

**WAGE INEQUALITY AND GLOBALISATION:
WHAT CAN WE LEARN FROM THE PAST?
A GENERAL EQUILIBRIUM APPROACH**

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De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

ISBN: 84-89116-07-5

La serie **DOCUMENTOS DE TRABAJO** incluye avances y resultados de investigaciones dentro de los programas de la Fundación de las Cajas de Ahorros.
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Wage Inequality and Globalisation: What can we Learn from the Past? A General Equilibrium Approach*

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Abstract

The current era of globalisation has witnessed a rising premium paid to skilled workers resulting in increasing wage inequality in most OECD countries. This pattern differs from that observed during the past globalisation period (1880-1913), in which wage inequality steadily decreased in most of the Old World countries. The present debate over 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. In order 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 skilled-biased technology shock increased wage inequality. However, education, emigration and capital accumulation had a more significant impact and led to a decrease in wage inequality.

JEL classification: N30, C68, J31

* Concha Betrán and María A. Pons acknowledge financial support from CICYT Grant SEJ2004-07402. Financial support from CICYT Grant SEC2002-00266, SEJ2005-01365, Fundación Rafael del Pino and EFRD is gratefully acknowledged by Javier Ferri. Preliminary versions of this paper were presented at the Sixth Conference of the European Historical Economics Society in Istanbul, September 2005, the European Social History Society Congress in Amsterdam, March 2006, IX Encuentro de Economía Aplicada in Jaén, June 2006, 18th Annual Conference of the European Association of Labour Economists in Prague, September 2006 and XXXI SAE in Oviedo, December 2006. Thanks to all the participants for their comments and suggestions.

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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 we are presently immersed in a process of diffusion of General Purpose 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 for skills of the new technologies.

Similar changes also took place during the past globalisation process, 1880-1913. 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 at 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 upheaval: this period witnessed the emergence of trade unions and a significant number of socialist organisations. The so-called "labour movement" was very active at the end of the nineteenth century and throughout the early decades of the twentieth century in many countries. Subsequently, labour institutions improved labour conditions and played a different role to that played

at present. Finally, most countries made an effort to improve education resulting in a considerable decrease in illiteracy rates and an increase in school enrolment. Both these facts 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 current globalisation process that is still to be completed. We consider that economic history is hence 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).

As a result, 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 advantages of using a GEM are several: first it allows the quantitative impact of each shock (trade, migration, education and demographic factors) on wage inequality to be explored and to simulate the effects of alternative scenarios to the observed ones. Second, the general equilibrium framework will make it possible to analyse the sensitivity of the results when some deep parameters of the model are changed. Third, the calibration of the model provides with some clues to assess the role of technological change in explaining the wage premium.

The structure of the paper is as follows: in Section 2, we show the main pattern of wage inequality over the period 1880-1913 and in the present. The UK is a representative case of the general pattern of wage inequality for Old World developed countries in the past and could be, as a labour abundant country in the past, a similar

case to developing economies in the present. In Section 3, we discuss the main factors that compete 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 to sort out the off-setting factors that explain wage inequality. Section 5 analyses the results and finally in Section 6 we present the main conclusions.

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 in order to ascertain whether the evolution of wage inequality shows the same pattern in both globalisation periods.

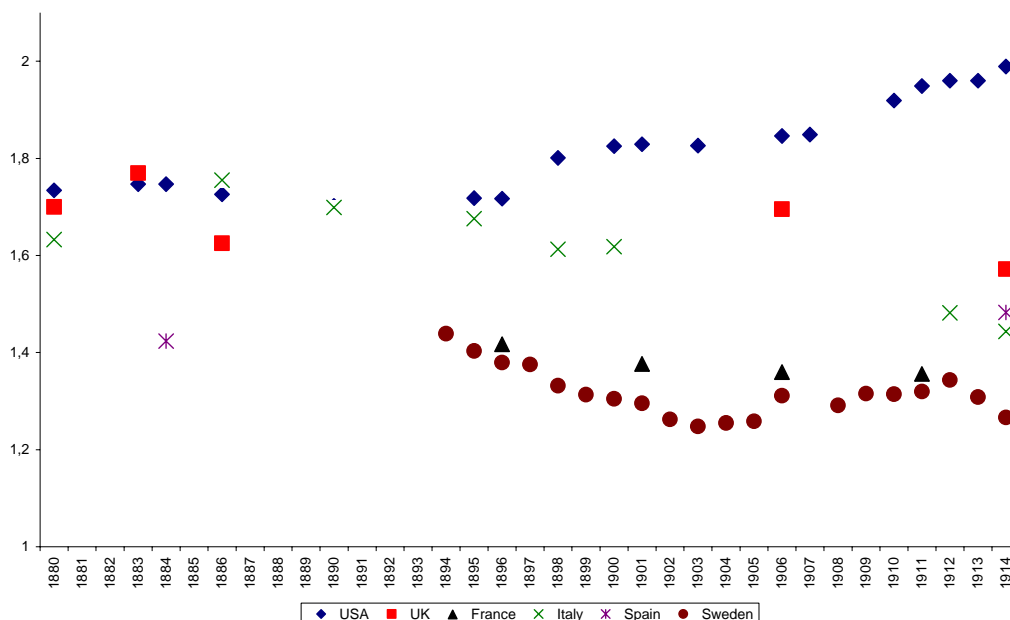
For the past, we define wage inequality as the ratio of the wages of skilled male workers to the wages of unskilled male workers in the industrial sector. For each country we have chosen the main industrial sectors and for each sector we have compared the average wage of a skilled worker with the wage of an unskilled worker: the labourer. We construct our measure of wage inequality as a weighted average of this ratio where the weights are the labour force employed in each sector. 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 and not necessarily with education. In this sense this ratio is also a proxy of the skill premium. Henceforth, the skill premium will be our measure of wage inequality for the past (sources are in the data appendix).

