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THE IMPACT OF TRADE ON UK WAGES IN GENERAL EQUILIBRIUM, 1975-1999
A GDP FUNCTION APPROACH

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Preliminary and incomplete!!!!!

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1. Introduction

This paper addresses the longstanding discussion on the impact of globalisation on domestic labour markets in two alternative ways: 1) it will address the extensive literature on increased wage inequality between skilled and unskilled workers, and 2) it will try to verify whether globalisation has indeed increased the national elasticity for the relative demand for labour.

First during the last two decades many developed countries, in particular the US and the UK, have witnessed a sharp increase in domestic wage inequality, while the preceding decades were characterised by a relative stable wage structure. As relative wages *and* employment both increased in the same direction the key explanations proposed in the literature are demand-based.[1] The three main demand-side explanations proposed in the literature focus on skill-biased technological change, globalisation and deindustrialisation. Although this paper will concentrate on the trade-based explanation of wage inequality it will also review the two alternative demand-side explanations.

Second, in addition to increasing wage inequality globalisation might also increase the national elasticity of demand for labour (Rodrik, 1997). Rodrik argues that these are important as they shift the incidence of non-wage costs, the burden of exogenous shocks, and it changes the relative bargaining power between labour and capital. Rauch and Trindade (2000) present a formal model in which it is shown how globalisation can increase this elasticity. Empirically several studies have appeared recently (Slaughter, 2000; Jean, 2001), but these typically focus on sectoral and firm-level elasticities. One difference between sectoral elasticities and the economy-wide elasticity is that labour demand curve on the sectoral will typically be downward-sloping while trade theory asserts that for a small open economy the labour demand curve will be horizontal (perfectly elastic). The reason for this that industry level labour demand curves do not explicitly take account of general equilibrium dynamics.

[1] In the end however it is the outcome of relative demand and supply and therefore one would have to take into account to gain the complete picture (ref???).

See Jones (1965) for the exact relationship for the exact relationship between the aggregate and sectoral elasticities. This paper envisages to give a first estimate of the change in the national elasticity of the demand for labour in the last 25 years.

In order to analyse these two issues a relatively new methodology is employed introduced by Harrigan and Balaban (1999) and Harrigan (2000). So far two standard approaches have been used in order to explain the increase in wage inequality in developed countries. First, factor demand regressions largely used by labour economists have been employed to evaluate the increase in wage inequality *within* industries. Such studies fail to take into account general equilibrium effects due to changes in the economy-wide changes in relative demand for labour. In addition the impact of trade has generally been assessed by using volumes rather than prices. Second, mandated wage regressions have been used to assess the importance of relative price and productivity changes on relative wages by applying the Stolper-Samuelson theorem to the data. Although this method may be well-suited to analyse the impact of exogenous price changes it is unclear how endogenous price changes can be properly accounted for. In particular this is the case when relative prices changes result from changes in relative factor supplies or more generally factor-biased structural change.

Harrigan and Balaban (1999) and Harrigan (2000) propose a third methodology based on general equilibrium trade theory which is flexible enough to account for heterogeneous responses of factor prices to goods prices as a result of differences in factor intensity. Moreover, by using the revenue function rather than the cost function first differentiating yields factor prices as a function of factor supplies, goods prices and productivity.

Their results indicate that factor supplies and prices have been the main cause of the increase in wage inequality in the US (‘*overwhelming evidence against factor price insensitivity theorem’*). In particular, he finds that the increase in the relative wage of skilled labour, in the 1980s and beyond, is highly correlated with the rise in the price of nontraded goods that use skilled labour, and similarly for unskilled labour where both the relative wage and price fell. He concludes therefore that wage changes have little to do with trade. However, the change in the relative price of non-tradables is

left unexplained. Moreover it is unclear whether the causality runs from relative prices in non-tradables to relative wages or the other way around (Feenstra, 2001). This is obviously an important question for further research.

