Wage Inequality and Globalisation: What can we learn from the Past? A general equilibrium model approach*

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Abstract

The present globalisation period has witnessed a rising premium paid to skilled workers resulting in increasing wage inequality in most OECD countries. This pattern differs from the one observed during the past globalisation period (1880-1913), in which wage inequality steadily decreased in most of the Old World countries. The current debate about wage inequality focuses on the implications of globalisation, technological change, the role of labour market institutions and education. Similar factors took place in the past globalisation process. To disentangle the main factors that contribute to wage inequality, we calibrate a general equilibrium model for the UK economy in the past globalisation period. The results show that a trade shock and a skill biased technology shock are compatible with the observed decrease in the ratio between skilled and unskilled labour wages. For that to be possible, other off-setting factors such as education, migration and capital accumulation must have occurred. This is different from the present situation in developed and developing economies, where all these off-setting factors do not seem to be at work.

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1. Introduction

The current debate surrounding the increase in wage inequality which took place in the 1980s and 1990s focuses on the implications of globalisation, technological change, the role of labour market institutions and education. The main globalisation factor is trade, given falling barriers to international transactions (Wood 1998). Skilled-biased technological change is considered as at present we are immersed in a process of diffusion of General Propose Technologies in which computers have led to important advances in communications and secondary innovations (Aghion, Howitt and Violante 2002). Labour market institutions are important as a consequence of the reduction of the minimum wage and the loss of trade union power, whereas education enters into the debate because it does not seem to be adapting to the demand of the new technologies.

Similar changes also took place during the past globalisation process, 1870-1913. In the second half of the nineteenth century there was a globalisation process with an increase in commodity trade and important movements of capital and labour across countries (O'Rourke and Williamson 1999). The technological and organisational changes of the end of the nineteenth century, namely the Second Industrial Revolution, affected the demand for skilled workers in relation to unskilled workers (electricity, as a General Purpose Technology, and the transport and communication revolution). Moreover, there was also an important institutional change: this period witnessed the emergence of the trade unions and an important number of socialist organisations. The so-called "labour movement" was very active at the end of the nineteenth century and throughout the first decades of the twentieth century in many countries. Then, labour institutions improved labour conditions and played a different role than the one they play at present. Finally,

most countries made an important educational effort with an important reduction in the illiteracy rates and an increase in school enrolment and these had a direct bearing on the number of skilled workers.

Looking into how the above mentioned factors affected wage inequality in the past could shed light on the debate surrounding the factors competing in the not yet finished present globalisation process. We consider that economic history is thus an important "laboratory" for the study of wage inequality. As Aghion and Howitt (2002, p.309) affirm, "any explanation of the recent patterns in wage inequality needs to integrate the distinguishing features of the past 20 years from previous episodes if it is to be taken as comprehensive". However, most of the literature on present wage inequality is "self-contained", and where historical context is offered, it is restricted to the post-1940 period (Margo, 1999).

Thus, the main purpose of this paper is to disentangle the main factors that contribute to wage inequality. To do so, we calibrate a general equilibrium model of the UK economy for the past globalisation period. The structure of the paper is the following. In Section 2, we show the main pattern of wage inequality in the period 1870-1913 and in the present. The UK is a representative case of the general pattern of wage inequality for the Old World countries in the past and for the developed economies in the present. In Section 3, we discuss the main factors competing in the explanation of wage inequality. In Section 4 we use the case of the UK in the past globalisation period to calibrate a general equilibrium model which allows us sort out the off-setting factors that explain wage inequality.

2. Wage inequality in the past and present globalisation processes

In this section we document the evolution of wage inequality in the past and in the present globalisation processes. This has been done with an aim to assessing whether the present rise in wage inequality has been unusual or if it has had some precedents in the past.

For the past, we define wage inequality as the ratio of the wages of skilled male workers to the wages of unskilled male workers in the industrial sector. For each country we have chosen the main industrial sectors, and for each sector we have compared the average wage of a skilled worker with the wage of an unskilled worker: the labourer. We study wage inequality under the assumption that occupations are a reasonable proxy for skills. As such, we are identifying skills with ability and job training. In this sense this ratio is also a proxy of the skill premium. We construct our measure of wage inequality as a weighted average where the weights are the labour force employed in each sector[1].

For the present, we use as indicator of wage inequality the ratio between the 90^{th}-percentile to the 10^{th}-percentile in the distribution of gross earnings for full-time male workers given that we have homogenous data for most of the countries from the OECD labour market statistics database (OECD, 2003).

The impact of globalisation (trade, migration and flows of capital) on wage inequality depends on the factor endowments and the level of integration and development of a country. For the past, taking into account factor endowments and the level of development, we can differentiate between two groups of countries: the labour-scarce and labour-receiving countries (the New World countries) and the labour-abundant and labour-sending countries (the Old World countries). Amongst the Old World countries we also distinguish between developed and less developed ones at that time. The New World

country we are going to study is the USA. The Old World developed countries are France and the UK; and Italy, Spain and Sweden, the less developed countries.

The main patterns of wage inequality are displayed in Figure 1. As we can see in Figure 1 in the USA (a New World country) there was an increase in wage inequality during the globalisation period. The USA was a labour scarce and receiving country and then, globalisation factors (especially migration) pushed wage inequality up. With respect to the Old World developed countries (France and the UK) we have obtained a decrease in wage inequality in the globalisation period (1880-1913). These two countries were labour abundant and integrated, and the UK was a sending labour country. The picture is different when we consider the evolution of wage inequality in the Old World less developed countries (Italy, Spain and Sweden). In this case we obtain a decrease in wage inequality in Italy and Sweden, two integrated countries in terms of labour, and an increase in wage inequality in Spain, a less integrated country. So the general pattern is an increase in wage inequality in the New World countries, and a decrease in wage inequality in the Old World integrated countries.

We shall compare the pattern of the past globalisation period with wage inequality in the 1980s and 1990s. As mentioned above the present process of globalisation is not yet completed and thus we are going to look at the pattern of wage inequality in only two decades.

To uncover the pattern of wage inequality in the present globalisation period we have to consider a different classification of countries from the one used for the past globalisation period, that is, a classification which contemplates the present developed (Figure 2) and developing countries (Figure 3). In relative terms the present developed

[1] For more information about the ratio, see Betran and Pons (2004).

countries are labour scarce, as were the New World countries in the past, and the present developing countries are labour abundant, as were the Old World countries in the past. We analyse the main developed countries and some developing countries, limited to a small sample of countries (East Asia, Latin America and Eastern European countries).

What is the pattern of present wage inequality? In the present developed countries, wage inequality increased in the 1980s and 1990s in most of the countries especially in the USA and the UK. Wage inequality also increased in most of the developing countries, with the exception of Korea, representing the four small East Asian countries.

To sum up, the descriptive analysis has shown that wage inequality increased in the labour scarce countries in both periods: the New World countries in the past and the developed countries in the present. However, the pattern of wage inequality in the labour abundant countries has been different in the past and in the present: wage inequality decreased in the Old World countries and, in has increased in most of the present developing countries. The different evolution between the past and the present could be an indication that we have to consider factors other than globalisation factors in order to explain the evolution of wage inequality.

3. Factors competing in the explanation of wage inequality

In the current debate on wage inequality, the main factors considered in the literature can be classified into three groups. In the first group we have the globalisation factors (trade, migration and flows of capital), especially international trade (Feenstra, 2000). The second group focuses on the effects of skill-biased technological change and how the new technologies have relatively increased the demand for high-skilled versus low-skilled workers (Machin and Van Reenen 1998, Aghion and Howitt 2002). Both of

these factors would have increased wage inequality. There is a third group of factors that considers an 'institutional' explanation for wage inequality and concentrates on the institutional structures of the labour market (the trends in unionisation, minimum wages and collective bargaining (Lee, 1999 and Card, Lemieux and Ridde, 2003) and the role of education (Goldin and Katz, 2001). However, these factors do not seem to be reducing wage inequality in any significant way.