For the present, we use the ratio between the 90th-percentile to the 10th-percentile in the distribution of gross earnings for full-time male workers as an indicator of wage inequality in light of the fact 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 factor endowments, development and the degree of international integration. For the past, taking into account factor endowments and the level of development, two different groups of countries can be identified: the labour-scarce and labour-receiving countries (the New World countries) and the labour-abundant and labour-sending countries (the Old World countries). We also distinguish between developed and less developed Old World Countries 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 are the less developed countries.

The main patterns of wage inequality are displayed in Figure 1, where we can see how the USA (a New World country) recorded 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 up wage inequality. As regards the Old World developed countries (France and the UK), we observe a decrease in wage inequality in the globalisation period (1880-1913). These two countries were labour abundant and integrated in the world market and furthermore, 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, but an increase in wage inequality in Spain, a less integrated country. Therefore, the general pattern indicates an increase in wage inequality in the New World countries and the Old World less integrated countries, and a decrease in wage inequality in the Old World integrated countries.

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



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

In order to reveal the pattern of wage inequality throughout 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 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.

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

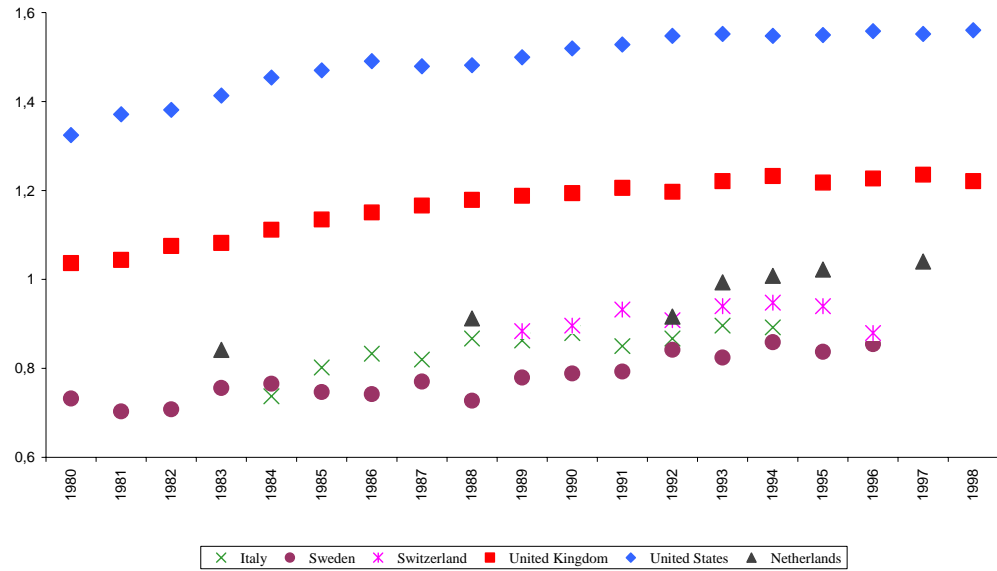
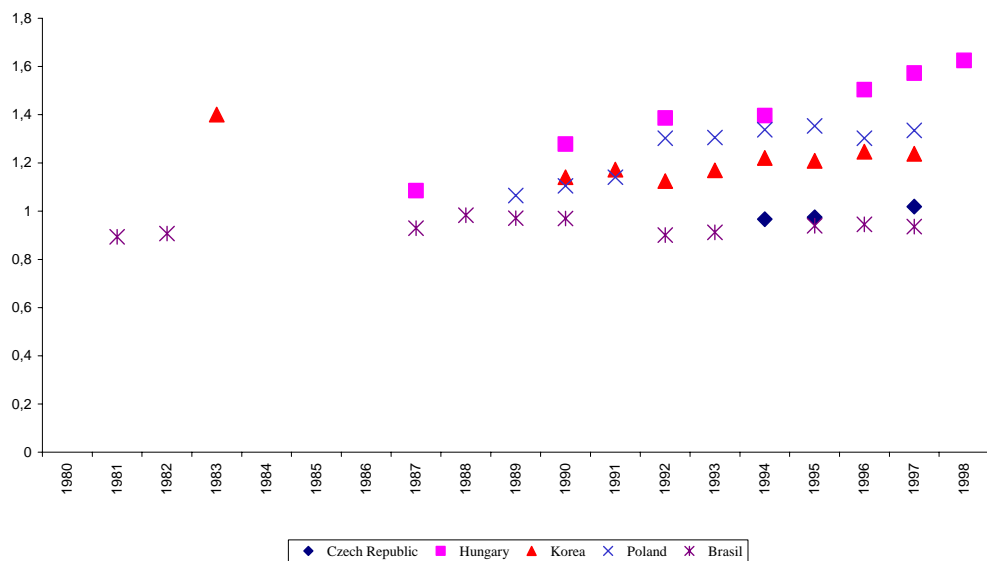


Figure 3: Wage Inequality in the Developing countries, 1980-1999



What pattern does wage inequality follow nowadays? Wage inequality increased in the 1980s and 1990s in most developed 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 relative labour scarce countries in both periods: the New World countries in the past and developed countries in the present. However, the pattern of wage inequality in the relative labour abundant countries was different in the past: wage inequality decreased in Old World integrated countries, but has increased in most developing countries today. Such a difference between the past and the present could be an indication that we have to consider factors other than those related to globalisation 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 capital flows), especially international trade (Feenstra, 2000). The second group focuses on the effects of skill-biased technological change and how 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 inequality¹. There is a third group of factors that contemplates an ‘institutional’ explanation for wage inequality and concentrates on the institutional structures of the labour market such as trends in unionisation, minimum

¹ The impact of trade on wage inequality would depend on factor endowments. In the H-O model, trade would increase wage inequality in labour-scarce countries and decrease it in labour-abundant countries.