The contribution of this paper is threefold. First it offers a complete description of the UK economy using data for primary sectors, manufacturing and services for the period 1975-1999. Typically econometric studies analysing explanations behind the increase in domestic wage inequality have solely concentrated on manufacturing. Harrigan and Balaban (1999) and Harrigan (2000) so far present the only econometric studies taking into account services and are based trade theory. Recently several AGE models have appeared that also take into account services (Tokarick, 2002, Greenaway, Reed and Winchester, 2002). The omission of services in studies that are meant to account for general equilibrium dynamics seems a serious issue.[2] Second, rather than *describing* structural change in the economy as do Gregory et al. (2001) using similar data, this paper also aims to *explain* the structural change using an econometric framework based on general equilibrium trade theory. More in particular it will employ a flexible framework that can account for both the sector and factor bias of technological change and outsourcing. In addition it is also possible to evaluate the role of factor supplies. Third, it will analyse whether indeed the national elasticity of demand has become more elastic over time.

Outline

2. Theory

[To be inserted]

3. Methodology

In theory in a small open economy the factor price equalisation theorem implies that changes in relative factor supplies do not affect relative factor prices. Leamer (1995) relabelled this issue appropriately the 'factor price insensitivity theorem'. However

[2] The key issue is wage equalisation across industries. The size of the nontradable sector should certainly affect the quantitative results but might even reverse qualitative results.

recently the trade literature seems to converge to a consensus that international FPE is an unrealistic assumption. Consequently the factor price insensitivity theorem may no longer hold. Factor supplies do matter when the number of factors exceeds the number of goods or when changes in factor supplies are so large that the product mix changes. Relative product prices also become endogenous when the domestic economy is relatively large or when there is large nontradable sector. Obviously, considering that in modern economies services account for about 80% of GDP, it is hard to maintain that product prices are exogenous. The framework employed in this paper was originally designed to allow for the impact of factor supplies. In the present paper it is argued that one needs a more flexible framework than generally used in the literature not only to capture the impact of a change in relative factor supplies on factor prices, but more generally, to capture the impact of all factor biased structural change on relative factor prices whatever its source (SBTC, outsourcing of factor supplies).

The remainder of this section will shortly set out the empirical framework. Throughout this paper it assumed that markets are perfectly competitive and that firms produce under constant returns to scale. For more on the underlying theory the reader is referred to Dixit and Norman (1980) and Harrigan and Balaban (1999).

As in Kolhi (1991), Harrigan (1997), and Balaban and Harigan (1999) it is assumed that the economy's revenue function can be approximated by a translog function.

$$\ln G = \alpha_0 + \sum_{i=1}^{N} \alpha_i \ln p_i + \sum_{k=1}^{M} \beta_k \ln v_k + \frac{1}{2} \sum_{j=1}^{M} \sum_{i=1}^{N} \gamma_{ij} \ln p_i \ln p_j$$
$$+ \frac{1}{2} \sum_{k=1}^{K} \sum_{l=1}^{K} \delta_{ij} \ln v_k \ln v_l + \frac{1}{2} \sum_{i=1}^{N} \sum_{k=1}^{K} \phi_{ik} \ln p_i \ln v_k \quad (3.1)$$

where p refers to the sum of value-added prices and total factor productivity (effective prices) and v to factor supplies. Impose constraints that the GDP function is linearly homogenous in prices and factor supplies:

$$\sum_{i=1}^{N} \alpha_i = \sum_{k=1}^{M} \beta_k = 1 \text{ and } \sum_{j=1}^{N} \gamma_{ij} = \sum_{i=1}^{N} \gamma_{ij} = \sum_{i=1}^{K} \delta_{ij} = \sum_{j=1}^{K} \delta_{ij} = \sum_{i}^{N} \phi_{ik} = \sum_{j=1}^{K} \phi_{ik} = 0 \quad (3.2)$$

And without loss of generality impose symmetry restrictions that

(3.3) $\gamma_{ij} = \gamma_{ji}$ and $\delta_{kl} = \delta_{lk}$

Differentiation of the revenue function (3.1) with respect to lnv_k gives the share of factor *k* in GDP:

(3.4) $s_k = \beta_k + \sum_{l=1}^{K} \delta_{kl} \ln v_l + \sum_{m=1}^{N} \phi_{jk} \ln p_j , \qquad k = 1,..., K$

where $s_k = \frac{w_k v_k}{Y}$. Differentiation of the revenue function (3.1) with respect to lnp_i yields the share of final output *i* in GDP:

(3.5) $s_{i,-j} = \alpha_i + \sum_{i=1}^{N} \gamma_{ij} \ln p_i + \sum_{k=1}^{K} \phi_{ik} \ln v_k , \qquad i = 1,..., N$

where $s_{i,-j} = \frac{p_i x_i}{Y}$ is the combined vector of final output share in GDP and the negative vector of positive import shares in GDP. When estimating the equation as a system (simultaneously) one should test for the cross-equation restriction that:

(3.6) $\phi_{ik} = \phi_{ik}$

If accepted it can be imposed as restriction which allows more precise estimates of ϕ_{ik}. The system approach gives T(N+K-2). See also literature on singular systems. Feenstra and Hanson (2001) argue that "even though the number of parameters is large, we can obtain reasonable estimates even if we only have annual data for one or two decades".

