



Globalisation And Wage Inequalities, 1870 –1970

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SUMMARY

This paper studies the impact of globalisation on wage inequality in eight now-developed countries during the century prior to 1970, using the same dependent variable and methodology as research on the impact of globalisation since 1970. The results suggest that the impact of globalisation was confined largely to the effects of the pre-1914 mass migrations in the United States and Canada. Powerful “domestic” forces, which included expanding home supplies of skilled labour, the growth of new skill-intensive industries, and fluctuations in the level of aggregate demand, had a greater impact on wage inequality for most of the period.

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1 INTRODUCTION

The recent impact of globalisation on inequality is a hotly debated issue (e.g. Wood, 1994, 1995; Richardson, 1995; Robbins, 1996). The effects of globalisation on inequality before the recent period have also been debated (e.g. O'Rourke *et al.*, 1996; O'Rourke and Williamson, 1997; Taylor and Williamson, 1997; Williamson, 1997). The “current” and “historical” debates have focused on both the between-country and within-country dimensions of inequality, but they have examined different aspects of inequality within countries. The current debate has focused on inequality between different groups of workers, particularly between skilled and unskilled wages. The historical debate has focused on other indicators of inequality, notably wage-rental and wage-productivity ratios.¹ The aim of this paper is to introduce wage inequality - the focus of the current debate - into the historical debate.² More specifically, it investigates the impact of globalisation on the wages of skilled relative to unskilled labour (hereafter referred to as the relative wages of skilled labour) during the century (1870-1970) prior to the current period.

1.1 The Arguments

The evidence on wage-rental and wage-productivity ratios suggests that globalisation before the recent period had a large impact on inequality within countries, for two main reasons. First, during the late nineteenth and early twentieth century, international commodity market integration and mass migration led to a process of relative factor-price convergence which saw the returns to labour decrease relative to land and other factors in the land-abundant countries of the “New World”, and increase in the labour-abundant countries of the “Old World” (O'Rourke *et al.*, 1996; Williamson, 1997). Secondly, during the inter-war period, “de-globalisation”, characterised by rising trade barriers and immigration quotas, led to a reversal of these patterns (Williamson, 1997).

Did these globalisation forces also have a large impact on wage inequality, and, if so, did they reinforce or counteract the trends in wage-rental and wage-productivity ratios? To begin with, it is likely that the mass migration of mainly unskilled workers during the late nineteenth and early twentieth centuries had a big impact on wage inequality, strongly *reinforcing* the trends in wage-rental and wage-productivity ratios. The impact of international trade, on the other hand, is less certain. New and Old World countries differed more in their relative endowments of land and labour than in their relative endowments of skilled and unskilled labour, so that trade was less likely to have led to the same process of relative factor-price convergence as with wage-rental ratios.³ Impacts on wage inequality may still have been important, given that trade based on differences in skill endowments may have taken place with countries outside the New and Old Worlds and that trade based on differences in relative endowments of land and labour will affect wage inequality if primary production requires relatively more unskilled labour than manufacturing, but seem as likely to have offset the trends in wage-rental and wage-productivity ratios as to have reinforced them.

This paper explores these potential impacts by estimating changes in the amounts of skilled and unskilled labour embodied in international trade and migration in the century prior to 1970, and examining their relationship with changes in the relative wages of skilled labour. It omits, however, the potential impact of international capital flows, which is left for further research.⁴ It is of course likely that purely “domestic” forces were more important determinants of movements in the relative wages of skilled labour over the century prior to 1970. This has tended to be the conclusion of other historical studies of wage inequality (e.g. Williamson & Lindert, 1980; Williamson, 1985), which have focused on factors such as the growth of skill-intensive sectors and domestic skill accumulation. These domestic forces are also likely to have led to changes in the amounts of skilled and unskilled labour embodied in international trade and migration, although in such cases the latter would not have been exogenous determinants of relative wages.

1.2 The Evidence

This paper focuses on eight now developed countries, comprising three “New World” countries (the United States, Canada, and Australia), and five “Old World” countries (the UK, Germany, France, Sweden, and Denmark). It uses two sets of evidence to trace changes in wage inequality between skilled and unskilled labour, which both use occupation as the indicator of skill.⁵ The first, and most widely available, is the average wage of skilled relative to unskilled manual workers, shown in Figure 1.1. In most cases these series refer to workers in the building sector; however, similar data for the engineering sector suggest that trends in the building sector were broadly similar to those in other sectors of the economy. A full description of the data and their sources is provided in Appendix 1.1.

The first point to note from the graphs is that, in the 1870s, differences in relative wages between countries were not substantial. In the US, a typical skilled manual worker received a wage approximately 50% higher than that of an unskilled labourer, while within Europe, a similar worker received a wage between approximately 60% (in the UK) and 30% (in Sweden) higher than that of an unskilled labourer.

Secondly, Figure 1.1 suggests a number of periods into which broad trends in wage inequality can be divided. For instance, a distinction can be made between the first and second half of the pre-WWI (1870-1914) period. Between the 1870s and the early 1890s, there was a tendency for the relative wages of skilled manual workers to rise in the Old World, while falling slightly in the New World. Between the early 1890s and 1914, on the other hand, relative wages rose significantly in the New World, while falling rapidly in the Old. Although there were certain exceptions to these broad patterns, Figure 1.1 suggests that after the early 1890s there was a strong tendency toward the growing divergence of relative wages between New World and Old.

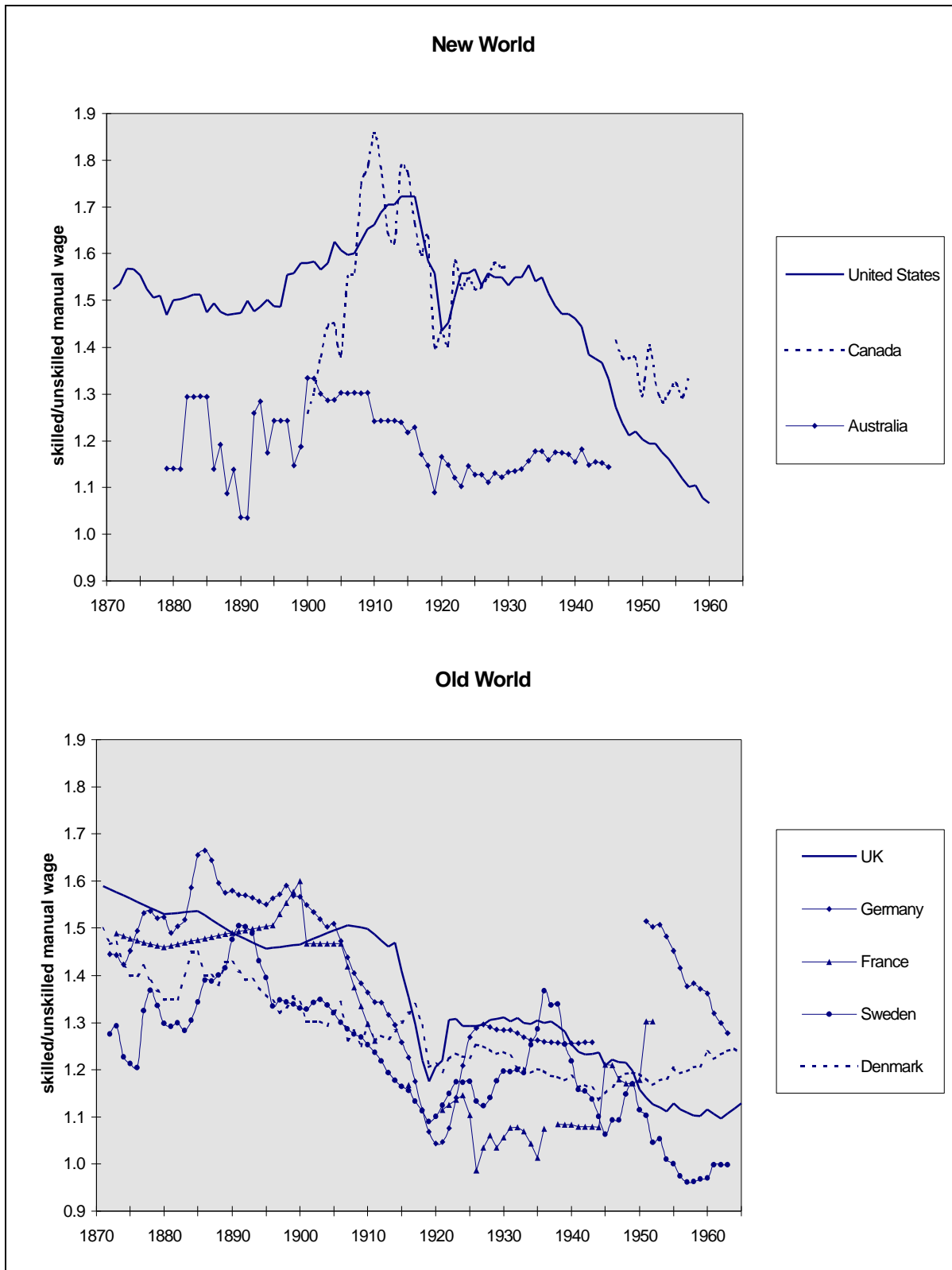


Figure 1.1 Relative wages of skilled manual workers, 1870-1965

Notes: The series shown are those in the building sector, except for Canada, where those in the engineering sector are considered more reliable. Each national series is linked to that of the UK using a set of independent estimates of average relative wages at either of two “benchmark” years, 1905 and 1927 (see Appendix 1.7). The 1927 results are used except for the US and France where the 1905 results are considered more reliable. The Swedish and German series are 3 year moving averages.

Sources: See Appendix 1.1

A breakdown of trends in wage inequality into broad sub-periods can also be made after 1914. The first, during WWI, saw the relative wages of skilled manual workers fall, and in many cases – particularly the US, Canada and the UK – failing to return to their pre-WWI levels following the return to peacetime conditions. The second, between the early-1920s and late-1930s, was characterised by broadly stable relative wages in nearly all countries. There then followed a period, roughly between the late-1930s and late-1950s, in which relative wages fell markedly, with much, although not all, of the fall occurring during WWII. Finally, between the late-1950s and early-1960s, the relative wages of skilled manual workers once again tended to stabilise, although at their lowest-ever levels by historical standards.

Again there were exceptions to these broad patterns. Nevertheless, in marked contrast to the pre-WWI period, the relative wages of skilled manual workers after 1914 showed a tendency to move in similar directions in all countries, and to converge rather than diverge among countries. Thus, by the 1960s the international dispersion of relative wages had fallen markedly from its pre-WWI peak, and had returned to the same low level that had characterised the 1870s.

The second set of evidence on wage inequality between skilled and unskilled labour used in this paper is the average wage of non-manual relative to manual workers, shown in Figure 1.2. Although this measure is available for a much smaller number of countries and time periods, the graph shows that in those countries for which both sets of evidence are available, trends in the relative wages of non-manual workers in the century prior to 1970 showed broad similarities with those of skilled manual workers.⁶ While there were certain exceptions, it seems reasonable to conclude that in general, trends in both sets of relative wages reflected changes in the relative price of a common underlying attribute of workers called “skill”, and that changes in the relative wages of skilled manual workers were likely to have been repeated in other wage relativities between occupations requiring different levels of skill.

The rest of the paper seeks to determine the influence of globalisation on the trends in wage inequality suggested by Figures 1.1 and 1.2. Section 2 looks at the impact of international migration on the supply of skilled relative to unskilled labour (hereafter referred to as the relative supply of skilled labour) in the pre-WWI (1870-1914) period, when migration flows were largest. Sections 3 and 4 then look at the potential impacts of international trade on the demand for skilled relative to unskilled labour (hereafter referred to as the relative demand for skilled labour): Section 3 first seeks to distinguish between supply-side and demand-side influences on relative wages over the whole period (1870-1970); Section 4 then asks to what extent demand-side influences were driven by international trade. A final section summarises the findings of the paper, and discusses their implications for the broader debate on the impact of globalisation on inequality.

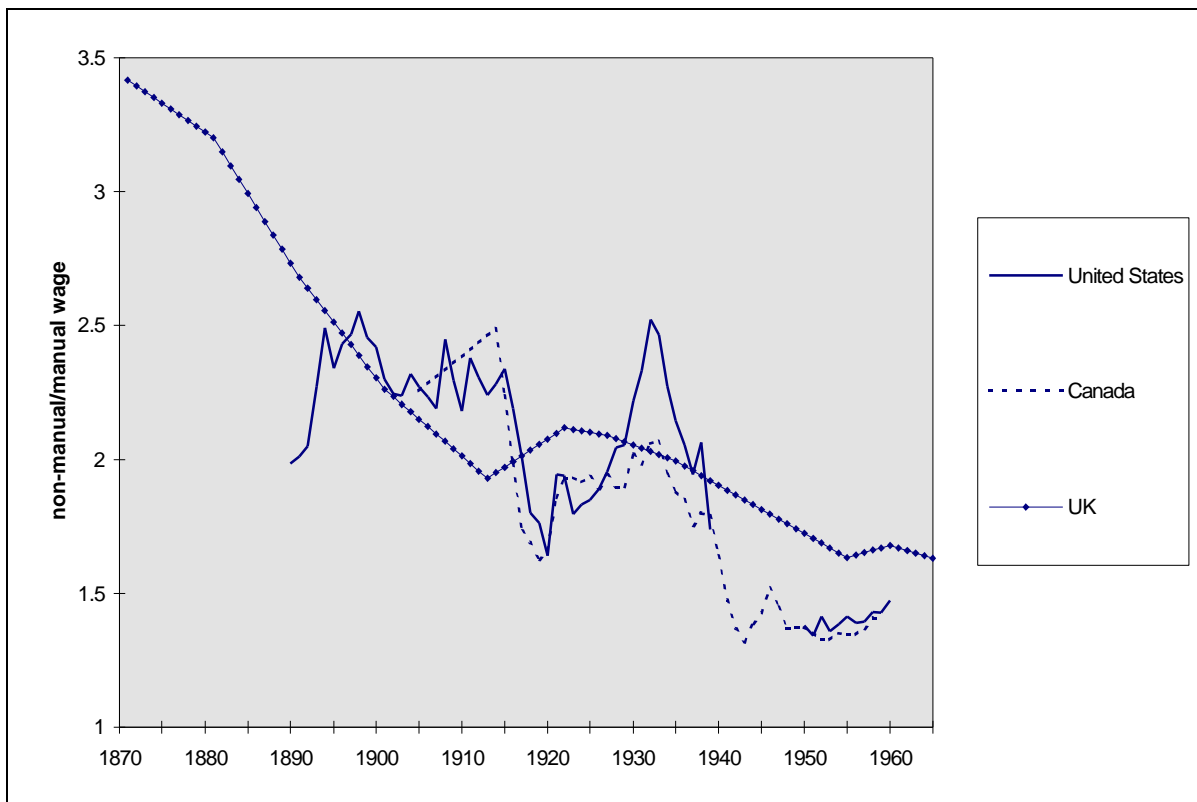


Figure 1.2 Relative wages of non-manual workers, 1870-1965

Notes: The differentials shown refer to workers in a number of sectors.

Sources: See Appendix 1.2

2 INTERNATIONAL MIGRATION AND THE RELATIVE SUPPLY OF SKILLED LABOUR

This section seeks to determine the impact of international migration on the relative supply and relative wage of skilled labour between 1870 and 1914. One hypothesis to be tested is that mass migration decreased the relative supply of skilled labour in the New World “receiving” countries, and increased the relative supply of skilled labour in the Old World “sending” countries, which, other things being equal, tended to increase relative wages in the New World and reduce them in the Old.

Such a hypothesis assumes that the underlying causes of migration were exogenous to relative wages. However, it is also possible that the relative number of skilled and unskilled migrants, and their associated impacts on domestic relative supply, were in fact *caused* by changes in relative wages driven by other underlying forces. This section therefore also tests the hypothesis that increasing relative wages in the New World and falling relative wages in the Old World resulted in migration flows which increased the relative supply of skilled labour in the New World, and reduced the relative supply of skilled labour in the Old World.

The section is divided into three parts. Section 2.1 discusses ways of measuring the contribution of international migration to relative supply before 1914, and presents evidence on the size and direction of such impacts. Section 2.2 then looks at the relationship between changes in the

contribution of migration to relative supply and changes in relative wages, first asking which of the above hypotheses regarding causality the data support, before determining how much of relative wage behaviour can be accounted for by migration. Section 2.3 concludes.

2.1 Measuring the Contribution of Migration

The total domestic supply of skilled (subscript s) relative to unskilled (subscript u) workers in any one country can be expressed as consisting of “home” and “foreign” workers, for example:

$$\frac{N_{st}}{N_{ut}} = \frac{(L_{st} + M_{st})}{(L_{ut} + M_{ut})} = \frac{L_{st}(1 + m_{st})}{L_{ut}(1 + m_{ut})} \quad (1)$$

where N_{kt} is the total domestic supply of skill group k in time period t , L_{kt} is the supply of “home” or “native” workers of skill group k in time period t , M_{kt} is the supply of “foreign” or “migrant” workers of skill group k in time period t , and m_{kt} is equal to $\frac{M_{kt}}{L_{kt}}$, consisting of positive numbers for receiving countries and negative numbers for sending countries. Taking logs, equation (1) can be written as:

$$\ln \frac{N_{st}}{N_{ut}} = \ln \frac{L_{st}}{L_{ut}} + \ln \frac{(1 + m_{st})}{(1 + m_{ut})} \quad (2)$$

where the term $\ln \frac{(1 + m_{st})}{(1 + m_{ut})}$ measures the contribution of migrant workers to the domestic relative supply of skilled workers in any year t .