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, providing useful insight into the evolution of wage inequality. During the period 1880-1913, globalisation forces 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 unions and the very active 'labour movement' that many countries experienced during that period. In addition to labour institutions, there was another institutional factor that must be considered: education. Investment in education was marked in most countries and this produced a rise in school-enrolment and literacy. Education was essential for the implementation of the new and more capital and R&D intensive techniques to succeed. Finally, the period also witnessed an important demographic transition which saw mortality rates decrease while high birth rates were maintained.

Now 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 and we will comment on some empirical evidence concerning the past globalisation period.

3.1 The expected impact of factors on wage inequality

The impact of globalisation (trade, migration and flows of capital) on wage inequality depends on factor endowments and the level of integration and development of a country. As far as trade is concerned, the Heckscher-Ohlin theory argues that

countries specialise in those commodities which intensively use the factors with which they are well endowed. Hence, trade growth may increase unskilled labour demand in unskilled labour-abundant countries, thus increasing the real wages of the unskilled workers. In this case, trade may reduce inequality. The opposite occurs in unskilled labour-scarce countries. Migration on the other hand changes the relative supply of skilled and unskilled workers and therefore also affects wage inequality. Finally, capital flows may affect wage inequality when they go from richer countries to poorer labour-abundant countries and change the relative demand between unskilled and skilled workers.

The technological advances in the 1870-1913 period that were part of 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 given. These technological changes were further accompanied by important organisational changes, such as Fordism and Taylorism (Chandler 1996, Rosenberg 1976, David 1991). Technology changes affected the relative demand for skilled and unskilled labour and thus wage inequality. There is a debate as to whether technological change was *skill displacing* or *skill-biased*. Although assembly line techniques resulted in capital and unskilled labour substituting skilled labour, the number of supervisors and other new professions increased at the same time due to the greater importance of capital in the production process. Moreover, assembly line techniques were not the only ones applied at that time. As Goldin and Katz (1996, 1998) indicate, the technological change from the artisanal shops or factories to continuous, 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 and, therefore, the impact of technology on the demand for skilled labour and hence on wage inequality, is an open empirical question.

In the case of the changes in labour market institutions, as mentioned previously, there was an outstanding increase in the importance of labour organisations, such as trade unions, labour affiliations and active participation in strikes and protests to improve working conditions and wages. However, the impact of such activity on wage inequality is not so clear. We do not know whether trade unions represented the interests of skilled workers more than the interests of the unskilled workers (as was the case when these organisations first emerged), as a consequence of the fact that trade unions became mass or general unions which defended the welfare of *the working class*. There has been a debate in the UK about the contribution of trade unions to 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 a significant effort to enhance education. This was important in order for the technological change to be applied as the increase in education facilitated the learning of these new technologies, thus increasing the supply of skilled labour. However, population growth and the subsequent effect on the labour force produced an increase in the supply of unskilled labour. The increase in education was at least able to offset part of this effect.

3.2 Empirical findings

Two previous papers have analysed the factors competing in the explanation of wage inequality in the past. Anderson (2001) estimates the impact of migration, trade and domestic forces. He concludes that domestic factors were the main determinants of wage inequality whereas globalisation forces had only a minor impact on wage inequality, migration being the most important globalisation factor. However, this research does not include technology in the analysis and estimates the influence of each factor separately without taking into account the interactions among them. More recently, Betrán and Pons (2004) estimated the importance of globalisation, technological change, structural change and trade unions in explaining the changes in wage inequality (the skill premium) over the period 1870-1930 by means of a panel data set for five countries (the USA, France, the UK, Italy and Spain). They concluded that globalisation factors (specially migration) were important explanatory variables in the process of wage inequality growth, but other factors such as technological and structural change also contributed to the rate of growth of the skill premium.

In this paper we change the approach. Instead of using a standard reduced form, we calibrate a general equilibrium model that allows us to determine the importance of these factors or, in other words, the importance of each individual shock (trade, migration, education and demographic factors) on wage inequality. We calibrate the model for the UK economy. General Equilibrium models have been used by economic historians to resolve the problems which arise in the long run when there are a lot of interrelationships and variable changes (see, for example Williamson 1990, Taylor and Williamson 1997, Harley 2002 and Voigtländer and Voth 2006). The advantages of using a general equilibrium approach with respect to reduced forms are several: first, it is based on an explicit model structure from which most of the reduced form models can

be derived; second, it avoids the identification problem implicit in the reduced form approach meaning that multiple model parameterisations are consistent with the same reduced form (see Abrego and Whalley, 2000) and finally it takes into account the interactions among all the variables. Thus, the general equilibrium model chosen is capable of sorting out the 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. Therefore, we also check the sensitivity of the results to these parameters to assess the extent to which the conclusions obtained in previous research hold.

