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Abstract

This paper examines the effect of shifts in the relative supply and demand of skills on the skill premiums and wage inequality in the British labour market 1972-2002. We test the Katz and Murphy (1992) hypothesis that the changes of skill premiums can be explained by their relative supply shifts, given stable or steadily growing relative demand. Alternatively, Machin (2001) hypothesis holds if the changes of skill premiums can be explained by relative demand shifts, given stable or steadily growing relative supply. From co-variation of relative skill wages and relative labour supplies of skills, we reject the hypothesis that the relative labour demand for skill is stable over time for either males or females. By using detrended relative skill wages and supplies, we infer that the acceleration of relative demand for skills caused a positive association between relative skill wages and labour supplies for males in the 1980s and the 2000s, and for females after the 1970s. Hence, the steadily growing relative demand in Katz and Murphy (1992) can only broadly fit with the cyclical co-variation of skill premiums and supply for males, but not for the long term increasing trend of skill premiums and supply of females. We find the acceleration of relative demand for skilled workers after the 1970s as suggested in Machin (2001) hypothesis.

Keywords: wage inequality, labor supply, labor demand
JEL codes: J22, J23, J24, J31

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1. Introduction

Wage inequality has increased substantially in the United Kingdom and arrived at a high level in terms of the UK's historical experience in the early years of the new century (Lindley and Machin, 2011). Rising wage differentials between education groups, i.e. skill premiums have been identified as a key feature of rising wage inequality (Acemoglu and Autor, 2010). Peng and Kang (2013a) also argue that two prominent changes in the British labour market contribute to the rising wage inequality: the increase in education/experience attainment inequality has made total employment more heterogeneous (endowment effect); skill premiums (mainly education and experience premiums) have been increasing over the entire period, especially after the 1970s (relative wage effect). This paper aims to investigate whether a simple supply and demand framework can fit with these changes in the wage structure of the British labour market over the thirty-year period of 1972-2002.

We use two strands of research to explain wage structure changes. The first one is from the work of Katz and Murphy (1992), which examines a negative association between relative skill supply and skill premium using the Current Population Surveys (CPS) 1964-1988. They argue that fluctuations in the growth rate of relative supply for skill, combined with steadily growing relative demand can explain changes of the skill premiums. Katz and Murphy's hypothesis is plotted in Figure 1. The horizontal axis represents the relative employment of skilled workers to unskilled workers (L_S/L_U), and the vertical axis represents the relative wage of skilled workers to unskilled workers (W_S/W_U). The relative demand (D_1) intersecting relative supply (S_1) give the original equilibrium point A, in which skilled workers have relative wage w_1 and relative employment l_1. Since the relative demand is constant or steadily growing, the relative demand curve would stay at D_1 or increase from D_1 to D_2. At the same time, relative supply S_1 increases to S_2. The new equilibrium has a lower relative wage w_2 or w_3 (that is, lower inequality) and higher relative employment l_2 or l_3 for skilled workers. Over the period of decreasing wage inequality, relative supply for skill has overwhelmed the relative demand of skill and showed a negative association between changes of relative wages and the changes of relative supplies.

(Figure 1 is around here)

On the other hand, many economists find that the changes in the British wage inequality are driven primarily by shifts in the relative labour demand favouring more skilled workers over less skilled workers (Nickell and Bell, 1995; Nickell and Bell, 1996; Machin, 2001; O'Mahony et al., 2008; O'Mahony and Peng, 2008). In a relative supply and demand framework, a simultaneously rising skill premiums and employment share of skilled workers can only suggest that relative demand must have risen at a faster rate than supply. Figure 2 describes the supply-demand changes behind this argument. Machin (2001) argues that skill-biased technology changes (SBTC) increase the relative demand for skilled workers, hence the relative demand curve for skilled workers would increase from D_1 to D_2. At the same time, the relative supply of skilled workers stays at S_1 or steadily increases from S_1 to S_2. Hence, the new equilibrium has a higher relative wage w_2 or w_3 (that is, higher inequality) and higher relative employment l_2 or l_3 for skilled workers. Over the period of rising wage inequality, relative demand for skill has won the race against the increasing relative supply of skill. There is a positive association between relative skill wage and relative supply of skill.

(Figure 2 is around here)

Therefore, Katz and Murphy (1992) argue that supply fluctuations dominate the relative wage changes in the USA during 1964-1988 by proving the negative association between relative wage and supply. Machin (2001) illustrates the positive associations and concludes that relative demand has surpassed relative supply in both the UK and the US during 1980-2000. The interaction between relative supply and demand decides relative wages. The positive or negative associations between relative supply and relative wage are just outcomes of a horse-race between relative supply and demand for skills. In this paper, we test whether this supply-demand framework can fit the wage structure changes in the British labour market over the last thirty years.

Even though the changes of skill supply can be due to exogenous institutions such as education policy, we do not know why the relative demand changes in the ways as described in Katz and Murphy hypothesis or Machin hypothesis. Many authors have analyzed the causal factors underpinning the relative demand shifts based on concepts of SBTC (Machin and Van Reenen (1998) for seven OECD countries and O'Mahony et al. (2008) for four countries), international trade (Wood, 1994; 1995; 1998) and labour market institutions (Addison et al., 2003; Card et al., 2004; Peng and Kang, 2013b). In this paper, we here assume that the shocks from technology, trade patterns and institutions have been completely absorbed by the relative supply-demand changes. Hence, there is no unemployment above the natural level in this framework as described in Figure 1 and 2. Holding the full employment assumption, the observed relative wage and employment must be "always at the equilibrium" and the changes of relative wages can be explained by the interaction between the relative supply and demand. The remainder of this paper is organised as follows. Section 2 reviews the simple model of supply and demand in Katz and Murphy (1992). Section 3 describes the main data sources and measurement of relative wage and relative labour supply. In Section 4, we provide the basic empirical results. The last section concludes.

2. A model of supply and demand

In this paper, we treat the different demographic (gender-education-experience) groups as distinct labour inputs, and hence imperfect substitutes for each other in the production process. Following Katz and Murphy (1992) model, there is an aggregate production function, which provides *K* types of outputs and requires *J* types of labour inputs (J=96 here, that is, 2×6×8 by two gender, six education and eight experience groups). It is assumed that there are *K* sectors in the aggregate production function and each sector can only provide one kind of output *k* but may employ all *J* types of labour. Each sector applies a different technology to combine labour inputs. Thus, the production function of sector k can be written as:

$$Y_{kt} = A_t\ F_{kt}(X_{kt}) \tag{1}$$

where Y_{kt} is the output of sector *k* in year *t*; A_t is the total factor productivity (TFP) decided by the neutral technology, that is, an index of the productivity level of the whole economy in year *t*; X_{kt} is a $J\times 1$ vector of labour inputs employed in the sector *k* in year *t*; $F_{kt}(X_{kt})$ is the contribution from the labour inputs, which is concave for each input and decided by non-neutral technology. Hence, the aggregate production function is: $Y_t = A_t\ F(X_t)$, where Y_t is a $K \times 1$ vector of all kinds of outputs in year t; X_t is a $J \times 1$ vector of total labour inputs employed and $F(X_t)$ is also concave for each aggregate labour input.

Under the free entry assumption, wages are set equal to the marginal products of labour inputs: $W_t = A_t\ F_X(X_t)$. Then, the labour demand for one kind of labour input is the sum of labour demand for this labour input in all sectors, that is, $X_t = \sum_{k=1}^{K} F_{kt}^{X\ -1}(W_t / A_t)$. Thus, the aggregate labour demand is simplified as:

$$X_t \equiv D(\frac{W_t}{A_t}, Z_t) \qquad (2)$$

X_t is the labour demand associated with the aggregate production function. In this demand function, W_t/A_t is a $J \times 1$ vector of relative wage to the total productivity in year t. In addition, Z_t is $Z \times 1$ vector of labour demand shifts induced by changes of technology, international competition and institutions. Under the assumption of a concave production function $F_{kt}(X_{kt})$, the relationship between the wage changes and labour supply is negative in each sector, given constant labour demand (Z_t-Z_{t-1}=0). According to Walras' Law of markets, if all output markets are in equilibrium, the market for labor will also be in equilibrium. Hence, there is a negative relationship between relative wage (to the contemporary TFP) and labour supply.[1]

Moreover, even if the demand in equation (2) shifts over the time (Z_t-$Z_{t-1}\neq$0), the ($J \times J$) matrix of cross relative wage effects on labour demands (i.e. $D_{W/A}$), is still negative semi-definite from the concave aggregate production function. Thus, the change of labour demand can be written in terms of differentials as:

$$dX_t = D_{\frac{W}{A}} d(\frac{W_t}{A_t}) + D_Z dZ_t \qquad (3)$$

Katz and Murphy (1992) rearrange equation (3) and multiply the two sides by the (1×J) vector of relative wage changes, i.e. $d(W_t / A_t)'$. The negative semi-definiteness of $D_{W/A}$ implies that

$$d(\frac{W_t}{A_t})'(dX_t - D_Z dZ_t) = d(\frac{W_t}{A_t})'\ D_{\frac{W}{A}} d(\frac{W_t}{A_t}) \leq 0 \qquad (4)$$

Thus, changes in labour supplies (dX_t) net of demand shifts $(D_Z dZ_t)$ are negatively associated with changes in relative wage. It shows the negative relationship between changes of net labour supply and relative wages. The discrete version of equation (4) is in the form of:

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[1] That is, $(W_t / A_t - W_{t-1} / A_{t-1})'(X_t - X_{t-1}) \leq 0$. If the TFP does not change in a short term, i.e. A_t=A_{t-1}, this inequality can be simplified as $(W_t$-$W_{t-1})'$ $(X_t$-$X_{t-1}) \leq 0$. This is the common sense of the supply-demand theory: as the labour supplies increase, the prices of labour inputs decrease, *ceteris paribus*.

$$(\frac{W_t}{A_t}-\frac{W_{t-1}}{A_{t-1}})'\left\{(X_t-X_{t-1})-[D(\frac{W_{t-1}}{A_{t-1}},Z_t)-D(\frac{W_{t-1}}{A_{t-1}},Z_{t-1})]\right\}\leq 0 \quad (5)$$

The changes of net supplies are the actual changes of labour supply less the demand changes that would have happened at fixed wage (W_{t-1}/A_{t-1}). Thus, there is a negative association between relative wage changes and net labour supply changes, as described in Figure 1.