The interpretation of the results is greatly facilitated when the elasticities of factor prices with respect to goods prices, TFP and factor supplies are calculated.

The Stolper-Samuelson elasticities of nominal factor prices to nominal goods prices (or TFP) is given by:

$$(3.7) \qquad \frac{\partial \ln w_k}{\partial \ln p_i} = \frac{\phi_{ki}}{s_k} + s_i$$

4. Wage inequality in UK, 1975-2001

This section will first give an extensive description of the data before entering in a detailed analysis of wage inequality.

4.1 The New Earnings Panel Data Set

Labour market data are obtained from the New Earnings Survey (NES). The NES is based on a series of surveys that cover approximately one percent of the working population. The present study is limited to full-time male workers. Table 4.1 shows a steady increase in real hourly wages over the period 1975-2001. In order to get a first impression of the increase in wage inequality it is useful to analyse how the variance of low hourly real wages developed over time. From Table 4.1 it follows that the variance was more or less constant during the period 1975-1980 but then increased rapidly reflecting the increasing dispersion of hourly wages across individuals. Comparing the difference between percentiles over time also reveals an increase in wage inequality. Although this holds essentially between all wage groups there is some convergence between the lower ends, while the increase in wages is particularly apparent among the top end of the distribution.

Table 4.1: Summary Statistics Real Hourly Wages (NESPD)

Year	1975	1980	1985	1990	1995	2001
Obs	81213	79422	70101	73946	69981	67468
Mean	4.05	4.34	4.91	5.63	6.23	6.93
Std. Dev.	2.00	1.99	2.60	3.51	4.52	5.78

Variance	4.00	3.96	6.76	12.30	20.44	33.40
Skewness	7.86	2.78	3.39	4.20	6.53	14.59
Kurtosis	306.42	18.83	29.43	43.64	108.03	727.50
Percentiles						
1%	1.40	1.85	1.94	1.98	1.88	2.22
5%	2.07	2.33	2.40	2.52	2.52	2.77
10%	2.41	2.60	2.71	2.86	2.91	3.14
25%	2.95	3.12	3.32	3.57	3.73	4.00
50%	3.64	3.85	4.26	4.72	5.11	5.51
75%	4.60	4.95	5.68	6.57	7.34	8.08
90%	6.06	6.61	7.82	9.26	10.50	11.81
95%	7.46	8.03	9.57	11.56	13.21	15.35
99%	11.10	11.81	14.44	18.83	22.31	26.96

Notes: Nominal hourly wages are based include full-time male workers only. It is constructed as the ratio of gross weekly earnings by total hours worked per individual where earnings were not affected by absence. Nominal hourly wages are deflated by the Retail Price Index (RPI).

Besides providing data on wages, employment and numerous other factors, it also classifies each employee to the Standard Occupational Classification (SOC), which allows one to construct a more accurate measure of skill than the one based on manual/non-manual workers generally used in the literature (Feenstra and Hanson, 1996; Machin and Van Reenen, 1998). In the NES workers are classified according to 9 Major Groups and 22 Sub-Major Groups.[3] The SOC Major Groups are based on qualifications, training, skills, and experience, while the Sub-Major Groups are determined by the nature of the job. Therefore, distinguishing skill groups on the basis of their Major Group Codes allows one to construct a very accurate measure of skill. For the determination of skill groups the approach taken by Gregory, Zissimos and Greenhalgh (2001) is adopted. Apart from providing a more accurate measure of skill, this approach allows one to distinguish three skill groups: skilled, intermediate, and unskilled.[4] As a result it is possible to see to what extent wage inequality is a phenomenon of the tails or instead affects the whole labour force.

[3] For a description of those skill groups see the appendix to this section.
[4] Unskilled workers are those classified in Major Groups 1 to 3, semi-skilled workers in Major Groups 4 to 7, and skilled workers in Major Groups in 8 and 9.