4. General Equilibrium Model Approach

We have elaborated a structural but simple general equilibrium model in order to analyse the principal factors affecting wage inequality. This type of 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 change². We also check the sensitivity of the results to different parameterisations of the model, which is not possible in the reduced-form equations estimated in the literature.

Abrego and Whalley (2000, 2003) stressed the importance of a fully specified structural model in the study of the factors underlying wage inequality changes. Here, we will extend the standard models, which consider trade and technology factors only, to also capture the effects of education, natural population growth and emigration. We

² In this general equilibrium approach we are not going to include the impact of labour movements because it would be necessary to make a significant number of ad-hoc assumptions regarding the power of skilled and unskilled workers in the wage negotiation process.

calibrate the model to the UK economy in 1913 and focus on the globalisation period (1880-1913). The calibration of the general equilibrium model allows us to determine parameter values that are consistent with both the initial equilibrium and the changes in exogenous variables contributing to the change in wage inequality.

There is already a previous reference for the UK (Abrego and Whalley, 2000) using general equilibrium simulations to decompose the change in wage premiums. This research explained the increase in wage inequality that took place in the period 1976-1990, but not a decrease in wage inequality, which is our case, and considered only two explanatory factors of wage inequality, trade and technology. They calculate the technology shock as the residual needed to yield the observed wage inequality change as a model solution in the presence of the trade factor. Here, we argue that the size and even the type of technology shock could vary in the presence of more competing factors other than simply the trade shock. We try to correct this kind of bias in the estimation of the technological shock due to the omission of relevant variables. For instance, if we had *only* considered the trade shock that raises wage premium, we would have needed an important technology shock that favoured unskilled wages more than the skilled wages in order to obtain the observed reduction in wage inequality. However, as we include other factors, if no technology shock were considered, the reduction in inequality would have been more important than that observed. As a result, we need a technology shock that negatively affects, in relative terms, unskilled wages.

4.1 The model

We use a two-sector (skilled labour intensive, X_1 and unskilled labour intensive, X_2) three-factor (skilled labour, S , unskilled labour, U and capital, K) model of a price-taker economy in the simulation. External trade differs from the traditional Heckscher-

Ohlin model 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 terms of trade change, such as the one observed in the globalisation period, because the model would display full specialization. The model includes all the basic components required to decompose wage inequality, understood as the wage premium: it has two traded and two produced goods but considers three different goods in consumption, as imports are seen as a different good from the domestically produced good that substitutes imports.

Both sectors of the economy use capital (K) and a different combination of skilled (S) and unskilled labour (U) to produce output by means of a two level constant elasticity of substitution (CES) technology. At the bottom level, producers decide on the demand for 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) 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 considered a price-taker of export and import prices, the price of X_2 (unskilled labour intensive sector) is endogenously determined, and this fact makes a difference with respect to 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 factors. Equilibrium is characterised by a set of prices resulting in optimal good and factor allocation so that producers maximise profits and consumers maximise utility. Optimal allocation simultaneously satisfies the zero profit condition for both sectors, market clearing in goods and factors, 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 estimate changes in wages, trade, population and capital over the period 1880-1913. In order to obtain the base year data, we distinguish between skilled and unskilled labour and separate the production of skilled and unskilled labour intensive industries; we also require data on skilled and unskilled average wages in order to calculate the rents of each type of labour; and finally we have 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’ is calculated as a residual subtracting the rents of labour from the value of the production of each sector.

The cornerstone of our data elaboration is the 1911 census. It has been chosen for being the census that is the closest to 1913, which is the turning point between the globalisation and the deglobalisation periods. However, as the 1911 census does not contain information on the skills of labourers for all industries, we have also made use of the data elaborated by Routh (1980) for 1951. Both censuses are comparable because

they were previously homogenised by Routh. More specifically, 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 labour force working in each industry. We select some sectors from 1911 for which we have data for skilled and unskilled workers to test the validity of this assumption and we find that 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 197%. As the weight of each industry change over time, so do the weight of the total skilled on unskilled manual workers. 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 at 79.83% in 1911 and at 86.48% in 1951.

We only consider the agriculture and industrial sectors which produce tradable goods³, assuming that agriculture belongs to the unskilled sector. For the industrial sector, we classify the industries into skilled and unskilled sectors by using the percentage of skilled manual labour on unskilled manual labour in each industry. We use manual workers because our wages data is only available for manual workers, which in this period is limited to occupational wages. As a result, our classification of skilled and unskilled sectors depends on the definition of skills we have decided upon.

We take into account agriculture and 16 more industries giving us a total of 17 economic activities. We define the skilled industries as those with an above average proportion of skilled manual workers and unskilled industries those with a below average percentage. The skilled sector, X_1 , consists of the following industries: Leather, Wood, Building, Vehicles, Paper printing, Textiles, Engineering, shipbuilding and

³ We have not included the service sector for two reasons: firstly due to the lack of data on wages, production and skills and secondly because we are interested in the globalisation shock in trade, and

electrical, Other manufacturing, Metal goods and instruments, Metal manufacture and Cement, ceramics and glass. The skilled sector is a net export sector, textiles and metal goods being the most important exports. Thus, the skilled sector is a producer of the exportable domestic goods. The unskilled sector, X_2 , comprises: Mining and quarrying, Clothing, Gas, electricity and water, Food, drink and tobacco, Chemicals and Agriculture. The unskilled sector is a net importer. The most important imports are agriculture products, followed by raw materials, such as cotton. Thus, the unskilled sector is a producer of non-exportable domestic goods which compete with imports.