These three groups of factors also operated in the past and are very useful in understanding the evolution of wage inequality. In the period 1870-1913, the forces of globalisation were very strong, with migration having more weight in the past than in the present. There were important technological and organisational changes, the so-called 'Second Industrial Revolution', and there were also important changes in labour institutions linked to the emergence of the unions and the very active 'labour movement' that many countries experienced in those years. In addition to labour institutions, there was another institutional factor which must be considered: education. There was a considerable investment in education by most of the countries which produced a rise in school-enrolment and literacy. Education was essential to the success of the application of the new techniques more intensive in capital and R&D than before. Finally, the period also witnessed an important demographic transition which consisted of the reduction of the mortality rates meanwhile the high birth rates were maintained. As such, in this section we are going to analyse what the expected impact of globalisation, technological change, trade unions, education performance and population pressure would be on wage inequality.

The impact of globalisation (trade, migration and flows of capital) on wage inequality depends on the factor endowments and the level of integration and development of a country. With respect to trade, the Heckscher-Ohlin theory argues that countries

specialise in those commodities which intensively use the factors with which they are well endowed. So, trade growth may increase unskilled labour demand in unskilled labour-abundant countries, increasing the real wages of the unskilled workers. In this case, trade may reduce inequality. The opposite is the case in unskilled labour-scarce countries. Regarding migration, this changes the relative abundance/scarcity of skilled and unskilled workers and so also affects wage inequality. Finally, the flow of capital may affect wage inequality when capital flows from richer countries to poorer labour-abundant countries and changes the relative demand from unskilled to skilled workers.

The technological advances of the 1870-1913 period that corresponded to the so-called Second Industrial Revolution were spectacular. There was a change in the main sources of energy (from coal to electricity, and petroleum), there was a revolution in transport and there were also important advances in communications (telegraph lines, telephone systems, etc). Electricity can be considered as General Purpose Technology because of the great scope of the improvements and the variety of uses it could be applied to. These technological changes were further accompanied by important organisational changes such as Fordism and Taylorism (Chandler 1996, Rosenberg 1976, David 1991). Technology change affected the relative demand for skilled and unskilled labour and thus wage inequality. There is a debate about whether technological change was *skill deplacing* or *skill biased*. Although the assembly line techniques caused the substitution of skilled labour by capital and unskilled labour, at the same time the number of supervisors and other new professions increased due to the greater importance of capital in the production process. Moreover, assembly line techniques were one part of the techniques applied at that time but not the only ones. As Goldin and Katz (1996, 1998) indicate, the technological change from the artisanal shops or factories to continuous and batch-process

methods (applied in petroleum refining, dairy products, chemicals and non-ferrous metals), and from steam and water power to electricity, may have increased the relative demand for skilled labour at least in the early twentieth century. Thus, the predominant effect is not so clear, therefore the impact of technology on the demand for skilled labour, and thus on wage inequality, is an empirical question.

In the case of the changes in the institutions of the labour market, as mentioned before, there was an outstanding increase in the importance of labour organizations, such as trade unions, labour affiliations and active participation in strikes and protest to improve labour conditions and wages. However, the impact of these on wage inequality is not so clear. We do not know whether trade unions represented the interests of the skilled workers more, as happened in the origin of these organizations, than the interests of the unskilled workers, as a consequence of the fact that trade unions became mass or general unions which defended the welfare of *the working class*. The UK is the only country where there has been a debate about the effect of trade unions in wage inequality but no consensus has yet been reached. Pollard (1999) considers that there is no relationship between labour movements and wage inequality while Hobsbawm (1985) and Hunt (1973) maintain that at least after 1900 the labour movement contributed to the progressive reduction of wage differentials.

As commented before, the period witnessed an important educational effort that was relevant for the application of technological change due to the fact that the increase in education facilitated the learning of these new technologies increasing the skilled labour supply. However, the rise in population and its effect on the labour force had to produce an increase in the supply of unskilled labour, at least the educational effect was sufficiently important to offset part of this increase.

Betrán and Pons (2004) estimate the importance of these factors in explaining the changes in wage inequality (the skill premium) in the period 1870-1930 by means of the construction of a panel data set for five countries (the USA, France, the UK, Italy and Spain) with different characteristics and levels of development. The results obtained are that the globalisation factors, trade (measured by the openness rate) and migration (immigration per thousand population per annum), were important explanatory variables in wage inequality growth, but technological and structural change (measured by the investment in GDP and the share of the agriculture labour force), education (proxy by literacy and the school-enrolment rate), the labour movements (proxy by the number of strikes), the increase in the population of a working age (measured by the growth rate of population lagged 15 years) and unemployment (to see the influence of labour demand) also contributed to the rate of growth of the skill premium. Trade affected the growth of wage inequality differently depending on the countries, not always according to the H-O theory. Immigration increased (decreased) wage inequality in the receiving (sending) countries. The effect of technological change was to increase skilled labour demand and consequently wage inequality thus this result supports the view that technological change was mainly *skill-biased*. Education and the increase in the population of a working age are negatively and positively correlated respectively to the growth of wage inequality. Labour movements contributed to the decrease of wage inequality and the opposite happened with unemployment.

In the case of the UK, the factors that mainly contributed to the change in wage inequality were, by order of importance: technological change, increasing wage inequality, trade and emigration, reducing wage inequality, the increase in the population of a working age, increasing wage inequality, and the labour movement, reducing wage inequality.

As commented in the previous section, wage inequality decreased in the period of past globalisation in the UK. Globalisation factors (trade and emigration), education and labour movements were complements in reducing wage inequality, while technological change and the increase in population increased wage inequality. However the dominant effect was the reduction in wage inequality.

We are now interested in studying why the off-setting factors were so influential in the evolution of wage inequality in the past. With this objective in mind, we calibrate a general equilibrium model that allows us to determine the importance of these factors or, in other words, the importance of each particular shock of trade, migration, education and demographic factors on wage inequality. The model chosen is capable of sorting out these off-setting factors that are operating to different degrees and signs in the explanation of wage inequality. The quantitative results are conditioned by the deep structural parameters calibrated in the model. We also check the sensitivity of the results to these parameters to assess the extent to which the conclusions obtained in a reduced form estimation in Betrán and Pons (2004) hold.

4. General Equilibrium Model Approach

To analyse the principal factors affecting wage inequality, we elaborate a structural, but simple, general equilibrium model. A general equilibrium model allows us to specify the fundamental relationships between variables when there are multiple factors acting in different ways. By means of this model we illustrate how technological change; globalisation factors, particularly trade and migration; and access to education, affected the observed wage inequality change. We have not considered the impact of labour movements on wage inequality because to do that it would be necessary to make a number

of assumptions about the power of skilled and unskilled workers in the wage negotiation process, and we have no data regarding this. We also check the sensitivity of the results to different parameterisations of the model, something that is not possible in the reduced forms equations estimated in the literature.

The calibration of a general equilibrium model allows us to determine parameter values consistent with both the initial equilibrium and the changes in exogenous variables contributing to the change in wage inequality. The importance of a fully specified structural model in the study of the factors underlying wage inequality changes has been stressed by Abrego and Whalley (2000, 2003). Here, we will extend these models, which consider trade and technology factors only, to also capture the effects of education and emigration. We calibrate the model to the UK economy in 1913 and focus on the globalisation period (1880-1913). The reason for taking the UK economy as a reference is twofold. First, there already exists a previous reference for the UK (Abrego and Whalley, 2000) using general equilibrium simulations, although this work explained the increase in wage inequality which took place in the period 1976-1990 rather than a decrease in wage inequality, which is our case, and considered only two explanatory factors of wage inequality, trade and technology. Given that in their simulations the technology shock is calculated as the residual needed to yield the observed wage inequality change as a model solution in the presence of the trade factor, we argue that the size and even the type of the technology shock could vary in the presence of more competing factors other than simply the trade shock. For instance, if we had *only* considered the trade shock that worsened unskilled wages in relation to skilled wages, we would have needed an important technology shock that favoured the unskilled wages more than the skilled ones in order to obtain the observed reduction in wage inequality. But, since we include other factors such

as the emigration of unskilled labour or the increase in the skilled labour force due to better access to education channels, it is the case that without considering any technology shock the reduction in inequality would have been more important than the observed one, and thus we need a technology shock type worsening, in relative terms, the unskilled wages. The second reason for using the UK economy is that the calibration of general equilibrium models requires a certain quantity and quality of information about the economy under study, such as the composition of the labour force, the classification of workers in skilled and unskilled labour, and the production and trade composition, and in this sense the UK is one of the countries with the most complete data for the period under consideration.

