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## **Changing Earnings Inequality in Costa Rica, 1976-1999: Evolution and Causes**

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### **I. Introduction**

Income and earnings inequality in Latin America has been a concern of policy makers and social scientists for many years. As a region, Latin America has the highest measured level of income inequality in the world (Deininger and Squire, 1998). The concern about increasing income inequality has heightened since the initiation of reforms in the 1990s. These reforms, trade liberalization, privatization, reduction of barriers to foreign direct investment, and generally increasing globalization and less government intervention in the economies, were expected by reform proponents to result in reductions in earnings inequality (see Krueger, 1990). Instead, reforms have been accompanied in almost all Latin American countries by increases in income and earnings inequality (Altimir, 1997 and Inter-American Development Bank, 1998). The increase in inequality accompanying reforms has been a significant contributor to criticisms of the expansion of trade, foreign direct investment and privatization in developing countries. Criticisms that have had their most visible expression in the protests against the World Trade Organization, World Bank, International Monetary Fund and other proponents of "globalization."

In order to adequately address the criticisms of reforms in Latin America, it is important to understand the causes of the increase in inequality since the introduction of reforms. Were the reforms the cause of the increase in inequality, or was the increase in inequality in the 1980s and 1990s unrelated to reforms (and instead caused by demographic changes, technological change, or other phenomena which would have resulted in an increase in inequality even if the reforms had never been enacted)? If the reforms were responsible, which reforms were most important in causing the increase in inequality? Even opponents of reforms have distinguished between the effects of, and advisability of, different types of policy reforms. For example, Oxfam International, previously a vocal and visible opponent of reforms in part because of their perceived negative impacts on poverty and inequality, issued a recent policy report in which it changed its position on trade liberalization. The report argues that increased trade between developing and developed economies can work to reduce poverty and inequality, and recommends continuing tariff reductions (especially in the developed economies). Although Oxfam now promotes trade liberalization, they continue to be more skeptical of privatization and foreign direct investment, in part because of their perceived negative effects on poverty and inequality.<sup>1</sup>

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<sup>1</sup> Paul Blustein, 2002, "New Faith in Free Trade: In Break With Allies, Oxfam Backs Globalization," *Washington Post*, April 11, pages E1 and E14.

Costa Rica has consistently exhibited lower levels of income and earnings inequality than the other countries in Latin America. Along with low inequality, Costa Rica also performs near the top in Latin America on other social indicators such as infant mortality, educational attainment, life expectancy and access to public utilities, despite having a per capita income in the lower-middle range.

As did most of the rest of Latin America, Costa Rica experienced a "debt crisis" and recession in the early 1980s, followed by significant structural adjustment reforms. Reforms in Costa Rica began in the mid-1980s, earlier than in many other Latin American countries. The package of reforms in Costa Rica has been similar to that introduced in other Latin American and developing countries in the 1980s and 1990s, and has included trade liberalization, exchange rate liberalization, privatization, financial market deregulation, capital account liberalization, and the encouragement of foreign direct investment. Prior to the reforms in the mid-1980s, income and earnings inequality in Costa Rica had generally been falling. After reforms were introduced, this fall in inequality stopped, and in the 1990s inequality began to increase (although only slightly) in Costa Rica.

In this paper we begin to develop an explanation of the causes of the changes in earnings inequality in the past 25 years. We will examine the impacts on inequality of different types of reforms and phenomenon not related to reforms, and measure the relative importance of each in causing changes in inequality in Costa Rica. Our results will shed light on whether or not criticisms of such reforms are valid, and if so how reforms can be structured to minimize the negative impacts on inequality.

## **II. Costa Rica**

### **a. Pre-reform: Social Democratic Policies, Primary Product Exporting and Import Substitution Industrialization (1948 to mid-1980s)**

There is broad agreement that the exceptional performance of social indicators in Costa Rica is largely the result of social and economic policies begun in the early 1940s by the government of Calderon-Guardia, and fully institutionalized after a social democratic "revolution" in 1948. Policies introduced or strengthened after 1948 include minimum wage and other worker protection legislation, a comprehensive social security system (which includes a government-financed health care system as well as a pension program), nationalized banking and insurance systems, elimination of the army, and high levels of government spending on health care, education, housing and other basic needs.

From 1950 to 1980, GDP grew at an average annual rate of 6.2% (3.2% in per capita terms), placing Costa Rica among the fastest growing economies in Latin America. Much of this growth was fueled by expansion of traditional primary product exports, chief of which were coffee, bananas, meat, sugar and cocoa. In the early 1960s these products accounted for over 20% of the GDP and 80 to 90 percent of all export earnings (Celis and Lizano, 1990).

In the 1960s, in part because of a perceived vulnerability to shifts in the prices of its principle exports (particularly coffee), Costa Rica instituted a policy of import-substitution-industrialization. The Central American Common Market (CACM), established in 1962, enlarged the market for Costa Rica's import-substituting products by lowering or eliminating barriers to trade between the Central American countries and instituted a common external tariff on imported manufactured products. The import substitution undertaken at the regional level provided the engine for growth and industrialization in Costa Rica. As the most developed member of the CACM, Costa Rica was well placed to achieve a significant surplus in manufactured goods trade within the CACM. Manufacturing output rose from 12% of GDP in 1960 to 22% in 1979. (Gindling and Berry, 1994, pages 218-219).

#### **b. Recession (1980-1982) and Recovery (1982-1985)**

Between 1979 and 1982, the real GDP fell by over 9% and average real wages fell by approximately 35%. In the summer of 1982 the new government of Alberto Monge (1982-1986) instituted a "100-day" stabilization plan which included an appreciation of the colon (the currency), together with controls on the outflow of capital and unification of the official and free-market exchange rates, income, sales and consumption tax increases, decreases in subsidies, increases in the prices of some public utilities, a public sector wage freeze, and a credit restraint/contraction of the money supply. The stabilization plan resulted in a lowering of the inflation rate, and a consequent rise in real minimum wages (which act as a guide in the setting of private sector wages), which were effectively indexed to the recent past inflation rate. Average real salaries increased by over 40% between 1982 and 1985. (Gindling and Berry, 1992).

#### **c. Structural Adjustment Reforms (1987-2000)**

Beginning in the mid-1980s, Costa Rica began a comprehensive, but gradual, program of structural adjustment. The most comprehensive reforms have been in the areas of trade liberalization, exchange rate liberalization and tourism promotion. These reforms resulted in a significant shift in the structure of production in Costa Rica, from traditional exports (coffee and bananas) and manufacturing for the Central American Common Market (CACM) to tourism and non-traditional exports to non-CACM markets (principally apparel, electronic assembly, tropical fruits and vegetables, cut flowers and ornamental plants to the U.S., Europe and Canada). Financial deregulation, principally the loosening of the government monopoly in banking and capital account liberalization, was initially slow but has accelerated in the second part of the 1990s. Little privatization of state-owned utilities and services has occurred, although the relatively small number of state-owned enterprises producing manufacturing goods have largely been privatized, and government employment in general has been steadily declining since the mid-1980s.

#### Trade Liberalization:

Political problems (conflict between El Salvador and Honduras, the Sandinista victory in Nicaragua) and the recession of the early 1980s eviscerated the Central American Common Market, contributing (along with the debt crisis) to Costa Rica's abandonment of a trade policy of import substitution industrialization and moves towards an outward-oriented trade policy. A law in 1982 created free-trade zones (export processing zones) where firms were able to import and export without paying export taxes on the sale of final goods outside of Costa Rica or import tariffs on inputs. A 1984 law eliminated export taxes and provided tax credits of 15-30% of value-added on "non-traditional exports" (basically anything not coffee, bananas, meat, sugar and cocoa) to "third-markets" (non-CACM countries), and created government-funded agencies to provide extension services for potential exporters. Non-traditional exports increased from 37% of export earnings in 1986 to almost 60% by 1992 (Robbins and Gindling, 1999). Tariff reductions began in 1986 with the passage of a new Central American Common Market tariff regime whereby the mean tariff was cut from 53 to 20 percent and the standard deviation of tariffs from 62 to 21 percent. The first structural adjustment agreement signed with the World Bank in 1986 called for the graduate reduction of tariffs on final goods and the elimination of all quantity restrictions on imports. In 1987, all tariffs on consumer goods that were above 40% were reduced by 10%. Tariffs were reduced between one-tenth and one-sixth twice-yearly between 1988 and 1992. In 1990 Costa Rica entered the GATT. Also in 1990, a second structural adjustment program signed in 1990 mandated continued gradual tariff reductions throughout the 1990s, and in 1992 Central American Common Market countries agreed to work towards a uniform tariff rate of between 10 and 20%.

The beginning of the 1990s saw the gradual elimination of tax credits for non-traditional exports to third markets. These tax credits went largely to apparel, electronic assembly and non-traditional agricultural products (the most import of the last included flowers, ornamental plants and tropical fruits and vegetables). The early 1990s also saw a change in the structure of non-traditional exports towards more "high-technology" products and tourism.

#### Tourism Promotion:

A 1985 law allowed tourist enterprises to import inputs tariff-free, provided tax breaks on the purchase of locally-produced inputs, and expanded the Costa Rican Tourism Institute to promote foreign tourism in Costa Rica. Further tax breaks were extended to foreign investment in hotels and other tourist enterprises. Beginning in the mid-1980s, foreign tourism has been growing steadily until by the mid-1990s tourism became the single largest source of foreign exchange inflows into Costa Rica.

#### Exchange Rate Liberalization:

Exchange rates were unified in 1983. Accompanying trade liberalization has been a policy of gradual depreciation of the real exchange rate through a policy of frequent "mini-devaluations" (Conejo, 1992). By the late 1980s, the *colon* was and continued to

remain fully convertible. Any remaining controls on the capital account were removed in 1992.

#### Encourage Foreign Direct Investment:

Costa Rica has historically had few limits on foreign direct investment. Beginning in the early 1980s, the government began a series of efforts to actively encourage foreign direct investment in exporting and tourism. Free-trade zones, established in 1982, were designed in part to encourage foreign direct investment. Publicly-funded agencies were set up to encourage foreign firms to invest in Costa Rica (among them the USAID-funded CINDE and CENPRO). Capital account liberalization, especially the elimination of any capital account controls in 1992, further encouraged foreign direct investment. After 1994 the new government re-focused policies to attract foreign direct investment in "high-technology" sectors. A process which culminated in the opening of INTEL's largest micro-chip factory in 1998.

#### Financial Deregulation:

At the beginning of the reform process banking in Costa Rica was a government monopoly, with the three largest state-owned banks dominating financial markets. Deregulation of was at first very gradual and partial. A 1985 law made it easier for foreign-owned banks to operate in Costa Rica, although they were not allowed to accept deposits. It was not until a 1995 law that private banks were finally allowed to accept savings and checking deposits. The 1995 law for the first time created a legal structure that allowed private financial firms to operate on a more level playing field with state-owned banks. Since the mid-1990s, the private financial sector in Costa Rica has grown substantially. Nevertheless, banking is still dominated by government-owned banks (Villasuso, 2000).

#### Reduction in Government Employment and Spending:

Privatization of government-owned enterprises is not very far advanced in Costa Rica. By 1993, government-owned enterprises producing goods had largely been sold (CODESA, Fertica and Cempasa). However, the larger government-owned service enterprises continue as private enterprises, including the largest banks, health care, and government monopolies in insurance and utilities. On the other hand, employment in the Central Government has been steadily declining since the introduction of reforms in the mid-1980s. Reductions in public sector employment have been part of all structural agreements signed with international agencies since the mid-1980s (agreements with the IMF in 1984, 1989, 1991 and 1995 and with the World Bank in 1985 and 1994-Ulate, 2000).

#### Tax Reforms:

Income tax rate have not changed much in the past 20 years, varying between 12 and 14% (Villasuso, 2000). As noted, a 1992 tax reform expanded the base and increased

income, sales and consumption tax rates. A 1988 tax reform lowered the maximum marginal tax rate and increased the threshold for contributions, instituted a flat 30% corporate tax rate, and increased the base for sales, property and stamp taxes. A reform in 1992 simplified the income tax, elimination a large number of exemptions.

### **III. Evolution of Earnings Inequality, Data and Results**

#### **a. Data**

The primary source of data on earnings and inequality we use are the Household Surveys for Multiple Purposes, conducted in July of each year (except for 1984) from 1976 until the present. The Household Surveys ask questions are asked about many personal and work-place characteristics The surveys are country-wide household surveys of approximately 1% of the population.

Several unusual characteristics of the surveys are important to take into account when interpreting the data on inequality. First, the comprehensiveness of the income and earnings measures has increased over time. From 1976 to 1979 only the earnings of paid employees are reported. From 1980 to 1986 earnings are reported for all workers (paid employees and self-employed workers). From 1987 to 1999, transfer income (principally pensions) and some income from capital are also reported, allowing one to construct a more comprehensive measure of total income. In this paper we concentrate on an analysis of the distribution of earnings among all workers, for which data is available from 1980 to 1999.