Katz and Murphy (1992) firstly assume the relative demand is stable, so there is no change in relative demand over time. Hence, their hypothesis is simplified as $(W_t/A_t - W_{t-1}/A_{t-1})'(X_t - X_{t-1}) \leq 0$. Secondly, technological and institutional changes may be reflected at last as a steadily growing relative demand for skill. The steady growth of relative demand affects equation (5) in two ways: a growth in relative wage and a decrease in net labour supply. Hence, equation (5) can be transformed as: $(W_t/A_t - W_{t-1}/A_{t-1} - b_1)'(X_t - X_{t-1} - b_2) \leq 0$, in which b_1 and b_2 are the slope vectors of time trends of relative wage and relative demand so that residual vectors of ε_1 and ε_2 only capture effects from supply side: $W_t/A_t=a_0+b_1t+\varepsilon_1$; $D_t=a_1+b_2t+\varepsilon_2$. If the inner products of the detrended relative wage changes with the detrended net supplies changes were negative, the steadily growing demand hypothesis described in Figure 1 would be proved.

However, Acemoglu (2003) argues that even if the returns to scale are constant at the firm level, the aggregate production possibilities set of the economy may exhibit increasing returns to scale because technologies are also determined endogenously. Hence, the production $F_{kt}(X_{kt})$ in equation (1) could be convex for skilled labour inputs because of skill-biased technical changes. It suggests that as more skilled workers join one sector, the marginal productivity of skilled workers may be even higher. The ($J\times J$) matrix of cross relative wage effects on labour demands in equation (4) may be positive semi-definite from the convex aggregation production.

Moreover, the wage setting institutions are assumed to be flexible to allow relative wage to change in Katz and Murphy (1992). Acemoglu et al. (2001) show that trade union could not only push unskilled workers' wages above the equilibrium (hence surplus for unskilled workers), but also depress the wages of skilled workers (hence shortage for skilled workers). It suggests that under a rigid labour market with strong trade union, relative wages for skilled workers cannot respond to market condition. The equation (5) could behave as a negative inequality only because strong union depressed the skill premiums below the equilibrium even without increase in relative supply of skill. Trade union density in the UK has been declining from the peak value around 60% in the 1970s to about 20% in the 2000s (Peng and Kang, 2013b). The declining trade union allows a more flexible wages for both unskilled and skilled workers. However, without intervention from trade union, the unskilled workers more possibly have downwards wage flexibility as well as upwards flexibility for skilled workers' wages. It would reflect as an increasing skill premium even with increasing relative supply of skills. Machin (2001) argued that SBTC and institutional changes (such as trade union decline) were reflected in an accelerating relative demand for skill in the 1980s, so that the relative skill supply and skill premium increased together. Thus, in the face of SBTC and decline of trade union, the positive association between relative wages and relative supply, i.e. $(W_t/A_t - W_{t-1}/A_{t-1})'(X_t - X_{t-1}) \geq 0$

or $(W_t / A_t - W_{t-1} / A_{t-1} - b_1)'(X_t - X_{t-1} - b_2) \geq 0$, suggested in the Machin (2001) hypothesis is observed.

3. Data description and measurement

3.1 Measurement of relative wage and relative supply

The data used in this paper is the series of the annual General Household Survey (GHS) for the period from 1972 to 2002. The GHS is a continuous, multipurpose survey of large random samples of households across Great Britain, conducted on an annual basis by the Office for National Statistics (ONS). The survey has been carried out continuously except for two breaks: (i) in 1997 when the survey was reviewed and (ii) in 1999 when the survey was redeveloped. Hence, we include 29 years of data in this paper (T=29) over the period 1972–2002.

We categorize the data of each year into 96 (2×6×8) distinct labour cells, distinguished by two gender, six highest education attainment and eight potential labour market experience groups (from one to forty by five years). The six education groups include: no any educational or vocational qualification, *NOQUAL*; with below O-level qualifications, *BOLEV*; with O-level equivalent qualifications, *OLEV*; with A-level equivalent qualifications, *ALEV*; with higher educational qualifications but without degrees, *HIGHER*; and degree equivalent or above qualifications, *DEGREE*. The experience variable is defined in the standard way as the minimum of (age-years of education-5, age-16) as in Katz and Murphy (1992). The 96 labour cells are regarded as distinct and imperfectly substitutable labour supplies in the supply-demand model.

Following the same line of Katz and Murphy (1992), two samples are created from the GHS data: (1) the count sample: this is a sample taken from the original GHS dataset so that we can measure the amount of labour supplied within each demographic cell. The count sample is a very close concept to total work force, including all individuals who work at least one week in the sample year with clear information of weekly working hours (*workhrs*), regardless of whether they were part- or full-time, self-employed, or otherwise. We use annual working hours (weekly working hours times annual working weeks) as measure of labour supply. According to the ONS (2006), this variable is the most continuous hours variable in the GHS, which reflects "Usual number of hours worked per week excluding mealtime and overtime". Furthermore, the total working hours within each demographic cell are calculated for each sample year. Then, the total working hours of each cell is divided by the sum of all cells in that year so that they are expressed as proportions. Thus, the labour supply concept used in this paper is actually a proportion to the total working hours, actually a relative labour supply.[2]

Since the working hour variable does not include over time hours before 1996, the main concern about our labour supply variable is overtime hours which is an important part of working hours in the British labor market (Bell et al., 2000). Hence, the missing overtime problem in annual working hours may bring biases in our labour supply variable. Bell and Hart (2003a; b) show that overtime hours and pay are not wholly geared to meeting short-term shifts in production requirements even in labour markets like Britain where statutory overtime rules do not apply. The maximum

[2] We have also tested the head count employment measure and found there is not much difference from our basic conclusions. The head count employment is an inferior measure of labour input to working hours. Hence, we only present results using working hours in this paper. The interested reader can contact with authors for results using head count employment.

lengths of standard weekly hours set by many firms follow wider industrial or regional or national collective bargaining norms. Their observations are consistent with the view that the conditions for overtime working follow "custom and practice" and a long-term contractual role for overtime, suggesting that the proportions of overtime in our labour input measure of annual working hours should be stable. Hence, the missing overtime problem in our working hours variable may be not very serious.

(2)The wage sample: the wage sample only includes all full-time employees aged sixteen to sixty-six. "Full time employee" here is defined as workers with weekly working hours exceeding 35 hours (excluding employer and self-employed). Self-employed workers, part time workers and those working without pay are excluded from the sample. The wage variable used in this paper is the real gross hourly earnings deflated by the annual Retail Price Index (RPI) based on the year of 1995. Wage variable is calculated only from the wage sample since it can provide accurate wage information by excluding noise from extreme cases. In GHS 1972, the count sample is broader than the wage sample by about 33 percent. The coverage difference between the two samples increases to 61 percent in the GHS 1995, which is consistent with the widely agreed fact of more labour participation of women as part-time workers after the 1970s. Even though the wage sample is much narrower than count sample, we still have enough observations in each cell.

Empirically, we measure variables in equation (5) using the above two samples. First of all, we calculate the working hours shares of 96 demographic cells for each sample year from the count sample. The average working hours share of each cell over the entire period 1972-2002 is the fixed weight for that cell, i.e. $\overline{E}$ (see Table A1 in Appendix). For example, male workers without any education qualification, but with experience less than 5 years provided about 3.19 percent of the total labour input in 1972. The proportion declined to only about 0.23 percent in 2002. Hence, the fixed weight of this cell (male-*NOQUAL*-5) is the average working hours share over the entire period: about 1.27 percent. On the other hand, male workers with more than 35 years of experience in the *DEGREE* group provided about 0.15 percent of the total labour input in 1972. The proportion increased to about 0.64 percent in 2002. Hence, the fixed weight of this cell (male-*DEGREE*-40) is the average working hours share over the entire period: about 0.44 percent.

Second, we calculate the mean hourly wage of each cell for each sample year. Hence, W_t in equation (5) is a 96 ×1 vector, which denotes the mean wages for our 96 demographic (gender-education-experience) cells in year t (t=1972…2002). Using the average working hours shares ($\overline{E}$), the fixed weighted mean wage of that year is calculated, that is the wage index of that year (A_t, see the upper part of Table A2 in Appendix). The fixed weighted mean wage was about 5.22 pounds (based on 1995 pounds) per hour in 1972, and then increased to about 7.07 pounds per hour in 2002. Thus, after controlling for the labour input composition shifts, the productivity level in the UK has increased about 35.4 percent, i.e. (7.07-5.22)/5.22 over the entire period.

Consequently, the mean wage of each cell is divided by the wage index of that year to get the relative wage of the cell (W_{jt}/A_t, see the lower part of Table A2 in Appendix). The average relative wage of each cell over the entire period 1972-2002 is the *efficiency units* of this worker group. For instance, the mean wage of the male-*NOQUAL*-5 group was about 55 percent of the wage index in 1972. In 2002, the relative wage of this group was about 58 percent. The average relative wage over the last thirty years is about 0.55. On the other hand, the mean wage of the male-*DEGREE*-40 group was about 2.54 times of the wage index in 1972 and 1.77 times in 2002. Hence, the *efficiency units* of this group are about 1.91, which suggest an average skill premium of 91% for this group.

Last but not least, the relative labour supply used in this paper is the working hours' share of each cell measured in *efficiency units*. The working hours share of each cell multiplies its efficiency units, and divided by the sum of all cells (see Table A3 in Appendix). Hence, the relative supply is quite different from the simple working hours share, especially for low skilled and high skilled workers. For example, the working hours' share of the male-*NOQUAL*-5 group was about 3.19 percent in 1972. However, as labour input is measured in *efficiency units*, this group only provided about 1.97 percent of total efficiency input in 1972. That is because the productivity of this group is only about 55 percent of the average level. Nevertheless, the working hours share of the male-*DEGREE*-40 group was only 0.15 percent in 1972, while the efficiency contribution of this group was about 0.32 percent as the productivity of this group is 1.91 times of the average level. Moreover, the efficiency share of this group increased from 0.32 percent in 1972 to 1.07 percent in 2002. This result shows the dramatic increase in working hours share of those educated senior males (from 0.15 percent in 1972 to 0.64 percent in 2002, see Table A1) on the one hand, and the decline of their relative earnings over the last thirty years (2.54 in 1972 to 1.77 in 2002, see Table A2) on the other hand.

