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A PICTURE OF WAGE INEQUALITY AND THE ALLOCATION OF LABOUR THROUGH A PERIOD OF TRADE LIBERALISATION: THE CASE OF BRAZIL

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Abstract

This paper constructs a picture of the labour market impact of trade liberalisation in Brazil. We examine the level and dispersion of wages, the skilled wage premium, and employment composition before and after trade liberalisation. After trade reform, there was a rise in the returns to college education which, since the share of college workers also rose, is attributable to rising demand. This change did not increase overall wage dispersion because of the small share of college-educated workers and of decreasing returns to intermediate levels of education. Among tradable goods industries, trade liberalisation is associated with increases in relative wages.

JEL Classification: F16, J21, J31

Keywords: Trade liberalisation, wage inequality, skill premium, employment, Brazil, Latin America.

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1. Introduction

What happens to wages and the allocation of labour during a period when a comparatively closed developing economy becomes increasingly exposed to international competition through a period of trade reform? Considerable interest in this question has emerged in recent years both for its policy implications and for its apparent ramifications for trade theories (Robertson, 2000). The traditional Stolper-Samuelson theorem leads to the expectation that trade liberalisation would raise the price of developing countries' abundant factor (unskilled labour), thus reducing the skilled wage premium and, by extension, wage inequality; this is the symmetric counterpart to the theory that trade expansion is a significant cause of rising inequality in industrialized countries (Wood, 1994). In a number of developing countries, however, no such fall in inequality has been detected; *au contraire*, some have even shown a rise in the skilled wage premium, for example Mexico (Hanson and Harrison, 1999; Robertson, 2000), Chile (Beyer *et al*., 1999), Morocco (Currie and Harrison, 1997), Costa Rica (Robbins and Grindling, 1999), and Colombia (Robbins, 1996a).[1]

In this paper we contribute towards an improved empirical understanding of the aggregate labour market impact of trade liberalisation by examining the experience of Brazil. In previous work on Brazil, it has been shown that trade liberalisation had a small short-term downward impact on aggregate employment and especially on manufacturing sector

[1] Robbins (1996b) also surveys similar conclusions applying in addition to Argentina, Malaysia, the Philippines, Taiwan and Uruguay.

employment (Moreira and Najberg, 2000). Trade liberalisation also had predictable positive effects on import penetration and export ratios, and provided a substantial positive shock to technical efficiency and to labour productivity (Moreira and Correa, 1998; Hay, 1998; Júnior and Ferreira, 1999). According to Chamon (1998), the rise in productivity also accounts for a rise in manufacturing sector real wages in the first half of the 1990s. However, previous work has examined neither changes in the economy-wide dispersion of wages nor changes in the more detailed allocation of labour through the trade liberalisation period.

Brazil's case is well suited as an exemplar of labour market adjustment for a number of reasons. First, trade liberalisation took place over a relatively short period of time, and the reductions in trade protection were widespread and substantial. They followed a century-long era of import substitution strategies that left Brazil an especially closed economy by the end of the 1980s. Though some tariff reductions were begun in 1988, serious liberalisation including reduction or removal of non-tariff barriers was initiated in 1990 by the incoming Collor government. The program began with the abolition in 1990 of 'Anexo C', a list of around 1300 products which previously could not be imported, and continued with a tariff reform program and other liberalizing measures. For the next three years, trade liberalisation was a key policy instrument aimed at stabilizing prices,[2] accompanying exchange rate appreciation. Other stabilization policies, including abortive price freezes in 1986, 1987, 1989 and 1990, four currency changes, and monetary and fiscal constraints were all unsuccessful. Only the Plano Real of 1994 succeeded in stabilizing inflation (Sachs and Zini, 1996). With the more open regime, the new currency created a degree of macroeconomic stability that was to last a

[2] The original plan in 1990 was to open the economy over a four-year period; however, the plan was completed by the middle of 1993.

number of years before contradictions began to re-emerge in the late 1990s (Amann and Baer, 2000). The privatisation movement began in a modest way in 1991, although by 1995 it had only encompassed the steel, fertilizer and petrochemical industries (Indicadores IESP, 1999). Other reforms, such as deregulation of international investment and banking, also became important after that time. Not until 1998 was labour regulation partially relaxed to permit flexible hours working, fixed-term contracts and lay-offs. Throughout the 1990s there was no anti-union legislation enacted. The fact that trade liberalisation was, apart from macroeconomic restraint, the most important game in town for a significant compressed period in the early 1990s, makes Brazil's case a quasi-natural experiment for looking at its impact.

Second, the case is especially suitable due to the availability of a long and reliable series of individual-level data covering most years from 1981 to the present, thus encompassing the periods before, during and after the 'experiment'. We base our findings here on successive cross-sectional analyses of this series, the Pesquisa Nacional por Amostras de Domicilio (PNAD). Successive surveys are nationally representative samples, including both urban and rural populations. In other countries where the issue of trade and inequality has been investigated, the available individual-level data is much less comprehensive.[3]

A third reason why Brazil's case is of particular interest is that, at least from the point of view of the average worker, Brazil remains thoroughly rooted in the developing world. Unlike in Mexico and Chile, where increases in wage inequality were accompanied by generally strong labour demand and consequent wage rises, average real wages in Brazil, after a period of

[3] Costa Rica is an exception (Robbins and Grindling, 1999).

growth in the 1970s, have remained largely stable over the long term from 1980 to 1999. Yet, Mexico and Chile are the exceptions in that real wages in most Latin American countries either remained steady or fell radically over the period (Weeks, 1999).[4]

The failure to detect falling inequality in Mexico and elsewhere following trade liberalisation has stimulated a number of explanations designed to capture the processes engendered by trade reform in an empirical and theoretical context more complex than that of the basic Heckscher-Ohlin/Stolper-Samuelson (HOS) framework. First, cogent country-specific reasons have been shown as to why inequality may have risen. In Mexico, for example, both Robertson (2000) and Hanson and Harrison (1999) show that trade liberalisation had most effect on unskilled labour intensive industries because prior to reform these were the most heavily protected. In Chile, trade reform was accompanied by other substantive measures with labour market implications inaugurated by the military regime, including privatisation and the suppression of trade unions. Moreover, the long-term trend increase in inequality dates back to the early 1960s, and thus is not easily associated just with the trade reforms begun in the mid 1970s. In Mexico, Morocco and the Philippines an important part of the impact on inequality is related to outsourcing (to 'Maquiladoras'), which are restricted to few areas and segmented from the rest of the economy (e.g. Feenstra and Hanson, 1997).

Second, from the perspective of all these countries, it has been suggested that they occupy, not the lowest, but an intermediate position in the global division of labour (Wood, 1999). Trade reform could thus expose unskilled labour intensive industries to very low pay competition

[4] The other exception is Colombia, where urban real wages were 20% higher in 1998 compared to 1980.

from, say, China, and this might outweigh the increased access to markets in the industrialized world. Which effect predominates depends on whether the country is located in a developing country cone of specialization or a developed country cone (Davis, 1996). It could be argued that Brazil, along with Mexico, Chile and other Latin American countries, is in serious competition with low pay China.

Third, it is argued that trade reform in *all* developing countries would generate an increased demand for skilled labour. It is suggested that trade reform stimulates capital inflows, and that capital is directly complementary with skilled labour. Moreover, in-flowing capital embodies in-flowing technology, which is assumed to be skill-biased because the new technology was mainly designed in the industrialized world, which is skill intensive and, *a fortiori,* because there is evidence that new technology is skill-biased within the industrialized world (Berman *et al*., 1998). Robbins (1996b) has termed this the 'Skill-Enhancing-Trade Hypothesis'. Where the gap between existing and newly imported technology is large, trade reform could have a relatively greater effect on skill demand in a developing country than it does in an industrialized country (O'Connor and Lunati, 1999). Pissarides (1997) adds a further possibility, namely that the transfer of the technology entails high skills, so that even if the transferred technology were skill neutral, there would be a temporary high demand for skilled labour while the new machinery and technology is being installed post-liberalisation. An additional argument suggesting that the rises in the skill premium might be temporary is that the elasticity of supply of skilled labour is likely to be much greater in the long than in the short run, whereas the elasticity of supply of unskilled labour is said to be high even in the short-run.

These arguments suggest that the findings of rising wage inequality in developing countries may have little or no relevance for the debate about the origins of changes in wage inequality in the industrialized world. In contrast to the symmetric expectations for the developed and developing world that arise in the standard HOS theorem, the new trade theories involve a fundamental asymmetry. If trade involves a transfer of technology that brings developing countries closer to the production frontier, there is no counterpart of technical regress to be expected in the industrialized world accompanying increased imports from developing countries. Nevertheless, if for the above reasons it becomes established that substantively rising wage inequality is a likely accompaniment of trade liberalisation in a developing country, the discovery will have substantive relevance for policy-makers in developing countries and in supra-national bodies contemplating further integration (Robertson, 2000).[5] To gain more insight into policy-relevant implications, it will be especially useful to examine Brazil's case.