Feinstein (1972) is used to calculate the production of each sector, whereas the exports and the imports for the skilled and unskilled sectors were obtained from *British Historical Statistics* (1990). We find that the skilled sector accounts for 48% of total production and the unskilled sector 52%. 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 denotes 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 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 market clearing (the sum of each row is zero). The figures of the social accounting matrix represent values (prices multiplied by

therefore we only consider the sectors which produced tradable goods.

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.

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

Note: 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; P_{F2}: 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.

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 have all 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).

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

4.3 Estimation of the shocks

We have plugged different estimated shocks to the initial situation of the UK economy in 1913 related to relevant exogenous variables and parameters over the period 1880-1913. We work backwards, so that when subtracting the shock from the observed data in 1913 we hypothetically place the UK economy in 1880. However, for the sake of clarity we transform the results and present the changes between 1880 (as the initial year) and 1913 (as the final year). The relative variation of the exogenous variables between 1880 and 1913 can be found in Table 3.

The UK belongs to the group of Old World developed countries for which, as explained above, wage inequality decreased in the globalisation period by 7.58%. The changes in the terms of trade, factor endowments and technology shocks are all important determinants for explaining wage inequality.

Table 3: UK shocks

	1880-1913
Wage premium (W_s/W_u)	-7.58
Terms of trade (P_1/P_{F2})	12.27
Labour force (manuals):	22.19
- Net emigration (unskilled workers)	15.97
-Education (skilled workers)	16.86
-Natural population growth	19.62
Capital	87.16

Note: Relative variation between 1880 and 1913, in percentages

Sources: See data appendix.

With respect to trade, the UK was an open economy with an external openness rate that averaged around 55% in 1880-1913. Over the period there was a rise in the terms of trade by 12.27%, as a consequence of the significant fall in agricultural prices, the main imports in this period. Agricultural prices fell sharply when New World countries entered international markets and overproduction occurred. As agricultural products represented 63% of total imports, such price decreases had a significant influence on UK terms of trade. 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 increase inequality by relatively increasing the price of the traded skilled intensive good.

Regarding the changes in the labour force, emigration was the most significant. The UK was an earlier emigration country and between 1853 and 1913 nearly 13 million people left the UK, around 6 million after 1870 (Hatton, 2003). An important effort in education was also made, resulting in the literacy rate rising from around 80% in 1880 to 96.4% in 1913. The schooling ratio jumped from 46.5% to 81.2% over the same period. Finally, the British population grew at a rate of 23% from 1880 to 1913.

In our model the changes in the labour force are captured by means of three variables: emigration, education and natural population growth, following the expression,

$$\rho_p (\rho_e S_{1880} + \rho_m U_{1880}) = S_{1913} + U_{1913} \quad (1)$$

where S_{1880} and U_{1880} are the endowments of skilled and unskilled labour in 1880 and S_{1913} and U_{1913} represent the endowments of skilled and unskilled labour in 1913. 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 growth that affects skilled and unskilled labour equally. To set ρ_e we take the evolution in the literacy rate between 1880 and 1913 (Flora, 1973), providing us with a more moderate educational factor than we would have obtained had we chosen the schooling ratio as the basis for the estimation. Thus, according to Table 3 we set $\rho_e = 1.1686$. We fix ρ_m to a value of 0.8403 (meaning a net emigration during the period of 15.97% of the unskilled labour force) 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 1.1962.

The capital growth rate has been borrowed from Mitchell's (1990) estimations showing an important increase of 87%. However, in our simulations this figure has been corrected downwards because part of our capital is formed by land (in the unskilled intensive sector) which was in fairly fixed supply over the period (see Appendix 2 for further details).

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. 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. The same method for calibrating the technology shock can be found in Abrego and Whalley (2000) and Abrego and Whalley (2003). This idea is broadly similar to that of using any decision rule in a dynamic general equilibrium model to calibrate technology shocks (see King and Rebelo, 2000 and Nakamura, 2005).

5. Results

In this section we will present the results in three different ways. First, we obtain the individual contribution of the observed change of each variable on the wage inequality change. As there are interaction effects, the sum of the individual effects does not add up to the observed change. Second, we normalize the variation of each factor to

1 per cent of the benchmark value so as to obtain general equilibrium elasticities. Finally, we estimate what the wage inequality would be in the absence of one factor, thus providing an approximation of the opportunity cost of an individual factor.

5.1 Individual contribution of each factor

The first set of results is displayed in Table 4. 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, we are interested in explaining a decrease in relative wages up to 0.9242 in 1913. 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 in explaining the percentage increase in wages 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.

Column (1) represents the effects in the relative wages for the baseline simulation, that is, taken as given the elasticities of substitution of Table 2 and the shocks of Table 3. When the effect is above one this means that the shock considered works against the observed variation in inequality. When the effect is below one, the shock works in favour of the observed variation in inequality. According to this, international trade, natural population growth (via demand) 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 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, contrary to the simple Heckscher-Ohlin case, in a model of a finite elasticity of substitution between domestic and imported production, trade shocks can be partially absorbed on the import demand side, without full transmission to domestic producer prices, resulting in a smaller trade effect and a larger technology effect.