3.2 Changes in relative supply

We compare relative labour supply measured in *efficiency units* with the working hours' shares at more aggregated levels in Table 1. The top panel is the working hours' shares for different groups in seven years: 1972, 1977, 1982, 1987, 1991, 1998 and 2002. The middle panel is relative labour supply measured in *efficient units* at the same seven years. The bottom panel of Table 1 summarizes the corresponding changes in relative labour supplies over the 1972-2002 and six sub-periods: 1972-1977, 1977-1982, 1982-1987, 1987-1992, 1992-1998 and 1998-2002.

(Table 1 is around here)

In the first two rows of each panel, the overall change in relative supply, i.e. X_t-X_{t-1} in equation (5) is presented by gender. The top panel shows that labour input of females has been increasing from about 32 percent to about 43 percent of total working hours over the entire period. However, the middle panel shows that the relative supply measured in *efficiency units* of females is much lower than their working hours' shares, only from about 25 percent to about 36 percent. The difference between the two measures is due to the fact that the average productivity of females (as measured by their *efficiency units*) is lower than that of males. Hence, their relative labour supply in *efficiency units* is lower than simple working hours' proportions. The bottom panel shows the relative supply of females has increased by about 37.6 percent over the entire period, corresponding to a continuous drop of males (-16.2 percent). This result reflects not only the increasing role of women in terms of workforce participation but also their increasing productivity level.

The similar analysis can be applied for other groups in Table 1. The top panel shows that working-hours proportions of college graduate (from about 2.3 percent to about 23 percent) and O-level holders (from about 9.7 percent to about 19.8 percent) has been increasing over the entire period. Meanwhile, the working-hours proportions of the *NOQUAL* group fell from 59.6 percent to 13.7 percent over the same period.

The middle panel also illustrates that there has been substantial long-run growth in the relative supply of college graduates (from 4.1 percent in 1972 to 32.1 percent in 2002) and O-level holders (from 9.5 percent in 1972 to 17.1 percent in 2002), while the relative labour supply of the *NOQUAL* group fell from 54.1 percent to 9.8 percent over the same period. Thus, relative labour measured in *efficiency units* is higher than the simple working-hours proportions for high skilled workers, but lower for unskilled workers. Relative supply of high skilled workers (28 percent for college graduate) is also growing faster than low skilled workers (7.6 percent for *OLEV*). As regards the experience groups, the relative supply of male new entrants fell almost half from 5.1 percent to 3 percent, while the relative supply of the senior males (with 26-30 years of experience) is quite stable over the entire period. Therefore, the relative labour supply in the UK has shifts a more educated and experienced (hence more skilled) structure.

4. Empirical results

To examine how relative supply changes line up with the relative wage changes, we implement the framework outlined above. We firstly test the changes of wage structure in the UK are from the interaction between relative labour supply net a stable demand. For this test, we compute the inner products of changes of relative wages with changes of relative labour supplies between time periods. In order to reduce the numbers of computations and minimize the impact of measurement error, we aggregate our 29 years into six five-year intervals centred in 1974, 1979, 1984, 1989, 1994 and 2000. Then, the average relative wages and average relative supplies of our 96 demographic cells are computed for these sub-periods. The inner products of the changes in these measures of wages and supplies are calculated for each pair of these six intervals.

The results of these calculations are given in the top part of Table 2. For the period taken as a whole, results in the top part appear to be inconsistent with the stable demand hypothesis in Katz and Murphy (1992). For males, only eight of all fifteen comparisons over the period are negative, as well as three for females. Thus, it seems that the stable labour demand hypothesis is only partially proved for the entire period.

(Table 2 is around here)

Moreover, inner products of wage and supply changes show a cyclical pattern for males, but an increasing trend for females over the entire period. As we expect, the positive associations between relative wages and labour supply are especially evident for males in the 1980s. For example, all comparisons between the interval centred in 1974 and intervals after 1974 (that is, 1979, 1984, 1989, 1994 and 2000) for males are negative, while all comparisons between the interval centred in 1979 and intervals after 1979 (that is, 1984, 1989, 1994 and 2000) are positive. Then, all comparisons between the interval centred in 1989 and intervals after 1989 (that is, 1994 and 2000) are again negative. However, we cannot find negative inner products for females except a few comparisons associated with two early intervals centred in 1974 and 1979, which may reflect a continuous acceleration in relative demand for female skilled workers after the 1970s.

As the relative supply of skilled workers in the UK has been increasing continuously over the entire period (see Table 1), the changes of relative supply of skilled workers are always positive. Hence, the cyclical pattern of males must be from the cyclical changes of skill premiums. Panel A of Figure 3 illustrates possible supply-demand movement behind the above comparison for males. The horizontal axis represents the relative labour supply of skilled workers to unskilled workers (L_S/L_U), and the vertical axis represents the relative wages of skilled workers to unskilled workers (W_S/W_U). The relative demand (D_1) and relative supply (S_1) cross in the 1974 interval to achieve the original equilibrium. Since the relative supply of skilled workers has continuously increased from S_1 to S_6 over the entire period, the changes of relative wages decide the signs of inner products. New equilibriums in later intervals have to follow the trace of the dashed curve to keep consistent with Table 2. Hence, skilled workers have lower relative wages in the intervals centred in 1979 and 1994, but higher relative wages in the intervals centred in 1974 and 1989.

The only possible explanation is that the increase of relative supply of skills has surpassed relative demand during the 1970s (from D_1 to D_2) and early years of the 1990s (from D_4 to D_5), between which the increase of relative supply of skills has been surpassed by the increase of relative demand. Hence, changes of relative wages of skills as well as inner products are negative in the 1970s and early years of the 1990s. Thus, Katz and Murphy (1992) hypothesis is proved for males during the 1970s and early years of the 1990s, while the 1980s and the 2000s seems more compatible to Machin (2001) hypothesis.

Similarly, Panel B of Figure 3 illustrates supply-demand movement for females. Equilibrium points also follow the trace of the dashed curve to keep consistent with Table 2. Hence, skilled female workers have lower relative wages in the interval centred in 1984 and higher relative wages in the interval centred in 1974 and 2000. After the interval centred in 1984, the relative demand of skills has surpassed the relative supply and pushed the relative wages to a historical height in the 2000s. Thus, Machin (2001) hypothesis is proved for females after the 1970s.

(Figure 3 is around here)

The top part of Table 2 rejects the stable demand hypothesis for the period taken as a whole. Consequently, the alternative steadily growing demand hypothesis is tested in the bottom part. We examine whether the observed relative wage changes can be made consistent with the observed pattern of relative labour supply changes, simply by allowing for steadily increasing relative demand. Thus, we include a time trend for relative wages and net labour supply in equation (5) to allow a steady relative demand growth. And then we take the average residuals over five-year intervals for each cell, and compute the inner products of detrended relative wages changes and net labour supply changes.

The results of this procedure are shown in the bottom part of Table 2. If the inner products were negative, results would support the steadily growing demand hypothesis in Katz and Murphy (1992). Otherwise, the acceleration of relative demand hypothesis in Machin (2001) is proved. From the bottom part of Table 2, we find some evidences to support the steadily growing relative demand hypothesis. For males, eight of all fifteen comparisons still show negative associations over the period, as well as only three for females. Those positive inner products in the 1980s and the 2000s (for example, 0.0017, between 1994 and 2000 for males, and 0.0023, between 1974 and 1984 for females) are too big to be regarded as measurement errors. This result suggests an acceleration of relative demand for skilled workers in the 1980s and the 2000s.

In order to test the robustness of our conclusion, Table 3 uses the same procedure for different time intervals (3-year centred interval) and different years: 1973, 1978, 1983, 1988, 1993 and 2001. We find a similar cyclical pattern of co-variation between the relative wages and relative supplies as already shown in Table 2, which rejects the stable relative demand as well. In the bottom part of Table 3, more detrended results (eleven of all fifteen comparisons) are negative for males. Nevertheless, those positive co-variations between relative wages and relative supplies such as 1978-1993 (0.0023) for males and 1973-1988 (0.0052) for females, again confirm the acceleration of relative demand in the 1980s and the 2000s.[3]

(Table 3 is around here)

Figure 4 plots (log form) relative supplies' changes against relative wages' changes of the 96 labour cells between 5 year interval centred in 1974 and 2000 and five sub-periods: 1974-1979, 1979-1984, 1984-1989, 1989-1994 and 1994-2000. In order to find the associations between relative wage and labour supply on these periods, we predict wage changes from a weighted least squares regression for each period.[4] These predicted values are represented as the lines drawn in the Figure 4. Since males are majority of labour input (see Table 1), the overall picture of all 96 labour cells would follow the cyclical pattern of wage differentials for males. We can find the associations between relative wage and labour supply are negative for the entire period 1974-2000, also for 1974-1979 and 1989-1994, but positive for the periods of 1979-1984, 1984-1989 and 1994-2000. Thus, the six graphs shown in the figure reinforce the cyclical pattern that we find in the inner products of males.

(Figure 4 is around here)

5. Conclusions

This paper examines the effect of shifts in the relative supply and demand of skills on the skill premiums and wage inequality in the British labour market 1972-2002. A supply and demand framework as in Katz and Murphy (1992) is built to examine the hypothesis that given stable or steadily growing relative demand, relative supply shifts can explain the changes of wage (that is, Katz and Murphy hypothesis, alternatively, Machin hypothesis).

From co-variation of relative wages and relative labour supplies, we reject the hypothesis that the relative labour demand is stable over time for both males and females. By using detrended relative wages and supplies, we infer that an acceleration of relative demand for skills, that is, a positive association between relative wages and labour supplies (males in the 1980s and the 2000s, females after the 1970s). Hence, the steadily growing relative demand in Katz and Murphy (1992) can only broadly fit with the cyclical co-variation of wage and labour supply of males, but not for the long term growing trend of wage differentials for females.

The acceleration of relative demand for skilled workers moves beyond the steadily growing relative demand model and can explain the continuous worsening wage inequality in the UK. However, these results cannot tell us why there is an acceleration of relative demand for skilled workers after the 1970s and what factors are accelerating relative demand for skills. Along with the technological changes, institutional factors such as decline of trade union should be important forces behind this model.