To obtain a perspective on the changes in the labour market at the time of trade reform, we present a picture covering a decade before and nearly a decade after reform. We examine changes in wages, the skilled wage premium, wage inequality and labour allocation in Brazil over the period encompassing trade liberalisation. The remainder of paper is organized as follows: section 2 discusses the data series; section 3 presents our analyses of these data; finally, section 4 concludes.

[5] Traditional trade theory based on the HOS theorem was used to support advocacy of trade liberalisation, one of the arguments being that it predicted a more equal distribution in developing countries (Krueger, 1990).

2. The Data Series

Our main data source, PNAD, is a series of nationally representative household surveys, conducted every year since 1976, excepting 1980, 1991 and 1994.[6] They are conducted using a consistent methodology by the government's statistical agency, Instituto Brasileiro de Geografia e Estatistica (IBGE). We use data from 1981 till 1999, during which time a consistent education classification is available, thus giving a series of nearly a decade each side of the initiation of trade reform. Each PNAD contains data on roughly 350,000 individuals in about 100,000 randomly selected households, following face-to-face interviews conducted in the third week of September. We restricted our analysis to employed individuals earning a positive wage, aged between 18 and 65.

We computed the hourly wage as monthly pay at the time of interview in the respondent's main job divided by weekly hours times 4.33; to obtain real hourly wages we deflated hourly wages by the CPI of September in each year, based in 1998 reais. Although the quality of PNAD data is known to be high (Sawyer, 1988), as a further precaution we eliminated outliers that might have been due to measurement error by trimming the top and bottom of the real wage distribution by 0.1 percent.

We defined potential work experience in the conventional way as age minus years of study minus six. The basic education variable gives the number of years of completed education, which was then used to classify education into six levels:[7]

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[6] In 1980 and again in 1991 there was a national census. In 1994, PNAD was cancelled due to shortage of funds.

[7] There was a technical change in the recording of this variable between the 1980s and 1990s. An algorithm, available on request from the IBGE, was used to make education levels commensurate across years.

Level 1: Illiterate (less than one year of study)
Level 2: Some elementary education
Level 3: Completed elementary, no or some primary
Level 4: Completed primary, no or some secondary
Level 5: Completed secondary, no or some college
Level 6: Completed college

We utilized the individual-level data in much of the analysis that follows, producing time-series of summary statistics from each annual cross-section. However, for the purposes of this paper, we also aggregated the PNAD data to the two-digit industry level and matched it with data on trade and the value of production. The trade variables we employed are nominal tariffs, effective tariffs and the growth of imports. The tariffs are from Kume *et al*. (2000), and the data on imports and the value of production are from Haguenauer *et al*. (1998). Where trade data were available at a greater degree of industry disaggregation than PNAD, to obtain commensurability with the PNAD industry codes we computed average values of the trade data weighted by industry output. In other cases where PNAD had the more disaggregated industry classification, we simply combined the PNAD individuals across industries to match the trade data sources. The result was a sample of 31 industries, of which 20 are in the traded-goods sector.

3. Findings

Average Real Wages

Did the episode of trade liberalisation begun around 1990 have a noticeable effect on average wages? Figure 1 shows that, over the whole of the period, the average real hourly wage was

almost unchanged, going from 2.96 reais in 1981 to 2.81 reais in 1999.[8] There was, however, a small steady change in the raw gender wage gap. The ratio of female to male wages rose from 70 percent in 1981 to 85 percent in 1999.

Even though the average wage was not substantially changed before and after trade liberalisation, were there nevertheless substantive changes in the distribution of employment and wages over this period?

(Figure 1 here)

Employment Allocation

Looking first at employment allocation, Table 1 shows trends in sectoral composition and in gender and schooling over the period. It is consistent with the finding of Moreira and Najberg (2000) that aggregate manufacturing employment was affected by trade liberalisation, in that the share of manufacturing, which held at around 15 percent in the 1980s, declined to roughly 13 percent by the middle of the 1990s. Changes in education and in the gender balance, however, took place over the entire period. The proportions of males gradually declined from 69 percent in 1981, to 61 percent in 1999, and the average length of completed schooling steadily rose over the same interval from 5.3 to 6.9 years, an increase of 32 percent within 18 years. The proportion of workers in non-manual occupations rose slowly from 38.5 percent to 41.8 percent, but the rise was all located during the 1980s. Meanwhile, average potential work experience remained at about 23 years. Figure 2 gives more education details: while the lower education levels lost share, the upper education echelons grew steadily. No obvious breaks

[8] The blip in 1986, known as the 'Plano Cruzado effect', is genuine. It resulted from a wage and price freeze program, which allowed wages to rise 8% faster than prices.

occurred in this upward trend around the introduction of trade liberalisation at the start of the 1990s.

Below, we examine more detailed evidence concerning re-allocation of educated labour among traded-goods industries, according to the extent of trade liberalisation.

(Table 1 and Figure 2 here)

Wage Inequality

Figures 3 to 9 and Tables 2 to 4 present salient indicators about the trends in wage dispersion. We begin with measures of overall wage inequality. Figure 3 shows the Mean Log Deviation (MLD) of wages for men and women separately and for both together.[9] The MLD is one of the class of 'Generalised Entropy' measures of inequality, with the advantage of decomposability which we exploit below (Shorrocks, 1980). It shows that, taking the period as whole, the level of inequality has been consistently high and remarkably steady. There was a small rise in inequality up to the middle of the 1980s, both for men and for women, and a small subsequent fall which nevertheless pre-dated trade liberalisation. At the end of the period, the MLD stood at 0.54, the same as at the beginning. From the evidence of this picture alone, neither trade liberalisation, nor any other policy changes before or afterwards, nor the very considerable changes in education and in gender and industrial composition, appear to have dented Brazil's high level of inequality.[10] Figure 4 and Table 2 confirm the same picture

[9] The MLD measure of inequality is defined as: $I = (1/n)\sum_i \log(\mu/y_i)$ where μ is the mean.

[10] The stability noted here is also found in respect of overall income inequality, though this masks a rise in the extent of extreme poverty in the 1990s (Ferreira and Barros, 1999).

of stability if either the Theil or the Gini indices are used, with the latter showing especially little change throughout the period.

(Figures 3 and 4, and Table 2 here)

Changes in overall wage inequality derive, in principle, from a range of factors, including demand changes, changes in the shares of educated labour, changes in the supply of unobserved skills, institutional changes and the shifting gender balance, to name just the major ones. In particular, the rising employment shares of better-educated workers could expect to have an equalizing impact as previously illiterate workers are replaced by literate ones; but as average educated workers are replaced by college-educated workers, this will tend to raise inequality.

A decomposition analysis of the changes in wage inequality helps to throw light on the changes during and after the period of trade reform. We decomposed the MLD into the contributions to overall inequality from within and between education groups, and examined changes in these components over time. Thus the MLD, which in 1990 was 0.626, was composed of 0.392 (or nearly two thirds) contributed by within-education-group inequality and 0.234 contributed by between-education-group inequality. The sources of change in each of these elements can also be decomposed into two components each, using the procedure developed by Mookherjee and Shorrocks (1982). Table 3A gives the overall change in inequality for various intervals, divided into four elements:[11]

[11] We use the Mookherjee and Shorrock (1982) 'approximate' decomposition which separates out the effect of group shares from relative changes in group mean wages. The overall change in the MLD inequality index can be expressed as:

$$\Delta I \approx \sum_k \overline{v}_k \Delta I_k + \sum_k \overline{I}_k \Delta v_k + \sum_k (\overline{\lambda}_k - \overline{\log \lambda}_k)\Delta v_k + \sum_k (\overline{\theta}_k - \overline{v}_k)\Delta \log \mu_k$$

- Term A: the contribution of changes in within-education-group inequality, given no change in education group shares;
- Term B: the contribution resulting from the impact on within-group inequality of changes in the shares of education groups;
- Term C: the contribution resulting from the impact on between-group inequality of changes in the shares of education groups;
- Term D: the contribution resulting from the impact on between-group inequality of changes in the relative mean wages of the education groups.

The analysis shows changes in within-education-group inequality (Term A) dominating the early 1980's rise in inequality; while from 1985 until 1992 the changing relative mean wages of the education groups (Term D) led to a small fall in inequality. Of particular note is the post-trade reform interval from 1992 onwards when inequality levelled off instead of confirming the downward movement it had shown in the previous four years. The decomposition shows a small fall in within-education-group inequality matched by a small rise associated with the changing relative mean wage of education groups.

