

# Coordination Failure and Employment in South Africa

David Fryer

Desire Vencatachellum

---

THE CHALLENGE OF GROWTH AND POVERTY: THE SOUTH AFRICAN ECONOMY SINCE DEMOCRACY.



T I P S / D P R U F o r u m 2 0 0 3

# Coordination Failure and Employment in South Africa\*

David Fryer

Désiré Vencatachellum

April 5, 2003

\*We thank Bruno Versaevel for helpful discussions. Authors' affiliations: D. Fryer, Department of economics and economics history, Rhodes University, Grahamstown, South Africa; D. Vencatachellum, HEC-Montreal, Université de Montréal, Montreal (Quebec) Canada H3T 2A7. Part of this research was completed while the second author was a visiting Professor at Rhodes University whose hospitality is gratefully acknowledged. Corresponding author: D. Vencatachellum, Email: [dv@hec.ca](mailto:dv@hec.ca)

## ABSTRACT

South Africa simultaneously lost more than 890,000 jobs and increased the number of skilled workers from 1989 to 1999. We argue this is the consequence of well-documented acute apartheid-era distortions which led to a current coordination failure where (i) firms are locked into a mostly skill-intensive technology where they have very little demand for semi-skilled and unskilled labor, and (ii) there are too few semiskilled *and* skilled blacks. It follows that the average level of blacks' human capital is too low for firms to adopt a technology which makes intensive use of less skilled workers in the production process. A firm cannot unilaterally change technology because current skilled (mostly white) workers would lose and move to other firms. All this points to a missing market for semi-skilled workers. Wealth redistribution, public investments in both the quantity and quality of education are shown to be Pareto-improving.

JEL Classification: O14, J48

Keywords: South Africa, Employment, Coordination Failure, Apartheid

There is no place for him in the European community above the level of certain forms of labour. For that reason it is of no avail to him to receive a training which has as its aim absorption into the European community, where he cannot be absorbed.

[Hendrik French Verwoerd, Minister of Native Affairs (1950-1959) and Prime Minister of South Africa (1959-1966), Senate Debates, 7 June 1954]

## 1 Introduction

This paper explains two related features of post-apartheid South Africa. First, while 16 percent of all jobs were lost between 1989 and 1999 (SAIRR 2002), the formal sector created new jobs for highly skilled workers.<sup>1</sup> What growth there has been in informal sector employment seems to have been in very low-skilled activities only. It is expected that in the future, employment of skilled workers will continue to increase while semi-skilled and unskilled positions, mostly held by blacks, will continue to fall (Human Sciences Research Council 1999). This implies South Africa is moving away from using semiskilled labor towards skilled labor intensive processes in the formal sector, and very low skill work in the informal sector. Most blacks are not sufficiently educated to work in skilled jobs.<sup>2</sup> Thus the lack of semi-skilled opportunities means that in effect South Africa is still a place where (in Verwoerd's words) there is "no place" for most blacks "above the level of certain forms of labour". Second, in contrast to most other developing countries (Psacharopoulos and Patrinos 2002), there appear to be no returns to primary education in South Africa (Moll 1998, Butcher and Rouse 2001). In other words, acquiring that level of skills is still of "no avail".

We draw from the skill-biased technology literature (Acemoglu 2002) to construct a model which explains the persistence of these two features into post apartheid South Africa. The model highlights a coordination failure that results in a missing market for less skilled (semiskilled and unskilled) workers. A lack of appropriately trained workers explains why South African firms have chosen technologies that continue to rely on skilled (mainly white) workers. In equilibrium firms do not change to a new technology which uses both semiskilled and skilled workers unless it is

Pareto-improving for current skilled (white) workers. There is an *endogenous* threshold level of black human capital when this is the case. Any firm which changes technology when the share of skilled blacks is too low would lose all its skilled workers and perish. Below the threshold firms continue using the exclusively skilled-technology and they have no demand for semiskilled workers. Such workers only find unskilled jobs: menial jobs in the formal sector or in the informal sector. As for blacks, the absence of job opportunities and high poverty rates undermine their incentives and ability to acquire skills.