Table 4. Simulated W_s/W_u in 1913 due to exogenous factors

	(1)	(2)	(3)	(4)	(5)
Trade	1.107	1.052	1.104	1.040	1.092
Emigration	0.712	0.703	0.732	0.877	0.717
Education	0.768	0.746	0.769	0.903	0.781
Population growth	1.042	1.022	1.017	1.016	1.053
Capital growth	0.826	0.938	0.942	0.930	0.795
Tech. change	1.626	1.701	1.493	1.178	1.664
Wage inequality					
without tech. change	0.534	0.529	0.611	0.789	0.512
Wage inequality					
including tech. change	0.924	0.924	0.924	0.924	0.924

(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

In columns (2) to (5) we perform a sensitivity analysis, consisting of how the results change when the elasticities of substitution are modified. This analysis is important in order to mitigate the critique of the dependence of the results at both the level of disaggregation and the choice of the base structural parameters. It should be noted that the sign of the results is robust to different elasticities of substitution, in all cases the positive effects of emigration and education reducing wage inequality,

overcoming the negative effect of trade increasing wage inequality. As mentioned previously, 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, technology changes always raise the skill premium. Conversely, both natural population growth and capital accumulation have smaller effects on relative wages.

The two most important changes in the effects of the shocks arise when we vary the elasticity of substitution between skilled and unskilled labour and the Armington elasticity. Regarding the elasticity of substitution between skilled and unskilled labour (column 4), the higher the value of this elasticity the lesser the effects of all the individual shocks in wage dispersion, as it is now easier to replace the more expensive type of labour with the cheaper one. However, a higher elasticity of substitution mainly modifies the emigration and education effects as these two variables directly affect the relative endowments of labour.

A reduction in the Armington elasticity (column 2), which implies that it is more difficult for domestic production to substitute imports, mainly alters the effect of the trade shock, weakening the transmission of world prices to domestic prices.

The Armington elasticity also modifies the effect of capital accumulation considerably. The explanation is as follows: an increase in the stock of capital tends to reduce the rental price of capital originating two effects. On the one hand, a decrease in the cost of capital makes production cheaper in the sector where capital is relatively more abundant. As the capital-intensive sector is unskilled, this pushes down the price of the goods that the unskilled industry produces. This shifts the demand from imports to domestic goods and then pushes up unskilled wages and thus pushes down the wage premium. This effect depends on the Armington elasticity. The lower the Armington

elasticity, the weaker the shift in demand towards domestic industry is, and therefore, the lower the decrease in the wage premium.

On the other hand, the reduction in the cost of capital means that entrepreneurs in each industry wish to augment the demand for capital and decrease the demand for labour, as far as technology allows. When the elasticity of substitution between capital and labour is low, the demand for labour augments together with the demand for capital and the result is a decrease in the rental price of capital (a supply effect) and a rise in unskilled wages which reduces the ratio W_s/W_u (a demand effect). The increase in unskilled wages depends on the elasticity of substitution between labour and capital (column 3) and between skilled and unskilled labour (column 4), in both cases the increase in unskilled wages is lower (and the fall in the wage premium is less pronounced) as long as substitution possibilities widen.

5.2 General equilibrium elasticity

We can solve the model by controlling for the magnitude of the shocks and simulating the elasticity of the wage premium to every different shock. The results would be in this way 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 those observed. In absolute values, the greatest 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 parameters are 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.

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	-1.706	-0.716	-1.820
Education	-1.640	-1.831	-0.630	-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

5.3 Opportunity cost

Finally we answer the question of what the wage inequality would have been at the end of the period in the absence of each of the considered shocks. The results are in Table 6 and they would be comparable to multiply the estimated coefficients in a reduced-form regression by the actual change in the explanatory variables. Table 6 and 4 are not strictly comparable, as now the results 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 1913 was 0.924, meaning that wage inequality decreased by 7.5% between 1880 and 1913. But, for instance, if there had not been a capital increase between 1880 and 1913, we would have observed that wage inequality would have slightly increased over the period. If there had been no technology change, the wage dispersion in 1913 would have been almost 47% smaller than in 1880. Conversely, if no workers had migrated the wage dispersion in 1913 would have been 30% higher than in 1880. According to these results, the presence of the technology shock had the highest opportunity cost in terms of the reduction in inequality. Although, the definition of

technology change is not strictly comparable, Betrán and Pons (2004) also find that technological change made the largest contribution to wage inequality change.

Table 6. Simulated W_s/W_u in 1913 in different scenarios

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
W_s/W_u	0.924	0.802	1.300	1.214	0.890	1.042	0.534

(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

5.4 Calibration with added restrictions

All the exercises above involve comparing two years (1880 and 1913). Starting from the benchmark year (1913), for which we have information on all the variables, the strategy used to calibrate the technology shock consists of obtaining a model solution that is consistent with the wage inequality change that will not generally match other observed data for the other year (1880). To check the validity of our calibration strategy we add new information on 1880. Namely, we take the ratio of production between the skilled labour and the unskilled labour intensive sectors X_1/X_2 in 1880 together with the wage premium W_s/W_u . This new information implies that exact calibration of the parameters does not hold for 1880. As a result, a similar approximated calibration procedure to that of Abrego and Whalley (2002) has been used.

The approximated calibration allows us to obtain another dimension for the technology shock in addition to the already considered unskilled biased technological change. In particular, we have considered a Hicks neutral technological change that affects the unskilled intensive sector (see Appendix 1 for further details). We compare the results with the exact calibration procedure in Table 7.

While the results vary depending on the calibration method, the quantitative differences are small. The main result that technical change worsens the unskilled wage in comparison to the skilled wage during the period 1880-1913 still holds. Moreover, once the model is calibrated using the new information in the second year, the effect of technology change in the wage premium is slightly larger (1.748 as opposed to 1.626). As the results show, this overall impact is consequence of a smaller effect of the unskilled biased technology change (1.515 as opposed to 1.626) together with an increase in the wage premium caused by the Hicks neutral technology change (1.115 as opposed to 1). In short, here we show that both a technology shock biased against unskilled labour and a Hicks neutral technology shock in the unskilled labour intensive sector worsened the unskilled wages relative to the skilled ones.