A similar decomposition by 11 one-digit industry groups shows the changes in inequality being dominated by within-industry changes (Table 3B). Over time the shares of industry groups have changed (see Table 1), but, as the decomposition shows, the small changes in wage inequality over time are mainly accounted for by changes in within-industry inequality.

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where: I_k is the inequality within subgroup k; v_k is the population share of subgroup k; $\lambda_k = \mu_k / \mu$ is the relative mean wage of subgroup k; $\theta_k = v_k \lambda_k$ is the wage share of subgroup k; Δ is the difference operator; and a bar over a variable denotes the average of current and base periods.

(Table 3A and 3B here)

The Skilled Wage Premium

Nevertheless, trade reform may be associated with detectable changes in the skilled wage premium, even if those changes do not contribute enough to affect overall inequality. We approximate skill levels by the six education groups, and begin by presenting raw data for the mean real wage – see Table 4. As expected, wages rise with education, but it is notable that for every group the mean wage has declined over the whole 1981-1999 period. The wage decline was least for illiterate workers, and greatest for those with intermediate levels of completed schooling. In the period since 1992, both very low- and very high-educated groups improved their wages relative to those at intermediate levels. Thus the stable average wage for the whole workforce over time reflects the combination of rising shares in the upper education groups and falling wages for every group, and a decline in the relative wage of those with intermediate levels of education.

(Table 4 here)

Since some of these changes may be associated with changes in work experience or in the gender balance, we also investigated trends in the conditional skill premium. We calculated the 'returns' to each education level for every year, by estimating basic wage equations.[12] The log of real hourly wages was regressed against five education level dummies, a quadratic in experience and, where appropriate, a gender dummy. The results for all workers, and for males and females separately, are shown in Figures 5A, 5B and 5C for all, male and female

[12] The phrase 'return' is potentially misleading as the calculation is strictly speaking not a return to education investment. We simply reflect conventional terminology is using the phrase. No calculation of lost wages or other education costs is included, but it is implicitly assumed that the length of time required to complete each education level remains stable throughout the period.

workers respectively. The figures show the difference between the predicted conditional log wage for each education level and that for the one below it.

(Figures 5A, 5B, 5C here)

For males, it can be seen that the returns at education levels 2 to 5 changed little over the period; the returns to levels 4 and 5 fell by a small amount. By contrast, the return to college education (relative to secondary education), which barely changed during the 1980s, took off on a rising trend after 1992: it rose from 82 percent in 1992 to 98 percent in 1999. A similar break is apparent in the trend for females at the same level: the return rose somewhat in the 1980s, took a dip immediately after 1990, but then resumed a substantive upward trend, rising from 76 percent in 1992 to 99 percent by 1999. Meanwhile, the returns to completed elementary, primary and secondary education were on a downward trend throughout the period, and the return to some elementary education declined after 1989.

The onset of the distinctive trend of the return to college education, reflected also in Figure 5A for all workers together, coincides with the period of trade reform. Since the share of college workers continued its gradual increase over the period (see Figure 2), the increased college premium cannot easily be ascribed to a supply shift. The trend therefore constitutes *prima facie* evidence that the impact of the reforms may have been to have accelerated the demand for very highly skilled workers. Such a picture is consistent with the experience of other developing countries (Robbins, 1994, 1996b). There is, by contrast, no evidence of any stimulus to the demand for slightly lesser skilled workers, namely those with completed secondary education. The decline in their wage premium may have been due to a range of factors, with the rising supply being an obvious candidate.

To confirm this interpretation of rising demand for college skills, we computed an index of demand for college skills relative to elementary school skills, using the method proposed by Katz and Murphy (1992).[13] Figure 6 shows the trend in this index using three different assumptions for σ, the elasticity of substitution between these two skill-types. For $\sigma = 1$ or $\sigma = 1.5$, the picture is one of rising relative demand up until 1988, succeeded by a spell in which relative demand fell. Following trade liberalisation, an increasing relative demand for college skills re-emerged after 1992. For the lower value of σ the estimate of relative demand more closely follows the relative supply.

(Figure 6 here)

The rise in the college wage premium was not, as seen above, reflected in a rise in overall wage inequality. One reason for this is that college educated workers are a small proportion of the workforce: even by 1999 their share was only 8.0 percent. Another reason is that the simultaneous rise in wages of illiterates, at the bottom of the wage scale, relative to those with intermediate levels of education, will have had an equalizing effect on wages. The small positive entry (0.02) for Term D in Table 3A in the post-1992 period reflects this balance of influences. Despite the rising returns to college-educated workers, the impact on overall wage inequality is quite small.

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[13] Each year's data is divided into 16 experience-gender cells. The relative wage (*RW*) is calculated by summing the weighted ratio of the average wages of the two education groups across cells. The weights are the proportions of each cell within total employment over the whole period. The relative supply (*RS*) in each year is the ratio of the supply of 'college skills' to that of 'elementary skills'. These supplies are computed as the weighted sum of all education groups, where the weights are calculated from regressing the wages of other education groups on the wages of college and elementary school educated workers. The logarithm of relative demand, $\log(RD)$, is then computed as $\log(RD) = \sigma \log(RW) + \log(RS)$.

A parallel indicator of skill is given by occupational affiliation. If the impact of trade is to accelerate demand for high-level skills, it is to be expected that higher skilled occupations would receive a boost to their mean wages. Figure 7 provides confirmation. Although the broad ranking of occupations remained largely unchanged throughout the period, the figure shows an increase in real wages especially for professional, technical and entrepreneurial occupations.

(Figure 7 here)

Returns to Experience

If trade has an effect on the education premium, it might also impact on the premium for work experience. Figure 8 therefore repeats the exercise of Figure 5, this time in respect of the marginal returns to work experience. We evaluate these at the median, and at the 10^{th} and 90^{th} percentiles of experience. As expected, the marginal returns to experience are decreasing. At the median the return is comparatively steady throughout the period. Thus neither trade nor other policies appear to have affected substantially the demand for the skills and other attributes associated with experience. However, there is some evidence of a gradually increased valuation of experience at the top end matched by a decreased valuation at the bottom end, starting in the mid 1980s. This mild compression of experience differentials came to a halt in 1993. It suggests the possibility that trade reform had a small positive effect on the returns to experience for younger workers, and a small negative effect on the returns to experience of older workers with high levels of work experience.

(Figure 8 here)

Inter-Industry Wage Differentials

Since trade reform is likely to affect industries in different ways, depending on the extent of reduction of trade protection and of trade exposure, a further route through which the reform might affect the dispersion of wages is through influencing the inter-industry dispersion of wages. Figure 9A presents a picture of the changing wages in each one-digit industry throughout the period. It may be noted that, just as for the whole economy, real wages rose in the first part of the 1990s in the manufacturing sector, consistent with the rise reported by Chamon (1998). However, our whole economy data here show that the rise was not confined to manufacturing; indeed, real wages moved in closely similar ways throughout the period in all sectors. The ranking of industries by wages was almost identical at the end of the period to what it was at the beginning.

(Figure 9A and 9B here)

To examine whether the magnitude of the differentials had changed through the period we computed standardized averaged inter-industry differentials using the method proposed by Haisken-DeNew and Schmidt (1997).[14] The standard deviation of the differentials for each year is plotted in Figure 9B, both for all workers and for men and women separately. Although some small yearly variation can be seen, for all workers there is little change in average dispersion over the whole 1981 to 1999 period. This finding is consistent with our conclusion from the industry decomposition analysis above that changes in industry wages did not contribute substantively to changing overall wage inequality. The pattern for males is close to that for all workers, but for females there is some decline in inter-industry wage dispersion. A possible interpretation of this trend is that women have become gradually more integrated into

[14] Control variables in the wage equation are education level dummies, a quadratic in work experience, a gender dummy where appropriate and a full set of industry dummies.

the workforce during the period. This interpretation, which is not tested here, would be consistent with the declining gender wage gap, and the rising proportion of females in the labour force, noted earlier. However, the decline in dispersion for women did not begin with trade reform.

Inter-industry wage differentials are typically ascribed to elements of departure from perfect competition in the labour market, whether due to mobility restrictions associated with labour market segmentation, efficiency wages or whatever. There is, therefore, little suggestion that trade reform had a major impact on such forces in Brazil.