A number of issues arise when seeking to measure the size of this term in the pre-WWI period. First, it is not possible to observe directly the separate components L_{kt} and M_{kt} of N_{kt} in equation (1) above, which correspond to native and migrant *stocks* of skill group k . The only alternative is to measure the level of migration *flows* of skilled and unskilled labour as a proportion of the total domestic *stocks* of skilled and unskilled labour. In what follows I sum annual migration flows over consecutive ten year periods, so that m_{kt} becomes the ratio of ΔM_{kt} , the total flow of migrants over each ten year period, to L_{kt} the total stock of “home” workers at each period end. In sending countries L_{kt} is equal to total domestic supply, but in receiving countries the total flow of migrants over the preceding ten year period is deducted.

Secondly, migration data are usually presented in gross form, whereas, because of return migration, net rates of migration were often substantially lower. For example, Hatton and Williamson (1994 p. 5) state that return migration from the US between 1890 and 1914 typically amounted to

around 30% of the gross inflow. In what follows I use 0.3 as an estimate of the rate of return migration. However, this is only a first approximation, with further research especially needed to determine whether the extent of return migration differed between skilled and unskilled workers.⁷

Thirdly, for the US and Canada it is also not always clear whether the occupations of immigrants presented in national statistics accurately reflect a migrant's occupation after entering the country, rather than occupation prior to entering the country. For example, it is possible that the large numbers of immigrants listed as farm labourers were in fact assimilated directly into industry, thereby having more impact on relative wages in industry than would otherwise have been the case. In what follows I use a narrow occupational definition of "unskilled" immigrants that excludes farm labourers. Their inclusion, however, would tend to show even larger impacts of immigration on relative supply in these two countries. In Canada, the issue is further complicated by the fact that the semi-skilled are included among the unskilled in the migration data, but among the skilled in the domestic employment data. A rough adjustment was made by dividing the original "unskilled" migrant series by two, and adding the remaining half to the "skilled" migrant series.

Fourthly, for Germany, Sweden and Denmark a direct breakdown of migrants by skill group before 1914 is not available. In order to estimate the relative supply impact of migration in these countries, emigrants from agriculture and general labourers were classified as "unskilled", while emigrants from industry were classified as "skilled". For the home supplies of these "skill" groups, total domestic agricultural and industrial employment were used respectively. The reasoning behind this procedure is that, on average, industry is more skill-intensive than agriculture, so that a higher m_i in industry than in agriculture would be expected to reduce the economy-wide relative supply of skilled labour, and vice versa. Of course, this is not an accurate estimate of the relative supply impact of migration, as it is not known whether emigration was highest among the more or less skilled workers *within* industry or agriculture.

Finally, migration flows by skill group in Sweden between 1874 and 1890, Germany between 1874 and 1900, and Canada between 1880 and 1900 have been estimated from total migration flows, using each country's average proportions of that total made up by skilled and unskilled manual workers during the remainder of the pre-WWI period.

Figure 2.1 shows trends in $\ln \frac{(1 + m_{st})}{(1 + m_{ut})}$, the contribution of annual migration flows of skilled and

unskilled manual labour (adjusted for a rate of return migration of 0.3 and summed over ten-year periods) to the relative supply of "home" skilled manual labour at each period end. It confirms that international migration before 1914 tended to reduce the relative supply of skilled labour in the New World. Impacts were often large; for instance, in 1893 the relative supply of skilled manual workers was approximately 18% (0.18 log points) lower in the US and 27% (0.27 log points) lower in Canada than it would have been had there been no immigration over the previous 10 years.

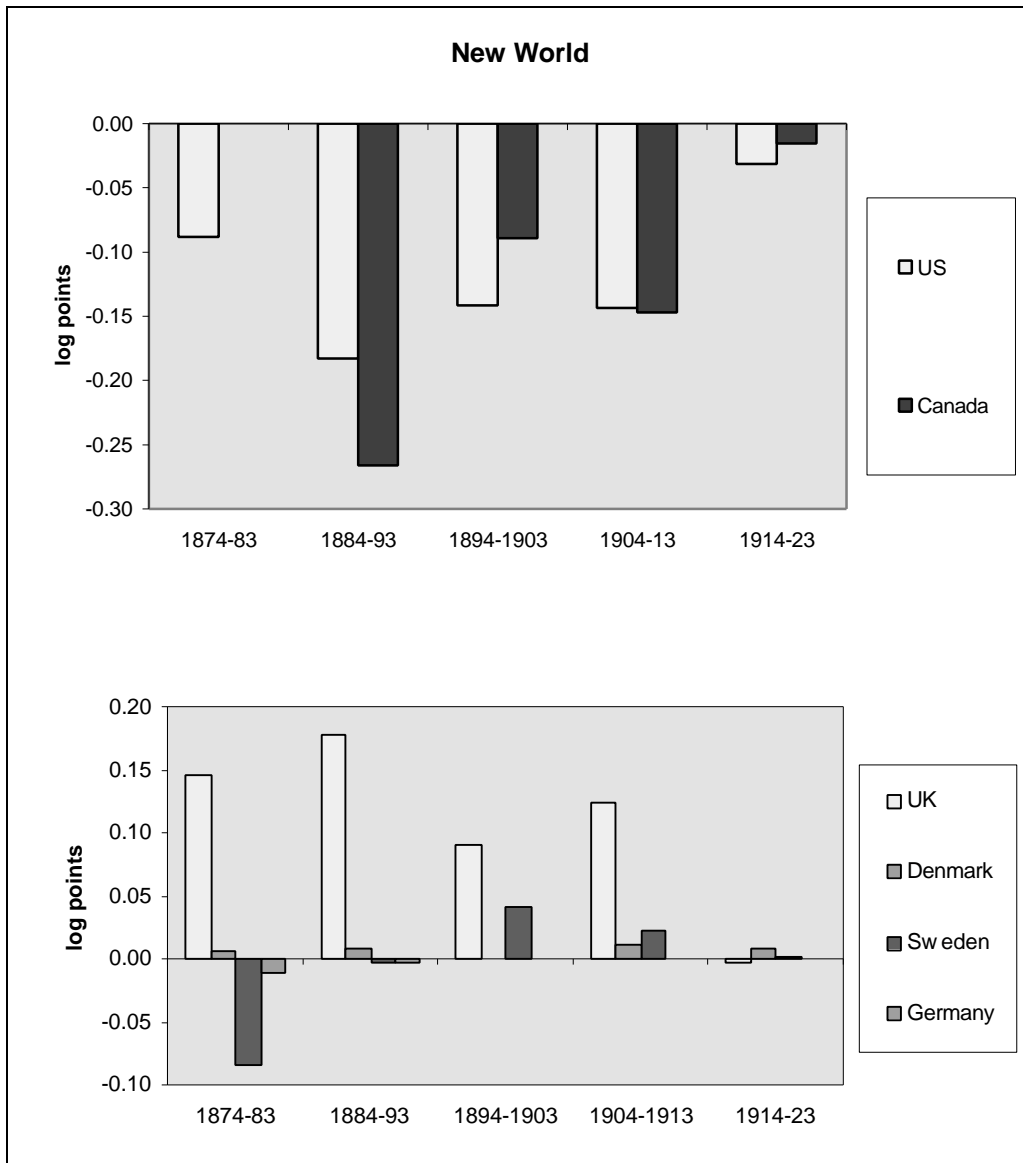


Figure 2.1 The impact of international migration on the relative supply of skilled manual workers, 1874-1923

Notes: Data on the domestic supplies of skilled and unskilled manual workers before 1900 in the US and 1911 in the UK have been estimated using the “between” component of relative employment (see Section 3.2). It was not possible to estimate the impact of migration on the relative supply of skilled manual workers in Canada between 1874 and 1883, as data on the domestic relative supply of skilled manual workers are unavailable, or in Australia and France throughout the whole period, as data on the skill composition of migration are unavailable.

Sources: See Appendix 1.3.

Figure 2.1 also suggests that the impact of immigration on relative supply tended to diminish in both countries; by 1913 the relative supply of skilled manual workers was approximately 14% (0.14 log points) lower in the US and 15% (0.15 log points) lower in Canada than it would have been had there been no immigration over the previous 10 years. This reflected the fact that, although absolute flows were as high as those of the 1880s, the impact of skilled immigration on domestic supply was growing relative to the impact of unskilled immigration.⁸ Impacts were still large however; it was the outbreak of WWI which saw the contribution of immigration to relative supply fall away most dramatically.

Among the Old World “sending” countries, Figure 2.1 suggests a more diverse picture. In the UK, where the data are most reliable, the clear tendency was for emigration to increase the relative supply of skilled labour. As in the US and Canada, impacts were large: for instance, between 1884 and 1893, emigration from the UK increased the domestic relative supply of skilled labour by approximately 18% (0.18 log points). Likewise, the relative impact of migration also tended to diminish in the UK, mainly because of a decline in the rate of emigration among unskilled relative to skilled workers rather than a decline in total emigration.

Among the other Old World countries, where the underlying data are less reliable, there was no clear tendency. Figure 2.1 suggests that the impact of emigration before 1914 on the relative supply of skilled labour in Germany and Denmark was small, not exceeding 2% in any one ten-year period. This reflects low *absolute* impacts of emigration; for example, between 1884 and 1893 emigration among the “unskilled” in these two countries equalled only 3% and 4% respectively of domestic supply, compared to 16% in Sweden and 20% in the UK. Figure 2.1 also suggests that the impact of emigration was small in Sweden. However, this reflected low *relative* impacts of emigration, due to the fact that the proportions of emigrants among “skilled” and “unskilled” workers in Sweden were similar. In fact, between 1873 and 1884, a higher proportion of “skilled” than “unskilled” workers emigrated, *decreasing* the relative supply of skilled workers, although this tendency had been reversed by the 1890s.

2.2 Effects on Relative Wages

Figure 2.1 shows that international migration in the pre-WWI period often had large impacts on the domestic relative supply of skilled labour. What were its effects on relative wages? In order to answer this question, I first show in Figure 2.2 the relationship between the changes in relative supply due to migration and changes in relative wages. The observations shown correspond to each of the countries and pre-WWI time-periods included in Figure 2.1; those for which the skill composition of migration flows was crudely estimated are shown as circles rather than diamonds.

A negative relationship, with increases/decreases in the relative supply of skilled labour due to migration associated with decreases/increases in relative wages, would indicate that migration was an exogenous determinant of relative wages, whereas a positive relationship, with increases/decreases in the relative supply of skilled labour due to migration associated with increases/decreases in relative wages, would indicate that migration responded to changes in relative wages driven by other underlying forces. Figure 2.2 suggests that, in broad terms, the first conclusion applies. However, the low correlation coefficient also suggests that migration cannot fully explain relative wage behaviour in the pre-WWI period, and that other explanatory forces must have been important.

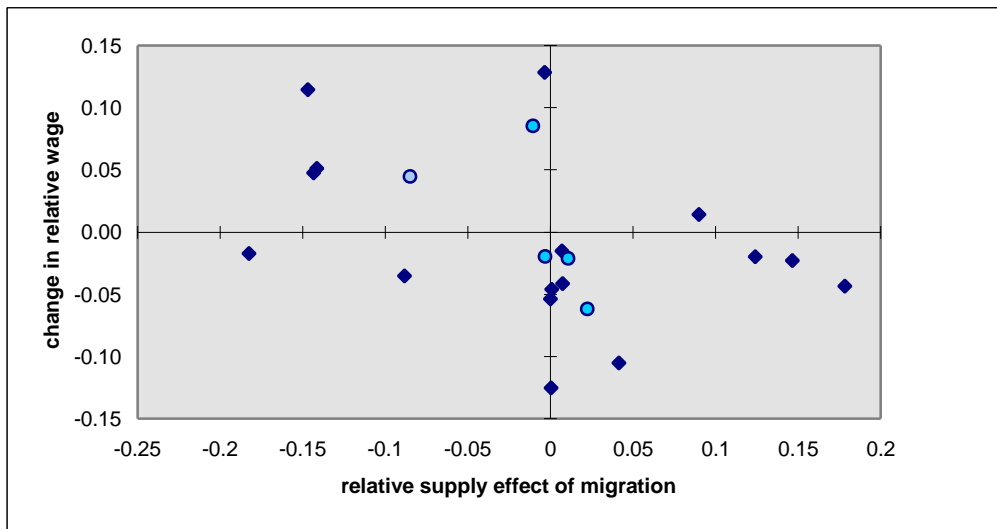


Figure 2.2 Correlation of the relative supply effect of migration flows with changes in relative wages, 1874-1913
 Notes: $r = -0.39$, $n = 21$. With the exclusion of the crudely estimated observations represented by circles, $r = -0.46$, $n = 16$.

It is possible to shed some light on the direction and magnitude of these other forces by calculating, for each country and time period, the “residual” change in relative wages after the effect of migration is accounted for. The results of such an exercise are shown in Table 2.1. The first column shows the “actual” change in relative wages in each period, while the second column shows the “predicted”

change in relative wages, equal to the term $\ln \frac{(1 + m_{st})}{(1 + m_{ut})}$ multiplied by $-\frac{1}{\mathbf{s}}$, where \mathbf{s} is the elasticity

of substitution. The third column then shows the “residual” change in relative wages, equal to the actual minus the predicted change. A unitary elasticity of substitution is assumed.⁹

The first row of the table, for instance, shows that immigration in the US between 1874 and 1883 would have increased the relative wage of skilled manual workers by approximately 9% (0.088 log points), had other determinants of relative wages remained constant. That relative wages of skilled manual workers actually fell by 4% (0.035 log points) over this period suggests that other factors reduced relative wages by 12% (0.124 log points), *outweighing* the effect of immigration.

How much of relative wage behaviour in the New World before 1914 can be accounted for by immigration? Of the rise in the relative wages of skilled manual workers in the US between 1894 and 1913, *more than 100%*, given a rate of return migration of 0.3 and a unitary elasticity of substitution. Between 1874 and 1893, the relative wages of skilled manual workers were in fact falling when immigration was pushing in the opposite direction; this was also the case for the relative wages of non-manual workers between 1894 and 1913. In Canada, again more than 100% of the rise in relative wages between 1903 and 1913 can be accounted for by migration.

<i>(log points)</i>			
Skilled/unskilled manual			
<i>Year /country</i>	Actual	Predicted	Residual
US			
1874-83	-0.035	0.088	-0.124
1884-93	-0.017	0.183	-0.200
1894-1903	0.051	0.141	-0.090
1904-13	0.048	0.144	-0.096
Canada			
1904-13	0.114	0.147	-0.033
UK			
1874-83	-0.023	-0.147	0.123
1884-93	-0.044	-0.178	0.135
1894-1903	0.014	-0.090	0.104
1904-13	-0.020	-0.124	0.105
Denmark			
1874-83	-0.015	-0.007	-0.008
1884-93	-0.041	-0.007	-0.034
1894-1903	-0.054	0.000	-0.054
1904-13	-0.021	-0.011	-0.011
Sweden			
1874-83	0.045	0.085	-0.040
1884-93	0.128	0.004	0.125
1894-1903	-0.105	-0.042	-0.064
1904-13	-0.062	-0.022	-0.039
Germany			
1874-83	0.085	0.010	0.075
1884-93	-0.020	0.003	-0.023
1894-1903	-0.046	-0.001	-0.045
1904-13	-0.125	-0.001	-0.125
Non-manual / manual			
US			
1894-1903	-0.043	0.108	-0.151
1904-13	0.000	0.151	-0.151
UK			
1874-83	-0.085	-0.002	-0.084
1884-93	-0.159	-0.008	-0.151
1894-1903	-0.147	0.000	-0.147
1904-13	-0.109	0.002	-0.111

Table 2.1 International migration and the relative wages of skilled labour, 1874-1913: predicted impacts and actual outcomes

The resulting negative “residual” changes in relative wages suggest two possible conclusions. The first is that my estimates of the impact of immigration on relative wages are upwardly biased, perhaps because more unskilled migrants returned than skilled migrants. The second is that there were strong counteracting forces that served to suppress the impact of immigration on relative wages. One plausible explanation is that immigration was accompanied by large increases in the “native” relative supply of skilled labour which offset the impact of immigration on the total “domestic” relative supply of skilled workers. This is supported by data in Williamson and Lindert (1980 p.211) which suggest impact of immigration.¹⁰

Another possible explanation is that there were large decreases in the relative demand for skilled labour, either because of a shift of employment toward less skill-intensive sectors and industries, or because of a contraction of skilled employment within individual firms and industries. Many authors have argued that the latter was important, with skill-saving technical change being *induced* by immigration. As early as 1911, the United States Immigration Commission argued that:

their [migrants'] employment in the mines and manufacturing plants of this country has been made possible only by the invention of mechanical devices and processes which have eliminated the skill and experience formerly required in a large number of occupations (sourced in Thomas, 1973, p.171).

The fact that the “residual” change in relative wages shown in Table 2.1 was smaller in Canada than in the US may have reflected a smaller impact of either of the above two factors. However, it is less plausible that the smaller “residual” in the US in the second half of the period reflected smaller increases in “native” relative supply, or less skill-saving technical change.¹¹ A more likely possibility, explored further in the next section, is an *increase* in the relative demand for skilled labour in the second half of the period due to changes in the *inter-* (rather than *intra-*) industrial structure of employment.

Across Europe, the degree to which changes in relative wages can be accounted for by emigration varies. In the UK, the decline in the relative wages of skilled manual workers between 1870 and 1914 was *less* than predicted, as reflected in the positive values in the “residual” column of Table 2.1. As for the US and Canada, this suggests either that my estimates of the impact of migration on relative supply are upwardly biased, or that strong counteracting forces offset the impact of migration on relative wages. In the case of the UK, however, the latter would have to have been in the opposite direction and, as a decline in the “native” relative supply of skilled manual labour is less plausible, most likely reflected a large increase in the relative demand for skilled manual labour.¹²

For Germany and Denmark, Table 2.1 suggests that the relative supply impact of emigration was too small to have had a large impact on relative wages. As a result, the fall in relative wages witnessed throughout the pre-WWI period in Denmark, and from the late-1890s to 1914 in Germany, must have been due instead either to increasing “native” relative supply of skilled labour, or to a decline in the relative demand for skilled labour. Similarly, the rise in relative wages in Germany in the early part of the pre-WWI period must have been due to an increase in the relative demand for skilled labour, again because the alternative – a decrease in the “native” relative supply of skilled manual labour – is less plausible.