Table 4.2: Wage and Employment Statistics by Skill Group (NESPD)

Year	Obs	Mean	Std. Dev.	Employment shares
Skilled				
1975	18517	5.63	2.60	0.23
1980	21766	5.88	2.48	0.27
1985	21291	6.85	3.43	0.30
1990	24200	8.17	4.68	0.33
1995	26520	9.00	6.02	0.38
2001	27134	10.13	7.81	0.40
Semi-skilled				
1975	37249	3.60	1.19	0.46
1980	34357	3.85	1.30	0.43
1985	30098	4.24	1.60	0.43
1990	30460	4.64	1.86	0.41
1995	26367	4.81	1.95	0.38
2001	25038	5.03	1.98	0.37
Unskilled				
1975	25447	3.56	1.85	0.31
1980	23299	3.61	1.46	0.29
1985	18712	3.77	1.23	0.27
1990	19286	4.01	1.38	0.26
1995	17094	4.11	1.44	0.24
2001	15296	4.38	1.50	0.23

Table 4.2 represents summary statistics on wages and employment by skill group. In terms of employment it follows that the employment share of skilled workers has risen dramatically at the expense of both semi-skilled and unskilled workers.

Real hourly wages have almost doubled for skilled workers, increased by approximately 40% times for semi-skilled workers, and 20% for unskilled workers. The relative wage of semi-skilled workers to unskilled workers has been fairly constant.

The dispersion within groups has risen importantly for skilled, has also risen for semi-skilled but fallen for the unskilled group.

4.2 Within Group and Between Group Wage Inequality

The previous section suggests that the increase in wage dispersion reflects at least to some extent an increase in wage inequality between different types of workers. I order to assess how much of the wage dispersion reflects increased wage inequality between

different skill groups it is possible to decompose the variance into the variance within groups and the variance between groups (for an example see Prasad, 2002). For year *t* the total variance of log hourly wages σ_t^2 can be decomposed into within- and between-skill group components as follows:

$$(4.1) \quad \sigma_t^2 = \sum_j s_{jt}\sigma_{jt}^2 + \sum_j s_{jt}(w_{jt} - \overline{w}_t)^2$$

where σ_{jt}^2 refers to the variance within skill group j, and $(w_{jt} - w_t)^2$ to the variance between groups as measured by the deviation of the average hourly wage of a worker of type *j* from the economy-wide average wage. Both variances are weighted by s_j which reflects the ratio of employment of type *j* in total employment. In order to analyse the change in wage inequality within and between skill groups over time one fully differentiates (4.1).

$$(4.2) \quad \Delta\sigma_t^2 = \sum_j \Delta\sigma_{jt}^2 s_{jt} + \sum_j \sigma_{jt}^2 \Delta s_{jt} + \sum_j \Delta(w_{jt} - w_t)^2 s_{jt} + \sum_j (w_{jt} - w_t)^2 \Delta s_{jt}$$

Equation (4.2) expresses the change in the wage dispersion as a combination of structural change, within group wage dispersion and wage dispersion between groups.

Table 4.3. shows the average annual changes for each period. The total variance was virtually constant during the period 1975-1980. From 1980 onwards the total wage dispersion increased at an almost constant rate.

The upper panel shows the decomposition of the variance within and between skill groups. For the table the same three skill groups are used as in table 4.2. It follows that the change in the within variance dominates the change in the between group variance. However considering that only three skill groups are used capturing 15%-30% of the total increase in wage dispersion may not be that bad at all. Composition effects did overall not play a major role, although it increased substantially for the within group variance during the 1990s.

The lower panel represents the decomposition of the total variance into the variance within 5-digit industries and the variance between variance industries. Conditioning the variance on industries might give an indication of the change in the industrial structure. It follows from the table that changes in the industrial composition do not importantly explain the increase in wage dispersion.