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[3] Our basic conclusions still remain using weekly wages as earnings variable and head count employment as labour input.

[4] Weights used here are the average working hours proportion over the entire period, i.e. $\overline{E}$.

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Figure 1: Negative association between relative supply and wages, Katz and Murphy (1992) hypothesis

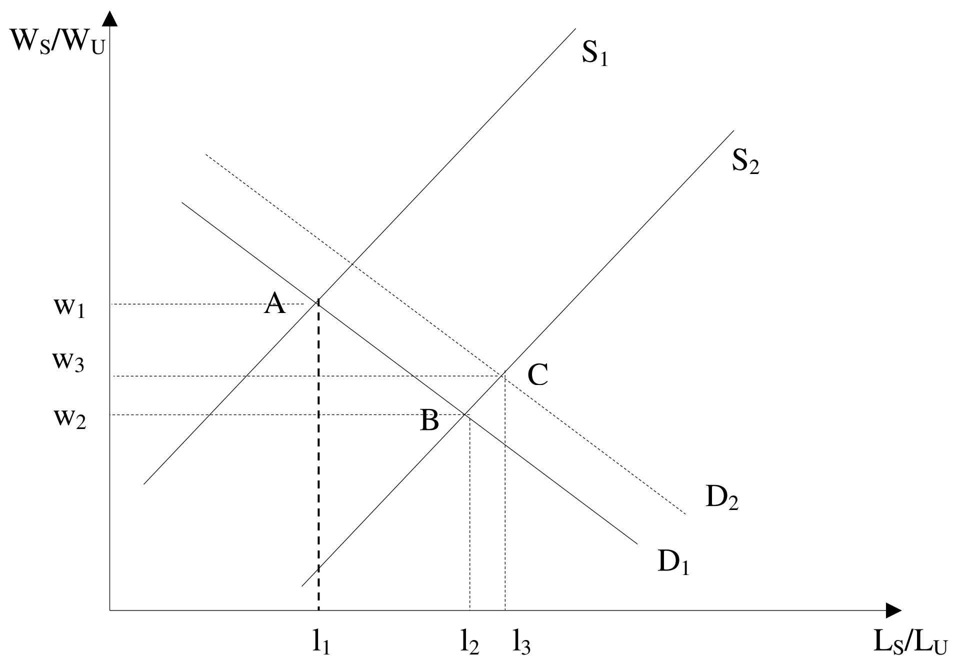

Figure 2: Positive association between relative supply and wages, Machin (2001) hypothesis

