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TREASURY WORKING PAPER

01/03

Human Capital Policies and the Distribution of Income:

A Framework for Analysis and Literature Review

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ABSTRACT

Income and wage inequality increased rapidly in a number of OECD economies. This report surveys the literature on the determinants of wage and income inequality and presents a framework for analyzing policy. The focus is on human capital policies, but other policies that could also reduce income inequality are considered.

The report concludes that increased income inequality in OECD economies reflects greater wage inequality and higher skill premia and that the most likely cause of the rise in skill premia is technical change that has increased the demand for skills and education, though changes in labor market institutions, such as minimum wage laws and the importance of union bargaining, are also likely to have played some role. Although increasing the supply of skills may have some beneficial effects, the most useful policies to reduce inequality would be those that can close the gap of skills between the top and the bottom of the income distribution, such as policies to improve the quality of secondary schooling and to encourage on-the-job training.

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1 Executive Summary

Income and wage inequality increased rapidly in a number of OECD economies. These trends spurred research both on the causes of this increase in inequality and on policies that could reduce inequality.

This report surveys the literature on the determinants of wage and income inequality and presents a framework for analyzing policy. The focus is on human capital policies, but other policies that could also reduce income inequality are considered.

The major conclusions from this survey and framework are as follows:

- Increased income inequality in OECD economies reflects greater wage inequality and higher skill prices (skill premia).
- The most likely cause of the increase in skill premia in the U.S. is technical change that has increased the demand for skills and education, though changes in labor market institutions, such as minimum wage laws and the importance of union bargaining, are also likely to have played some role.
- Since many of the technologies that have spread throughout the U.S. economy over the past 20 years are also affecting many other OECD economies, we may expect further increases in inequality in these economies, including New Zealand. However, there has already been a large and rapid increase in inequality in New Zealand, so it is possible that most of the adjustment to new technologies has already taken place.
- Although greater openness to international trade could also increase inequality, international trade per se does not appear to have been a major factor in the recent widening of the earnings distribution. This suggests that limiting international trade is unlikely to be an effective policy to reduce inequality.
- Standard economic theory suggests that an increase in the supply of skills will reduce skill premia. Therefore, increases in the average human capital in the economy could

reduce inequality. Nevertheless, because technologies adjust to changes in the supply of skills, the effect of the relative supply of skills on inequality is likely to be small. Moreover, the effects of policies that increase the supply of skills work only slowly, so policies that affect average human capital, without changing its distribution, will have little effect in the near future.

- Overall, human capital policies to reduce inequality must close the gap of skills between the top and the bottom of the income distribution.
- Although changes in the signal value of education to employers and changes in the distribution of rents in the labor market may have contributed to the increase in inequality, these effects appear to have been limited in the U.S. case.
- In the U.S., changes in the types of jobs that firms create (“good” jobs being replaced by “bad” jobs) may have been important in shaping the wage distribution, but such changes are likely to have been due to changes in technology, and still suggest that narrowing the gap of skills between the top and the bottom of the earnings distribution should be the top policy priority.
- Higher returns to schooling may be expected to encourage further schooling, and through this channel, they may reduce inequality in the future. But since the effect of increases in average human capital on skill prices is limited, this self-correcting feature of inequality is unlikely to be important. Moreover, there is little evidence showing a strong effect of returns to schooling on education investments
- Human capital policies would also be useful because there may be underinvestment in education and training. The main reason for underinvestment in education is credit market problems. This suggests that increasing the availability of education loans would be useful.

- Human capital policies that would be most useful in reducing inequality are those that increase the skills at the bottom of the skill distribution. These are likely to be policies that increase the quality of secondary schooling, rather than those encouraging increased college attendance.
- Among policies that subsidize college education, those that provide direct subsidies to college are likely to cost a large amount, and subsidize families that would have sent their children to college even in the absence of the policies. For this reason, policies that are specifically targeted at lower income families, such as means-tested subsidies or need-based scholarships, are likely to be more effective, less costly, and fiscally less regressive.
- Policies encouraging training could be quite useful in increasing the skills at the bottom of the earnings distribution. The policies that look most promising for encouraging training are a combination of subsidies or tax credits for training and government regulation of existing training programs.
- Training investments are also affected by contracting problems between firms and workers and by the organization of the labor market. An important issue to bear in mind is that when labor markets are noncompetitive, firms may invest substantial amounts in the training of their employees. In the presence of such firm-sponsored training, wage compression may actually increase training investments.
- Work-first policies encouraging the employment of individuals that might otherwise drop out of the labor market may also be useful.
- Although many economists fear the disincentive effects of policies that encourage wage compression, such as minimum wages or progressive unemployment benefits, there is little evidence that moderate amounts of wage compression create large distortions. Moreover, wage compression may encourage firms to invest in the

skills of their employees. Therefore, such policies may also be useful in limiting wage inequality.

- Redistributive taxation could also be highly effective in reducing post-tax income inequality, but before an increase in redistributive taxation, the effect of high tax rates on the labor supply and outmigration rates of high earners needs to be studied further.

2 Introduction

2.1 Objective

Income and wage inequality (dispersion) increased rapidly in a number of OECD economies, most notably the Anglo-Saxon countries, the U.S., the UK, Canada, Australia and New Zealand. In the U.S., for example, in 1980 college graduates earned about 40% more than high school graduates. Today this number is over 60%. The standard deviation of weekly earnings was approximately 0.5 in 1980, whereas today this number stands above 0.6. The available evidence suggests that the increase in New Zealand has been even larger than in the U.S., the U.K. and Australia (see Dixon, 1998, O'Dea, 2000, Borland, 2000).

Although increased wage inequality may reflect increased remuneration of skills, the general consensus among social scientists, economists and policy makers is that inequality is also socially costly. For this reason, there has been increased interest in ways of reducing inequality. There are three broad types of policies for combatting inequality.

1. Human capital policies. These policies aim to increase the human capital of the society as a whole, or of specific groups within the society. They will affect inequality, first because they may help in narrowing the skill gap between different groups, and secondly because they may reduce the scarcity and therefore the price of skills.
2. Wage compression policies. These policies try to induce or force firms to narrow the pay gap between skilled and unskilled workers for a given distribution of skills.
3. Redistributive taxation. This type of policy would leave the wage distribution largely unchanged, but would equalize the post-tax distribution of income by increasing the tax rate on higher earnings, and reducing the taxes of lower earners.

The general consensus among economists is that the role of wage compression and redistributive taxation policies in reducing inequality is limited. So a natural starting

place is a discussion of how human capital policies may affect the distribution of earnings and what their costs and benefits are. I will return to wage compression and redistributive taxation policies later, since I believe that these policies can be more effective reducing, or at least limiting, inequality than usually assumed.

The purpose of this report is to investigate the effectiveness and costs and benefits of various human capital policies. There is a large academic literature on wage inequality and human capital investments that has generated a number of important insights. This report will review the findings of this literature, place them within a simple framework that can be used for policy analysis, and draw some tentative policy conclusions.

2.2 Outline

An analysis of the effects of human capital policies on inequality needs to start from a framework that highlights the major determinants of inequality. In Part 3 of the proposal, I start with the most common framework that links wage inequality to supply and demand for skills and distribution of skills across individuals. This simple framework highlights a number of important issues:

1. Wage inequality is determined by the gap of skills across individuals and the price of skills (the skill premium).
2. Human capital policies can have both direct and indirect effects on inequality. The direct effect will depend on how human capital policies change the distribution of skills. For example, if they encourage relatively low skill individuals to acquire more skills, they will narrow the skills gap. On the other hand, if it is the relatively high earners who invest more in skills as a result of these human capital policies, they may increase inequality. Human capital policies will also have an indirect effect by changing the price of skills in the society. Although there are some important countervailing effects, this indirect effect, by making skills more abundant in the

society, is likely to reduce skill premia and hence inequality. These beneficial effects may, however, take a long time and have large financial costs.

3. Immigration of relatively unskilled workers is likely to increase inequality through similar direct and indirect channels. New immigrants may be relatively unskilled, and consequently earn less than most natives. Therefore, greater immigration of unskilled workers may increase inequality by widening the gap between the top and the bottom of the earnings distribution. Increased immigration of unskilled workers may also increase inequality among natives by reducing the relative supply of skills and increasing skill premia. Conversely, greater immigration of relatively skilled workers will tend to reduce inequality.
4. Technological changes that have been taking place over the past thirty years make it likely that the demand for skills will continue to increase in many countries, and specifically in New Zealand, creating another force towards higher inequality both now and in the future.
5. Increased international trade may also create a force towards greater inequality, especially if trade with less developed countries increases further. However, this effect is likely to be relatively small.

Although the simple supply-demand framework of Part 3 is useful in isolating a number of important factors, it leaves out a range of issues. In Part 4 of the proposal I discuss these issues. I pay special attention to the following:

1. The signaling role of education and selection: if education is in part a signal to potential employers regarding employees' unobserved ability, the relationship between the supply of skills and inequality may be different. For example, greater fractions of individuals within a cohort receiving high education may signal to the employers that those with less education are increasingly lower ability, and hence reduce the

earnings of low education workers. This may increase the earnings gap between high and low education workers. The same forces may operate even in the absence of signaling if workers with different characteristics, unobserved in the standard surveys, select into education differentially. For example, it may be only those with very low unobserved skills who do not obtain higher education today, once again widening the gap between the earnings of those with and without higher education. Nevertheless, I will argue that there is relatively little evidence that this has been an important consideration in the U.S., and hence, perhaps unlikely to have been important in New Zealand.

2. Rent-sharing in the labor market. I discuss how changes in the patterns of rent-sharing in the labor market could have increased inequality. For example, if jobs that previously paid high wages, because workers were able to share some of the labor market rents, managed to reduce wages, a large number of workers would experience a fall in their real earnings. This change in the distribution of labor market rents would increase inequality. I argue that although changes in labor market rents are likely have taken place in the U.S. over the past twenty-five years, they are unlikely to have been the main driving force of the increase in inequality.
3. Good jobs versus bad jobs. I also discuss how changes in the quality composition of jobs may have contributed to the increase in inequality. I conclude that such changes in the quality distribution of jobs are likely to have been important. Nevertheless, they do not affect the conclusions regarding what the causes of the increase in inequality are (though they somewhat affect the welfare implications of these changes).

Overall, after Parts 3 and 4 of the report, I conclude that the most useful policies to reduce income inequality would be those that close the skills gap between the top and bottom of the income distribution.

In Part 5, I discuss incentives to invest in education and training, with special emphasis on possible market failures. The main conclusion of this part of the report is that credit market problems are likely to lead to underinvestment in education and training. Although human capital externalities could also lead to underinvestment, these appear less important in practice.

A number of other factors also shape both the incentives and the efficiency of training investments. I discuss under what circumstances firms will invest in the training of their employees, and how contractual problems between firms and workers will complicate whether the efficient amount of investment, or any investment at all, will take place. I also show that in the presence of noncompetitive elements in the labor market, wage compression may actually increase training investments.

In Part 6 of the report, I discuss a variety of policies to reduce inequality. Although the focus of this part is on human capital policies, I start the discussion with policies that could reduce inequality without changing the human capital distribution directly. More specifically, I discuss policies encouraging wage compression in the private sector and redistributive taxation. The conclusions I reach from the literature can be summarized as follows:

1. Many economists fear the disincentive and disemployment effects of wage compression policies, such as minimum wages or progressive unemployment benefits. I argue below that these effects may have been exaggerated. This suggests that moderate wage compression policies may be useful in limiting income inequality. Because the minimum wage is already relatively high in New Zealand, likely causing some amount of wage compression, further wage compression policies may be unnecessary. But in that case this analysis suggests that existing policies that encourage wage compression should not be dismantled.
2. Similarly, the disincentive effects of redistributive taxation may have also been ex-

aggregated. Redistributive taxation, in moderation, could be an effective policy to reduce post-tax income inequality.

3. As noted above, the most effective policies to reduce income inequality are those that close the skills gap between the top and the bottom of the income distribution. So human capital policies are of central importance. There are also many reasons to suspect that there may be underinvestment in human capital, so some amount of subsidy for human capital investments may be necessary. Yet, governments already subsidize all three levels of education. It is therefore not clear whether further direct subsidies are called for.
4. Although many economists and commentators advocate further direct subsidies to college education, such policies may not be the best option for policymakers. These policies are often regressive, because they benefit mostly middle and higher income families.
5. If the concern is to alleviate credit market problems, education loans may be a better policy tool. If the objective of human capital policies is to increase college attendance by lower-income families, on the other hand, the best policy would be need-based or means-tested subsidies or scholarships. Such policies would be cheaper and more effective in encouraging college education among lower-income families.
6. An important conclusion of this report is that encouraging college education is unlikely to narrow the gap between the top and the bottom of the income distribution. This is because policies encouraging college attendance do not affect the human capital of workers at the very bottom (e.g. to 10 percentile) of the wage distribution. Therefore, they may close the gap between the middle and the top, but would not affect the gap between the bottom and the top. To narrow the skills gap between the top and the bottom, we need policies that encourage higher quality

secondary education for lower-income families and policies that encourage training for relatively low-pay workers.

7. Work-first type policies that encourage individuals that would otherwise be out of the labor force to first gain employment and policies that support pre-school human capital accumulation of children from lower-income families by providing day-care could also be useful, though these are unlikely to be the most effective policies to reduce overall inequality.

3 A Simple Framework

3.1 Components of Income Inequality

A discussion of human capital policies to combat inequality requires a theory of inequality. In this section I start from the simplest framework. Income inequality among individuals reflects the distribution of employment hours and wages across individuals. For many purposes, we may care about the household distribution of income, which also depends on the correlation between the incomes of the two earners in families consisting of two adults, as well as the fraction of families with two adults.

The evidence from the U.S. indicates that the major source of the increase in income inequality has been the increase in wage inequality. The overall increase in income inequality is larger than the increase in wage inequality because of two factors:

1. The distribution of hours of work among employed workers has become more unequal. In particular, higher earners now work more hours than lower earners (see, for example, Wang, 1998).
2. The probability that a low skill individual is unemployed or out of the labor force has also increased substantially, while the employment rates of high skill individuals has changed much less (e.g., Juhn, Murphy and Topel, 1991).

In addition, there is some evidence that household income inequality may have increased somewhat more than income inequality among individuals (e.g., Levy and Murnane, 1992, for the U.S., O'Dea, 2000, for New Zealand). Although issues related to why the composition of households has changed are interesting, they are beyond the scope of this report, so I will focus on determinants of individual income inequality. Moreover, since the reasons why the distribution of employment and hours has become more unequal are likely to be related to the increase in wage inequality, this part of the report will focus on the determinants of wage inequality.

Finally, in most of the discussion I will focus on the cross-sectional (point-in-time) distribution of earnings, since we have most information about cross-sectional measures of inequality, and such measures of inequality are likely to best reflect the distribution of worker productivity (and human capital). Lifetime earnings inequality may behave differently than cross-sectional inequality, for example, because of increased earning mobility. In an influential paper, Gottschalk and Moffitt (1994) point out that in the U.S. there has been a large increase in earnings instability (or mobility). Nevertheless, their findings also show that despite this greater mobility, lifetime earnings inequality also increased by a large amount over the same period. So the focus here on cross-sectional inequality as a measure of overall income inequality is not misleading.

3.2 Determinants of Wage Inequality

While, undoubtedly, many factors affect the distribution of wages, a natural starting point for an economic analysis is that of supply and demand. In the introduction to his pioneering study of income distribution, Tinbergen (1975, p. 15) wrote

“...what matters is the difference between qualities *available* and qualities *required* by the demand side, that is by the organization of production.”
(italics in the original).

So I start with a competitive framework where wages reflect differences in worker productivities. In this framework, wage inequality will consist of two components:

1. Skill gaps across workers.
2. The prices of skills.

For example, a worker will be paid more than another because he can perform more advanced tasks or produce different goods, which reflects the skill gap (or his different

skills). The exact magnitude of the wage gap will also reflect the market prices of these different tasks or goods.

I start with a framework that takes skill gaps as given, and discuss the determinants of skill prices (skill premia). I will later analyze the determinants of skill gaps. At a fundamental level, skill prices are determined by two factors: the supply of skills and the demand for skills. The supply of skills is determined by education decisions, the education system in general, training investments by firms and workers, and also immigration. The demand for skills reflects a variety of forces, but most notably, technology and trade.

Although the main issues are relatively straightforward, it is helpful to express the basic relationships using a simple model. In what follows, I consider a relatively stripped but rich framework, which is normally viewed as a workhorse in the labor economics and macroeconomics literatures. This framework was informally discussed by Becker (1964), Tinbergen (1974, 1975), and Welch (1970), among others, and has featured in many recent papers, including Katz and Murphy (1992), and Acemoglu (1998, 2000).

Consider an economy with two goods and two different types of workers. For concreteness, let us suppose that these two types of workers are those with college education and those with high school education (or high and low education workers, or alternatively, skilled and unskilled workers). One of these goods is produced by low education workers, while the other requires high education workers. Suppose that the economy consists of l low and h high education workers. Moreover, suppose that both types of workers differ in terms of their effective units of labor. In particular, denote the efficiency units of labor possessed by a low education worker i by e_l^i . Similarly the efficiency units of skills supplied by a high education worker j is e_h^j . We can also think of these efficiency units as corresponding to unobserved skills, including “soft” or “people” skills, which according to a number of economists including Breshnahan et al. (1999), have recently become more important. Also denote the total supply of efficiency units of low education labor by L and the total supply of efficiency units of high education workers by H . I will refer to

H/L as the relative supply of skills in the economy.

Next assume that the production of the two goods are equal to:

$$\begin{aligned} Y_l &= A_l L \\ Y_h &= A_h H \end{aligned}$$

In this equation, A_l is the productivity of low education workers in the production of the labor-intensive good, while A_h is the productivity of high education workers in the production of skill-intensive good. The parameters A_l and A_h are determined by technology.

To make further progress we need to specify how society trades off the two goods, and whether there is international trade. Let us start with no international trade, so that aggregate consumption is equal to aggregate production for both goods. Let us also suppose that the utility of the consumers in this society takes the following constant elasticity of substitution (CES) form,

$$U = [C_l^\rho + C_h^\rho]^{1/\rho}, \tag{1}$$

where C_l is the consumption of the labor-intensive good and C_h to the consumption of the skill-intensive good, and $\rho \leq 1$. The elasticity of substitution in consumption between the two goods is $\sigma \equiv \frac{1}{1-\rho}$. When this elasticity is high, the two goods are close substitutes, whereas when this elasticity is low, consumers need a balanced composition of the two goods. For example when $\sigma \rightarrow 0$, we have a fixed-proportions utility function where consumers need to consume the two goods in fixed proportions. The importance of the parameter σ for us is that it will also turn out to be the elasticity of substitution between high education (skilled) and low education (unskilled) workers. The value of the elasticity of substitution will play a crucial role in thinking about the implications of technical change and changes in the supply of skills.

Market clearing and consumer maximization imply that the relative prices of the two goods have to satisfy the following equation

$$\frac{p_h}{p_l} = \left(\frac{A_h H}{A_l L} \right)^{-1/\sigma}$$

This is the familiar relative demand equation. A greater supply of the skill-intensive good relative to the supply of the labor-intensive good reduces the relative price of the skill-intensive good, p_h/p_l . In this case, because of the absence of international trade, the supply of skill-intensive goods is equal to $A_h H$, while the supply of the labor-intensive good is $A_l L$. When the elasticity of substitution, σ , is low, the effect of relative supply on the relative price is strong, and a given increase in relative supply translates into a larger fall in the relative price of skill-intensive goods

Let us next turn to the labor market, and assume that it is competitive. Although rent-sharing between firms and workers is likely to be an important characteristic of many labor markets, the competitive equilibrium is a useful benchmark from which to start. Since in a competitive market all workers are paid the value of their marginal product, we immediately obtain that the wage for labor services is $w_L = p_L A_L$, whereas the wage for a unit of human capital is $w_H = p_H A_H$. Intuitively, these wages are equal to the physical marginal product multiplied by the price of the goods produced. These equations imply that the price of a unit of skilled labor relative to a unit of unskilled labor is:

$$\omega = \frac{w_H}{w_L} = \left(\frac{A_h}{A_l} \right)^{(\sigma-1)/\sigma} \left(\frac{H}{L} \right)^{-1/\sigma}. \quad (2)$$

We are now in a position to discuss the distribution of wages in this hypothetical economy. Suppose that an average low education worker has e_L units of labor, while an average high education worker has e_H units of skills. Then, a natural measure of inequality, earnings of the average skilled worker relative to the earnings of the average

unskilled worker, is given by

$$\begin{aligned}\frac{y_H}{y_L} &= \omega \frac{e_H}{e_L} \\ &= \left(\frac{e_H}{e_L} \right)^{(\sigma-1)/\sigma} \left(\frac{A_h}{A_l} \right)^{(\sigma-1)/\sigma} \left(\frac{h}{l} \right)^{-1/\sigma}\end{aligned}$$

We can now see the two forces that determine earnings inequality. The first is the skill gap e_H/e_L , that is, the relative skills of the two groups of workers. The second determinant of earnings inequality is the price of skills (the skill premium), ω . When the skill premium is larger, a given skill gap will translate into greater earnings inequality.

To make further progress, we need to have a sense of how these various factors affect earnings inequality quantitatively, and also discuss in more detail the determinants of the skill premium. To do this, rewrite equation (2) by taking logs:

$$\ln \omega = \frac{\sigma - 1}{\sigma} \ln \left(\frac{A_h}{A_l} \right) - \frac{1}{\sigma} \ln \left(\frac{H}{L} \right). \quad (3)$$

This equation highlights that in our setup with no international trade, the skill premium is a function of technology, the first term, and the relative supply of skills, the second. This equation can also be thought as the relative demand for skills: it gives the skill premium that is consistent with market clearing. Naturally, the relative demand for skills is downward sloping, or in other words, the skill premium increases when skilled workers become more scarce:

$$\frac{\partial \ln \omega}{\partial \ln H/L} = -\frac{1}{\sigma} < 0. \quad (4)$$

Figure 1 shows this relative demand curve diagrammatically. It draws the relative demand for skills as captured by equation (3) against the relative supply of skills, H/L , which is taken to be given for the purposes of this exercise. An increase in the relative supply, from H/L to H'/L' , moves the equilibrium point along the downward sloping relative demand curve, and depresses the skill premium from ω to ω' . Intuitively, an increase in the relative supply of skills increases the production of skill-intensive goods relative to

the production of labor-intensive goods. Given the absence of international trade, this translates into an increase in the relative consumption of skill-intensive goods. However, consumers view the two goods as complementary—they will only consume more of the skill-intensive good if its relative price falls. Therefore, the increase in the relative supply of skills leads to a reduction in the relative price of skill-intensive goods. This change in relative prices affects the relative value of marginal products of the two types of workers, and reduces the relative wages of high education workers.