Table 4.3: Variance Decomposition Real Hourly Wages Between and Within Groups

	Within Group		**Between Group**		**Total Change in Variance**
	Change in variance	Composition Effect	Change in variance	Composition Effect	
Skill groups					
1975-1980	-0.084	0.038	0.016	0.019	**-0.008**
1980-1985	0.330	0.044	0.138	0.014	**0.561**
1985-1990	0.684	0.062	0.275	0.018	**1.108**
1990-1995	0.967	0.269	0.262	0.051	**1.628**
1995-2001	1.508	0.202	0.343	0.017	**2.160**
1975-2001	**0.630**	**0.209**	**0.211**	**0.025**	**1.131**
Industries					
1975-1980	-0.044	0.029	0.009	0.004	**-0.008**
1980-1985	0.333	-0.199	0.083	-0.017	**0.561**
1985-1990	0.727	0.146	0.143	0.039	**1.108**
1990-1995	1.249	0.169	0.150	0.018	**1.626**
1995-2001	2.076	-0.118	0.092	0.010	**2.157**
1975-2001	**0.510**	**-0.050**	**0.070**	**-0.011**	**1.131**

Average annual changes in real wages.

4.3 Between versus Within Industry Inequality between Groups

It has become common practice to decompose the change in wage inequality between different skill groups in changes between and within wage inequality.[5] Berman, Bound and Griliches (1994) show that the increase in the relative demand for skilled labour occurred *within* rather than *across* industries.[6] Consequently they conclude that trade cannot be the predominant source of wage inequality. However this only true as far as the sector bias is concerned. Hijzen (2003) argues that when trade takes the

[5] Assuming that employment is proportional to each output in each industry we have:
[6] Because trade affects on the margins it does not seem to make sense to decompose imports, exports and home production. The only question is whether a product is traded or not. This is different from BBG.

form of trade in intermediates, it may affect relative factor prices through both its factor and sector bias. Therefore, the between versus within composition should be considered suggestive evidence in the relative importance of factor bias relative to sector bias. It should not be taken as evidence that trade does not contribute importantly to the rise in wage inequality. Bearing this in mind Table 4.4 represents the results obtained with the standard decomposition in (4.3):

4.3) $$\Delta P_s = \sum_i \Delta S_i \overline{P}_{si} + \sum_i \Delta P_{si} \overline{S}_i$$

where $P_{si} = E_{si} / E_i$ is the proportion of skilled labour in industry *i*, and $S_i = E_i / E_i$ is the share of employment in industry *i*. A bar denotes the average for period *t*. The first term of the right-hand side represents the change in relative employment for the economy as a whole that is due shifts in employment between industries. The second term captures the change in relative employment as result of a change in the employment mix within industries.

Total inequality between skill groups increased throughout the period. The finding that the wage inequality between skill groups already started rising before overall wage dispersion is consistent with table 4.2. Inequality in terms of earnings increased more than in terms of employment. This indicates that shifts in relative employment and relative wages moved in the same direction.[7] Generally wage inequality between skill groups increased both within and between industries. Only in the period 1980-1985 between industries shifts in employment led to a reduction in wage inequality. As a matter of fact this was the strongest effect between industry shifts in employment ever had during the period 1975-2001. In line with previous findings by Berman, Bound and Griliches (1994) and Machin and Van Reenen (1998) the increase in wage inequality was generally due to within industry shifts in employment rather than between industry shifts. However in recent years this pattern might have changed. The overall increase in relative employment due to shifts between industries were for the first time larger than shifts within industries. In terms of relative earnings shifts within

[7] BBG p. 371: "As long as the elasticity of substitution between production and nonproduction workers is above one, changes in the production share in the wage bill

industries remained more important than between industry shifts, but the difference has become much smaller. Thus factor bias effects seem to dominate sector bias effects, although in recent years the balance might have reversed.

Usually such exercises are confined to manufacturing. It is interesting therefore to further the decompose the two components of (4.3). The first question that is addressed is whether upgrading within industries has taken place at a different pace in manufacturing and services industries.

4.4) $$\sum_i \Delta P_{si} \overline{S}_i = \sum_i \overline{S}_i \, \Delta P_{si}^{\,T} + \sum_i \overline{S}_i \, \Delta P_{si}^{\,NT}$$

Again results are qualitatively similar when measured in terms of employment and earnings. For most of the period skill upgrading within industries is faster in services than the remainder of the economy. However, once again the data suggest a change in the trend for recent years. In the period 1995-2001 skill upgrading within industries was concentrated in tradables industries.

In a similar way the between effect is decomposed into changes as result of employment shifts in the tradables sector and the nontradables sector.