Second, there were substantial changes in the survey sample, design and questionnaire between 1986 and 1987. The sample was changed to be consistent with the results of the 1984 census. The questionnaire was changed in consultation with input from international experts. In addition, a new team began to administer the surveys. One focus of the new team was a stronger effort to obtain data from non-responding households by repeatedly returning to those households until data could be obtained.<sup>2</sup> Although it should be possible to construct consistently-defined variables in the pre- and post- 1986 surveys, in practice many of the variables change in unrealistic ways. One such variable is education; measured average levels of education fall substantially between 1985 and 1987 (because of a coding problem, the education variable is not available in the 1986 survey). Another is inequality in earnings; measured inequality in the surveys increases substantially between 1986 and 1987. This increase does not occur when we compare the results of other surveys (see Trejos, 1999). Also, there are no dramatic macroeconomic or policy changes between 1986 and 1987 that we would expect to result in such a dramatic increase in inequality. For these reasons, we argue that the data on inequality in the pre-1986 and post-1986 periods are not strictly comparable, and

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<sup>2</sup> We expect that such households to be over-represented both at the very high end and very low end of the income distribution. The evidence supports this interpretation; between 1986 and 1987 the proportion of total income going to the highest decile increased (from 27% to 33%) while the proportion of income going to the lowest decile fell (from 2.2% to 1.8%).

we are careful not to base any of our conclusions on this 1986-1987 change. In the graphs and tables that we present, we generally will not include the 1986-1987 changes.<sup>3</sup>

## **b. Evolution of Earnings Inequality, 1976-1999**

From figure 1 we can identify three long-term trends in the evolution of earnings inequality in Costa Rica. The clearest break is between the pre-1987 period and the post-1987 period. Between 1976 to 1986 inequality fell. Then, after an unrealistic increase between 1986 and 1987 caused by changes in the survey, this fall in inequality slowed and eventually reversed. The turning point came in 1992; inequality continued to fall from 1987 to 1992 (although more slowly than before), but then increased (worsened) from 1992 to 1999. Within the first period (1976-1985), we can also identify a temporary increase in inequality that corresponds to the recession of 1980-1982, followed by a return to the previous falling trend with the recovery of 1983-1985. Table 1 presents the changes in three commonly used measures of inequality over these three periods, the variance of the logarithm of earnings, the Gini coefficient and the Theil coefficient. The variance of the logarithm of earnings is sensitive to changes at the bottom of the distribution, the Gini coefficient is most sensitive to changes in the middle, and the Thiel is most sensitive to changes at the top.

Summarizing the changes in inequality shown in Figure 1 and Table 1:

(1) From 1976 (or 1980) to 1986 there was a clear improvement in the distribution of earnings, accompanied by significant increases in real earnings. All measures of inequality fell. Within this period, inequality increased during the recession (1980-1982), and then fell and returned to trend with the recovery (1982-1985).

(2) From 1987 to 1992 earnings inequality continued to fall, although at a slower rate than in the previous period. For example, between 1980 and 1986 the Gini coefficient fell by 0.035, while between 1987 and 1992 it fell only 0.011.

(3) From 1992 to 1999 real earnings began to rise substantially, with increases in real earnings being larger for each successively higher decile in the distribution. Therefore, all of our measures of inequality increased, with the largest increase occurring in the variance of the logarithm of earnings (the measure most sensitive to changes at the bottom of the distribution).

## **IV. Recession (1980-1982) and Recovery (1982-1985)**

Before discussing the causes of the longer-term trends identified above, we will discuss the causes of the temporary increase in inequality during the recession of the early 1980s. This period has been the focus of much previous research, and consequently much of

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<sup>3</sup> The measured increase in inequality between 1985 and 1987 cannot be explained by changes associated with measured changes in education, sex, age or region. Using results from the Fields' decompositions (described below), 75% of the increase can be attributed to changes in the residual in an earnings equation.

what happened in the labor market during this period is well-known. The dramatic increase in inequality, followed by an equally dramatic fall in inequality, is due to two phenomenon: a change in the composition of the work force caused by an added-worker effect during the recession, and changes in the public-private sector wage differentials.

Mean real earnings fell by over 30% between 1980 and 1982, and then recovered most of this amount between 1982 and 1985. The rapid decrease in average real wages in the first two years of the decade led to an "added-worker" effect, whereby family members not usually in the labor force entered in order to help to maintain family incomes. These added workers had, on average, less human capital than those already in the labor force, mostly found work in the low-paying informal and rural sectors, and often worked less than full time. For example, Gindling (1993) shows that during the recession there was an influx of less-educated women into the informal sector. This influx increased the unadjusted male-female wage gap (although the wage gap adjusted for education and experience did not change). With the recovery, these women left the labor force. Another type of added worker entering the labor force during the recession were grade school and secondary school students of both sexes. Funkhouser (1998) shows that the fall in earnings from 1980 to 1982 was the primary determinant of falling enrollment rates in secondary schools during this period. These students did not return to school after the recession, and enrollment rates in secondary schools did not recover until later in the 1980s. Table 2 shows that labor force participation rates increased from 1980 to 1982, and then fell from 1983 to 1985, varying more for women than for men. The proportion of women and non-household heads in the labor force increased from 1980 to 1982, and then fell from 1982 to 1985. The average level of education among workers increased much more slowly during the recession than before or after. During the recession, as added workers entered the work force at less than full time in the informal and rural sectors, the average hours worked fell, the variance of hours worked among workers increased, and the proportion of workers in small firms and in the rural sector increased. These patterns reversed themselves with the recovery (1983-1985).

Gindling (1989) shows that during the recession the formal-informal sector and public-private sector wage gaps increased. This may be because labor market institutions such as relatively well-enforced minimum wages and public sector wage setting policies partly protected workers in large firms and the public sector from the effects of the recession. After the recession, the formal-informal sector wage gap fell to pre-recession levels, while the public-private sector differential fell even farther. The bigger fall in the public-private wage differential reflects the stabilization plan introduced in 1982, which limited the growth of public sector salaries.

Other evidence of an added worker effect comes from studies that interviewed poor families to find out how they coped with the recession (Cordero and Gamboa, 1990)<sup>4</sup>. These studies conclude that the main coping mechanism of poor families during the recession was to send housewives and school-age children to work in whatever employment could be found, generally in the informal sector in the city or to the farms of

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<sup>4</sup> Cordero, Allen and Nuria Gamboa, 1990, *La Sobrevivencia de los Mas Pobres*, Editorial Porvenir, San Jose, Costa Rica.

relatives. Further evidence in favor of this explanation is that, although inequality in the distribution of earnings increased during the recession, and fell after, inequality in the distribution of household (labor) income did not deviate from its downward trend in the first half of the 1980s (see figure A1 in the appendix).

#### IV. Decomposition of the Changes in Earnings Inequality

##### a) Fields' Decomposition Technique

To guide our examination of the causes of the different patterns of change in inequality in Costa Rica in the three periods of interest (1976-1985, 1987-1992 and 1992-1999), we begin by decomposing the changes in the inequality of earnings and wages into components attributable to changes associated with the personal and work place characteristics of workers. To decompose the changes in inequality we use the technique developed by Fields (Fields, 1998 and Fields and Gyeongjoon, 1999).

The Fields' decomposition technique is based on the estimation of a standard log-linear earnings equation,

$$(EQ 1) \quad \ln Y_{it} = \sum_j B_{tj} * X_{itj} + E_{it} = \sum_j B_{tj} * Z_{itj}$$

where:

The  $X_{itj}$  are variables  $j$  associated with person  $i$  in year  $t$  that might affect earnings. It is especially important that the  $X_{itj}$  include variables that represent phenomenon that might cause changes in the distribution of earnings. The residual,  $E_{it}$ , is the part of the variation in earning among workers that cannot be explained by variation between the variables included in the earnings equation. That is, the residual measures the part of inequality that can be assigned to inequality WITHIN narrowly defined education/gender/zone/industry/hours-worked groups.

We illustrate the derivation of the Fields' decomposition using the variance of the log of earnings as the measure of dispersion. Given the log-linear earnings function, the variance of the logarithm of earnings can be written as

$$(EQ 2) \quad \text{Var}(\ln Y_{it}) = \text{Cov}(\ln Y_{it}, \ln Y_{it}) = \text{Cov}(\sum_j B_{tj} * Z_{itj}, \ln Y_{it}) = \sum_j \text{Cov}(B_{tj} * Z_{itj}, \ln Y_{it})$$

Dividing equation (2) by the variance of the logarithm of earnings,

$$(EQ 3) \quad 1 = \frac{\sum_j \text{Cov}(B_{tj} * Z_{itj}, \ln Y_{it})}{\text{Var}(\ln Y_{it})} = \sum_j S_{jt}$$

The  $S_{jt}$  measure the proportion of the variance in the logarithm of earnings explained by each variable  $j$  in year  $t$ .

Shorrocks (1982) showed that if one can describe income (or the logarithm of income) as the sum of different components, then the  $S_{jt}$  measures the contribution of each variable  $j$  to inequality for a large number of inequality measures (not only for the variance), including the Gini coefficient and the Theil coefficient. (Unfortunately, the decomposition works only if the variables are entered linearly. This excludes the possibility of interactions between the right-hand-side variables.)

While one can use the  $S_{jt}$  to measure the contribution of each variable  $j$  to the level of inequality, in order to measure the impact of each variable to changes in inequality we need to use more than  $S_{jt}$ . This is because the magnitude of the change in inequality (and at times the direction of the change) will depend on the measure of inequality that we use. To measure the contribution of each variable to the change in inequality, one must multiply the  $S_{jt}$  in each period  $t$  by the measure of inequality in that period. Specifically, if  $I(t)$  is the measure of inequality in period  $t$ , the change in inequality between periods 1 and 2 can be written as

$$(EQ\ 4) \quad I(2) - I(1) = \sum_j \{ I(2) * S_{j2} - I(1) * S_{j1} \}$$

Equation 4 can be used to measure the contribution of each variable to the change in inequality.

Changes in each variable can contribute to changes in overall inequality because of changes in the prices/coefficients (the  $B_j$ ) of these characteristics or because of changes in the distribution of these characteristics (changes in the distribution of the  $Z_j$ ). It would be useful to distinguish between changes caused by changes in the prices/coefficients and changes caused by changes in the distribution of each  $Z_j$ . Fields (1998) derives an approximate decomposition into price/coefficient components and quantity components. Fields notes that if the right-hand-side variables in the earnings equation are orthogonal (not correlated), then we can write  $S_{jt}$  in the following way:

$$(EQ\ 5) \quad S_{jt} = \frac{B_{jt}^2 * \text{Var}(Z_{jt})}{\text{Var}(\ln Y_t)}$$

Fields (1998) derives an approximate decomposition into price/coefficient and quantity effects under the assumption that such changes are infinitesimal and that the variables  $Z_j$  are orthogonal. The decomposition is approximate because variables  $Z_j$  are not orthogonal and real world changes are not infinitesimal. Taking logarithms, taking

derivatives with respect to time, summing over  $j$ , and substituting  $\sum_j \log(S_j) = 0$  and  $\sum_j S_j = 1$ , Fields (1998) derives

$$(EQ\ 6) \quad \% \Delta \{ \text{Var}(\ln Y) \} \cong \sum_j \% \Delta \{ B_j \} * S_j * 2 + \sum_j \% \Delta \{ \text{Var}(Z_j) \} * S_j$$

Where  $\% \Delta \{ \theta \}$  is the percentage change in  $\theta$ . Although approximate, equation 6 has intuitive appeal. The first term on the right-hand-side of equation 6 measures the contribution of the change in the price/coefficient  $j$  as the percentage change in the coefficient weighted by  $2 * S_j$ . The second term measures the contribution of the change in the distribution of each variable  $Z_j$ . As the percentage change in the variance of  $Z_j$  weighted by  $S_j$ . Unfortunately, one can distinguish between price/coefficient and quantity effects only if the phenomenon enters as a single variable in the wage equation. For example, we cannot calculate separate price/coefficient and quantity effects for experience (which enters as  $\text{exp}$  and  $\text{exp-squared}$ ) not industry (which enters as a series of dummy variables).

The earnings equations include right-hand-side variables that capture the phenomenon that might affect earnings or the distribution of earnings. These variables include variables that reflect the human capital of the worker such as years of education (ED) and potential experience (EXP and EXP-squared), gender (SEX), and variables associated with the job of the worker such as hours worked per month (HOURS) dummy variables that are one if the worker works in urban areas (ZONE), the public sector (PUBLIC), a firm with more than 5 workers (GRANDE), and 9 industries (IND).

## b) Decomposition of Inequality in Monthly Earnings<sup>5</sup>

Table 3 presents the results of the calculation of equation 4, the contribution of changes associated with each right-hand-side variable to the change in inequality, for the three periods 1980-1985, 1987-1992 and 1992-1999.<sup>6</sup> Recall that inequality fell from 1980-1985, stabilized in the 1987-1992 period, and then rose from 1992-1999. Table 3 suggests that these changes are associated primarily with two variables: hours worked and education. These two variables explain an average of approximately 30% of inequality in any year (21% of inequality is explained by other right-hand-side variables, leaving 49% “explained” by the residual, that is, by inequality within narrowly defined demographic and work place groups). The biggest cause of falling inequality in the pre-reform period were changes associated with education. Table 4, which presents the approximate decomposition of the percent change in the variance of monthly earnings,

<sup>5</sup> When Costa Ricans refer to earnings or wages, the earnings referred to are almost always monthly earnings (unlike in the United States, where earnings usually refer to yearly earnings or hourly wages). Yearly earnings for Costa Rican paid employees include 12 months of pay plus a legally-required 13<sup>th</sup> month bonus (*aquinaldo*), which is paid in December.

<sup>6</sup> The file for the 1986 Household Surveys for Multiple Purposes do not contain information on education not size of firm, therefore we cannot estimate the decompositions for 1986, and must compare 1980 to 1985.

suggests further that the fall in inequality associated with education in the 1980-1985 period was principally due to a fall in the coefficient on education (returns to education or the “price” of education). Table 4 further suggests that the increase in inequality from 1987 to 1999 occurred because of increases in the dispersion (inequality) of hours worked among workers, and to increases in the coefficient on education (returns to education or the “price” of education).

Changes in returns to education have been identified previously as a primary cause of changes in inequality in Costa Rica (Gindling and Robbins, 1999 and Trejos, 1998) and in Latin America (Inter-American Development Bank, 1998). To our knowledge, no one has previously identified changes in the distribution of hours worked as an important cause of the increase in inequality. Although changes in the distribution of hours worked has been shown to not be an important determinant of the increase in inequality in the United States, it does seem to have played a role in the increase in inequality in Canada (Wong and Picot, 2001).

The role of changes in the distribution of hours worked as the primary cause of changes in the distribution of monthly earnings suggests dividing the analysis of changes in the inequality of monthly earnings into two separate problems:

- (1) an analysis of the causes of changes in the distribution of hourly wages and
- (2) an analysis of the causes of changes in the distribution of hours worked by workers.