The framework here abstracts from substitution of skilled and unskilled workers in the production process, so the effect of the increase in the relative supply of skills on relative wages works through changes in product prices (changes in the substitution in consumption). This is only a simplification. Similar results would apply if skilled and unskilled workers also worked together in the production of the same goods. Then an increase in the relative supply of skills would lead to the substitution of skilled workers for tasks previously performed by the unskilled, and similarly reduce their marginal product.

The slope of the relative demand curve, or the quantitative effect of a change in the supply of skills on the skill premium, depends on the elasticity of substitution σ . So it is crucial to know how large this elasticity is likely to be. One way of estimating this elasticity of substitution is to run a regression of the form (3). Katz and Murphy (1992) estimate a similar equation to (3) using aggregate U.S. data between 1963-1987. They take the skill premium to be the college premium in the U.S. labor market and define skilled workers as those with college and the unskilled workers as those with high school degree.¹ Plausibly, over a period of 25 years, technology will change as well, affecting the skill premium. To deal with the change in the demand for skills coming from technology or perhaps international trade, they also include a linear time trend in the equation. They

¹More specifically, they use the relative supply of college equivalent workers. This is defined as $\text{college graduates} + 0.29 \times \text{some college} - 0.05 \times \text{high school dropouts}$ divided by $\text{high school graduates} + 0.69 \times \text{some college} + 0.93 \times \text{high school dropouts}$.

find

$$\ln \omega = \begin{matrix} 0.033 \cdot t & -0.71 \cdot \ln \left(\frac{H}{L} \right) \\ (0.01) & (0.15) \end{matrix}$$

This approach does fairly well in capturing the salient features of the changes in the college premium between 1963 and 1987. For example, the predicted values from this regression are quite close to the realizations of the college premium. This suggests that the simple model above in terms of substitution between higher education and low education workers is a useful framework for thinking about the determination of college premia, or more generally, skill premia. More important for our purposes here, the estimates imply that the elasticity of substitution between college graduate workers and noncollege workers is about $\sigma = 1/0.71 \approx 1.4$. More recently, Murphy, Riddle and Romer (1998) have argued this for Canada and the U.S., and Card and Lemieux (1999) for the U.S., Canada and the U.K. and found similar elasticities.

There is also more microlevel evidence corroborating this finding. Freeman (1986) surveys a number of papers, and concludes that there is widespread consensus that the elasticity of substitution between high and low education workers is between $\sigma = 1$ and 2.

An interesting study from a quasi-natural experiment also supports this range of estimates. Angrist (1995) looks at the response of the returns to schooling to the increase in the supply of skills in the West Bank and Gaza Strip during the 1980s resulting from an institutional change. There was a very large increase in the supply of skilled Palestinian labor as there opened Palestinian institutions of higher education, which were totally absent before 1972. Angrist shows that premia to college graduate workers (relative to high school graduates) that were as high as 40 percent quickly fell to less than 20 percent. The extent of substitution was also clear. First, many college graduate workers could not find employment in skilled jobs. Angrist (1995) shows a sharp increase in the unemployment rate of college graduates, and Schiff and Yaari (1989) report that only one in eight Palestinian graduates could find work in his profession, with the rest working

as unskilled laborers, mainly in the construction industry. Second, the premia for tasks usually performed by more educated workers fell sharply. Between 1984 and 1987, the premium for administrative and managerial jobs (relative to manual laborers) fell from .32 to .12, while the premium for clerical workers fell from .02 to -.08 (see Angrist, 1995, for details).

3.3 Application: The Effect of Relative Supply of Skills on Skill Premia and Implications of Immigration

From this discussion we can conclude that an increase in the relative supply of skills is likely to reduce the skill premium, and for a given distribution of skills within the society, this is likely to reduce inequality. The most natural reason for an increase in the supply of skills is increased education or other forms of investment in human capital. This highlights that policies that encourage human capital accumulation may have the effect of reducing inequality through their effect on skill premia. They may also have a direct effect on inequality because they are changing the distribution of human capital in the society.

Conversely, a decline in the relative supply of skills will tend to increase the skill premium and inequality. There are two reasons why the relative supply of skills may decline:

1. Immigration of less skilled workers. When a greater number of unskilled workers immigrate to a country, this will make skilled workers more scarce, and increase the skill premium. Therefore, increased immigration may increase inequality through two channels. First, with increased immigration, there could be more low skill workers, thus increasing the skill gap between the top and the bottom of the distribution. Second, increased immigration of unskilled workers may raise inequality even among natives by increasing the skill premium.
2. Changes in the education system may imply that high education workers have less skill now than before, because they may have lower ability, or the education

system may be teaching them less. In terms of the simple framework above, this would amount to a reduction in e_H , and therefore, to a reduction in the relative supply of skills, H/L .

I discuss below reasons why there may be forces counteracting the effect of the relative supply of skills on inequality. But for now, it is useful to calculate how large the effect of an increase in the supply of skills on skill premia can be in the absence of these counteracting effects. To do this, consider a hypothetical economy in which workers are in the labor force for 50 years, there is no population growth, and a quarter of these workers are college graduates (high education). Also for concreteness, suppose that $e_H = e_L = 1$ (this is simply a normalization, since A_h/A_l is not specified). Then the steady-state relative supply of skills is $H/L = 1/3$.

Imagine we now double the capacity of the university system. So once the system has adjusted, H/L will rise to 1. However, this adjustment will take a very long time. For example, 10 years after the change, H/L will have only risen to 0.42, because the flow of new workers is relatively small compared to the stock of workers (with a 50 year working life and no net population growth, the flow of new workers is equal to 1/50th of the stock of workers in the labor market at a given point in time). Now using the above elasticity estimates, we can calculate the implied change in skill premia resulting from these changes in supplies.

In the long-run, the relative supply will have tripled as a result of the doubling of the capacity of the university system. Taking $\sigma = 1.4$ as a baseline estimate of the elasticity of substitution, this implies that the skill premium will fall by over 50 percent in the long run. However, ten years after the doubling of the capacity of the university system, the effect will still be relatively limited. The same parameters imply that in this case the skill premium will have fallen by 16 percent. The conclusion is that although in the long run a large increase in the supply of skills will have a substantial effect on the skill premium and hence inequality, these effects may take quite a long time to operate.

A similar calculation applies to the flow of unskilled immigrants into the economy, and suggests that they are unlikely to have had a major effect on skill premia. This conclusion that the effect of inflows of migrants into the economy will have only a limited effect on skill premia and the wages of natives is also supported by research on the effects of immigrant flows in to the U.S. and other advanced economies. Possibly the most famous paper in this literature is that by Card (1990) on the effect of the Mariel boat lift to Miami in 1980, which brought a large number of relatively unskilled Cubans to the Miami labor market. The increase was quantitatively very large, as Miami's population increased by over 7 percent. However, Card found that this had little effect on the wages, employment and unemployment rates for unskilled whites and blacks in Miami. A similar study is also conducted by Hunt (1992) where she examines the effect of the repatriation to France of individuals of European origin after Algerian Independence in 1962. Similarly, she finds small effects on natives. More recently, Borjas, Freeman and Katz (1997) investigated the contribution of increased immigration in the U.S. labor market on the decline in the wages of low skill workers during the 1980s. Although they conclude that increased immigration had some effect, this effect is still relatively small. I therefore conclude that increased immigration of unskilled workers is unlikely to be the main force leading to inequality.

In the New Zealand case, the average skill level of migrants appears to be greater than the native population. This suggests that immigration may be a force towards less inequality. Nevertheless, the same arguments suggest that the role of immigration in shaping the wage structure will be limited.

3.4 Technology and Wage Inequality

Another crucial determinant of wage and income inequality is technology. A large literature has emphasized the role of skill-biased technical change in explaining the rise in inequality in the U.S. and the UK (see Katz and Autor, 1999, or Acemoglu, 2000, for a survey). In our above framework, equation (3) shows that the skill premium depends on

A_h/A_l , which can be interpreted as the productivity of high education workers relative to the productivity of low education workers. How changes in this relative productivity translate into changes in skill premium depends on the elasticity of substitution.

It is straightforward to see that, as long as the elasticity of substitution is greater than 1, i.e., $\sigma > 1$, we have

$$\frac{\partial \omega}{\partial A_h/A_l} > 0.$$

That is, improvements in the relative productivity of high education workers increase the skill premium. In terms of Figure 1, an increase in A_h/A_l shifts the relative demand curve out and increases the skill premium for a given supply of skills. Consequently, for a given distribution of skills in the society, wage and income inequality will increase as a result of such a change. For natural reasons, we refer to an increase in A_h/A_l as skill-biased technical change—it is a change in technology that benefits skilled/highly educated workers more than unskilled/less educated workers.

It is important to observe that an increase in the productivity of skilled workers may not always increase wage inequality. If the elasticity of substitution is less than 1, i.e., if $\sigma < 1$, an improvement in the productivity of skilled workers, A_h , relative to the productivity of unskilled workers, A_l , shifts the relative demand curve in and reduces the skill premium. This case appears paradoxical at first, but is, in fact, quite intuitive. Consider, for example, the case of fixed proportions utility function. In this case, when A_h increases and high education workers become more productive, the demand for low education workers, who are necessary to produce the labor-intensive good which is now in greater demand, increases. In some sense, in this case, the increase in A_h is creating an “excess supply” of skilled workers given the number of unskilled workers. This increases the unskilled wage relative to the skilled wage. Nevertheless, the case of $\sigma < 1$ appears of limited empirical importance, since most of the estimates of elasticity of substitution are greater than 1 as discussed above.

Are changes in technology important in accounting for the increase in inequality? There is a large literature on this topic, and considerable disagreement. Nevertheless, there seems to be little doubt that over the past 50 years, or even over the past hundred years, many technological improvements have been skill-biased. Consider Figure 2 which plots a measure of the supply of college skills between 1949 and 1995.² It also plots returns to college. It shows that there has been a remarkable increase in the supply of skills in the U.S. economy over the past sixty years. In 1939, just over 6 percent of American workers were college graduates. By 1996 this number had increased to over 28 percent. In 1939, almost 68 percent of all workers did not have a high school degree. In 1996, this number had fallen to less than 10 percent (see, for example, Autor, Katz and Krueger, 1998, Table 1). The relative supply of skills plotted in Figure 2 gives a sense of these changes. However, there has been no tendency for the returns to college to fall in the face of this large increase in supply—on the contrary, there is an increase in the college premium over this time period. If the relative demand for skills, and therefore A_h/A_l , were stable over this period, we would expect a large increase in the relative supply to substantially reduce the skill premium (the college return). The fact that this hasn't happened is the strongest piece of evidence in favor of a secular increase in the demand for skills. With half of this picture, Welch (1970, p. 36) reached the same conclusion 30 years ago, and argued:

“With the phenomenal rise in average education, why have rates of return failed to decline?...

It is obvious that changes have occurred to prevent the decline in returns to acquiring education that would normally accompany a rise in average educational level. Presumably, these changes have resulted in growth in demand

²These measures of relative supplies are constructed along the lines of Autor, Katz and Krueger (1998), as the ratio of college equivalents (those with college plus $0.5 \times$ those with some college) to noncollege equivalents (those with high school or less $+ 0.5 \times$ those with some college). It is important to include workers with some college and those with less than high school, since they also perform similar tasks to college and high school workers, and therefore affect the relative supply of skills to the society.

for ... education... sufficient to absorb the increased supply with constant or rising returns.”

The developments in the thirty years since then have only strengthened this conclusion. The regression from Katz and Murphy (1992) also supports this view. There is a highly significant time trend term in the regression, indicating that for a given relative supply of skills, the skill premium will be increasing over time. This time trend is therefore capturing the secular increase in the demand for skills. Most economists view these long-term changes in the demand for skills to be due to technology

How large are the changes in technology required to explain the patterns observed in the U.S. labor market? Some back-of-the-envelope calculations provide a sense of the rise in A_h/A_l implied by the changes in the structure of wages and employment in the U.S.. If we assume a specific value for the elasticity of substitution, σ , we can translate these numbers into changes in A_h/A_l . In particular,

$$\frac{A_h}{A_l} = \frac{S_H^{\sigma/(\sigma-1)}}{H/L}, \quad (5)$$

where S_H is the share of high education workers in the wage bill, which we can obtain from census data. In Table 1, I calculate the implied A_h/A_l values for $\sigma = 1.4$ and for $\sigma = 2$ using workers with some college, college graduates, and college equivalents definitions of Autor et al. In all cases, there is a very large implied increase in A_h/A_l and $(A_h/A_l)^{(\sigma-1)/\sigma}$ (see Autor, Katz and Krueger, 1998, for more a detailed analysis that controls for potential composition effects). For example, the numbers indicate that, assuming an elasticity of substitution of 1.4, the relative productivity of college graduates, A_h/A_l , was approximately 0.030 in 1960, increased to 0.069 in 1970, and to 0.157 in 1980. Between 1980 and 1990, it increased by a factor of almost three to reach 0.470. As equation (3) shows, changes in the demand index $D = (A_h/A_l)^{\frac{\sigma-1}{\sigma}}$ may be more informative than changes in A_h/A_l , so Table 1 also gives the evolution of D .

An important feature that emerges from Table 1 is that while technical change appears to have been skill-biased throughout the postwar era, the pace of skill-biased change seems to have accelerated after 1970s. Although there is an academic debate regarding whether there has in fact been such an acceleration, many economists now believe that the speed of skill-biased technical change has been somewhat faster over the past twenty-five years (see, among others, Krueger (1993), Berman, Bound and Griliches (1994), and Autor, Katz and Krueger (1998) for evidence that the rapid spread of computers has increased the demand for skills. See Krusell, Ohanian, Rios-Rull and Violante (2000), Galor and Tsiddon (1997), Greenwood and Yorukoglu (1997), Caselli (1999), Galor and Moav (2000), Violante (1999), Rubinstein and Tsiddon (1999), Aghion, Howitt and Violante (1999), and Gould, Moav and Weinberg (1999). See Acemoglu (2000) for a summary of the evidence for and against acceleration and an evaluation).

What are the implications for New Zealand? It is reasonable to presume that many of the technologies used in New Zealand have common characteristics with technologies being used in the U.S., or even many of these technologies may have been originally developed in the U.S. (see Acemoglu and Zilibotti, 2001). Therefore, patterns in the U.S. labor market are indicative of what has been happening in many OECD economies in general, and in New Zealand, in particular. A number of papers present evidence supporting this view. Berman, Bound and Machin (1998) and Machin and Van Rennes (1998) present evidence that skill-upgrading has happened in the same industries in many OECD economies, suggesting that they have been affected by similar technological changes. Berman and Machin (2000), on the other hand, present evidence documenting the same pattern for middle-income countries. In all of these cases, there also seems to be a delay in the spread of skill-biased technical change from the U.S. to other countries. This suggests that over the next 20 years, technological change will be highly skill-biased in New Zealand. Therefore, without measures combating inequality, we may expect to see even higher levels of inequality in the years to come.

3.5 A Caveat: The Relationship Between Relative Supply of Skills and Technology

The discussion so far has treated technology as exogenous. The recent endogenous growth literature has placed considerable emphasis on the endogeneity of technology. In Acemoglu (1998, 1999), I argued that the skill bias of technology is also endogenous, and depends on the availability of skilled workers.

The argument in Acemoglu (1998) is that when skill-biased techniques are more profitable, firms will have greater incentives to develop and adopt such techniques. A key determinant of the profitability of new technologies is their market size; machines that can be sold in greater numbers will be more profitable. Schmookler (1966), in his pioneering study *Invention and Economic Growth*, placed great emphasis on market size. He argued (p. 206) “invention is largely an economic activity which, like other economic activities, is pursued for gain;... expected gain varies with expected sales of goods embodying the invention.” Therefore, this perspective implies that machines complementary to skilled workers will be more profitable to develop when there are more skilled workers to use them. As a result, a large increase in the supply of skills may not only move the economy along a relative demand curve for skills as in Figure 1, but would also shift this relative demand curve out through its effect on technology.

The main argument in Acemoglu (1998) works through the creation of new technologies, and it may be conjectured that the relevance of this argument for New Zealand is limited, since New Zealand would be using mostly technologies already developed in the U.S. or in Europe. Nevertheless, the same argument applies not only to the invention of new technologies, but to the adoption decisions. If adapting existing technologies to the labor market or consumer demand in New Zealand is costly, firms will tend to adapt technologies that are more profitable faster. With a similar reasoning, technologies that have greater market sizes, i.e., there are more workers to use them, will be more profitable. Therefore, an increase in the supply of educated and skilled workers will increase

the profitability of adapting and marketing more skill-biased technologies, increasing the degree of skill bias of new technologies

The argument in Acemoglu (1999) is related. In that paper, it is not the technology frontier that changes as a result of an increase in the supply of skills, but how firms use the available technology. In particular, when there are more skilled workers, firms find it more profitable to invest in high skilled jobs and try to find workers suitable for these jobs. In contrast, when skilled workers are more scarce, firms may create jobs that both skilled and unskilled workers could fill. Therefore, an increase in the supply of skills may take the economy from a “pooling equilibrium,” where there are high-wage jobs both for skilled and unskilled workers, to a “separating equilibrium” in which there are only high-quality jobs only for skilled workers. I will return to this topic in the next part of the report when I discuss how the quality composition of jobs (good vs. bad jobs) may influence the distribution of income.

For now, the relevant conclusion is that when technology or the organization of jobs is endogenous, the behavior of the economy may not simply correspond to a move along a well-defined downward sloping relative demand curve for skills. Figure 3 draws a case to illustrate this diagrammatically. Because of changes in technologies, the relative demand curve shifts to the right, and as a result, the effect of an increase in the relative supply of skills on skill premia is limited. Essentially, the changes in the supply of skills is creating, at least in part, its own demand: when there are more skilled workers, firms will eventually demand more skilled workers. As a result, the effect of the increase in the relative supply of skills on skill premia will be muted. These considerations raise important caveats about policies that try to combat inequality simply by affecting the skill premium through changes in the supply of skills.

3.6 International Trade and Inequality

The discussion so far treated the country in question as a closed economy. Many economists and commentators have argued that increased international trade may have been an important factor in the increase in inequality. The underlying reasoning is one of standard factor proportions theory: if New Zealand starts trading with countries that are more scarce in skills than New Zealand, it would be exporting skill-intensive goods and importing labor-intensive goods. This will act in effect like a decrease in the relative supply of skills, and increase inequality. In the New Zealand case, much of the trade is with other OECD economies, so there is little difference in terms of skill abundance. This suggests that international trade is unlikely to have played a major role in the rise in inequality. In any case, most evidence suggests that the effect of increased trade with LDCs on U.S. inequality has been limited as well.

To discuss these effects further using our framework, suppose that instead of consuming all of its production of the skill-intensive and the labor-intensive goods, our hypothetical economy now exports a fraction ϕ_h of its skill-intensive production, and imports labor-intensive goods, of an amount equal to ϕ_l fraction of its domestic production. Then, the relative demand equation changes to

$$\frac{p_h}{p_l} = \left(\frac{(1 - \phi_h) A_h H}{(1 + \phi_l) A_l L} \right)^{-1/\sigma}, \quad (6)$$

and following similar steps to above, the skill premium becomes

$$\ln \omega = \frac{\sigma - 1}{\sigma} \ln \left(\frac{A_h}{A_l} \right) - \frac{1}{\sigma} \ln \left(\frac{(1 - \phi_h) H}{(1 + \phi_l) L} \right). \quad (7)$$

An increase in international trade corresponds to an increase in ϕ_h and ϕ_l . This has an unambiguous effect on the skill premium, because it acts as an effective decrease in the supply of skills in the society.

Is the increase in international trade likely to be an important contributor to increase inequality? And the related question: can limiting the international trade be an effective

tool to reduce inequality? In theory, the answer to both of these questions could be yes. Since New Zealand is more abundant in skilled and educated workers than many of its trading partners, a large increase in trade openness could have a substantial effect on the skill premium. The evidence from the U.S., however, suggests that the answers are no.

Despite claims by many economists and commentators that trade has been an important contributor to inequality, much evidence suggests that these effects are rather limited, and consequently, limiting trade is unlikely to reduce income inequality substantially. Moreover, given that international trade enables an economy like New Zealand to exploit its comparative advantages, the costs of limiting international trade are likely to be substantial.

I now summarize the evidence from the U.S. labor market. First, as equation (6) shows, the effect of international trade works through a *unique intervening mechanism*: more trade with countries that are more scarce in skills increases the relative price of skill-intensive goods, p_h/p_l , and affects the skill premium via this channel. In fact, in this simple framework, the percentage increase in the skill premium is directly proportional to the percentage increase in the relative price of skill-intensive goods. Perhaps the most damaging piece of evidence for the trade hypothesis is that most studies suggest the relative price of skill intensive goods did not increase over the period of increasing inequality. Lawrence and Slaughter (1993) found that during the 1980s the relative price of skill-intensive goods actually fell. Sachs and Shatz (1994) found no major change or a slight decline. A more recent paper by Krueger (1997) criticized the methods and data used by these studies, and found an increase in the relative price of skill intensive goods. Nevertheless, the increase in these prices is relatively small, so would not be able to account for the large increase in the skill premium experienced in the U.S. economy (recall that the change in the relative price of skill intensive goods needs to be of the same order of magnitude as the change in the skill premium).

Second, with trade as the driving force, wages of skilled workers should increase be-

cause greater than production of skill-intensive goods is drawing workers away from other sectors. In contrast, as documented by Murphy and Welch (1993), Berman, Bound and Griliches (1994) and Autor, Katz and Krueger (1998), all sectors, even those producing less skilled goods, increased their demands for more educated workers. This pattern is not consistent with trade being the main driving force of the increase in the demand for skilled workers.³

Third, a direct implication of the trade view is that, as shown above, while demand for skills and inequality increase in the U.S., the converse should happen in the less skill abundant countries that have started trading with the more skill abundant U.S. economy. The evidence, however, suggests that more of the less developed countries that have started trading with the U.S. experienced rising inequality after opening to international trade (see Robbins, 1995). Although the increase in inequality in a number of cases may have been due to concurrent political and economic reforms, the preponderance of evidence is not favorable to this basic implication of the trade hypothesis.

