wages. Wage rewards to increased human capital are also important. A higher percentage of workers with A-level or equivalent qualifications has a positive impact on wage changes⁶. Structural conditions are also important, with workers on permanent contracts achieving larger increases in wages than those on temporary ones. Perhaps more surprising is the negative impact of the percentage of male workers on the rate of change of wages, though this may reflect the rapid decline in male dominated staple industries throughout the 1980s which is not fully reflected in output changes.

What about the effects of foreign competition? It appears from column three that an increase in the level of import penetration causes a contemporaneous fall in wages, which is significant at the 95% level. The long run impact of increases in import penetration is also negative and statistically significant. Interestingly, increases in the level of export activity also have a negative impact both in the short and long run, presumably reflecting the reduction in costs and prices necessary to gain increased market share overseas.

It is striking that the export and import variables perform as they do and that the results are both robust and consistently significant. As noted at the outset, we are also interested in whether country of origin is influential. Table 2 breaks imports down into those originating

⁵ There is some controversy in the literature regarding the interpretation of the employment growth term in wage equations of this type. Nickell and Wadhvani (1989) predict a negative result in line with a dynamic monopsony model which runs counter to their firm specific hysteresis explanation (Nickell and Wadhvani 1990). Wulfsberg (1997) explains the negative impact obtained by the fact that 'firms lay off workers in reverse order of seniority when reducing employment, so average wage costs per worker increase', p. 425. Denny and Machin (1991) also find a negative contemporaneous impact. Neither test for lagged impacts.

⁶ Other levels of qualification were tried in the wage equation with similar implications.

from the Newly Industrialising Countries (Hong Kong, Singapore, Taiwan and Korea) and New Exporting Countries (Thailand, Malaysia and Indonesia), Japan, the United States and the European Union. It appears that the impact of imports, both in terms of the magnitude and timing of their impact does depend on origin. Imports from the EU and USA appear to have their largest and most (statistically) significant impact in the same period as the change. The response to imports from Japan and particularly the NICs and NECs is by comparison forestalled. Quantitatively the impact of imports from the EU appears to be more pronounced than other regions.

As stressed at the outset a major concern in recent years has been with the impact that changing trade patterns have on the distribution of income. Since changes in import and export shares have been found to have a negative impact on wage changes, if changes in the pattern of trade were a major contributor to a changing income distribution, the wage level should be negatively correlated with trade changes, since this would imply larger wage falls at the lower end of the income scale. As a crude test of this, the correlation coefficients between percentage changes in trade shares and the level of log average wages was calculated. However, as can be seen from Table 3, the correlation coefficient with wages is weakly positive both for imports and exports. Thus contrary to the initial hypothesis, the impact of trade changes in total appears to be to compress the distribution of income.

This conclusion is qualified however when Table 4 is examined, which computes correlation coefficients for country groupings. Although the coefficients remain positive for imports from the United States and the European Union, they are negative for Japan and the Asian Tigers/Dragons. Thus trade with East Asia appears to increase the gap in wages between the skilled and the unskilled. The fact that differing effects are found for different country groupings is perhaps not surprising given the different nature of trade flows with the UK. Whilst the UK engages largely in intra-industry trade with the European Union and the United States, trade with the East Asian Economies tends to be predominantly inter-industry. Thus imports from the different country groupings serve to restrain the wages of different groups of workers, with Asian trade tending to affect those in lower skilled categories.

5. Conclusions

This paper has examined the impact of trade changes on industry level wage outcomes in a bargaining framework. The results suggest that on average increases in trade, whether

emanating from imports or exports, serve to decrease wage changes. This evidence is consistent with the view that foreign trade acts to moderate demand for an industry's output and hence to discipline wage setting and is consistent with what Konings and Vandebussche (1995) reported for UK manufacturing.

Since trade changes seem to impact negatively on wage changes, if those at the bottom end of the income scale are disproportionately affected by trade liberalisation then this will cause income distribution to become more unequal. We find no evidence for such an effect for trade in total. Trade changes have tended to affect the relatively high skilled workers as intra-industry trade within the European Union has expanded. However some inequality may have been generated, from trade with the Asian Economies which has disproportionately affected the wages of those at the lower end of the income distribution.

Table 1: Wage Equations for UK manufacturing Industry

	1		2		3	
Constant	-0.008	(-2.797)	-0.009	(-2.924)	-0.009	(-3.028)
$\Delta \ln \text{ Wage Rate}_{-1}^*$	0.191	(4.228)	0.187	(4.544)	0.178	(4.691)
$\Delta \ln \text{ Wage Rate}_{-2}^*$	-0.129	(-4.324)	-0.097	(-3.239)	-0.096	(-2.802)
$\Delta \ln \text{ Labour Prod}^*$	0.179	(9.976)	0.160	(8.743)	0.172	(9.729)
$\Delta \ln \text{ Labour Prod}_{-1}^*$	-0.014	(-0.556)	-0.025	(-1.017)	-0.028	(-1.156)
$\Delta \ln \text{ Labour Prod}_{-2}^*$	-0.054	(-3.441)	-0.055	(-3.501)	-0.059	(-3.965)
$\Delta \ln \text{ Concentration}$	-0.006	(-1.130)	-0.004	(-0.857)	-0.007	(-1.359)
$\Delta \ln \text{ Employment Growth}^*$	-0.065	(-1.603)	-0.084	(-2.079)	-0.065	(-1.602)
$\Delta \ln \text{ Employment Growth}_{-1}^*$	0.120	(3.713)	-0.094	(2.904)	0.102	(2.773)
$\Delta \ln \text{ Industry Size}^*$	-0.896	(-22.015)	-0.880	(-21.714)	-0.883	(-21.423)
$\Delta \ln \text{ Import share}$					-0.002	(-2.637)
$\Delta \ln \text{ Import share}_{-1}$					0.001	(1.230)
$\Delta \ln \text{ Import share}_{-2}$					-0.001	(-0.840)
$\Delta \ln \text{ Export share}$					-0.001	(-7.918)
$\Delta \ln \text{ Export share}_{-1}$					-0.002	(-1.159)
$\Delta \ln \text{ Export share}_{-2}$					-0.002	(-0.965)
$\Delta \ln \text{ Union}$			0.005	(2.278)	0.005	(2.122)
$\Delta \ln \text{ A-Level}$			0.003	(2.736)	0.003	(2.426)
$\Delta \ln \text{ Male}$			-0.012	(-4.079)	-0.012	(-4.454)
$\Delta \ln \text{ Full time}$			0.0002	(0.024)	0.002	(0.204)
$\Delta \ln \text{ Perm. Workers}$			0.077	(4.926)	0.075	(4.728)
2 nd order serial corr. (N(0,1))		0.669		0.289		0.081
Sargan Test (P-value)		0.691		0.709		0.743