In the rest of this work, we will do this. In this paper, we examine (1), the causes of changes in the distribution of hourly wages. In forthcoming work we will examine the causes of changes in the distribution of hours worked.

### **c) Decomposition of Inequality in Hourly Wages<sup>7</sup>**

Figure 2 presents the evolution of inequality among workers in hourly wages. The pattern of change is similar to that of the evolution on inequality in monthly earnings: falling from 1980 to 1986 (with a temporary increase during the recession), stability between 1987 and 1992, and then an increase from 1992 to 1999. As might be expected given the disequalizing effect of changes in hours worked from 1987 to 1992, the fall in inequality from 1987 to 1992 is larger for hourly wages than for monthly earnings, while the increase in inequality from 1992 to 1999 is smaller for hourly wages than for monthly earnings (panel B of figure 2)

Table 5 presents the results of the calculation of equation 4--the contribution of changes associated with each right-hand-side variable to the change in inequality in hourly wages--for the three periods 1980-1985, 1987-1992 and 1992-1999. As expected, table 5 suggests changes in the evolution inequality in hourly wages from the 1980-1985 period to the 1987-1999 period are associated with education. The influence of education is

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<sup>7</sup> Earnings are reported as monthly earnings while hours worked are reported as hours worked per week. To calculate hourly wages we divide monthly earnings by (hours worked\*4.3).

equalizing in the 1980-1985 period, neutral (or at least less equalizing) in the 1987-1992 period, and disequalizing in the 1992-1999 period.

As expected, table 6, which presents the approximate decomposition of the percent change in the variance of hourly wages, suggests that the changes associated with education are due primarily to changes in the coefficient on education (returns to education or the “price” of education). The decline in the coefficient on education explains more than the total change fall in inequality in the 1980-1985 period. Returns to education were more stable in the 1987-1992 period, and disequalizing from 1992 to 1999. This result is consistent with the results using a different inequality decomposition technique that were derived in Gindling and Robbins (2001). Gindling and Robbins (1999) decomposed the change in inequality in hourly wages into education and experience price and quantity effects, and found that both the fall in inequality in the 1980-1985 period, and an increase in the 1987-1995 period, could be explained primarily by changes in returns to education. In the next section we examine the causes of the change in returns to education. Before doing that, we discuss the influence of other variables on the change in the distribution of hourly wages.

Table 6 shows that the contribution of changes in the distribution of education (holding returns to education constant) were disequalizing in all periods. Our results are consistent with the analysis of Knight and Sabot (1983), who distinguish between a “wage compression effect” and a “composition effect” of educational expansion on inequality. The wage compression effect is the decline in returns to education as the supply of more educated workers increases (holding the distribution of education among workers constant). The wage compression effect is unambiguously equalizing. The composition effect of educational expansion occurs when one examines the impact of increasing the proportion of workers with more education while holding returns to education constant. The impact of the composition effect on earnings inequality is ambiguous. In the context of educational expansion between two education levels, the composition effect of educational expansion will be disequalizing if begun from a situation where the more-educated group is relatively small, and will be equalizing if begun from a situation where the more-educated group is relatively large. This is a manifestation of the well-known Kuznets’ effect (Kuznets, 1955, Robinson, 1976). Our results indicate that Costa Rica is on the disequalizing part of this curve, where increases in the proportion of the work force with more education (holding returns to education constant) will cause inequality to increase, and more rapid increases will cause inequality to increase faster.<sup>8</sup> The disequalizing contribution of changes in the distribution of education among workers is larger (more disequalizing) when the average education level of workers increases more rapidly (during the 1980-1985 and 1992-1999 periods).

Recall that inequality declined from 1987 to 1992 (although at a slower rate than in the pre-reform period), and then increased from 1992 to 1999. While changes associated with education can largely explain the change in the pattern of inequality changes between the 1980-1985 periods and the 1987-1999 period, other factors contributed to the increase in inequality in the 1992-1999 period. Most importantly, male-female and

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<sup>8</sup> This result was also shown by Gindling and Robbins (2001).

urban-rural wage gaps, which had been declining in both the 1980-1995 and 1987-1992 periods, rose in the 1992-1999 period. Changes associated with the residuals (within-group inequality) were also important. Within-group inequality (the residuals) fell in the 1987-1992 period and then rose in the 1992-1999 period.<sup>9</sup>

The influence of change in the proportion of the work force employed in the public sector are equalizing in all periods. The equalizing impact of these changes occurs both because of declines in the wage gaps between public and private sector workers (in all periods) and because of changes in the proportion of public sector workers, which were equalizing in the 1987-1999 period.<sup>10</sup> The declining public-private wage gap is probably related to government policies that limited the growth in public sector salaries, first as part of the stabilization plans at the end of the 1980-1982 recession, and then as part of the structural adjustment reform plans (and agreements signed with the World Bank). Increases in the proportion of public sector workers had a disequalizing impact on inequality in the 1980-1985 period, while decreases in the proportion of public sector workers had an equalizing impact on inequality in the 1987-1992 period. This last occurred because increases in the proportion of workers in a relatively small (at most 30% of the work force) higher-paid sector increased inequality, and vice-versa. Overall, the results of the Fields' decompositions suggests that declines in the proportion of workers and the salaries of workers in the public sector, both components of the structural reforms of the 1980s and 1990s, contributed to declining inequality.

## **VI. Causes of Changing Returns to Education**

We found in the last section that changes in returns to education explain the largest part of the change in inequality in the distribution of hourly wages. Figure 3 presents the change in the coefficient on year-of-education in earnings equations using data for all workers (1980-1999) and for paid employees only (1976-1999). The timing of the changes in returns to education is somewhat different from the timing of the changes in inequality. The coefficient (returns to education) fell from 1976 to 1983, and then remained stable thereafter, while overall wage inequality continued falling until 1986.<sup>11</sup> This pattern of change in returns to education in Costa Rica is not surprising, similar changes have been identified as among the most important causes of increasing inequality in the United States and other developing economies (see Katz and Autor, 1999, for a

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<sup>9</sup> The importance of changes in the residual (which is 1 minus the R-squared) is probably over-stated because of limitations inherent in the Fields' decomposition technique. Specifically, in order to measure the separate effects of each variable, we cannot include interactions in the wage equations. In Gindling and Robbins (2001) we use a different decomposition technique that allows us to interact education and experience. When we do this, the measured influence of the residual on changes in inequality is much smaller.

<sup>10</sup> Controlling for other productivity-related characteristics, public sector workers earn more than private sector workers (in both large and small firms) in Costa Rica (Gindling, 1989 and 1992).

<sup>11</sup> Alternative measures and methodologies yield the same conclusions regarding the change in returns to education. Using different methodologies and different measures of returns to education (or skill), other studies have found the same pattern of change: declines from 1976 to 1983, and stability (or small increases) thereafter (Funkhouser, 1998, Robbins and Gindling, 1997 and Sauma and Vargas, 2000).

review), other Latin American economies (see Inter-American Development Bank, 1998, for a review) and in Costa Rica (Funkhouser, 1998; Robins and Gindling, 1998; Trejos, 1999; Sauma and Vargas, 2000; and Gindling and Robbins, 2001).

### **a. Aggregate Time-series Evidence on the Importance of Supply, Demand and Institutional Factors**

#### i) Framework

We follow Katz and Autor (1999) and examine whether changes in returns to education were caused by: (1) changes in the relative supply of educated workers, (2) changes in the relative demand for educated workers, or (3) institutional factors. Funkhouser (1998), following Katz and Murphy (1992), considers the relative demand and relative supply for educated workers to be functions of the return to education and exogenous shift parameters,

$$(EQ\ 7) \quad \begin{aligned} \log D_t &= f(B_{st}) + \log \mathbf{D}_t \\ \log S_t &= g(B_{st}) + \log \mathbf{S}_t \end{aligned}$$

where  $B_{st}$  are returns to education in time  $t$ , and  $\mathbf{D}_t$  and  $\mathbf{S}_t$  are shifts in demand and supply that are unrelated to the return to education. We observe only the equilibrium return to education. Setting demand equal to supply, assuming constant elasticities, and solving for the equilibrium return to education leads to

$$(EQ\ 8) \quad B_{st} = s (\log \mathbf{D}_t - \log \mathbf{S}_t)$$

where  $s$  is equal to the inverse of the elasticity of relative supply of educated workers minus the elasticity of relative demand for educated workers (recall that  $B_s$  is the return to each year of education received).<sup>12</sup>

Adding  $I_t$ , we can write the changes in returns to education as being determined by exogenous demand and supply shifts and the institutional factors ( $I_t$ ) in time  $t$ ,

$$(EQ\ 9) \quad B_{st} = s (\log \mathbf{D}_t - \log \mathbf{S}_t) + b \log I_t$$

#### ii) Relative Supply

Katz and Murphy (1992) derive a supply shift index based on the assumption that the education levels with each birth/gender cohort is fixed over time, and that exogenous shifts in supply occur over time as different cohorts enter and leave the working age population. Funkhouser (1998) applies this technique to an estimation of supply shifts in

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<sup>12</sup> Katz and Murphy (1992) and Robbins and Gindling (1999), assuming that supply is perfectly elastic, interpret  $s$  as the inverse of the elasticity of substitution in a constant elasticity of substitution labor demand equation.

the average years of education variable. Specifically, following Funkhouser (1998) we calculate the “returns-constant” supply of years of education in year  $t$  as

$$(EQ\ 10) \quad \log S_t = \sum_n \sum_f ED_{s,nf} N_{nft}$$

where  $ED_{s,nf}$  is the mean years of education of one-year birth cohort  $n$  and gender  $f$ , and  $N_{nft}$  is the total number of hours worked by workers in age-gender cell  $n$ - $f$  in year  $t$ .

Figure 4 presents the evolution of two measures of the supply of more-educated workers in Costa Rica: the actual (unadjusted) mean years of education and the returns-constant shift described by Equation 10. Both show increases in supply over all time periods. However, the rate of the increase is smaller after 1987 than before. This suggests that reductions in the rate of increase in the supply of more educated workers might explain at least some of the difference in the evolution of returns to education between the pre- to post-1987 periods.

The reduction in the rate of growth of the actual mean years of education was at least partly the result of the added-worker effect of the recession of 1980-1982, during which children in poor families were pulled out of the upper elementary grades and secondary schools to help maintain family incomes in the face of falling real earnings for the household heads. These students, generally, did not return to school after the recession and this may have had ripple effects into the early 1990s. We have found that the reduction in the rate of growth of mean education levels in the late 1980s and early 1990s occurred because of a decline in the proportion of workers with a complete secondary education (while rates of growth for elementary school graduates and college graduates continued to increase at pre-recession rates--Gindling and Trejos, 2001). Another contributing factor to low rates of growth in high school graduates was a reduction in public spending in education in the late 1980s and early 1990s. The reduction in spending on secondary education was especially marked.<sup>13</sup> After 1991, the rate of growth in mean education levels of workers again began again to increase (to almost pre-recession levels). This increase was driven by an increasing rate of college graduates entering the work force, which in turn was the result of an explosion of enrollments in new private universities (most of which opened in the late 1980s and early 1990s). Before the mid-1980s, private universities enrolled a very small percent of university students in Costa Rica. The increase in enrollment in private universities occurred in response to an increase in demand by potential students who could not test into the more prestigious public universities.

There is a difference after 1991 in the rate of growth of the unadjusted mean years of education and the returns-constant shift index. Specifically, the rate of growth of the unadjusted mean years of education increases while the rate of growth of the returns-constant supply shift index slows. Why did the rate of growth of our index of supply

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<sup>13</sup> Because public spending on university education is constitutionally-mandated to be a fixed percent of the GDP, university budgets were partially protected from the reduction in public spending on education. In 1998 the constitution was modified to also include a mandated fixed percent of GDP for primary and secondary education.

decline after 1987 even though the rate of growth for the actual average years of education increased. One potential explanation was substantial immigration from Nicaragua, which began in the mid-1980s and accelerated in the 1990s. These Nicaraguans are likely to be less-educated and older than other recent labor force entrants. These demographic changes (the “aging” of the work force) would cause the the index of supply to be lower than it would otherwise be. Against this trends is the explosion of private universities in the later part of the 1990s, which probably contributed to the increase in the actual mean years of education in the later half of the 1990s. Because this later change would not affect the distribution of workers by age/gender, it will not affect the index of supply that we calculate. Unfortunately, we cannot explicitly test this hypothesis because the Household Surveys do not allow us to identify migrants.

### iii) Relative Demand

We do not attempt to directly measure demand shifts. Instead, we examine the potential causes of such demand shifts. The literature attempting to explain such shifts in the United States and Latin America has focused on two phenomenon, (1) trade-related explanations, and (2) technological-change related explanations. Skill-biased technological change (especially related to personal computers and industrial robotics) has been identified as an important cause of increasing demand for more-educated workers in the United States. For Costa Rica, skill-biased technological change is likely to be introduced through the importation of newer capital that embodies this technological change. Figure 5 presents two measures of the introduction of newer capital to the Costa Rican economy, gross private capital formation in machinery and equipment and imported capital (both as a percent of the GDP). Figure 5 suggests that investment in imported capital is a good candidate to explain the change in returns to education. Investment and the changes in returns to education are highly correlated, both falling from 1976 to 1983 and then rising from 1983 on.

Some critics of globalization have focused on investments by multinational corporations, in particular, as the cause of increasing inequality. While foreign direct investment does increase in the 1980s and 1990s, the timing of this increase is not as closely correlated with returns to education as is overall investment. While overall investment began to increase in 1983 (at the same time that returns to education began increasing), foreign direct investment did not begin to increase until 1987 (when the structural adjustment program began).