Table 7. Simulated W_s/W_u in 1913 due to technical change

<i>Exact calibration to wage premium</i>	
Total technical change	1.626
Unskilled biased technical change	1.626
Hicks neutral technical change in X_2	1.000
<i>Inexact calibration to wage premium and production ratio</i>	
Total technical change	1.748
Unskilled biased technical change	1.515
Hicks neutral technical change in X_2	1.115

6. Conclusions

Aimed at disentangling the main factors that contribute to wage inequality and studying what we can learn from past experience, we have documented the evolution of wage inequality in the past and in the present. The pattern of wage inequality is upward in the relative labour scarce countries, both in the past (New World countries and Old World less integrated countries) and in the present (developed countries). However, in the relatively labour abundant countries in the past (Old World integrated 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 most of the latter. In the case of the UK, which belongs to the group of Old World developed 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 that emerges is that globalisation factors, especially trade, were not fully responsible for the observed change in wage inequality in the past. Instead, other factors such as technological change, education, demographic pressure and capital accumulation must have also played a relevant role in explaining the wage premium, emigration being an important factor which does not seem to be acting in the same way in the present.

The main hypotheses about the factors competing in the explanation of wage inequality change are examined by means of a general equilibrium model for the UK economy. One primary result is that the globalisation factors (trade and emigration) had a significant effect on wage inequality when considered separately. However, when all factors act simultaneously, the total effect on the wage premium is modest. Numerical simulations show that a trade shock, in the terms of trade, and a technology shock biased against unskilled labour are compatible with the observed decrease in the ratio between skilled and unskilled labour wages during the 1880-1913 globalisation period.

For that to be possible, there must have been other off-setting factors such as education, emigration and capital accumulation. This pattern 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.

One of our purposes has been to categorise the importance of all the shocks that affected wage inequality in the UK. In order to achieve this, we have presented three types of effects. First, we have calculated the individual effect of each shock, showing that the total negative impact of emigration and education on the wage premium offset the positive impact of trade and technology. Technology change also played an important role in avoiding wage equalisation, thus supporting the hypothesis that technological change in the second industrial revolution favoured skilled workers. These results are somewhat 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. However, the main results are robust to parameter checking.

Secondly, we present the simulated elasticity of wage dispersion to a change in each individual factor in order to illustrate that, once we homogenise by the size of the shock, emigration and education were most affected. In a reduced-form estimation these results would be translated to the parameters of the main offsetting factors (emigration and education) to be the most important.

Thirdly, we calculate the opportunity cost of each of the shocks that happened in the past, concluding that, in absolute values the technology change was the most important in this sense, as wage inequality would have improved the most had this factor been absent. The main difference with respect to the first set of results is the fact

that interaction effects are considered. In a reduced-form estimation these results would be roughly similar to multiply the coefficient by the actual change in the explanatory variable.

What can we learn from the past? Our results indicates that in the past globalisation process, as in most of the research on 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 a significant influence in the past and do not seem to be acting in the present. These factors could explain why wage differentials decreased in the past in some countries, but increased in the last decade of the twentieth century. Nevertheless, this paper is based on data from only one country. Further research is needed to elucidate whether the above results can be generalised to other countries.

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.
- Anderson, E. (2001): "Globalisation and wage inequalities, 1870-1970". *European Review of Economic History*, Vol. 5, pp. 91-118.
- Bagge, G., Lundberg, E. and Svernillson, 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.
- Betrán, 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.
- Hatton, T. J. (2003): "Emigration from the UK, 1870-1913 and 1950-1998" (July 2003). *IZA Discussion Paper*, No. 830.
- 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.
- King, R. G. and S. T. Rebelo (2000): ‘Resuscitating real business cycles’. *NBER Working Paper Series*, 7345.
- 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*, n° 286.
- Nakamura, E. (2005): ‘Deconstructing the success of RBC’, *Mimeo*, Harvard University.
- 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.
- Taylor, A. and Williamson, J.G. (1997): “Convergence in the age of mass migration”, *European Review of Economic History*, vol. 1, pp. 27-63.
- Voigtländer, N. and Voth, Hans-Joachim (2006): “Why England? Demographic factors, structural change and physical capital accumulation during the Industrial Revolution”, *Journal of Economic Growth*, 11, pp. 319-361.
- Williamson, J.G. (1990): “The impact of the Corn Laws just prior to repeal”, *Explorations in Economic History*, 27, pp. 123-156.
- 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
ν	Parameter related with the elasticity of substitution $\eta = \frac{1}{1-\nu}$
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}	Skilled labour endowment
\overline{U}	Unskilled labour endowment
\overline{CTD}	Current trade déficit

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 skilled intensive sector
P_{L_2}	Price for the labour composite in the unskilled intensive sector
W_s	Skilled labour wage
W_u	Unskilled labour wage
P_W	Welfare price index
P_Y	Price for Armington composite
P_{F_2}	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 a composite of skilled and unskilled labour:

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

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

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

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

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

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

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

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

A1.2 Zero profit conditions

Perfect competition and free entry imply that firms do not have extraordinary profits.

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

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

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

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

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

$$P_{F_2} = \overline{P}_{M_2} P_{FX}$$

Unitary revenue is on the left hand side of the equations and unitary cost on the right.