For Sweden, of the decline in relative wages between 1894 and 1913, Table 2.1 suggests that between 40% (for 1894-1903) and 35% (for 1904-13) can be accounted for by emigration; the residual must have reflected, as in Germany and Denmark, either a large increase in the “native” relative

supply of skilled labour, or a large fall in the relative demand for skilled labour. Of the rise in relative wages in Sweden between 1874 and 1893, the implications of Table 2.1 are slightly more complicated; between 1884 and 1893, when emigration had no impact on relative supply, an increase in the relative demand for skilled labour is the most likely explanation. However, between 1874 and 1883, emigration can account for *more than 100%* of the rise in relative wages, suggesting that there must also have been either an increase in the “native” relative supply of skilled labour or a decrease in the relative demand for skilled labour.

2.3 Summary

This section shows that international migration between 1870 and 1914 was an exogenous force which tended to reduce the relative supply of skilled labour in the New World and increase the relative supply of skilled labour in the Old World. However, the section also finds that:

- the impact of emigration on the relative supply of skilled labour in Germany, Denmark and Sweden was relatively small. In these countries, other forces are required to explain changes in wage inequality in the pre-WWI period;
- where the impact of migration on relative supply was larger (the US, Canada, and UK), there were strong counteracting forces which dampened the impact on wage inequality. In the US and Canada, the most likely candidates were an increase in the “native” relative supply of skilled labour or a decline in the relative demand for skilled labour; in the UK, the most likely candidate was an increase in the relative demand for skilled labour;
- in the US, there is no evidence that the relative supply impact of migration grew larger in the second half of the period, nor is it likely that counteracting forces grew smaller. In these years, an increase in the relative demand for skilled labour due to inter-sectoral shifts in employment may also be required to explain the increase in wage inequality.

Thus, a full accounting of relative wage behaviour between 1870 and 1914 clearly requires the consideration of shifts in the relative demand for skilled labour and shifts in the “native” relative supply of skilled labour. This is the aim of the next two sections of the paper, which also extend the analysis to the post-1914 period. Section 3 seeks to disentangle demand-side from supply-side influences on relative wages, while section 4 asks whether shifts in the relative demand for skilled labour were due to international trade.

3 CHANGES IN RELATIVE WAGES – WERE THERE DEMAND-SIDE EFFECTS?

This section asks whether the broad patterns in wage inequality identified in Section 1 were driven primarily by demand-side or supply-side forces, a common question in the “current” debate on the

determinants of wage inequality (e.g. Katz & Murphy, 1992; Robbins, 1996). More precisely, given a CES demand function of the form

$$\frac{w_{st}}{w_{ut}} = D \left(\frac{N_{st}}{N_{ut}} \right)^{-\frac{1}{s}} \quad (3)$$

where w_{kt} is the wage of skill group k in time period t , N_{kt} is the total domestic supply of skill group k in time period t , D is a term representing relative demand shifts, and s is the elasticity of substitution, the question is to what extent relative wage behaviour is consistent with the hypothesis that the demand term D is constant. This necessarily implies a negative relationship between the relative supply and relative wage of skilled labour. Empirical evidence of such a relationship then indicates that relative wage movements have the *potential* to be explained by relative supply shifts alone, without the need to consider demand shifts. Whether or not relative wage movements *can* be explained by relative supply shifts alone depends on the magnitudes involved, and on what value is assumed for the elasticity of substitution.

The above procedure relies on the assumption that labour markets clear, whereas it is likely, especially after 1914, that movements in the relative wages of skilled labour reflected changing institutional influences rather than demand and supply forces alone. Such influences are not considered in this paper, as they have been extensively documented elsewhere. However, it is worth noting that although institutional effects may be important in explaining differences between countries in the exact timing and magnitude of the broad patterns in wage inequality, they are unlikely to be able to account for the broad patterns themselves.¹³

In order to disentangle demand-side from supply-side influences, data is required on relative employment levels by skill group, where the skill groups match those used in constructing the relative wage series. Such data tends to be limited in availability for much of the period and countries under consideration, but what exists is utilised in section 3.1. In section 3.2 an indirect source of information on relative employment is considered, one that is available for the majority of countries and time periods. Section 3.3 concludes.

3.1 Evidence from the Relative Employment of Skilled Labour

Figure 3.1 shows trends in the relative employment and relative wages of skilled labour for those countries and time-periods for which both are available. Where the two move in opposite directions, changes in relative wages have the potential to be explained by relative supply shifts alone; where they move in the same direction, changes in relative wages *cannot* be explained without the explicit consideration of relative demand shifts. For instance, if the rise in wage inequality in the New World

between the early 1890s and 1914 was due to immigration alone, one would expect Figure 3.1 to show a combination of rising relative wages and falling relative employment during these years.

Table 3.1 goes one stage further by estimating the size of relative demand shifts in each period given a unitary elasticity of substitution ($s = 1$), close to that of 1.41 used by Borjas *et al.* (1997). Again, had the rise in wage inequality in the New World between the early 1890s and 1914 been due to immigration alone, one would expect Table 3.1 to show little change in relative demand during these years, as the magnitude of the increase in relative wages would be similar to that of the decline in relative employment.

Country	Skill group *	Relative demand, $s = 1$ (base year in each country = 100)						
		1900	1910	1920	1930	1940	1950	1960
UK	(a)		100	36	30		31	21
	(b)		100	122	121		130	155
US	(a)	100	116	115	126	129	161	165
	(b)	100	103	86	134	115	105	131
Canada	(a)	100	68	58	66		132	155
	(b)	100	124	144	125	95	108	133

Table 3.1 Relative demand shifts in the UK, US and Canada, 1900-1960

Notes: * (a) = skilled/unskilled manual; (b) = non-manual/manual. Relative demand is calculated according to the equation

$$\ln D_t = \ln \left(\frac{w_{st}}{w_{ut}} \right) + \frac{1}{s} \ln \left(\frac{N_{st}}{N_{ut}} \right), \text{ which is derived from the logarithmic form of equation (3).}$$

First, the combination of rising relative employment and relative wages in the US between 1900 and 1910 suggests that the rise in wage inequality reflected an increase in the relative demand for skilled labour rather than a decrease in the relative supply of skilled labour. In contrast, the combination of falling relative employment and rising relative wages of skilled manual workers in Canada over the same period suggests that the rise in wage inequality reflected a decrease in the relative supply of skilled labour rather than an increase in the relative demand for skilled labour.

These results shed further light on the effects of immigration on relative wages in the New World. In the US, the rise in relative employment suggests that the impact of immigration was offset by increases in the *native* relative supply of skilled labour. In contrast, that domestic relative employment in Canada fell by more than the increase in relative wages suggests that the impact of immigration was offset by decreases in the relative demand for skilled labour.

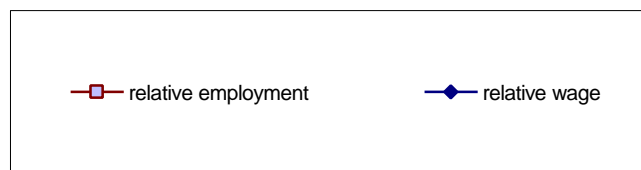
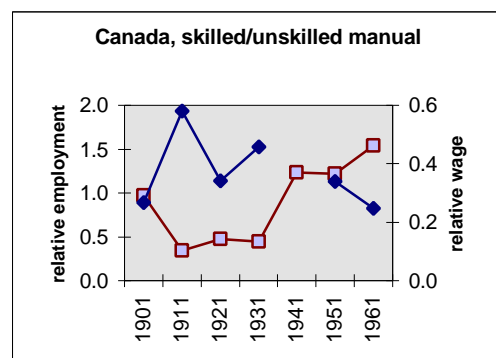
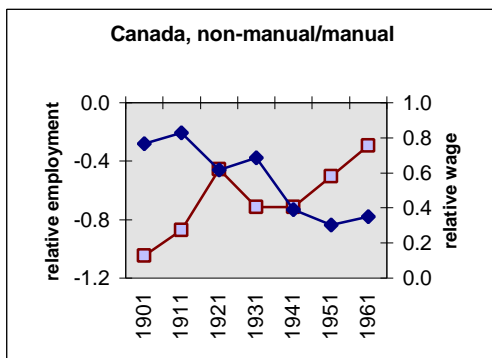
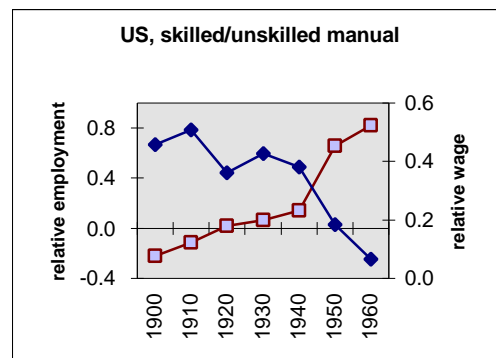
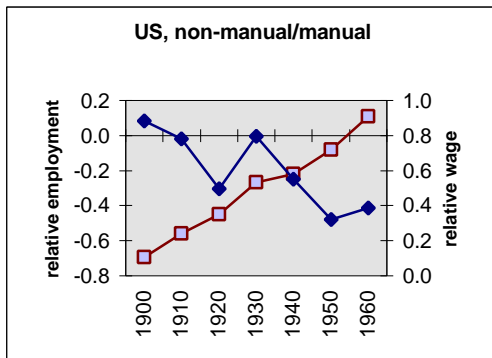
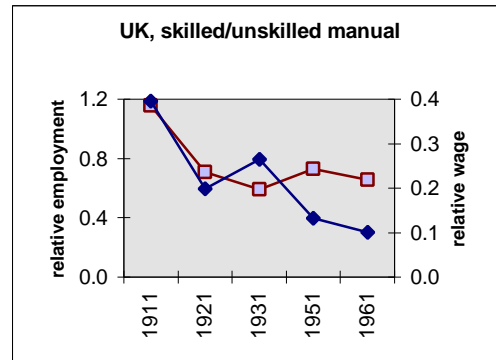
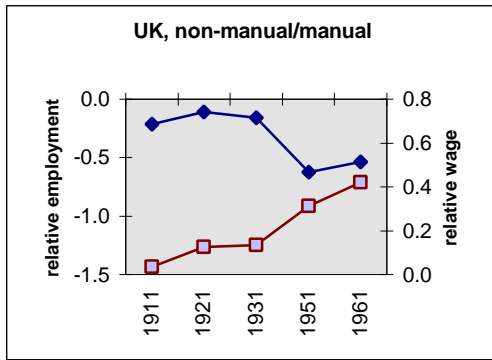


Figure 3.1 Relative employment and relative wages

Notes: Relative employment and relative wages are expressed in logarithms.

Sources and definitions: See Appendix 1.4. “Unskilled manual” excludes farm labourers and domestic/private household workers. The latter groups were large in size, especially in earlier years, and the above results are somewhat sensitive to their inclusion. The decision to exclude them is made on the basis of difficulty in defining their skill level and predicting their impact on the relative wages of skilled manual workers in the building or engineering sectors.

Figure 3.1 and Table 3.1 also shed light on the determinants of trends in wage inequality after 1914. First, the decline in relative wages during WWI appears to have reflected large increases in the relative demand for *unskilled* labour.¹⁴ Second, the fall in relative wages in the UK between the late 1930s and early 1950s appears to have reflected large increases in relative supply. However, the fall in the relative wages of non-manual workers in the US and Canada during this period also appears to have reflected an increase in the relative demand for unskilled labour.¹⁵ Finally, the results suggest that the stability of relative wages during the 1950s reflected a balance between large increases in relative supply and large increases in relative demand.

However, the drawback of the above procedure is that, as a result of data availability, it can only be applied to three countries, and to limited time-frames within each. The next sub-section presents an indirect measure of relative employment that is available for more countries and time periods. This can then be used to look again at disentangling demand-side from supply-side forces, across the whole sample rather than just for the above three countries.

3.2 Evidence from the Industrial Structure of Employment

It is possible to consider changes in the relative employment of skilled labour as the combination of two effects: “between-industry”, in which there is a relative expansion or contraction of employment by industries that use skilled labour in different proportions; and “within-industry”, in which there is a relative expansion or contraction of skilled employment within individual firms and industries. Following Wolff (1996 p.111), the total change in the supply of skill group k can be written in terms of “between” and “within” components as

$$\Delta N_k = \sum_j \Delta p_j s_{kj} + \sum_j p_j \Delta s_{kj} \quad (4)$$

where p_j is employment in industry j as a proportion of total employment, and s_{kj} is employment of skill group k as a proportion of total employment in industry j . In Section 3.1, the relative employment data shown for the UK, US and Canada incorporate both of these components.

Prior to WWII, employment data are much more common on an industrial basis than they are on an occupational basis. As a result, changes in the relative employment of skilled labour due purely to “between-industry” shifts can be estimated for a larger number of countries and time periods than total changes. By adopting a benchmark-year estimate of s_{kj} , and combining it with time-series data on p_j , it is possible to see what *would have* happened to relative employment had the within-industry effect remained constant.¹⁶

Furthermore, if changes in the “within” component of relative employment are small, or stable over time, the sign of the relationship between the “between” component and relative wages will indicate – as for the case of “total” relative employment in Section 3.1 - whether demand-side or

supply-side forces were the predominant influences on relative wages. In addition, evidence that relative demand shifts were important would also indicate that such shifts operated by altering the distribution of employment among industries using skilled labour in different proportions.

Clearly, the extent to which changes in the “within” component were small relative to changes in the “between” component, or were stable over time, is important. A comparison of the two can be made for UK, US and Canada (shown in Appendix 2.3). The results of this comparison suggest that changes in the “between-industry” component of relative employment account for a much larger part of total changes in the US and Canada than in the UK. This reflected the fact that the shift from agriculture to manufacturing – an important source of the increasing relative employment of skilled labour – had largely ended in the UK by the late nineteenth century, on account of its mature stage of industrialisation.¹⁷ As the UK was unique in this respect, one would expect other countries in the sample to follow the US pattern. Thus changes in the “between-industry” component do arguably provide a useful approximation to changes in total relative employment for the majority of countries and time periods covered in this paper.

Figures 3.2a and 3.2b show trends in the “between-industry” component of relative employment together with relative wages. What do they imply regarding the relative importance of demand-side and supply-side forces in explaining the broad patterns in wage inequality identified in Section 1? First, the combination of rising relative wages and rising “between-industry” component of relative employment in the US between 1900 and 1910 suggests that the increase in wage inequality during those years was driven by an increase in the relative demand for skilled labour that operated by shifting the structure of employment toward more skill-intensive sectors. However, there is less evidence that this was the case for the rise in wage inequality during the 1890s, when the “between-industry” component of relative employment did not change substantially.¹⁸

Figure 3.2b suggests that similar demand-side forces may also have been behind the increase in wage inequality witnessed in Germany and Sweden between 1870 and 1890, and in Denmark during the 1880s. However, such forces clearly *cannot* explain the fall in wage inequality between 1890 and 1910 in these countries, when relative wages and the between-industry component of relative employment were negatively related. Instead, Figure 3.2b suggests that these trends were driven either by an expansion of relative supply, or by a fall in the relative demand for skilled labour reflected in “within-industry” shifts in employment.

For the UK, Figure 3.2a suggests that supply-side forces were predominant in the pre-WWI period, given that changes in relative wages and the “between-industry” component of relative employment were negatively related over this period. However, it was suggested in Section 2 that the fall in the relative wage of skilled manual labour before 1914 was smaller than expected given the impact of emigration; thus, after accounting for the impact of emigration, changes in the relative wages and relative employment of skilled manual labour in the UK were more likely to have been positively related over this period, suggesting that there was an increase in the relative demand for

skilled manual labour reflected in “between-industry” shifts in employment, especially between 1871 and 1901, when such employment shifts were large.

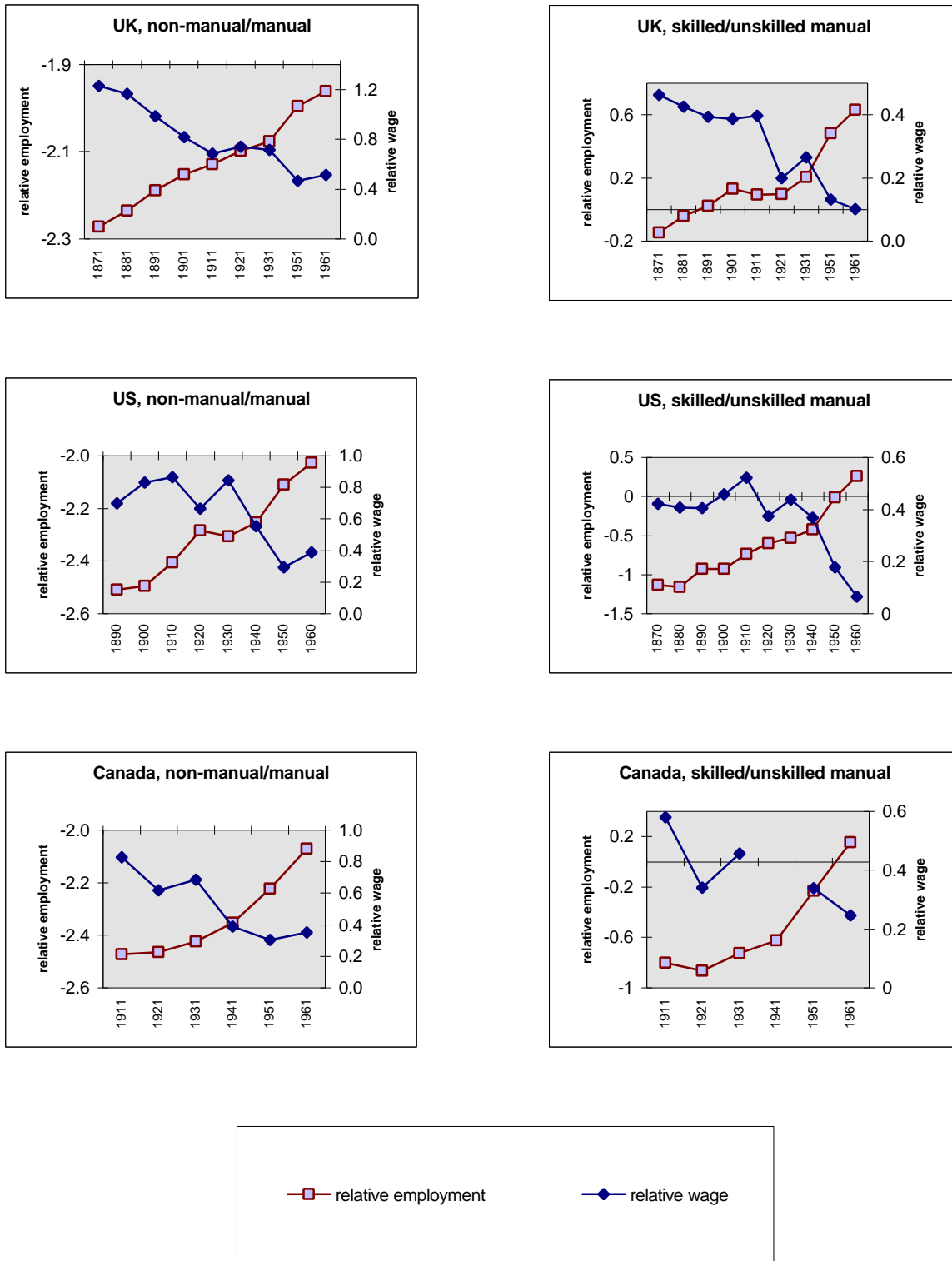


Figure 3.2a Relative employment implied by between-industry employment shifts, and relative wages: US, Canada and UK

Notes: Relative wages and relative employment are expressed in logarithms.