Although similar models have been applied to other settings, ours is to our knowledge the first application to South Africa, and also the first to link coordination failure and absence of returns to education. Our explanation complements existing ones and is an important contribution to the South African debate. Indeed, existing explanations, such as those blaming labor market distortions for the poor labour market performance, cannot explain the extent of the collapse of semiskilled positions in South Africa. The policy implications differ from previous ones. A big education push similar to that envisaged by the South African government's Reconstruction and Development Programme (RDP) is appropriate. The RDP acknowledged that apartheid-created distortions were undermining the economy. It proposed large expenditure in key sectors like health and education, and asset redistribution. However, the RDP became subservient to the Growth, Employment, and Redistribution programme (GEAR) whose main goal is macroeconomic stability. GEAR involves lower expenditure and asset redistribution than the original RDP (Marais 2001).

The remainder of the paper is as follows. Section 2 develops a model which is consistent with the characteristics of post-apartheid South Africa, and we solve for the equilibrium share of black skilled workers in Section 3. Section 4 discusses the policy implications of our model and provides additional evidence which is consistent with our findings. Finally section 5 concludes. All figures and proofs are in the appendix.

## 2 Model

We consider a two-period economy populated by more blacks than whites. Each agent lives for two periods and dies at the end of the second period. Each agent is endowed with one unit of non-leisure time in each period, and  $a$  units of wealth which for simplicity yields  $a$  units of the consumption good.<sup>3</sup> Wealth endowment is distributed over a bounded support  $[\underline{a}, \bar{a}]$  for blacks and  $[\underline{\alpha}, \bar{\alpha}]$  for whites. We assume that the average white is significantly richer than the average black so as to capture the well documented wealth inequality in South Africa (Bhorat, Leibbrandt, Maziya, van der Berg and Woolard 2001, Michaud and Vencatachellum 2003).

A consequence of apartheid era policies is the stark differences between educational attainment of blacks and whites (Fedderke and Luiz 2002). Using the 1993 Project for Statistics on Living Standard and Development, we calculate that 71 per cent of black labor market participants have at most attended school up to standard 7, while the comparative figure for whites is 5 percent. So as to reflect education inequality in South Africa, we assume that in the first period blacks are either unskilled or semiskilled in the first period while all whites are skilled. By semiskilled we mean that they have some education or training which is not enough for them to be considered as skilled workers. For instance, they may have primary and even some secondary education.

Unskilled workers are assumed not to have completed primary education and are not able to acquire any further education. Thus may occur because those unskilled workers are illiterate and the costs to educate them so that they would be able to undertake further education is too high.<sup>4</sup> We therefore focus on semiskilled blacks education decisions. A black semi-skilled agent can either allocate all of his time to produce the numéraire good or attend school full time. Those who attend school can work as skilled workers in the second period. Attending school here means that the agent acquires sufficient education to be a skilled worker. Whites are wealthy enough, and

benefited sufficiently from apartheid-era policies, to have acquire enough training. They qualify as skilled workers in the first period and can immediately work as such.

The homogenous good can be produced either in the formal or informal sector. Unskilled agents can work in the informal sector where they earn their reservation wage which is normalized to 1. The informal sector differs from the formal one in that there are no human capital externalities, and wages are much lower in the informal sector. The evidence suggests that South Africa informal sector is predominantly unskilled (see Berry (2001) and Section 4).

Firms in the formal sector have access to either an existing technology which they are currently using, or a new one. Both technologies exhibit human capital externalities following Lucas (1988). However, given the historical discriminations in South Africa and evidence of asymmetric human capital externalities in that country as documented by Michaud and Vencatachellum (2003), these externalities differ depending on which technology is used.

**A. 1 (Existing technology)** *There is an existing (old) technology which uses only skilled labor for production and unskilled workers for menial jobs. Skilled and semiskilled workers cannot be substituted.*

We assume that firms use a number of unskilled workers which is determined by their infrastructure whose cost has already been incurred. One could think of unskilled workers as office cleaners and gardeners who do not contribute to the actual production process. Unskilled workers can be viewed as a fixed cost which the firm has already incurred when it decided on its investment in infrastructure. We assume there is a large supply of unskilled workers who are paid at their reservation wage which is normalized to 1. This assumption reflects the large supply of unskilled workers in South Africa and allows us to focus on skilled workers. The latter are paid at their marginal product and hired on a competitive labour market.

Aggregate output under the existing technology is as follows:

$$y_o = g(x_w)l_s \tag{1}$$

where  $g$  is a scale function which captures human capital externalities,  $x_w$  is the share of skilled workers among whites and measures whites' human capital, and  $l_s$  is the number of skilled workers. Equation (1) implicitly assumes that human capital externalities arise only from white workers. This assumption is made purely for simplicity and one could assume that  $g$  is also a function of black skilled workers' human capital. All our results would still hold provided that human capital externalities from skilled black workers are not too high in the old technology.