It has been argued that trade contributed to the increase returns to education in the United States as low-skilled intensive manufacturing moved off-shore, primarily to developing economies. Some had argued that the same phenomenon should cause a fall in returns to education in developing economies such as Costa Rica. For example, based on a modified Hecksher-Ohlin/Stopler-Samuelson framework, Krueger (1990) argued that trade liberalization in developing economies would cause production to shift towards the unskilled-labor-intensive products in which those countries had a comparative advantage (compared with the developed economies). This shift in the structure of production would then increase the demand for the relatively cheap and abundant unskilled labor at

the expense of relatively expensive capital and skilled labor, driving down the skilled-unskilled wage gap.

Others have presented arguments that trade liberalization in Latin America might increase the skilled-unskilled wage gap. For example, while Latin America might have a comparative advantage in unskilled-labor intensive products compared to the United States, it will no compared to many other developing economies such as China. If Latin American countries and China, which were liberalizing at the same time in the 1980s and 1990s, compete in the same export markets, then the Latin American comparative advantage may be in more skilled-labor intensive products (Inter-American Development Bank, 1998). In this case, trade liberalization will result in a shift towards more skilled-intensive production in Latin America, and result in an increase in returns to education.

Figure 6 presents several measures of shifts in the Costa Rican economy towards an outward-oriented, export-oriented economy following the introduction of the structural adjustment plan in the mid-1980s. The best indicators of this change in the structure of the economy are the evolution of non-traditional export earnings and foreign exchange earnings from tourism, both of which were explicitly promoted by government policies within the context of the structural adjustment program. Both non-traditional export earnings and tourism earnings show substantial increases from 1987 to the late 1990s. These increases drive the increase in total foreign exchange earnings (exports plus tourism), which also increases from 1987 to the late 1990s. The increase in foreign exchange earnings is also accompanied by a fall in the balance of trade, as tariff reductions also lead to increases in imports after 1987. However, trade appears to be a less-likely candidate to explain the changes in returns to education because trade changes are not as closely correlated to changes in returns to education as is investment. Specifically, while the increase in returns to education begins in 1983, the changes caused by trade do not begin until at least 1987.

Note that the increase in non-traditional exports after 1987 does not occur at a steady rate, increasing from 1987 to 1990, stabilizing from 1990 to 1994/95, and then increasing again beginning in the mid-1990s. The two periods of increase are also characterized by a shift in the type of non-traditional export. Increases in the 1987-1990 period were largely in non-traditional agricultural products (fruits and vegetables, ornamental plants and flowers) and in assembly plants in free-trade zones (electronic assembly and apparel). In the late 1990s non-traditional exports were more likely to be more capital intensive, culminating in the opening in 1998 of a large INTEL microchip factory on the outskirts of San Jose.

#### iv) Institutional Factors

The two most important institutional factors affecting wages in Costa Rica are legal minimum wages and the size and structure of wages within the public sector. Wages in the public sector are higher than in the private sector for workers with similar observable human capital and other characteristics (Gindling, 1992). Wage setting in the public sector is different from that in the private sector both because of the special nature of

labor markets in the public sector and because the public sector is the only heavily unionized sector in Costa Rica (unionization rates outside of the public sector are only 2-3% of the work force). The structural adjustment plan resulted in significant changes in the public sector in Costa Rica. Most importantly, privatization of public sector production and general reductions in levels of Central Government spending have resulted in declines in the proportion of the work force in the public sector. Sustained reductions in public sector employment began in 1987 and continued throughout the late 1980s and 1990s (the fall between 1986 and 1987 observed in Figure 7 is not a true decline and reflects changes in the Household Surveys between those two years).

Costa Rica has a complex and generally well-enforced system of legal minimum wages. Minimum wages are set separately for different industries and for occupations within each industry. In 1980, over 300 different minimum wages were set. Since 1980 the legal minimum wage has been simplified, with the most dramatic simplification occurring in 1992. In figure 7 we present two measures of the evolution of legal minimum wages; the real minimum wage and the ratio of the maximum to minimum legal minimum wage. The real minimum wage does not change much between 1987 and 1998. The ratio of the maximum to minimum legal minimum wage increases from 1980 to 1989, falls from 1989 to 1992, and then remains stable after 1992.

#### v) Time-series Regressions (Equation 9)

We estimated several specifications of equation 9 using the data presented in the previous figures. Because of the small sample size (only 16 years for which we have data for all variables), the results of this estimation should not be seen as definitive. Nevertheless, the results are suggestive. The most consistently significant coefficient in these equations is that on investment, which is positive. A representative sample of the results, with four different specifications of the investment variable, is presented in table 7. Significant coefficients on the log of investment range between .025 and .030, indicating that a 10% increase in the investment/GDP ratio will lead to an increase in the return to education of .25 to .30 percent.<sup>14</sup>

Although the other variables in the equations are rarely significant, the signs on the coefficients of most variables are robust to different specifications. The results of the regressions suggest that two other variables might help explain the increase in returns to education after 1983. The sign on the supply variable, for example, is negative, as expected, indicating that increases in the supply of more educated workers leads to a decline in the return to education, and vice-versa. Therefore, the reduction in the rate of growth of the relative supply of more-educated workers from the mid-1980s is likely part of the explanation for the increase in returns to education. The sign on the foreign direct investment variable is positive, indicating that increases in foreign direct investment (since the mid-1980s) may also help explain the increase in returns to education. The sign

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<sup>14</sup> This result is robust to specifications using different specifications of the export variable and to using returns to education estimated from paid employees only.

of the coefficient on the proportion of the workforce in the public sector is negative but insignificant, indicating that a decrease in the proportion of workers in the public sector may have contributed to an increase in returns to education. This is unexpected.

The sign on the export variable is negative, indicating that the structural change towards a more outward-oriented economy led to a reduction in returns to education. Alternative specifications of the export variables (non-traditional exports, balance of trade, current account balance) are also not significant. These results suggest that trade-related phenomenon are not an important determinant of changes in returns to education in Costa Rica, although these results are clearly preliminary given the small sample size. If trade were important, the effect is equalizing rather than disequalizing (and therefore cannot explain the increase in inequality after 1992).

The coefficient on the ratio of the maximum to minimum legal minimum wage is insignificant, sometimes negative and sometimes positive. The results suggest that minimum wages are not an important influence on returns to education.<sup>15</sup>

Given the small sample size, the results from these aggregate time-series equations are clearly preliminary, especially when the conclusions is that the variable is not a significant determinant of returns to education. Although the evidence is strong that the importation of new capital was a contributing factor in causing returns to education to increase after 1983, the insignificance of other coefficients could easily be the result of the small sample size.

#### vi) Simulated Effect on Returns to Education of Supply and Investment and Sectoral Changes

In Figure 8 and table 8 we take the results of the time-series regressions at face value, and calculate the relative magnitudes of the effects of supply, demand and institutional factors.<sup>16</sup> For these figures we use the coefficients from equation (1) in table 7. Figure 8 suggests that the fall in returns to education prior to 1983 can be entirely explained by the increase in the supply of more-educated workers--the simulated effect of the change in supply tracks actual changes almost exactly. However, despite continuing increases in the relative supply of more educated workers after 1983, returns to education stopped falling, and may have even increased. Table 8 suggests that the new pattern of change in returns to education was due to both a slower rate of growth in the relative supply of more-educated workers, and to an accelerated rate of increase in demand-related and

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<sup>15</sup> The insignificance and instability of the coefficients on the minimum wage variable is not sensitive to the specification of the minimum wage variable. Coefficients are insignificant and unstable whether we use the maximum/minimum wage ratio and/or the mean real minimum minimum wage.

<sup>16</sup> To calculate the simulated values, we multiply the change in the logarithm of the supply index by the coefficient on the log of supply from the first column of table 7. The simulated impact of investment and foreign direct investment is calculated in the same way; multiplying changes in the logarithm of investment and foreign direct investment by the coefficients from the first column of table 7.

institutional factors.<sup>17</sup> Supply and demand/institutional changes contributed equally to the change in returns to education.

The 5<sup>th</sup> and 6<sup>th</sup> columns of table 8 suggest that a part of the increase in returns to education not explained by supply changes can be explained by increases in investment in machinery and equipment and foreign direct investment. The last column of table 8 suggests that part of the increase in returns to education can also be explained by the decline in the proportion of workers in the public sector (although we are skeptical). However, even if taken at face value, changes in investment, foreign direct investment and public sector employment explain only about one-half of the total increase in inequality explained by changes in demand and institutional factors. While the time-series regressions are suggestive, their usefulness is limited.

### **b. Decomposition into Between- and Within-Industry Changes**

The time-series data suggests that trade-related explanations are not the cause of the change in returns to education, and therefore do not explain the increase in wage inequality. In this sub-section we present another test of the hypothesis that increases in returns to education were trade-related.

The mechanism by which trade could affect returns to education is through the impact of trade on the mix of products produced. Specifically, trade liberalization (and competition with other developing economies such as China) may cause the structure of production in Costa Rica to shift to more skilled-labor-intensive products. This implies that if trade caused changes in returns to education and inequality, then that change should occur because of shifts in the structure of employment and production between industries (that is, because of increases in total employment in skilled-labor-intensive industries relative to other industries). These have been called “between-industry” changes (see Katz and Autor, 1999). Trade-related changes should not cause within-industry changes in relative demand for more educated workers. That is, if the increase in inequality occurs within all industries (and not because of increases in the proportion of workers in high-inequality industries), then this is evidence that changes in inequality are not trade-related.

We decomposed the changes in wage inequality into between- and within-industry components. A finding that between-industry changes were responsible for the increase in returns to education is evidence consistent with a trade-related explanation for the increase. This finding would not be conclusive because the between-industry changes could also be due to shifts in product demand derived from domestic changes. On the other hand, a finding that between-industry changes played no role in the increase in

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<sup>17</sup> This result is consistent with those presented in Robbins and Gindling (1999). Following the technique developed in Katz and Murphy (1992), Robbins and Gindling (1999) calculated the inner-product of changes in supply and wages for detailed demographic-occupation cells. They found that these changes are consistent with a supply explanation for the fall in returns to education prior to 1987, but that supply changes alone cannot explain the increase in returns to education after 1987.

returns to education would be evidence that trade cannot be the explanation for the increase. In table 9 we present decompositions between both 1-digit and 2-digit industry classifications. These decompositions provide no evidence in favor of trade-related explanations for the increase in inequality after 1987 or 1992. Between-industry changes are equalizing in all periods. The increase in inequality after 1992 is entirely due to within-industry changes. In addition, especially in the post-1987 period, within-industry changes are much larger than between-industry changes.

## **VII. Summary of Results So Far and the Next Steps**

### **a. Summary**

We divide the evolution of inequality in Costa Rica into three periods:

From 1976 (or 1980) to 1986 inequality in earnings fell (improved), primarily because of a fall in the wage gap between more- and less-educated workers (returns to education). Returns to education fell because of an increase in the relative supply of more-educated workers. Within this Pre-reform period, there was a temporary increase in inequality in the early 1980s caused by an added-worker effect in response to falling real wages in the 1980-1982 recession. With recovery from the recession (1983-1985), most of these added workers left the labor force and the pattern of change in inequality returned to pre-recession levels.

The pattern of the evolution of inequality changed in 1987. Between 1987-1992 inequality in earnings continued to fall, although at a slower rate, and then between 1992 and 1999 inequality in earnings increased. The change in the pattern of the evolution of inequality after 1987 occurred largely because of two phenomena: returns to education fell more slowly and then increased, and inequality in the number of hours worked increased.

A smaller shift in the pattern of evolution of inequality occurred in 1992. From 1987 to 1992 inequality fell (although at a slower rate than from 1980-1986). Then, from 1992 to 1999 inequality rose slightly. The increase in inequality from 1992 to 1999 occurred because the inequality in the number of hours worked and returns to education increased even faster than in the 1987-1992 period. In addition to these two phenomena, the male-female and urban-rural wage gaps, which had been falling in the previous two periods, increased from 1987 to 1999.

In this paper, we have concentrated on a search for explanations for the changes in returns to education. Our results suggest that increases in the supply of more-educated workers fully explain the fall in returns to education in the 1970s and early 1980s in Costa Rica. Although the supply of more educated workers continued to grow in the 1987-1999 period, the rate of growth was smaller than in the pre-reform period. The reduction in the rate of growth in the supply of more-educated workers partly explains the change in returns to education in the post-reform period. The increase in returns to education in the post-reform period is also partly explained by demand changes related to

investment in machinery and equipment and foreign direct investment. Changes in returns may also be partly explained by changes in the proportion of workers in the public sector. One important finding is negative: we find no evidence that the increase in returns to education in Costa Rica is directly related to the substantial changes in the structure of production brought on by trade liberalization. However, our measures of the relative magnitudes of the impacts of supply, demand and institutional factors depend on coefficients estimated using a small time-series data set, which limit the confidence that we have in the magnitude of these coefficients.

#### b. The Next Step

The next step in our analysis will be to estimate an equation similar to equation 9 using an industry-level data set. The evidence so far suggests that increases in returns to education occurred because of within-industry changes in demand-related or institutional factors. This suggests the usefulness of examining the causes of changing returns to education within-industries. An examination of changes within-industries has other advantages. One is that it greatly increases the sample size used in the regressions, which will now be the number of years for which we have data multiplied by the number of industries. Another is that many of the demand and institutional factors of interest will differ by industry. Because of the complex structure of legal minimum wages in Costa Rica, both the average legal minimum wage and the dispersion of legal minimum wages will differ between industries. The level of investment in imported machinery and equipment and the proportion of workers in the public sector (or unionized) can also be expected to differ between industries. There is an extensive and fruitful literature in the United States that examines the causes of within-industry increases in the hourly wage gap between more- and less-educated workers. One conclusion that has come from this literature (although there is still debate) is that different levels of investment in R&D and newer technology (for example, computers) can explain much of the increase in the hourly wage gap between more- and less-educated workers within industries. Among some of the well-known studies in this literature are papers by Berman, Bound and Griliches, QJE (1994), and Autor, Katz and Krueger, QJE (1998). Thus, an analysis of industry-level changes in returns to education may present us with more robust and significant results regarding these variables than did the aggregate time-series estimates.