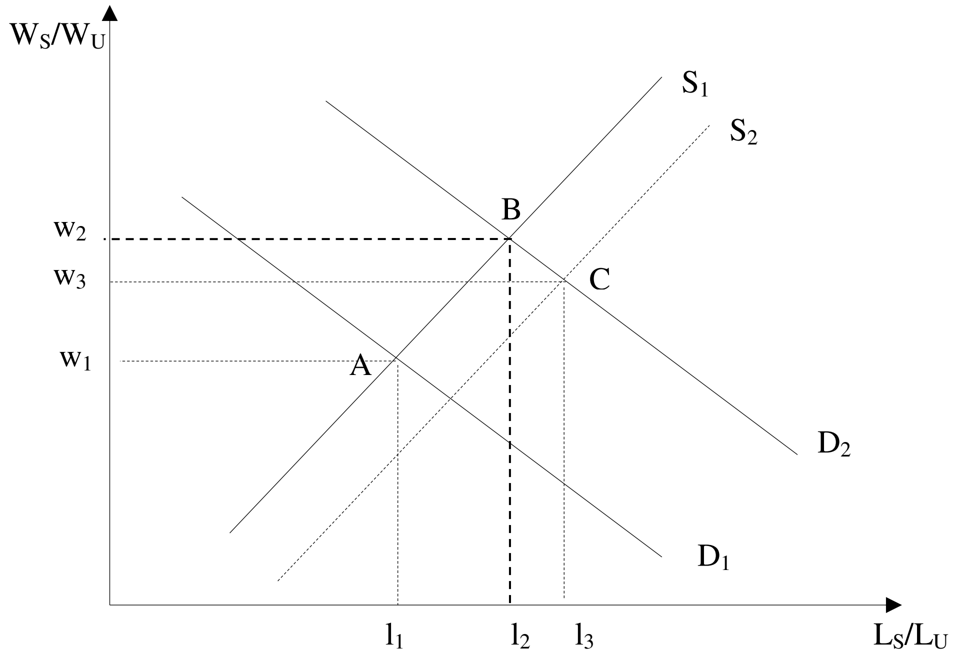

Figure 3: Relative wages and relative supply in the UK, 1972-2002

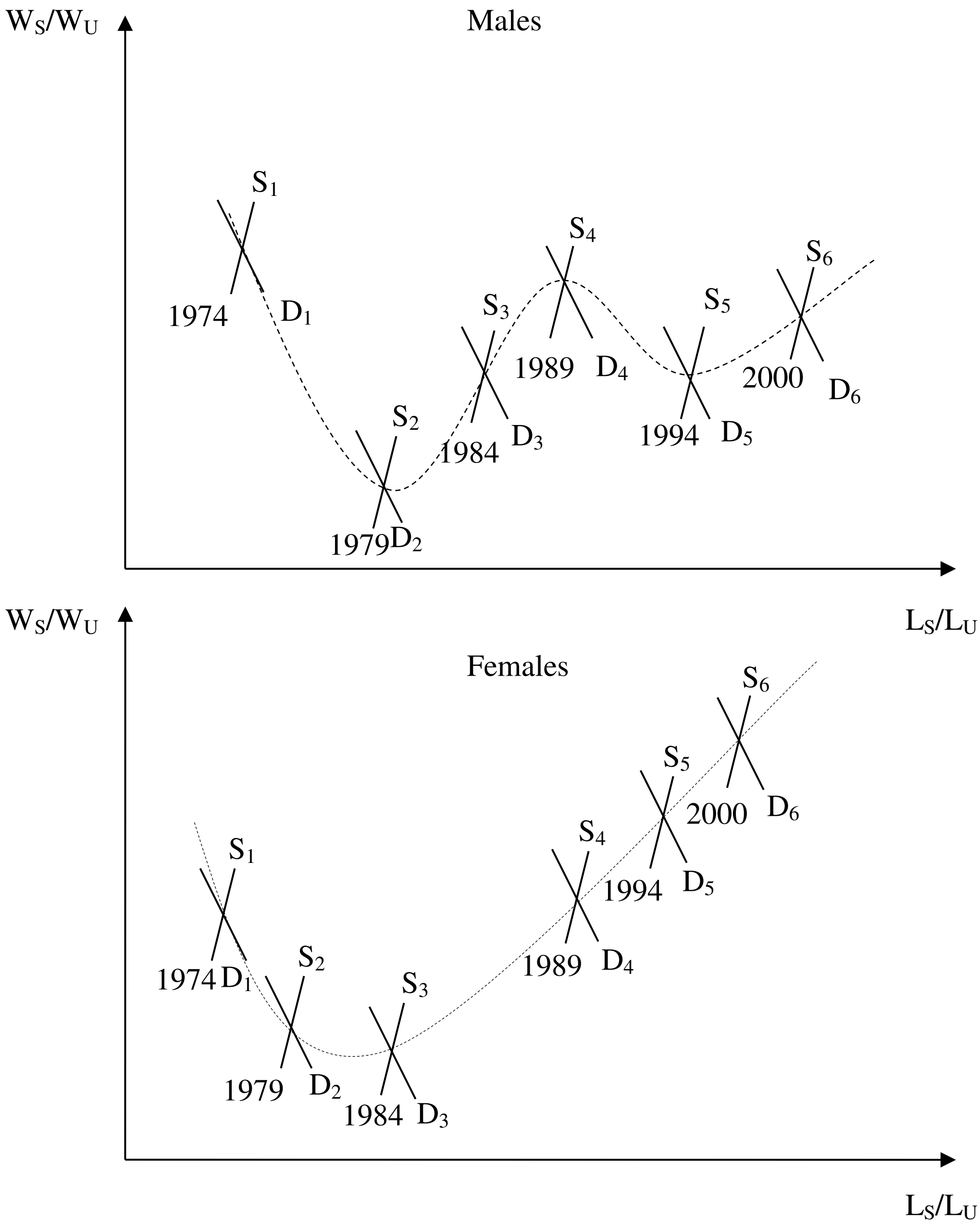

Figure 4: Price and quantity changes for 96 demographic cells

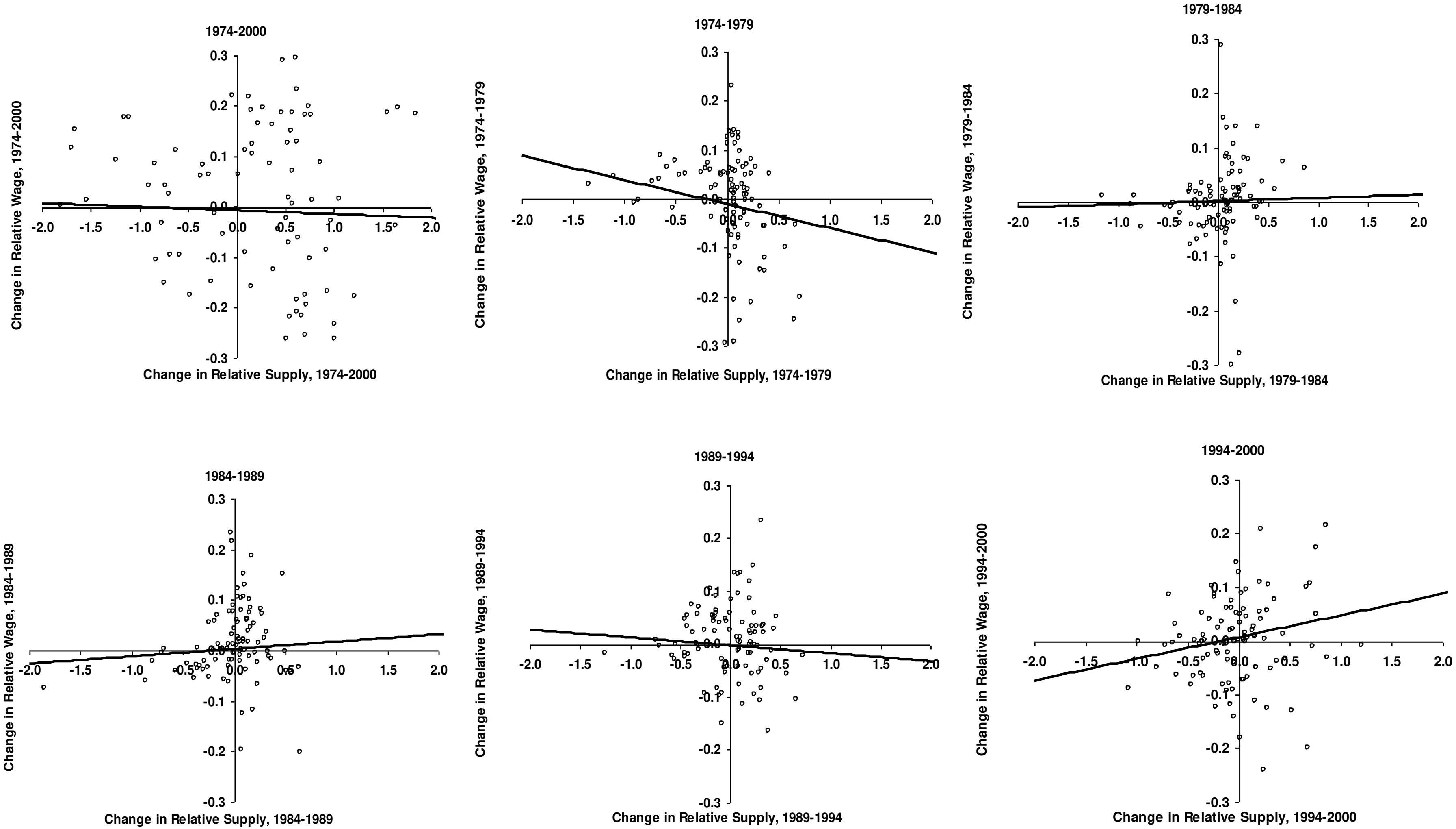

Table 1: Relative supply changes in the UK, 1972-2002

Group	Share of annual working hours (%) 1972	1977	1982	1987	1992	1998	2002
Gender:							
Men	68.0	65.6	63.3	61.4	58.2	58.0	57.2
Women	32.0	34.4	36.7	38.6	41.8	42.0	42.8
Education:							
No qualification	59.6	48.5	40.2	30.6	23.8	14.6	13.7
O-level	9.7	14.9	18.2	20.6	24.7	23.5	19.8
Degree	2.3	5.2	7.1	10.3	11.6	18.4	23.4
Experience (men):							
1-5 years	7.5	8.0	7.6	8.0	4.9	4.4	4.6
26-30 years	7.4	6.3	6.2	6.1	7.9	6.6	6.6
	Relative labour supply (annual working hours measured in *efficiency units*, %)						
Group	**1972**	**1977**	**1982**	**1987**	**1992**	**1998**	**2002**
Gender:							
Men	75.4	73.4	71.3	69.4	66.3	65.3	64.1
Women	24.6	26.6	28.7	30.6	33.7	34.7	35.9
Education:							
No qualification	54.1	42.3	34.4	24.7	18.5	10.5	9.8
O-level	9.5	14.2	16.4	18.4	22.1	20.8	17.1
Degree	4.1	8.9	11.9	16.4	17.9	25.6	32.1
Experience (men):							
1-5 years	5.1	5.5	5.1	5.3	3.2	2.8	3.0
26-30 years	9.2	8.0	7.8	8.1	10.2	8.6	8.5
	Change in log form relative labour supply (annual working hours measured in *efficiency units*, multiplied by 100)						
Group	**1972 -1977**	**1977 -1982**	**1982 -1987**	**1987 -1992**	**1992 -1998**	**1998 -2002**	**1972 -2002**
Gender:							
Men	-2.7	-2.9	-2.7	-4.5	-1.5	-1.8	-16.2
Women	7.7	7.6	6.5	9.6	2.9	3.3	37.6
Education:							
No qualification	-24.7	-20.6	-33.0	-28.8	-56.5	-7.0	-170.6
O-level	39.6	14.8	11.4	17.9	-5.9	-19.5	58.4
Degree	76.4	28.7	32.5	8.6	35.8	22.8	204.8
Experience (men):							
1-5 years	7.6	-6.5	3.6	-51.6	-12.8	5.6	-54.1
26-30 years	-13.6	-3.2	3.8	23.3	-16.9	-0.8	-7.5

Note: Figures in this table represent the shares of annual working hours and relative labour supply measured in *efficiency units* (average relative wage of each demographic cell over the last thirty years) using the GHS 1972-2002. Samples include all workers in the count sample.

Table 2: Inner products of changes in relative wages and changes in relative supply (annual working hours measured in *efficiency units*)

A. Actual changes					
	5-year centred interval				
5-year centred interval	**1974**	**1979**	**1984**	**1989**	**1994**
Inner Products of actually changes:			**Male**		
1979	-0.0120				
1984	-0.0192	0.0029			
1989	-0.0176	0.0101	0.0016		
1994	-0.0384	0.0057	-0.0022	-0.0031	
2000	-0.0270	0.0198	0.0083	-0.0007	0.0068
Inner Products of actually changes:			**Female**		
1979	-0.0006				
1984	-0.0016	-0.0003			
1989	0.0053	0.0051	0.0020		
1994	0.0079	0.0098	0.0074	0.0008	
2000	0.0070	0.0110	0.0140	0.0039	0.0005
B. Detrended changes					
Inner Products of changes in detrended data::			**Male**		
1979	-0.0016				
1984	-0.0028	0.0007			
1989	-0.0015	0.0001	-0.0012		
1994	-0.0011	0.0025	0.0000	0.0008	
2000	0.0009	-0.0018	-0.0011	-0.0008	0.0017
Inner Products of changes in detrended data:			**Female**		
1979	0.0006				
1984	0.0023	0.0005			
1989	0.0023	0.0008	-0.0010		
1994	0.0003	0.0006	-0.0002	-0.0001	
2000	0.0004	0.0006	0.0036	0.0033	0.0013

Table 3: Inner products of changes in relative wages and changes in relative supply (annual working hours measured in *efficiency units*)

A. Actual changes

	3-year centred interval				
3-year centred interval	**1973**	**1978**	**1983**	**1988**	**1993**
Inner Products of actually changes:			**Male**		
1978	-0.0146				
1983	-0.0207	0.0037			
1988	-0.0299	0.0082	-0.0006		
1993	-0.0520	0.0038	-0.0068	-0.0034	
2001	-0.0470	0.0168	0.0000	-0.0035	0.0065
Inner Products of actually changes:			**Female**		
1978	-0.0010				
1983	0.0011	0.0010			
1988	0.0036	0.0036	0.0001		
1993	0.0103	0.0107	0.0064	0.0026	
2001	0.0009	0.0080	0.0057	0.0072	-0.0029

B. Detrended changes

Inner Products of changes in detrended data::			**Male**		
1978	-0.0017				
1983	-0.0027	-0.0002			
1988	-0.0042	-0.0004	-0.0010		
1993	-0.0025	0.0023	-0.0001	0.0004	
2001	0.0016	-0.0026	-0.0011	-0.0033	0.0006
Inner Products of changes in detrended data:			**Female**		
1978	0.0005				
1983	0.0025	0.0002			
1988	0.0052	0.0016	-0.0001		
1993	0.0012	-0.0006	0.0004	-0.0002	
2001	0.0000	0.0004	0.0026	0.0054	0.0004

APPENDIX

Katz and Murphy (1992) supply –demand framework

Table A1: Annual working hours shares by gender, education and experience (percentage)

GENDER	EDUCATION	EXP	1972	1977	1982	1987	1992	1998	2002	Fixed Weight $\overline{E}$
Male	**NOQUAL**	**5**	3.19	2.10	1.25	1.32	0.50	0.39	0.23	1.27
Male	**NOQUAL**	**10**	3.69	2.09	1.72	1.40	0.44	0.30	0.33	1.40
Male	**NOQUAL**	**15**	3.95	3.26	1.91	1.72	1.12	0.49	0.47	1.82
Male	**NOQUAL**	**20**	3.68	2.98	2.69	1.64	1.27	0.69	0.55	1.97
Male	**NOQUAL**	**25**	3.76	3.00	2.73	2.46	1.52	0.98	0.83	2.23
Male	**NOQUAL**	**30**	4.75	3.06	2.93	2.03	2.14	0.93	0.77	2.51
Male	**NOQUAL**	**35**	5.20	3.70	3.05	2.21	2.43	1.41	1.05	2.86
Male	**NOQUAL**	**40**	10.89	9.91	8.50	5.43	4.40	3.13	3.95	6.67
Male	**BOLEV**	**5**	1.24	1.07	1.39	1.35	0.44	0.43	0.41	0.90
Male	**BOLEV**	**10**	1.89	0.81	0.99	0.97	0.66	0.40	0.43	0.84
Male	**BOLEV**	**15**	1.95	1.05	0.72	0.78	0.67	1.00	0.71	0.93
Male	**BOLEV**	**20**	1.51	1.07	0.89	0.59	0.79	0.86	1.07	0.92
Male	**BOLEV**	**25**	1.19	1.17	1.02	0.91	0.65	0.59	0.89	0.91
Male	**BOLEV**	**30**	1.38	1.46	1.25	0.91	0.86	0.59	1.08	0.98
Male	**BOLEV**	**35**	1.38	1.25	1.27	1.26	0.78	0.76	0.81	1.05
Male	**BOLEV**	**40**	2.83	2.97	2.89	2.27	1.64	1.52	2.12	2.34
Male	**OLEV**	**5**	1.56	2.32	2.50	2.38	1.53	1.13	1.35	1.97
Male	**OLEV**	**10**	1.18	1.71	1.86	2.24	2.10	1.13	1.32	1.79
Male	**OLEV**	**15**	0.81	1.53	1.31	1.51	2.00	1.94	1.33	1.67
Male	**OLEV**	**20**	0.51	1.16	1.41	1.10	1.38	2.22	1.65	1.45
Male	**OLEV**	**25**	0.47	0.73	0.88	1.16	1.31	1.90	1.74	1.19
Male	**OLEV**	**30**	0.38	0.47	0.62	0.92	1.47	1.12	1.21	0.97
Male	**OLEV**	**35**	0.46	0.50	0.48	0.69	1.09	1.36	1.07	0.81
Male	**OLEV**	**40**	0.62	0.89	0.66	1.04	1.43	1.93	1.64	1.08
Male	**ALEV**	**5**	0.68	1.25	1.19	1.25	1.45	0.98	1.08	1.19
Male	**ALEV**	**10**	0.59	1.50	1.47	1.52	1.54	1.61	1.44	1.36
Male	**ALEV**	**15**	0.33	1.16	1.24	1.40	1.53	1.57	1.49	1.22
Male	**ALEV**	**20**	0.33	0.47	0.82	1.30	1.30	1.89	1.39	1.05
Male	**ALEV**	**25**	0.15	0.32	0.58	0.75	1.38	1.46	1.61	0.87
Male	**ALEV**	**30**	0.16	0.36	0.41	0.57	1.02	1.23	1.19	0.67
Male	**ALEV**	**35**	0.13	0.23	0.27	0.39	0.59	0.98	1.33	0.53
Male	**ALEV**	**40**	0.08	0.28	0.48	0.50	0.67	0.99	1.39	0.54
Male	**HIGHER**	**5**	0.51	0.73	0.79	1.08	0.62	0.70	0.42	0.66