So as to guarantee that in equilibrium the total wage bill is equal to total output, we assume that (i) a lump sum tax is levied on each skilled worker to pay the unskilled workers and (ii) both technologies use the same number of unskilled workers. This assumption means that each skilled worker pays the same non-distortionary tax irrespective of the technology and therefore we can focus on their gross wages. It follows from (1) that skilled workers earn a gross wage, denoted  $w_s$ , which equals:

$$w_s = g(x_w) \tag{2}$$

**A. 2 (New Technology)** *The second (new) technology uses both skilled and semiskilled labor simultaneously as imperfect substitutes in the production process. Unskilled workers still do menial jobs.*

Contrary to the existing (old) technology, under the new technology semiskilled workers contribute actively to the production process where they are paid at their marginal product. Let the amount

of effective units of labour be equal to:

$$h = l_m + \mu(\mathbf{x})l_s \quad (3)$$

where  $\mathbf{x} \equiv (x_b, x_w)$  is the vector of shares of skilled blacks and whites,  $l_m$  and  $l_s$  are the amount of semiskilled and skilled workers respectively.

**A. 3 (Labour Productivity)** *Skilled workers are more productive than semiskilled ones:  $\mu(\mathbf{x}) \geq 1$  for all  $x_b$  and  $x_w \in (0, 1]$ .*

The second technology is skill-biased and output equals:

$$\tilde{y} = a(\mathbf{x})h \quad (4)$$

where  $a(\mathbf{x})$  is a scalar function. We could also assume that the scalar function is also influenced by the measure of semiskilled workers in the economy. As firms operate in a perfectly competitive environment, in equilibrium, firms earn zero profits and factors are remunerated at their marginal product:

$$\tilde{w}_m = a(\mathbf{x}) \quad (5)$$

$$\tilde{w}_s = \mu(\mathbf{x})\tilde{w}_m \quad (6)$$

where  $\tilde{w}_m$  and  $\tilde{w}_s$  denote the gross wages of semiskilled and skilled workers respectively. Note that it is possible if there are too few semiskilled workers then (4) cannot be used. This would be similar to the existence of a threshold level of intermediate human capital similar to Azariadis and Drazen (1990). Although such an explicit assumption is not made here because the measure

of semiskilled workers is exogenous, we will discuss its implications for the South African economy when we investigate relevant policies.

Recall that firms are already locked into the old technology which was chosen under apartheid, whose main objective was to maximize whites' welfare. As in equilibrium firms earn zero profits, they should in theory be indifferent between the two technologies. However, they will adopt the second technology if and only if skilled (white) workers' wages do not fall. To see this assume a firm unilaterally decides to use the new technology even though skilled workers earn lower wages under that technology. Skilled workers from the deviating firm will migrate to other firms which are still using the old technology. As all firms are of measure zero and all markets are perfectly competitive, it follows that no firm will adopt the new technology unless skilled workers benefit from such a change. In other words  $\tilde{w}_s > w_s$  is a necessary and sufficient condition for firms to adopt the new technology. If that condition is met, then all firms will use the new technology. The timing of events is as follows. Firms use the existing technology in the first period. They decide whether or not to use the second technology in the second period.

Given the assumption that all whites are skilled in the first period, and that human capital does not depreciate, it follows that  $x_w = 1$  in both periods and cannot be increased any further. We therefore need to determine the share of semiskilled blacks who train to become skilled workers.

**Lemma 1 (Threshold)** *There exists a threshold level of black workers human capital, denoted  $\tilde{x}$ , below which skilled workers' wages under the existing technology exceeds those under the new technology.*

The threshold level of human capital arises because of the difference in the two production functions. Moreover, we do not need to assume the existence of an exogenous threshold as in Azariadis and Drazen (1990) and Dessy and Pallage (2001).

We now turn to (black) semiskilled agents' education investment decisions. If  $e \in \{0, 1\}$  denotes whether or not a black individual trains as a skilled worker,  $1 - e$  is the time allocated to working. We assume that agents' preferences are additively separable:

$$u(c_1, c_2) = f(c_1) + v(c_2) \tag{7}$$

where  $c_t$  is consumption in period  $t \in \{1, 2\}$ , and  $v$  is the present value utility of consuming  $c_2$  units of the good in period 2. Equation (7) captures the fact that agents care about both their first and second period consumption, and therefore income.