Wage Dispersion and the Allocation of Labour in Traded Industries

In the whole economy analysis conducted so far, we have seen that the increasing returns to college-educated labour constituted a substantive trend break which coincided with the serious trade liberalisation measures of 1990 to 1993. Yet, owing to the relatively small proportion of college-educated labour in the workforce, and to simultaneous equalizing tendencies elsewhere in the distribution, the rising return to college-educated workers had no discernible impact on overall wage inequality; moreover, there was no obvious break in the gradual increase in the share of college-educated workers throughout the period.

These aggregate developments raise the question as to whether the differential pattern of reduction of trade protection is associated with a differential pattern of adjustment of wages and employment among the tradable-goods industries directly affected by the reforms. Did industries that experienced larger reductions in tariffs and non-tariff barriers also experience bigger boosts to competition from imports, employ more college-educated labour, or, as the time series data suggest, boost the relative pay of their college-educated workers?

A picture of these relative changes among 20 two-digit tradable-goods industries is presented in Table 5. We focus on changes over the years 1987 to 1995.[15] The figures are the Spearman rank correlation coefficients between changes in the trade measures along the columns, with changes in labour market variables along the rows.

As expected, the best measure of the change in trade protection, effective tariff changes, is negatively and significantly correlated with imports growth. The correlation of imports growth with nominal tariff changes is also negative but less strong and insignificantly different from zero.

The next two rows show that changes in effective (or nominal) tariffs are not significantly correlated with changes in either the relative wage or the relative share of college-educated workers.[16] The fact that there is no correlation with the share is consistent with the aggregated observation of no break in the overall growth of college-educated-workers. However, the fact that there is no correlation with relative wages is something of a puzzle in view of the rising returns to college-educated workers reported above.

The last two rows of Table 5 show the correlation of trade changes with changes in average wages and in total employment in each industry. There is evidence that those industries which

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[15] 1987 is determined by the start data of available trade data. We chose 1995 as representing the end of the sharpest period of trade reform. Subsequent years saw small increases in trade protection in some industries, such as vehicles and parts, agriculture, chemical, pharmaceuticals and textiles.

[16] Unsurprisingly, the share of college-educated workers in total wage costs is also uncorrelated with the change in effective tariffs.

experienced the largest effective and nominal trade protection reductions were those which also paid the largest increases in wages. This finding is consistent with the argument of Chamon (1998) who suggests that the sharply rising productivity associated with trade liberalisation explains the rise in manufacturing wages. However, the correlation with industry employment share is insignificantly different from zero.

(Table 5 here)

4. Conclusions

In this paper we have constructed a picture of changing wage dispersion and employment allocation in a major developing country, over a period surrounding a bout of substantive trade reform. Interest in such a picture has been motivated by the potential for trade theory to explain changing income distribution in both the developing and the developed world. The implications for the developed world of this and other studies of developing countries are unclear, in light of a range of theories which predict increasing inequality due to transfer of skill-biased technology. Nevertheless, for developing countries an improved understanding of the consequences of trade liberalizing measures is important. The case of Brazil is especially useful because of the availability of good individual-level wage data over a long period, and because the trade reform was concentrated into just a few years during which, apart from the restrictive macroeconomic policies, the trade liberalisation measures were the key economic policy taking place, predating other, lesser, liberalisation measures by several years.

In constructing our picture, we have preferred to describe as succinctly as possible the changes in the quantities and prices of key variables conventionally associated with wage dispersion (education achievement, occupation, experience, gender balance and industry), and to present

formal statistics of the overall wage distribution and suitable decompositions. While the picture suggests that there has been some impact from trade reform, we have deployed no formal modelling and do not claim to have established a causal role.

The most notable finding is that from 1992 onwards there was a significant and substantial rise in the returns to college education. This coincided with the time when the trade reforms were beginning to bite, a connection that is unlikely to have been accidental. Moreover, it is a similar finding to that obtained in some other developing countries (Robbins, 1996b).

The boost to the returns to college education was not accompanied by any slowdown in the gradual upward trend of the share of college-educated labour in the workforce. Using a simple supply-demand framework, we inferred that there was an increase in the relative demand for college-educated labour, and computed and graphed an index of this change. This trend could be explained as resulting from an influx of skill-biased technology following trade liberalisation – that is, Robbins' skill-enhancing hypothesis. Also notable, however, is the lack of any break in the trend returns to secondary, primary and elementary education. In particular, the returns to secondary and primary education were on a steady downward trend for much of the period we investigate. There is no evidence, therefore, that the newly imported technology is also biased towards the use of these intermediate-level skills.

The third main finding is that these changes in the returns to college labour are by no means important enough to affect overall wage inequality. By a range of measures, overall wage inequality has stayed fairly constant for the 1980s and 1990s, with just a small peak in the middle of the 1980s. Our decomposition analysis, carried out using the Mean Log Deviation of wages, showed that what changes there have been in inequality over the whole period have

been mostly associated with changes in within-education-group inequality. The change in the relative wages of the different education groups after 1992 made no substantial change to overall wage inequality. One reason is that from the mid-1980s onwards there was a steady rise in the relative wage of illiterates (possibly reflecting decreases in their relative supply). The second reason is that college-educated workers remain quite a small proportion of the workforce. If increased demand for skills is to drive overall wage inequality, it may be necessary for this demand to extend to secondary-school-educated workers which, as we have seen, was not the case.

Not only was there little effect on overall wage inequality, there has also been a stable pattern of inter-industry wages for all workers. In other words, high-paying industries at the start of the period remained high-paying throughout. Nevertheless, for female workers there has been some convergence between the pay of different industries. This convergence has accompanied the steady process of integration of women into the labour market that is familiar in many countries. The indicators of this process are the rise in the proportion of the overall workforce that is female, and the fall in the gender wage gap. Both of these trends are long term and, unsurprisingly, were not obviously accelerated or decelerated at the time of trade reform.

One puzzle in our findings arises when we look at differences among tradable industries. Although the time trend in the return to college-educated labour shows a substantive break in 1992, there is no significant rank correlation between changes in effective trade protection and changes in either the proportions of college-educated labour, or their relative wages, at the two-digit industry level. However, the reduction in trade protection is associated with a rise in relative mean wages of industries; we have interpreted this as consistent with the finding (from other studies) that the trade liberalisation shock induced substantially greater

productivity and technical efficiency, on the assumption that workers were able to acquire their share of the increase. These findings merit investigation in further detail, but the inquiry would also benefit from an industry-level analysis in which trade effects can be formally investigated within an industry labour demand equation.

From the policy angle, one can conclude from our findings that when considering trade liberalisation the social and egalitarian consequences are not that important. By the same token, given that Brazil is at very high levels of inequality and poverty, the need for social and egalitarian measures remains paramount, but trade liberalisation is not a suitable measure. However, a caveat is that Brazil is such a large economy that trade exposure remains at a comparatively low level (around 13 percent in 1997 - Loser and Guerguil, 1999), while less than one in twelve workers had completed a college education. If and when the economy becomes yet more open in the coming decade, and as college-educated workers carry more weight in the labour force, the link between the two could become more important in the present decade than it was in the last.

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Figure 1: Mean Real Wages (at 1998 prices)