Finally, a number of economists have pointed out that U.S. trade with the less developed countries is not important enough to have a major impact on the U.S. product market prices and consequently on wages. Krugman (1995) illustrates this point by undertaking a calibration of a simple North-South model. Katz and Murphy (1992) and Berman, Bound and Griliches (1994) emphasize the same point by showing that the content of unskilled labor embedded in the U.S. imports is very small relative to the changes in the supply of skills taking place during this period.⁴

In view of this evidence from the U.S., I tentatively conclude that international trade is not the major reason for the increase in inequality, and therefore, limiting international trade is unlikely to be an effective way of reducing inequality.

³Increased outsourcing associated with international trade makes this fact harder to interpret (see Feenstra and Hanson, 1999).

⁴This is probably the weakest criticism against the trade view, and many studies have pointed out how international trade could have a larger effect on U.S. labor market prices in the presence of labor market rents. I discuss this below in Part 4 of the report.

3.7 Within Group Inequality

The framework developed so far is most directly applicable to what labor economists refer to as between-group inequality. Between-group inequality refers to the wage gap between workers with different characteristics, such as high and low education workers. The evidence from the U.S. suggests that much of the increase in overall inequality is accounted for by increases in within-group inequality, that is, increases in inequality among workers with similar characteristics.

Nevertheless, the framework here can also be used to think about within-group inequality, because the characteristics of workers we observe, such as education, age and sex, are only imperfect measures of their true skills. To illustrate this, take two workers with high education, but assume that they have different amounts of skills, for example, e_H and e'_H , because of different amounts of motivation or because they have attended different schools with different instructions. Neither of these differences would be observed in typical data sets. Within-group inequality therefore reflects the remuneration to these unobserved skills.

Now imagine that because of technical change, or some other reason, the skill premium, ω , increases. This change will not only cause a rise in between-group inequality, but will also increase the earnings gap between the two workers. Therefore, in this framework, the same forces that cause between-group inequality will also cause within-group inequality. This framework is therefore a convenient starting place for a discussion of within-group inequality as well. Nevertheless, the U.S. evidence shows that understanding within-group inequality is often harder. For example, while between-group inequality fell during the 1970s in the U.S., within-group inequality appears to have increased (Juhn, Murphy and Pierce, 1993, Katz and Autor, 1999). This suggests that a more appropriate model for analyzing changes in the distribution of wages is one that allows for different types of skills, with different remunerations. Although this type of model is interesting, it is beyond the scope of this report, and for the purposes of understanding the determinants of the rise

in inequality, its implications are not very different from the simple framework outlined here (see Acemoglu, 2000).

3.8 Concluding Comments

This section has outlined the standard framework for analyzing inequality. This framework is useful as it clearly distinguishes between the two crucial determinants of wage inequality: the gap of skills across workers and the price of skills. In turn, it also links the price of skills to relative supply of skills, technology and trade. In addition to making theoretical predictions, this framework also enables a quantitative assessment of some of these effects.

My conclusions from the literature in general, and the discussion above, can be summarized as follows:

1. Skill-biased technical change is likely to have been the major factor in the increase in wage inequality.
2. Changes in the relative supply of skills, due to increased education of the workforce or changes in immigration, can change skill prices. However, these effects take a long time to operate because the flow of new workers into the labor force is relatively small compared to the stock of workers. Moreover, when technology choices and development of new production methods are endogenous, changes in the relative supply of skills can have countervailing effects, substantially weakening the overall impact of the relative supply of skills on the price of skills.
3. International trade is also a crucial determinant of skill prices, and therefore income inequality. Nevertheless, the evidence from the U.S. shows that the increase in international trade has not been the most major factor contributing to the increase in inequality.

Therefore the overall conclusion from this framework is that the most effective way of combating inequality may be to change the distribution of skills within the society.

4 Other Important Determinants of Inequality

The previous part of the report outlined a standard framework based on competitive labor markets for thinking about the distribution of wages. Real world labor markets have many non-competitive elements, including imperfect information and rent-sharing. The presence of such elements often affects how wages are determined, and therefore how the relative supply of skills, skill gaps and technology determine the distribution of wages. In this part of the report, I discuss three important considerations:

1. Because of imperfect information, education may act as a signal. As well as the signaling role of education, I will discuss how selection into obtaining different amounts of education may affect the distribution of wages.
2. Unions often bargain on behalf of workers, and the decline in the bargaining power of unions, due to deunionization and other factors, may have reduced wages, and affected the distribution of wages between different types of workers.
3. There is an increasing sense that the composition of jobs, in particular the fraction of high-quality versus low-quality (good vs. bad jobs) has changed, and this has had a major effect on the distribution of income.

In this part of the report I review the literature related to these topics. I will conclude that although some of these factors may have been important, they do not affect the basic conclusions reached at the end of the previous part, and therefore call for policies similar to those emphasized in that part.

4.1 Education As a Signal and Selection

The above framework was firmly grounded in the human capital tradition of Becker (1964). It therefore emphasized the role of education in increasing human capital and productivity. A well known alternative view emphasizes that education acts as a signal (see Spence,

1974). For example, many in the business world argue that the degree of master of business administration (MBA) is as much a signal of ability and motivation as a real contributor to human capital.

To illustrate the basic notion suppose that education has no productivity enhancing role, but workers differ in their underlying ability,⁵ and ability increases productivity. Suppose also that there are two levels of education, high (e.g. college) and low (e.g. high school). The crucial assumption of all signaling models is that the cost of acquiring education is lower for high ability workers. This is motivated by arguing that high ability workers are not only more productive in jobs, but also more effective at learning, and completing the requirements for education.

In this hypothetical world, we can have a situation in which relatively high ability workers obtain education in order to signal that they are high ability. If these signals are credible, then employers will pay higher wages to workers with education, anticipating that these workers will be more productive because of their higher ability. Lower ability workers naturally would like to mimic this behavior, but because their costs of acquiring education are higher, they may not find this profitable.

Now imagine an increase in education, for example because the cost of education has declined. It will naturally be the workers with higher ability, among those who had previously not obtained high education, who now choose to acquire education. As a result, the average ability of those without education will decline. An implication of this reasoning is that as the fraction of those obtaining high education in successive cohorts increases over time, employers may start preceiving those without education as very low ability workers. This will in turn reduce the wages they're willing to pay to these workers, and contribute to the increase in inequality.

A related story emphasizes “selection” effects rather than signaling. In the signaling

⁵In this context, ability normally refers to all skills that are unobserved to employers, and does not need to be related to innate ability.

story, the imperfect information is between workers and firms: workers know their ability, and firms are trying to infer it from workers' education decisions. In the selection story, certain skills, such as those that were referred to as ability above, are observed by employers, but not by us in the usual surveys. So the imperfect information is not between agents in the economy, but between us, the analysts, and the agents. Then, as long as those obtaining education have higher ability than those not obtaining education, similar effects will arise. The average ability of those not obtaining education will be lower than those obtaining education, and more important, as average education increases, the average ability of workers not obtaining high education will decline. Since in this world employers observe ability and pay accordingly, their wages will also decline. Below I will explain in more detail how this mechanism works exactly.

There are a number of reasons for why the contribution of the signaling and selection effects to the increase in inequality appears to be limited.

A first qualitative piece of evidence suggests that signaling and selection effects cannot by themselves explain the recent changes in inequality in most countries: these effects by themselves suggest that inequality among educated and uneducated workers should move in opposite directions (for example, when education increases, there are more marginal workers added to the more educated group, and less marginal workers left in the less educated group). However, overall and residual inequality increased among both college graduates and high school graduates in the U.S.. This suggests that changes in the true returns to skills have played at least some role in the changes in inequality.

Second, theoretically it is not clear whether signaling and selection effects will really serve to increase the gap between the wages of high and low education workers. To discuss this issue, and also clarify how exactly the signaling and selection mechanisms are supposed to increase inequality, I now outline a simple model with two levels of education high $h = 1$ and low $h = 0$. Suppose wages are given by

$$\ln w_{it} = a_i + \gamma_t h_i \tag{8}$$

where h_i is a dummy for high education and a_i is unobserved ability. Define the (log) education premium—the difference between the average wages of high and low education workers—as

$$\begin{aligned}\ln \omega_t &\equiv E(\ln w_{it} \mid h_i = 1) - E(\ln w_{it} \mid h_i = 0) \\ &= \gamma_t + A_{1t} - A_{0t}\end{aligned}$$

where $A_{1t} \equiv E(a_i \mid h_i = 1)$ and A_{0t} is defined similarly. The increase in the education premium can be caused by an increase in γ_t (a true increase in the returns to skills) or an increase in $A_{1t} - A_{0t}$. There are basically two reasons for an increase in $A_{1t} - A_{0t}$: (1) changes in cohort quality, or (2) changes in the pattern of selection into education/signaling.

Consider changes in cohort quality first. If the high school system has become worse, we might expect a decline in A_{0t} without a corresponding decline in A_{1t} . As a result, $A_{1t} - A_{0t}$ may increase.

Alternatively and more central to the focus of this report, as a larger fraction of the population obtains higher education, it is natural that selection into education (i.e., the abilities of those obtaining education) will change. It is in fact possible that those who are left without education could have very low unobserved ability, which would translate into a low level of A_{0t} , and therefore into an increase in $A_{1t} - A_{0t}$. This is the essence of both the signaling and selection stories—as average education in a cohort (or labor market) increases, the workers obtaining education will be those who were high ability relative to the workers not obtaining education, but low ability relative to those already obtaining education. As a result, average ability in both high education and low education groups will fall. If the fall in average ability in the low education group is larger, then both signaling and selection mechanisms will serve to increase inequality.

Nevertheless, the theoretical effects of selection/signaling on the wage gap between high and low education workers is ambiguous. These interactions will depress not only

average ability among those not obtaining education, A_{0t} , but they will also depress A_{1t} , so the net effect is ambiguous. To see this more clearly, assume that there is perfect sorting—i.e., if an individual with ability a obtains education, all individuals with ability $a' > a$ will do so as well. In this case, there will exist a threshold level of ability, \bar{a} , such that only those with $a > \bar{a}$ obtain education. Next consider a uniform distribution of a_i between b_0 and $b_0 + b_1$, as drawn in Figure 4. Then, in Figure 4, A_0 and A_1 are given by the midpoints of the rectangles created by the thick line at \bar{a} . Specifically, $A_0 = \frac{1}{\bar{a}-b_0} \int_{b_0}^{\bar{a}} a da = \frac{\bar{a}+b_0}{2}$ and $A_1 = \frac{1}{b_1-b_0-\bar{a}} \int_{\bar{a}}^{b_0+b_1} a da = \frac{b_0+b_1+\bar{a}}{2}$. So both A_0 and A_1 will decline when \bar{a} decreases to \bar{a}' (they shift from the solid lines to the dashed lines). Moreover, $A_1 - A_0 = b_1/2$, so it is unaffected by the decline in \bar{a} . Intuitively, with a uniform distribution of a_i , when \bar{a} increases, both A_0 and A_1 fall by exactly the same amount, so the signaling/selection effects have no influence on the education premium. Clearly, with other distributions of ability, this extreme result will no longer hold, but it remains true that both A_0 and A_1 will fall, and whether this effect will increase or decrease the education premium is unclear. Overall, therefore, the effects of changes in selection on education premia is an empirical question.

Empirically, the evidence also suggests that signaling and selection effects have been limited. There are two types of evidence motivating this conclusion.

First, the importance of selection (and signaling) effects can be uncovered by looking at inequality changes by cohort (see Blackburn, Bloom and Freeman, 1992; Juhn, Murphy and Pierce, 1993). To see this, rewrite equation (8) as

$$\ln w_{ict} = a_{ic} + \gamma_t h_{ic} + \varepsilon_{cit} \quad (9)$$

where c denotes a cohort—i.e., a group of individuals who are born in the same year. I have imposed an important assumption in writing equation (9): returns to skills are assumed to be the same for all cohorts and ages; γ_t —though clearly they vary over time.

We can now define cohort specific education premia as

$$\begin{aligned}\ln \omega_{ct} &\equiv E(\ln w_{ict} \mid h_i = 1) - E(\ln w_{ict} \mid h_i = 0) \\ &= \gamma_t + A_{1ct} - A_{0ct}\end{aligned}$$

where $A_{1ct} \equiv E(a_{ic} \mid h_i = 1)$ and A_{0ct} is defined similarly. Under the additional assumption that there is no further schooling for any of the cohorts over the periods under study, we have

$$\ln \omega_{ct} = \gamma_t + A_{1c} - A_{0c}. \quad (10)$$

This implies

$$\Delta \ln \omega_{c,t'-t} \equiv \ln \omega_{ct'} - \ln \omega_{ct} = \gamma_{t'} - \gamma_t, \quad (11)$$

i.e., changes in the returns to education within a cohort will reveal the true change in the returns to skills. One can extend this discussion to the case in which h stands for unobserved skills, with the only difference that now we will have to look at some fixed percentile difference in the wage distribution (e.g., 90-10 difference). See the detailed discussion in Juhn, Murphy and Pierce (1993).

Nevertheless, the assumption that returns to skills are constant over the lifetime of an individual may be too restrictive. Murphy and Welch (1992), for example, show quite different age earning profiles by education in the U.S. labor market. Nevertheless, a similar argument can be applied in this case too. For example, suppose that returns to skills depend on age, s . Then equation (10) can be written as

$$\ln \omega_{cst} = \gamma_{st} + A_{1c} - A_{0c},$$

for cohort c of age s in year t . Suppose moreover that $\gamma_{st} = \gamma_s + \gamma_t$ (this assumption is also not necessary, but simplifies the discussion). Then

$$\Delta \ln \omega_{c,t'-t} = \gamma_{s'} - \gamma_s + \gamma_{t'} - \gamma_t,$$

where obviously $s' - s = t' - t$. Now suppose that we look at a different cohort, c'' that is age s' in the year t and age s in the year t'' . We have

$$\Delta \ln \omega_{c'', t-t''} = \gamma_{s'} - \gamma_s + \gamma_t - \gamma_{t''}.$$

Therefore, the double difference

$$\Delta^2 \ln \omega \equiv \Delta \ln \omega_{c, t'-t} - \Delta \ln \omega_{c'', t-t''} = \gamma_{t'} - \gamma_{t''}, \quad (12)$$

will reveal the true change in the returns to skills between the dates t'' and t' .⁶

Using data from the 1950, 1960, 1970, 1980 and 1990 from the U.S. censuses, Table 2 gives some of the single and double differences of cohort inequality for white men aged 26-55. The single differences show increases in the returns to college within most cohorts, with the exception of the years between 1970 and 1980. Therefore, these increases are likely to reflect differential age effects by education. In contrast, the numbers in Panel C for the 1950-70 period show no increases, suggesting that the double difference does a good job of controlling for selection effects. The numbers for the 1960-80 period are negative, which likely reflect the decline in the college premium between 1960 and 1980. The final row gives the most important results of this table. The 1970-90 double differences are large and positive, suggesting that the true returns to education increased over this time period in the U.S.. Interestingly, despite the well-known evidence that the college premium increased faster for younger workers over the 1980s, the results in Table 2 show that the true increase in returns to skills between 1970 and 1990 are comparable for cohorts born between 1936 and 1955. These results therefore indicate that the major component of the increase in the college premium during the 1980s and 90s in the U.S. was changes in skill prices, not selection/signaling effects.

⁶A different form of (8) would be $\ln w_{ict} = \gamma_t (a_{ic} + h_{ic}) + \varepsilon_{cit}$, which would imply that returns to observed and unobserved skills are the same. For the purposes of the exercise here, which is to show that there must have been an increase in the true returns to skill, γ_t , this is not a major difference. If γ_t were constant, then even with this more general form we would find that $\Delta^2 \ln \omega = 0$.

Table 3, which replicates Table 3 from Juhn, Murphy and Pierce (1993), shows that the increase in overall and residual inequality cannot be explained by composition effects either. For example, Panel A shows that the 90-10 differential for cohorts entering the market between 1935 and 1964 is approximately constant between 1964 and 1970, but increases sharply for each cohort between 1970 and 1976, and then increases further in 1982 and 1988. Panel B shows a similar picture for log wage residuals. These results suggest that the changes in the structure of wages observed over the past 30 years cannot be explained by selection or signaling effects alone, and these effects are likely to be limited.

The second piece of evidence that signaling effects are limited comes from results reported in Acemoglu and Angrist (2000). They estimate the effects of increases in average schooling in U.S. states between 1920 and 1960, driven by changes in compulsory schooling laws, on average wages. In the presence of signaling, average wages should increase by less than that implied by cross-sectional wage regression (i.e. by less than 6-8 percent, see for example Card, 1999). In the presence of significant human capital externalities, average wages should increase by more. Acemoglu and Angrist (2000) find that average wages increased by similar amounts to those implied by cross-sectional wage regressions. In other words, they do not find evidence for positive or negative human capital externalities. This evidence therefore suggests that the effects of signaling on wages are also limited.

4.2 Rent-Sharing in the Labor Market

Another important dimension ignored in the framework of Part 3 is the presence of labor market rents. In many labor markets, wages are not simply determined by marginal products, but reflect other factors. Two important ones are likely to be rent-sharing because of market power of workers and efficiency wages. If these rents were proportional to marginal product, the conclusions derived in Part 3 would apply. However, there are reasons for thinking that the extent to which workers receive these labor market rents

has changed over time, and it to may have changed differentially for skilled and unskilled workers (high and low education workers). For example, it may be the case that today managers and nonproduction workers receive at least as much in rents as before, while production workers receive fewer rents.

In the context of the U.S. labor market, there are three potential reasons why the distribution of labor market rents may have changed. First, worker rents depend on how effectively they bargain with their employers, which in turn is a function of how well they are organized. Unions have traditionally played the role of coordinating worker bargaining. The importance of unions in the U.S. labor market has declined over the past 30 years. This may have had two important implications: (i) since unions are typically stronger in manufacturing sectors, their weakening may have reduced the wages of semi-skilled workers in manufacturing; (ii) for ideological or other reasons, unions traditionally compress the structure of wages within firms (see for example Freeman and Medoff, 1984). Throughout the postwar period in the U.S. economy, unions negotiated the wages for many occupations, even indirectly influenced managerial salaries (see DiNardo, Hallock and Pischke, 2000). Unions also explicitly tried to compress wage differentials. The decline of unions may have removed this wage compression, increasing wage inequality. There is also evidence that wage inequality has increased more among non-unionized workers than unionized workers (see Freeman, 1991, DiNardo, Fortin and Lemieux, 1995, Card, 1996).

Second, the real value of the U.S. minimum wage has fallen sharply during the 1980s (see, for example, DiNardo, Fortin and Lemieux, 1995, and Lee, 1999). The minimum wage often increases the earnings of low-paid workers, and may cause overall wage compression, reducing inequality (e.g., Freeman and Medoff, 1984). So the erosion of the minimum wage may have shifted rents from workers to firms, and from low-paid workers to high paid workers.

The third reason why the distribution of rents in the labor market may have changed is related to the increase in international trade. Although I have argued that the direct

effect of international trade has been limited, there is a potential indirect effect of international trade which may have been important for the wages of some workers. Imagine a situation in which production workers receive rents because of bargaining. Increased international trade, or the possibility of outsourcing, will act to increase the bargaining power of employers, and through this channel, reduce labor market rents. This may have contributed to the decline in the wages of certain groups of workers (see, for example, Borjas and Ramey (1995), Rodrik (1996)).

Although all of these channels are likely to have contributed somewhat to the increase in inequality, there are unlikely to have been the major factors. There are three reasons for this:

1. It appears likely that deunionization and the decline in the real value of minimum wages have played at least some role in the increase in wage dispersion in the U.S. labor market (see Freeman, 1991, DiNardo, Fortin and Lemieux, 1995, Lee, 1999). Nevertheless, the timing of both deunionization and the erosion of the real value of the minimum wage suggests that these changes are not by themselves the major driving force of the increase in inequality. In the U.S., minimum wages started falling only in the 1980s, after the first large surge in inequality. U.S. deunionization also started in the 1950s, a period of stable wage inequality (Troy, 1990). During the 1970s, although unionization fell in the private sector, overall unionization rates did not decline much because of increased unionization in the public sector. Overall union density was approximately constant, around 30 percent of the workforce, between 1960 and 1975. It was the anti-union atmosphere of the 1980s and perhaps the defeat of the Air Traffic Controllers' Strike that led to the most major declines of the unions, once again dating the sharp declines in unionization after the rapid increase in inequality during the early 1970s.⁷

⁷An interesting recent paper Farber and Western (2000) date the major decline in union activity to the early 1980s, a few months before the Air-traffic Controllers Strike.

Evidence from other countries also paints a similar picture. For example, in the UK, wage inequality started its sharp increase in the mid 70s, while union density increased until 1980 and started the rapid decline only during the 1980s (Gosling, 1998). In Canada, while unionization rates increased from around 30 percent in the 1960s to over 36 percent in the late 1980s (Riddell, 1993, table 4.1), wage inequality also increased (for example, the 90-10 log wage differences were higher both among college graduates in high school graduates in 1986 than in 1975 and in 1979, see, e.g., Freeman and Needels, 1993, figure 2.4).

2. Wage dispersion in the U.S. increased in all occupations, even in those that had little contact with unions and that were not affected by minimum wages, such as lawyers, doctors, engineers etc. (e.g., Juhn et al, 1993). Moreover, wage inequality increased very similarly at the top and the bottom of the U. S. wage distribution. Figure 5 plots the behavior of the 90-10, 90-50 and 50-10 log wage differentials in the U.S. labor market. The 90-10 differential is a common measure of wage dispersion. The 90-50 gives how wage dispersion has changed at the top of the distribution, since it compares high earners to the median of the distribution. Similarly, the 50-10 differential shows how wage dispersion is change at the bottom. The remarkable feature in Figure 5 is that all three inequality measures track each other very closely. This suggests that similar factors have affected both the top and the bottom of the wage distribution. Many of the rent-sharing stories, however, suggest differential behavior, since, according to these stories, the rents of the relatively low earners are being cut.
3. If these rent-sharing effects were important, we would expect a large component of the increase in inequality to be due to changes in average wages across industries. Murphy and Welch (1992) show that the contribution of changes in average wages across industries (industry effects) is very small.