An agents' consumption in period  $t$  is equal to the wage received in that period. In the first period the semiskilled worker may either train to become a skilled worker, or because the old technology prevails take unskilled work (in the informal sector or menial formal sector jobs). If the worker takes the informal sector work, he receives a wage equal to 1 in the first period. Consequently his first-period income is the sum of his endowment and wages, i.e.  $(1 + a)$ . However, if he trains his first-period income equals  $a$ .

In the second period a worker who has trained in the first period becomes a skilled worker whichever technology prevails. His second-period wage is given by either (2) or (6) depending on whether the old or the new technology is respectively used. If the worker has not trained, he works as a semiskilled worker in the second period if the new technology is adopted and earns (5). However if he has not trained, and the old technology is still used, he still works as an unskilled worker earning a wage of 1. Note that the semiskilled human capital is only rewarded if the new technology is adopted. This has important implications for the equilibrium as explored in section 3.

More formally, let  $w_t$  denote a semiskilled black worker's wage in period  $t$ . In the first period his wage is given by

$$w_1 = 1 - e \tag{8}$$

where we recall that  $e = 1$  if the agent trains as a skilled worker, and  $e = 0$  if he works. In the second period his wage is equal to:

$$w_2 = ew_s + (1 - e)w_m \quad (9)$$

where  $w_s$  is the skilled wage is given by (2) or (6) depending on whether the old or the new technology is respectively used, and  $w_m$  is the semiskilled wage which equals 1 under the old technology or (5) under the new one.

### 3 Equilibrium

Agents must form expectations on the share of blacks who train to become skilled workers. Each semiskilled black compares his utility from attending school to train as a skilled worker in the first period or to take employment as an unskilled worker immediately. A semiskilled black agent earns (9) in the second period. The benefit to a semiskilled black of training as a skilled worker, when he expects a share  $x^e$  of semiskilled blacks to attend the training program, equals:<sup>5</sup>

$$\begin{aligned} B(a, x^e) &= u(a) - u(1 + a) + v(w_s(x^e)) - v(w_m(x^e)) \\ &\equiv \Delta(a) + v(w_s(x^e)) - v(w_m(x^e)) \end{aligned} \quad (10)$$

where  $\Delta$  is implicitly defined and is the instantaneous marginal utility from consumption. As the utility function is monotone increasing and strictly concave by assumption, it follows that  $\Delta < 0$  and  $\Delta_a > 0$  because of diminishing marginal utility. Moreover, we expect skilled workers to earn higher wages because of the difference in their marginal product. This is consistent with the findings of skill-biased technology literature: although the share of skilled workers has been increasing, their wages have also been increasing relative to those of unskilled workers. As documented by Michaud

and Vencatachellum (2003) for South Africa, the increased in demand for skilled workers, due to the increase in their productivity, dominates the increased supply. Hence it makes sense to assume that  $v(w_s(x^e)) > v(w_m(x^e))$  for all  $x^e \in [0, 1]$ .

As for all  $x \in [0, 1]$ , (i)  $B_a$  and  $B_x$  are continuous and (ii)  $B_a \neq 0$  for any finite  $a$ , there exists a unique continuous differentiable function  $h(x^e)$  that solves  $B(h(x^e), x^e) = 0$ . Therefore, when expectations equal  $x^e$ , all semiskilled blacks with a wealth greater than  $h(x^e)$  train to become skilled workers and those who are poorer do not. Note that there is no guarantee that  $h(x^e) \in [\underline{a}, \bar{a}]$ . We will return to that when we discuss the nature of the different equilibria.

**Definition 1 (Fulfilled Expectations Equilibrium)** *An equilibrium is a realized share  $x$  of blacks who train to become skilled workers such that agents' expectations are fulfilled ( $x = x^e$ ), their decisions are optimal, and the realized schooling rate solves*

$$x = 1 - \Psi(h(x)) \tag{11}$$

Hence, the equilibrium share(s) of blacks who train to become skilled workers is (are) the fixed point solution(s) to (11).