## BIBLIOGRAPHY

Oscar Altimir, (1997), "Income Distribution and Poverty Through Crisis and Adjustment," Chapter 2 in Albert Berry, ed., Poverty, Economic Reform, and Income Distribution in Latin America, Lynne Rienner Publishers, August, 1997.

Autor, D. and L. Katz and A. Krueger, 1998, "Computing Inequality: Have Computers Changed the Labor Market?," *Quarterly Journal of Economics*, Vol. 113, No. 4 (November), 1169-1214.

Baldares, M, 1985. *La distribución del ingreso y de los sueldos en Costa Rica*. San José, Costa Rica: Editorial Costa Rica.

Berman, E. J. Bound and Z. Griliches, 1994, "Changes in the Demand For Skilled Labor Within U.S. Manufacturing: Evidence From the Annual Survey of Manufacturers," *Quarterly Journal of Economics*, May, 367-397.

Céspedes, Victor Hugo y Ronulfo Jiménez, 1994. *Apertura Comercial y Mercado Laboral en Costa Rica*, San José, Costa Rica: Academia de Centroamérica y Centro Internacional Para el Desarrollo Económico.

Fields, Gary S., 1998, "Accounting for Income Inequality and Its Change," Cornell University, mayo. Documento mimeografiado.

Fields, Gary S. y Ion Gyeongjoon, 1999, "Falling Labor Income Inequality in Korea's Economic Growth: Patterns and Underlying Causes," *Review of Income and Wealth*.

Funkhouser, E., 1999, "Cyclical Conditions and School Attendance in Costa Rica," *Economics of Education Review*, Vol. 18-1, 31-50.

Funkhouser, E., 1998, "Changes in the Returns to Education in Costa Rica," *Journal of Development Economics*, Vol. 57-2, 289-317.

Gindling, T. H., 1993, "Women's Wages and Economic Crisis in Costa Rica," Economic Development and Cultural Change, Vol. 41, No. 2 (January), pp. 277-298.

Gindling, T. H., 1992, "La Mujer y la Crisis Económica en Costa Rica," *Revista de Ciencias Económicas*, Volumen X11, Numero 2, Diciembre, 3-24.

Gindling, T. H., 1989, "Crisis económica y segmentación del mercado de trabajo en el área urbana de Costa Rica" (Economic Crisis and Segmentation in the Urban Labor Market in Costa Rica), Revista de Ciencias Económicas (Costa Rica), Vol. IX, Nos. 1 and 2 (January), pp.79-94.

Gindling, T. H. and Albert Berry, 1994, "Costa Rica," in Labor Markets in an Era of Adjustment, Volume 2: Case Studies, edited by Sue Horton, Ravi Kanbur and Dipak Mazumdar, The World Bank, Washington, D.C., pp. 217-257.

Gindling, T. H. And Albert Berry, 1992, "The Performance of the Labor Market During Recession and Structural Adjustment: Costa Rica in the 1980s," World Development, Vol. 20, No. 11 (November), pp.1599-1616.

Gindling, T.H. y Donald Robbins, 2001, "Patterns and Sources of Changing Wage Inequality in Chile and Costa Rica During Structural Adjustment," *World Development*, 29-4 (April), 725-745.

Gindling, T.H. y Donald Robbins, 1999, "Trade Liberalization and the Relative Wages of More-Skilled Workers in Costa Rica," Review of Development Economics, Vol 3., No. 2 (June), pp.140-154.

Gindling, T. H. and J. D. Trejos, 2001, "Cambios en la Desigualdad del Ingreso laboral en Costa Rica, 1976-1999: Medidas y Causas," mimeograph, University of Costa Rica, San Jose.

Funkhouser, E., 1998, "Changes in Returns to Education in Costa Rica," *Journal of Development Economics*, Vol 57, 289-317.

Inter-American Development Bank, 1998, *Facing up to Inequality in Latin America: Economic and Social Progress in Latin America, 1988-1999 Report*," Washington.

Juhn, C., K. Murphy y B. Pierce, 1993, "Wage Inequality and the Rise in Returns to Skill," *Journal of Political Economy*, 101-3, 410-442.

Katz, L. and D. Autor, 1999, "Changes in the Wage Structure and Earnings Inequality," in O. Ashenfelter and D. Card (eds.), *The Handbook of Labor Economics, Volume 3*, North Holland, 1464-1555.

Katz, L. and K. Murphy, 1992, "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *Quarterly Journal of Economics*, Vol. 107, 35-78.

Knight, J. B. and R. Sabot, 1983, "Educational Expansion and the Kuznets Effect," *American Economic Review*, Vol. 73, No. 5, 1132-1136.

Krueger, A., "The Relationship Between Trade, Employment, and Development," in Gustav Ranis and T. Paul Shultz (eds.), *The State of Development Economics: Progress and Perspectives*, Cambridge, MA, Basil Blackwood, 357-385.

Kuznets, S., 1955, "Economic Growth and Income Inequality," *American Economic Review*, Vol 45 (March), 1-28.

Montiel Masis, Nancy, 2000, "Reformas Economicas, Mercado Laboral y Calidad de los Empleos," paginas 423-472 en A. Ulate, editora, *Empleo, Crecimiento y Equidad: Los Retos de las Reformas Económicas de Finales del Siglo XX en Costa Rica*, Editorial de la Universidad de Costa Rica.

Robbins, Donald y T. H. Gindling (1997), *Liberalización Comercial, Expansión de la Educación y Desigualdad en Costa Rica*, Serie de Divulgación Económica #27, Instituto de Investigaciones en Ciencias Económicas de la Universidad de Costa Rica.

Robinson, S., 1976, "A Note on the U-Hypothesis Relating Income Inequality and Economic Development," *American Economic Review*, Vol. 66, 437-440.

Sauma, P y J. D. Trejos. 1990. *Evolución reciente de la distribución del ingreso en Costa Rica*. Documento de Trabajo No. 132. Instituto de Investigaciones en Ciencias Económicas de la Universidad de Costa Rica.

Sauma, P y J. R. Vargas. 2000. *Liberalización de la balanza de pagos en costa Rica: efectos en el mercado de trabajo, la desigualdad y la pobreza*. Documento mimeografiado.

Shorrocks, Anthony, 1982, "Inequality Decomposition by Factor Components," *Econometrica*, January.

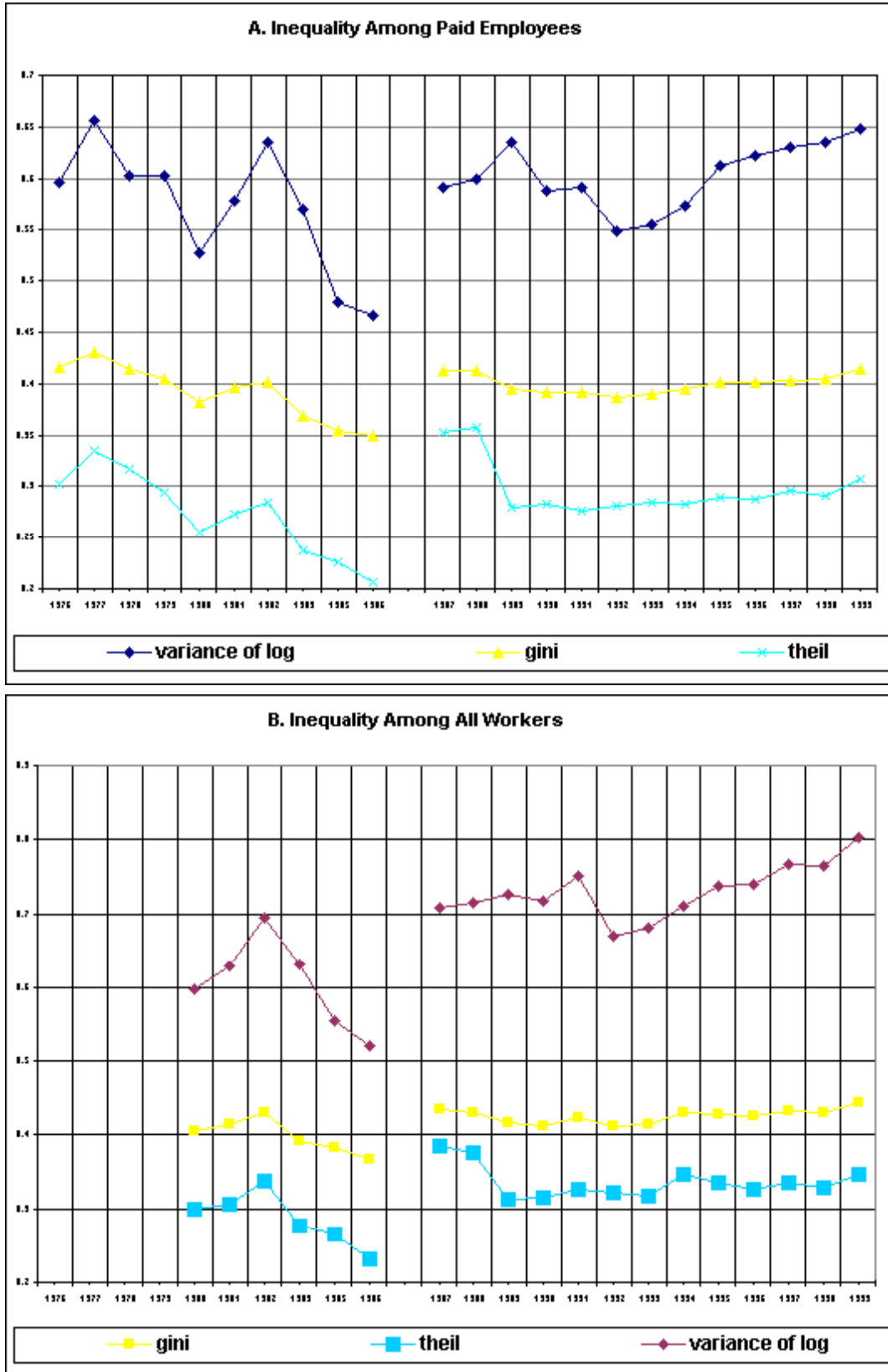
Trejos, J. D.. 1999, *Reformas económicas y distribución del ingreso en Costa Rica*, Serie Reformas Económicas 37, Comisión Económica para América Latina y el Caribe, Santiago, Chile.

Trejos, J. D. 2000, "Cambios Distributivos Durante las Reformas Económicas en Costa Rica," paginas 473-556 en A. Ulate, editora, *Empleo, Crecimiento y Equidad: Los Retos de las Reformas Económicas de Finales del Siglo XX en Costa Rica*, Editorial de la Universidad de Costa Rica.

Trejos, J. D. 2000, "Reformas Económicas y Formación de Capital Humano en Costa Rica," paginas 131-198 en A. Ulate, editora, *Empleo, Crecimiento y Equidad: Los Retos de las Reformas Económicas de Finales del Siglo XX en Costa Rica*, Editorial de la Universidad de Costa Rica.

Villasuso, J. M., 2000, "Reformas Estructurales y Política Económica en Costa Rica," in Anabelle Ulate Quiros (ed.), *Empleo, Crecimiento y Equidad: Los Retos de las Reformas Económicas de Finales del Siglo XX en Costa Rica*, Editorial de la Universidad de Costa Rica and the U. N. Economic Commission for Latin America and the Caribbean, San Jose, 75-130.

Figure 1: Changes in Inequality in Monthly Labor Earnings, 1976-1999



**Table 1: Changes in Inequality in Monthly Labor Earnings: 1976-1986, 1987-1992 y 1992-1999**

<b>A. Inequality Among Paid Employees</b>							
		<b>year</b>	<b>var of log</b>	<b>gini</b>	<b>theil</b>		
Changes in Inequality (between 3-year average)							
		76-86	-0.113	-0.062	-0.095		
		87-92	-0.043	-0.017	-0.050		
		92-99	0.072	0.018	0.017		
		<b>changes in the % of earnings in each decile between 3-year averages</b>			<b>rate of growth of real earnings in each decile (%) between 3-year averages</b>		
<b>decile</b>		76-86	87-92	92-99	76-86	87-92	92-99
<b>1</b>		0.20	0.16	-0.22	12.8	10.4	1.3
<b>2</b>		0.56	0.31	-0.33	17.9	9.4	5.1
<b>3</b>		0.78	0.30	-0.35	17.8	6.9	7.4
<b>4</b>		0.95	0.21	-0.23	17.8	4.1	10.8
<b>5</b>		1.06	0.11	-0.13	16.6	2.3	12.8
<b>6</b>		1.03	0.01	-0.05	13.7	1.0	14.2
<b>7</b>		0.93	-0.10	0.05	10.3	-0.5	15.6
<b>8</b>		0.46	-0.08	0.03	4.6	0.0	15.4
<b>9</b>		-0.62	0.09	0.27	-3.3	1.3	17.3
<b>10</b>		-5.36	-1.01	0.96	-16.0	-2.4	18.5

<b>B. Inequality Among All Workers</b>							
		<b>year</b>	<b>var of log</b>	<b>gini</b>	<b>theil</b>		
Changes in Inequality (between 3-year averages)							
		80-86	-0.072	-0.035	-0.056		
		87-92	-0.014	-0.011	-0.036		
		92-99	0.077	0.019	0.015		
		<b>changes in the % of earnings in each decile between 3-year averages</b>			<b>rate of growth of real earnings in each decile (%) between 3-year averages</b>		
<b>decile</b>		80-86	87-92	92-99	80-86	87-92	92-99
<b>1</b>		0.12	0.03	-0.15	18.0	1.2	4.4
<b>2</b>		0.29	0.15	-0.32	19.7	3.8	5.2
<b>3</b>		0.50	0.23	-0.38	22.3	4.1	7.4
<b>4</b>		0.54	0.17	-0.31	21.3	1.8	10.7
<b>5</b>		0.70	0.13	-0.22	22.0	0.7	12.8
<b>6</b>		0.50	0.06	-0.13	17.7	-0.3	14.8
<b>7</b>		0.35	-0.08	0.02	14.7	-1.8	16.8
<b>8</b>		0.11	-0.02	0.07	11.9	-1.4	17.2
<b>9</b>		-0.25	0.10	0.51	9.2	-0.5	20.6
<b>10</b>		-2.86	-0.78	0.91	1.0	-3.4	19.7

**Note: 1980-1986 is the change between the mean of 1980-1982 and 1983-1986, 1987-1992 is the change between the mean of 1987-1989 and 1991-1993, and**

**1992 and 1999 is the change between the mean of 1991-1993 and 1997-1999.**

Table 2: Selected Labor Market Indicators, 1976-1986										
Year	Composition of the Labor Force (%)		Labor Force Participation Rate		Proportion of Workers		Mean Education of Workers	Mean Age of Workers	Mean Real Earnings	
	Female	Not Household Head	Female	Male	Urban	Large Firms (>5 employees)			Paid Employees	All Workers
1976	22.5	46.7			0.481		5.69	33.29	1061	
1977	23.5	47.2			0.481		6.03	30.6	1199	
1978	25.1	47.5			0.493		6.39	30.79	1314	
1979	25.8	48.6			0.496		6.53	30.8	1401	
1980	24.8	51.3	24.36	75.96	0.479	0.584	6.48	33.11	1346	1357
1981	26.4	52.4	25.86	74.43	0.49	0.558	6.59	33.34	1141	1161
1982	26.2	53.3	27.01	76.74	0.476	0.529	6.54	33.15	956	899
1983	24.5	52.1	25.22	75.93	0.492	0.548	6.96	33.23	1030	1051
1985	26.1	51.8	25.5	75.63	0.49	0.557	7.2	33.26	1162	1223
1986	27.3	51.5	25.79	75.06	0.506	na	na	32.82	1230	1286
									1339	1375

Source: Columns 1-4 from Gindling (1993).