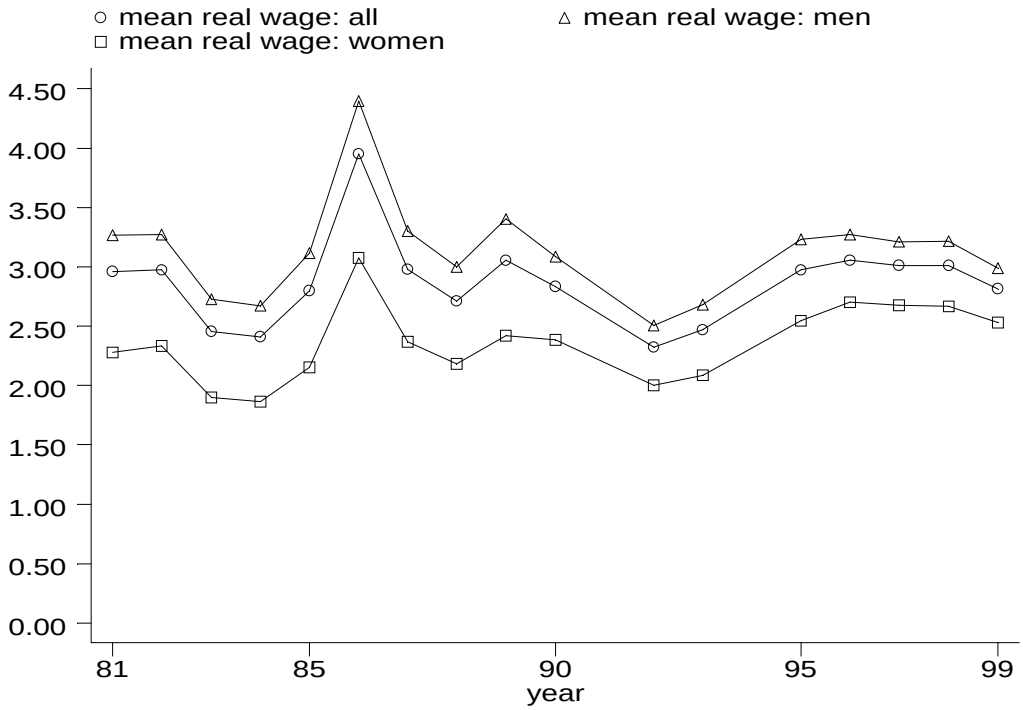
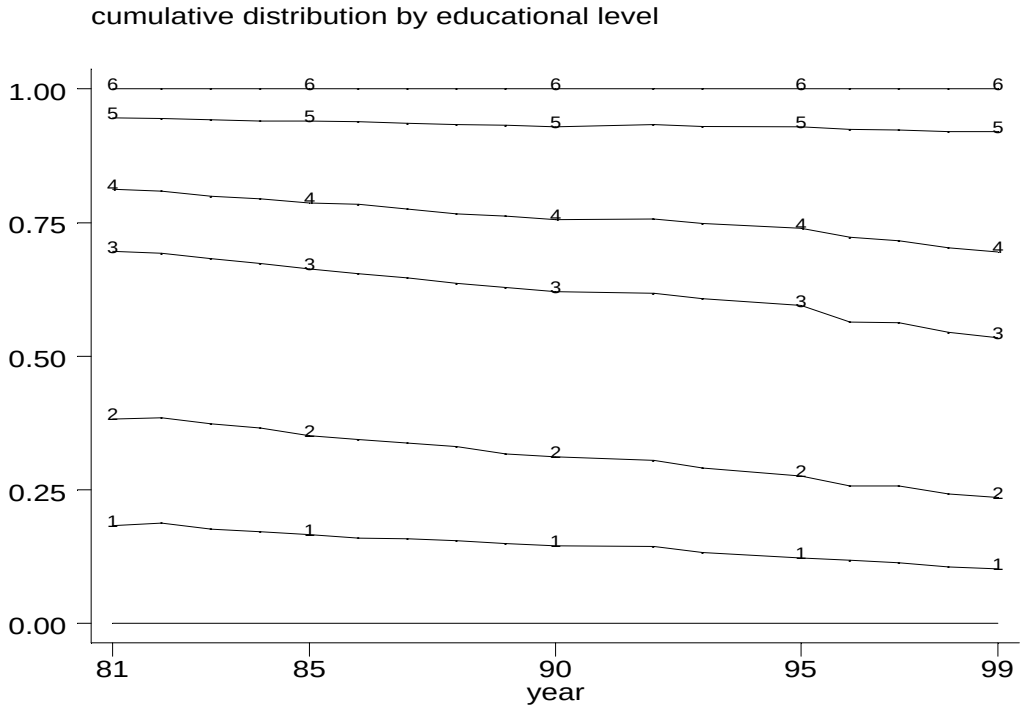


Figure 2: Education Composition of Employment



Note: The graph depicts the cumulative proportion of workers who have attained each education level. For education level key, see notes to Table 4.