4.1 The model

In the simulation we use a two-sector, three-factor model of a small open price-taker economy. The external trade differs from the traditional Heckscher-Ohlin because imports and domestically produced goods are imperfect rather than perfect substitutes (the Armington assumption). The reason for using the Armington model is that the H-O model finds it difficult to adapt a substantial relative price change, such as the one observed in the globalisation period. The model has two traded and two produced goods but considers three different goods in consumption, since imports are seen as a different good from the domestically produced good that substitutes for imports, which in turn is not traded.

The two sectors in the economy use capital (K) and a different combination of skilled (S) and unskilled labour (U) to produce by means of a two level constant elasticity of substitution (CES) technology. At the bottom level the producers decide on the demand of skilled and unskilled labour, whereas at the top level they have to decide how much capital and aggregated labour (L) is used by each sector. X_1 is the initially skilled labour

intensive sector that produces the exportable domestic good (X_1) and X_2 is the initially unskilled labour intensive sector that produces the non-exportable domestic good (X_2) competing with imports (M). All three goods (imports, the non-exportable domestic good and the exportable domestic good) go to make up total consumption, which is derived from a two-level CES utility function. At the bottom level of the utility function, the representative consumer decides on the consumption of the two closest goods (the non-exportable domestic good and the import good) and at the top level of the utility function the consumer chooses between the exportable domestic good and the composite of X_2 and M (call this composite Y). Although the economy is a price taker of export and import prices due to the small economy assumption, the price of X_2 is endogenously determined, and this fact makes a difference with respect the H-O model, because changes in world prices do not necessarily transmit completely to the domestic economy. The macroeconomic closure states that the current external deficit in the model is fixed.

Capital and each type of labour are mobile between sectors and as a consequence of the profit maximization in each sector a demand for each type of factor arises. There is full employment for all the factors. The equilibrium is characterised by a set of prices resulting in an optimal allocation of goods and factors so that producers maximise profits and consumers maximise utility. This optimal allocation satisfies simultaneously the zero profit condition for both sectors, the market clearing in goods and factors, the income constraints and the macroeconomic closure. The complete set of equations that determine the model can be found in Appendix 1.

4.2 Data and calibration

We calibrate the model to 1913, the benchmark year of the UK data, and to estimated changes in wages, trade, population and capital over the period 1880-1913. To obtain the base year data, we have distinguished between skilled and unskilled labour and separated the production of skilled and unskilled labour intensive industries; we have also required data on skilled and unskilled average wages in order to calculate the rents of each type of labour; and finally we have had to calculate the exports of the skilled labour intensive sector and the imports of the unskilled labour intensive sector to obtain the domestic consumption of both goods. The rents of 'capital' has been calculated as a residual subtracting the rents of labour from the value of the production of each sector. This is a rough measure of capital, because it includes in addition to pure capital, the rents of land and non-manual workers wages.

During the process, we have only considered the agriculture and industrial sectors which produce tradable goods, and thus we have not included the service sector. We have assumed that agriculture belongs to the unskilled sector. For the industrial sector, we have classified the industries into skilled and unskilled sectors using the percentage of skilled manual labour on unskilled manual labour in each industry[2]. The earliest previous available data for skilled and unskilled labour were elaborated by Routh (1980) for 1951, thus we have employed the 1951 percentages of skilled manual labour on unskilled manual labour in each industry and apply these to the 1911 census where we have the total labour force working in each sector. We have chosen the 1911 census because this census was the closest year to 1913, which was the turning point between the globalisation and the deglobalisation periods and moreover this census was previously homogenised by Routh

[2] We use manual workers because our wages data is only available for manual workers, which in this period is limited to occupational wages.

and as such is comparable to the 1951 census. Given that Routh's data does not separate male and female labour, we have included both of them in the employment data, although in our wage inequality measure we only consider male labour wages to avoid the gender gap effect. Operating as such, we are assuming that the proportion of skilled manual workers to unskilled manual workers in each industry in 1911 is the same as in 1951[3]. However, as the weight of each industry changed over time, so did the weight of the total skilled on unskilled manual workers. For example in the case of the industrial sector, for the earlier years in which we can use the homogenized census data, the total percentage of skilled to unskilled labour is estimated as 79.83% in 1911 and as 86.48% in 1931.

We classify the skilled industries as those with a proportion of skilled manual workers superior to the average and the unskilled industries those with a proportion inferior to the average. To calculate the production of each sector, we have used Feinstein (1972), whereas we have obtained from the *British Historical Statistics* (1990) the exports and the imports for the skilled and unskilled sectors. Appendix 2 contains more details on the estimated data.

A rectangular social accounting matrix representation of this benchmark year data is displayed in Table 1. A positive entry is an income (a sale in a private market or a factor supplied by a consumer). A negative result is an expense (an input purchase in a market or a consumer demand). If we read further down the columns, the entire set of transactions linked to an activity can be found. The sum of each column must be equal to zero to meet the condition of zero profit. In the same way, the sum of each row must be zero to meet the condition of market clearing (the sales of a commodity must be the same as the total

[3] Although we are conscious that this is rather a strong assumption to make, it is our only alternative given the data. We have used some sectors from 1911 for which we have data for skilled and unskilled workers and these proportions are not very different from the 1951 proportions. For example, the proportion of skilled on unskilled workers for the building industry in 1911 was around 220% and in 1951 in Routh's data it was

purchases of that good). The sum of the consumer's column equal to zero indicates the condition of balanced revenue. Thus, this social accounting matrix is consistent with the general equilibrium conditions, as it satisfies the zero profit conditions (the sum of each column is zero), and the market clearing (the sum of each row is zero). The figures of the social accounting matrix represent values (prices multiplied by quantities). The way these figures are divided up into prices and amounts is arbitrary, provided consistency is maintained. It is common practice to choose units so that the greatest number of variables possible are equal to one in the benchmark equilibrium. In our economy with no taxes or other distortions, prices and levels of activity have been normalized to one. This is why, for example, the figures in Table 1 can be understood as the quantities involved in the production of an activity that operates at a unitary level.

The estimated database for the UK economy in 1913 allows us to calibrate some parameters of the model (mainly distributional and scale parameters in the utility and production functions) but additional information is still required on elasticities of substitution. Table 2 shows the basic elasticities of substitution considered in our simulations. The elasticity of substitution in consumption between the skilled intensive good and the unskilled intensive good; between skilled and unskilled labour in production; and between capital and aggregated labour all have been set to a low value of 0.5, indicating difficulty in substituting among goods and factors when prices change at these levels of aggregation. Conversely, the Armington elasticity has been set to a relatively high value of 5 which means that substituting imports for domestic production is relatively easy. These elasticities are in accordance with previous economic history research using a calibrated general equilibrium model, such as Harley and Crafts (2000), Harley (2002) and Federico and O'Rourke (2000).

197%.

The social accounting matrix is used as a part of the calibration, but we have also used the estimated shocks in some relevant variables over the period 1880-1913, so that when subtracting the shock from the observed data in 1913 we hypothetically place the UK economy in 1880. In Table 3 can be found the relative variation in some variables between 1913 and 1880 that will be used to calibrate the shocks. We work backwards, so a positive figure in the growth of rate between 1913 (as the initial date) and 1880 (as the final date) can be understood as a fall in the variable between 1880 (as the initial date) and 1913 (as the final date).