Columns 5-8 are the author's calculations from the July Household Surveys for Multiple Purposes

Columns 9-10 from Gindling and Berry (1992).

**Table 3: Fields' Decomposition, Contributions of Each Variable to the Change in Inequality in Monthly Labor Earnings, 1980-1985, 1987-1992, 1992-1999**

	Mean of S <sub>j</sub> (%)	Contribution to the Change in the Gini Coefficient			Contribution to the Change in Variance in the Log			Contribution to the Change in Theil Index		
		between 3-year averages			between 3-year averages			between 3-year averages		
		80-85	87-92	92-99	80-85	87-92	92-99	80-85	87-92	92-99
<b>TOTAL</b>	<b>100%</b>	<b>-0.014</b>	<b>-0.011</b>	<b>0.019</b>	<b>-0.013</b>	<b>-0.014</b>	<b>0.077</b>	<b>-0.014</b>	<b>-0.017</b>	<b>0.012</b>
<b>ED</b>	19.6%	-0.021	0.002	0.006	-0.030	0.004	0.019	-0.019	0.002	0.005
<b>SEX</b>	2.4%	-0.001	-0.001	0.001	0.000	-0.002	0.003	-0.001	-0.002	0.001
<b>ZONE</b>	1.5%	0.000	-0.003	0.001	-0.001	-0.005	0.002	0.000	-0.004	0.001
<b>LHOUR</b>	13.2%	-0.001	0.013	0.018	-0.001	0.022	0.039	-0.001	0.016	0.019
<b>PUBLIC</b>	3.6%	-0.006	-0.002	-0.004	-0.008	-0.002	-0.005	-0.005	-0.002	-0.005
<b>LARGE</b>	6.0%	0.001	0.000	-0.001	0.002	0.000	0.001	0.001	-0.001	-0.002
<b>EXP</b>	1.9%	0.000	-0.005	0.000	0.000	-0.007	0.001	0.000	-0.006	0.000
<b>IND</b>	2.3%	0.001	-0.002	0.000	0.002	-0.003	0.001	0.001	-0.002	0.000
<b>Residual</b>	48.6%	0.013	-0.012	-0.004	0.023	-0.018	0.015	0.010	-0.017	-0.011

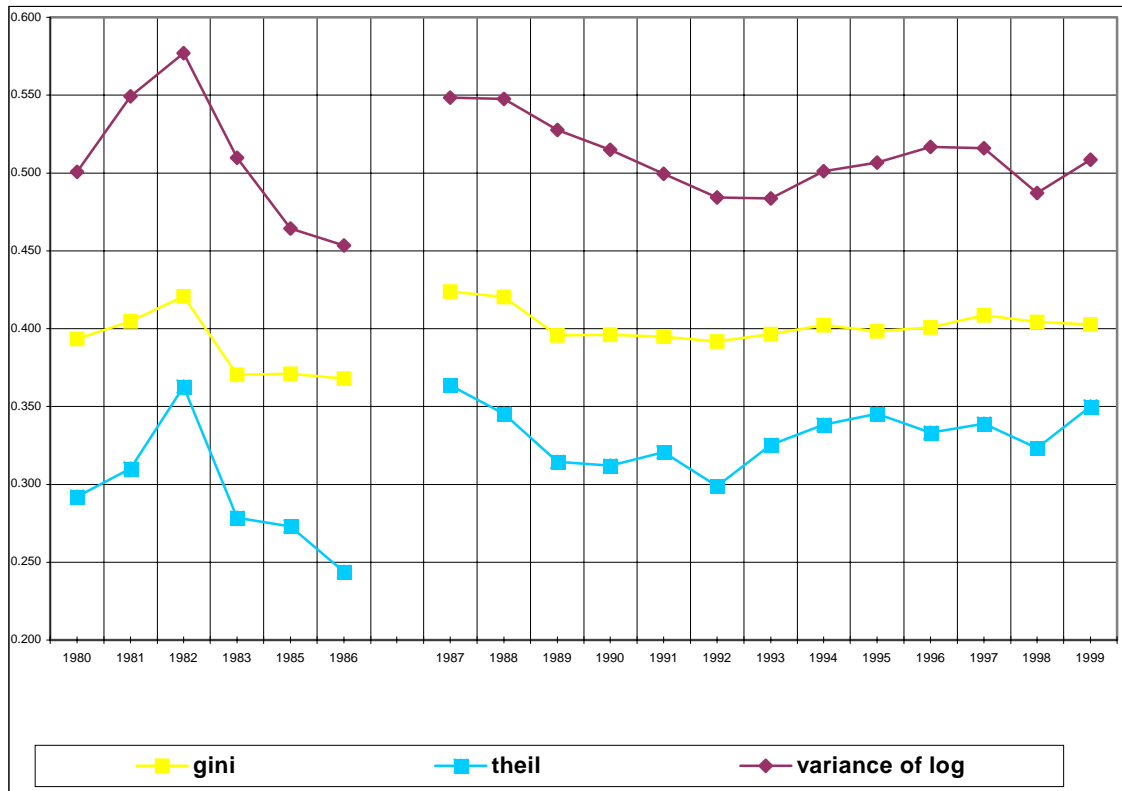
**Note: 1980-1985 is the change between the mean of 1980-1981 and 1983-1985, 1987-1992 is the change between the mean of 1987-1989 and 1991-1993, and 1992 and 1999 is the change between the mean of 1991-1993 and 1997-1999.**

**Table 4: Approximate Contributions to the Percent Change in the Variance of the Log of Monthly Earnings of Coefficients (B) and the Variance of Each Explanatory Variable (X)**

Changes between 3-year Averages												
	Total Contribution of each variable to the percent change in the variance			Contribution of the Coefficient on each variable to the percent change in the variance			Contribution of the Variance of each variable to the percent change in the variance			% Change in the mean of		
	80-85	87-92	92-99	80-85	87-92	92-99	80-85	87-92	92-99	80-85	87-92	92-99
<b>ED</b>	-4.7%	0.5%	2.7%	-5.1%	-0.4%	1.4%	1.1%	0.1%	0.8%	6.0%	3.5%	5.5%
<b>SEX</b>	-0.1%	-0.3%	0.5%	-0.2%	-1.0%	0.6%	0.0%	0.1%	0.1%	-0.8%	-1.7%	-2.0%
<b>ZONE</b>	-0.1%	-0.8%	0.3%	0.0%	-1.0%	0.6%	0.0%	0.0%	0.0%	3.2%	-3.1%	3.0%
<b>LHOUR</b>	-0.1%	3.1%	5.5%	-0.8%	0.7%	0.7%	0.3%	3.2%	3.6%	-0.1%	-0.6%	-0.2%
<b>PUBLIC</b>	-1.3%	-0.3%	-0.7%	-1.5%	-0.2%	-0.6%	0.5%	-0.3%	-0.5%	1.6%	-9.0%	-15.9%
<b>LARGE</b>	0.4%	0.0%	0.1%	-0.8%	0.2%	0.5%	0.0%	0.0%	0.0%	-2.8%	-0.1%	-9.0%
<b>EXP</b>	0.0%	-1.0%	0.1%							-1.5%	2.3%	4.1%
<b>IND</b>	0.3%	-0.4%	0.2%									
<b>Residual</b>	3.5%	-2.5%	2.1%									

**Note: 1980-1985 is the change between the mean of 1980-1981 and 1983-1985, 1987-1992 is the change between the mean of 1987-1989 and 1991-1993, and 1992 and 1999 is the change between the mean of 1991-1993 and 1997-1999.**

Figure 2: Changes in Inequality in Hourly Wages among All Workers, 1980-1999



**Table 5: Fields' Decomposition, Contributions of Each Variable to the Change in Inequality in Hourly Wages, 1980-1985, 1987-1992, 1992-1999**

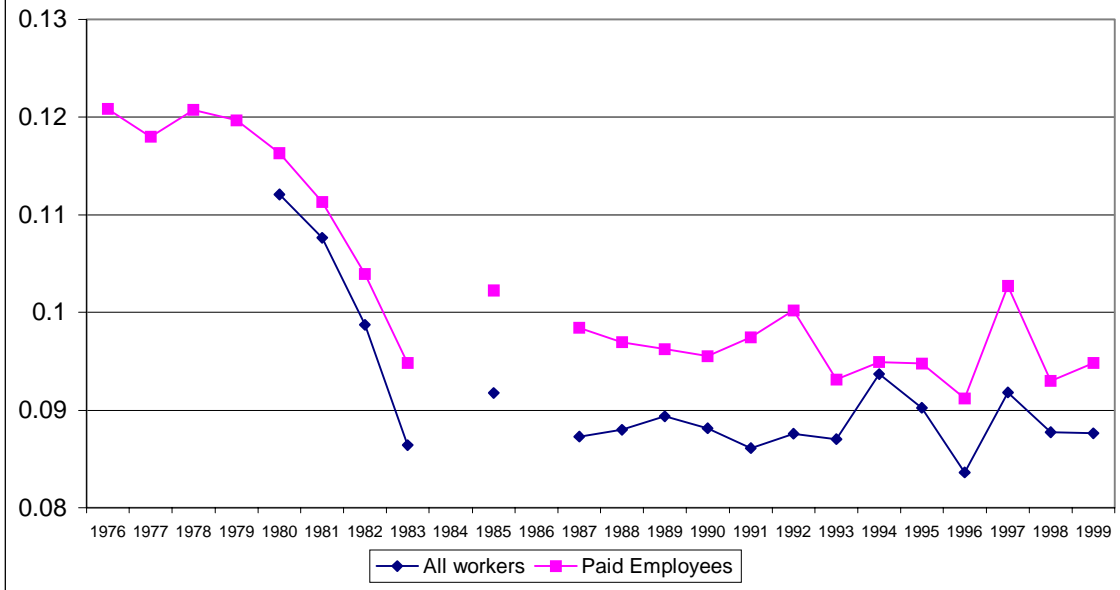
	Mean of S <sub>j</sub> (%)	Contribution to the Change in the Gini Coefficient between 3-year averages			Contribution to the Change in Variance in the Log between 3-year averages			Contribution to the Change in Theil Index between 3-year averages		
		80-85	87-92	92-99	80-85	87-92	92-99	80-85	87-92	92-99
<b>TOTAL</b>	<b>100%</b>	<b>-0.02</b>	<b>-0.019</b>	<b>0.011</b>	<b>-0.026</b>	<b>-0.052</b>	<b>0.015</b>	<b>-0.018</b>	<b>-0.02</b>	<b>0.023</b>
<b>ED</b>	21.8%	-0.026	0.002	0.007	-0.034	-0.004	0.009	-0.020	-0.001	0.009
<b>SEX</b>	0.6%	-0.001	-0.002	0.000	-0.001	-0.003	0.000	0.000	-0.002	0.000
<b>ZONE</b>	2.2%	-0.001	-0.003	0.000	-0.001	-0.005	0.000	-0.001	-0.003	0.000
<b>PUBLIC</b>	3.7%	-0.006	-0.002	-0.003	-0.008	-0.004	-0.004	-0.005	-0.002	-0.002
<b>LARGE</b>	3.4%	0.001	-0.004	-0.002	0.001	-0.007	-0.002	0.001	-0.004	-0.001
<b>EXP</b>	1.3%	-0.001	-0.003	-0.002	-0.001	-0.005	-0.002	-0.001	-0.003	-0.001
<b>IND</b>	1.8%	0.001	-0.002	0.000	0.001	-0.003	-0.001	0.000	-0.002	0.000
<b>Residual</b>	64.6%	0.013	-0.002	0.011	0.017	-0.021	0.015	0.008	-0.009	0.019

**Note: 1980-1985 is the change between the mean of 1980-1981 and 1983-1985, 1987-1992 is the change between the mean of 1987-1989 and 1991-1993, and 1992 and 1999 is the change between the mean of 1991-1993 and 1997-1999.**