Figure 3: Mean Log Deviation: All Workers, Males and Females

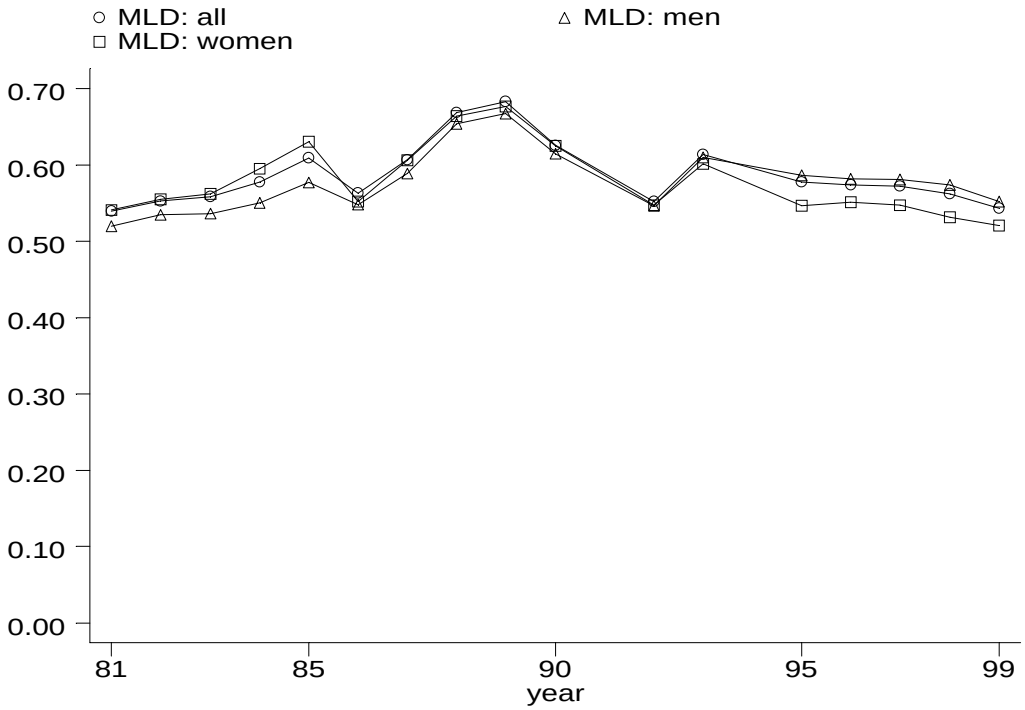


Figure 4: Three Measures of Wage Inequality: All Workers

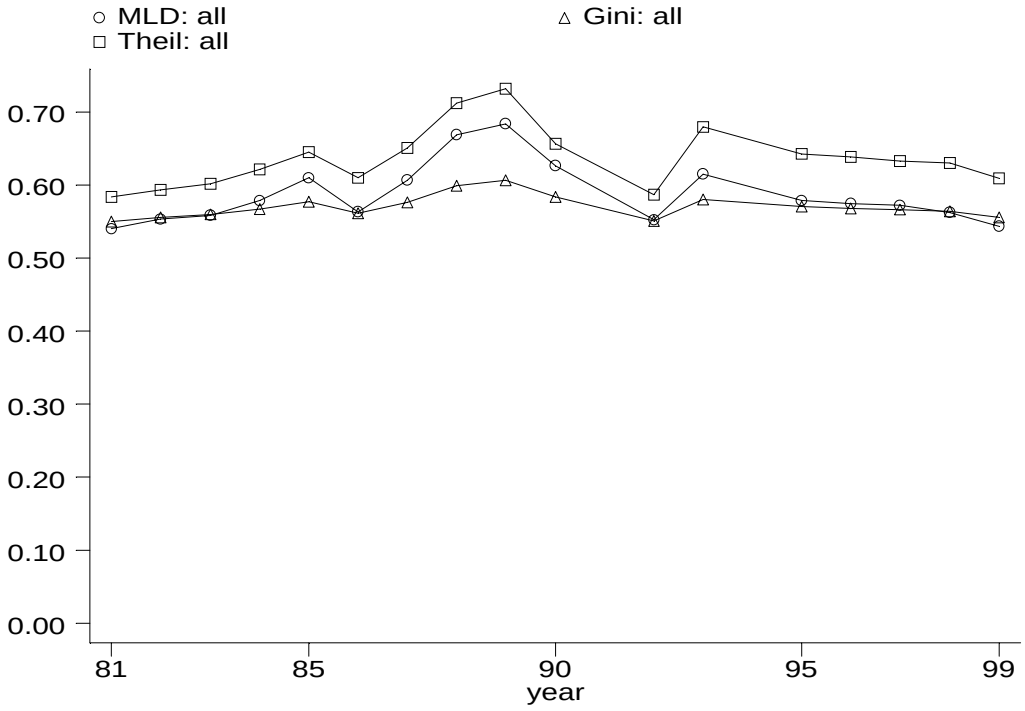
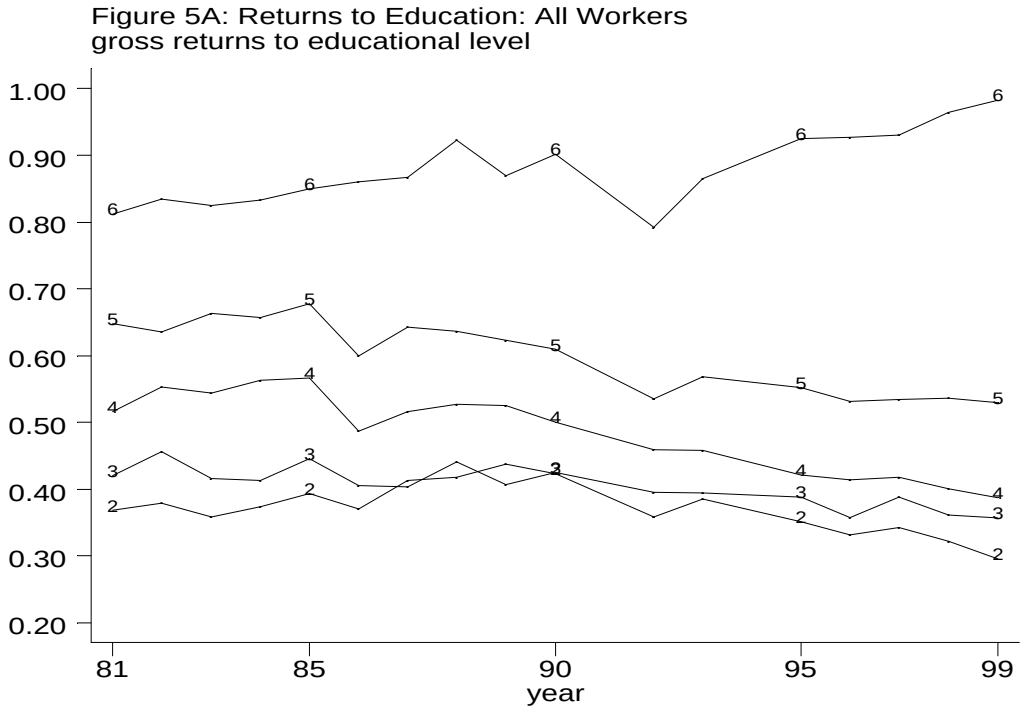
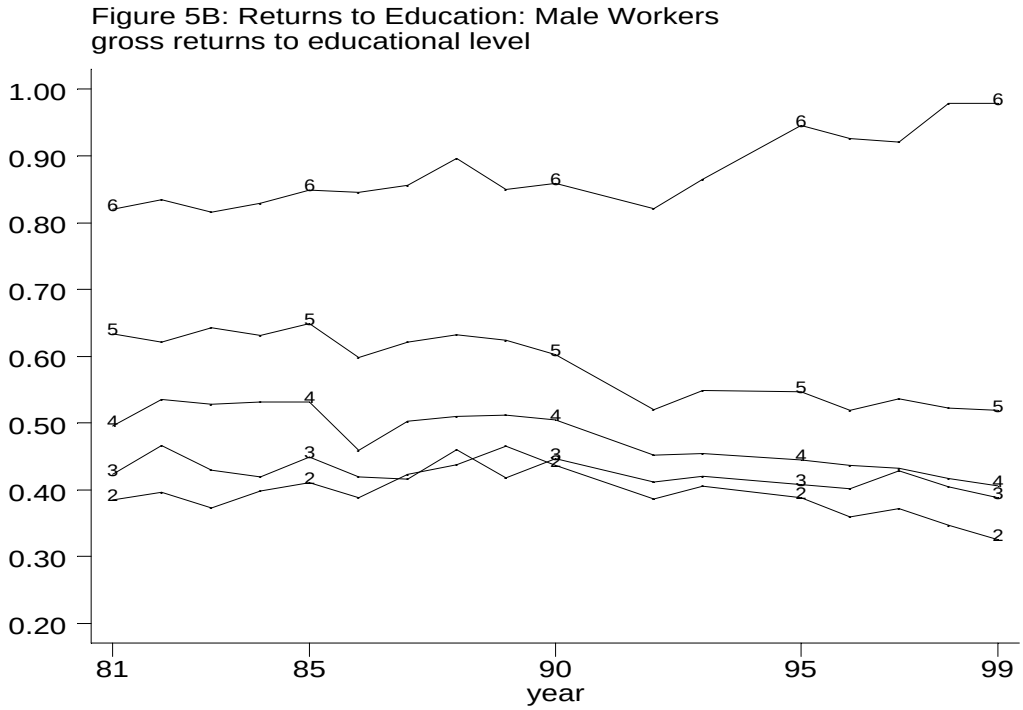
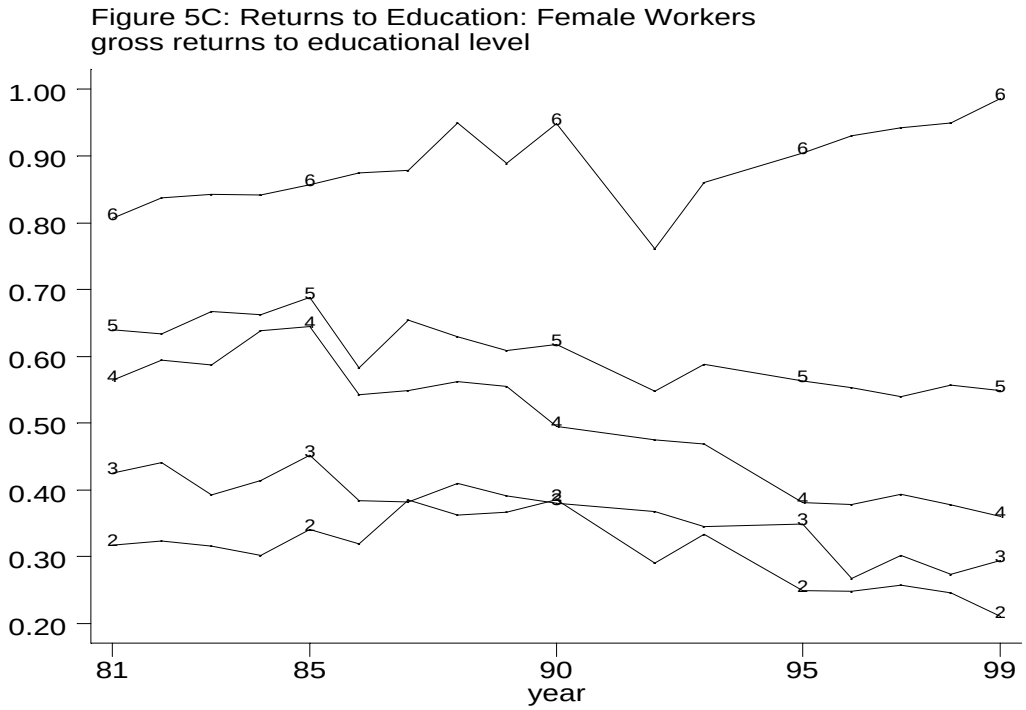