The UK belongs to the group of Old World developed countries for which, as explained above, wage inequality decreased in the globalisation period, so when comparing 1880 (as the final date) with 1913 (as the initial date) we observe an increase in inequality of 8.14%, the figure that we want to match with the model. The evolution in the terms of trade, the changes in the factors endowments and the technology shocks, are all important determinants to take into account when explaining inequality evolution.

Over the period there was a rise in the terms of trade, as a consequence of the important fall in agriculture prices, the main imports in this period. We model this shock as a variation in the price of imports which in the model is a purely exogenous variable determined by world prices. This factor tends to push up inequality by relatively increasing the price of the traded skilled intensive good.

Population changes have been modelled by means of the following expression:

$$\rho_p \left(\rho_e \overline{S}_{1913} + \rho_m \overline{U}_{1913} \right) = \overline{S}_{1880} + \overline{U}_{1880} \qquad (1)$$

where S_{1913} and U_{1913} are the endowments of skilled and unskilled labour in 1913 and S_{1880} and U_{1880} represent the endowments of skilled and unskilled labour in 1880. ρ_e stands for the factor affecting the skilled labour endowment due to educational change, ρ_m captures

the factor affecting unskilled labour during the period due to migration, and ρ_p stands for the part of the growth in the labour force that is due to natural population development that affects skilled and unskilled labour equally. To set ρ_e we take the evolution in the literacy rate between 1913 and 1880 (Flora, 1973), providing us with a more moderate educational factor than we would have got in the case that we had chosen the schooling ratio as the basis for the estimation. Thus, according to Table 3 we set ρ_e = 0.8557. We fix ρ_m to a value of 1.19 taking the O'Rourke, Williamson and Hatton (1994) estimations on the number of unskilled workers emigrating during the period. Finally, ρ_p has been obtained as the unknown in expression (1) that can be solved for a value of 0.836.

The globalisation period witnessed an important shock in aggregate capital. The capital growth rate has been borrowed from Mitchell's (1990) estimations showing an important increase of 87% (a decrease of 46.6% if we take 1913 as the reference year, see Table 3).

With respect to technology change, this is supposed to be biased (positively or negatively) towards unskilled workers, meaning that the demand for unskilled labour in each sector changes exogenously as a consequence of the technology. The technology shock is calibrated as the residual such that when simultaneously adding the other exogenous shocks, the model solution replicates the observed change in wage inequality. The same method for calibrating the technology shock can be found in Abrego and Whalley (2000) and Abrego and Whalley (2003). Note that the effects of a positive biased technology shock in favour of unskilled labour can be mimicked by means of a biased technology shock against skilled labour, thus the factor receiving the shock is not relevant as we do not impose an *a priori* sign for it.

4.3 Results

Table 4 displays the results for different parameters corresponding to the inclusion of different factors in explaining the reduction in wage inequality over the period. In each column we have isolated the individual effect of each contributing factor, including the calibrated technology factor, to the wage inequality change. As prices have been normalised to one in 1913, we are interested in explaining an increase in relative wages up to 1.082 in 1880. This is the result that we have obtained in all the cases, once the technology shock is included (the last row). Note that the sum of the individual effects does not necessarily result in the observed variation in relative wages, because there are also interaction effects, which cannot be attributed to any one individual factor but is a consequence of the interaction of the different factors in the model acting simultaneously. Taking the difference between the last but one row and the last row and subtracting the difference between the technology change row and the last row would be a proxy of the part of the actual change in wages explained by interaction effects.

Column (1) represents the effects in the relative wages for the baseline simulation, that is, taken as given the elasticities parameters of Table 2 and the shocks of Table 3. When the effect is above one this means that the shock considered works in favour of the observed variation in inequality. When the effect is below one, the shock works against the observed variation in inequality. According to this, international trade, natural population growth and the technology shock, all acted against the observed reduction in inequality, whereas emigration, education and capital growth favoured the reduction in inequality. Each isolated factor creates important effects on wage inequality, with the variation in the labour force composition (due to emigration and education) overcoming the effects of international trade. This means that the technology shock compatible with the observed

reduction in wage inequality has a very important negative effect on unskilled wages. As Abrego and Whalley (2000) argue, conversely to the simple Heckscher-Ohlin case, in a model of a finite elasticity of substitution between domestic and imported production, the trade shocks can be partially absorbed on the import demand side, without full transmission to domestic producer prices, resulting in a smaller effect of trade and a bigger effect of technology.

In columns (2) to (5) we perform a sensitivity analysis, consisting of how the results change when we modify the elasticities. It should be noted that the sign of the results are robust to different elasticities of substitution, in all the cases the positive effects of emigration and education overcoming the negative effect of trade. As mentioned before, the influence of technology on wage inequality during the period has been subject to debate. Here we show that for a wide range of sensible parameters, and in the presence of more shocks than just international trade, the technology change had an unequivocal negative effect on wage inequality. Conversely, natural population growth and capital accumulation both have smaller effects on relative wages. These conclusions are in line with those obtained by Betran and Pons (2004), the main difference being the impact of trade. In the reduced-form data panel estimation the openness rate is used as a measure of trade and the sign of the coefficient of this variable is opposite to that obtained now using the terms of trade variable. We consider that the terms of trade is a more accurate variable to measure the effect of trade in wage dispersion.

The two most important changes in the effects of the factors are produced when we vary the elasticity of substitution between skilled and unskilled labour and the Armington elasticity. As expected, the higher the elasticity of substitution between skilled and unskilled labour (column 4), the lesser the effects of all the individual shocks in wage

dispersion, given that it is now easier to replace the more expensive type of labour by the cheaper one, thus pushing down its wage. However, it mainly modifies the emigration and education effects as these two variables directly affect the relative endowments of labour.

With respect to a reduction in the Armington elasticity (column 2), implying more difficulties in substituting domestic production by imports, it mainly alters the effect of the trade shock, weakening the transmission of world prices to domestic prices. It also modifies considerably the effect of capital accumulation. Thinking of what happened backwards up to 1880, it is true that a decrease in the stock of capital would have tended to increase the rental price of 'capital' originating two opposing effects: on the one hand, the increase in the cost of capital would have made production in the sector where capital is relatively more abundant more expensive, which is the unskilled labour sector[4]. In turn, the rise in P_2 would have favoured the unskilled wages, pushing down the ratio W_s/W_u. Thus, this effect depends on the Armington elasticity. A reduction in the Armington elasticity strengthens the positive effect of the shock on P_2, further reducing the increase in wage dispersion. On the other hand, the increase of the cost of capital would have meant that entrepreneurs in each industry would have wished to reduce the demand for capital and increase the demand for aggregated labour, as far as technology would allow for it. When the elasticity of substitution between capital and labour is low, the demand for labour falls together with the demand for capital and the result is an increase in the rental price of capital relative to wages (a supply effect) and a larger fall of unskilled wages which raises the ratio W_s/W_u (a demand effect). This effect depends on the elasticity of substitution between labour and capital (see column 3) and between skilled and unskilled labour (column 4), and can be reversed as long as the substitution possibilities widen.

[4] Note that in the unskilled sector we include the agriculture sector where the main production factor is land, and other sectors such as chemicals or 'gas, electricity and water' where non-manual workers have a very

We can solve the model controlling for the magnitude of the shocks and simulating the elasticity of inequality. The results would be thus comparable with the coefficients of a log-reduced-form model. Table 5 shows the percentage variation in the ratio W_s/W_u with respect to a 1 per cent shock of the same direction as the observed ones. In absolute terms, the biggest elasticity would correspond to emigration, followed by education, trade, the technology shock, natural population growth and capital growth. This order of importance is maintained whatever the parameters considered in the sensitivity result, except for the Armington parameter whose reduction does make a change in the importance of trade (easing it) and technology (amplifying it) on wage dispersion.