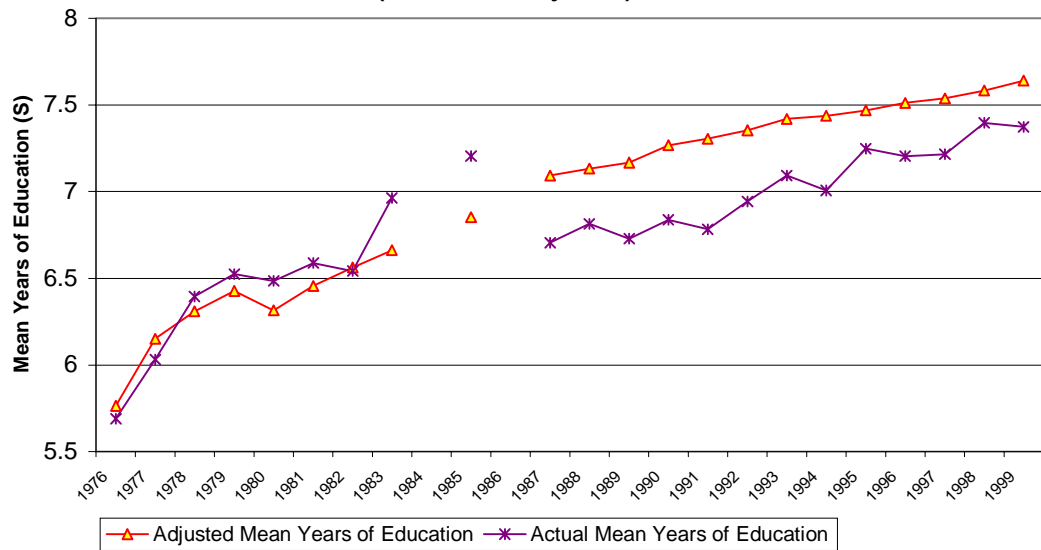
**Table 6: Approximate Contributions to the Percent Change in the Variance of the Log of Hourly Wages of Coefficients (B) and the Variance of Each Explanatory Variable (X)**

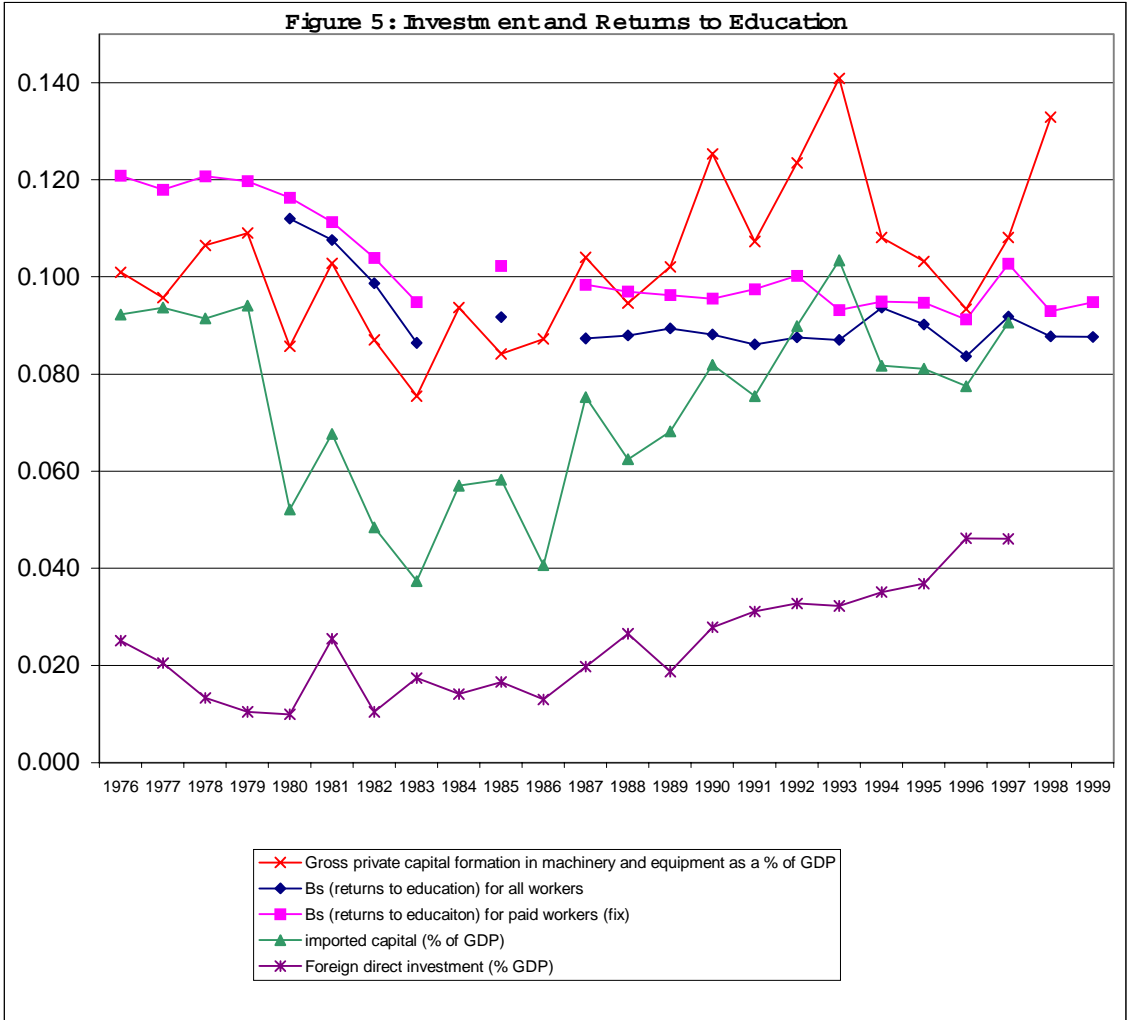
Changes between 3-year Averages												
	Total Contribution of each variable to the percent change in the variance			Contribution of the Coefficient on each variable to the percent change in the variance			Contribution of the Variance of each variable to the percent change in the variance			% Change in the mean of		
	80-85	87-92	92-99	80-85	87-92	92-99	80-85	87-92	92-99	80-85	87-92	92-99
<b>ED</b>	-6.3%	-0.7%	1.8%	-5.7%	-0.7%	1.1%	1.2%	0.1%	0.9%	6.0%	3.5%	5.5%
<b>SEX</b>	-0.1%	-0.5%	-0.1%	-0.1%	-0.5%	0.1%	0.0%	0.0%	0.0%	-0.8%	-1.7%	-2.0%
<b>ZONE</b>	-0.2%	-0.9%	0.0%	-0.2%	-1.1%	0.2%	0.0%	0.0%	0.0%	3.2%	-3.1%	3.0%
<b>PUBLIC</b>	-1.4%	-0.8%	-0.8%	-1.4%	-0.5%	-1.0%	0.5%	-0.3%	-0.5%	1.6%	-9.0%	-15.9%
<b>LARGE</b>	0.3%	-1.2%	-0.5%	-0.7%	1.0%	-0.8%	0.0%	0.0%	0.0%	-2.8%	-0.1%	-9.0%
<b>EXP</b>	-0.2%	-0.9%	-0.4%							-1.5%	2.3%	4.1%
<b>IND</b>	0.1%	-0.5%	-0.1%									
<b>Residual</b>	3.1%	-3.8%	3.1%									

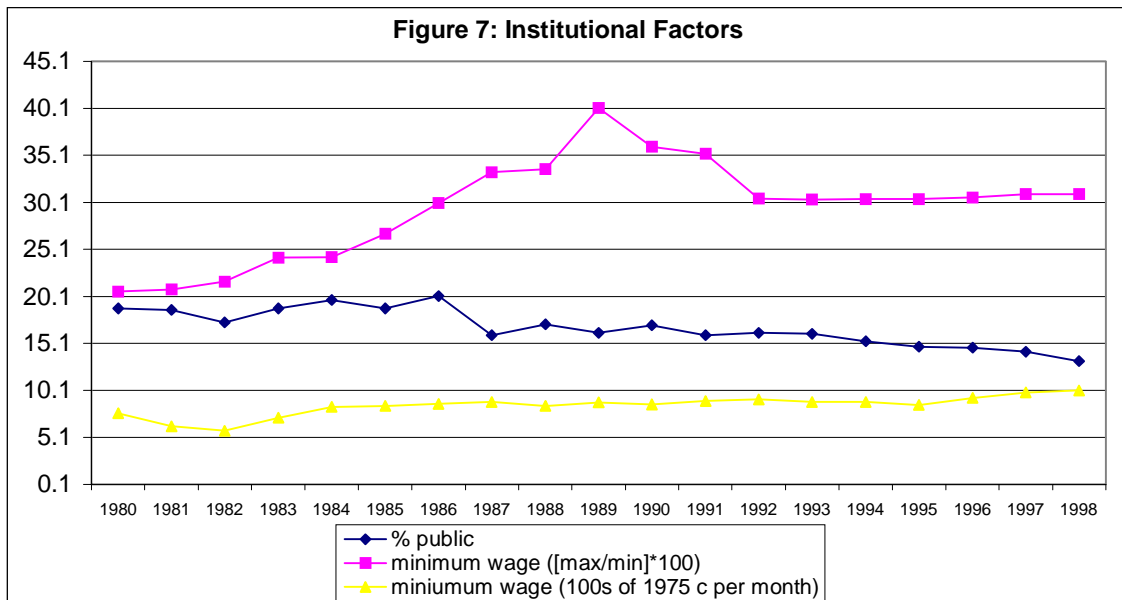
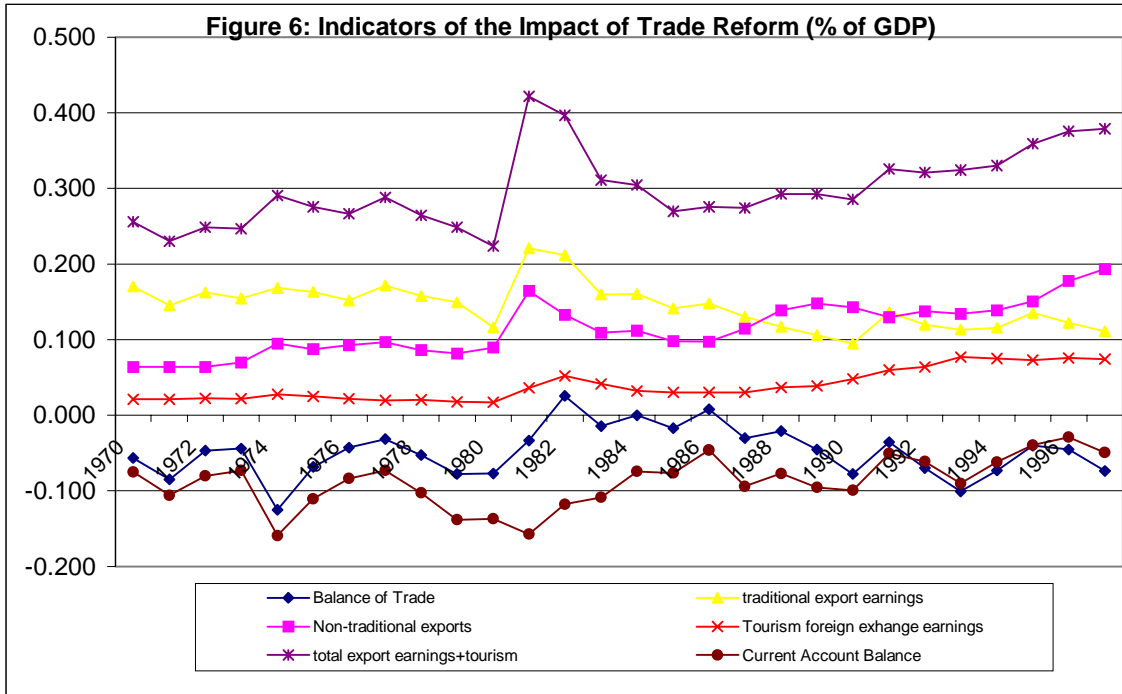
**Figure 3: Returns to Education (Coefficient on the years-of-education variable in the hourly wage equations)**



**Figure 4: Changes in the Supply of Years of Education for All Workers  
(Actual and Adjusted)**







**Table 7: Time-Series Estimation of the Determinants of Changes in Returns to Education**  
 (The dependent variable is the coefficient on years-of-education from the Hourly Wage Equations)