Notes

1. The dependent variable is $\Delta \ln \text{ Wage Rate}$.
2. Heteroskedastic consistent t-ratios in parentheses.
3. All models are estimated in differences by instrumental variable. Starred variables are treated as possible endogenous and instrumented using variable lags dated t-2 and earlier.
4. Coefficients on time dummies are not reported.

Table 2. Wage Equations for UK manufacturing Industry and Origin of Imports

	4	
Constant	-0.010	(-3.230)
$\Delta \ln \text{ Wage Rate}_{-1}^*$	0.143	(3.696)
$\Delta \ln \text{ Wage Rate}_{-2}^*$	-0.073	(-2.119)
$\Delta \ln \text{ Labour Prod}^*$	0.165	(9.368)
$\Delta \ln \text{ Labour Prod}_{-1}^*$	-0.021	(-0.935)
$\Delta \ln \text{ Labour Prod}_{-2}^*$	-0.054	(-3.713)
$\Delta \ln \text{ Concentration}$	-0.006	(-1.167)
$\Delta \ln \text{ Employment Growth}^*$	-0.060	(-1.506)
$\Delta \ln \text{ Employment Growth}_{-1}^*$	0.075	(2.067)
$\Delta \ln \text{ Industry Size}^*$	-0.900	(-21.968)
$\Delta \ln \text{ Export Share}$	-0.001	(-7.617)
$\Delta \ln \text{ Export Share}_{-1}$	-0.002	(-1.164)
$\Delta \ln \text{ Export Share}_{-2}$	-0.002	(-0.731)
$\Delta \ln \text{ Union}$	0.005	(2.469)
$\Delta \ln \text{ A-level}$	0.003	(2.166)
$\Delta \ln \text{ Male}$	-0.014	(-5.016)
$\Delta \ln \text{ Full Time}$	0.004	(0.570)
$\Delta \ln \text{ Permanent Workers}$	0.074	(4.802)
$\Delta \ln \text{ Import EU}$	-0.002	(-2.426)
$\Delta \ln \text{ Import EU}_{-1}$	0.001	(1.582)
$\Delta \ln \text{ Import EU}_{-2}$	-0.0007	(-0.677)
$\Delta \ln \text{ Import Tiger/Dragon}$	0.000065	(0.238)
$\Delta \ln \text{ Import Tiger/Dragon}_{-1}$	-0.001	(-6.129)
$\Delta \ln \text{ Import Tiger/Dragon}_{-2}$	0.0004	(1.597)
$\Delta \ln \text{ Import Japan}$	-1.7E-05	(-1.603)
$\Delta \ln \text{ Import Japan}_{-1}$	-4E-06	(-0.365)
$\Delta \ln \text{ Import Japan}_{-2}$	0.000012	(2.179)
$\Delta \ln \text{ Import USA}$	-0.00013	(-2.249)
$\Delta \ln \text{ Import USA}_{-1}$	0.000035	(0.835)
$\Delta \ln \text{ Import USA}_{-2}$	-9E-06	(-0.166)
2^{nd} order serial corr. (N(0,1))		-0.346
Sargan Test (P-value)		0.739

Notes

1. The dependent variable is $\Delta \ln \text{ Wage Rate}$.
2. Heteroskedastic consistent t-ratios in parentheses.
3. All models are estimated in differences by instrumental variable. Starred variables are treated as possible endogenous and instrumented using variable lags dated t-2 and earlier.
4. Coefficients on time dummies are not reported.

Table 3. Correlation Coefficients between the level of wages and trade shares

Correlation Coefficients	Percentage change in Import share	percentage change in export share	log of average real wages
percentage change in import share	1.0000	.5170	.0494
percentage change in export share	.5170	1.0000	.0812
log of average real wages	.0494	.0812	1.0000

Table 4. Correlation Coefficients between the level of wages and trade shares for different country groups

	Log of average real wages	Tigers/ Dragons	USA	Japan	EU
log of average real wages	1.0000	-.0104	.0207	-.0273	.0334
Tigers/Dragons	-.0104	1.0000	.1732	.2454	.2530
USA	.0207	.1732	1.0000	.2673	.4488
Japan	-.0273	.2454	.2673	1.0000	.3570
EU	.0334	.2530	.4488	.3570	1.0000

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