These considerations imply that changes in the distribution of labor market rents is unlikely to have been the major determinant of the changes in the wage and income distribution. This does not mean, however, that changes in these rents played no role in the changes in the wage structure nor that labor market imperfections are themselves unimportant. The decline in the real value of the earnings of low-paid workers in the U.S. is likely to be related to the declining power of the unions and the erosion of the minimum wage. I will discuss the importance of labor market imperfections further in the next part of the report.

4.3 Good Jobs Versus Bad Jobs

A variety of evidence suggests that major changes in the structure of firms have been taking place in the U.S. economy over 25 years. For example, team production and other high-performance production methods are now widespread in the U.S. economy (e.g., Ichinowski, et al. 1997, or Applebaum and Batt, 1994, Cappelli and Wilk, 1997). Yet in the meantime, many relatively high-paying manufacturing jobs that were previously open to low or semi-skilled workers have disappeared. Murnane and Levy (1996) report case study evidence consistent with these patterns. From their interviews with human resource personnel at a number of companies, they describe the change in the hiring practices of U.S. companies. A manager at Ford Motor company in 1967 describes their hiring strategy as follows: “If we had a vacancy, we would look outside in the plant waiting room to see if there were any warm bodies standing there. If someone was there and they looked physically OK and weren’t an obvious alcoholic, they were hired” (p. 19). In contrast, comparable companies in the late 1980s appear to use a very different recruitment strategy. Murnane and Levy discuss the cases of Honda of America, Diamond Star Motors and Northwestern Mutual Life. All three companies spend substantial resources on recruitment and hire only a fraction of those who apply. Kremer and Maskin (1999) provide evidence of more segregation of workers across establishments. It seems that high wage

workers are now much more concentrated in certain establishments.

Similarly, in Acemoglu (1999a) I documented a change in the composition of jobs over the past 20 years. Figure 6 here replicates a pattern found in that paper. This figure plots the total percentage of workers employed in the top 25 percent and bottom 25 percent industry-occupation cells (what I called Weight-at-the-tails of the job quality distribution). In other words, these are the cells (job types) that pay relatively high or relatively low wages. In 1983, 35 percent of employment was in the top and bottom 25 percent job categories. By 1993, this number had risen to just under 38 percent. So, approximately 2.5 percent more workers now have either higher or lower quality jobs rather than medium quality jobs.⁸ The actual changes in the distribution of jobs may be much larger than this since substantial changes in the types of jobs often take place within given occupations (industries).

Changes in the quality-distribution of jobs could be important for wage inequality. Many relatively low skill workers (for example high school graduates) previously worked in jobs that paid high wages, such as manufacturing jobs. When this type of manufacturing jobs disappears, this could increase wage inequality by forcing these workers to work for lower wages.

Although changes in the quality distribution of jobs are likely to have been an important intervening mechanism for the increase in inequality in the U.S., the fact that such changes have occurred does not overturn our main conclusions. Still technological changes that will increase the demand for skills, or even facilitate further changes in the quality distribution of jobs, are likely to increase inequality further. And the workers who lose out as a consequence of the changes in the quality distribution of jobs are those with low skills. Therefore, the most important objective of human capital policies should be to close the skills gap between the top and the bottom of the distribution.

Nevertheless, the presence of good and bad jobs introduces a number of new consider-

⁸This happens both with the weights at the left and right tails becoming larger (see Acemoglu, 1999a).

ations when we discuss other types of policies. There are also reasons to suspect that the economy may be under-supplying good jobs. In Acemoglu (2001), I argued that firms will typically underinvest in the creation of high-quality jobs. The reason is that such jobs naturally are more productive, but in the presence of labor market imperfections, this higher productivity will enable workers to bargain to higher wages. This means that the opening of the high-quality jobs creates a positive (pecuniary) externality in that it leads to higher wages for their employees. Firms do not take this externality into account, and therefore, tend to under-supply high wage jobs. This implies that a change in the quality distribution of jobs will not only increase inequality, but may also lead to a deterioration in the allocation of resources.

There are also other reasons why the quality distribution of jobs may be relevant for inequality. It may be argued that low-wage jobs (such as retail jobs or jobs in fast food restaurants) provide limited opportunities for on-the-job learning and human capital accumulation. As a result, a large fraction of “bad” jobs (low productivity jobs) may imply that the number of workers will not only receive low wages today, but will have few opportunities to move to higher wage jobs. One example for why this may happen is that retail or fast food restaurant jobs rarely offer extensive training. In contrast, many workers who take this type of jobs in the U.S., would be employed in some manufacturing establishments in Germany, where with the apprenticeship system, they would be receiving extensive training (Acemoglu and Pischke, 1998).

Nevertheless, there are also arguments against the point of view that we should care about what fraction of jobs are “good” (high-paying) and what fraction are “bad” (low-paying). For example, Topel and Ward (1992) document that a male worker in the U.S. will on average change six jobs during the first ten years of his labor market market experience. More important, they show that many of these job changes are associated with wage gains. The interpretation that they suggest is that there is a considerable amount of learning (or accumulation of match-specific human capital) taking place during the early

years of a worker's career, for example regarding what type of jobs this worker is suited to, etc.. The fact that wages increase rapidly during times of job change is consistent with this interpretation. This point of view therefore suggests that workers may often need to start from low-paying jobs, and then move to higher paying jobs. Although this evidence is interesting and to some degree convincing, the exact implications for the debate about good vs. bad jobs is unclear. The learning story does not suggest that workers should start from low productivity jobs in fast food restaurants and then move to higher paying manufacturing jobs. In contrast, they should start in sectors in which they suspect they will be a good match. Therefore, a plausible interpretation for Topel and Ward (1992)'s findings is that although there is some amount of learning, part of the movements out of low-paying into high-paying jobs reflects the fact that many young workers cannot find high-paying jobs at first.

Another relevant aspect is that certain policies are likely to affect the quality distribution of jobs (the fraction of good vs. bad jobs). In particular, policies that encourage wage compression, such as minimum wages or unemployment benefits, imply that firms will have to pay high wages to their employees. Once they realize that they will pay higher wages, it makes more sense for the employers to increase the productivity of their workers. Previously (i.e., before wage compression), some bad jobs which paid low wages but were also less productive may have been profitable for employers. However, once employers are forced to pay higher wages even in these low productivity jobs, they may opt for higher productivity jobs. Acemoglu (2001) demonstrates that this argument applies quite generally, and also provides empirical evidence suggesting that increases in minimum wages and unemployment benefits shift the distribution of employment from low-wage occupations to high-wage occupations. I return to this topic in the next part of the report.

4.4 Concluding Comments

This part of the proposal has surveyed additional determinants of wage inequality, including the effect of signaling and selection on inequality, the importance of changes in rent sharing, and the possible effects of changes in the composition of jobs. All three of these factors could in theory be important determinants of inequality, and even modify some of the conclusions reached at the end of the previous part. Nevertheless, I conclude that these considerations do not modify the main conclusions reached above.

In summary,

1. Although in the presence of signaling, increased education may contribute to increased inequality because low education workers may be viewed as low ability, this case is theoretically not very likely. Moreover, the evidence from the U.S. suggests that the importance of signaling and selection effects on wages are limited, and changes in selection and signaling appear to have played a relatively minor role in the increase in U.S. inequality.
2. Changes in the distribution of labor market rents, among workers or between workers and firms, are likely to have also contributed to the increase in U.S. inequality. Nevertheless, existing evidence suggests that these factors are not the major cause of the increase in inequality, but simply contributing forces.
3. On the other hand, there is evidence that the composition of jobs has changed significantly in the U.S. labor market, and these changes may have been important in affecting the distribution of wages. Nevertheless, the presence of such changes does not affect the conclusions reached at the end of the previous part.

Overall, I conclude that as emphasized in the previous part, the most effective policies for reducing inequality are likely to be those that close the skill gaps among workers.

5 Incentives to Invest in Human Capital

In this part of the report, I discuss incentives to invest in human capital. An understanding of these incentives is crucial for a discussion of human capital policies and their welfare implications.

The two important types of human capital investments are education and on-the-job training. While education investments are often made before individuals arrive in the labor market, training takes place concurrent with or after some labor market experience. This is by no means the only difference between education and training, however. While education often tends to be general-purpose, in the sense that the human capital that an individual acquires as a result of education can be used in a variety of different activities, training often provides human capital useful for specific tasks. Perhaps more important, while education decisions are made by an individual and his family, training investments are not only under the control of the individual, but are made jointly with the employer. This complicates the analysis, and raises a number of additional issues. For all of these reasons, I will discuss education decisions and training decisions separately.

A usual starting place for any investment problem is the observation that individuals who control the investment decision will choose the level that equates marginal benefit to marginal cost. In the case of education, there are many factors affecting costs and benefits, and the picture is also more complicated because families often play some role in determining their children's education investments.

5.1 Benefits of Education

A key determinant of the benefits to investing in education is the skill premium. When the skill premium—or more specifically in this case, the return to schooling—is larger, each year of schooling will have a higher financial reward for the worker. We may therefore expect schooling to increase when skill premia and wage inequality are high. This is good news, since it suggests that higher inequality will create a tendency for the relative supply

of skills to increase, and through the channels discussed in Part 3, this increase in the relative supply of skills may be expected to reduce inequality. Proponents of this view find support in the fact that U.S. college enrollment rose during the 1980s when the college premium was increasing sharply (e.g. Mincer, 1995, Topel, 1997). For example, Topel (1997) compares the increase in education in the U.S. to the behavior of enrollments in Sweden, and argues that the greater increase in enrollments in the U.S. is evidence for the view that greater inequality will encourage education, and will tend to self-correct itself.

Nevertheless, there is little evidence overall to guide our thinking on how important these effects could be. First, it has to be borne in mind that, as pointed out in Part 3, the effects of an increase in the relative supply of skills are likely to work slowly, and there may be a number of countervailing effects, such as the adjustment of technology to the increase in the supply of skilled workers.

Perhaps more important, a quick look at the data does not show overwhelming evidence that the effect of returns on education are large, or consistently in the direction predicted by simple economic theory. Acemoglu and Pischke (2000) analyzed the behavior of college enrollments across U.S. states. According to the simple economic reasoning discussed above, enrollments should have increased more in states where wage inequality and returns to schooling rose more substantially. In contrast, Acemoglu and Pischke do not find any evidence of such a correlation. Although migration of educated workers across states could explain the lack of such a correlation, Acemoglu and Pischke also show that the extent of migration is more limited than commonly believed, and migration does not appear to be arbitraging return to schooling differences. To further investigate this issue, one can look at the cross-country evidence. Acemoglu and Pischke also look at whether there has been more investment in higher education in OECD economies experiencing more rapidly increasing inequality. This cross-country evidence also failed to show any correlation between returns and higher education. This still leaves the large increase in enrollments in the U.S. labor market during the 1980s, a period during which returns

to schooling also increased.

I conclude that the evidence on the effect of returns to schooling on schooling decisions is ambiguous, and shows no clear evidence that higher returns to schooling have a large effect on education. So it would be too optimistic to rely on the self-correcting forces within the market.

5.2 Costs of Education

The other side of the equation determining education decisions are the costs faced by individuals. Here it is useful to distinguish between pecuniary and nonpecuniary costs. Pecuniary costs consist of the tuition and living expenses that individuals will incur during their schooling and foregone earnings because they will not be working during the period in which they receive education. I will discuss how various policies that affect these costs impact on education. For now it suffices to note that the consensus in the literature is that policies that reduce tuition costs or provide aid to students are highly effective. For example, McPherson and Schapiro (1991) and Leslie and Brinkman (1987) survey a variety of studies showing that higher tuition costs discourage college enrollments while aid encourages enrollments.

Here I will briefly discuss another component of these costs; costs of borrowing money, or more generally costs of imperfect consumption smoothing resulting from education investments. It is well known that in a world with perfect credit markets, individuals will invest an amount only determined by the marginal cost of investment and the marginal return. Whether they have high income during the period of investment is immaterial, since they can borrow at the going market interest rate, smooth their consumption, and then repay their loans during their employment period.

This separation between investments and consumption decisions no longer applies once we move away from perfect credit markets. For example, in the extreme case where individuals cannot borrow, investment in education will come at the cost of very

low consumption during the period of investment. Since individuals typically like to smooth consumption, i.e., they dislike periods of very low consumption, the effective cost of investing in education would be much higher, and education investments would be discouraged. An extreme case would be when individuals cannot borrow at all, and they do not have enough money to afford education. In this case, education becomes impossible. In many countries, these types of problems motivate the presence of education loans to enable students to attend school. I will discuss such policies in the next part of the report as well.

It is also useful at this point to touch upon nonpecuniary costs of education. Education is a substantial investment not only in terms of money, but time and life plans. How individuals value the time they spend learning will clearly be an important determinant of whether they will undertake these education investments. We can think that sociological/psychological factors that determine how education is valued will therefore affect costs of education. Most important among these factors may be family and peer group effects: that is, how the immediate family and friends of an individual value education. This may be an important determinant for why individuals who grow up in inner cities, or poor neighborhoods with little education, are themselves less likely to obtain education. I will return to these issues as well in the next part.

5.3 Market Failures in Education Decisions

Although the main focus of this report is how human capital policies can be used to reduce inequality, such a discussion cannot be separated from whether there is underinvestment in education. For example, imagine a hypothetical situation in which, because of government support for education, all individuals are already receiving more education than the socially optimal amount. In this case, further human capital policies could be used to encourage more education, but since there was overinvestment in education to start with, any further increase in education would have high costs, not only in terms of money

spent, but also in distorting the allocation of resources. In contrast, in a society in which there is underinvestment in education, human capital policies that encourage education may have a double benefit: reducing inequality and improving the allocation of resources. These considerations motivate a careful discussion of whether there are market failures in education, and whether these are likely to lead to under or over-investment.

There are a number of reasons for market failures in education:

1. As discussed above, credit market problems may prevent individuals from choosing the right amount of education. This will typically lead to underinvestment in education.
2. Often, education decisions are not taken by individuals alone, but by their families. For example, families often contribute towards schooling expenses. However, parents may be only imperfectly altruistic, that is, they may not care sufficiently about their children. In this case, they will tend to underinvest in their children's education.
3. There may also be human capital externalities, in the sense that the productivity of a worker may increase in the human capital of other workers in the economy. An obvious case where this could apply is that of scientists. High human capital scientists are more likely to make new discoveries, in which case other scientists could build on these discoveries, to make new ones. In less extreme forms, similar type of externalities because of exchange of ideas may arise in a number of occupations. Moreover, in Acemoglu (1996), I showed that pecuniary human capital externalities may arise when labor markets are not perfectly competitive: when there are more skilled workers in the labor market, firms invest more in their physical capital anticipating to produce with these workers, and as a result, all workers benefit from these larger physical capital investments. Because individuals only take into account their own private returns, human capital externalities will also imply that

there will be underinvestment in education.

4. There can also be externalities on the cost side. Recall the discussion of peer group effects where the costs of education are determined by the attitudes of friends and neighbors. An individual who invests in education is more likely to have a positive attitude towards education. Therefore, an individual, by investing in education, does not only increase his own returns, but also affects the costs of people around him. Once again, individuals will not take this type of externality into account, and underinvest in education.
5. A final market failure will arise because of imperfect information regarding ability. As discussed in Part 4, when there is such informational imperfections, education may act as a signal. However, when education acts as a signal, it not only increases the wage of the worker who has invested, but also reduces the wages of those not obtaining education (this is because those not obtaining education are then perceived as lower ability). In this case, we may expect overinvestment in education.

Before a further discussion of these issues, it is useful to note that these market failures refer to the case in which there is no government intervention. Clearly, in all countries governments are heavily involved in providing and subsidizing education. So it is possible that even though in the absence of government intervention there would have been underinvestment in education, due to government intervention the amount of investment may be greater than optimal. This caveat has to be borne in mind in the discussion of market failures in education.

Taking all of these issues into consideration, is there likely to be under or overinvestment in education? This is a very difficult question to answer, and there is no single study that takes all of these aspects into consideration. Therefore, in my discussion I will focus separately on two aspects: how important are credit market problems? And, how important are human capital externalities and signaling effects? I will start with a

discussion of how important credit market problems are, and then turn to an assessment of the joint significance of signaling issues and human capital externalities.

Although the proposition that credit market problems will affect education decisions, and cause underinvestment appears plausible, its importance in relatively developed economies may be limited. In most OECD economies, individuals have access to loans and there is already some public financing of investment. Despite these existing loans and subsidies, are credit market problems still important?

There is a way of investigating this question directly. The prediction of standard theory in the absence of credit market problems is very clear. The income of the family or the individual contemplating education should play no role in this decision: as pointed out above, education is a pure investment decision, so individuals should undertake the correct amount, and use the credit market to smooth their consumption. This of course does not mean that all individuals should choose the same level of education. There may be ability differences, or other differences, dictating that different individuals should invest up to different levels of schooling. For example, children with more educated families may find it easier to invest in education, because of family support or other issues, so may invest to a higher level even in the absence of credit market problems. So it is important to control for such differences in an investigation of whether family resources and income matter for education decisions.

Although there are numerous studies investigating the impact of family resources on education outcomes, whether income truly matters is still a hotly debated issue. Early studies in this area have been surveyed by Haveman and Wolfe (1995). Most studies just relate schooling outcomes to family income in OLS equations. However, in ordinary least squares (OLS) regressions, family income may be proxying for family characteristics affecting “the education production function” (Lang and Ruud, 1986). In fact, many studies find that including parents’ education and controls for type of school attended previously or test scores substantially reduce the effect of the family income on children’s

education (e.g. Cameron and Heckman, 1999, Ellwood and Kane, 1999, or Cameron and Taber, 2000). Nevertheless, such estimates of the income elasticity of education may be seriously biased downwards. First, there are substantial measurement error and transitory movements in incomes measured at a point in time. Both of these factors will attenuate the effect of income on education, or in other words, they will create a downward bias in the estimates of the effect of family income on education. This attenuation bias will be worse if other variables correlated with permanent income, like parents' education or the type of secondary school chosen, are included as controls. Intuitively, these other variables will capture some of the true effect of family income, because they are correlated with family income, and our measure of family income is less than a perfect measure. As a result, the estimate of the income effect may be substantially understated. Second, test scores and previous schooling experience are likely to be endogenous and also affected by family income, so their inclusion may lead to biased estimates.

A different strategy is to exploit exogenous variation in parents' income. The negative income tax experiments provide the only experimental study of the effect of income on schooling, but they confound the effect of income with changes in marginal tax rates affecting the decisions of youths to work (see e.g. Venti, 1984). A few recent studies have made other attempts to address the possibility that income may also be correlated with unobserved factors which predict schooling outcomes of the child. Duncan et al. (1998) use sibling differences arguing that family income varies while other family characteristics remain the same. Shea (2000) uses industry and union wage differentials and income changes due to job displacement as instruments for family income and argues that these proxy "luck." He finds no effects of parental resources on education, but his estimates are quite imprecise. Both of Shea's instruments are also not entirely convincing, since they are likely correlated with parental attitudes towards education. Perhaps more interesting is Duflo (2000) who exploits the expansion of old-age pensions in South Africa to analyze the effect of family resources on child health. Like education, child health should be unaffected

by family resources in the presence of perfect credit markets, since it may be thought to correspond to a type of investment. Duflo finds positive effect of resources on health, though given the differences in the level of development between South Africa and OECD economies, it is not clear whether these results can be generalized to OECD economies or New Zealand. Mayer (1997) also finds an effect of family income on education, using a variety of methods. However, she also emphasizes that the effect of income is quite small, and nonincome characteristics of families are likely to be much more important in shaping children's education.

Finally, Acemoglu and Pischke (2001) exploit the changes in the distribution of family income in the U.S. that have taken place over the past 30 years to estimate the effect of parental resources on college education. This strategy exploits the fact that families at the bottom of the income distribution were much poorer in the 1990s than they were in the 1970s, while the opposite is true for families in the top quartile of the distribution. This approach is attractive since it exploits variations in family income caused by changes in the U.S. income distribution, which are unlikely to be correlated with other (observed and unobserved) characteristics affecting education choices. Their estimates suggest large effects of family income on enrollments. For example, they find that a 10 percent increase in family income is associated with a 1.4 percentage point increase in the probability of attending a four-year college.

Overall, the evidence on whether family income matters for education decisions and hence whether credit market problems are important is mixed. My own reading is that there is evidence suggesting that credit market imperfections are important, but given the already existing levels of subsidies for education, it is not clear whether this evidence calls for further subsidies. A more sensible policy may be to expand existing loan programs for investment in higher education. If credit market problems are not important, the expansion of such loan programs would not have any adverse effects, and if credit market problems are important, such programs could be very useful. I return to this topic in the

next part of the report.

What about human capital externalities and signaling? I combine the discussion of these two topics, because the same type of evidence is useful in evaluating the aggregate implications of both. When there are significant human capital externalities, the social return to human capital will exceed the private return. More specifically, define the social return as how much the society benefits from a given increase in the human capital of all workers—for example, a one-year increase in the education of all employees. The private return, on the other hand, is how much an individual benefits from increasing his/her education. There are many reasons for the social and the private returns to differ. For example, if other factors of production, such as capital, are in scarce supply, these two returns could differ. More important and interesting for our purposes, they will also differ if either human capital externalities or signaling are important.

When human capital externalities are important, an individual becomes more productive as a result of others in the economy increasing their human capital. This would immediately imply that social returns are greater than private returns. If, on the other hand, schooling has signaling value, social returns to education will be less than private returns. In the extreme case where schooling does not increase human capital but is only a signal, aggregate income is unchanged when all workers increase their schooling by one year, so social returns are zero.

This discussion suggests that by comparing social and private returns, we can see whether human capital externalities or signaling are important. If social returns exceed private returns, human capital externalities would be important, and if private returns exceed social returns, signaling would be important. How can we measure social returns?

One method of investigating the difference between private and social returns is to look at what happens to earnings or wages in a given labor market when there is a large increase in the human capital of all the workers there. More straightforwardly, we can look at the effect of changes in average schooling (human capital) in a labor market on

the wages of participants. In particular, recall that the labor literature has estimated equations of the following form:

$$\ln w_i = \gamma \cdot s_i + X_i' \cdot \beta$$

where $\ln w_i$ is log earnings or wages of individual i , s_i is his/her years of schooling, and X_i is a set of other controls, including experience, sex, geographic and demographic controls. The typical estimate of γ is between 0.06 and 0.1, indicating that a one-year increase in education increases individual earnings by between 6 and 10 percent (see for example Card, 1999, Angrist and Krueger, 1991).