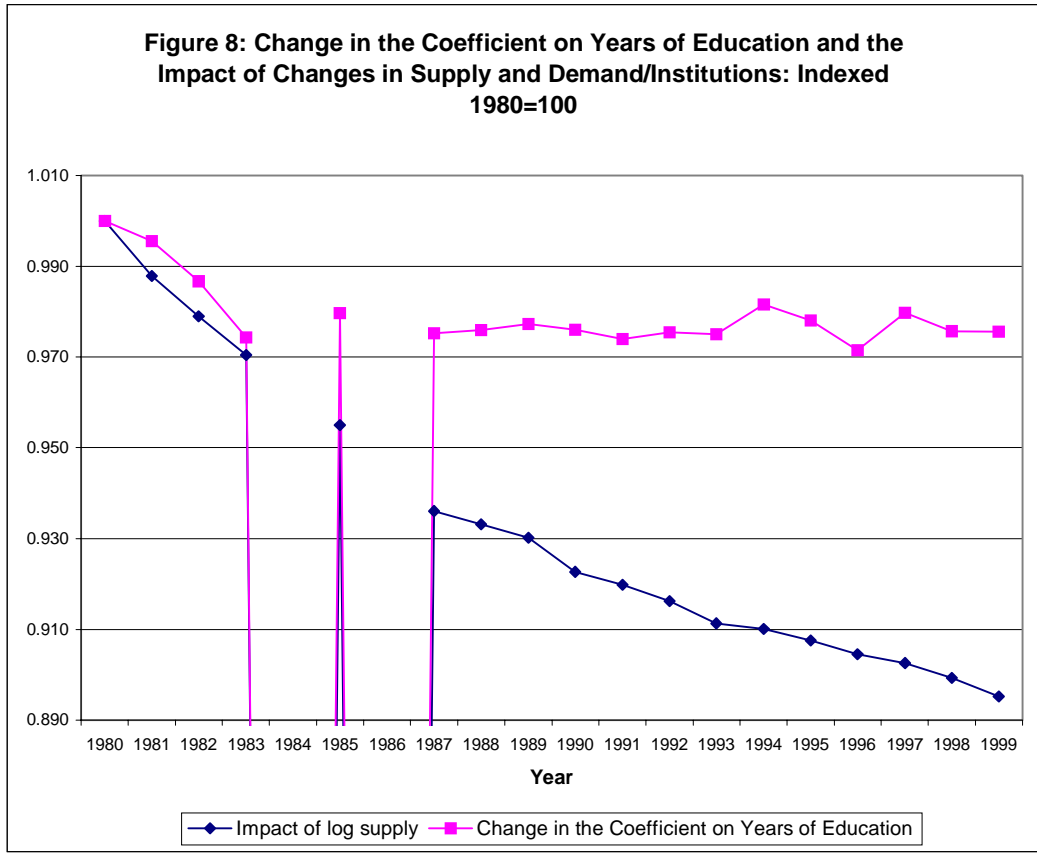
Independent Variables (all in natural logarithms)	Specification of the Investment Variable		
	(1) gross investment in machinery and equipment	(2) Imported Capital	(3) gross investment
investment	0.025** <i>0.0107</i>	0.025** <i>0.0074</i>	0.029** <i>0.0112</i>
foreign direct investment	0.007 <i>0.0059</i>	0.003 <i>0.0052</i>	0.007 <i>0.0057</i>
exports	-0.015 <i>0.0097</i>	-0.008 <i>0.0083</i>	-0.011 <i>0.0093</i>
GDP	0.013 <i>0.0114</i>	0.016 <i>0.0097</i>	0.013 <i>0.0107</i>
index of supply	-0.557* <i>0.2966</i>	-0.627** <i>0.2487</i>	-0.501* <i>0.2673</i>
maximum/minimum wage	0.006 <i>0.02</i>	0.014 <i>0.0175</i>	-0.002 <i>0.018</i>
proportion in public sector	-0.057* <i>0.0303</i>	-0.027 <i>0.0278</i>	-0.049 <i>0.0295</i>
constant	1.252** <i>0.4814</i>	1.272** <i>0.3879</i>	1.108** <i>0.4237</i>
number of observations	16	16	16
R-squared	0.848	0.892	0.861

*Standard errors in italics.*

\* = significant at 10%

\*\* = significant at 5%

Table 8: Separate Contributions of Changes in Supply and Changes in Demand Factors to the Change in the Coefficient on Years of Education (Returns to Education) (between 3-year averages)						
	Change in Coefficient	Impact of Supply (s=-.55)	Impact of Demand and Institutions	Impact of Investment of (Binv=.025)	Impact of FDI (Bfdi=.007)	Impact of Changes in Public Sector (Bpub=-.057)
1980-1985	-0.014	-0.021	0.007	-0.003	0.000	0.000
1987-1992	-0.001	-0.017	0.016	0.005	0.003	0.001
1992-1997	0.001	-0.014	0.016	-0.003	0.002	0.006



**Table 9: Decomposition of Inequality Among All Employees into Between and Within Industry Components of the Theil Index and the Variance of the Logarithm of Hourly Wages**

**Panel A: Decomposition using 1-digit Industry Classifications**  
(between 3-year averages)

**i. Decomposition of the Theil Index**

Period	Within	Between
1980-1985	-0.047	-0.010
1987-1992	-0.031	0.000
1992-1999	0.031	-0.009

**i. Decomposition of the Log Variance**

Period	Within	Between
1980-1985	-0.055	-0.003
1987-1992	-0.025	-0.005
1992-1999	0.028	-0.005

**Panel A: Decomposition using 2-digit Industry Classifications**  
(between 3-year averages)

**i. Decomposition of the Theil Index**

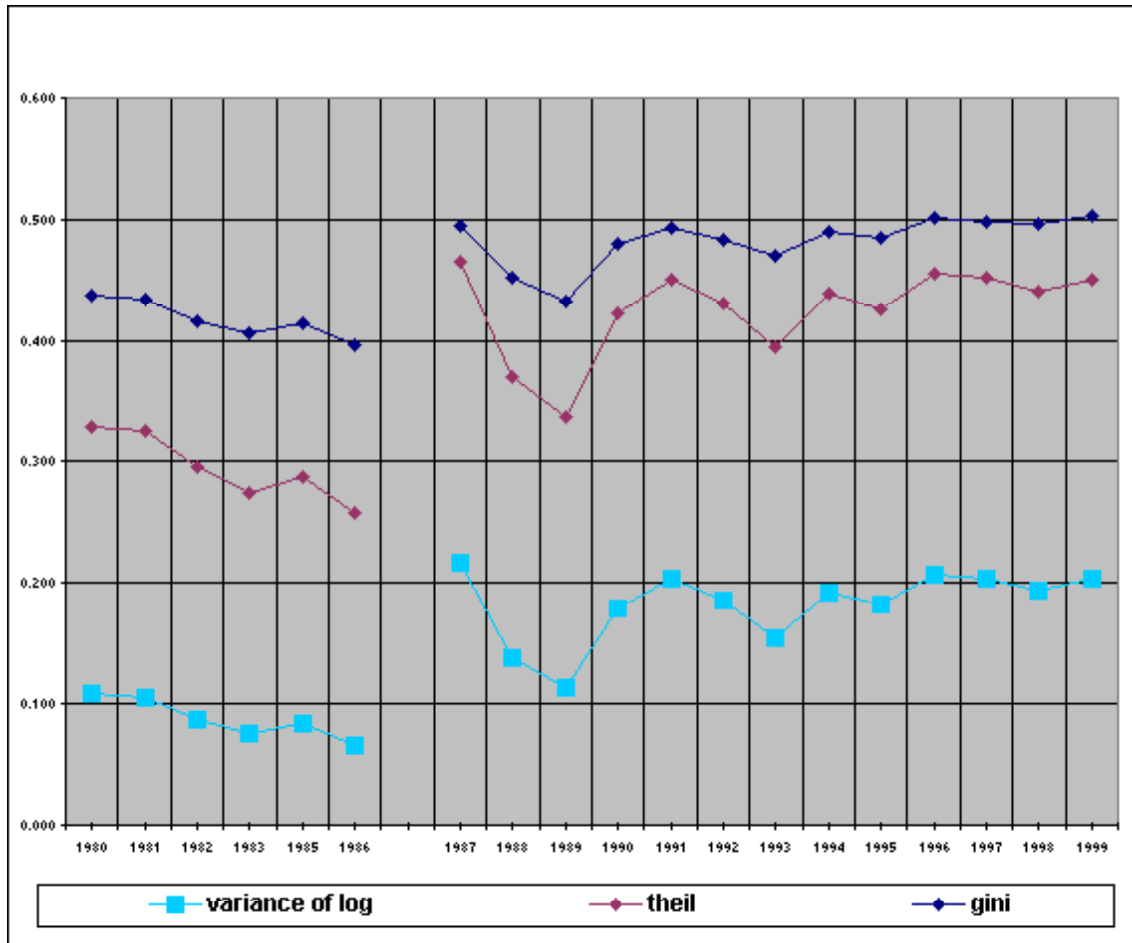
Period	Within	Between
1980-1985	-0.034	-0.018
1987-1992	-0.031	0.000
1992-1999	0.036	-0.013

**i. Decomposition of the Log Variance**

Period	Within	Between
1980-1985	-0.036	-0.022
1987-1992	-0.022	-0.012
1992-1999	0.036	-0.014

APPENDIX  
ADDITIONAL TABLES AND FIGURES

Figure A1: Inequality of Household Earnings Income, 1980-1999



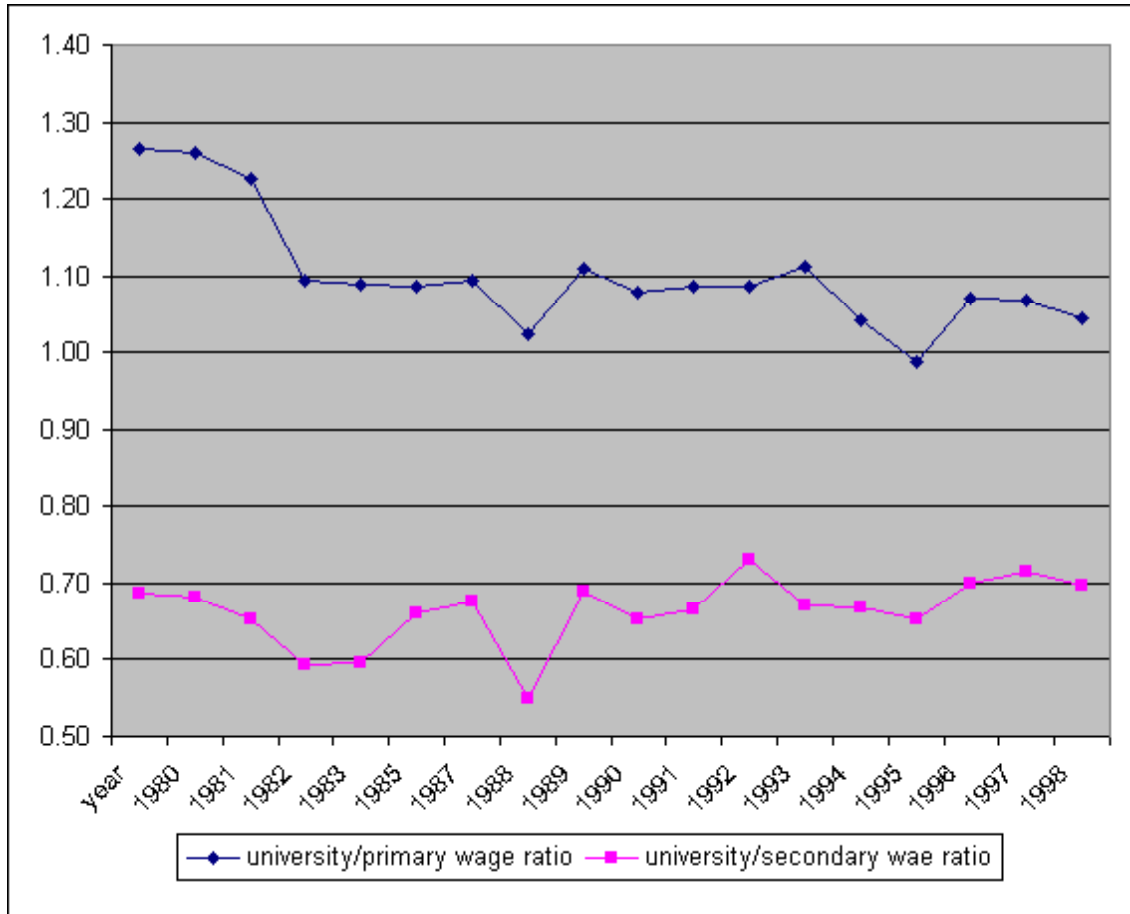
**Table A1: Variance of the Independent Variables**

	Year																	
	1980	1981	1982	1983	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
<b>ED</b>	15.2	15.1	15.0	16.1	16.7	15.8	15.7	15.6	16.0	15.2	15.7	16.3	16.1	16.1	15.9	15.9	16.8	16.4
<b>SEX</b>	0.184	0.191	0.192	0.190	0.194	0.205	0.205	0.208	0.206	0.212	0.209	0.212	0.209	0.212	0.208	0.214	0.217	0.218
<b>ZONE</b>	0.250	0.250	0.250	0.250	0.249	0.250	0.248	0.248	0.248	0.247	0.247	0.248	0.249	0.249	0.248	0.247	0.247	0.250
<b>LHOUR</b>	0.135	0.172	0.206	0.171	0.148	0.181	0.183	0.247	0.215	0.288	0.212	0.258	0.248	0.273	0.271	0.313	0.327	0.323
<b>PUBLIC</b>	0.163	0.163	0.153	0.163	0.230	0.146	0.154	0.146	0.147	0.136	0.140	0.138	0.131	0.127	0.127	0.123	0.123	0.113
<b>LARGE</b>	0.243	0.247	0.249	0.248	0.247	0.249	0.247	0.248	0.247	0.250	0.247	0.248	0.249	0.249	0.250	0.250	0.250	0.250
<b>EXP</b>	235	227	234	225	209	210	215	219	209	209	204	203	210	211	204	214	212	206

**Table A2: Means of the Independent Variables**

	Year																	
	1980	1981	1982	1983	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
<b>ED</b>	6.56	6.68	6.60	7.07	7.36	7.10	7.18	7.13	7.25	7.20	7.37	7.57	7.47	7.68	7.71	7.72	7.86	7.79
<b>SEX</b>	0.76	0.74	0.74	0.75	0.74	0.71	0.71	0.71	0.71	0.70	0.70	0.69	0.70	0.70	0.71	0.69	0.68	0.68
<b>ZONE</b>	0.49	0.51	0.49	0.52	0.53	0.48	0.45	0.45	0.46	0.45	0.45	0.45	0.46	0.46	0.46	0.45	0.45	0.49
<b>LHOUR</b>	3.79	3.76	3.75	3.76	3.78	3.78	3.77	3.74	3.76	3.70	3.76	3.75	3.76	3.74	3.75	3.73	3.72	3.73
<b>PUBLIC</b>	0.21	0.21	0.19	0.21	0.22	0.18	0.19	0.18	0.18	0.16	0.17	0.17	0.16	0.15	0.15	0.14	0.14	0.13
<b>LARGE</b>	0.58	0.56	0.53	0.55	0.56	0.53	0.55	0.54	0.56	0.52	0.55	0.55	0.52	0.53	0.51	0.49	0.51	0.50
<b>EXP</b>	21.2	21.4	21.2	21.0	20.7	20.8	20.9	21.4	21.1	21.8	21.5	21.2	21.7	21.8	22.1	22.5	22.3	22.3

Figure A2: Alternative Measures of Returns to Education



Source: Wage equations with dummy variables for each level of education.