Sources: See Appendices 1.5 and 3.2.

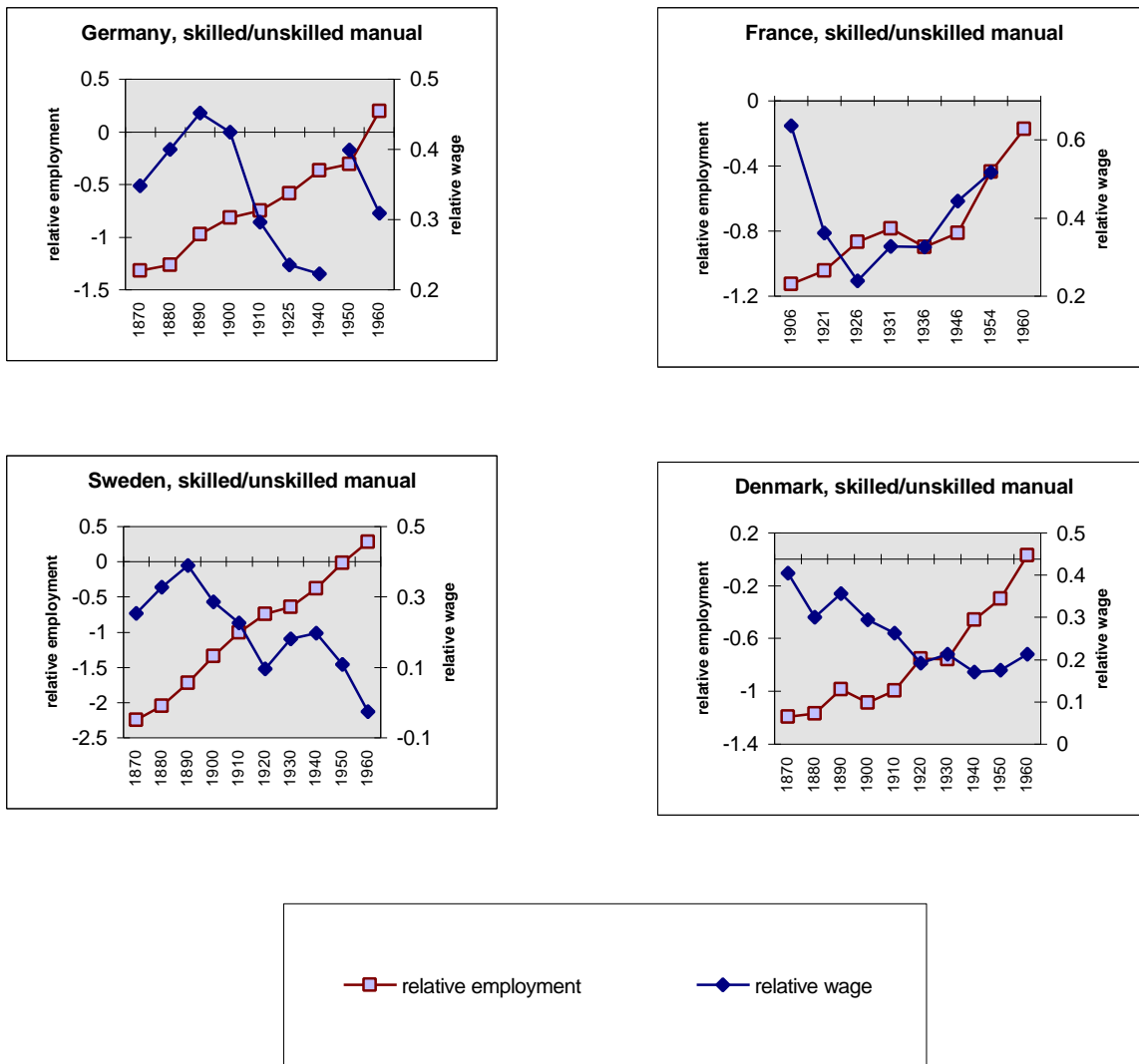


Figure 3.2b Relative employment implied by between-industry employment shifts, and relative wages: Germany, France, Sweden and Denmark
Notes: Relative wages and relative employment are expressed in logarithms.
Sources: See Appendices 1.5 and 3.2.

These findings are also able to shed more light on the determinants of trends in wage inequality after 1914. For instance, the substantial decline in relative wages in all countries during the 1910-20 decade was negatively related to trends in the “between-industry” component of relative employment. This suggests that the fall was due either to a large increase in the relative supply of skilled labour, or a large increase in the relative demand for unskilled labour due to “within-industry” shifts in employment. Between 1920 and 1930, however, there is evidence that inter-industry shifts in employment increased the relative demand for skilled labour in the US and Canada, where both the between-industry component of relative employment and relative wages increased during this decade (with the exception of non-manual labour in the US). In Europe, on the other hand, movements in relative wages during this decade appear to be more the result of either changes in relative supply or changes in relative demand due to “within-industry” shifts in employment.

Similarly, that the decline in relative wages in all countries between the late 1930s and 1950s, in the majority of cases, coincided with increases in the between-industry component of relative employment suggests that it reflected large increases in the relative supply of skilled labour, or declines in the relative demand for skilled labour at the within-industry level. There were certain exceptions to this pattern; for instance, during the 1950s in the UK, US, and Canada, increasing relative wages for non-manual (not for skilled manual) labour coincided with increases in the between-industry component of relative employment; this was also the case for skilled manual labour in France and Denmark. In these cases, relative wage behaviour is consistent with an increase in relative demand due to exogenous shifts in the inter-industry structure of employment.

3.3 Summary

This section sheds light on the determinants of wage inequality in the century prior to 1970 by disentangling demand-side from supply-side influences. It finds that:

- in the US, increasing wage inequality between 1900 and 1910 was not consistent with an explanation based on immigration. Instead, the rise reflected an increase in the relative demand for skilled labour due to a shift in employment toward skill-intensive sectors and industries. The rise in the domestic relative employment of skilled labour also suggests that the impact of immigration on relative wages was offset by increases in “native” relative supply;
- in Canada, increasing wage inequality between skilled and unskilled manual workers between 1901 and 1911 was consistent with an explanation based on immigration. The size of the fall in total domestic relative employment also suggests that the impact of immigration on relative wages was offset by exogenous decreases in relative demand;
- in the Old World, increasing relative wages in Sweden and Germany between 1870 and 1890, and in Denmark between 1880 and 1890, are consistent with increasing relative demand due to shifts of employment toward skill-intensive sectors and industries. The latter are also able to account for the smaller fall in relative wages in the UK between 1870 and 1900 than predicted by emigration. However, such forces cannot explain the decline in relative wages in the latter half of the pre-WWI period in mainland Europe;
- the fall in relative wages in all countries during WWI on the whole reflected increases in the relative demand for unskilled labour, operating primarily via “within-industry” shifts in employment;
- the fall in relative wages in most countries between the late 1930s and early 1950s also reflected increases in the relative demand for unskilled labour via “within-industry” shifts in employment, but also reflected large increases in the relative supply of skilled labour;

- the stability of relative wages in the UK, US and Canada during the 1950s represented continued large increases in the relative supply of skilled labour, offset by increases in the relative demand for skilled labour.

Thus shifts in the relative demand for skilled labour, due to shifts in employment between industries using skilled labour in different proportions, were often important. The next section considers the role of international trade, as one possible source of such shifts.

4 INTERNATIONAL TRADE AND THE RELATIVE DEMAND FOR SKILLED LABOUR

This section asks whether changes in the level and commodity composition of trade (hereafter referred to as the pattern of trade) influenced trends in wage inequality over the century prior to 1970. One hypothesis to be tested is that increases/decreases in (net) exports of relatively skill-intensive commodities were associated with increases/decreases in the relative demand for skilled labour which, other things being equal, led to increases/decreases in relative wages. Such a hypothesis assumes that changes in the trade pattern were autonomous to changes in relative wages, instead resulting from exogenous forces such as declining barriers to trade. However, it is possible that the pattern of trade also responded to changes in relative wages driven by supply-side forces. This section therefore also explores whether increases/decreases in the domestic relative supply of skilled labour were associated with increases/decreases in (net) exports of relatively skill-intensive products and decreases/increases in relative wages.

The organisation of the sections is as follows. Section 4.1 first uses factor-content of trade (FCT) calculations for the UK and US as a means of comparing the size of the impact of trade with that of migration on the relative employment of skilled labour. It then uses a simpler method, based on data on net exports of certain broad commodity groups, in order to estimate the impact of trade on relative employment in all countries and time periods. Section 4.2 then asks whether trade was a significant exogenous determinant of relative wages. Section 4.3 concludes.

4.1 Measuring the Impact of Trade

Factor-content of trade approach

One method of estimating the impact of trade on the relative employment of skilled labour, which has been used frequently in the “current” debate, is the factor content of trade (FCT) approach (Wood, 1994 chap.3). This procedure involves calculating the amount of skilled and unskilled labour embodied in trade flows: the employment of either is said to be increased/reduced by trade if a larger/smaller quantity is used per dollar of exports than per dollar of imports. Firstly, factor-content coefficients for a country’s exports are calculated as:

$$z_x = Ax$$

where A is a ($q \times r$) matrix specifying the quantity of each of the q factors used per million dollars of output in each of the r sectors of the economy, and x is an ($r \times 1$) vector of sectoral shares of total exports (which sum to unity). Similarly, factor-content coefficients for a country's competing imports are calculated as:

$$z_m = Am$$

where m is an ($r \times 1$) vector of sectoral shares of total competing imports. The factor-content coefficients z_x and z_m thus specify the average use of skilled and unskilled labour per million dollars of exports and imports, weighted by the sectoral shares of total exports and imports respectively. Given balanced trade, the impact of trade on factor use is calculated as

$$Z = X(z_x - z_m)$$

where Z is a ($q \times 1$) vector of factor quantities and X is the total value of a country's exports. The sign of the impact of trade on the use of any one factor depends on whether z_x is greater or smaller than z_m ; the size of the impact depends on the difference between z_x and z_m , and on the total volume of exports.

A number of methodological issues arise when calculating the factor content of trade prior to the current period. Firstly, due to data availability, the level of disaggregation by sector is low. This means that the calculations will tend to understate the impact of trade on factor use, as exports and imports do not tend to be equally distributed among all goods within broadly defined sectors. Secondly, in order to estimate the factor-input coefficients in matrix A above, it was necessary to use information on the proportion of total employment in each sector made up by skilled and unskilled *manual* employment, for which the earliest years available were 1960 for the US and 1951 for the UK. This will also lead to an understating of the amount of skilled and unskilled labour embodied in trade, due to the long-run tendency in both countries for the share of non-manual employment to increase. Finally, much of the trade in primary products consisted of "non-competing" imports, in which case the relevant factor-input coefficient is zero (ibid., p.72-74). Exactly how much trade was non-competing, however, is hard to determine; in what follows therefore, calculations are made using two alternative assumptions, one in which all imports of primary products are assumed to be competing, and another in which all are assumed to be non-competing.¹⁹

	UK			US		
	1899	1913	1937	1899	1913	1937
<i>Factor content per \$m of exports, no. of workers</i>						
Skilled manual	99	91	86	21	22	25
Unskilled manual	50	52	46	32	22	19
Skill-intensity	2.0	1.8	1.9	0.7	1.0	1.3
<i>Factor content per \$m of imports, no. of workers</i>						
Skilled manual	80	82	60	15	13	14
Unskilled manual	111	109	91	31	25	28
Skill-intensity	0.7	0.8	0.7	0.5	0.5	0.5
<i>Total exports, \$m</i>	3,927	6,427	2,578	3,717	5,286	3,299
<i>Factor content of trade, '000 workers</i>						
Skilled manual	59.8	62.4	68.0	23.3	51.7	37.1
Unskilled manual	-238.4	-367.5	-116.5	1.0	-14.6	-30.3
<i>Domestic employment, '000 workers</i>						
Skilled manual		5,601	5,618		4,297	5,641
Unskilled manual		1,962	2,993		4,606	5,013

Table 4.1 Factor content of trade (FCT) calculations for the US and UK, 1899, 1913 and 1937

Notes: The results shown are based on the assumption that all primary imports are competing. They are also based on the assumption of balanced trade, although for the purposes of this paper, the relevant assumption is that there was no change in the balance of trade between the above years. Underlying data (factor-input coefficients, employment shares of skilled and unskilled manual workers, and sectoral shares of exports and imports) are contained in Appendix 3. Domestic employment data in 1913 and 1937 are interpolated estimates between the data at ten-year intervals presented in Section 3.1.

Table 4.1 shows the FCT calculations for the US and UK at three points in time: 1899, 1913 and 1937. It indicates that in the UK in 1899, a million dollars of exports embodied on average 99 skilled workers and 50 unskilled workers, while a million dollars of imports embodied 80 skilled workers and 111 unskilled workers. Given total exports of \$3,927m, trade is estimated to increase the employment of skilled manual workers by 59,800, and reduce the employment of unskilled manual workers by 238,400. However, the relevant question is whether *changes* in the pattern of trade had a large impact on the domestic *relative* employment of skilled labour. In the US, between 1899 and 1913 changes in trade increased the employment of skilled manual workers by 0.7% and decreased the employment of unskilled manual workers by 0.3% (when measured as a percentage of the total domestic employment of each skill group in 1913), implying an increase in the relative employment of skilled labour of about 1% (0.010 log points).²⁰ Between 1913 and 1937 changes in the pattern of trade reduced the employment of both skilled and unskilled manual labour by 0.3%, thus having little effect on relative employment. For the UK, Table 4.1 suggests that between 1899 and 1913 changes in the trade pattern had little impact on the employment of skilled manual workers, but reduced the employment of unskilled manual workers by 6.6%, implying an increase in the relative employment of skilled manual workers of approximately 7% (0.068 log points). Between 1913 and 1937 changes in the pattern of trade increased the employment of skilled manual labour by 0.1%, while increasing the employment of

unskilled manual labour by 8.4%, implying a decrease in relative employment of approximately 8% (0.080) log points.

The results in Table 4.1 are based on the assumption that all primary imports were competing. Under the alternative assumption that all primary imports were non-competing, the above results are very similar for the US, but different for the UK; in this case, changes in the pattern of trade between 1899 and 1913 reduced the relative employment of skilled manual labour by approximately 3% (0.031 log points), and between 1937 and 1937 increased the relative employment of skilled labour by approximately 0.8% (0.008 log points).

Overall, the evidence for the US and UK suggests that the impact of trade on the relative employment of skilled labour was smaller than that of migration. Comparing Table 4.1 with Table 2.1 of Section 2 suggests that the latter was over ten times as large as the former in the US, and approximately twice as large in the UK. However, the impacts of trade were clearly not negligible in the UK, where changes in the changes in the pattern of trade in the pre-WWI period may have contributed to the increase in relative demand for skilled manual workers, but only if the majority of primary imports were competing.

Net exports of total manufactures and skill-intensive manufactures

While the data requirements of the FCT procedure preclude its use for all countries and time periods, an alternative and simpler way of measuring the impact of trade on the relative employment of skilled labour is to look at trends in net exports of certain broad commodity groupings, as in Figures 4.1 and 4.2. Figure 4.1 shows trends in net exports of total manufactures; positive values mean that, given balanced trade, the share of manufactures in total exports exceeds their share in total imports, which will tend to imply, given the factor-input coefficients used in Table 4.1, a positive impact of trade on the relative employment of skilled labour. Similarly, Figure 4.2 shows trends in net exports of “skill-intensive” manufactures, broadly defined as exports of machinery and chemical products; positive values mean that, given balanced trade, the share of such products in total manufactured exports exceeds their share in total manufactured imports, which will also tend to imply a positive impact of trade on relative employment.