Male	**HIGHER**	**10**	1.04	1.01	1.03	1.25	1.03	0.89	0.37	0.98
Male	**HIGHER**	**15**	0.74	1.03	1.37	1.08	1.62	1.56	1.01	1.10
Male	**HIGHER**	**20**	0.62	0.67	0.93	1.33	1.30	1.58	1.16	1.08
Male	**HIGHER**	**25**	0.62	0.59	0.87	1.13	1.36	1.34	0.94	0.94
Male	**HIGHER**	**30**	0.54	0.60	0.61	0.93	1.29	1.51	0.64	0.82
Male	**HIGHER**	**35**	0.50	0.51	0.39	0.64	0.73	1.09	0.79	0.65
Male	**HIGHER**	**40**	0.57	0.45	0.62	0.69	0.54	0.87	0.81	0.59
Male	**DEGREE**	**5**	0.30	0.51	0.51	0.65	0.41	0.73	1.12	0.59
Male	**DEGREE**	**10**	0.36	0.88	0.99	1.39	1.10	2.04	1.90	1.15
Male	**DEGREE**	**15**	0.32	0.73	1.07	1.27	0.98	1.75	2.23	1.13
Male	**DEGREE**	**20**	0.29	0.57	1.00	1.26	1.15	1.83	1.97	1.10
Male	**DEGREE**	**25**	0.18	0.47	0.74	0.99	1.39	1.64	2.08	1.02
Male	**DEGREE**	**30**	0.17	0.33	0.36	0.74	1.07	1.22	1.69	0.71
Male	**DEGREE**	**35**	0.15	0.39	0.46	0.57	0.81	0.82	1.50	0.59
Male	**DEGREE**	**40**	0.15	0.30	0.23	0.44	0.70	0.51	0.64	0.44
Female	**NOQUAL**	**5**	2.42	1.44	0.82	0.74	0.16	0.23	0.12	0.90
Female	**NOQUAL**	**10**	1.67	1.07	0.79	0.75	0.30	0.06	0.16	0.72
Female	**NOQUAL**	**15**	1.33	1.38	1.05	0.75	0.38	0.27	0.18	0.81
Female	**NOQUAL**	**20**	1.59	1.51	1.42	1.13	0.89	0.36	0.31	1.15
Female	**NOQUAL**	**25**	2.16	2.13	1.91	1.51	1.12	0.86	0.50	1.65
Female	**NOQUAL**	**30**	2.99	2.62	2.50	2.08	2.05	1.02	0.75	2.12
Female	**NOQUAL**	**35**	3.05	2.96	2.38	2.23	2.02	1.36	0.91	2.30
Female	**NOQUAL**	**40**	5.22	5.27	4.59	3.26	3.04	2.13	2.56	3.94
Female	**BOLEV**	**5**	0.87	1.17	1.31	1.16	0.35	0.35	0.32	0.84
Female	**BOLEV**	**10**	0.83	0.65	0.83	0.89	0.58	0.28	0.23	0.64
Female	**BOLEV**	**15**	0.49	0.60	0.40	0.54	0.63	0.52	0.64	0.54
Female	**BOLEV**	**20**	0.34	0.61	0.47	0.56	0.42	0.64	0.88	0.55
Female	**BOLEV**	**25**	0.42	0.51	0.71	0.73	0.74	0.48	0.89	0.65
Female	**BOLEV**	**30**	0.46	0.54	0.58	0.64	0.99	0.70	1.28	0.71
Female	**BOLEV**	**35**	0.45	0.67	0.58	0.69	0.88	0.96	0.90	0.69
Female	**BOLEV**	**40**	0.69	0.76	0.89	0.83	0.96	1.05	1.57	0.91
Female	**OLEV**	**5**	1.58	2.41	2.93	2.74	2.16	1.10	1.06	2.06
Female	**OLEV**	**10**	0.91	1.17	2.08	2.20	2.59	1.14	0.80	1.70
Female	**OLEV**	**15**	0.32	0.50	0.89	1.01	1.84	1.67	0.87	1.08
Female	**OLEV**	**20**	0.18	0.37	0.75	0.86	1.42	1.47	1.36	0.90
Female	**OLEV**	**25**	0.19	0.32	0.53	0.93	1.23	1.47	1.18	0.81
Female	**OLEV**	**30**	0.18	0.38	0.51	0.80	1.35	1.36	1.11	0.76
Female	**OLEV**	**35**	0.20	0.16	0.26	0.54	1.01	1.30	0.89	0.62
Female	**OLEV**	**40**	0.20	0.33	0.51	0.50	0.83	1.29	1.23	0.63
Female	**ALEV**	**5**	0.35	0.31	0.60	1.00	1.00	1.06	1.17	0.80
Female	**ALEV**	**10**	0.21	0.44	0.57	0.72	1.08	1.52	0.82	0.74
Female	**ALEV**	**15**	0.05	0.11	0.26	0.40	0.53	1.18	0.92	0.48
Female	**ALEV**	**20**	0.02	0.04	0.10	0.31	0.50	0.87	0.55	0.34
Female	**ALEV**	**25**	0.01	0.05	0.09	0.17	0.37	0.71	0.72	0.28

Female	**ALEV**	**30**	0.01	0.02	0.13	0.10	0.35	0.66	0.64	0.28
Female	**ALEV**	**35**	0.03	0.06	0.05	0.10	0.29	0.40	0.46	0.18
Female	**ALEV**	**40**	0.01	0.04	0.01	0.07	0.15	0.37	0.68	0.19
Female	**HIGHER**	**5**	0.40	0.39	0.37	0.62	0.45	0.38	0.38	0.44
Female	**HIGHER**	**10**	0.35	0.45	0.65	0.78	0.73	0.62	0.67	0.61
Female	**HIGHER**	**15**	0.22	0.42	0.41	0.60	0.74	0.73	0.75	0.52
Female	**HIGHER**	**20**	0.28	0.30	0.53	0.68	0.79	0.82	0.75	0.60
Female	**HIGHER**	**25**	0.26	0.30	0.45	0.69	0.89	0.56	0.85	0.58
Female	**HIGHER**	**30**	0.21	0.38	0.46	0.50	0.83	0.89	0.96	0.60
Female	**HIGHER**	**35**	0.18	0.32	0.27	0.48	0.62	0.80	0.83	0.46
Female	**HIGHER**	**40**	0.27	0.24	0.28	0.33	0.59	0.49	0.64	0.36
Female	**DEGREE**	**5**	0.10	0.22	0.40	0.52	0.63	0.90	1.38	0.52
Female	**DEGREE**	**10**	0.06	0.24	0.44	0.83	0.78	1.61	1.83	0.74
Female	**DEGREE**	**15**	0.01	0.12	0.29	0.48	0.55	1.27	1.46	0.54
Female	**DEGREE**	**20**	0.04	0.06	0.11	0.36	0.58	1.34	1.43	0.46
Female	**DEGREE**	**25**	0.05	0.09	0.15	0.26	0.64	1.21	1.32	0.45
Female	**DEGREE**	**30**	0.05	0.09	0.12	0.18	0.51	0.71	1.43	0.33
Female	**DEGREE**	**35**	0.02	0.06	0.17	0.19	0.21	0.56	0.90	0.21
Female	**DEGREE**	**40**	0.05	0.12	0.06	0.12	0.05	0.26	0.53	0.13

Notes: All figures in this table are calculated from the GHS 1972-2002.