To find out the the difference between social and private returns, we can run an extended version of this regression of the form

$$\ln w_i = \gamma \cdot s_i + \theta \cdot \bar{S}_i + X_i' \cdot \beta$$

where \bar{S}_i is average schooling in the labor market in which individual i is working. In this regression, θ is the difference between social and private returns (or what Acemoglu and Angrist, 2000, call external returns). When all individuals in a given area increase their education by one year, wages increase by a factor of $(\gamma + \theta)$, so when $\theta < 0$, social returns are less than private returns, and conversely when $\theta > 0$, social returns are greater than private returns.

Rauch (1993) is the first attempt to estimate a regression of this form. Rauch's results suggest that there are externalities on the order of 3-5 percent, though he also reports some considerably larger estimates. Rauch's estimates are driven by differences in average schooling across cities. But higher incomes might cause more schooling instead of vice versa. Cities with greater average schooling may also have higher wages for a variety of other reasons.

To solve this problem, one needs to identify an exogenous source of variation in average human capital in a given labor market. Acemoglu and Angrist (2000) accomplish this by

using differences in compulsory schooling laws across U.S. states. More specifically, they exploit differences in compulsory attendance laws and child labor laws in U.S. states between 1920 and 1960, which had large effect on average education in these states. They find that θ is positive, but very small, typically in the order of 0.01, and statistically not significant. This evidence suggests that the extent of human capital externalities are limited, and social returns do not significantly exceed private returns. The fact that θ is almost always positive also rules out significant signaling effects.

5.4 Training in Competitive Labor Markets

Academic economists have been interested in training for a long time. Pigou (1912) argued that firms would not have efficient incentives to invest in their workers' skills because trained workers can quit to work for other employers who can use these skills. Rosenstein-Rodan (1943), in his famous article on the "big push", not only pointed out the importance of market demand, but also of skills, and noted that training of workers was a prerequisite for industrialization, though unlikely to happen. These early contributions, therefore, emphasized the difficulties faced by a market economy in achieving the right level of investment in worker skills. The policy prescription from these studies was that government subsidies were necessary for on-the-job training as well as for schooling.

Current thinking on training is shaped by the seminal work of Gary Becker, which reaches quite different conclusions. Becker (1964) drew a crucial distinction between general and specific skills. General skills are defined as those which are also useful with other employers. In contrast, specific skills increase the productivity of the worker only in his current job. Notice that general skills in Becker's sense are not the same as general-purpose skills as defined above. General-purpose skills are those that are useful in a variety of tasks, and they may often be more abstract skills. General skills in this context, in contrast, may be highly specific to a certain task or industry. But they are general in the sense that the skills are not only useful with a single employer, but with a variety

of employers. Therefore, the labor market for such skills can be competitive with many firms competing to employ the worker who possesses the skills.

Becker pointed out that Pigou's arguments apply to general skills. In fact, in a competitive labor market where workers receive their marginal product, firms could never recoup their investments in general skills, so they will never pay for general training. However, Becker noted, workers themselves will have the right incentives to improve their general skills because in competitive markets, they are the sole beneficiaries of the improvements in their productivity. Moreover, workers can undertake such investments quite easily by accepting a lower wage than their productivity during the period of training. This argument appears to account well for the apprenticeship systems of earlier centuries, where apprentices often paid fees or worked for very low-pay until they mastered a certain trade. Becker also argued that training in specific skills was quite different because workers would not benefit from higher productivity when they changed jobs. Firms therefore could recoup their investments in specific skills and would be willing to share some of the costs of specific training investments.

An important conclusion of this work is that there need not be any market failure in training. As long as workers can pay for training, either out of their pockets or by taking lower wages, the right amount of investment would be undertaken. So insufficient investment in skills could only arise because workers are severely credit constrained. But in this case, the solution may be better loan markets rather than direct subsidies to training. Becker's seminal contribution, therefore, seriously questions the argument in favor of government regulation and subsidies for training.

To explain more clearly why firms will not invest in the general training of their employees, but workers will have the right incentives, and what may go wrong in the presence of credit market problems or contractual imperfections, it is useful to consider a simple model. Suppose that a worker is hired at time 0 during which he can be trained, and then he becomes productive at time 1. Let me normalize the productivity of the

worker during time 0 to zero, and denote the output of the worker at time 1 by $f(\tau)$, where τ is his level of training. Training costs $c(\tau)$, there is no discounting, and all parties are risk-neutral. Figure 7 draws these two functions. Assume that all skills are general in order to focus on the case of interest for our purposes, so the productivity of the worker is $f(\tau)$ in other firms as well.

Denote the wage of a worker with training τ at time 1 by $w(\tau)$. A competitive labor market corresponds to the case where many firms compete for the labor services of the worker at time 1, ensuring that $w(\tau) = f(\tau)$. If this were not the case, every firm would be willing to hire the worker, creating excess demand for his labor services. The significant feature is that the wage of the worker at the initial employer is no different than the wage the worker can obtain at a different firm, because all of his skills are general and there are no mobility costs. This immediately implies that the firm will not pay for the worker's training as it would not be able to recoup its investment costs.

So if the firm will not pay for training in a competitive labor market, will the worker? To answer this question, first consider the hypothetical case where the worker can choose the amount of training and has the resources to pay for it. It is clear that in a competitive labor market, the worker is the residual claimant of the returns generated by the training investments. He will therefore choose the efficient amount of investment, given by $\tau^* > 0$ where $c'(\tau^*) = f'(\tau^*)$, as shown in Figure 7. This is the outcome discussed by Becker. The market achieves the efficient level of training without firms making any investments in worker skills. There are, however, two important requirements for this to happen.

The first is that the worker must have the resources to invest in training. In the case we have just described, the worker is not productive during time 0. He must therefore make a payment to the firm to compensate for the expenses that the firm incurs. In practice, most on-the-job training is not full-time, so the worker can take part in some productive activities. This would enable him to bear the costs of training by taking a wage cut, rather than making a payment to the firm. Such wage cuts are costly, however,

when credit markets are imperfect and workers have a desire for smooth consumption. For example, with a concave, time separable utility function, the worker would like to have the same level of consumption in both periods. Taking a wage cut at time 0, without a possible loan, would take him away from his desired consumption path. Hence, even when workers are productive during their training, efficient investment in skills requires perfect loan markets. These are unlikely to exist because of the inherent moral hazard and adverse selection problems. So the ability of workers to invest in training is likely to be limited in practice.

There is a second condition for workers to be able to invest in general skills. As pointed out above, training is different from schooling in that training investments have to be undertaken jointly by firms and workers. Although workers can take vocational courses, many skills are best learned by on-the-job training, combining production, learning-by-doing, and mentoring by more experienced colleagues. However, the employment relation gives the control over the worker's time to his employer. It is therefore possible for a firm to pay a low wage with a training promise, and then use the worker in regular production activities.

This possibility could be avoided if what constitutes training were easily observed by courts, so that employment contracts could unambiguously specify the training obligations of the employer. Nevertheless, since important parts of the training program are intangible, involving mentoring, advice and practice, it is quite hard to specify them in advance and monitor the firm's compliance in individual cases. This problem might be overcome in a dynamic world, where a firm that does not deliver on its training promises would develop a bad reputation. But, training practices inside the firm are hard to observe by outsiders, and returns to training depend on individual worker's ability and effort, making it hard to infer training from future earnings of workers. So this reputation mechanism is also highly imperfect. With this reasoning, for example, outside agencies and works councils in Germany monitor the curriculum and implementation of apprenticeship pro-

grams and credential skills. We should therefore view the contracting difficulties between firms and workers as an additional constraint on workers' ability to "buy" training in the workplace.

The above discussion shows that worker investments in general training may not reach the efficient amount because of credit market problems or contractual problems between firms and workers. But more important for Becker's theory of training is the prediction that firms should never invest in the general skills of their employees. How successful is this prediction? Firms very often invest in the skills of their employees. The standard theory explains the training investments we observe in practice either by pointing out that the skills are specific, or by arguing that the workers are effectively paying for these investments by taking a wage lower than their productivity. A body of evidence, however, questions the validity of this explanation.

First of all, while most skills may be industry specific, they are likely to be "general" because typically there are many firms in the same industry using similar technologies. For example, the know-how to use a printing machine is of limited use outside the printing industry, but firms within the same industry would find such know-how very valuable. Skills acquired in the course of a training program therefore can be specific only if they relate to a technology or practice used solely in that firm. Since most technologies and practices are common across firms, most skills acquired in training programs are likely to be general. Therefore, the standard theory can explain the presence of training programs only by arguing that workers are paying for the full costs of these programs.

And yet, there is evidence suggesting that in many instances of training programs the content is general and firms still bear a significant fraction of the costs. Three studies estimate the net cost of apprenticeship programs to employers in Germany. They survey training firms about their accounting costs and apprentice productivity to assess the net cost of training. The most careful of these was conducted in 1991 by the Federal Institute for Vocational Training (Bundesinstitut für Berufsbildung) and is described in

von Bardeleben, Beicht, and Fehér (1995). The first step is to calculate gross costs as the sum of the payroll costs of apprentices and training personnel, costs of material, equipment, and structures used in the training, and direct costs of any external training that the firm pays for. In addition, the studies assess apprentice output, by surveying supervisors about the jobs done by apprentices, and their productivity. A money measure of the output contribution is constructed by multiplying the time spent in productive activities with the payroll costs of a skilled worker and the relative apprentice productivity. Acemoglu and Pischke (1998) survey the results of these studies and show that under a variety of alternative assumptions, there are very substantial costs borne by employers in these training investments. Overall, the evidence therefore suggests that even under conservative assumptions, large German firms bear a significant financial cost in providing general training to their apprentices. Similar studies exist for other countries. For example, Ryan (1980) examined welder apprentices at a US shipyard, and Jones (1986) looked at apprentices in British manufacturing. All of these studies find substantial net costs for training apprentices.

There are also many examples of firms that send their employees to college, MBA, literacy programs, or problem solving courses, and pay for the expenses while the wages of workers who take up these benefits are not reduced. In addition, many large companies, such as consulting firms, offer training programs to college graduates involving general skills. These employers typically pay substantial salaries and bear the full monetary costs of training, even during periods of full-time classroom training.

On the basis of these evidence, Acemoglu and Pischke (1999a,b) conclude that we need to go beyond the simple models of training. They argue that only in imperfect competitive labor markets firms will have incentives to invest in the general skills of their employees. I discuss this issue next.

5.5 Training Investments in Non-Competitive Labor Markets

As noted above, noncompetitive elements are likely to be important in many labor markets. I argued, however, that these noncompetitive elements were unlikely to change many of the insights of the supply-demand framework regarding the causes of the recent increase inequality in the U.S.. In contrast, the presence of noncompetitive elements in the labor market will change the incentives to invest in training radically.

To start with, let me consider Figure 8, and assume that wages are given by $w(\tau)$ as drawn in the figure. I continue to assume that all skills are general. The function $w(\tau)$ specifies the wage that the firm has to pay a worker with training τ . The key feature is that wages are below the productivity of the worker, so the situation depicted in the figure is not consistent with a perfectly competitive labor market. Instead there are rents in the employment relation accruing to the employer (i.e. there is some monopsony power). To see why this is important for firm-sponsored training, notice that if the firm could never pay a worker below his productivity, it could not recover the up-front costs of training (see Acemoglu and Pischke 1999a for a detailed discussion of mechanisms that lead to such rents).

The second and more important feature is that the wage function is increasing in the level of training less steeply than productivity, so the gap between productivity and the wage, $\Delta(\tau)$, is higher at greater levels of skills. Acemoglu and Pischke (1999a) refer to this type of wage structure as a *compressed wage structure*, since the return to skills for a worker is less than the one prevailing in a competitive labor market. The gap between the two curves in the figure, denoted by $\Delta(\tau)$, is the profit that the firm makes from employing the worker (gross of training costs, if any): its revenues are equal to $f(\tau)$, and its cost is equal to the wage, $w(\tau)$. Therefore, with the wage function drawn in Figure 7, the firm prefers a more skilled worker to a less skilled one. This contrasts with the situation in the perfectly competitive labor market where profits from skilled and unskilled workers were equal, i.e. $\Delta(\tau) = 0$ for all τ , and so the firm was indifferent regarding the skill level

of its employee. In the non-competitive labor market outlined in Figure 8, the firm may therefore want to invest in the skills of its employees so as to increase its profits.

To see this more clearly, suppose that workers themselves cannot invest in training at all. Then, inspection of Figure 8 shows that the firm will provide and pay for training up to $\tau^f > 0$, given by $c'(\tau^f) = f'(\tau^f) - w'(\tau^f)$. In other words, the firm would choose the level of training by setting the marginal change in the second period profit equal to the marginal cost of training.

It is important to emphasize that, due to labor market imperfections and monopsony power, workers are not being paid their full marginal product even though the skills are general. So general skills are being rewarded as if they were (partly) specific. Labor market imperfections therefore turn general skills into *de facto* specific skills.

Observe also that wage compression is necessary for firm-sponsored training. Suppose the wage function were $w(\tau) = f(\tau) - \Delta$ as drawn by the dashed line in Figure 7. In this case, in contrast to a perfectly competitive labor market, the worker is paid less than his productivity, so there are rents and monopsony power. But because the gap between productivity and the wage is independent of the skill level of the worker, the firm has no interest in increasing the worker's skills, and there is no firm-sponsored training.

Why is it useful to contrast competitive and noncompetitive models of labor markets in a discussion of training investments? In addition to challenging the prediction that firms should never invest in the general training of their employees, models of training with imperfect labor markets make a very different prediction from the Becker model. In the Becker model, the worker is the residual claimant of the returns from investment in general training. Therefore, the forces shaping investment in general training should be very similar to those affecting education decisions. In particular, greater returns to training, in the form of higher wages for trained workers, should encourage further training. Perhaps at first paradoxically, models with imperfect labor markets make a very different prediction. When firms undertake investments in general training, as is often the case,

the lower are the wage returns to training (for a given productivity of training in terms of future production), the greater are the incentives of firms to invest in training. In other words, when trained workers are paid less, wages will be more compressed, and as a result, firms will have greater incentives to invest in training.

This contrast between competitive and noncompetitive models of the labor market is important in a discussion of how to reduce inequality. As pointed out before, a direct way of reducing earnings inequality is by legislating policies that induce wage compression (minimum wages, for example). Many economists fear the adverse allocational effects of these policies, and Becker's theory of training also suggests that these policies will discourage further investments in human capital. The scorecard for these policies therefore appears very negative. However, in the presence of noncompetitive labor markets, these policies may in fact encourage investments in training, and be therefore much less costly than often perceived.

What is the evidence on the relationship between wage compression and training? There is no clear consensus, in part because we do not know how to measure wage compression. The concept of wage compression refers to differences between wages relative to marginal product. Since marginal productivities of workers are not observed, wage compression is also not observed. Therefore, investigations of this question have to rely on proxies for wage compression. I will discuss three types of evidence of this sort. First, minimum wages directly compress the wage structure, so we could look at the relationship between training and minimum wages. Second, as pointed out above, unions often compress the structure of wages, so we can look at the effect of unions on training investments. Finally, there is a general consensus that the degree of wage compression varies across countries because of differences in labor market institutions. So we can also study the cross-country relationship between returns to skill and training.

Part of the literature investigating the impact of minimum wages on training in the U.S. focused on whether minimum wage laws lead to slower observed wage growth in micro

data. This type of evidence may be useful in understanding the effect of a minimum wage on training investments, because training investments will increase the productivity and therefore the wages of workers later in their careers. A steeper age-earnings profile can therefore be interpreted as corresponding to more investment in training. Both Leighton and Mincer (1981) and Hashimoto (1982) have found this to be the case and concluded that minimum wage laws lead to less training. This evidence on wage growth does not necessarily imply that less training takes place, however. Since minimum wages cut the lower tail of the wage distribution, and typically create a spike at the minimum, they would appear to reduce the slope of age-earnings profiles even when they have no effect on training. In fact, in the presence of noncompetitive elements in the labor market, even though minimum wages may increase training, they unambiguously reduce the slope of age-earnings profiles. Grossberg and Sicilian (1997), for example, find no effect of minimum wages on training, but still find lower wage growth for minimum wage workers. Furthermore, Card and Krueger (1995) compared cross sectional wage profiles in California before and after the 1988 minimum wage increase with a number of control states. They also found flatter profiles in California after the minimum wage increase. However, they point out that the Californian profile also shifts up and does not cross the previous age-wage profile, which is inconsistent with the competitive theory, and accords well with the predictions of non-competitive theories.

Given the difficulty of interpreting changes in the slope of wage profiles, it is more compelling to look at the impact of minimum wages on training directly. Leighton and Mincer (1981) use worker reported data on the receipt of training from the Panel Study of Income Dynamic (PSID) and the National Longitudinal Survey. They find that workers in states with more binding minimum wages receive significantly less training. Cross state comparisons may be confounded by the presence of other state effects, however. For example, industrial and occupational composition of employment varies substantially across states, and different industries and occupations have different skill requirements.

These considerations suggest that across state comparisons are hard to interpret. Schiller (1994) reports a similar finding using later data from the National Longitudinal Survey of Youth (NLSY) by comparing the training incidence of minimum wage workers with those earning higher wages. The evidence from this study is even harder to interpret because worker traits which lead to higher pay are typically also associated with more training. Grossberg and Sicilian (1997) use the Employment Opportunities Pilot Project (EOPP) data and compare minimum wage workers both to workers earning slightly less and slightly more, ameliorating the problem of worker heterogeneity somewhat. They find insignificant negative effects on training for male minimum wage workers and insignificant positive effects for women.

Some of these problems are overcome by Neumark and Wascher (1998), who use Current Population Survey (CPS) supplements to compare the impact of minimum wages on training within states using comparisons of young workers in 1991 with older workers (who are unlikely to be affected by the minimum wage) and with young workers in 1983. These comparisons assume that state differences in training levels over long periods are the same for younger and older workers or over long time periods, which is a stringent requirement. They find negative effects of minimum wages on training, which seem to be too large, especially since not all young workers are affected by the minimum wage. This suggests that the fixed effects assumptions is suspect.

Acemoglu and Pischke (2000) analyze the effect of minimum wage increases on worker training using the NLSY for the period 1987 to 1992. This period encompasses a number of state minimum wage increases as well as two hikes in the federal minimum wage in 1990 and 1991. The federal increases had very different impacts on low skilled workers in high and low wage states (Card (1992)). Thus, this analysis uses within state variation in minimum wages for a homogeneous group of workers. Acemoglu and Pischke find no evidence of a reduction in training in response to minimum wages. On the contrary, most of their estimates show that higher minimum wages are associated with somewhat greater

training incidents, though these effects are typically not statistically significant. Zero or small positive effects of minimum wages on training investments for workers near the minimum wage are inconsistent with the standard theory of human capital, while they are what non-competitive theories predict.

The evidence on the impact of unions on training is mixed. Many studies look directly at the impact of unions on training. Duncan and Stafford (1980) use the PSID, Lillard and Tan (1992) use the CPS, and Barron, Fuess, and Loewenstein (1987) use the EOPP and find negative effects of union status on training. Barron, Berger, and Black (1997), on the other hand, report insignificant union effects using the EOPP data and find positive effects for formal training in the SBA data. Lynch (1992) also finds positive effects for formal training in the NLSY (National Longitudinal Study of Youth). For the UK, Booth (1991) reports more training for union workers, and Green (1993) finds more training for unionized workers in small establishments but not in large establishments. Overall, this evidence does not give strong support either to competitive or non-competitive theories.

It is also useful to look at the relation between returns to skill and training across countries which have different wage structures. In the mid 1980s, the log difference of ninetieth and tenth percentile wages was 1.73 in the US and 1.11 in the UK as opposed to 0.83 in Germany, 0.67 in Sweden, 1.22 in France and 1.01 in Japan (OECD (1993)). These differences in wage structures suggest that returns to training are also likely to be compressed in Germany, France, Sweden and Japan as compared to the US and the UK. In line with the predictions of the non-competitive theories, the incidence of company provided *formal* training appears to be higher in Europe and Japan than in the US: OECD (1994, Table 4.7) reports that 23.6 percent of young workers in France, 71.5 percent of those in Germany and 67.1 percent of new hires in Japan receive formal training. By way of comparison, only 10.2 percent of US workers receive any formal training during their first seven years of labor market experience. However, comparisons of training levels across countries are difficult because the data are collected using different methods, and

the measured training levels are not easily comparable. Perhaps more important than the level of training in different countries is the observation that firms seem to be more likely to bear the costs of general training in Europe than in the US. In Germany, vocational skills are typically learned in apprenticeships and as pointed out above, large firms have sizable net costs for this type of training. Comparable skills are more often learned in community colleges and vocational schools in the in the US, and paid for by the trainees themselves. This pattern is in line with the predictions of the non-competitive theories.

5.6 Market Failures in Training?

In this section, I discuss the policy implications of the non-competitive theories of training outlined so far. Although our state of knowledge is not advanced enough to make precise policy recommendations, a brief discussion of whether the amount of training achieved by the market economy is likely to be efficient is useful.

Recall that in the standard theory of human capital, training investments are efficient if workers are not liquidity constrained. In this theory, government intervention is often unnecessary, and should be mostly limited to improving loan markets. In fact, subsidies to training would be counterproductive when the degree of liquidity constraints varies across workers, because with subsidies, workers who are not liquidity constrained will invest more than the efficient amount due to the lower marginal cost of investment.

A theory based on noncompetitive labor markets leads to two different conclusions. First, even when workers are severely liquidity constrained, the amount of training may not be as low as predicted by Becker's theory, because firms would undertake some of the general training investments. Second, and more important, even when workers are unconstrained, the amount of training is likely to fall well short of the first-best level of investment.

The first source of underinvestment arises simply because with a compressed wage structure, both firms and workers share the benefits of increased productivity, and each

may fail to internalize the effect on its partner. This inefficiency can be overcome if the worker and the firm can write employment contracts which specify both the wage and the training level in advance.

Nevertheless, there is another externality which remains operative even in this case. This externality arises because general training in non-competitive labor markets often benefits future employers. In contrast to competitive labor markets where future employers pay the full marginal product of workers, in a labor markets with a compressed wage structure, a new employer would also make higher profits from employing a more skilled worker. I developed this argument in Acemoglu (1997) and showed that even when workers have access to perfect loan markets and there are no contractual problems, the amount of training in an imperfect labor market will be suboptimally low. If the source of market failure in training is the positive externalities on future employers, the policy remedies of the standard theory would be of no benefit.