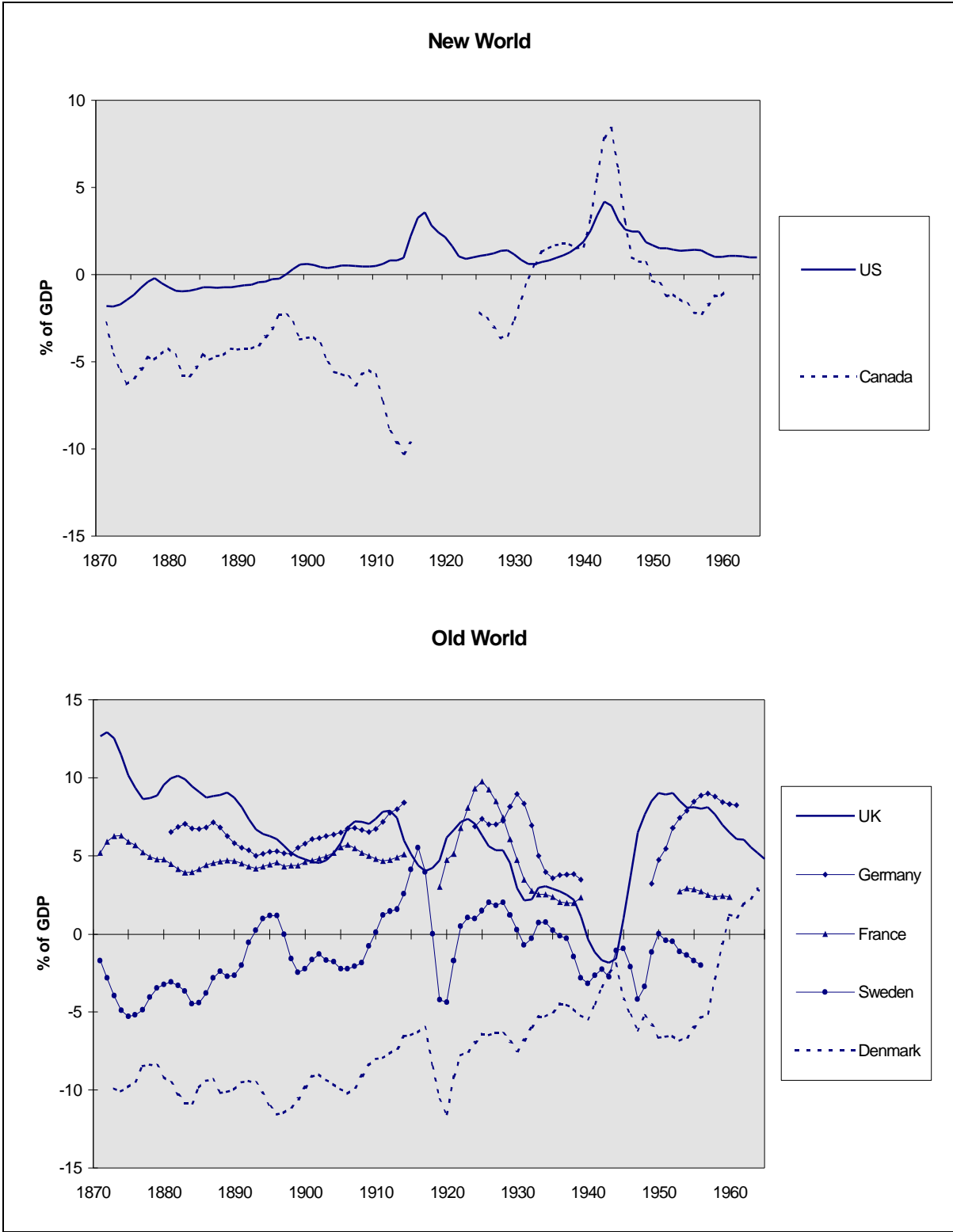


Figure 4.1 Trends in net exports of total manufactures, 1870-1965

Notes: Manufactures are generally defined in the statistical sources as “finished products”, not including “semi-manufactures”. All series are 3-year moving averages.

Sources: See Appendix 1.6.

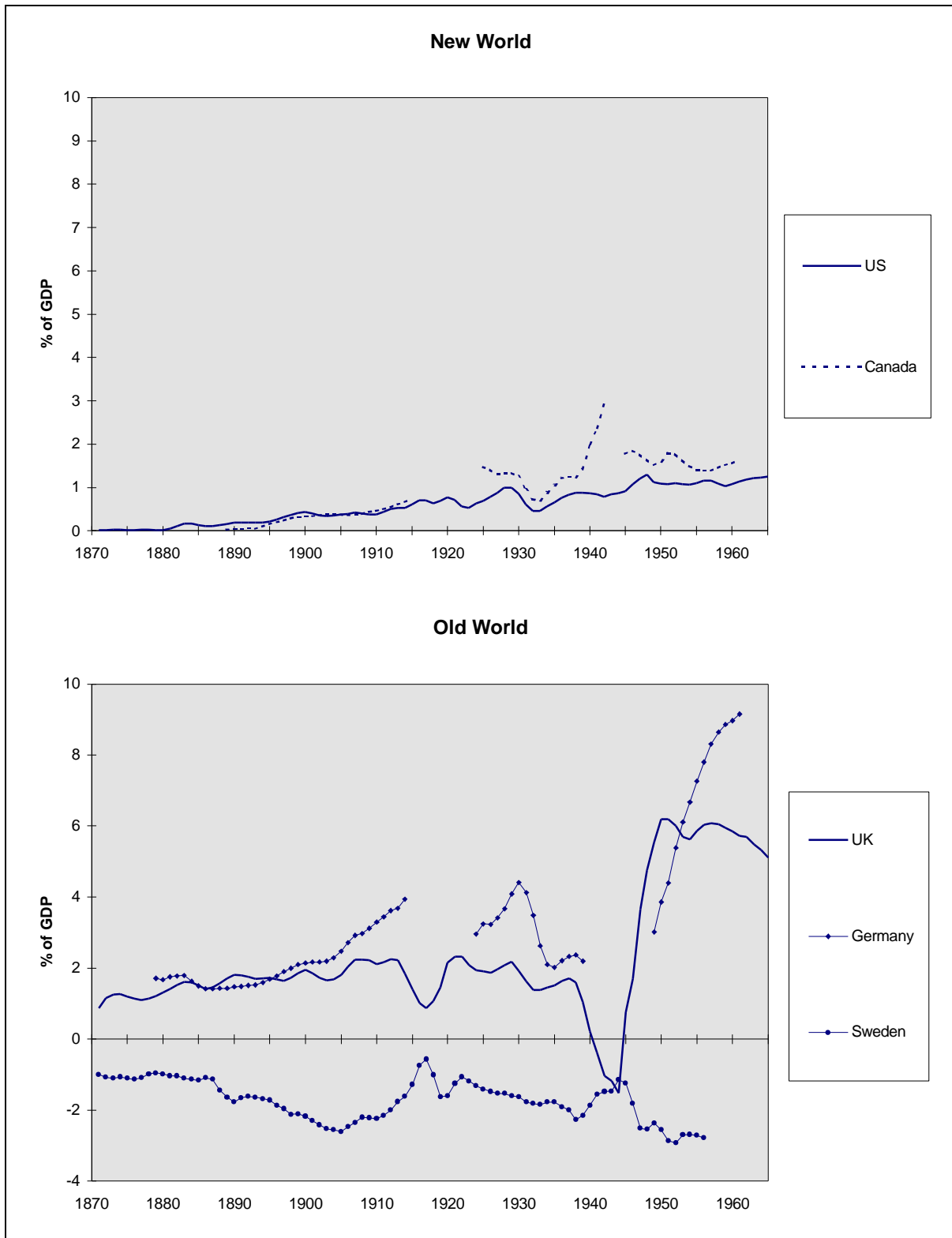


Figure 4.2 Trends in net exports of “skill-intensive” manufactures, 1870-1965

Notes: “Skill-intensive” manufactures are machinery and chemicals for the UK, Germany and Canada, machinery only for the US and chemicals only for Sweden. It was not possible to construct such a series for France, Denmark or Australia. The data for Germany refer to gross exports, which are misleading as a guide to effects on relative wages if they were accompanied by increases in skill-intensive imports. However, data in Maizels (1963 p. 446, 479) suggests that, between 1899 and 1913, net exports of machinery and chemicals actually grew faster than gross exports. All series are 3-year moving averages.

Sources: See Appendix 1.6.

Increases or decreases in each variable can therefore be interpreted as approximating increases or decreases in the relative employment of skilled labour, if there is no change in the trade balance. And when expressed as a percentage of GDP, changes will occur not only as a result of compositional changes within total exports or imports, but also as a result of changes in the overall volume of trade. Of course, if the trade balance does change, the ratio of net exports of manufactures or skill-intensive manufactures to GDP will also change. However, in what follows, it is assumed that an increase/decrease in net exports of total or skill-intensive manufactures because of an increase/decrease in the trade balance has the same impact on relative employment as a change owing to increases/decreases in the volume or composition of trade.²¹

For example, the increase in the relative employment of skilled labour in the UK between 1899 and 1913 identified in Table 4.1 is approximated in Figures 4.1 and 4.2 by an increase in net exports of total and skill-intensive manufactures as a proportion of GDP.²² It is immediately clear that trade was likely to have led to larger changes in the relative employment of skilled labour in other time-periods and countries; for instance, the substantial fall in net exports of all manufactures in the UK between 1870 and 1900 would be expected to have significantly *reduced* the relative employment of skilled labour (although the fact that net exports of skill-intensive manufactures increased over the same period may have dampened this impact). Similarly, the large increase in net exports of both total and skill-intensive manufactures in Germany between 1890 and 1914 would have increased the relative employment of skilled labour. Other instances in which changes in the pattern of trade are likely to have been associated with large changes in relative employment include the large fall in net exports of both total and skill-intensive manufactures during the early 1930s and the large subsequent increases in the immediate post-WWII years, both of which occurred in the majority of countries.

4.2 Effects on Relative Wages

While the above identifies the most likely instances in which changes in the trade pattern affected the relative employment of skilled labour, it remains to be asked whether such changes represented important and exogenous influences on relative wages capable of explaining the changes in relative demand for skilled labour identified in Section 3.2. In order to answer this question, this section explores the correlation between the “between-industry” component of relative employment presented in Section 3.2 and the changing pattern of trade shown in Figures 4.1 and 4.2; if trade did have an important impact on the economy-wide relative demand for skilled labour, one would expect to find a close positive relationship between these variables. If not, other *domestic* determinants of relative demand and the inter-industry structure of employment must have been more important. This section also looks at the correlation between changes in the pattern of trade and relative wages; if trade was a truly exogenous influence, one would expect to find a positive relationship between trade-related changes in relative employment and changes in relative wages. A negative relationship, on the other hand, would indicate that changes in the domestic relative supply of skilled labour was the exogenous

driving force, simultaneously leading to higher/lower net exports of both total and skill-intensive manufactures, and declining/increasing relative wages.

In the pre-WWI period, there is little evidence that changes in the pattern of trade represented an important and exogenous influence on the relative demand for skilled labour in the Old World countries. In the UK, the fact that the decline in net exports of manufactures between 1870 and 1900 occurred when the “between-industry” component of relative employment was growing rapidly suggests that domestic forces were more important determinants of the relative employment of skilled labour, outweighing the negative impact of trends in net exports. Thus it appears from Figures 4.1 and 4.2 that the increase in the relative demand for skilled manual labour in the UK before 1914 was driven by domestic forces rather than trade.

In Germany, there was little change in net exports of either total or skill-intensive manufactures as a proportion of GDP between 1870 and 1890, again suggesting that domestic forces drove the increase in the relative demand for skilled labour identified for this period in Section 3.2. Furthermore, between 1890 and 1914, when there was a large increase in net exports of total and skill-intensive manufactures, relative wages in fact fell. This suggests that the change in the trade pattern over this period, although large, was not an exogenous influence on relative wages; instead it represented an endogenous response to a large increase in the relative supply of skilled labour.

In Denmark and France, there was little change in net exports of total manufactures as a proportion of GDP in the pre-WWI period, suggesting that the impact of trade on the relative employment of skilled labour was likely to have been small. In Sweden, although there was a steady increase in net exports of total manufactures, declining net exports of “skill-intensive” manufactures implied that the overall impact of trade on relative employment was also likely to have been small. As a result, increases in the relative demand for skilled labour between 1870 and 1890 in Sweden, and during the 1880s in Denmark, also appear to be attributable mainly to domestic forces.

Turning to the New World countries in the pre-WWI period, in the US increasing relative wages of skilled manual workers between the early 1890s and 1914 were associated with rising net exports of both total and skill-intensive manufactures, which is consistent with trade being an exogenous driving force behind the widening of wage inequality. This process may have been related to the closing up of the frontier during the 1890s; beforehand, as the frontier expanded, land-labour ratios would have remained relatively constant despite population growth and immigration. As the frontier closed, however, land-labour ratios would have begun to fall, resulting in a shift in comparative advantage away from primary products toward manufactures, and an increase in the relative demand for skilled labour.

One problem with this hypothesis is that the correlation between inter-industry employment shifts and changes in the trade pattern is not high: as was shown in section 3.2, the largest increases in the “between-industry” component of relative employment took place during the 1880s and between 1900-20, with only small changes between during the 1890s when increases in net exports of skill-

intensive products were largest. Furthermore, the FCT calculations in Table 4.1 indicate only a small impact of the changing pattern of trade on relative employment, as the size of (net) exports of both total and skill intensive manufactures relative to total GDP remained small.

In Canada, there was a large decline in net exports of manufactures as a percentage of GDP in the latter half of the pre-WWI period, which would have tended to reduce the relative employment of skilled labour. Evidence on the industrial structure of employment before 1911 is not available, but the fact that the total relative employment of skilled labour between 1901 and 1911 fell by much more than the rise in relative wages may have been due to this change in the trade pattern. Thus the evidence suggests that trade in Canada before 1914 was another important and exogenous influence on relative wages, which reduced the relative demand for skilled labour and offset the increase in wage inequality caused by immigration.

After 1914, there is again little evidence that trade represented an important and exogenous influence on the relative demand for skilled labour. Surprisingly, the large decreases in net exports of total and skill-intensive manufactures as a proportion of GDP in the majority of countries during the late 1920s and early 1930s were associated with stable rather than falling relative wages. One possible reason is that domestic influences on the relative demand for skilled labour offset the negative influence of trade, as changes in the “between-industry” component of relative employment shown in Section 3.2 tended to be smaller than the changes in the trade pattern, the former falling only in France during the 1930s.

Two countries that saw different trends in the pattern of trade during the inter-war period were Canada and Denmark, where net exports of total manufactures grew steadily. In these countries the “between-industry” component of relative employment also grew faster after 1914 than before, suggesting that these trends in the trade pattern did have an important influence on the structure of employment. In Canada, where relative wages were stable or rising slightly over this period, the suggestion is that the change in the trade pattern provided a source of increasing relative demand. In Denmark, however, where relative wages continued falling during this period, the suggestion is that the changing trade pattern was not an exogenous demand-side force, instead reflecting increasing relative supply.²³

In the immediate post-WWII years, there is evidence to suggest that the large increases in net exports of all and skill-intensive manufactures were associated with large increases in the “between-industry” component of relative employment, and therefore that trade did provide an important contribution to the large increases in the economy-wide relative employment of skilled labour that occurred during these years. Even so, domestic considerations must have been equally important, especially during the 1950s when, despite the fact that the ratio of net exports of total and skill-intensive manufactures to GDP tended to stabilise or decline, there was no sign of smaller inter-industry employment shifts. Furthermore, the fact that relative wages tended to fall in the majority of countries over this period is evidence that once again changes in the trade pattern were not an

exogenous determinant of relative wage behaviour. Instead, both the increase in net exports of relatively skill-intensive products and falling relative wages are more consistent with a large increase in the domestic relative supply of skilled labour.

4.3 Summary

This section asks whether changes in the level and commodity composition of trade influenced trends in wage inequality over the century prior to 1970. It finds that:

- the impacts of changes in the pattern of trade on the relative employment of skilled labour were smaller than the impacts of migration;
- there are certain instances in which trade was also likely to have represented an important and exogenous influence on relative wage behaviour. One such example was Canada in the pre-WWI period, when trade appeared to contribute to the large fall in the relative demand for skilled manual workers identified in Section 3.1;
- however, there was often a tendency for the impacts of changes in the pattern of trade on the relative employment of skilled labour to be offset by important domestic forces. Such forces may have included increases in domestic consumption or investment demand for skill-intensive products, perhaps associated with a high income elasticity of demand for manufactures relative to agricultural products, and the growth of new skill-intensive industries within manufacturing;
- in those instances in which changes in the pattern of trade did have a close positive relationship with changes in the economy-wide relative employment of skilled labour, such as in the immediate post-WWII period, relative wages were tending to fall. The implication for these years is that, rather than increasing net exports of skill-intensive products driving up relative wages, large increases in the domestic relative supply of skilled labour simultaneously led to increasing net exports of skill-intensive products, and falling relative wages.

5 CONCLUSION

This paper studies the impact of globalisation on wage inequality in a group of eight now-developed countries during the hundred years prior to 1970. The dependent variable – the wage of skilled relative to unskilled labour – and methodology it uses are those of the debate regarding the impact of globalisation since 1970. The countries studied include three “New World” countries: the US, Canada, and Australia; and five “Old World” countries: the UK, Germany, France, Sweden and Denmark. This final section first summarises the main findings of the paper; it then goes on to discuss the implications of these findings for the broader debate on the impact of globalisation on inequality within countries.

5.1 Summary

On the basis of the previous four sections, and certain other studies, Figure 5.1 presents a stylised accounting of trends in the relative demand, relative supply, and relative wages of skilled workers between 1870 and 1970 in New and Old Worlds. For each region, one line is shown corresponding to the relative supply of skilled labour, and another to the relative demand for skilled labour, the vertical distance between the two lines representing the relative wage of skilled labour. When the two lines are parallel, the inference is that relative supply and demand are growing at the same rate, and that relative wages are constant. In the interests of clarity, Figure 5.1 highlights the most important differences between the two regions; differences within each region are referred to in the discussion.