Table A2: Relative wages of gender-education-experience groups to wage index (ratio)

Wage Index (At), in 1995 pounds	1972	1977	1982	1987	1992	1998	2002	average
	5.22	5.64	5.97	6.35	6.11	6.08	7.07	6.24

GENDER	EDUCATION	EXP	1972	1977	1982	1987	1992	1998	2002	Efficiency units
Male	NOQUAL	5	0.55	0.60	0.60	0.50	0.41	0.59	0.58	0.55
Male	NOQUAL	10	0.86	0.88	0.85	0.76	0.89	0.65	0.80	0.81
Male	NOQUAL	15	0.95	0.94	0.97	0.90	0.90	0.85	0.94	0.91
Male	NOQUAL	20	0.97	1.01	0.96	0.94	0.94	0.90	0.87	0.97
Male	NOQUAL	25	0.99	1.01	1.00	1.02	0.94	0.92	0.91	0.99
Male	NOQUAL	30	0.92	0.99	1.00	1.03	1.04	0.98	0.98	1.00
Male	NOQUAL	35	0.95	0.97	1.01	1.00	0.99	0.93	0.97	0.99
Male	NOQUAL	40	0.85	0.91	0.92	0.97	0.95	0.93	0.93	0.92
Male	BOLEV	5	0.53	0.56	0.59	0.50	0.54	0.59	0.58	0.55
Male	BOLEV	10	0.96	0.93	0.86	0.82	0.86	0.82	0.84	0.87
Male	BOLEV	15	1.04	1.03	1.00	1.04	1.06	0.91	0.90	0.99
Male	BOLEV	20	1.12	1.10	1.10	1.17	0.97	0.95	0.90	1.07
Male	BOLEV	25	1.07	1.12	1.13	1.10	1.11	0.99	0.93	1.10
Male	BOLEV	30	1.06	1.06	1.20	1.14	1.21	1.11	1.07	1.14
Male	BOLEV	35	1.09	1.10	1.11	1.16	1.00	1.11	1.10	1.14
Male	BOLEV	40	1.01	1.00	1.08	1.04	1.06	1.05	1.04	1.03
Male	OLEV	5	0.53	0.60	0.59	0.53	0.60	0.52	0.62	0.56
Male	OLEV	10	0.99	0.93	0.91	0.93	0.88	0.80	0.79	0.92
Male	OLEV	15	1.21	1.08	1.16	1.06	1.05	1.03	1.07	1.08
Male	OLEV	20	1.34	1.22	1.21	1.17	1.22	1.16	1.11	1.21
Male	OLEV	25	1.38	1.32	1.22	1.24	1.25	1.12	1.11	1.25
Male	OLEV	30	1.47	1.27	1.28	1.35	1.12	1.18	1.27	1.31
Male	OLEV	35	1.45	1.47	1.37	1.33	1.38	1.23	1.20	1.30
Male	OLEV	40	1.38	1.20	1.21	1.22	1.22	1.11	1.15	1.24
Male	ALEV	5	0.60	0.72	0.68	0.70	0.71	0.61	0.61	0.68
Male	ALEV	10	1.08	1.05	0.98	1.05	1.05	0.92	0.94	1.01
Male	ALEV	15	1.51	1.21	1.18	1.14	1.23	1.24	1.11	1.22
Male	ALEV	20	1.26	1.29	1.30	1.34	1.30	1.22	1.34	1.31
Male	ALEV	25	1.76	1.36	1.29	1.34	1.44	1.38	1.23	1.39
Male	ALEV	30	1.27	1.33	1.53	1.66	1.35	1.46	1.34	1.42
Male	ALEV	35	1.42	1.45	1.64	1.42	1.49	1.18	1.46	1.38
Male	ALEV	40	1.18	1.16	1.20	1.39	1.29	1.17	1.10	1.28
Male	HIGHER	5	0.88	0.93	0.91	0.90	0.88	0.82	0.91	0.90
Male	HIGHER	10	1.21	1.20	1.08	1.17	1.20	1.10	1.33	1.18
Male	HIGHER	15	1.40	1.32	1.30	1.39	1.35	1.28	1.26	1.34
Male	HIGHER	20	1.61	1.46	1.47	1.52	1.27	1.42	1.18	1.44
Male	HIGHER	25	1.85	1.54	1.57	1.49	1.51	1.50	1.50	1.53

Male	**HIGHER**	**30**	1.72	1.50	1.54	1.42	1.47	1.39	1.61	1.57
Male	**HIGHER**	**35**	1.88	1.54	1.73	1.33	1.24	1.39	1.52	1.56
Male	**HIGHER**	**40**	1.66	1.38	1.62	1.33	1.47	1.36	1.65	1.45
Male	**DEGREE**	**5**	1.00	0.92	0.87	1.10	0.96	1.04	1.10	1.02
Male	**DEGREE**	**10**	1.51	1.36	1.34	1.36	1.48	1.45	1.33	1.40
Male	**DEGREE**	**15**	1.85	1.65	1.60	1.62	1.80	1.83	1.61	1.70
Male	**DEGREE**	**20**	2.25	1.96	1.89	1.86	1.83	2.18	1.78	1.90
Male	**DEGREE**	**25**	2.11	1.95	1.81	2.25	1.81	2.23	1.86	1.94
Male	**DEGREE**	**30**	2.48	2.00	1.95	1.90	1.89	1.94	1.86	2.03
Male	**DEGREE**	**35**	2.59	1.90	1.73	2.05	1.55	2.12	1.98	2.00
Male	**DEGREE**	**40**	2.54	2.21	2.16	1.92	1.65	2.08	1.77	1.91
Female	**NOQUAL**	**5**	0.40	0.51	0.49	0.47	0.47	0.58	0.64	0.50
Female	**NOQUAL**	**10**	0.53	0.65	0.60	0.59	0.62	0.60	0.64	0.61
Female	**NOQUAL**	**15**	0.54	0.64	0.62	0.66	0.83	0.67	0.46	0.64
Female	**NOQUAL**	**20**	0.51	0.64	0.68	0.63	0.62	0.81	0.74	0.65
Female	**NOQUAL**	**25**	0.54	0.65	0.67	0.59	0.62	0.71	0.64	0.63
Female	**NOQUAL**	**30**	0.52	0.65	0.65	0.64	0.76	0.73	0.77	0.67
Female	**NOQUAL**	**35**	0.54	0.66	0.65	0.61	0.68	0.68	0.81	0.67
Female	**NOQUAL**	**40**	0.52	0.63	0.66	0.65	0.72	0.65	0.78	0.65
Female	**BOLEV**	**5**	0.41	0.51	0.47	0.45	0.41	0.47	0.56	0.49
Female	**BOLEV**	**10**	0.65	0.70	0.67	0.62	0.76	0.70	0.78	0.69
Female	**BOLEV**	**15**	0.69	0.77	0.72	0.76	0.76	0.94	0.88	0.79
Female	**BOLEV**	**20**	0.65	0.67	0.80	0.61	1.00	0.79	0.99	0.77
Female	**BOLEV**	**25**	0.67	0.68	0.75	0.72	0.84	0.60	0.94	0.78
Female	**BOLEV**	**30**	0.69	0.78	0.78	0.78	0.82	0.93	0.99	0.79
Female	**BOLEV**	**35**	0.64	0.84	0.75	0.81	0.76	0.88	0.86	0.79
Female	**BOLEV**	**40**	0.68	0.80	0.75	0.74	0.86	0.80	0.81	0.79
Female	**OLEV**	**5**	0.48	0.53	0.56	0.52	0.48	0.55	0.63	0.53
Female	**OLEV**	**10**	0.74	0.75	0.76	0.75	0.79	0.79	0.69	0.76
Female	**OLEV**	**15**	0.68	0.83	0.83	0.93	0.84	1.04	0.98	0.88
Female	**OLEV**	**20**	0.63	0.82	0.82	0.90	0.87	1.05	1.01	0.87
Female	**OLEV**	**25**	0.77	0.78	0.86	0.91	0.88	0.96	0.92	0.86
Female	**OLEV**	**30**	0.83	0.76	0.89	0.88	0.75	0.95	0.83	0.84
Female	**OLEV**	**35**	0.91	0.93	0.83	1.00	0.93	0.95	0.91	0.90
Female	**OLEV**	**40**	0.68	0.98	0.91	0.88	0.66	0.89	0.96	0.86
Female	**ALEV**	**5**	0.56	0.59	0.70	0.65	0.59	0.60	0.73	0.62
Female	**ALEV**	**10**	0.85	0.86	0.85	0.79	0.89	0.86	0.81	0.85
Female	**ALEV**	**15**	0.88	1.23	1.01	0.91	1.18	1.12	1.02	1.02
Female	**ALEV**	**20**	0.71	1.34	0.83	1.02	1.17	1.14	1.08	1.04
Female	**ALEV**	**25**	0.77	0.76	0.87	0.95	0.83	1.12	0.96	0.94
Female	**ALEV**	**30**	0.93	0.97	0.90	0.46	1.05	1.21	1.12	0.97
Female	**ALEV**	**35**	1.26	0.75	0.95	0.93	1.02	1.06	1.02	1.16
Female	**ALEV**	**40**	0.79	1.18	0.97	1.09	1.02	0.93	0.85	0.94
Female	**HIGHER**	**5**	0.68	0.71	0.79	0.78	0.83	0.80	0.72	0.76

Female	**HIGHER**	**10**	0.80	0.97	1.01	0.97	1.21	1.07	0.89	0.99
Female	**HIGHER**	**15**	0.71	1.00	1.13	1.08	1.14	1.13	1.12	1.10
Female	**HIGHER**	**20**	1.17	0.89	1.13	1.12	1.24	1.15	1.23	1.08
Female	**HIGHER**	**25**	0.98	1.24	1.10	1.17	1.33	1.14	1.13	1.12
Female	**HIGHER**	**30**	1.11	1.16	1.25	1.32	1.22	1.32	1.32	1.16
Female	**HIGHER**	**35**	1.15	1.09	1.23	0.95	0.92	1.23	1.14	1.08
Female	**HIGHER**	**40**	1.03	0.94	1.20	1.34	1.00	1.02	1.04	1.10
Female	**DEGREE**	**5**	0.84	0.80	0.88	1.00	0.92	0.68	0.84	0.90
Female	**DEGREE**	**10**	1.24	1.26	1.31	1.17	1.31	1.33	1.37	1.23
Female	**DEGREE**	**15**	1.27	0.97	1.23	1.58	1.17	1.61	1.48	1.37
Female	**DEGREE**	**20**	1.80	1.81	1.19	1.19	1.35	1.76	1.61	1.46
Female	**DEGREE**	**25**	0.85	1.85	1.83	1.53	1.50	1.57	1.54	1.41
Female	**DEGREE**	**30**	1.92	1.41	1.11	1.45	1.59	1.54	1.29	1.48
Female	**DEGREE**	**35**	1.34	1.21	0.85	1.46	1.36	1.39	1.41	1.35
Female	**DEGREE**	**40**	2.02	1.61	1.56	1.29	2.08	1.37	1.73	1.60

Notes: All figures in this table are calculated from the GHS 1972-2002.