4.5) $$\sum_i \Delta S_i \overline{P}_{ni} = \sum_i \Delta S_{ij}^{\,T} \overline{P}_{nij}^{\,T} + \sum_i \Delta S_{ij}^{\,NT} \overline{P}_{nij}^{\,NT}$$

This decomposition is interesting as it might yield some insight in the relative importance of two rival explanations that are both based on between effects: international trade and deindustrialisation. A positive sign for nontradables might reflect both an increase in the relative importance of skill-intensive industries within sector nontradables, but may also reflect deindustrialisation assuming that nontradables are overall more skill-intensive than tradables. [check]. For tradables the trade-based explanation implies if anything a shift towards more skill-intensive industries (assuming that the UK is relatively skill-intensive). The fact that the sign is

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provide a better measure of the demand shift toward nonproduction labor during the 1980s understating by less than changes in the employment share". [Why?]

negative for all periods might suggest that deindustrialisation outweighs restructuring between industries within the tradables sector. The between effect is generally positive in the nontradables sector. This might indicate the growing importance of services in the economy or the increasing importance of skill-intensive producer services relative to unskilled-intensive consumer services.

Table 4.4: Labour Market Inequality Decompositions: Between versus within industry decomposition

		Employment			Earnings	
		Between	Within		Between	Within
1975-1980						
Tradables		-0.39	3.24		-0.13	4.05
Nontradables		2.21	3.63		2.88	4.06
Total	8.68	1.82	6.87	10.87	2.75	8.12
1980-1985						
Tradables		-3.76	1.49		-4.72	2.65
Nontradables		-9.80	4.09		-12.59	6.21
Total	6.19	-13.56	5.58	10.78	-17.31	8.86
1985-1990						
Tradables		-0.12	0.67		-0.78	1.79
Nontradables		1.47	2.36		4.77	4.16
Total	4.38	1.35	3.03	9.94	3.99	5.95
1990-1995						
Tradables		-2.40	2.51		-3.22	4.06
Nontradables		5.10	5.16		7.55	6.56
Total	10.37	2.70	7.67	14.95	4.33	10.62
1995-2001						
Tradables		-1.73	1.90		-2.79	2.84
Nontradables		4.19	0.06		5.98	1.55
Total	4.37	2.47	1.96	7.50	3.20	4.39

Employment is measured by total weekly hours worked. Earnings equal the product of hourly wages and weekly working hours. All values are multiplied times thousand for readability.

In conclusion factor biased induced wage inequality generally outweighs sector biased induced wage inequality. Increased wage inequality within industries due to factor bias effects has generally been more important in nontradables than in tradables. Increases in wage inequality between industries due to sector bias effects largely result from either deindustrialisation or structural change within services towards more skill-intensive activities.

What does this mean for the possible impact of trade on relative wages? If trade had contributed to increased wage inequality than the impact seems to be small and offset

by deindustrialisation. Globalisation could still be important if outsourcing were a major determinant of the increase in wage inequality within industries. Trade might still be important to the extent that it induced deindustrialisation. The relative importance of factor-biased structural change as indicated by the dominance of changes in wage inequality within industries suggests that economy wide relative demand for labour is far from horizontal!!! However it is clear from the above analysis that it is impossible to evaluate explanations for the increase in wage inequality without taking into account the nontradables sector.

5. Data analysis by skill-intensity

For the analysis we will be using data for the period 1975-1999. Data are constrained by labour market data downwards and by NIESR dataset upwards.

5.1 Data sources

Producer price indices (ONS)

Disaggregated producer price indices for the UK are only available for the 1990s for the UK and only for manufacturing industries. However, Indices of Production are available at the sectoral level for both services and manufacturing. Such indices should reflect the growth in output by sector in real terms. This index has been compiled on a more or less consistent basis since the 1940s. The construction of these indices is based on turnover data deflated using weighted combinations of producer price indices and export price indices. Without having data on price indices one could retrieve the 'producer price indices' by combining data on value added at current prices with the index of production, that is, to convert nominal value-added into an index (1995=100) and subsequently divide the index of value added (current prices) by the index of production (constant prices). Obviously constructing producer price indices for services is subject to many problems. In particular the output indices might not be limited to the real growth of output of services as it is maybe even impossible to disentangle cost-price effects from volume effects. Both output indices and nominal value added are obtained from the ONS.

Capital Stock and TFP (NIESR)

These data are taken from the Sectoral Productivity Database compiled by Mary O'Mahony and publicly available from the NIESR. For more information on the sources and the construction of these variables the reader is referred to O'Mahony (1999).