5.7 Concluding Comments

This part of the report surveyed key determinants of the incentives to invest in education and training. In both cases, costs and benefits of these investments are essential for understanding who will invest in human capital and how much investment will be undertaken. I emphasized the differences between education and training investments, and how the presence of labor market imperfections could change incentives to invest in training.

The following points may be useful to reiterate:

1. Education decisions are affected by returns to education and costs of education. Greater returns should increase education investments. In practice, this effect seems to be relatively small. Combined with the conclusion above that increases in the relative supply of skills will only have a slow effect on inequality, this suggests that there is relatively little room for an increase in inequality to self-correct itself in the near future.

2. Costs of education will also matter for education decisions. These costs comprise of tuition costs, foregone earnings and nonpecuniary costs, determined by family and peer groups. How the financial costs feature in the calculations of individuals and families will also depend on credit market problems. In the presence of credit market imperfections, individuals cannot borrow in order to smooth their consumption, and the perceived costs of education will be much higher.
3. When labor markets are perfectly competitive, training decisions are shaped by similar forces. Individuals will invest more when returns are large, and when costs, for example in terms of forgone earnings or consumption smoothing, are small.
4. However, the fact that training investments are made jointly by workers and firms complicates the analysis. For example, when there are contractual problems between firms and workers, so that firms cannot commit not to minimize the training time of the workers in order to increase their production, training investments may be severely curtailed.
5. When labor markets are imperfectly competitive, firms may have a greater incentive to invest in the training of their employees. In this case, what matters are the returns for firms, not for workers. A more compressed wage structure, which rewards trained/skilled workers relatively less than their skills, may actually encourage further investment in training, because it increases the returns to firms from raising the productivity of their employees.
6. There are many types of market failures in both education and training. Most important, credit market problems will cause underinvestment in both types of investments. Evidence suggests that such credit market problems are present. There can also be other reasons for underinvestment, for example signaling or human capital externalities, but the extent of these problems appears more limited.

Armed with these insights, I now turn to a discussion of policies.

6 Policies to Reduce Inequality

The previous three parts of the report laid out the key determinants of inequality and reviewed the theory of human capital investments. We are now in a position to discuss policies. Although human capital policies, which encourage further investment in human capital, are the central focus of this report, I start with other policies that could be useful in reducing inequality, and then turn to human capital policies.

At this juncture, it is also useful to highlight what features of the New Zealand economy and society will be important in thinking about the relative efficacy of these different policies. In particular, the following questions are relevant in thinking about the New Zealand case:

1. How does the New Zealand economy compare to the U.S., Australia, and Canada, in terms of worker skills? Much of the evidence is from the U.S., where there is relatively little shortage of skills. It is plausible to think that human capital policies may be more effective if there are more serious skill shortages in New Zealand than in these other countries.
2. Is there a shortage of key skilled personnel, such as engineers and managers, necessary for the absorption of advances in frontier technology? Shortage of specific types of skills may have a large effect on inequality by increasing the pay of certain workers, and what type of shortages there are is clearly very relevant for the types of policies that need to be considered.
3. Is human capital rewarded appropriately? For example, what is the return to education in New Zealand relative to other comparable countries? Since the rate of return to education in New Zealand appears to be higher than in other comparable countries, wage compression policies may not have substantial costs in terms of discouraging education.

4. What is the composition of broad human capital in the New Zealand economy? What types of human capital (more specific, general, abstract skills) are in shorter supply?
5. How important is international trade in affecting the labor market in New Zealand compared to the U.S. or Canada? In a more open economy, the effect of changes in supply of skills on skill prices and inequality will be even more limited.
6. What is the sectoral composition of production in New Zealand? How far behind the U.S. is the New Zealand economy in the share high tech industries, such as office and computing equipment, producer durables, medical technologies and chemicals? These are the sectors that are generally thought to generate a large demand for skills. If a large increase in the share of production of these sectors is expected in New Zealand, demand for skills and inequality may increase further.
7. In which respects do the current programs in New Zealand fall short of encouraging human capital accumulation?
8. What is the structure of redistributive taxation in New Zealand economy at the moment?
9. What type of policies encouraging wage compression are there in New Zealand, and how effective are they?

I will briefly mention the specific context for New Zealand in the discussion of some of the policies, but a much more detailed knowledge of the New Zealand economy and society is necessary for a more complete evaluation of these programs.

6.1 Wage Compression

Inducing a compression in the wage structure in the private sector is a direct way of reducing inequality. Government intervention could induce wage compression through a

variety of mechanisms. Probably, the most straightforward wage compression policy is the imposition of the minimum wage. The minimum wage forces employers to pay higher wages to low-paid workers, and many economists also believe that it creates spillover effects, causing a compression of wages even among workers who were not directly affected by the minimum wage (i.e., those who were previously paid above the minimum wage). Much evidence suggests that minimum wages do have a substantial effect on the distribution of wages. For the U.S., such evidence has been presented by DiNardo, Fortin and Lemieux (1995) and Lee (1999). Both studies find that the erosion of the real value of minimum wage in the U.S. due to inflation during the 1980s led to a substantial increase in wage dispersion at the bottom of the distribution, and the subsequent increase in the minimum wage during 1990-91 led to a compression. Other policies that can induce wage compression include unemployment benefits, which are by their nature progressive (i.e., they offer a greater replacement rate to lower paid workers), and policies that encourage union bargaining.

Many economists are against such policies for a variety of reasons. These reasons can be classified into two groups. First, many suspect that wage compression will discourage human capital investments. The reasoning for this has already been discussed; wage compression reduces returns to skill, and may reduce the incentives to invest in further human capital accumulation. Second, many economists believe that wage compression, by increasing the cost of employing low skill workers, may cause higher unemployment among low skill workers.

Both of these concerns are important, and to some degree valid. However, their importance can be exaggerated as well. As discussed in the previous part of the report, the extent to which wage compression reduces investments in human capital may be limited. First, in the case of education, there is little conclusive evidence that lower returns to education discourage schooling (or higher returns encourage schooling). Second, in the case of training, wage compression may actually encourage further investment by firms.

The evidence on whether wage compression reduces or increases training is mixed, but there is certainly no evidence that moderate wage compression has a very negative effect on training investments. I therefore conclude that the negative effects of wage compression on human capital investments may be rather limited.

It should also be noted that wage compression type policies may encourage the creation of more good jobs. The argument has already been raised above in Part 4, but it is useful to reiterate it here. Wage compression policies imply that firms will have to pay high wages to their employees. Once they realize that they will pay higher wages, it makes more sense for the employers to increase the productivity of the workers. Previously (i.e., before wage compression), bad jobs paid low wages and were also less productive. Nevertheless, they may have been profitable for employers because of the lower wages. However, once employers are forced to pay higher wages even in these low productivity jobs, they may opt for higher productivity jobs. In Acemoglu (2001), I demonstrated that this argument applies quite generally, and also provided empirical evidence suggesting that increases in minimum wages and unemployment benefits shift the distribution of employment from low-wage occupations towards high-wage occupations.

What about the negative effects of wage compression on the employment prospects of low skill workers? Here too, the consensus among economists is changing. Although many economists still believe that minimum wages and other policies that increase the costs of employing low skill workers will be very detrimental to employment, recent evidence challenges this view. Card and Krueger (1995) provide a variety of evidence showing that in the U.S. increases in minimum wages did not have a negative effect on the employment prospects of teenage workers or other low skill workers. They look at cross-state evidence, time series evidence, changes in policies across states, and the imposition of the federal minimum wage in 1990-91. In neither case do they find strong evidence that minimum wages reduced employment. In fact, they show that many previous results showing such negative effects are fragile, and in most of their estimates, there is a positive associa-

tion between exogenous increases in minimum wage and employment. Similar evidence has been presented for other countries by Machin and Manning (1996) and others. We should be cautious in interpreting the positive association, which is likely to reflect imprecise estimates or other factors (some economists have tried to justify such positive association using monopsony model of the labor market, but I do not find this necessarily compelling). Overall the evidence from the U.S. and other OECD countries suggests that the disemployment effect of minimum wages is likely to be limited.

Similarly, unemployment benefits are likely to discourage workers from finding jobs and perhaps encourage them to demand higher wages. Nevertheless, existing evidence suggests that disemployment effects of unemployment benefits are also limited. For example, Meyer (1995) finds that a 10 percent increase in unemployment benefits raises unemployment duration by about a week, while Ehrenberg and Oxaca (1978) and Atkinson and Mickelright (1991) estimate a slightly smaller response. These are relatively small effects on unemployment.

What about cross-country comparisons? This is important because a famous thesis, often attributed to Krugman (1994), explains high unemployment in Europe as a result of wage compression there (see also OECD, 1994). According to this theory, and as argued in Part 3 of this report, the past 30 years have experienced rapid skill-biased technical change. This skill-biased technical change led to an increase inequality in the relatively competitive labor market of the U.S.. In contrast, the labor market institutions of Europe prevented the increase in wage inequality, instead raising the amount of wage compression. This wage compression lead to an increase in unemployment. If this conclusion is correct, it points to a very significant cost of wage compression policies

The view that wages are more compressed in Europe clearly has some merit. Blau and Kahn (1996) show that the major difference in overall inequality between the U.S. and many continental European economies is not in the 90-50 differential, but in the 50-10 differential. This suggests that the minimum wage, strong unions, and generous transfer

programs are in part responsible for the relative wage compression in Europe.

Despite its intuitive appeal, the Krugman hypothesis runs into two difficulties. First, unless there are extremely rigid institutions that fix the skill premium exogenously, skill-biased technical change should increase wage inequality irrespective of the degree of exogenously imposed wage compression. In contrast, in many continental European economies, most notably in Germany, wage inequality was very stable (see, e.g., Freeman and Katz, 1995).

Second, the Krugman hypothesis makes an explicit prediction: to the extent that wage compression is preventing the increase in the inequality of wages, profit maximizing employment decisions of firms should lead to a large decline in the employment of unskilled workers relative to that of skilled workers. In fact, skill-biased technical change might even reduce the unemployment rates of skilled workers. Yet, in Europe, the unemployment of skilled and unskilled workers increased together (e.g. Nickell and Bell, 1996, Krueger and Pischke, 1997), and unskilled employment did not grow faster in the U.S. than in European economies (Card, Kramartz and Lemieux, 1996, Krueger and Pischke, 1997).

It is possible that bargaining arrangements in Europe between firms and unions lead not only to wage compression, but also to deviations from the relative demand curve for skills shown Figure 1. This can be because European institutions may be forcing firms to pay uniform wages to all educated workers irrespective of their exact contribution, making the employment of skilled workers less profitable as well. Alternatively, if unions represent both skilled and unskilled workers, and are committed to wage compression, they may not want to suffer a large decrease in the employment of unskilled workers. So they may be willing to make certain concessions in wage levels in order to induce firms to employ more unskilled workers at a compressed wage structure. Although such deviations from the relative demand curve drawn in Figure 1 are a possibility, we have no direct evidence to assess how far off the relative demand curve European economies may be, and how they would respond to skill-biased technical change in this situation.

This discussion suggests that the costs of wage compression policies in terms of discouraging human capital investments and employment declines may have been exaggerated. Therefore, moderate wage compression policies may be a useful tool in reducing inequality. However, there is still quite a lot of uncertainty about the effects of wage compression policies, so care must be taken. Although the existing evidence on the effects of wage compression policies is mixed, it is not inconceivable that wage compression policies may have adverse long run effects. This suggests that only very moderate wage compression policies should be used.

In the New Zealand case, the minimum wage appears to be somewhat more generous than in the U.S.. This suggests that a further increase in the minimum wage, or other wage compression policies, may be undesirable. In that case, perhaps the implication of this discussion is not to encourage further wage compression policies, but to raise serious caution in regards to policies that are designed to dismantle existing wage compression policies. Dismantling of such policies during a period of already increasing wage dispersion could amplify the increase in inequality, with little benefit in terms of increased human capital investments or employment.

6.2 Redistributive Taxation

Redistributive taxation is an attractive policy to reduce income inequality. As discussed in the previous section, policies that directly compress the structure of wages may have some adverse effects, such as reducing the employment of low-paid workers. Redistributive taxation would avoid such costs. On the contrary, if a given tax system becomes more redistributive, without increasing the overall tax burden, it would increase the marginal return to working for low-pay workers.

Nevertheless, many economists are cautious about redistributive policies because they may have disincentive effects. The presumption is that a higher tax rate will discourage higher effort or reduce working hours. With redistributive taxation, high taxes fall specifi-

cally on high income individuals, and some commentators have even raised the possibility that such a policy may reduce business creation.

The predictions of economic theory on the effects of redistributive taxation are ambiguous, however. Everything else equal, a higher tax rate reduces working hours and effort. This is the usual substitution effect in economics. Yet there is also an income effect counteracting this. A higher tax rate reduces the individual's disposable income, and forces him to consume less of all normal goods (i.e., less of all goods that have a positive income elasticity). Since leisure is a normal good, this implies that the income effect created by a higher tax rate will encourage greater working hours and more effort. Therefore, the implications of redistributive taxation on the work incentives of the rich is an empirical matter. Clearly, very high marginal rates, for example rates over 70 or 80%, will have serious disincentive effects. The implications of moderately high marginal tax rate on the rich are unclear.

There is a large U.S. literature estimating how incomes change in response to increases in tax rates. Although there are estimates that show large effects, the majority of estimates show small responses. A large portion of this literature is surveyed by Pencavel (1986). He concludes that the elasticity of hours of work to changes in tax rates is close to zero. More recently, some authors have estimated large effects of the cuts of the tax rates for high income brackets during the 1980s on the pre-tax incomes of high income individuals (e.g., Feldstein, 1995). However, these tax cuts took place during a period of already widening income inequality, and these estimates do not control for other factors increasing the gap of incomes between middle and high income individuals. Moreover, these tax cuts changed incentives for reporting taxable income, in particular the incentives for shifting labor income to capital income (or corporate income). So measured incomes of high-income individuals will reflect these changes as well.

Therefore, I conclude that moderate redistributive taxation in the U.S. context is unlikely to have had large disincentive effects, and could be a useful tool in reducing

post-tax income inequality when the underlying wage inequality is very high.

Another adverse consequence of redistributive taxation has been pointed out by Heckman, Lochner and Taber (1998). They argue that redistributive taxation, by reducing the net return to schooling, may discourage human capital investments. Lower average human capital investments may then act to increase skill premia and inequality. Although this argument is theoretically correct, the discussion in Parts 3 and 5 suggests that its empirical importance is limited. First, the impact of changes in average human capital on skill prices is likely to be small. Secondly, there is little evidence that individuals respond to net returns to schooling strongly in their human capital investment decisions. I therefore conclude that a moderate amount of redistributive taxation could be useful in reducing post-tax income inequality.

Nevertheless, it is difficult to apply the U.S. evidence to New Zealand. There are a number of distinctive features of the New Zealand economy which may have an important bearing on how redistributive taxation will influence economic activity. First, high earning individuals in New Zealand may outmigrate with relative ease to Australia. In contrast, such migration opportunities from the U.S. to other countries are limited. The possibility of migration by high wage individuals increases the danger that redistributive policies may have adverse consequences. Second, there are major differences in the structure of taxes between New Zealand and the U.S.. In particular, taxes are already more progressive in New Zealand, and the structure of indirect taxation is different. Therefore, before an increase in redistributive taxation, a careful assessment of the tax elasticity of labor supply and migration rates by high earners is necessary.

6.3 Human Capital Policies

I now turn to the discussion of human capital policies narrowly defined, that is, policies that explicitly target human capital investments. I will discuss the following human capital policies:

1. general subsidies to higher education that reduce costs of higher education for all individuals;
2. means-tested subsidies to higher education, including partly need-based scholarships, that reduce higher education costs specifically for lower income individuals;
3. specific tuition waivers and aid for selective majors;
4. increasing availability of credit to be used for education purposes;
5. policies directed at secondary schooling, including those specifically encouraging secondary schooling for lower income families;
6. voucher type programs encouraging school choice;
7. policies encouraging on-the-job training.
8. “work first” policies encouraging welfare recipients and other individuals out of the labor force to obtain jobs first, as a pathway to human capital accumulation;
9. policies that encourage pre-school education for children from disadvantaged families.

Before discussing these policies, it is useful to reiterate the broad conclusions reached so far. Increasing average human capital in the economy is unlikely to have a large effect on inequality, at least not in the near future. This implies that the most pressing objective of human capital policies should be to close the skill gap between the top and the bottom of the wage distribution.

6.3.1 The effect of subsidies to higher education

One of the most common human capital policies is direct subsidies to higher education. Most OECD economies subsidize the university system. The reasoning for this type

of policies is clear. As discussed above, high tuition costs are expected to discourage enrollments in colleges. Therefore subsidies that reduce tuition costs should increase college enrollments. The available evidence supports this presumption.

There is a large literature attempting to uncover the effect of tuition costs on enrollments. McPherson and Schapiro (1991) and Leslie and Brinkman (1988) review various studies showing that costs of attending college matter. The consensus estimate seems to be that a \$1000 decline in net price of college (tuition minus aid) is associated with a 5 percentage point increase in the college attendance of the target group. This amounts to a sizable elasticity, and shows that such policies could be quite effective. Many of the studies surveyed by these authors, however, look at the effect of aid rather than tuition costs. In most simple models, what should matter is the net price of college attendance, but some studies find that the effects of aid and tuition costs may differ. For this reason, it is useful to look at studies that only focus on tuition costs. A recent study by Kane (1995) uses the National Educational Longitudinal Survey of 1988 to examine how tuition in public universities affects college attendance. He finds that a \$1000 increase in tuition reduces the attendance rate by about 5 percentage points. Perhaps more interestingly, he finds that the effect is larger on youth from lower income families (7.2 percentage points as compared to the effect on middle and upper-income youth which is about 4.4 percentage points).

So are subsidies to higher education an effective tool to reduce inequality? I believe the answer to be no. There are a number of problems with general subsidies to college education.

1. The most important is that such subsidies are very costly, because they are subsidizing not only marginal agents—i.e., students who would not have attended college in the absence of such subsidies—, but also intramarginal agents—i.e., students who would have attended college anyway. This clearly increases the costs of running such subsidy programs. For example, to achieve a 5 percentage point increase in college

attendance, the government has to give in effect \$1000 to every student enrolled in college. This will clearly amount to a very large sum. Moreover since intramarginal students are often from middle and upper income families, such subsidies often benefit middle and upper-income families. This problem is made worse when one takes into account that even in the presence of subsidies, the majority of the students attend college are from middle and upper-income background. Therefore, direct subsidies to higher education are quite regressive in nature, benefiting the richer segments of the society.

2. The second problem with such subsidies is that their effect may be rather limited. As discussed in Part 3 the effect of an increase in average human capital of skill prices will be small. Therefore, any human capital policy to be effective in reducing inequality has to close the skill gap between the top and bottom of the distribution. Such subsidies will provide only little help to those who are truly at the bottom of the skill distribution, since even in the presence of subsidies the students contemplating college attendance are relatively high skill, for example, they would never be at the bottom 10 percent of the wage distribution. On the contrary, such policies may encourage further education by individuals already at the top of the income distribution, widening the gap even further. Therefore, although such policies may be useful in closing the gap between the top of the income distribution and the middle, they will not be very useful in closing the gap between the bottom and the top.

6.3.2 Means-tested subsidies to higher education

Instead of general subsidies to higher education that benefit all families sending their children to college, means-tested policies, such as need-based scholarships, are much more effective. They will be more cost-effective because they will subsidize fewer intramarginal households. Moreover, they will more explicitly target families from the lower end of the

income distribution. In fact, it is possible to make such policies highly progressive (highly means-tested) to achieve such a goal. Although these policies would still not deal with the second problem raised above (i.e. the fact that policies that encourage higher education will not help individuals at the bottom of the distribution), they are likely to be successful in increasing college enrollments.

Another argument in favor of such policies is that the evidence suggesting that this type of aid matters for college attendance is in fact much more convincing than that related to the effect of tuition costs. This is because a number of recent studies have exploited natural variation in aid in the U.S. to provide convincing estimates. For example Angrist (1993) analyzes the impact of veterans educational benefits on schooling. In the late 1970s, veterans benefits were quite generous. Angrist exploits time series variation in program generosity and find that these educational benefits had a large effect on enrollments and completed schooling. Dynarski (1998) looks at the effect of the elimination of Social Security students benefit program in 1982. This program had subsidized a large number of college students who were children of dead, disabled or retired Social Security beneficiaries. Dynarski looks at the effect of this program by comparing the change in the enrollments of students who were previously eligible and those who were never eligible. She also find a large effect of this type of aid on enrollments (approximately, a \$1000 increase in grant aid raising college attendance by 4.2 percentage points). A final benefit of this type of aid is that it does not need to be simply means-tested and can be targeted to very specific groups, such as certain disadvantaged demographic groups or minorities.

I therefore view means-tested subsidies to college as an effective policy that will increase the earnings of some otherwise disadvantaged youth. However for the reasons raised in the previous subsection, this policy is unlikely to increase the earnings of the individuals at the bottom of the distribution, so it needs to be supplanted with other policies to close the gap between the top and the bottom of the distribution.

6.3.3 Specific tuition waivers or aid for selective majors

These refer to policies that try to target specific majors, or specific occupations to receive more grant or aid. The underlying reasoning for such policies would be that the government may have a better sense of what areas will face shortages in the future. Although there can be an argument in favor of this point of view, there are too many pitfalls.

It is likely that the government will decide which majors or fields to subsidize by looking at recent experience, and will have less information than individuals. Moreover, just subsidizing specific majors without monitoring what is being taught may be ineffective: if individuals did not want to take these majors, colleges would have to cater to these needs, and they would simply change the names of the fields they teach, but not the instruction. Therefore such policies would involve heavy regulation, and are likely to be counterproductive. I conclude that such policies are not very attractive.

6.3.4 Increasing the availability of educational loans

If the reason why individuals do not invest enough in education is credit market problems, the most effective tool to deal with this may be increasing the availability of educational loans. The attraction of this policy compared to direct subsidies is that if there is already too much subsidy to education or if credit market problems are not severe, further subsidies may distort the allocation of resources (see the discussion in Part 5 above). In contrast, just increasing the availability of educational loans would not create a large distortion. Therefore, this type of policy appears attractive.