Finally we answer the question: what would have been the wage inequality at the end of the period in the absence of each of the considered shocks? We do this in Table 6. The results are not strictly comparable to the ones in Table 4, as now they include the interaction effects among the remaining shocks, and can be interpreted in terms of opportunity costs (positive or negative). Taking into account price normalization, we know that the actual ratio of wages in 1880 was 1.082, meaning that wage inequality decreased by 7.5% between 1880 and 1913. But, for instance, if there had not been a capital reduction between 1913 and 1880, we would have observed that wage inequality would have remained constant over the period. If there had been no technology change, the wage dispersion in 1880 would have been 78% higher than in 1913. Conversely, if no workers had migrated the wage dispersion in 1880 would have been 23% lower than in 1913. According to these results, the presence of the technology shock has the highest opportunity cost in terms of the reduction in inequality.

high weight. Both, land and non-manual workers, are part of our rough measure of capital.

5. Conclusions

With the objective of disentangling the main factors that contribute to wage inequality and studying what we can learn from the experience of the past we have documented the evolution of wage inequality in the past and in the present. The pattern of wage inequality is that in the relative labour scarce countries, both in the past (New World countries) and in the present (developed countries) wage inequality increased in most of the countries. However, in the relatively labour abundant countries in the past (Old World countries) and in the present (developing countries) wage inequality does not seem to be following the same pattern. Wage inequality decreased in the former and increased in the latter. In the case of the UK, which belongs to the group of Old World countries in the past and to the developed countries in the present, wage inequality decreased in the first period and increased in the second period. The main hypothesis arising from this pattern in the past is that globalisation factors (especially migration), education and labour movements were complements in reducing wage inequality; however technological change and the increase in population pushed up wage inequality. However, in the present, for the labour abundant developing countries, with the same factor endowments as the UK in the past, the off-setting factors (trade, migration, education, and labour movements) do not seem to be reducing wage inequality, the dominant effect being an increase in wage inequality.

Some of the hypotheses arising from the empirical patterns and previous reduced-form estimations are confirmed by means of a general equilibrium model for the UK economy. Numerical simulations have been performed to show that a trade shock, in the terms of trade, and a technology shock biased against (in favour) unskilled (skilled) labour is compatible with the observed decrease in the ratio between skilled and unskilled labour wages during the globalisation period, 1880-1913. For that to be possible, other off-setting

factors such as education, migration and capital accumulation must have occurred. As we have mentioned, this is different from the present situation in developed and developing economies, where all these compensating factors do not seem to be at work, or act in the opposite way.

Our purpose has been to categorise the importance of all shocks affecting wage inequality and therefore we have presented three types of effects. First, we have calculated the individual effect of each shock, showing that the total positive impact of migration and education overcomes the negative impact of trade, but that the technology change also played a very important role in avoiding wage equalisation, thus supporting the hypothesis that the technological change of the second industrial revolution favoured skilled workers. These results are especially sensitive to the elasticity of substitution between skilled and unskilled workers, reducing the magnitude of all the effects, and to the elasticity of substitution between imports and domestic production, reducing the impact of trade and increasing the impact of technology, but also, to a lesser extent, to population changes.

Secondly, we offer the simulated elasticity of wage dispersion to a change of each individual factor to illustrate that, once we homogenise by the size of the shock, the higher impact corresponded to migration and education. In a reduced-form estimation these results would be translated to the parameters of the main offsetting factors (migration and education) to be the most important.

Thirdly, we calculate the opportunity cost of each shock occurring, concluding that, in absolute terms, the technology change had the highest opportunity cost, given that in its absence wage inequality would have improved the most. The main cause of the difference with respect to the first set of results is the existence of interaction effects.

To sum up, what can we learn from the past? Our results show that in the past globalisation process, as in most of the studies about wage inequality for the present, technology change played an important role against a reduction in wage inequality. The most important difference between past and present being the existence of offsetting factors (especially migration, education and perhaps trade unions) that had an important influence in the past and do not seem to be acting in the present. These factors explain why wage differentials decreased in the past in some countries but increased in the last decade of the twentieth century.

References

Abrego, L. and Whalley, J. (2000): "The Choice of Structural Model in Trade-Wages Decompositions". *Review of International Economics*, Vol. 9(3), pp. 462-477.

--- (2003): "Good market responses to trade shocks and trade and wages decompositions", *Canadian Journal of Economics*, Vol. 36, 3, pp. 747-757.

Aghion, P., Howitt, P. (2002): "Wage inequality and the New World economy". *Oxford Review of Economic Policy*. Vol.18 (3), pp.306-323.

Aghion, P., Howitt, P., and Violante, G.L. (2002): "General Purpose Technology and Wage Inequality", *Journal of Economic Growth*, Vol. 7 (4), pp. 315-45.

Bagge G, Lundberg E y Svennilson I (1933): *Wages, cost of living and National Income in Sweden 1860-1930*. Vol. I and II. Stockholm, Institute for Social Sciences University of Stockholm.

Betran, C. and Pons, M.A. (2004): "Skilled and unskilled labour wage differentials and Economic Integration, 1870-1930". *European Review of Economic History.* Vol. 8, April, pp. 29-60.

Card, D., Lemieux, T. and Ridde, W.C. (2003): "Unionization and Wage Inequality: A comparative study of the U.S., the U.K. and Canada", *NBER*, WP 9473.

Chandler, A. D. (1996): *Scale and scope: the dynamics of industrial capitalism.* Cambridge (MA). Belknap Press of Harvard University Press.

David, P. (1991): "Computer and dynamo: The modern productivity paradox in a not too distant mirror", in *Technology and Productivity: the Challenge for Economic Policy*. Paris. OCDE.

Federico, G. and O'Rourke, K. H. (2000): "Much Ado About Nothing? Italian trade policy in the late nineteenth century" in Pamuk, S. and Williamson, J. G. (eds.): *The Mediterranean Response to Globalisation before 1950*. London, Routledge, pp. 269-296.

Feenstra, R. C. (2000): *The Impact of International Trade on Wages*. Chicago, The University of Chicago Press.

Goldin, C. and Katz, L. F. (1996): "Technology, Skill, and the Wage Structure: Insights from de Past", *American Economic Review*, LXXXVI, pp. 252-257.

--- (1998): "The origins of technology-skill complementarity", *The Quarterly Journal of Economics*, August, pp. 694-732.

--- (2001): "The Legacy of U.S. Educational Leadership: Notes on Distribution and Economic Growth in the 20th Century". *American Economic Review*, Vol. 91 (2), pp. 18-23

Harley, C.K. and Crafts, N.F.R. (2000): "Simulating the Two Views of the British Industrial Revolution", *The Journal of Economic History*, Vol. 60, No. 3, pp. 819-841.

Harley, C.K. (2002): "Computational general equilibrium models in economic history and an analysis of British capitalist agriculture", *European Review of Economic History*, 6, pp. 165-191.

Hobsbawm, E.J. (1985): "The 'New Unionism' Reconsidered" in Mommsen, W.J. and Husung, H.G.: *The Development of Trade Unionism in Great Britain and Germany, 1880-1914*. London. George Allen & Unwin.

Hunt, E.H. (1973): *Regional wage variation in Britain 1850-1914*. Oxford. Clarendon Press.

Lee D.S. (1999): "Wage inequality in the US during the 1980s: rising dispersion or falling minimum wage?" *Quarterly Journal of Economics*, August, pp.977-1023.

Machin, S. and Van Reen, J. (1998): "Technology and Changes in Skill Structure: Evidence from Seven OECD Countries", *The Quarterly Journal of Economics*, November, pp. 1215-1244.

Margo, R. (1999): "The History of Wage Inequality in America, 1820 to 1970". *The Levy Economics Institute of Bard College Working Paper*, nº 286.

O'Rourke, K. H. and Williamson, J.G. (1999). *Globalization and History. The evolution of a Nineteenth-Century Atlantic Economy*, Cambridge Mass, The MIT press.

O'Rourke, K. H., Williamson, J.G. and Hatton, T.J. (1994): "Mass migration, commodity market integration and real wage convergence. The latte-nineteenth-century Atlantic Economy" in Hatton T.J. and Williamson, J.G. (eds.): *Migration and the International Labour Market, 1850-1939*. London and New York, Routledge.

Pollard, S. (1999): "The New Unionism in Britain: Its Economic Background", in Pollard, S.: *Labour History and labour movement in Britain*. Ashgate. Aldershot.