Below each graph a table summarises the underlying forces driving the changes in relative demand and supply. There are two which affect relative demand. The first is labelled inter-sectoral (IS), referring to shifts in employment between sectors and industries that use skilled labour in different proportions. For example, increases in the share of employment in manufacturing, and, especially after 1914, new skill-intensive industries within manufacturing, increase the relative demand for skilled labour, although the main effect of the latter may be to increase the relative demand for the “semi-skilled”, rather than the traditional skilled manual workers considered in this paper.²⁴ The second is labelled aggregate demand (AD): periods of high aggregate demand (which included the two world wars as special cases) increase the relative demand for *unskilled* labour, thus tending to reduce relative wages, while periods of low aggregate demand reduce the relative demand for unskilled labour, thus tending to increase relative wages (Phelps Brown, 1977 p.76-77). There are two forces which affect the relative supply of skilled labour; one labelled migration (M), referring to the effect of international migration, and another labelled native relative supply (N), referring to increases in the relative supply of skilled labour due primarily to the expansion of education.

Thus, Figure 5.1 indicates that in the New World between 1870 and 1914, the relative supply of skilled labour increases despite the impact of immigration, because of large increases in the “native” relative supply of skilled labour. Between 1870 and 1890, there is little change in the relative demand for skilled labour, so that relative wages fall slightly. Between 1890 and 1914, however, relative demand increases because of inter-sectoral effects, so that relative wages rise. This description corresponds most closely to the US case; in Canada, the relative supply of skilled labour does fall over this period, and there is no increase in relative demand. Relative wages therefore also rise, but for different reasons.

In the New World between 1914 and 1955, relative supply accelerates, as a result of the end of immigration and an expansion of education, now tending to match the continued increase in relative demand.²⁵ However, between 1914 and 1920 there is a temporary increase in the relative demand for unskilled labour associated with WWI, so that relative wages fall. Furthermore, during the 1920s continued high levels of aggregate demand mean that, while relative demand and supply grow at the same rate, relative wages remain at a level lower than that implied by inter-sectoral effects.²⁶

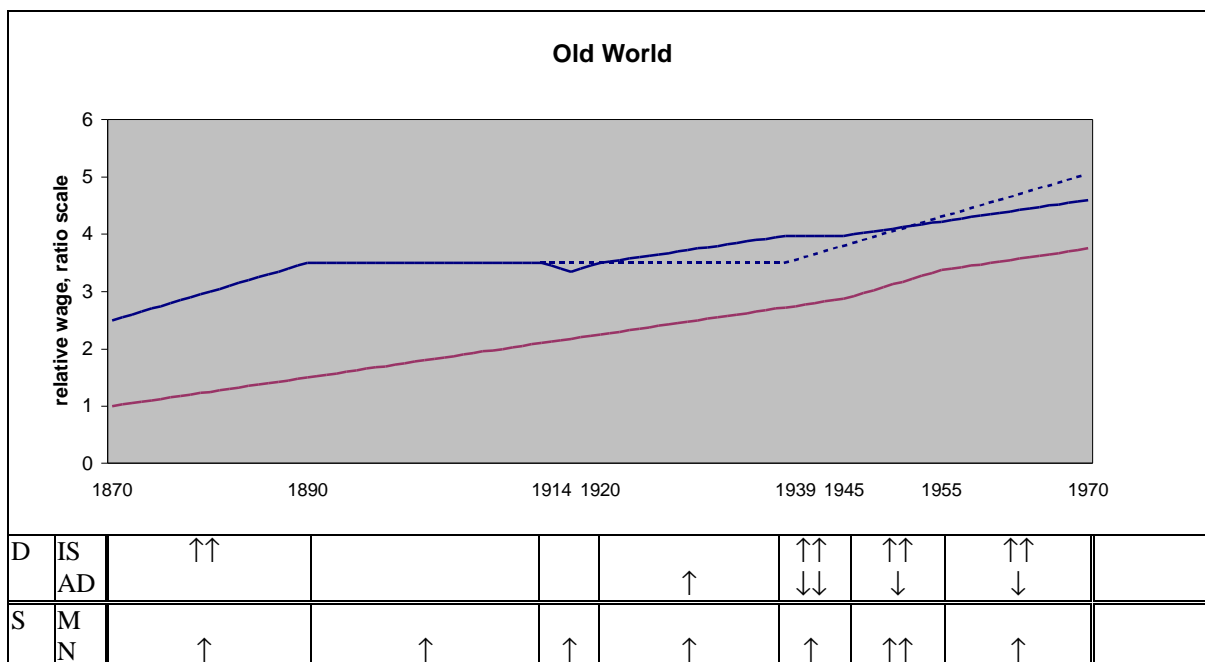
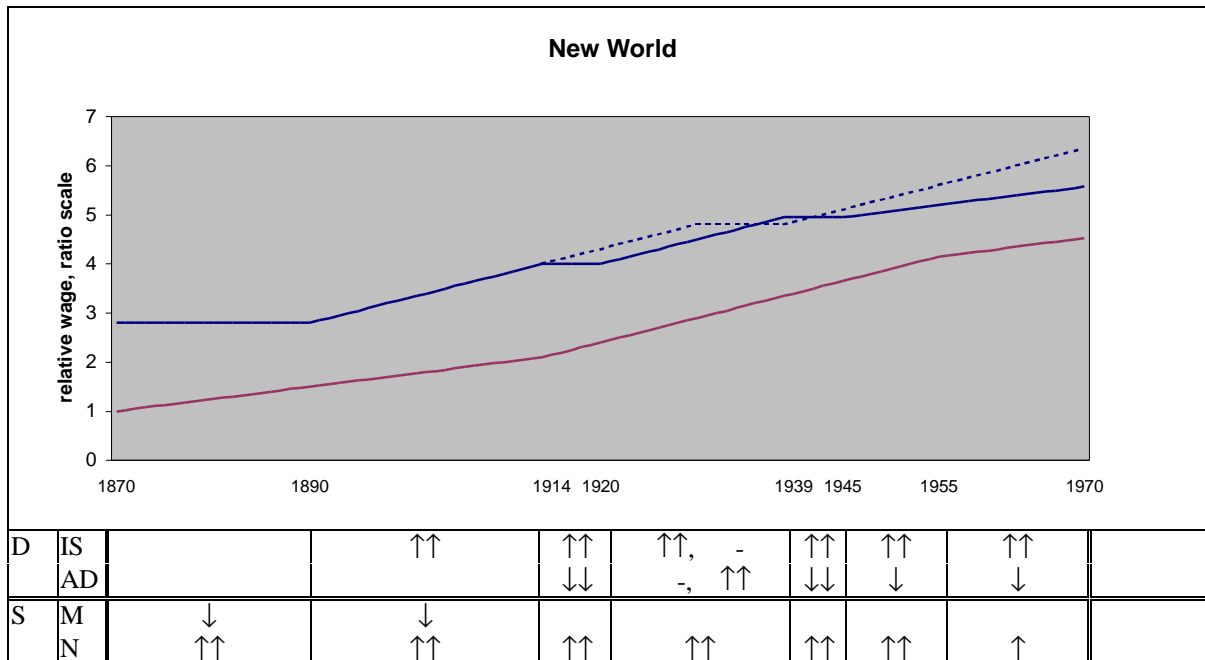


Figure 5.1 Stylised trends in the relative demand and supply of skilled labour, New and Old Worlds, 1870-1970

Notes: In the box below each graph, demand-side (D) explanatory forces include inter-sectoral shifts in employment (IS) and the level of aggregate demand (AD); supply-side (S) explanatory forces include international migration (M) and changes in the native relative supply of skilled labour (N). The dashed demand line indicates the level of relative demand due to inter-sectoral effects only. For example, if the dashed line is rising more steeply than the continuous line, this indicates that “structural” pressures to increase the relative demand for skilled labour are being offset by strong aggregate demand pressures to raise the relative demand for unskilled labour.

The subsequent low levels of aggregate demand during the 1930s would normally be expected to reverse this suppression of the level of relative wages. That this did not occur suggests that low aggregate demand also slowed the expansion of new skill-intensive industries. Thus, Figure 5.1 shows a temporary levelling of the dashed demand-line in the New World during the 1930s; although relative demand and supply continue to grow at the same rate, increases in the former are driven by aggregate demand rather than inter-sectoral effects.

Between 1940 and 1955 relative wages fall, as WWII and continued high levels of aggregate demand during the post-war economic boom increase the relative demand for unskilled labour, offsetting increases in the relative demand for skilled labour due to inter-sectoral effects.²⁷ The fall continues until 1955, when the increase in relative supply slows down as educational expansion begins to reach a limit, and relative wages stabilise.

Turning to the Old World, between 1870 and 1890 the relative demand for skilled labour increases due to inter-sectoral effects. Although relative supply is increasing, the increase in relative demand is large enough to push up relative wages. Between 1890 and 1914, however, relative demand stabilises while relative supply continues to increase, so that relative wages fall. During WWI, relative wages again fall due to an increase in the relative demand for unskilled labour, although – unlike the New World – this is soon reversed given the low level of aggregate demand during the 1920s. Between 1920 and 1939, the relative demand for skilled labour increases, but mainly because of aggregate demand rather than inter-sectoral effects; as in the New World during the 1930s, relative wages would have risen had both been in operation. Thus in the Old World throughout the inter-war period, the dashed demand-line in Figure 5.1 falls below the continuous line, indicating that relative wages would have continued to fall had demand reflected purely inter-sectoral effects.

After 1940, the relative demand for skilled labour does increase due to inter-sectoral effects. However, between 1940 and 1955 relative wages fall, because WWII and continued high levels of aggregate demand during the post-war economic boom increase the relative demand for unskilled labour, and because relative supply accelerates.²⁸

The experience of the UK differs from Figure 5.1 before 1914, when relative wages fall steadily in both the 1870-90 and 1890-1914 periods, and during WWI, when the fall in relative wages is permanent rather than transitory. In the former case, it appears that a growing relative supply of skilled labour due to emigration was more or less balanced throughout the period by a growing relative demand for skilled labour due to domestic inter-sectoral effects. In the latter case it appears that the war and its immediate aftermath brought about a large and permanent negative shift in the relative demand for skilled labour.²⁹

5.2 Implications for the Broader Debate

Recent research suggests that globalisation since 1970 has had a large impact on inequality between workers with different levels of skills (Wood, 1994, 1995). Recent research has also suggested that globalisation before 1970 had a large impact on inequality (O'Rourke *et al.*, 1996; Williamson, 1997). To date, evidence on the impact of globalisation before 1970 has focused on two dimensions of inequality: wage-rental ratios (measuring inequality between unskilled workers and landowners), and wage-productivity ratios (measuring inequality between unskilled workers and the average returns to all factors, including land, capital, labour, and skills). This paper adds to this evidence by explicitly analysing the impact of globalisation before 1970 on inequality between workers with different levels of skills. In doing so it also provides some interesting comparisons between the impacts of globalisation on wage inequality before and after 1970. The paper finds that:

1. Trends in wage inequality in the pre-WWI period (1870-1914) of globalisation were broadly similar to the trends shown by wage-rental and wage-productivity ratios, which increased in the New World and decreased in the Old. There were, however, a number of important differences. First, the similarity of trends exists only after 1890; before that date, wage inequality had tended to increase in the Old World and decrease in the New, contrary to the trends shown by wage-rental and wage-productivity ratios. Secondly, movements in wage inequality after 1890 represented a process of relative factor-price divergence, rather than the convergence shown by wage-rental ratios. Thirdly, in contrast to wage-productivity ratios, there was no tendency for wage inequality to fall further in Sweden and Denmark than in the UK, Germany and France,.
2. The impact of globalisation in the pre-WWI period on wage inequality was generally smaller than that on wage-rental and wage-productivity ratios. International trade did not have a significant impact on wage inequality in either New or Old World, which contrasts with the findings of O'Rourke *et al.* (1996), who report that commodity market integration in this period had a large impact on wage-rental ratios. Mass international migration in the pre-WWI period did sometimes have a large impact on wage inequality, but mainly in the New World countries of the US and Canada. This differs from the findings of Williamson (1997), who reports that that mass international migration had a large impact on wage-productivity ratios in both New and Old Worlds, contributing to particularly large falls in the countries of the Old World periphery, such as Sweden and Denmark.
3. After 1914, although there was a clear end to the process of increasing wage inequality in the New World and falling inequality in the Old World, wage inequality tended to move in similar directions in all countries. This differs from the findings of Williamson (1997), that the inter-war (1920-1939) period saw a reversal of the pre-WWI trends in wage-productivity ratios, which fell in the New World and rose in the Old World. "De-globalisation" in the inter-war period, characterised by the reduction

of trade flows, had little impact on wage inequality, and nor did the subsequent increase in trade in the immediate post-WWII period.

4. The impact of globalisation on wage inequality before 1970 tended to be smaller than its impact since 1970, except in the case of mass immigration in the New World before 1914. International trade did not at any stage have the importance which has been attached to it in the current debate.

Many of these findings are somewhat unexpected. It is surprising that international trade before 1970 did not have more impact, in comparison both with its impact on wage-rental ratios before 1970 and with its impact on wage inequality after 1970, given the large changes in openness to trade that took place in the period under study. The pre-WWI period witnessed large reductions in transport and communication costs, which probably matched those of the recent period. The years after 1914 first saw a reversal of this trend, due to large increases in artificial trade barriers during the 1920s and 1930s, followed by a re-emergence after WWII due to the dismantling of trade barriers and further reductions in the costs of international transport and communication.³⁰

This puzzle seems smaller when one considers certain important differences between globalisation before and after 1970. Globalisation between 1870 and 1914 involved the economic integration of two regions (New and Old World) that differed most significantly in terms of their relative endowments of land and labour. Reductions in trade barriers led to an expansion of demand for land in the New World and for labour in the Old, leading to the convergence of wage-rental ratios. Globalisation since 1970 has involved integration between two regions (North and South) that differ most significantly in terms of their relative endowments of skilled and unskilled labour. Reductions in trade barriers in this case have led to an expansion of demand for skilled labour in the North and for unskilled labour in the South, leading to the convergence of relative wages.

Thus there are two main reasons why international trade was not a significant exogenous driving force behind movements in wage inequality before 1970. First, the exchange of primary products for manufactures between New and Old World prior to 1970, while having a large impact on the demand for land relative to labour in each region, did not apparently affect the demand for skilled relative to unskilled labour in either region. This in turn may have been due to two possible reasons: one, that the average skill-intensity of manufactures and primary products did not differ substantially in this period; and two, that unskilled workers in the agricultural and industrial sectors were non-competing groups.

Secondly, trade in manufactures between 1870 and 1914, although substantial, was not driven by broad differences in skill endowments between countries. This conclusion differs from that of some other studies;³¹ however, it is supported by the fact that differences in the relative price of skills among these countries were not great, and in fact tended to diverge over this period (rather than converging between skill-abundant and skill-scarce countries).

This conclusion also provides clues as to why “de-globalisation” in the inter-war period, and the subsequent increase in trade after WWII, appeared to have had little exogenous impact on wage inequality. The largest reductions in the volume of trade during the 1930s were witnessed among trade in manufactures between developed countries, especially within Europe (Kenwood and Lougheed, 1983 p.231). Similarly, the great majority of the large expansion of trade in the immediate post-WWII period took place between developed countries. Thus the largest impacts of fluctuations in the pattern of trade after 1914 fell on that portion of trade which was most likely to have consisted of goods embodying fairly similar proportions of skilled and unskilled labour.

As a result, truly exogenous impacts of changes in the pattern of trade in manufactures before 1970 were small. Instead, these changes in trade, together with movements in wage differentials, appear to have been jointly driven by three other underlying “domestic” forces. One was the growth of new skill-intensive industries, associated with advances and diffusion of technology on the one hand, and increasing final demand for the products of these industries on the other, which was associated with increases in intra-industry trade. The second was fluctuations in the level of aggregate demand, which were as much a cause as an effect of “de-globalisation” and “re-globalisation” after 1914. For instance, the inter-war slump particularly hurt the expansion of intra-industry trade, where calls for protection from domestic sectors were loudest; similarly, the post-war boom particularly facilitated the expansion of intra-industry trade. The third was a steady exogenous increase in the relative supply of skilled labour, which tended to increase the share of manufactures and skill-intensive manufactures in total exports in all countries.

Thus, in summary, this paper finds only a small impact of globalisation on wage inequality in the century prior to 1970. However, the fact that a combination of domestic forces had, by 1970, reduced the relative wages of skilled labour to their lowest ever levels by historical standards was to have large implications for the post-1970 period. The emergence of a large disparity in the relative price of skilled labour between the developed countries considered in this paper and the less-developed countries not considered in this paper must have contributed to the search for ways of utilising cheaper foreign sources of unskilled labour, which provided the basis for an extension of globalisation after 1970 which *was* to have substantial impacts on wage inequality.

NOTES

- ¹ The wage being that of urban unskilled workers, and productivity being GDP per worker-hour.
- ² Trends in wage inequality are of course one component of trends in wage-productivity ratios; the contribution of this paper lies in disentangling it from trends in all the other non-skilled-wage elements of wage-productivity ratios.
- ³ Although it is not possible to measure skill endowments directly in this period, this is reflected in the fact that cross-country differences in skill differentials tended to be smaller than they were for wage-rental ratios, especially between the New and Old Worlds.
- ⁴ The flow of capital from Old World to New during the late nineteenth and early twentieth century may have had a large impact on wage inequality if there were complementarities between capital and skills, as has been shown in the recent period (e.g. Berman *et al.*, 1994). However, the degree to which capital and skills were complements rather than substitutes before the current period remains a complex issue (Goldin and Katz, 1996).
- ⁵ These occupational measures of the relative wages of skilled labour are also frequently used in the current debate; see, for example, Wood (1994, p. 435-444).
- ⁶ Wood (1994) reports a similar finding for the current period.
- ⁷ It is possible that the extent of return migration among skilled relative to unskilled workers was in fact an endogenous variable, which responded to changes in the demand for skilled relative to unskilled workers, and therefore tended to dampen the impact of migration on wage inequality in receiving countries. See Hatton and Williamson (1995) for an examination of “safety valve” or “guest worker” theories of immigration in the US before 1914.
- ⁸ This is not true, however, if farm labourers are included among “unskilled” migrants, in which case the impact of skilled immigration on domestic supply *falls* relative to the impact of unskilled immigration in the latter half of the pre-WWI period.
- ⁹ The procedure was also undertaken using values of 0.5 and 2 for the elasticity of substitution. In the former case, the predicted changes in relative wages were greater than in Table 2.1, so that the residual changes in relative wages were also greater. In the latter case, the predicted and residual changes were smaller than in Table 2.1. However, in the majority of cases, only the magnitude (as opposed to the direction) of the residual varied under these alternative assumptions.
- ¹⁰ The most likely reason for large increases in the “native” relative supply of skilled manual workers was the expansion of education: data in Fishlow (1966 p. 430), for example, shows that total educational expenditures in the US grew from 0.8% of GNP in 1860 to 1.7% in 1900.
- ¹¹ Total educational expenditures in the US as a proportion of GNP in fact grew faster between 1880 and 1900 than they did between 1860 and 1880 (Fishlow, 1966 p. 430). The number of patents granted for inventions - a common barometer of the pace of technological change - shows a constant rate of increase in the US between 1870 and 1914 (Thomas, 1973 p.173).