A1.3 Market clearing conditions

These conditions imply that demand equals supply for each good and factor.

$$\begin{aligned}
X_1 - E_1 &= (\alpha^w)^{-1} \left[(\delta^w) + (1 - \delta^w) \left(\frac{\delta^w P_Y}{(1 - \delta^w) P_1} \right)^{(1-\eta^w)} \right]^{\frac{\eta^w}{(1-\eta^w)}} W \\
Y &= (\alpha^w)^{-1} \left[(\delta^w) \left(\frac{(1 - \delta^w) P_1}{\delta^w P_Y} \right)^{(1-\eta^w)} + (1 - \delta^w) \right]^{\frac{\eta^w}{(1-\eta^w)}} W \\
X_2 &= (\alpha^y)^{-1} \left[(\delta^y) + (1 - \delta^y) \left(\frac{\delta^y P_{F_2}}{(1 - \delta^y) P_2} \right)^{(1-\eta^y)} \right]^{\frac{\eta^y}{(1-\eta^y)}} Y \\
M_2 &= (\alpha^y)^{-1} \left[(\delta^y) \left(\frac{(1 - \delta^y) P_2}{\delta^y P_{F_2}} \right)^{(1-\eta^y)} + (1 - \delta^y) \right]^{\frac{\eta^y}{(1-\eta^y)}} Y \\
W &= \frac{I}{P_W} \\
\bar{K} &= \sum_{j=1}^2 \left[(\alpha_j^x)^{-1} \left[(\delta_j^x) + (1 - \delta_j^x) \left(\frac{\delta_j^x P_{L_j}}{(1 - \delta_j^x) P_K} \right)^{(1-\eta_j^x)} \right]^{\frac{\eta_j^x}{(1-\eta_j^x)}} X_j \right] \\
L_1 + L_2 &= \sum_{j=1}^2 \left[(\alpha_j^x)^{-1} \left[(\delta_j^x) \left(\frac{(1 - \delta_j^x) P_K}{\delta_j^x P_{L_j}} \right)^{(1-\eta_j^x)} + (1 - \delta_j^x) \right]^{\frac{\eta_j^x}{(1-\eta_j^x)}} X_j \right] \\
\bar{U} &= \sum_{j=1}^2 \left[(\alpha_j^l)^{-1} \left(\frac{1}{\beta^u} \right) \left[(\delta_j^l) \left(\frac{(1 - \delta_j^l) \beta^u W_s}{\delta_j^l \beta^s W_u} \right)^{(1-\eta_j^l)} + (1 - \delta_j^l) \right]^{\frac{\eta_j^l}{(1-\eta_j^l)}} L_j \right] \\
\bar{S} &= \sum_{j=1}^2 \left[(\alpha_j^l)^{-1} \left(\frac{1}{\beta^s} \right) \left[(\delta_j^l) + (1 - \delta_j^l) \left(\frac{\delta_j^l \beta^s W_u}{(1 - \delta_j^l) \beta^u W_s} \right)^{(1-\eta_j^l)} \right]^{\frac{\eta_j^l}{(1-\eta_j^l)}} L_j \right]
\end{aligned}$$

Supply is on the left hand side while the right captures demand.

A1.4 Income balance

The following equation defines total income as revenues from total capital endowment, skilled and unskilled labour endowments and current trade deficit.

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

A1.5 Macro closure rule

This rule reflects the fact that the current trade deficit is constant.

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

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

A1.6 Calibration with added restrictions

Two changes in calibration are included with respect to exact calibration in which only information for the wage premium is considered. First, we allow for Hicks neutral technology change in sector X_2 as captured by $\Delta\alpha_2^x$ in addition to the unskilled biased technological change ($\Delta\beta^u$) used in the exact calibration procedure. Second, we choose β^u and α_2^x for 1880 in order to minimise a criterion function. In particular we choose the sum of squared deviation of model-predicted wage and production ratios (with a hat in the expression below) with respect to the actual values in 1880 (the variables without hat):

$$\min_{\beta_u^{1880}, \alpha_2^{x,1880}} \left(0.5 \left(\frac{W_s^{1880}}{W_u^{1880}} - \frac{\hat{W}_s^{1880}}{\hat{W}_u^{1880}} \right)^2 + 0.5 \left(\frac{X_1^{1880}}{X_2^{1880}} - \frac{\hat{X}_1^{1880}}{\hat{X}_2^{1880}} \right)^2 \right)$$

This particular form implies the same weight for wage and production deviations. According to our results the minimum value for this function is 0.004 that is reached for a value of $\beta_u^{1880} = 0.600$ and $\alpha_2^{x,1880} = 1.230$.

Appendix 2:

Data for wage inequality in the past

For France, the UK, Italy, Spain and the USA see Betrán and Pons (2004). For Sweden, we have calculated from Bagge, G., Lundberg, E. and Svernilson, I. (1933).

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 are 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 semi-skilled and unskilled manual workers to classify industries in skilled and unskilled sectors. The skilled industries are those that display an above average proportion and the unskilled industries a below average proportion.

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 Manual 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 the 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). As in our model capital involves land and capital. In order to identify productive capital and land accumulation separately we use the percentage which represents the rent of land on GDP in 1841 (from Harley and Crafts, 2000) and extrapolate to the year 1913 using the rate of growth of the rents of land and buildings calculated by Feinstein (1972). According to our estimation the rents of land represented a 15% of the production of agriculture (A) and industry (I) in 1913. As the participation of the total rents of capital on GDP (A+I) according to the social accounting matrix was 58.2%, we use the ratio $43.2/58.2$ to correct the shock in capital of Table 3.

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