Rosenberg, N. (1976): *Perspectives on Technology*. Cambridge, Cambridge University Press.

Wood, A. (1998): "Globalisation and the Rise in Labour Market Inequalities", *The Economic Journal*, 108, pp. 1463-1482.

Appendix 1: Parameters, variables and equations

Table A1: Parameters of the model

α	Scale parameter
δ	Shift parameter
υ	Parameter related with the elasticity of substitution $\eta = \frac{1}{1-\upsilon}$
β^s	Skilled biased technology change
β^u	Unskilled biased technology change

Table A2: Exogenous variables

$\overline{P_{E_1}}$	World price for the export good
$\overline{P_{M_2}}$	World price for the import good
$\overline{K}$	Total capital endowment
$\overline{S}$	Skill labour endowment
$\overline{U}$	Unskill labour endowment
$\overline{CTD}$	Current trade deficit

Table A3: Endogenous variables

X_1	Production index for the skill intensive sector
X_2	Production index for the unskilled intensive sector
L_1	Labour composite in sector 1
L_2	Labour composite in sector 2
W	Welfare index
Y	Armington composite
M_2	Imports of good 2
E_1	Exports of good 1
P_1	Price for the good in the skilled intensive sector
P_2	Price for the good in the unskilled intensive sector
P_{L_1}	Price for the labour composite in the skill intensive sector
P_{L_2}	Price for the labour composite in the unskill intensive sector
W_s	Skilled labour index
W_u	Unskilled labour index
P_W	Welfare price index
P_Y	Price for Armington composite
P_{F2}	Price for the imported unskilled good
P_{FX}	Exchange rate
I	Total income for the representative consumer

A1.1 Production functions

Each sector produces using capital and an a composite of skilled and unskilled labour:

$$X_j = \alpha_j^x \left[\delta_j^x K_j^{\upsilon_j^x} + \left(1 - \delta_j^x\right) L_j^{\upsilon_j^x} \right]^{\frac{1}{\upsilon_j^x}}$$

where $j = 1, 2$ stands for the skilled (1) and unskilled (2) sector. The composite of labour for each sector takes the form:

$$L_j = \alpha_j^l \left[\delta_j^l (\beta^s S_j)^{\upsilon_j^l} + \left(1 - \delta_j^l\right) (\beta^u U_j)^{\upsilon_j^l} \right]^{\frac{1}{\upsilon_j^l}}$$

There is a sector that takes the consumption of the representative household and produces welfare (an utility function):

$$W = \alpha^w \left[\delta^w X_1^{\upsilon^w} + (1 - \delta^w) Y^{\upsilon^w} \right]^{\frac{1}{\upsilon^w}}$$

where Y is a composite of the domestic produced unskilled good and an equivalent imported good (Armington assumption):

$$Y = \alpha^y \left[\delta^y X_2^{\upsilon^y} + (1 - \delta^y) M_2^{\upsilon^y} \right]^{\frac{1}{\upsilon^y}}$$

The model is composed of the following equations determined by zero profit conditions, market clearing conditions, income balance and the macroeconomic closure rure.

A1.2 Zero profit conditions

$$P_j = \left(\alpha_j^x\right)^{-1} \left[\left(\delta_j^x\right)^{\eta_j^x} P_K^{\left(1-\eta_j^x\right)} + \left(1 - \delta_j^x\right)^{\eta_j^x} P_{L_j}^{\left(1-\eta_j^x\right)} \right]^{\frac{1}{\left(1-\eta_j^x\right)}}$$

$$P_{L_j} = \left(\alpha_j^l\right)^{-1} \left[\left(\delta_j^l\right)^{\eta_j^l} \left(\frac{W_s}{\beta^s} \right)^{\left(1-\eta_j^l\right)} + \left(1 - \delta_j^l\right)^{\eta_j^l} \left(\frac{W_u}{\beta^u} \right)^{\left(1-\eta_j^l\right)} \right]^{\frac{1}{\left(1-\eta_j^l\right)}}$$

$$P_W = (\alpha^w)^{-1} \left[(\delta^w)^{\eta^w} P_1^{(1-\eta^w)} + (1 - \delta^w)^{\eta^w} P_Y^{(1-\eta^w)} \right]^{\frac{1}{(1-\eta^w)}}$$

$$P_Y = (\alpha^y)^{-1} \left[(\delta^y)^{\eta^y} P_2^{(1-\eta^y)} + (1 - \delta^y)^{\eta^y} P_{F_2}^{(1-\eta^y)} \right]^{\frac{1}{(1-\eta^y)}}$$

$$P_1 = \overline{P_{E_1}} P_{FX}$$

$$P_{F2} = \overline{P_{M_2}} P_{FX}$$

A1.3 Market clearing conditions

$$X_1 - E_1 = (\alpha^w)^{-1}\left[(\delta^w) + (1-\delta^w)\left(\frac{\delta^w P_Y}{(1-\delta^w)P_1}\right)^{(1-\eta^w)}\right]^{\frac{\eta^w}{(1-\eta^w)}} W$$

$$Y = (\alpha^w)^{-1}\left[(\delta^w)\left(\frac{(1-\delta^w)P_1}{\delta^w P_Y}\right)^{(1-\eta^w)} + (1-\delta^w)\right]^{\frac{\eta^w}{(1-\eta^w)}} W$$

$$X_2 = (\alpha^y)^{-1}\left[(\delta^y) + (1-\delta^y)\left(\frac{\delta^y P_{F_2}}{(1-\delta^y)P_2}\right)^{(1-\eta^y)}\right]^{\frac{\eta^y}{(1-\eta^y)}} Y$$

$$M_2 = (\alpha^y)^{-1}\left[(\delta^y)\left(\frac{(1-\delta^y)P_2}{\delta^y P_{F_2}}\right)^{(1-\eta^y)} + (1-\delta^y)\right]^{\frac{\eta^y}{(1-\eta^y)}} Y$$

$$W = \frac{I}{P_W}$$

$$\overline{K} = \sum_{j=1}^{2}\left[(\alpha_j^x)^{-1}\left[(\delta_j^x) + (1-\delta_j^x)\left(\frac{\delta_j^x P_{L_j}}{(1-\delta_j^x)P_K}\right)^{(1-\eta_j^x)}\right]^{\frac{\eta_j^x}{(1-\eta_j^x)}} X_j\right]$$

$$L_1 + L_2 = \sum_{j=1}^{2}\left[(\alpha_j^x)^{-1}\left[(\delta_j^x)\left(\frac{(1-\delta_j^x)P_K}{\delta_j^x P_{L_j}}\right)^{(1-\eta_j^x)} + (1-\delta_j^x)\right]^{\frac{\eta_j^x}{(1-\eta_j^x)}} X_j\right]$$

$$\overline{U} = \sum_{j=1}^{2}\left[(\alpha_j^l)^{-1}\left(\frac{1}{\beta^u}\right)\left[(\delta_j^l)\left(\frac{(1-\delta_j^l)\beta^u W_s}{\delta_j^l \beta^s W_u}\right)^{(1-\eta_j^l)} + (1-\delta_j^l)\right]^{\frac{\eta_j^l}{(1-\eta_j^l)}} L_j\right]$$

$$\overline{S} = \sum_{j=1}^{2}\left[(\alpha_j^l)^{-1}\left(\frac{1}{\beta^s}\right)\left[(\delta_j^l) + (1-\delta_j^l)\left(\frac{\delta_j^l \beta^s W_u}{(1-\delta_j^l)\beta^u W_s}\right)^{(1-\eta_j^l)}\right]^{\frac{\eta_j^l}{(1-\eta_j^l)}} L_j\right]$$

A1.4 Income balance

$$I = P_K\overline{K} + W_s\overline{S} + W_u\overline{U} + P_{FX}\overline{CTD}$$

A1.5 Macro closure rule

$$P_1 E_1 - P_{F_2} M_2 = P_{FX} \overline{CTD}$$

Equations (from A2.2) to (A2.5) determine a model with 19 equations that is solved for 19 endogenous variables (see Table A3 above)

Appendix 2: Data for UK

A2.1 Employment

Skilled workers: skilled manual workers.