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- ¹² A different conclusion applies when considering the relative wages of non-manual workers in the UK before 1914. In this case, the impact of migration on relative supply was small, and the “residual” change in relative wages is negative, implying that the combined effect of forces other than migration was to reduce relative wages.
- ¹³ For instance, evidence on the increase in trade unionism suggests that the importance of labour-market institutions grew rapidly in Europe between 1910 and 1920, but a similar trend did not take place in the US until between 1935 and 1945 (Thomas, 1992; Fortin and Lemieux, 1997).
- ¹⁴ The exceptions are the cases of skilled manual labour in the US and non-manual labour in Canada, where the evidence suggests that the decline reflected large increases in the relative supply of skilled labour.
- ¹⁵ The exceptions are the cases of skilled manual labour in the US and Canada, where the evidence suggests an increase in the relative demand for skilled manual labour over this period, as the fall in relative wages was smaller than the rise in relative employment
- ¹⁶ See Appendix 3 for a fuller discussion of the estimating procedure. In estimating shifts in the “between” component of relative employment, the level of disaggregation of employment data by industry is important. In this paper, employment is broken down into four “sectors” (agriculture, mining, manufacturing and construction), and seven “sub-sectors” within manufacturing (food, beverages and tobacco; textiles and leather; paper and printing; construction materials and furniture; metals; chemicals; and miscellaneous). Service employment is omitted from the calculations.
- ¹⁷ This is confirmed by Appendix 3.2, which shows that employment shifts between broad *sectors* were less important determinants of the relative employment of skilled labour (relative to shifts within *manufacturing*) in the UK than in other countries.
- ¹⁸ In Canada, due to the unavailability of data on employment by industry prior to 1911, it is not possible to ask whether the changes in the relative demand for skilled labour identified in Section 3.1 reflected inter- or intra-industry employment shifts.
- ¹⁹ Under the latter assumption, the impact of trade on factor use is calculated as $Z = X(z_x - \mathbf{I}z_m)$, where the vector z_m contains the average use of skilled and unskilled labour per million dollars of manufactured imports, and \mathbf{I} equals the share of manufactured imports in total imports.
- ²⁰ The effect on relative employment in log points is calculated as $\ln\left(\frac{1 + \Delta T_{st}/N_{st}}{1 + \Delta T_{ut}/N_{ut}}\right)$, where ΔT_{kt} is the change in the factor content of trade of skill group k over the period, and N_{kt} is domestic employment of skill group k at the period end.
- ²¹ A proper treatment of changes in the trade balance would need to consider the role of capital flows and the non-traded sector in influencing relative wage outcomes. However, as explained in

the introduction, it has not been possible to explore these issues within the confines of the present paper.

²² The increase in net exports of total manufactures was much larger than the increase in net exports of skill-intensive manufactures, reflecting the large difference between the FCT calculations under alternative assumptions regarding the degree to which imports of primary products were competing.

²³ The picture for the immediate post-WWII years in Denmark is slightly different; during the 1950s, a particularly large increase in the between-industry component of relative employment coincided with a particularly large increase in net exports of manufactures as a proportion of GDP, and a reversal of the long-run decline in relative wages, suggesting that trade was an important exogenous influence on relative wages.

²⁴ The semi-skilled (termed “operatives” in the US labour statistics) were an increasingly important occupational class of manual workers after 1914, mainly - although not totally - because of the expansion of new manufacturing industries in which they were employed in relatively high proportions. The effect of the increase in the demand for semi-skilled workers on the wage differential between skilled and unskilled manual workers depends on the extent to which either skilled or unskilled manual workers were relative complements or substitutes.

²⁵ Goldin and Katz (1997) suggest that the acceleration of educational expansion in the US and Canada between 1910 and 1940 led to a large gap in attainments relative to the UK and other European countries, which had only been partially eroded by the mid-1950s. The same authors also argue that the increase in relative demand in the US between 1910 and 1940 not only reflected the growth of new skill-intensive industries, but also the emergence of certain new technologies, such as electrification and continuous or batch processes of production (Goldin and Katz, 1996).

²⁶ Average unemployment rates between 1922 and 1929 were 3.2% in Canada, 3.8% in the US, and 5.5% in Australia, compared with 8.0% in the UK, 9.9% in Germany, and 11.4% in Sweden (Mitchell, 1992 p. 159; 1993 p.108).

²⁷ Fortin and Lemieux (1997) also suggest that changing institutional influences may have been important in explaining the fall in relative wages in the US during this period.

²⁸ Postan (1967, p.319) documents that in the UK, 45% of youths entering employment at the end of the 1950s were trained for skilled jobs, compared with less than 20% before WWII. Similar changes also took place in France and Germany.

²⁹ Other authors have noted how the expansion of new industries and processes of production during WWI particularly hurt British skilled manual workers, who saw the demand for their services fall relative to the “semi-skilled” (Pollard, 1992 p.34,41). It has also been noted that the 1910-20

decade saw a large change in labour-market institutions which was biased toward the fortunes of the unskilled (Phelps Brown, 1977 p. 77).

³⁰ In the UK, for example, trade openness (the ratio of the sum of total exports and imports to GDP) varied from 44% in 1870, to 48% in 1913, 25% in 1938 and 32% in 1960.

³¹ Crafts and Thomas (1986) for example, have argued that in the UK, comparative advantage within manufacturing lay in less skill-intensive products, in contrast to the US and Germany where comparative advantage lay in more skill-intensive products.

Appendix 1. Data sources

A1.1 THE WAGES OF SKILLED RELATIVE TO UNSKILLED MANUAL WORKERS

UK *1870-1913*: Weekly wage rates of bricklayers relative to bricklayers' labourers, unweighted average across regions, from Knowles and Robertson (1951 Table 1 p.111). Linear interpolation used for missing observations. Series extrapolated from 1880 to 1870 using the nominal annual earnings of skilled building workers relative to urban common labourers in Williamson (1982 Appendix Table 4 p.48). *1913-1945*: As above, average across 39 towns. *1945-1965*: As above, extended to 1965 using hourly wage rates of bricklayers relative to bricklayers' labourers, average of London and Manchester, from ILO *Yearbook of Labour Statistics* (various years) and UK DoE (1971 Table 9 p.40-41). Linear interpolation used for missing observations in 1948, 1961, and 1963-64.

GERMANY *1870-1943*: Hourly wage rates of skilled relative to unskilled building workers, average of 3 cities 1871-1913, all cities 1913-43, from Bry (1960 Table A4 p.335-337). Missing observations in 1914-1923 estimated using index of hourly wage rates of skilled and unskilled building workers (ibid., Table A39, p.437). *1951-1962*: Hourly wage rates of skilled building workers (average of six occupations) relative to building labourers, country-wide average, from ILO *Yearbook of Labour Statistics* (various years).

FRANCE *1873-1952*: Hourly wage rates of bricklayers and carpenters relative to common labourers in the Paris region, from INSEE (1961, Table 1 p.252). Linear interpolation used for missing wage observations from 1874-79, 1881-95, 1897-99, 1902-5, 1907-1910, 1922-23.

DENMARK *1870-1965*: Hourly wage rates of skilled relative to unskilled male workers in the crafts and industries, from Johansen (1985 Table 7.5).

SWEDEN *1870-1930*: Hourly earnings of skilled relative to unskilled municipal workers in all towns, from ISS (1935 Vol II Part 2 p.27). Series extrapolated backwards from 1890 to 1870 using hourly earnings of skilled relative to unskilled municipal workers in Stockholm (ibid. p.55). *1931-62*: Hourly earnings of skilled relative to unskilled building workers in Stockholm from ILO *Yearbook of Labour Statistics* (various years) used to extrapolate forward the all town series from 1931.

UNITED STATES *1870-1907*: Ratio of skilled to unskilled wage rates in manufacturing and building, daily wage rates to 1890 and weekly rates thereafter, taken from Williamson & Lindert (1980 Appendix D Table 5 p.307). *1907-1960*: Hourly wages of skilled building workers relative to helpers and labourers from Williamson & Lindert (1980, Appendix D Table 13 and 14).

CANADA 1900-30: Hourly wages of fitters and machinists relative to labourers in the railway industry, average of four provinces weighted by population shares, from MacKinnon (1996, Table 1 p.118-119). 1946-62: Hourly wages of fitters and turners relative to engineering labourers, all Canada average, from ILO *Yearbook of Labour Statistics* (various years).

AUSTRALIA 1879-1913: Daily wage rates of bricklayers relative to bricklayers' labourers in Sydney, from Allen (1990, Appendix Tables 3 and 4, p.45-46). 1914-1945: Weekly wage rates of skilled relative to unskilled workers, average across sectors in Melbourne, from Oxnam (1950, Table 1 p.115).

A1.2 THE WAGES OF NON-MANUAL RELATIVE TO MANUAL WORKERS

UK 1871-1911: Weighted average of the annual earnings of non-manual workers divided by the weighted average of the annual earnings of manual workers (the latter excluding agricultural workers), from Williamson (1982 App. Table 4 p.48); occupational weights from App. Table 1 p.31. 1913-1960: Weighted average of the annual earnings of non-manual workers divided by the weighted average of the annual earnings of manual workers from Routh (1980 Table 2.27 p.120-121), occupational weights from Table 1.1 p.6-7. Linear interpolations are used between observations.

UNITED STATES 1890-1926: Annual earnings of salaried employees relative to wage earners in manufacturing from Douglas (1930, Table 133 p.361 and Table 147 p.392); 1927-1938 Annual earnings of salaried employees relative to wage earners in manufacturing constructed from data in Kuznets (1954, Tables M5,M7,M22,M24); 1939-1960 Average annual earnings of male white-collar (professional, technical; managers, officials; clerical; sales workers) relative to male blue-collar (craftsmen; operatives; service workers; labourers) workers, from Miller (1966, Table III-6 p.82).

CANADA 1905-1959: Annual earnings of supervisory/office employees relative to production workers, from Urquhart (1965 Series D280-287 p.99), with linear interpolations for the years 1906-1914 on the basis of data for 1905 and 1910.

A1.3 Migration flows of skilled and unskilled labour

UNITED STATES US Dept. of Commerce (1975, Series C120-137, p.110-111). Between 1870 and 1898, series 133 (skilled) and 136 (labourers) are used for the number of skilled and unskilled manual immigrants respectively. Between 1899 and 1923, series 125 (craftsmen, foremen, operatives and kindred workers) and 129 (labourers, excl. farm and mine) are used. For "non-manual" immigrants series 131 and 132 were used between 1870 and 1898; between 1899 and 1923 series 121, 123 and 124 were used. For "manual" immigrants series 133 and 136 were used before 1899 and series 125 and 129 thereafter.

CANADA Urquhart (1965 Series A284-299, p.25). Series 293-4 (skilled mechanics) and series 295-6 (unskilled and semi-skilled labourers) are used for the number of skilled and unskilled manual migrants (half of the latter series – a rough estimate of the number of "semi-skilled" - is added to the former series).

UK 1876-1911: Thomas (1973 Tables 10 and 12, p.60,63). Between 1876 and 1900 "skilled workers" and "labourers and domestic servants" are used for skilled and unskilled manual migrants respectively;

between 1903 and 1911 “skilled” and “labourers” are used. Data are expressed as annual averages of 5 or 3 year period totals.

GERMANY 1901-24: Ferenczi and Willcox (1929 p.335-336). “Agriculture” and “domestic service and general labour” are used for unskilled, “industry” for skilled. 1870-1900: estimated from total emigration in Mitchell (1992 Table A9 p.126) using the average shares of skilled and unskilled workers in total emigration between 1901 and 1915.

DENMARK Ferenczi and Willcox (1929 p.669). “Agriculture” and “domestic service and general labour” are used for unskilled, “industry” for skilled. Data refer to male emigrants only.

SWEDEN 1891-1924 Ferenczi and Willcox (1929 p.759). “Agriculture” and “domestic service and general labour” are used for unskilled, “industry” for skilled. Data includes continental migration. 1870-1890 estimated from total emigration in Mitchell (1992 Table A9 p.126) using the average shares of skilled and unskilled in total emigration between 1891 and 1914.

A1.4 Relative employment of skilled labour

UK Routh (1980 Table 1.1 p.6-7); Non-manual includes all professional, managerial and clerical workers (groups 1A,1B,2A,2B,3); manual includes all skilled, semi-skilled, and unskilled manual workers (groups 5,6,7). Skilled manual corresponds to group 5; unskilled manual to group 7 (which does not include farm labourers or private household workers).

UNITED STATES US Dept. of Commerce (1975 Series D182-232 p.139). Non-manual includes all white-collar workers (series 184-187), manual includes all blue-collar workers (series 190-192). Skilled manual corresponds to series 190 (craftsmen, foremen and kindred workers); unskilled manual to series 192 (all labourers, except farm and mine).

CANADA Urquhart (1965 Series D86-106). Non-manual includes all professional occupations, owners and managers, and clerical and sales workers (series 89,92,95); manual includes operatives and labourers (series 98 & 104); farmers and farm workers are excluded from both. Series 98 (operatives) and 104 (labourers) are used for skilled and unskilled manual workers respectively.

A1.5 Industrial structure of employment

UK Mitchell (1992 Table B1 p.156) for employment by sector; industrial shares within manufacturing are from OECD (various years) for 1951 and 1961; with earlier years spliced back from data in UK DoE (1971 Table 103 p.197 for 1921-51, and Table 102 p.195 for 1871-1921). There is a break in the latter series between 1911 and 1921.

GERMANY Hoffman (1965, Table 15 p.196-7 and Table 20 p.204-6);

FRANCE INSEE (1961, Table 1 p.86);

SWEDEN AND DENMARK Bairoch (1971 p.114-5; 90-91), which includes employment by broad sector only;

UNITED STATES US Dept of Commerce (1975 Series D167-181 p.139) for employment by sector; industrial shares within manufacturing are from OECD (various years) for 1950 and 1960, Fabricant (1942, Table B1 p.211-212 and Table B2 p.218-220) for 1900-40, and Edwards (1943 Table 8 p.105-

112) for 1870-1890. The latter are not entirely accurate as they combine an industrial and occupational classification of workers.

CANADA Urquhart (1965 Series D8-85)

AUSTRALIA Vamplew (1987 Table LAB 50-58 p.149 and Table MANF 13-22 p.289).

A1.6 Trade flows

UK Mitchell (1987 Table 5 p.456-459 and Tables 10-11 p.474-485);

GERMANY Hoffman (1965 Table 125-128 p.520-529);

FRANCE INSEE (1961 Table II p.199);

DENMARK Johansen (1985 Tables 4.1 and 4.2);

SWEDEN Johansson (1967 Tables 49 and 51, p.138-143);

UNITED STATES US Dept. of Commerce (1975 Series U213-224 p.889-890, and U274-316 p.897-902);

CANADA Urquhart (1965 Series F246-269 p.174-177) and Mitchell (1993 Table E5 p.495-505).

A1.7 The benchmark relative wage estimates

1905 Weekly wages of skilled relative to unskilled manual workers for the UK, Germany, France, and US are from Williamson (1995 Table A3.1 p.184), the original sources being UK Board of Trade reports. The US data refers to 1909. Wages are unweighted averages across a range of skilled occupations in the building sector. The data for Canada and Australia is taken from an international comparison of the wages of skilled and unskilled building workers in Allen (1990 Appendix Tables 4 and 5 p.45-6). In this case however, skilled building workers refer to bricklayers only, and as these workers tended to be among the highest paid of the skilled building occupations, probably over-estimates the average relative wage. I therefore used wage rates of other building occupations in 1905 (in Urquhart, 1965 Series D40-59, p.86-87) to re-estimate the average wage of skilled relative to unskilled building workers in Canada for this benchmark year. Lacking similar alternative wage sources for Australia, I used the same adjustment ratio as that of Canada. For Sweden and Denmark, independent estimates of relative nominal wages for this benchmark year were not available.

1927 Hourly wages of skilled relative to unskilled workers for the UK, Germany, France, US, Canada, and Australia are taken from ILO, *International Labour Review*, April 1927 and January 1928. Skilled workers in building refer to an average of bricklayers/masons, carpenters, plumbers, joiners and painters; skilled workers in engineering refer to an average of fitters, turners, patternmakers and ironmoulders. Unskilled refers to labourers in each sector. Unlike the 1905 benchmark, wages are given not as country averages but for various cities - London, Berlin, Paris, Philadelphia, Ottawa, and Sydney. Again for Sweden and Denmark, independent estimates of relative wages for this benchmark year were not available.

1955 Hourly wages of skilled relative to unskilled workers for the UK, Germany, Sweden, US, Canada and Australia are taken from ILO *Yearbook of Labour Statistics 1956* (Table 20 p.285-302). The data for France refers to 1952. Skilled workers in building refer to bricklayers/masons, carpenters, plumbers, painters and electrical fitters; skilled workers in engineering refer to fitters, patternmakers and ironmoulders. Unskilled refers to labourers in each sector. The data for Germany, Canada, US and Sweden refer to national averages (the latter two by unweighted averages of cities); for other countries

the data refer to rates in London, Paris, and Sydney. For Denmark, independent estimates of relative nominal wages for this benchmark year were not available.