Figure 5: Returns to Education

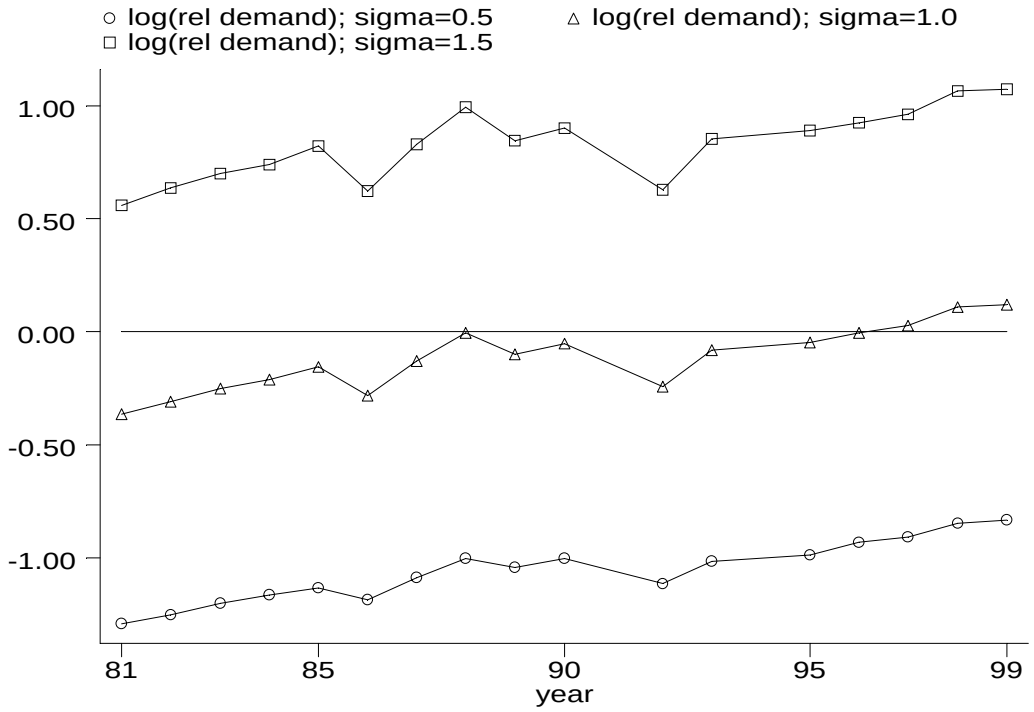






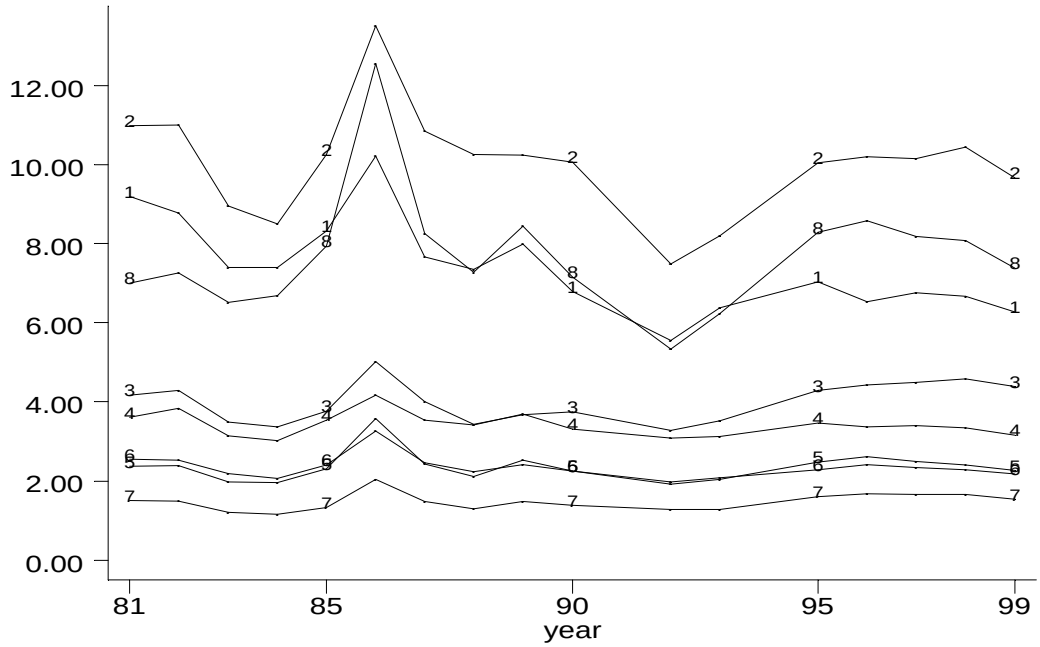
Note: The graphs depict the gross return to each educational level (see Table 4 for definitions). For example, the line labelled 5 is the return that an individual who had completed secondary education (level 5) would receive over and above someone who had only completed primary education (level 4).

Figure 6: Demand for College Skills Relative to Elementary School Skills



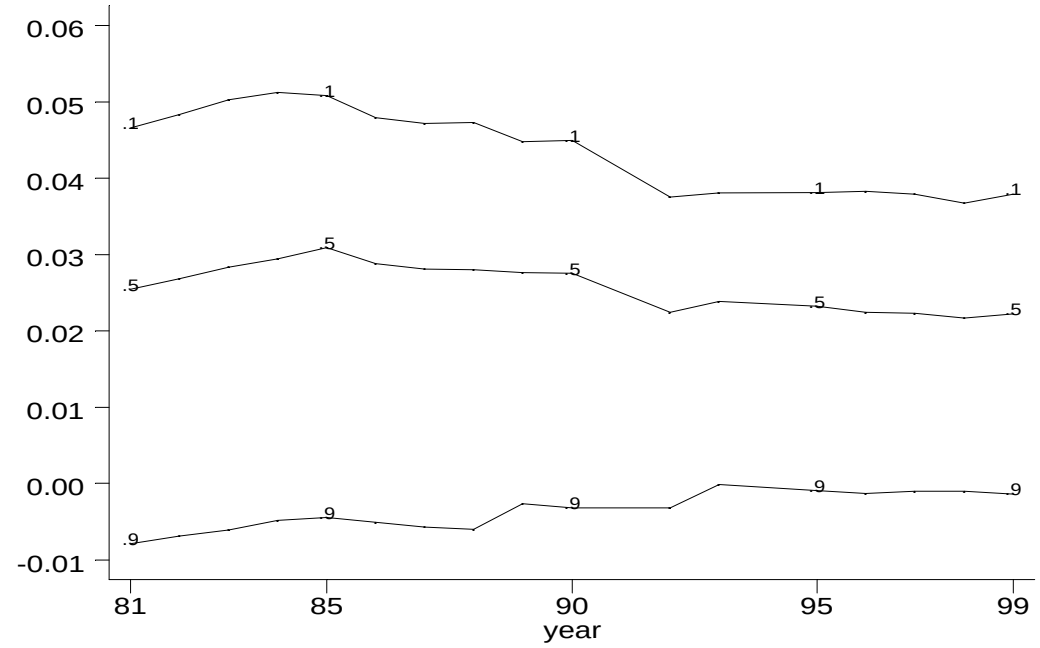
Note: The demand for college skills relative to elementary school skills is computed using the methodology of Katz and Murphy (1992); see text for details.

Figure 7: Mean Real Wages by Occupation



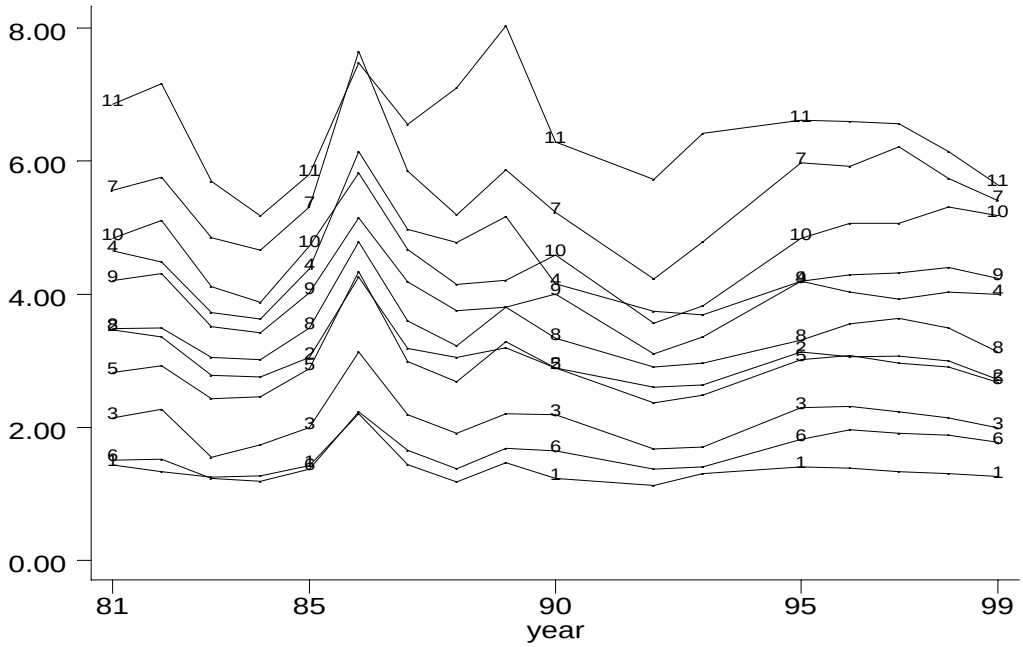
Key: 1. Manager 2. Professional 3. Technical 4. Clerical 5. Sales 6. Skilled 7. Unskilled 8. Employer

Figure 8: Returns to Work Experience: All Workers



Note: The graph depicts the return to work experience at the 90th percentile of experience (.9), the median experience (.5) and the 10th percentile of experience (.1).