Unskilled workers: semiskilled and unskilled manual workers. Males and Females for Industry and Males for Agriculture. (In thousands).

Sectors: Industry (Manufacturing, Building, Gas, Electricity and Water, Mining and Quarrying) and Agriculture. We have not considered the non-trade service sector.

Years: 1911 (census year).

We have used employment of manual workers by industry elaborated by Routh, G. (1980): *Occupation and Pay in Great Britain 1906-1979*, London, MacMillan. These data are elaborated from the Census of Population to obtain a homogeneous classification. As we need data by industry for skilled, semi-skilled and unskilled manual workers and there is only the data elaborated by Routh, G. (1980) for 1951, we have calculated the proportions of skilled manual workers, semi-skilled and unskilled manual workers and non-manual workers in the labour force for each industry in 1951 and we have considered that these proportions are the same as in 1911.

We have also used the proportion of skilled on semiskilled and unskilled manual workers to classify industries in skilled and unskilled sectors. The skilled industries are those that have this proportion superior to the average and the unskilled industries inferior.

Classification of sectors in decreasing order:

Skilled sectors: 1) Leather, 2) Wood, 3) Building, 4) Vehicles, 5) Paper Printing, 6) Textiles, 7) Engineering, shipbuilding and electric, 8) Other manufacturing, 9) Metal goods and instruments, 10) Metal manufacture and 11) Cement, ceramic and glass.

Unskilled sectors: 12) Mining and quarrying, 13) Clothing, 14) Gas, electricity and water, 15) Food, drink, tobacco, 16) Chemicals and 17) Agriculture.

Source: Routh, G. (1980): *Occupation and Pay in Great Britain 1906-1979*, London, MacMillan.

A2.2 Production

We have obtained the data of production for the different industries for 1924. We have calculated the production data from Gross Domestic product at factor cost (million pounds) for 1924 elaborated by Feinstein, Ch. (1972): *National income, expenditure and output of the UK, 1855-1965*, Table 9, p. T26 and the share of value added in manufacturing for 1924 in Mathews, Feinstein and Odling-Smee (1982): "Output, Inputs, and Productivity by Sector" in *British Economic Growth, 1856-1973*, Oxford, OUP, Chapter 4, p. 239. To obtain the data for the year 1913 we have used the index of production of each industry and agriculture, forestry and fishing elaborated by Feinstein, Ch. (1972).

We have used the above classification of skilled and unskilled sectors to obtain the skilled and unskilled production for the skilled and unskilled sectors.

A2.3 Capital

The capital is estimated for each sector as a residual obtained from the difference between Production and Labour income.

A2.4 Trade

Exports (£m): Mitchell (1990, p.481).

Imports (£m): Mitchell (1990, p.475-476)

Source: Mitchell, B.R. (1990): *British historical statistics*. Cambridge: Cambridge University Press.

Terms of trade: Prices of Exports on Prices of Imports in percentages.

Source: Feinstein**,** C. H**.** (1976): *Statistical tables of national income, expenditure and output of the U.K. 1855-1965.* Table 61, Cambridge, University of Cambridge.

A2.5 Average wage and minimum wage

We have calculated an annual average wage and an annual minimum wage for the year 1913 (in pounds), weighted by the participation of each group of workers in the total number of manual workers. We have used the data from Routh (1980, p.99) for 1911 and for obtaining the data for 1913 we use the Index of Money Wages from Bowley, A.L. (1937): *Wages and income in the UK since 1860*, Cambridge.

A2.6 Education:

Literacy: the percentage of population over 10-12 years old able to read and write in the initial year of each period. Source: Flora, P. (1973): "Historical processes of social mobilization: urbanization and literacy, 1850-1965", Eisenstadt, S.N. and Rokkan, S.: *Building states and nations. Models and Data Resources*, Vol. I, pp. 213-258, p. 245.

School-enrolment ratio: primary school enrolment as a percentage of the population aged 5 to 14 years old in the initial year of each period. Calculated from Flora, P (1987): *State, economy, and society in Western Europe, 1815-1975: a data handbook in two volumes*, Frankfurt, Verlag, pp. 78, 559, 624.

A2.7 Other variables:

Migration rate: The migration rate is total net immigration divided by total population (in thousands). UK: Mitchell (1998): *International Historical Statistics: Europe 1750-1993*. New York, Stockton Press. To calculate the impact of emigration in the labour market, we consider that emigration reduced the unskilled labour force by 16% in 1911 following O'Rourke, Williamson and Hatton (1994, p. 208).

Population: total population (in thousands) from Mitchell (1998).

Labour force: We have used the data for the labour force in 1913 elaborated by Routh (1980) which is homogenous with the data of 1951 Census. To calculate the labour force in 1880 we have used the increase in the labour force in the considered sectors from 1880 to 1913 from Mitchell (1998, p. 104)

The growth rate of capital stock: We have considered the growth of the total gross stock of capital at 1900 prices between 1880-1913 from Mitchell (1990, p.864)

Figure 1: Wage Inequality in the Past globalisation process (1870-1930)