Table A1.1 presents the relative wage estimates at benchmark years together with the relative wage estimates obtained by extrapolating each benchmark forward or backward using the national time series. Overall, the results are close, suggesting that the national time series are reliable indicators of actual long-run movements of relative wages, and that the results of cross-country comparisons of relative wages are robust to the choice of benchmark.

The largest discrepancies emerge for the US, France, and Germany. Tables A1.1 suggests either that the relative wage reported in the ILO *International Labour Review* (April 1928) for the US is an underestimate, or that the national relative wage series underestimates the fall in relative wages between 1909 and 1927. The former is more plausible given that the benchmark data for 1927 refer to union wage rates in Philadelphia; MacKinnon (1996, p.120) argues that in northern US cities, payroll earnings of builders' labourers were much lower than union scales on an hourly basis.

	1905	1905 <i>extrapolated from 1927</i>	1927	1927 <i>extrapolated from 1905</i>	1955	1955 <i>extrapolated from 1927</i>
US	1.653	1.573	1.482	1.558	1.452	1.084
Canada	1.445	1.323	1.550	2.185	1.352	1.323
Australia	1.303		1.111			
UK	1.470	1.495	1.296	1.274	1.165	1.128
Germany	1.312	1.502	1.302	1.137	1.451	1.465
Sweden	1.162		1.091		1.186	1.003
Denmark	1.324		1.250		1.204	1.203
France	1.467	1.888	1.333	1.035	1.258	1.677

Table A1.1 Comparison of benchmark estimates with the national extrapolated estimates

For Germany, it appears that the UK Board of Trade data underestimates the relative wage in 1905; while there is a large discrepancy for the 1905/1927 comparison, the 1927/1955 comparison is much closer, suggesting that the 1905 rather than 1927 data is biased. The large discrepancies for the French building sector reflect the somewhat limited sources of historical wage data. It appears that the 1927 benchmark relative wage is an overestimate, reflected in the fact that it overestimates the 1927 relative wage extrapolated from 1905, and its extrapolated value in 1952 overestimates the benchmark relative wage for that year.

APPENDIX 2 THE BETWEEN-INDUSTRY COMPONENT OF RELATIVE EMPLOYMENT

A2.1 SECTORAL EMPLOYMENT COEFFICIENTS

Tables A2.1 presents the estimates of s_{kj} , the employment of occupational group k as a percentage of total employment in sector j . It also shows relative employment in each sector, measuring skill-intensity.

	Non- manual	Manual	Relative employ- ment	Skilled manual	Unskilled manual	Relative employ- ment

<i>Sector</i>						
Manufacturing	13.25	86.75	0.15	19.6	5.9	3.3
Construction	8.83	91.17	0.10	53.8	16.9	3.2
Mining	7.20	92.80	0.08	22.3	54.4	0.4
Agriculture	4.54	95.46	0.05	0.7	36.1	0.02
<i>Sub-sector</i>						
Chemicals	23.84	76.16	0.31	17.2	5.5	3.1
Paper & printing	23.69	76.31	0.31	24.5	3.0	8.2
Food, beverages & tobacco	18.01	81.99	0.22	14.4	7.4	1.9
Miscellaneous	16.52	83.48	0.20	17.4	2.2	5.3
Metals	12.92	87.08	0.15	25.2	4.9	5.4
Construction materials & furniture	10.41	89.59	0.12	16.0	19.5	0.8
Textiles & leather	9.05	90.95	0.10	8.1	2.4	3.3

Table A2.1 Benchmark calculations of sectoral employment coefficients

Source: Kuznets (1954, Tables A3 p.545; Q9 p.557; M22 p.597; M24 p. 599; C4 p. 643); Bairoch (1971, Table D6 p.163).

The coefficients in Table A2.1 are calculated from US data, using 1919 for the non-manual/manual comparison and 1960 for the skilled/unskilled manual comparison. UK data for 1951 generated similar results. Employers and the self-employed are not included among non-manual workers, which ensures the result that agriculture is less skill-intensive than manufacturing. Within manufacturing there is little change to the ranking of skill-intensity when the self-employed are included among non-manual workers. For agriculture, farm labourers are included among the unskilled manual group; for mining, “operatives” are included.

The service sector is omitted in both cases, the reason being that it is harder to measure skill-levels on an occupational basis in this sector. Also, the classifications of service sectors used in employment data often differ substantially across countries. In any case, the largest shifts in employment toward services associated with deindustrialisation did not really begin until the 1970s, beyond the coverage of this paper.

A2.2 Total, inter-sectoral, and intra-manufacturing effects

Table A2.2 and A2.3 show changes in the estimated “between-industry” component of relative employment, for non-manual/manual labour and skilled/unskilled labour respectively, obtained by weighting the sectoral employment coefficients by their respective shares of total employment in each year. Each table also provides a breakdown of the total change into that part due to inter-sectoral shifts in employment, and that part due to shifts in employment within the manufacturing sector. For instance, Table A2.2 suggests that shifts in the industrial structure of employment in the UK between 1871 and 1961 would have led to an increase in the employment of skilled relative to unskilled manual workers of 0.78 log points, had other factors remained constant. Of this figure the majority (0.60 log points) was accounted for purely by inter-sectoral shifts in employment.

Skilled/unskilled manual workers (log points)											
UK				Germany				France			
Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg
1871-81	0.10	0.09	0.01	1870-80	0.05	0.05	0.01				
1881-91	0.07	0.06	0.01	1880-90	0.29	0.28	0.02				
1891-1901	0.11	0.09	0.02	1890-1900	0.16	0.13	0.03				
1901-11	-0.04	-0.05	0.01	1900-10	0.07	0.05	0.02				

1911-21	0.00	-0.06	0.06	1910-25	0.17	0.13	0.03	1906-21	0.08	0.02	0.06
1921-31	0.11	0.12	-0.01					1921-31	0.26	0.24	0.02
1931-51	0.28	0.22	0.05	1925-40	0.22	0.18	0.04	1926-36	-0.03	-0.04	0.01
1951-61	0.15	0.12	0.03	1940-50	0.06	0.07	-0.01	1936-46	0.08	0.06	0.03
				1950-60	0.50	0.43	0.06	1946-60	0.64	0.61	0.04
Total	0.78	0.60	0.19		1.51	1.33	0.22		0.95	0.83	0.17

US				Canada				Australia			
Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg
1870-80	-0.03	-0.04	0.01								
1880-90	0.23	0.23	0.00								
1890-1900	0.00	-0.02	0.01								
1900-10	0.19	0.18	0.01					1891-1914	0.09	0.08	0.00
1910-20	0.14	0.08	0.04	1911-21	-0.07	-0.08	0.01	1914-19	-0.23	-0.22	0.00
1920-30	0.07	0.07	0.00	1921-31	0.14	0.14	0.00	1919-29	0.27	0.25	0.02
1930-40	0.11	0.12	-0.01	1931-41	0.10	0.07	0.02	1929-39	-0.01	-0.02	0.01
1940-50	0.41	0.38	0.03	1941-51	0.39	0.39	0.00	1939-49	0.26	0.23	0.02
1950-60	0.28	0.24	0.03	1951-61	0.39	0.40	-0.01	1949-59	0.18	0.15	0.03
Total	1.39	1.23	0.11		0.96	0.93	0.03		0.55	0.46	0.04

Table A2.2 Changes in the “between” component of the relative employment of skilled manual workers; total, inter-sector and inter-industry effects

Notes: The influence of purely inter-sectoral movements in any one period is estimated by holding the industrial shares of manufacturing employment constant at the base year level, and calculating the ensuing change in economy-wide relative employment. The influence of purely intra-manufacturing movements in any one period is estimated by holding the sectoral shares of total employment constant at the base year level, and then calculating the ensuing change in economy-wide relative employment. Inter-sector and inter-sector effects do not always sum exactly to the total change in relative employment, although the difference is generally small.

Non-manual/manual labour (log points)											
UK				Germany				France			
Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg
1871-81	0.04	0.02	0.02	1870-80	0.03	0.01	0.02				
1881-91	0.05	0.03	0.02	1880-90	0.06	0.06	0.00				
1891-1901	0.04	0.01	0.02	1890-1900	0.06	0.04	0.02				
1901-11	0.02	0.00	0.02	1900-10	0.03	0.01	0.02				
1911-21	0.03	0.01	0.02	1910-25	0.07	0.05	0.02	1906-21	0.03	0.00	0.03
1921-31	0.02	0.01	0.01					1921-31	0.08	0.06	0.01
1931-51	0.08	0.04	0.04	1925-40	0.04	0.04	0.00	1926-36	0.00	-0.02	0.02
1951-61	0.03	0.02	0.02	1940-50	0.02	0.01	0.01	1936-46	0.02	0.00	0.01
				1950-60	0.15	0.12	0.03	1946-60	0.20	0.17	0.03
Total	0.31	0.13	0.16		0.46	0.44	0.09		0.31	0.19	0.10

US				Canada				Australia			
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Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg	Year	Total	Inter-sector	Intra-mnfrg
1870-80	0.02	0.00	0.02								
1880-90	0.05	0.05	-0.01								
1890-1900	0.01	0.00	0.01								
1900-10	0.09	0.08	0.01					1891-1914	0.05	0.05	0.00
1910-20	0.12	0.10	0.02	1911-21	0.01	0.00	0.01	1914-19	0.01	0.00	0.01
1920-30	-0.02	-0.03	0.01	1921-31	0.04	0.04	0.00	1919-29	0.03	0.04	-0.01
1930-40	0.05	0.06	-0.01	1931-41	0.07	0.08	-0.01	1929-39	0.04	0.04	0.00
1940-50	0.14	0.11	0.03	1941-51	0.13	0.12	0.01	1939-49	0.11	0.10	0.00
1950-60	0.08	0.06	0.02	1951-61	0.15	0.12	0.03	1949-59	0.04	0.03	0.01
Total	0.55	0.42	0.08		0.40	0.35	0.04		0.29	0.26	0.03

Table A2.2 Changes in the “between” component of the relative employment of non-manual workers; total, inter-sector and inter-industry effects

Notes: As Table A2.2.

A2.3 Changes in total relative employment: between-industry and within-industry components

Country	Year	Non-manual/manual			Skilled/unskilled manual		
		Total	Between	Within	Total	Between	Within
UK	1911-21	0.17	0.03	0.14	-0.44	0.00	-0.44
	1921-31	0.01	0.02	-0.01	-0.12	0.11	-0.23
	1931-51	0.33	0.08	0.25	0.14	0.28	-0.14
	1951-61	0.21	0.03	0.18	-0.07	0.15	-0.22
US	1900-10	0.14	0.09	0.05	0.11	0.19	-0.08
	1910-20	0.11	0.12	-0.01	0.13	0.14	-0.01
	1920-30	0.18	-0.02	0.20	0.05	0.07	-0.02
	1930-40	0.05	0.05	0.00	0.08	0.11	-0.03
	1940-50	0.14	0.14	0.00	0.51	0.41	0.10
	1950-60	0.19	0.08	0.11	0.17	0.28	-0.11
Canada	1911-21	0.42	0.01	0.41			
	1921-31	-0.26	0.04	-0.30			
	1931-41	0.00	0.07	-0.07			
	1941-51	0.21	0.13	0.08			
	1951-61	0.21	0.15	0.06			

Table A2.4 Changes in total relative employment: decomposition into between-industry and within-industry components

Notes: Data are expressed as log differences. The “within” component is the residual obtained after subtracting the between component from the total change.

Table A2.4 presents a breakdown of changes in total relative employment into the “between-industry” and “within-industry” effects, for those three countries for which data is available. The main point to note is that changes in the “between-industry” component of relative employment can account for a much larger part of total changes in relative employment in the US (and to a lesser extent Canada) than in the UK.

APPENDIX 3 FACTOR CONTENT OF TRADE (FCT) CALCULATIONS

A3.1 SECTORAL TRADE SHARES

FOR THE US, TOTAL EXPORTS AND IMPORTS ARE BROKEN DOWN INTO THE FOLLOWING CATEGORIES: CRUDE FOOD, CRUDE MATERIALS, MANUFACTURED FOOD; SEMI-MANUFACTURES; FINISHED MANUFACTURES. USING DATA FROM MAIZELS (1963) FOR 1899 AND 1913, TOTAL EXPORTS AND IMPORTS OF SEMI- AND FINISHED MANUFACTURES CAN BE BROKEN DOWN INTO TEXTILES AND CLOTHING; METALS & MACHINERY; CHEMICALS; MISCELLANEOUS FINISHED; AND MISCELLANEOUS SEMI-MANUFACTURES. FOR THE UK, THE SECTORAL BREAKDOWN OF TRADE FLOWS IS SLIGHTLY DIFFERENT, WITH THREE BROAD CATEGORIES AS FOLLOWS: FOOD, DRINK AND TOBACCO; RAW MATERIALS AND MAINLY UNMANUFACTURED GOODS; AND MAINLY MANUFACTURED GOODS. WITHIN THE THIRD CATEGORY, HOWEVER, DATA CAN AGAIN BE USED FROM MAIZELS (1963) FOR 1899 AND 1913, TO DIVIDE MAINLY MANUFACTURED EXPORTS AND IMPORTS INTO TEXTILES AND CLOTHING; METALS & MACHINERY; CHEMICALS; MISCELLANEOUS FINISHED; AND MISCELLANEOUS SEMI-MANUFACTURES.

US	<i>Exports</i>			<i>Imports</i>		
	1899	1913	1937	1899	1913	1937
Crude food and materials	0.43	0.38	0.25	0.45	0.47	0.45
Manufactures	0.57	0.62	0.74	0.55	0.52	0.53
<i>of which:</i>						
Food	0.25	0.13	0.05	0.18	0.11	0.14
Textiles and leather	0.03	0.04	0.03	0.22	0.20	0.10
Chemicals	0.03	0.04	0.06	0.04	0.07	0.03
Metals and machinery	0.18	0.30	0.50	0.03	0.05	0.09
Other finished manufactures	0.05	0.08	0.08	0.07	0.07	0.07
Other Intermediates	0.02	0.03	0.02	0.01	0.03	0.10
<i>UK</i>						
Food, beverages and tobacco	0.05	0.06	0.08	0.44	0.38	0.42
Raw materials and mainly unmanufactured goods	0.11	0.14	0.13	0.31	0.37	0.31
Mainly manufactured goods	0.84	0.80	0.80	0.25	0.25	0.27
<i>of which:</i>						
Textiles and clothing	0.43	0.39	0.27	0.11	0.09	0.03
Chemicals	0.04	0.05	0.06	0.02	0.02	0.02
Metals and machinery	0.29	0.28	0.34	0.04	0.07	0.14
Other finished manufactures	0.07	0.07	0.09	0.06	0.05	0.04
Other semi-manufactures	0.01	0.01	0.03	0.03	0.03	0.04

Table A3.1 Shares of total exports and imports by sector, 1899-1937

A3.2 Factor input coefficients

The earliest year for which I have data on employment and gross output by sector is 1919 in the US, from Kuznets (1954), which is used for the 1899 and 1913 FCT calculations, while 1937 data from the same source are used for the 1937 calculations. Sectors are classified as follows: agriculture, mining, manufacturing; within manufacturing: food and tobacco, textiles and leather, metals, chemicals, miscellaneous. The 1919 coefficients need to be adjusted in order to take into account differences in labour productivity, between 1899, 1913 and 1919, and between the US and UK. These adjustments were carried out using differences in GDP per capita (in constant PPP adjusted dollars) from Maddison (1995).

The sectors do not match exactly the trade sectors for either the US or the UK. For the US, factor input coefficients for agriculture are used for exports of crude food and crude materials (in 1899 and 1913, approximately 90% of total exports of crude food and crude materials were made up of three commodities, wheat, cotton, and leaf tobacco). In 1899 and 1913 85% and 60% of total imports of crude food and crude materials were made up by sugar, coffee, hides and skins, silk, rubber and tea respectively. Many imports in this category are therefore likely to have been non-competing, although it is uncertain exactly how many.

For the UK, factor input coefficients for agriculture are used for trade in food, drink and tobacco (assuming that only a small proportion of this category was manufactured). Among exports of raw materials and unmanufactured goods, coal accounted for the majority, whereas about half of the imports of this category were made up of raw wool, cotton, and timber. Factor input coefficients for mining are used for this category; while this is appropriate for exports, it is not so for imports, much of which were non-competing. For both countries, I use average factor input coefficients in manufacturing for other semi-manufactures.

<i>(no. of workers)</i>	US			UK		
	1899	1913	1937	1899	1913	1937
Agriculture	168	128	151	146	135	164
Mining	480	366	255	416	387	276
Manufacturing	229	175	163	199	184	177
<i>of which:</i>						
Food and tobacco	110	84	90	96	89	97
Textiles and clothing	255	195	265	222	206	287
Chemicals	135	104	76	118	109	83
Metals and machinery	254	194	153	221	205	166
Miscellaneous manufactures	309	236	219	268	249	238

Table A3.2 Total employment per \$m of output, 1899-1937

A3.3 FACTOR CONTENT OF TRADE

Two further procedures were required in order to calculate the factor content of trade. First, the adjusted factor-input coefficients (which refer to total employment per \$m) need to be decomposed into their skilled and unskilled labour components. This was done for the US using the 1960 sectoral

employment coefficients of skilled and unskilled manual workers in Appendix 2.1, and for the UK using equivalent data for 1951.

Second, it was necessary to ensure that the gross export data was measured in the same prices as the factor-content coefficients. For the 1899 and 1913 calculations therefore, gross exports of the UK in 1919 were converted to dollars at the official nominal exchange rate; then gross dollar exports of the US and UK in 1899 and 1913 at 1919 prices were estimated using volume indices of total exports in Maddison (1982).

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