Table A3: Relative labour supplies of gender-education-experience groups (measured in efficiency units)

GENDER	EDUCATION	EXP	1972	1977	1982	1987	1992	1998	2002	Average
Male	NOQUAL	5	1.97	1.25	0.72	0.73	0.26	0.19	0.11	0.75
Male	NOQUAL	10	3.35	1.83	1.46	1.14	0.34	0.22	0.23	1.22
Male	NOQUAL	15	4.00	3.18	1.81	1.56	0.97	0.39	0.37	1.76
Male	NOQUAL	20	3.98	3.11	2.72	1.59	1.17	0.59	0.47	1.95
Male	NOQUAL	25	4.14	3.18	2.82	2.44	1.43	0.86	0.72	2.23
Male	NOQUAL	30	5.28	3.28	3.05	2.03	2.03	0.83	0.68	2.45
Male	NOQUAL	35	5.74	3.93	3.16	2.19	2.29	1.24	0.91	2.78
Male	NOQUAL	40	11.21	9.84	8.21	5.03	3.87	2.57	3.20	6.27
Male	BOLEV	5	0.75	0.63	0.79	0.74	0.23	0.21	0.19	0.51
Male	BOLEV	10	1.85	0.76	0.90	0.86	0.55	0.31	0.33	0.79
Male	BOLEV	15	2.16	1.12	0.75	0.77	0.63	0.88	0.62	0.99
Male	BOLEV	20	1.80	1.23	1.00	0.64	0.81	0.82	1.00	1.04
Male	BOLEV	25	1.45	1.38	1.17	1.00	0.68	0.57	0.85	1.02
Male	BOLEV	30	1.75	1.79	1.49	1.04	0.93	0.60	1.08	1.24
Male	BOLEV	35	1.75	1.54	1.52	1.44	0.84	0.77	0.80	1.24
Male	BOLEV	40	3.26	3.30	3.13	2.35	1.61	1.40	1.92	2.43
Male	OLEV	5	0.98	1.41	1.48	1.34	0.82	0.57	0.67	1.04
Male	OLEV	10	1.21	1.70	1.79	2.07	1.84	0.92	1.06	1.51
Male	OLEV	15	0.97	1.78	1.48	1.64	2.06	1.87	1.26	1.58
Male	OLEV	20	0.68	1.51	1.78	1.33	1.59	2.39	1.75	1.58
Male	OLEV	25	0.66	0.99	1.15	1.46	1.57	2.12	1.91	1.41
Male	OLEV	30	0.56	0.67	0.85	1.21	1.84	1.31	1.39	1.12
Male	OLEV	35	0.68	0.71	0.66	0.91	1.35	1.58	1.23	1.02
Male	OLEV	40	0.85	1.18	0.86	1.30	1.69	2.12	1.78	1.40
Male	ALEV	5	0.52	0.92	0.85	0.86	0.94	0.60	0.64	0.76
Male	ALEV	10	0.67	1.62	1.55	1.54	1.48	1.45	1.27	1.37
Male	ALEV	15	0.45	1.52	1.58	1.71	1.77	1.70	1.59	1.47
Male	ALEV	20	0.48	0.66	1.13	1.71	1.63	2.21	1.60	1.35
Male	ALEV	25	0.24	0.48	0.84	1.05	1.82	1.81	1.97	1.17
Male	ALEV	30	0.25	0.55	0.61	0.82	1.38	1.56	1.49	0.95
Male	ALEV	35	0.20	0.35	0.40	0.53	0.77	1.20	1.61	0.72
Male	ALEV	40	0.12	0.38	0.64	0.64	0.82	1.12	1.56	0.75
Male	HIGHER	5	0.52	0.70	0.74	0.98	0.53	0.56	0.34	0.63
Male	HIGHER	10	1.37	1.29	1.27	1.48	1.16	0.94	0.38	1.13
Male	HIGHER	15	1.11	1.49	1.92	1.46	2.07	1.86	1.19	1.59
Male	HIGHER	20	1.00	1.03	1.39	1.92	1.78	2.02	1.46	1.52
Male	HIGHER	25	1.06	0.98	1.39	1.73	1.99	1.83	1.26	1.46
Male	HIGHER	30	0.96	1.02	1.01	1.46	1.94	2.11	0.89	1.34
Male	HIGHER	35	0.88	0.86	0.64	1.01	1.08	1.52	1.09	1.01
Male	HIGHER	40	0.92	0.70	0.95	1.00	0.75	1.13	1.04	0.93

Male	**DEGREE**	**5**	0.34	0.56	0.54	0.67	0.39	0.66	1.00	0.60
Male	**DEGREE**	**10**	0.56	1.33	1.45	1.95	1.47	2.55	2.34	1.66
Male	**DEGREE**	**15**	0.62	1.34	1.91	2.18	1.59	2.65	3.33	1.95
Male	**DEGREE**	**20**	0.61	1.16	1.99	2.41	2.08	3.10	3.28	2.09
Male	**DEGREE**	**25**	0.40	0.98	1.50	1.92	2.57	2.83	3.55	1.97
Male	**DEGREE**	**30**	0.39	0.72	0.76	1.51	2.07	2.21	3.01	1.52
Male	**DEGREE**	**35**	0.34	0.83	0.96	1.14	1.54	1.45	2.64	1.27
Male	**DEGREE**	**40**	0.32	0.62	0.46	0.85	1.27	0.87	1.07	0.78
Female	**NOQUAL**	**5**	1.34	0.77	0.43	0.37	0.08	0.10	0.05	0.45
Female	**NOQUAL**	**10**	1.14	0.70	0.50	0.46	0.17	0.03	0.08	0.44
Female	**NOQUAL**	**15**	0.95	0.95	0.70	0.48	0.23	0.16	0.10	0.51
Female	**NOQUAL**	**20**	1.15	1.05	0.97	0.73	0.55	0.21	0.18	0.69
Female	**NOQUAL**	**25**	1.53	1.45	1.27	0.96	0.68	0.48	0.28	0.95
Female	**NOQUAL**	**30**	2.23	1.89	1.75	1.39	1.30	0.61	0.44	1.37
Female	**NOQUAL**	**35**	2.27	2.13	1.66	1.49	1.28	0.81	0.53	1.45
Female	**NOQUAL**	**40**	3.82	3.71	3.15	2.14	1.90	1.24	1.47	2.49
Female	**BOLEV**	**5**	0.47	0.62	0.68	0.57	0.16	0.15	0.14	0.40
Female	**BOLEV**	**10**	0.65	0.49	0.60	0.62	0.38	0.17	0.14	0.44
Female	**BOLEV**	**15**	0.43	0.51	0.33	0.43	0.48	0.36	0.44	0.43
Female	**BOLEV**	**20**	0.29	0.50	0.38	0.43	0.30	0.44	0.59	0.42
Female	**BOLEV**	**25**	0.36	0.43	0.58	0.58	0.55	0.33	0.61	0.49
Female	**BOLEV**	**30**	0.41	0.46	0.48	0.51	0.75	0.49	0.89	0.57
Female	**BOLEV**	**35**	0.40	0.57	0.48	0.55	0.66	0.67	0.63	0.57
Female	**BOLEV**	**40**	0.60	0.65	0.73	0.65	0.72	0.74	1.08	0.74
Female	**OLEV**	**5**	0.93	1.37	1.62	1.46	1.09	0.52	0.49	1.07
Female	**OLEV**	**10**	0.76	0.96	1.64	1.67	1.86	0.77	0.53	1.17
Female	**OLEV**	**15**	0.31	0.47	0.82	0.89	1.54	1.31	0.67	0.86
Female	**OLEV**	**20**	0.18	0.34	0.68	0.75	1.18	1.14	1.04	0.76
Female	**OLEV**	**25**	0.18	0.30	0.48	0.80	1.00	1.12	0.89	0.68
Female	**OLEV**	**30**	0.16	0.34	0.45	0.67	1.08	1.02	0.81	0.65
Female	**OLEV**	**35**	0.20	0.16	0.25	0.49	0.86	1.04	0.70	0.53
Female	**OLEV**	**40**	0.20	0.31	0.46	0.44	0.68	0.99	0.93	0.57
Female	**ALEV**	**5**	0.24	0.21	0.39	0.62	0.59	0.59	0.64	0.47
Female	**ALEV**	**10**	0.20	0.40	0.51	0.61	0.87	1.15	0.61	0.62
Female	**ALEV**	**15**	0.06	0.12	0.28	0.41	0.52	1.08	0.83	0.47
Female	**ALEV**	**20**	0.02	0.04	0.11	0.32	0.50	0.81	0.50	0.33
Female	**ALEV**	**25**	0.01	0.05	0.09	0.16	0.33	0.60	0.59	0.26
Female	**ALEV**	**30**	0.01	0.02	0.13	0.10	0.33	0.57	0.54	0.24
Female	**ALEV**	**35**	0.04	0.08	0.06	0.12	0.32	0.42	0.47	0.21
Female	**ALEV**	**40**	0.01	0.04	0.01	0.07	0.13	0.31	0.56	0.16
Female	**HIGHER**	**5**	0.34	0.32	0.30	0.47	0.33	0.26	0.26	0.33
Female	**HIGHER**	**10**	0.38	0.48	0.68	0.78	0.69	0.54	0.58	0.59
Female	**HIGHER**	**15**	0.28	0.50	0.48	0.67	0.78	0.72	0.73	0.59
Female	**HIGHER**	**20**	0.34	0.35	0.60	0.73	0.81	0.79	0.71	0.62

Female	**HIGHER**	**25**	0.33	0.36	0.53	0.78	0.95	0.56	0.83	0.62
Female	**HIGHER**	**30**	0.27	0.48	0.56	0.58	0.93	0.92	0.98	0.68
Female	**HIGHER**	**35**	0.22	0.37	0.31	0.52	0.64	0.77	0.79	0.52
Female	**HIGHER**	**40**	0.33	0.29	0.33	0.36	0.62	0.48	0.62	0.43
Female	**DEGREE**	**5**	0.10	0.22	0.37	0.47	0.54	0.72	1.09	0.50
Female	**DEGREE**	**10**	0.08	0.31	0.56	1.02	0.91	1.76	1.96	0.94
Female	**DEGREE**	**15**	0.02	0.17	0.42	0.66	0.71	1.55	1.75	0.75
Female	**DEGREE**	**20**	0.07	0.09	0.17	0.53	0.81	1.74	1.82	0.75
Female	**DEGREE**	**25**	0.08	0.14	0.22	0.37	0.86	1.52	1.63	0.69
Female	**DEGREE**	**30**	0.08	0.14	0.19	0.27	0.72	0.93	1.85	0.60
Female	**DEGREE**	**35**	0.04	0.09	0.24	0.26	0.27	0.68	1.07	0.38
Female	**DEGREE**	**40**	0.10	0.20	0.10	0.19	0.07	0.36	0.74	0.25

Notes: All figures in this table are calculated from the GHS 1972-2002.