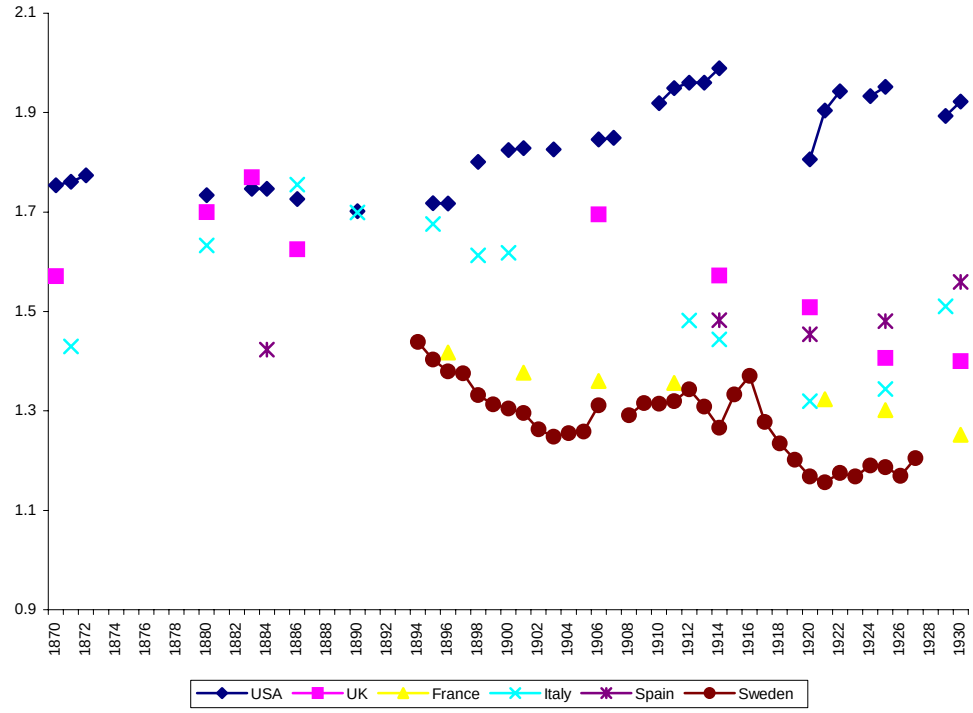

Figure 2: Wage Inequality in the Developed countries, 1980-1999

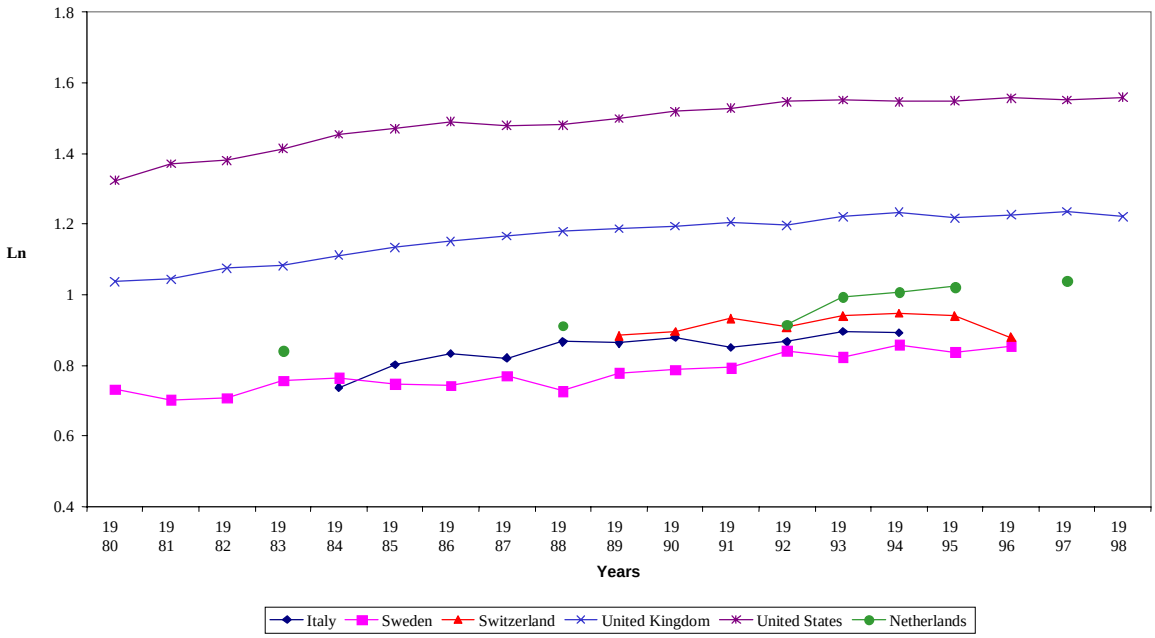

Figure 3: Wage Inequality in the Developing countries, 1980-1999

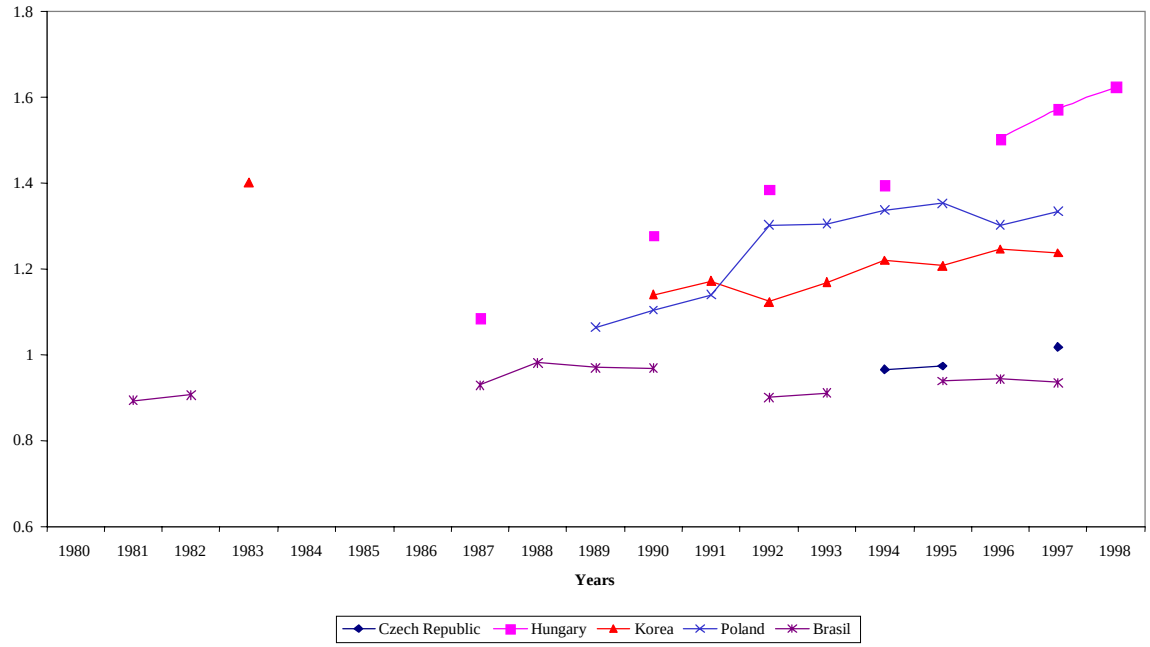

Table 1. Estimated social accounting matrix for UK economy in 1913

(Millions of pounds)

	X1	X2	E	M	W	CONS
P_1	836		-171		-665	
P_2		906			-906	
P_{F2}				234	-234	
W_S	-276	-129				405
W_U	-121	-202				323
P_K	-439	-575				1014
P_W					1805	-1805
P_{FX}			171	-234		63

X1: production index for skilled good; X2: production index for unskilled good; E: export index for skilled good; M: import index for unskilled good; W: welfare index; CONS: income level for the consumers; P1: price index for skilled good; P2: price index for unskilled good; PF_2: price index for imported unskilled good; W_S: skilled wage index; W_U: unskilled wage index; P_K: rental price of capital; P_W: welfare price index; P_{FX}: real exchange rate index.

Table 2: Elasticities of substitution used to calibrate the model

	Utility	Skilled sector	Unskilled sector
Armington	5		
Sk. Good/ Unsk. Good	0.5		
Sk. Labour/ Unsk. Labour		0.5	0.5
Capital/Labour		0.5	0.5

Table 3: UK shocks between 1913 and 1880
(relative variation between 1880 and 1913)

	1913-1880
Wage Inequality (Ws/Wu)	8.15
Terms of Trade (P_1/P_{F2})	-10.93
Labour force (manuals)	-18.16
Immigration (unskilled workers)	19.00
Education (skilled workers)	-14.43
Natural population growth	-16.40
Capital	-46.57

Sources: See data appendix.

Table 4. Simulated W_s/W_u in 1880 due to exogenous factors

	(1)	(2)	(3)	(4)	(5)
Trade	0.903	0.951	0.906	0.962	0.916
Emigration	1.404	1.423	1.366	1.140	1.395
Education	1.302	1.340	1.301	1.107	1.281
Population growth	0.960	0.978	0.983	0.984	0.950
Capital growth	1.139	1.049	1.040	1.051	1.172
Tech. change	0.637	0.594	0.677	0.864	0.629
Wage inequality without tech. change	1.782	1.860	1.630	1.245	1.823
Wage inequality including tech. change	1.082	1.082	1.082	1.082	1.082

(1) Baseline simulation

(2) Armington elasticity set to half the baseline value

(3) Elasticity of substitution between labour and capital set to double the baseline value

(4) Elasticity of substitution between skilled and unskilled labour increased to 1.5

(5) Elasticity of substitution between goods X1 and X2 increased to 1.5

Table 5. Elasticity of W_s/W_u to different shocks to 1913 situation (per cent)

	(1)	(2)	(3)	(4)	(5)
Trade	-0.947	-0.447	-0.926	-0.367	-0.824
Emigration	1.860	1.940	1.709	0.716	1.820
Education	1.640	1.831	1.630	0.631	1.544
Population growth	-0.234	-0.126	-0.095	-0.091	-0.288
Capital growth	0.198	0.084	0.058	0.076	0.253
Tech. change	-0.851	-0.931	-0.704	0.285	-0.812

(1) Baseline simulation

(2) Armington elasticity set to half the baseline value

(3) Elasticity of substitution between labour and capital set to double the baseline value

(4) Elasticity of substitution between skilled and unskilled labour increased to 1.5

(5) Elasticity of substitution between goods X1 and X2 increased to 1.5

Table 6. Simulated W_s/W_u in 1880 in different scenarios

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
W_s/W_u	1.082	1.228	0.771	0.827	1.124	0.999	1.782

(1) Baseline shocks

(2) No trade shock

(3) No emigration

(4) No education change

(5) No population growth

(6) No capital growth

(7) No technological change