5.2 Analysis of key variables by skill-intensity

Table 5.1 reports summary statistics for the average annual percentage change in TFP and prices for the economy as a whole, by skill-intensity and traded and nontraded sectors. Factor-intensity determines the Stolper-Samuelson responses of factor prices to goods price changes. It is interesting to distinguish between traded and non-traded sectors as it might gives some suggestive evidence of the potential affect of trade on wages.

Table 5.1: Average annual changes in log TFP and log prices

ΔlnTFP							
	Total			Tradable		Nontradable	
		Unskilled	Skilled	Unskilled	Skilled	Unskilled	Skilled
1975-1980	0.15%	0.96%	-0.51%	1.05%	-1.42%	-3.52%	-1.54%
1980-1990	2.66%	2.25%	3.00%	1.97%	3.47%	-0.46%	1.51%
1990-1999	1.48%	1.32%	1.64%	0.96%	2.16%	-2.54%	1.26%
$\Delta \ln p^{VA}$							
1975-1980	12.82%	9.46%	17.64%	15.28%	15.86%	6.69%	26.02%
1980-1990	5.15%	5.16%	5.12%	3.60%	5.80%	6.50%	3.59%
1990-1999	2.84%	2.88%	2.77%	2.93%	2.23%	2.47%	3.17%
$\Delta \ln p^{VA}$+ΔlnTFP							
1975-1980	4.48%	4.00%	5.26%	5.92%	4.18%	2.92%	5.93%
1980-1990	3.77%	3.54%	3.94%	2.70%	4.52%	4.18%	2.43%
1990-1999	2.15%	2.09%	2.19%	1.92%	2.19%	2.09%	2.19%

TFP

Total factor productivity was slow during the second half of the 1970s, grew at an average rate of 2.7% during the 1980s, while in the 1990s TFP growth averaged 1.5%. The next two columns reveal the sector-bias of TFP. The economy is divided in skill and unskilled-intensive industries. The definition of skill-intensity is based on the average share of skilled labour costs in value-added in each specific year.

During the late 1970s TFP growth was biased towards the low-skilled intensive sectors. However during the 1980s and 1990s TFP growth was biased towards the skill intensive industries. Thus sector-biased TFP growth might have contributed importantly to the increase in domestic wage inequality. Further decomposing the trend in TFP between tradable and nontradable sectors does not change the picture qualitatively. In all three periods TFP growth was biased towards skill-intensive nontradable industries. Note that over all three periods TFP growth was substantially slower in nontradables than in tradables. Interestingly, Haskel and Slaughter (2001) find the opposite for both the 1970s and the 1980s. An explanation for this could be the different definition of skill, the cut-off points of the periods, or the labour market data. Sector-biased TFP growth towards skill-intensive tradables during the 1990s is consistent with findings by Hijzen for the UK (2003) using the same definition of skill but different data sources.

Prices

Overall value-added prices have come down substantially over the sample period. Only during the 1970s were price changes significantly sector-biased. During this period price changes were biased towards skill-intensive sectors. This finding is consistent with findings by Leamer (1998) for the US. He labelled the 1970s the Stolper-Samuelson decade. The same holds for tradables and nontradables, although it should be noted that the sector-bias of price changes largely occurred within the non-tradables sector.

During the 1980s and 1990s price effects at first sight did not seem to play an important role. However when distinguishing between tradables and nontradables it follows that price changes were strongly biased towards skill-intensive industries for tradables, while the opposite was true for nontradables. Haskel and Slaughter (2001)

also find strong price effects during the 1980s for manufacturing consistent with increased wage inequality. During the 1990s the picture was reversed with price changes being biased towards unskilled-intensive industries in tradables and the opposite for nontradables. Hijzen (2002) also finds that the price effects should if anything have reduced wage inequality during the 1990s.

6. Results

This section reports the results obtained from estimating equations (3.1) and (3.2) simultaneously using three stage least squares. For the moment it is assumed that all relationships are linear.[8] Of the six equations (4 factors, goods) only four are linearly independent. The system is therefore estimated for only those four equations.