One issue needs to be borne in mind, however. The government may want to use human capital policies not simply to correct underinvestment in education, but to encourage more education than the efficient amount, because it cares about the distribution of income. In this case, educational loans may be less attractive than means-tested aid or direct subsidies.

I conclude that educational loans are useful policies, and should probably be used in

conjunction with means-tested aid to college students.

6.3.5 Policies directed at secondary schooling

Perhaps the biggest challenge for human capital policies is to close the gap between the top and the bottom of the distribution. Policies that encourage college attendance cannot achieve this, since individuals at the bottom of the distribution are unlikely to take advantage of these programs. This suggests that policies that directly subsidize secondary schooling, in particular, those that increase the quality of the secondary schooling that children from disadvantaged backgrounds receive may be very useful. Although such policies are likely to help those who will be in the bottom quartile of the earnings distribution, it is useful to note that this point that they are unlikely to help all of those in the bottom quartile. Policies directed at improving the cognitive skills of low achievers will still leave some students with low achievement, and may not close the gap between the very top and the very bottom of the income distribution (say the gap between the 90 percentile and the bottom one or two percentiles). This may be a particularly important concern if there are many youths from poor backgrounds, with inadequate preparation for school, and likely to engage in risky behavior, including substance abuse, and a tendency to dropout of school. General policies increasing the quality of secondary schooling are unlikely to help students with such special needs. Despite these shortcomings, policies directed at improving the quality of secondary schooling are likely to help the overall dispersion, and less extreme measures of achievement and earnings gap, such as the 90-10 earnings differential or the 75-25 differential.

Governments in all OECD economies already invest substantial amounts in secondary schooling. Moreover, many economists believe that further increases in school resources will have only marginal effect on quality of schooling or the human capital that schools provide students. This point of view is forcefully expressed by Hanushek (1996). Hanushek argues that the very large increase in the amount of resources invested in schools in the

U.S. over the past 40 years did not have any appreciable positive effect on school outcomes. On the contrary, in many dimensions American schools are doing worse today. He also surveys a variety of studies that estimate the relationship between school resources, such as class size, and student performance. He argues that there isn't enough evidence from the studies showing that school quality matters. Instead, Hanushek and others argue that what is required is to improve incentives for teachers. According to this view, American schools are performing badly because teachers are not given the proper incentives and are not monitored to make sure that they work hard. So should we conclude that investing further resources in secondary schooling is unlikely to improve the human capital of the society?

Although Hanushek is likely to be correct in emphasizing the importance of teacher incentives, his other conclusions have been challenged on a number of fronts. Many studies may not find beneficial effects from class size, but this is likely to reflect the fact that many schools allocate students with learning difficulties or other problems to smaller classes, such as special education students in the U.S.. In fact, studies that exploit more convincing source of variation in class size or school quality find large effects. For example, Card and Krueger (1992) look at the effect of higher school quality on the labor market outcomes in the U.S., by exploiting cross state variation in school quality among all students or among black students. They find sizable effects of school quality on performance. Angrist and Lavy (1999) provide evidence from Israel that exogenous differences in class size have large effects on student achievement. Krueger (1999) provides evidence from an experimental study in the U.S., showing significant effects of class size on performance. On balance, it appears that larger classes are detrimental to learning, so further resources, especially directed to poorer neighborhoods, may be useful.

Large classes or inexperienced teachers may not be the only problem facing children from disadvantaged backgrounds. A common problem in the U.S. is that secondary schools are highly segregated along income lines. Although there are a number of policies trying

to deal with these problems, such segregation is a fact of life. The reason why this type of segregation may be bad for inequality is as follows: learning at the secondary schooling level is likely to be a team activity, in the sense that students learn from each other, and perhaps imitate each other. Children from higher income families have more support from their parents, and because of greater resources, they are likely to be in an advantageous position. If all high income children segregated in their high income schools, they would benefit from each other's advantages, while low income children would fail to benefit from the same forces. The problem becomes more serious if, as in many U.S. inner cities, low income neighborhoods also lack attractive role models (e.g., adults or young adults who project an image encouraging further education to teenagers). A policy that ensures that children from low income families receive high-quality education, perhaps being mixed with children from high income families, may be useful.

Nevertheless, such policies may have negative effects as well, disrupting the decentralized nature of schooling decisions, increasing commuting time for students who have to go to schools far away from where they live etc. So whether such policies are desirable or not is an empirical question.

A recent paper by Guryan (2000) looks at the effect of the forced-integration of black and white schools in the U.S.. Many of the issues of segregation along income lines that are present today took the form of racial segregation in the '70s. He finds that this type of integration had a highly beneficial effect on the high school dropout rates of black youth. On the basis of this, it appears that such policies may have beneficial effects. Nevertheless, given the high level of disruption that such policies may cause, a lot of caution is required, and they should not be the policies at the top of the agenda.

Another important consideration is the distribution of achievement in high school. Recent evidence suggests that there is a larger fraction of secondary school students in Anglo-Saxon countries, including New Zealand, with serious problems in reading and math (e.g. Elley, 1992). The students with low achievements are then likely to become the low

earners of the future. Whether human capital policies directed at secondary schooling can deal with these problems is unclear since these problems may have more deep rooted social causes. Nevertheless, improving the quality of secondary schooling, especially for the bottom tail of the achievement distribution, appears as a very promising policy option.

6.3.6 Vouchers

A policy currently in the U.S. agenda is a provision of schooling vouchers to enable families, that would otherwise send their children to public schools, to send their children to private schools. The motivation for this policy is that many public schools are thought not to provide good education to low income families. More generally, some also argue that public schools do not face any competition, and the introduction of vouchers would also lead to improvements in public schools. A full discussion of the effect of vouchers, and other new school arrangements, is beyond the scope of this report. A previous report prepared for the New Zealand Treasury by Nechyba (1998) discusses these issues in great detail.

Here it suffices to say that evidence on the effect of vouchers on performances mixed. One of the most careful studies, Rouse (1998), finds that they do have a beneficial effect on students taking advantage of vouchers, but these effects are relatively small. Nevertheless, such policies may be a more limited interest in countries other than the U.S. where public schools may be facing fewer problems. Moreover, the above discussion suggests that if vouchers work by enabling greater segregation among a group of students from well-to-do families, they may benefit the students using vouchers, but equally hurt students who are left behind. More important, vouchers may also be quite regressive, benefiting higher income families, and eventually reducing the political support for public schooling.

However, independent from the interest of vouchers for New Zealand, the general principle that greater school choice may be beneficial, as long as it does not lead to a large amount of segregation across income lines, is useful to bear in mind.

6.3.7 Policies encouraging on-the-job training

The discussion in Part 5 showed that there is likely to be underinvestment in training. This makes policies encouraging training potentially useful. More important for the focus of this report, policies encouraging training are likely to be one of the most effective ways of reducing the skill gap between the top and the bottom of the distribution. This is because, in contrast to policies encouraging college education, policies encouraging training can help workers at the lower tail of the skill and earnings distribution. Workers with no high school degree, or who are only high school graduates, can benefit from acquiring skills for a certain occupation, such as mechanics or carpentry, or in a given industry, such as automobile manufacturing or banking. With such skills, their productivity and earning capacity can be substantially higher, closing the skill and earnings gap in the society.

That such policies are effective in reducing inequality is illustrated by the German example. In contrast to the U.S. or the U.K., there is a widespread apprenticeship system in Germany. A large fraction of youth who do not continue to college work in firms that simultaneously offer them training. Such apprenticeship programs typically last for three years, and consist of both classroom learning and factory floor training. Many commentators argue that German workers with high school education or less, who have been through such apprenticeship programs, are much more skilled than comparable U.S. workers (see, for example, Steedman, 1993, Franz and Soskice, 1995). In fact, while the real earnings of workers with high school education or less fell sharply in the U.S. during the 1980s, those of comparable workers in Germany increased. A likely explanation for this is that the technological changes during the 1980s that increased the demand for skills hurt U.S. high school graduates who possessed relatively few skills, but not the German high school graduates who had acquired considerable skills via apprenticeship programs.

Although the German apprenticeship program is financed by employers themselves, the government does play a substantial role. For example, it regulates classroom learning,

and certifies the skills of workers who have received apprenticeship. In the construction industry, where high turnover makes firm sponsored training impractical, the government also subsidizes training.

This discussion suggests that policies encouraging training will be highly beneficial and effective in reducing inequality. But what type of policies? There are three broad types of policies that governments can pursue to encourage training: subsidies or tax credits to firms providing training to their employees, direct provision of training by government agencies, and regulation of training programs offered by firms.

The most common remedy is subsidies. As long as there is underinvestment in training, subsidies to training firms or tax credits for on-the-job training would be beneficial. Even in the absence of underinvestment in training, such subsidies could increase the human capital of workers at the bottom tail of the skills distribution in the society and serve to reduce inequality.

One potential problem, however, is that when monitoring workplace training is difficult, subsidies may be relatively ineffective. For example, if the amount or quality of training the firm provides is non-contractible, then with or without subsidies, the firm will choose the same amount of training, and subsidies are simply a windfall gain to the firm.

An alternative to subsidies would be the direct provision of training by the government. However, government training programs fail to exploit the complementarity between training and production and their curricula may lag behind the needs of businesses and trainees. The US experience with subsidies and government run training programs is rather mixed, suggesting that only expensive government programs are successful, see e.g. Lalonde (1995).

This suggests that it may be necessary to supplement subsidies with regulation. Most regulation, as in the case of the German apprenticeship system, monitors the quality of training programs and certifies skills. One effect of regulation would be that it makes

it easier for firms and workers to contract on the amount of training, allowing them to eliminate the externality that arises when training is decided non-cooperatively (see e.g. Acemoglu and Pischke (1998)). Hence, regulation would allow workers to contribute to the amount of training they receive, so it would be most useful when workers have some ability to pay for training. With a similar argument, regulation would also complement the use of subsidies by enabling the government to monitor whether a firm receiving subsidies is actually providing training. But it has to be born in mind that regulation could also be counterproductive. For example, if other firms' uncertainty about the value of skills acquired in a training program encourages initial employers to provide training because employers would then be able to keep these workers, for example as in the model of Katz and Ziderman (1990), certification of the skills may reduce firm-sponsored training. In practice such counterproductive effects are unlikely, especially in view of the fact that in Germany government agencies certifies skills acquired in apprenticeship programs.

Two additional considerations are important in thinking about policies that encourage on-the-job training. First, such policies are very effective in dealing with skill shortages for specific industries or occupations. If shortage of engineers or qualified craftsmen is an important constraint in New Zealand, training policies will be more useful both in increasing output and reducing inequality. Second, there is an important question related to the timing of human capital investments. Policies directed at secondary schooling encourage more human capital at the earlier stages of a worker's life (when he or she is a teenager). Training policies, on the other hand, increase the human capital of the worker later. Everything else equal, earlier policies may be preferred, but training policies have important advantages. For example, workers and firms can undertake such investments after finding out the exact comparative advantage and interests of the worker, or in what areas further investment will have greater return. Although there is little evidence on this topic, common sense suggests that a combination of early and later investments is likely to be optimal to build lifetime skills for workers.

Overall, policies encouraging training are likely to be quite effective in reducing inequality. They may also be useful because there is likely to be underinvestment in training. Among such policies, direct training provision by the government seems least appealing. Although there is little empirical research on this topic, theoretical considerations suggest that the best mix of policies is likely to be a combination of government subsidies or tax credits for training and regulation to ensure the quality of the training programs.

6.3.8 Work-first policies

A serious problem for some workers is not simply low labor income, but lack of jobs. In Europe unemployment is very high, and workers of different demographic characteristics and education are among the unemployed. In contrast, in the U.S. workers facing difficulty finding jobs are concentrated among those with very few marketable skills. This group includes workers with disabilities and welfare recipients (single mothers with low education, especially minorities). A similar problem may exist in New Zealand with low education individuals with Maori descent.

It has been argued that the most effective way of dealing with the problem of very low or zero earnings among such groups is to encourage employment first. Such workers will not be able to get high paying jobs, so their employment must be in low-paid jobs such as in the fast foods or retail sector. Given the discussion on the pitfalls of bad jobs above, one may worry that such jobs may be dead end avenues for these workers.

Nevertheless, this conclusion needs to be qualified. The discussion regarding good versus bad jobs above referred to workers with high labor market attachment (i.e., workers who would not drop out of the labor market). Such workers will not be easily discouraged when they cannot find a job, and if there are certain high wage jobs open to them, they will eventually find those, and benefit from both the higher wages and the greater human capital accumulation opportunities offered by these jobs.

The problem for the marginal groups, such as those with disabilities or welfare re-

cipients, is different. They can easily get discouraged and drop out of the labor market. This weighs in favor of policies that provide jobs for these groups, even if these jobs are low-paying. Another consideration in favor of this prescription is that a significant component of the human capital of a middle aged worker is his/her labor market experience. In other words, workers who have spent more years in employment earn substantially higher wages. In theory this could simply reflect age effects, that is, the fact that older workers are more productive. An interesting paper by Angrist (1991), however, shows that this is more likely to reflect the productivity gains from labor market experience than simply age. Angrist compares different cohorts that spend different amounts in the army, and finds that cohorts that spent longer in the army lost precisely the amount that would have accrued to them as a result of these additional years of experience. This evidence suggests that there may be considerable gains from labor market experience.

In view of this, encouraging groups with low attachment to the labor force to find jobs appears as a useful policy. It will increase their immediate earnings, and likely contribute to their future earnings. However, since the jobs they can get, without much subsidy or further training, are likely to be very low-pay, policies that subsidize their employment are likely to be highly complementary. For example, a policy like the Earned Income Tax Credit in the U.S. that subsidizes the earnings of low income workers would be useful both in encouraging employment and in reducing inequality.

6.3.9 Policies directed at pre-school education

There is evidence suggesting that child poverty, and more generally childhood experiences before school, have an effect on the development of children and their education, and consequently on their subsequent labor market outcomes (e.g. Duncan et al, 1998). Especially in the case of immigrant families, preschool experiences of children may be quite important. The other reason for this is the importance of language skills in the labor market (see Bleakley and Chin, 2000). This suggests that policies directed at pre-

school education may be useful. Nevertheless, in their detailed survey of the literature on the effect of family resources on student performance, Nechyba et al. (1999) conclude that family resources are likely to have only a limited effect on outcomes in later childhood or adolescence. They note, however, that the effect of such resources may be much larger when family income is below a certain threshold. This suggests that although some pre-school policies directed at very poor families will be useful, there may not be a need for a broad range of pre-school policies.

Another problem with policies directed at pre-school is that they have to be catered not to be too intrusive with the way that families want to bring up their children. An ideal compromise may be highly subsidized, or even free, day-care for families below a certain income threshold. Such a policy would also complement the work-first policies discussed previously, since an important barrier to the entry of many women into the labor market is costs of child care.

Here again the timing of human capital investments becomes important. Now the contrast is between very early investments, before a child reaches school-age, and investments during secondary school. Once again, a combination of investments at different times as likely to be optimal. Moreover, lack of investment at the very early stage is likely to create high costs for investments at later stages (Nechyba, et al. 2000). This consideration reiterates the importance of policies directed at preschool education.

6.4 Concluding Comments

This part of the report discussed various policies that could be useful in reducing inequality. I tried to highlight both the efficiency implications of these policies and their effect on the distribution of income. The overall conclusions I reached can be summarized as follows:

1. Although many economists fear the disincentive and disemployment effects of wage compression policies these effects may have been exaggerated. This suggests that

wage compression policies, in great moderation, may be a useful tool to reduce inequality. Since the minimum wage is already relatively high in New Zealand, a further increase may be unnecessary. In this case, the analysis here suggests that existing policies that encourage wage compression, such as minimum wages, should not be dismantled.

2. Similarly, the disincentive effects of redistributive taxation may have also been exaggerated. Redistributive taxation could be an effective policy to reduce post-tax income inequality, again as long as it is used in great moderation. The possibility of high earners to migrate to Australia in response to high taxes may make redistributive taxation more distortionary and less useful in the context of New Zealand. This suggests that a careful study of the tax elasticity of outmigration from New Zealand is necessary.
3. Perhaps the most effective tool in the arsenal of governments to reduce income inequality is human capital policies. There are many reasons to suspect that there may be underinvestment in human capital, so some amount of subsidies are necessary. Governments already subsidize all three levels of education. It is not clear whether further direct subsidies are unnecessary.
4. Although many economists and commentators advocate further direct subsidies to college education, such policies may not be the best option for policymakers. These policies are often regressive, as they benefit mostly middle and higher income families. If the concern is to alleviate credit market problems, education loans may be a better policy tool. To increase college attendance by lower-income families, on the other hand, the best policy would be need-based or means-tested subsidies or scholarships. Such policies would be cheaper and more effective in encouraging college education among lower-income families.
5. However, encouraging college education is unlikely to narrow the gap between the

top and the bottom of the income distribution. To do this, we need policies that encourage higher quality secondary education for lower-income families and policies that encourage training.

6. Although they are unlikely to be highly effective by themselves, work-first type policies that encourage individuals that would otherwise be out of the labor force to obtain employment, and policies that support pre-school human capital accumulation for children from lower-income families could also be useful.

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Table 1: Implied Skill-Biased Technical Change 1940-1990 In the U.S. Labor Market

	Employment share			Wage Bill Share		
	Some col.	Col. grad	Col. equi.	Some col.	Col. grad.	Col. equi
1940	6.4	6.1	9.3	8.9	12.3	16.7
1950	9.5	7.7	12.4	11.0	11.9	17.4
1960	12.5	10.1	16.4	14.1	16.4	23.4
1970	16.4	13.4	21.5	16.5	21.5	29.7
1980	23.6	19.2	31.0	22.4	28.1	39.3
1990	30.8	24.0	39.3	28.5	36.7	51.0

	$\sigma = 1.4$						$\sigma = 2$					
	Some col.		Col. grad		Col. equi.		Some col.		Col. grad		Col. equi	
	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D
1940	0.004	0.21	0.016	0.31	0.035	0.38	0.140	0.37	0.303	0.55	0.392	0.63
1950	0.006	0.24	0.011	0.28	0.030	0.37	0.146	0.38	0.219	0.47	0.313	0.56
1960	0.013	0.29	0.030	0.37	0.080	0.48	0.189	0.43	0.343	0.59	0.476	0.69
1970	0.017	0.32	0.069	0.47	0.179	0.61	0.199	0.45	0.485	0.70	0.652	0.81
1980	0.042	0.40	0.157	0.59	0.486	0.81	0.270	0.52	0.643	0.80	0.933	0.97
1990	0.090	0.50	0.470	0.81	1.777	1.18	0.357	0.60	1.064	1.03	1.673	1.29

Note: The first panel of this table gives the ratio of the employment of skilled relative to unskilled, and the wage bill of skilled to unskilled workers for the corresponding skill categories. These data are taken from Autor, Katz and Krueger (1998). Some college refers to those with more than a high school (hence the measure is those with more than high school divided by those with high school or less). College graduate refers to all of those with a college degree, and college equivalent is defined as in Autor et al. It is those with a college degree+ 0.5 \times those with some college (correspondingly, the unskilled are defined as those with high school and less +0.5 \times those with some college). The bottom panel gives the implied technology shifts using equation (5) above for different values of the elasticity of substitution. The demand index D is defined as $(A_h/A_l)^{\frac{\sigma-1}{\sigma}}$.

Table 2: Evidence on Selection and Signaling Effects from the U.S. Labor

Market										
Born in 19- Year ↓ →	06-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55
Panel A										
1950	1.448	1.370	1.175	1.093						
1960	1.551	1.564	1.525	1.421	1.303	1.132				
1970			1.680	1.656	1.613	1.539	1.392	1.153		
1980					1.567	1.560	1.538	1.402	1.222	1.063
1990							1.798	1.761	1.723	1.674
Panel B										
$\Delta \ln \omega_{50-60}$	0.103	0.194	0.350	0.328						
$\Delta \ln \omega_{60-70}$			0.155	0.234	0.311	0.407				
$\Delta \ln \omega_{70-80}$					-0.047	0.021	0.146	0.249		
$\Delta \ln \omega_{80-90}$							0.260	0.359	0.500	0.611
Panel C										
$\Delta^2 \ln \omega_{50-70}$			0.051	0.040	-0.040	0.079				
$\Delta^2 \ln \omega_{60-80}$					-0.201	-0.213	-0.165	-0.158		
$\Delta^2 \ln \omega_{70-90}$							0.307	0.338	0.354	0.362

Note: The top panel of this table gives the college premium from the Census indicated at the beginning of the row for cohorts born in the five year intervals indicated at the head of the column. For example, the first number is for individuals born between 1906-10 from the Census of 1950. The college premium is defined as the wages of workers from that cohort with a college degree or more divided by the wages of workers from that cohort with twelve years of schooling (high school degree). The bottom panel gives the change in the college premium for a given cohort between the two indicated dates and the difference between the wage growth of two neighboring cohorts as indicated by equations (11) and (12). All data are from the public use microsamples of the decennial censuses for white males born in the U.S..

Table 3: Changes in Inequality by Cohort From the U.S. (from Juhn et al, 1993)

Panel A: 90-10 Differentials for Log Weekly Wages					
Year of market entry	1964	1970	1976	1982	1988
1983-88					1.38
1977-82				1.27	1.38
1971-76			1.13	1.24	1.38
1965-70		1.08	1.12	1.29	1.42
1959-64	1.13	1.01	1.13	1.30	1.40
1953-58	1.02	1.07	1.16	1.32	1.43
1947-52	1.02	1.11	1.15	1.30	
1941-46	1.02	1.07	1.16		
1935-40	1.06	1.09			
1929-34	1.09				
Panel B: 90-10 Differentials for Log Wage Residuals					
Year of market entry	1964	1970	1976	1982	1988
1983-88					1.09
1977-82				1.06	1.16
1971-76			.96	1.09	1.18
1965-70		.86	.96	1.12	1.23
1959-64	.92	.86	.98	1.12	1.21
1953-58	.88	.91	.99	1.15	1.26
1947-52	.89	.94	.99	1.14	
1941-46	.94	.94	1.05		
1935-40	.95	.98			
1929-34	.99				

Note: This table replicates Table 3 of Juhn, Murphy and Pierce (1993). The top panel reports the 90-10 differential for log weekly wages of the cohorts that have entered the labor market in the corresponding six year interval. Panel B gives the 90-10 differential for the residuals from a regression of log weekly wages on education controls. All data are from the March CPSs (see Juhn, Murphy and Pierce for details).