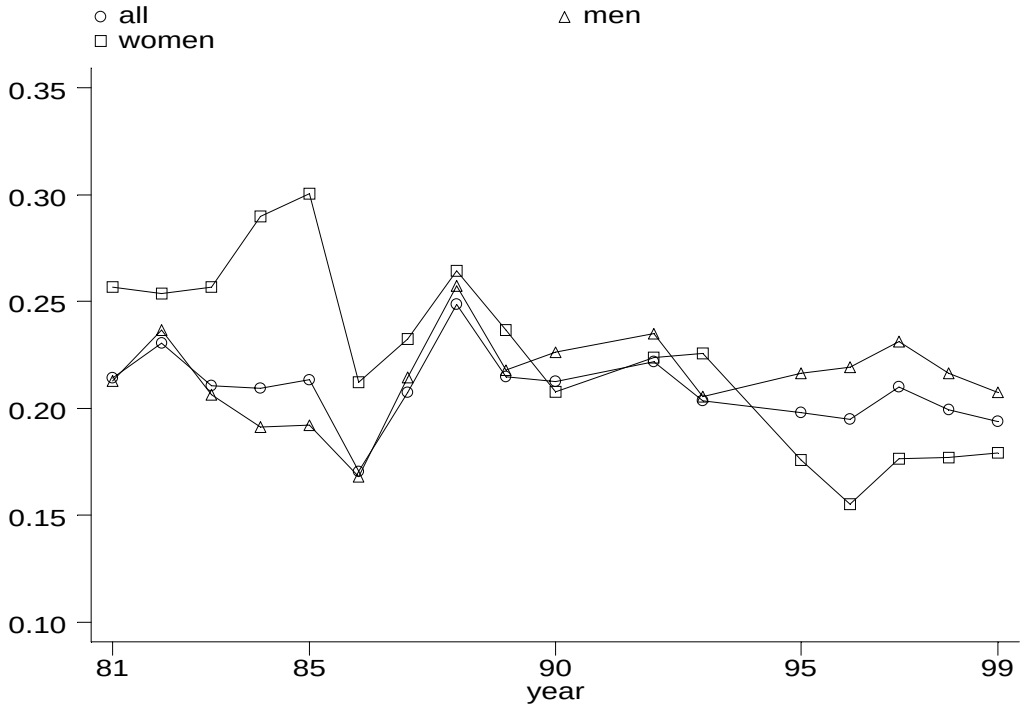
Figure 9A: Mean Real Wages by Industry



Key:

1. Agriculture
2. Manufacturing
3. Construction
4. Other industrial activities
5. Retail
6. Services
7. Industrial services
8. Transport and communication
9. Social services
10. Public administration
11. Other activities

Figure 9B: Inter-Industry Wage Differentials



Note: The inter-industry wage premium was estimated using the methodology of Haisken-DeNew and Schmidt (1997), with wages regressed on education level dummies, a quadratic in work experience, a gender dummy where appropriate and a full set of industry dummies.

Table 1: Characteristics of Employment

Year	Average years of:		% male	Employment Composition (%)			% non-manual
	Schooling	Experience		Agriculture	Manufact-uring	Other	
1981	5.28	23.2	68.7	17.2	15.4	67.4	38.5
1982	5.29	23.1	68.0	17.6	15.1	67.3	38.4
1983	5.41	23.1	67.3	16.0	14.3	69.7	38.7
1984	5.50	23.0	67.5	18.8	14.7	66.5	38.8
1985	5.62	22.8	66.8	17.9	15.1	67.0	39.1
1986	5.70	22.7	66.3	17.2	15.8	66.9	40.0
1987	5.79	22.8	65.5	15.9	15.5	68.6	40.4
1988	5.90	22.9	64.9	16.0	15.0	69.0	40.9
1989	6.00	22.8	64.8	15.1	15.5	69.4	42.3
1990	6.08	22.9	64.3	14.8	14.8	70.4	43.1
1992	6.12	23.0	63.8	14.8	14.2	71.0	41.3
1993	6.26	23.0	63.7	14.0	14.2	71.7	41.3
1995	6.40	23.1	62.4	13.5	13.3	73.2	41.9
1996	6.65	22.9	62.1	12.6	13.2	74.2	42.1
1997	6.68	23.0	62.4	12.9	13.1	74.0	41.6
1998	6.86	23.0	61.9	11.8	12.6	75.6	42.0
1999	6.94	23.0	61.4	12.3	12.5	75.2	41.8

Table 2: Measures of Wage Dispersion - Inequality Indices

	Inequality Index		
Year	Mean Log Deviation	Gini Coefficient	Theil Index
1981	0.540	0.549	0.584
1982	0.553	0.556	0.593
1983	0.558	0.560	0.601
1984	0.578	0.567	0.621
1985	0.609	0.577	0.645
1986	0.563	0.561	0.609
1987	0.607	0.576	0.651
1988	0.669	0.599	0.712
1989	0.683	0.606	0.731
1990	0.626	0.583	0.657
1992	0.552	0.551	0.587
1993	0.614	0.580	0.679
1995	0.578	0.570	0.642
1996	0.574	0.568	0.639
1997	0.572	0.566	0.633
1998	0.562	0.563	0.630
1999	0.543	0.555	0.608

Table 3A: Decomposition of Change of MLD by Education Levels

			TERM A		TERM B		TERM C		TERM D
ΔMLD(1985-1981)=	0.0695	=	0.0527	+	0.0007	+	0.0041	+	0.0119
ΔMLD(1992-1985)=	-0.0568	=	-0.0132	+	0.0002	+	0.0015	+	-0.0452
ΔMLD(1999-1992)=	-0.0093	=	-0.0303	+	0.0021	+	0.0003	+	0.0190
ΔMLD(1999-1981)	0.0033	=	0.0058	+	0.0064	+	0.0094	+	-0.0156

Note: For definitions of education levels, see Table 4.

Table 3B: Decomposition of Change of MLD by One-Digit Industry Groups

			TERM A		TERM B		TERM C		TERM D
ΔMLD(1985-1981)=	0.0695	=	0.0651	+	0.0038	+	0.0048	+	-0.0042
ΔMLD(1992-1985)=	-0.0568	=	-0.0343	+	-0.0028	+	-0.0073	+	-0.0125
ΔMLD(1999-1992)=	-0.0093	=	-0.0104	+	-0.0021	+	-0.0034	+	0.0063
ΔMLD(1999-1981)	0.0033	=	0.0195	+	-0.0001	+	-0.0056	+	-0.0106

Note: For definitions of one-digit industry groups, see Figure 9A.

Table 4: Mean Real Wage* by Educational Level

	Education Level					
Year	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**
1981	1.151	1.646	2.249	3.061	5.159	12.215
1982	1.114	1.569	2.234	3.184	5.225	12.422
1983	0.934	1.320	1.805	2.508	4.223	9.919
1984	0.910	1.309	1.754	2.431	4.078	9.442
1985	1.000	1.454	1.999	2.785	4.703	11.248
1986	1.571	2.267	2.994	3.827	6.188	14.726
1987	1.076	1.571	2.073	2.820	4.878	11.537
1988	0.897	1.332	1.808	2.521	4.380	10.888
1989	1.033	1.578	2.085	2.872	4.897	11.328
1990	0.962	1.418	1.919	2.608	4.419	10.557
1992	0.920	1.248	1.624	2.217	3.626	7.967
1993	0.940	1.273	1.638	2.211	3.774	8.989
1995	1.098	1.472	1.980	2.630	4.333	10.956
1996	1.148	1.532	1.988	2.655	4.268	10.834
1997	1.085	1.480	1.945	2.559	4.227	10.608
1998	1.103	1.450	1.872	2.469	4.042	10.763
1999	1.045	1.363	1.763	2.264	3.710	10.000
% change						
1981-92	-20.1	-24.2	-27.8	-27.6	-29.7	-34.8
1992-99	13.6	9.2	8.6	2.1	2.3	25.5
1981-99	-9.2	-17.2	-21.6	-26.0	-28.1	-18.1

* at 1998 prices

Education level definitions:

1. Illiterate (less than one year of study)
2. Some elementary education
3. Completed elementary, no or some primary
4. Completed primary, no or some secondary
5. Completed secondary, no or some college
6. Completed college

Table 5: Trade Reform, and Changes in Industry Wages, Relative College Wages and Employment Allocation, 1987 to 1995: Correlation Analysis

	Changes in:		
Changes in:	Effective Tariffs	Nominal Tariffs	Imports
Nominal Tariffs	0.912 [0.00]	1.000	
Imports	-0.447 [0.05]	-0.268 [0.27]	1.000
Relative Wage of College-Educated Workers *	0.123 [0.60]	0.016 [0.95]	0.272 [0.25]
Proportion of College-Educated Workers	0.044 [0.85]	0.075 [0.76]	0.150 [0.53]
Industry Wage Premium #	-0.612 [0.00]	-0.546 [0.02]	0.523 [0.02]
Industry Share of Aggregate Employment	-0.180 [0.45]	-0.258 [0.29]	0.305 [0.19]

Note: Spearman rank correlation coefficients; 20 industry observations are used, except for nominal tariffs for which there are 19 observations; p-values are given in [ ].
* The ratio of the mean wage of college-educated-workers to the mean wage of all workers.
# The inter-industry wage premium was estimated using the methodology of Haisken-DeNew and Schmidt (1997), with wages regressed on education level dummies, a quadratic in work experience, a gender dummy and a full set of industry dummies.