Table 6.1: Results

	Primary factor shares			**Final output shares**
	Skilled	Semi-skilled	Unskilled	High-skilled
Factor supplies				
Skilled labour	0.095	0.367	0.947	9.218
	(0.63)	(1.57)	(1.58)	(1.93) *
Semi-skilled labour	-0.104	-0.560	-1.417	-14.248
	(-0.45)	(-1.57)	(-1.55)	(-1.95) *
Unskilled labour	0.072	0.458	1.067	11.144
	(0.38)	(1.54)	(1.40)	(1.83) *
Capital	0.001	-0.073	1.770	-2.015
	(0.03)	(-1.36)	(1.04)	(-1.84) *
TFP				
High skilled	0.619	1.011	1.769	20.891
	(1.46)	(1.53)	(1.04)	(1.55)
Low skilled	-0.832	-2.138	-4.308	-44.241
	(-1.06)	(-1.75) *	(-1.15)	(1.78) *
Prices				
High skilled	0.267	-0.029	-0.342	-0.085
	(3.61) ***	(-0.25)	(-1.15)	(-0.04)
Low skilled	-0.553	-0.132	0.209	-2.049
	(-2.92) ***	(-0.45)	(0.28)	(-0.34)

[8] Harrigan uses inequality constrained GMM which in the linear model with Gaussian errors (check) is equivalent to constrained 3SLS.

Trend	0.014 (2.16) **	0.008 (0.79)	0.016 (0.61)	0.176 (0.86)
Constant	-25.940 (-2.26) **	-11.360 (-0.64)	-21.890 (-0.48)	-263.838 (-0.72)

Dependent variables are shares of GDP listed as columns. Explanatory variables are in logs. All 4 equations are estimated simultaneously using 3SLS. Z-values in parentheses, *, **, *** indicate significance levels of 10%, 5%, and 1% respectively.

In Table 6.2 the Stolper-Samuelson elasticities based on the estimates in Table 6.1. For high-skilled the results are conform expectations. The results for the intermediate skill group are less clear-cut. For unskilled workers price increases (reductions) of unskilled (skilled) products do indeed raise low skilled wages. The role of TFP on the wage of unskilled workers present a puzzle.

Table 6.2: Stolper-Samuelson elasticities

	High-skilled	**Semi-skilled**	**Unskilled**
Prices			
Low skill	-1.95	-0.10	2.01
High skill	1.68	0.33	-1.92
TFP			
Low skill	-3.21	-9.96	-29.57
High skill	3.27	3.18	12.84

For the calculation of the elasticities the average GNP shares over time are used (Harrigan chooses arbitrary year in the middle of the sample). Standard errors to be calculated.

7. Conclusion

From the analysis of the labour market data it was concluded that factor-biased structural change was the major force explaining wage inequality. The relative importance of factor-biased structural change as indicated by the dominance of changes in wage inequality within industries suggests that economy wide relative demand for labour is far from horizontal!!!

Increases in wage inequality due to employment shifts between industries seem to reflect either deindustrialisation or restructuring in the services sector low-skill intensive activities to high-skill intensive activities. Alternatively it is possible to analyse the sources of between industry shifts in employment by considering the sector bias of prices of TFP. From this analysis it followed that prices might have

contributed to wage inequality during the 1980s but reduced it during the 1990s. Sector-biased TFP appears to the main candidate to explain employment shifts between industries.

So far the analysis suggests a rather limited role for trade (if anything) in explaining the increase in wage inequality in the UK during the last tow decades. Trade might have played an important role indirectly by encouraging (sector-biased) TFP and deindustrialisation. Alternatively when trade takes the form of trade in intermediates it might be able to explain factor-biased structural change.

It might be interesting to see to what extent the recent change in between and within industry effects is related to a change in the slope of the labour demand curve. If this were the case than this might imply that the potential impact of trade on the domestic wage distribution might have considerably gained in importance.

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Appendix

Industry classification

code	industry
1000	Agriculture and Forestry
3000	Mining and extraction
4005	Total machinery and equipment
4010	Food, drink and tobacco
4020	Textiles, clothing and leather
4040	Wood products
4050	Paper and printing
4060	Coal &petroleum
4070	Chemicals
4080	Rubber & Plastics
4090	Non-metallic mineral products
4100	Basic metals & fabricated metal products
4140	Furniture and miscellaneous
5000	Electricity, gas and water
6000	Construction
7200	Retail
7300	Hotels and catering
8000	Financial and business services
9100	Transport
9200	communications
12000	Public administration and defence
15000	Personal services
20000	*Manufacturing*
30000	*Total market sectors*
40000	*Non-market services*
50000	**Total economy**