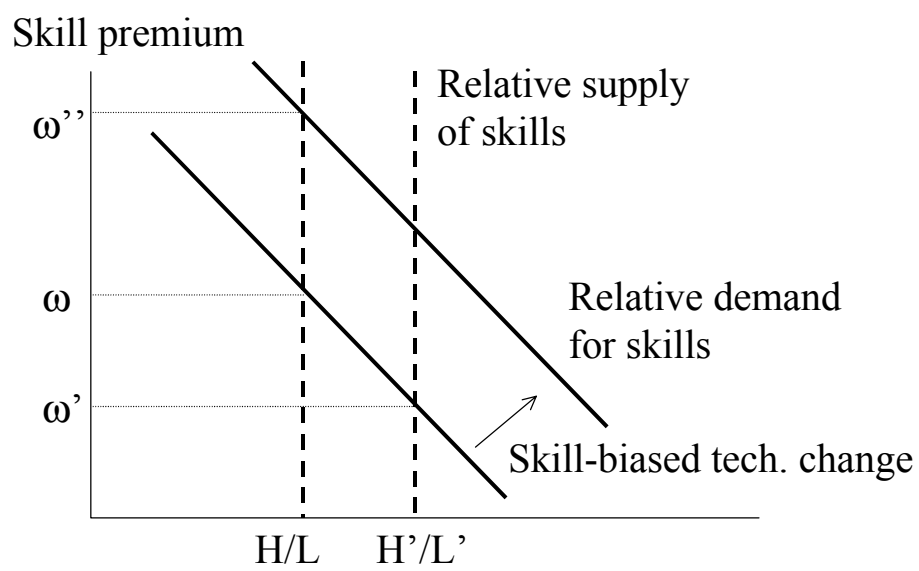


Figure 1: The relative demand for skills.

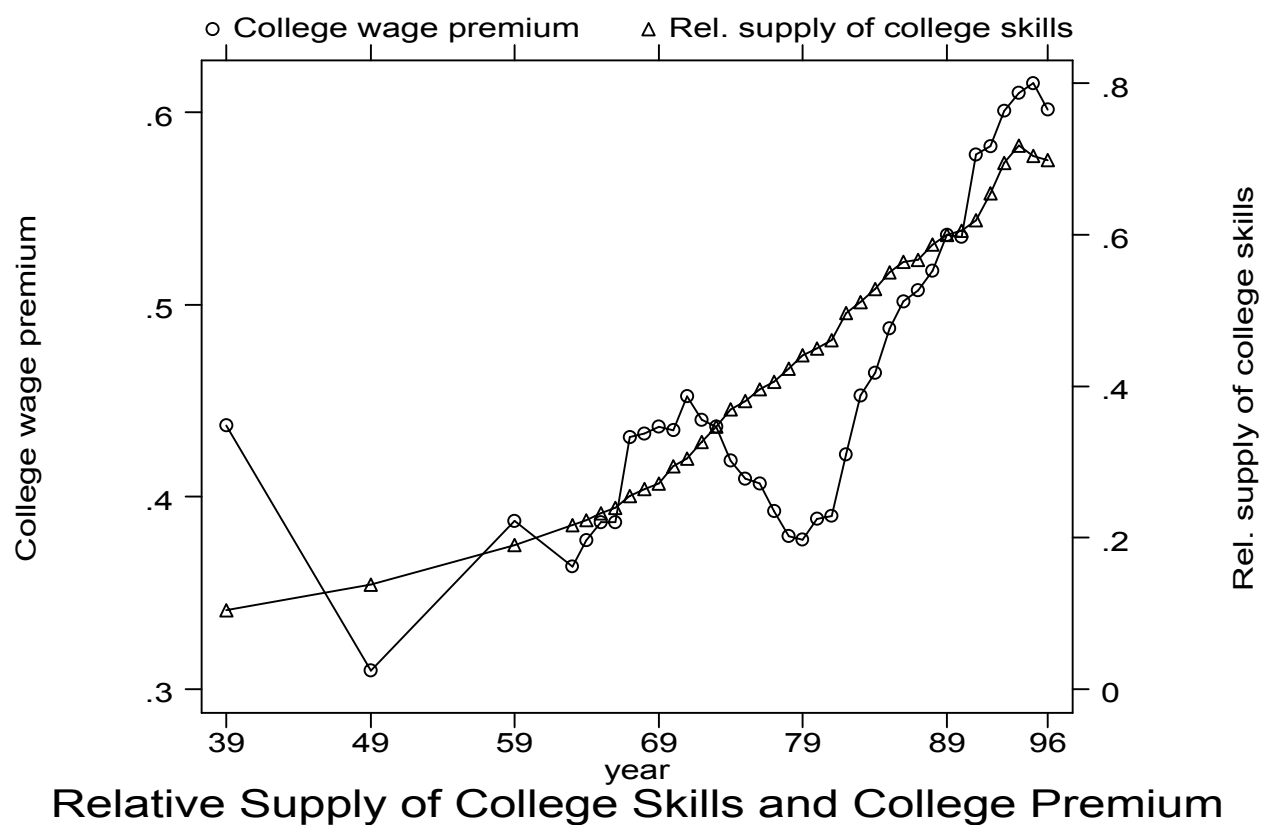


Figure 2: The behavior of the (log) college premium and relative supply of college skills (weeks worked by college equivalents divided by weeks worked of noncollege equivalents) between 1939 and 1996. Data from March CPSs and 1940, 1950 and 1960 censuses.

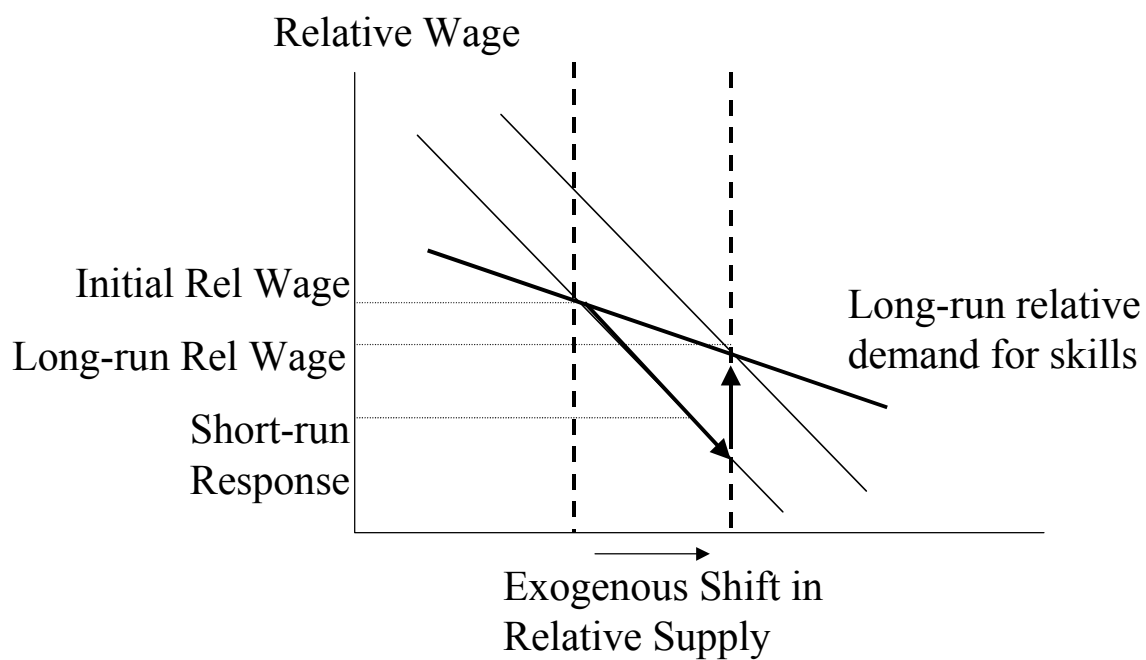


Figure 3: The dynamics of the relative wage of skilled workers in response to an increase in the supply of skills with limited endogenous skill-biased technical change.

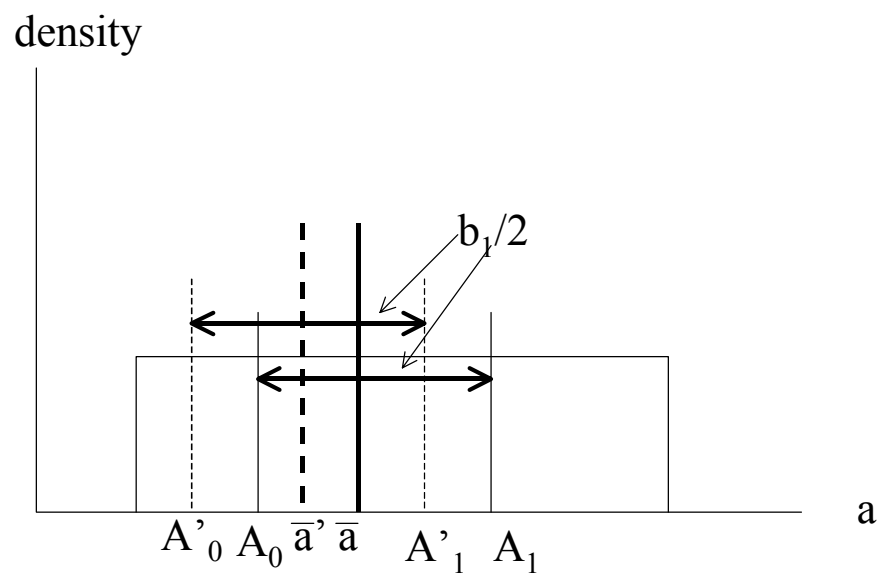
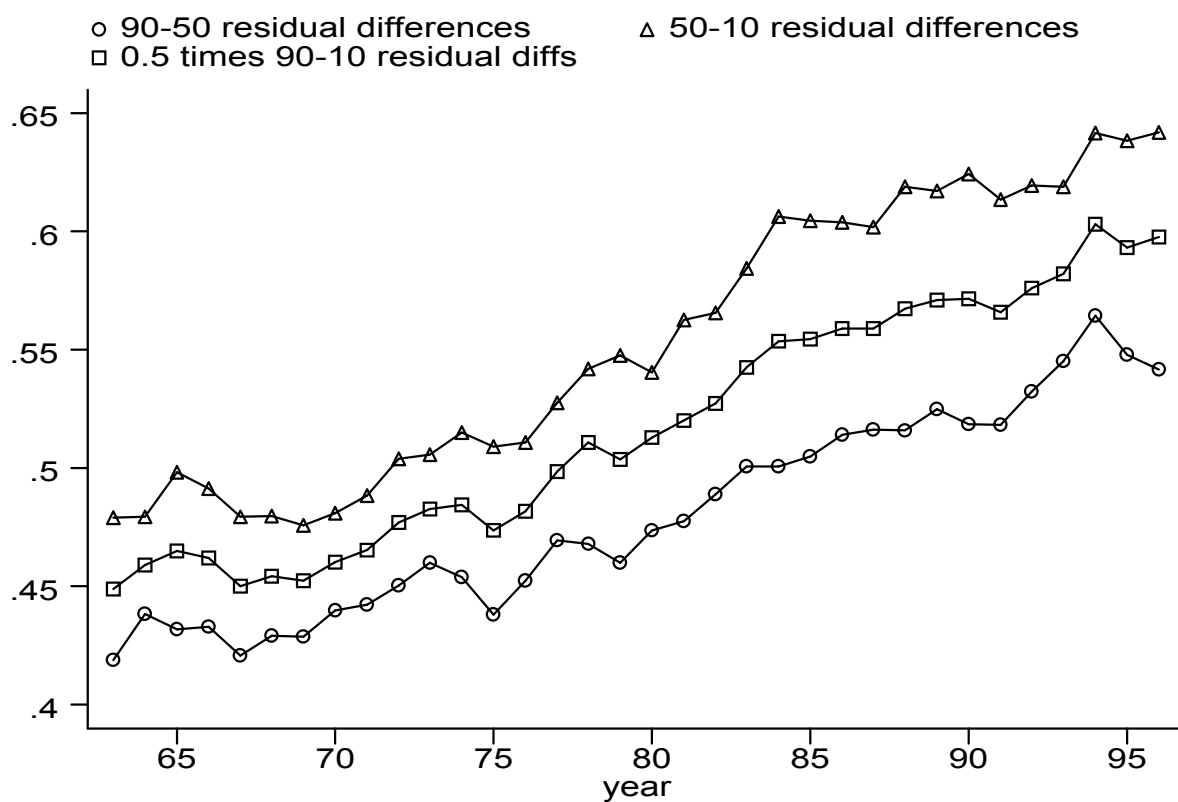


Figure 4: Selection into different education levels on the basis of ability.



Residual inequality measures for white males 1963-1997

Figure 5: 90-50, 50-10 and 0.5×90-10 differentials from log weekly wage regressions for white males aged 18-65.

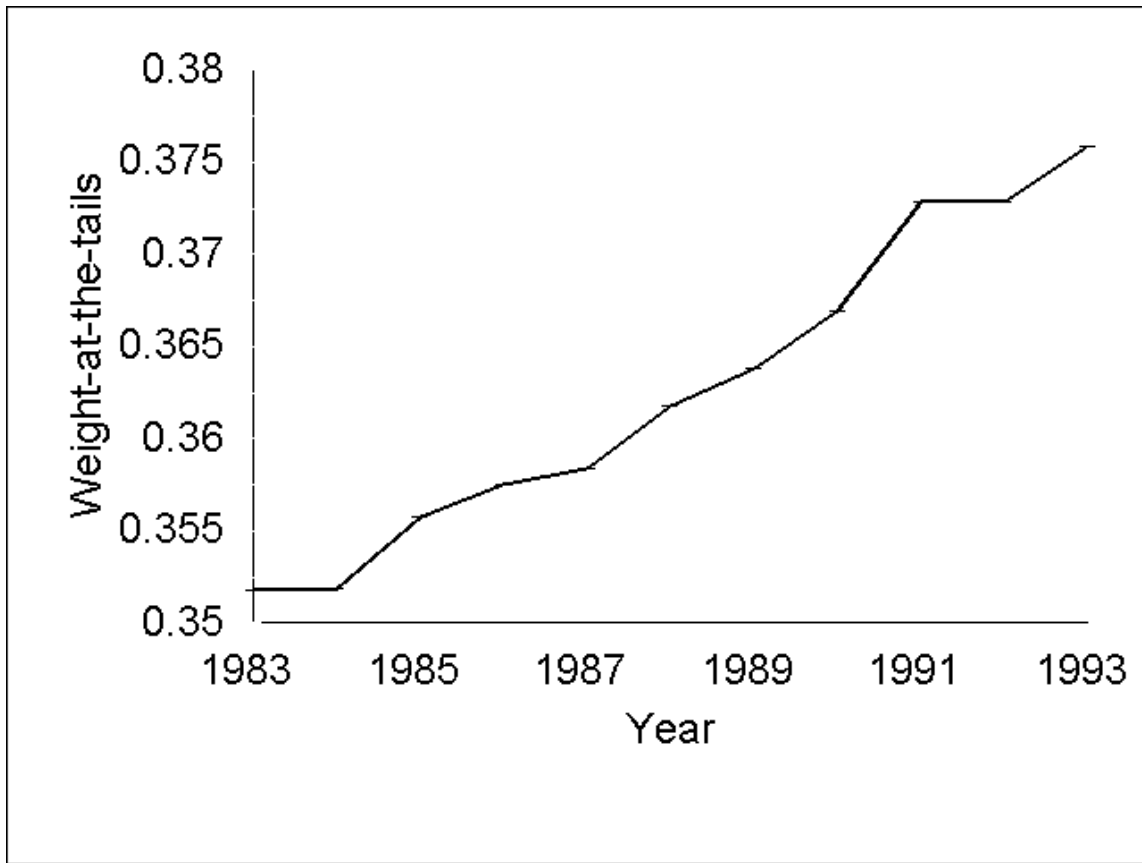


Figure 6: The evolution of the percentage of employment in the top and bottom 25 percentile industry-occupation cells (weight-at-the-tails of the job quality distribution).

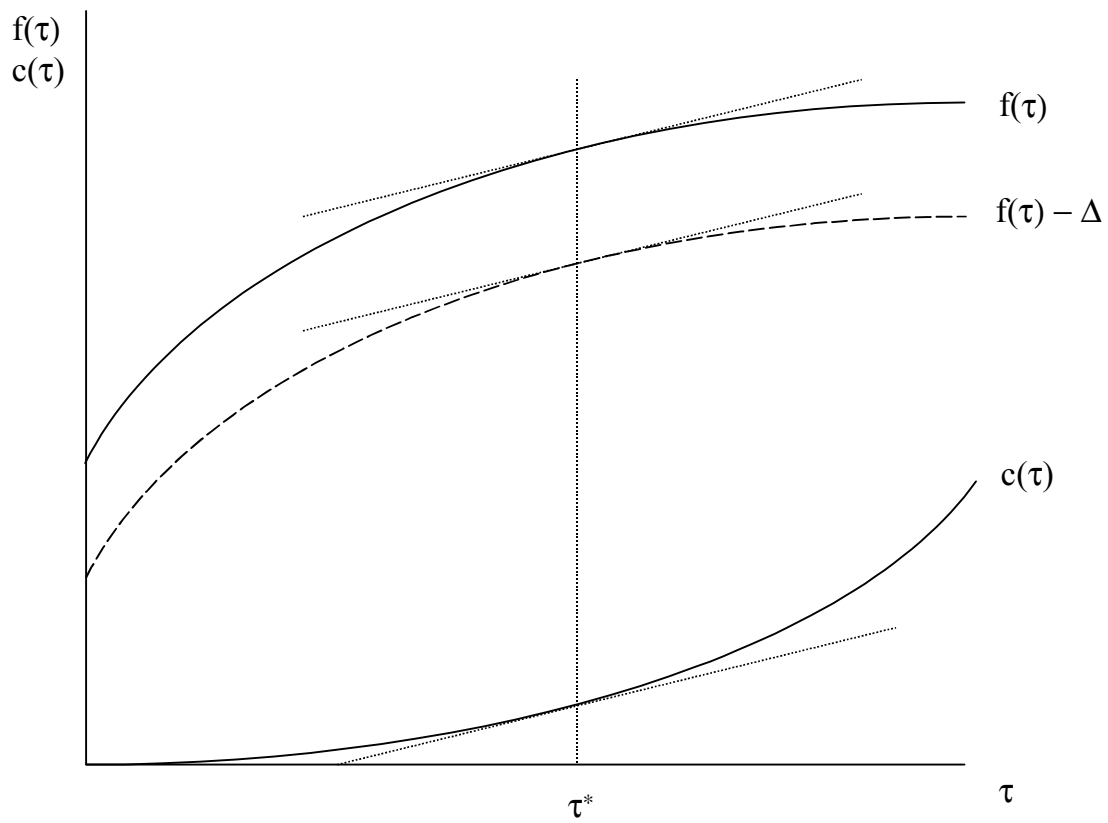


Figure 7: Training incentives in competitive labor markets.

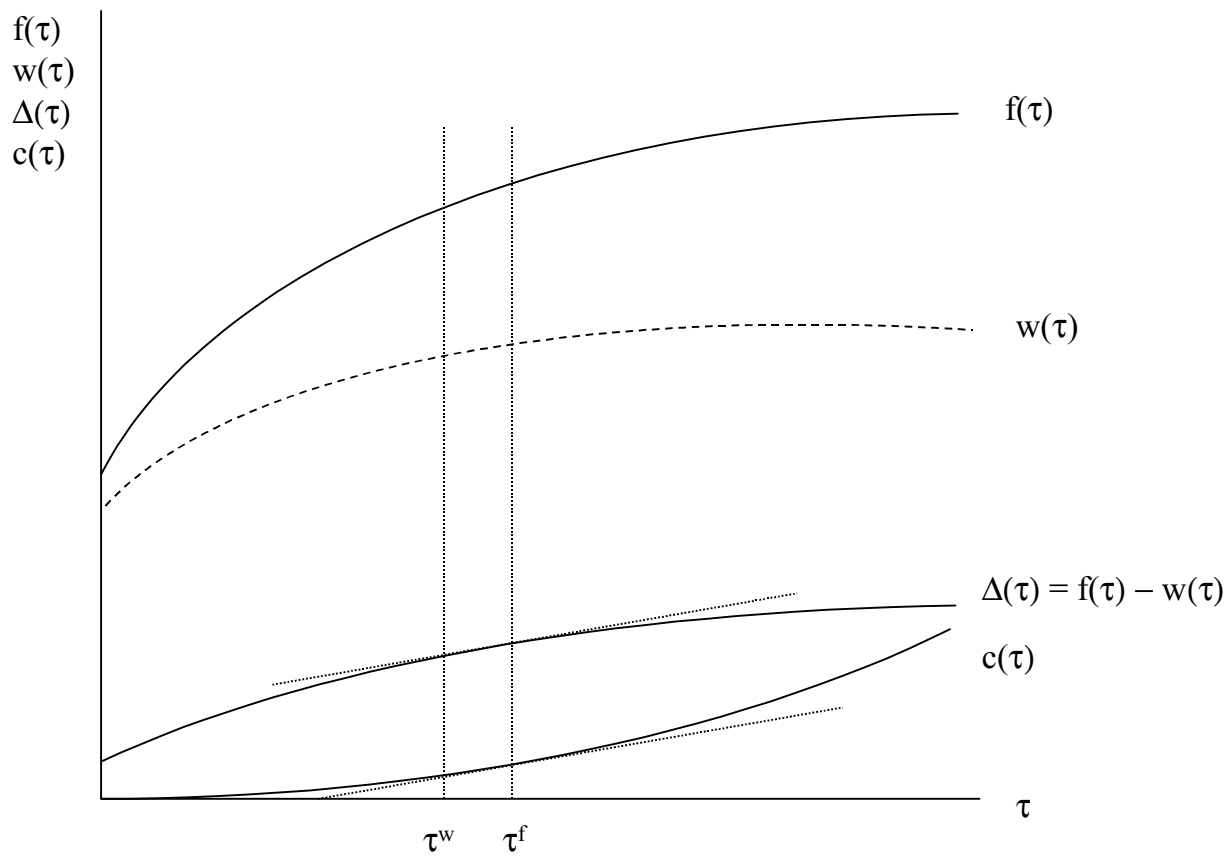


Figure 8: Training incentives in non-competitive labor markets.