**Proposition 1 (Existence)**

- i) There always exists a fulfilled expectations equilibrium.*
- ii) The equilibrium where no black is a skilled worker does not always exist.*

The first part of Proposition 1 is a direct application of Brower's fixed point theorem. The second part of Proposition 1 contrasts with the child labour literature. For instance Dessy and Vencatachellum (2003) show that no-school enrollment is always an equilibrium in developing countries. The absence of such an (equivalent) equilibrium in all cases in our model occurs because post-1994

educated blacks can work as skilled workers even if firms retain the old technology and no other black becomes a skilled worker. Not only does legal discrimination no longer exist in South Africa, but there is evidence that skilled blacks are highly sought after. Assume the richest black thinks that no other black trains to be a skilled worker. In this case, using (10) the benefits to training as skilled-worker are positive if  $\bar{a}$  is sufficiently high. However, no black attends school if even the richest black worker cannot afford to. In this case, an equilibrium where no black trains as a skilled worker exists. Given that in modern South Africa there is a positive measure of sufficiently wealthy blacks, the no-skilled blacks equilibrium is unlikely to be generated.<sup>6</sup>

That all blacks train to become skilled workers is an equilibrium only if all are sufficiently rich. Consider for instance the poorest black whose expectations are that everyone attends school. Such an agent benefits from training to become a skilled worker if and only if the second-period wage differential is sufficiently high and  $\Delta(a)$  is not too negative. That last condition is not likely to hold for poor blacks. In this case, the marginal utility of first-period consumption is very large and those blacks cannot afford to defer consumption to the next period. Hence, if some blacks are poorer than a wealth threshold, they do not attend school even if the expectations are that everyone else will train to become a skilled worker. As a significant share of black South Africans are at the subsistence level, it is unlikely that even the poorest black can afford to train as a skilled worker. Therefore that all blacks become skilled workers is unlikely to be generated as an equilibrium by the fundamentals of the South African economy.

The share of blacks who train to become skilled workers as a function of the expectations  $x^e$  is as shown in Figure 1. When the wealth distribution is given by  $\Psi$  there exists a unique equilibrium denoted  $x_l$ . Blacks are not rich enough to generate an equilibrium which is at least as high as the threshold level  $\tilde{x}$ . In that economy, only policies which increase the wealth of the poorest may be effective. This can be achieved either by economic growth which trickles down or income redistribution.

Consider now an economy where all blacks are wealthier. In this case, for all expectations  $x^e \in [0, 1]$  more blacks train to become skilled workers. The function  $1 - \Psi(h(x))$  shifts up and a new equilibrium where a larger share of blacks are skilled workers is obtained. If the economy grows sufficiently fast and blacks' wealth increases sufficiently, then the new equilibrium is greater than  $\tilde{x}$  and the new technology is adopted. However, if economic growth does not benefit the poor, then there is no change in the share of blacks training to become skilled workers and the economy is trapped in using the old technology.

Now consider the effect of income redistribution when old apartheid-era technology is used. For instance, the government may redistribute some assets from the rich (whites or blacks) to poor blacks so as to entice them to train to become skilled workers. The share of blacks who become skilled workers after a mean-preserving Dalton wealth redistribution (Ray 1998) is illustrated by the new cumulative wealth distribution  $\Psi_d$  in Figure 1.

The second possibility is that multiple equilibria may exist when there is a sufficient measure of relatively rich blacks.

**Proposition 2 (Multiple equilibria)** *Assume there exists an  $\hat{x} \in (\tilde{x}, 1)$  such that*

$$1 - \Psi_d(h(\hat{x})) \geq \hat{x}, \quad (12)$$

*and some individuals cannot become skilled workers when the expectations are that everyone will become skilled ( $\Psi_d(h(1)) > 0$ .) Then such an economy exhibits three school-enrollment equilibria.*

When the conditions given in Proposition 2 hold, then the share of blacks who choose to become skilled workers is as illustrated in Figure 1. In this case there are three fixed-point equilibria which solve (11): (i) a low one  $x_d^l$  which is below  $\tilde{x}$ , (ii) an intermediate unstable equilibrium  $x_d^i$  which is still lower than  $\tilde{x}$ , and (iii) a high equilibrium  $x_d^h > \tilde{x}$ . On the one hand, if the  $x_d^h$  equilibrium

is selected, firms adopt the new technology in the second period and both semiskilled and skilled blacks and skilled whites are winners. On the other hand if  $x_d^l$  is selected, the old technology is retained. Then semiskilled workers can work only in the informal sector or perform menial jobs. As a result, semiskilled workers earn no returns to education.

Therefore, when an economy generates multiple equilibria and selects the equilibrium where the new technology is not adopted there are Pareto-improving policies. Such policies ensure that the economy selects the equilibrium where the share of blacks who train as skilled workers is greater than the threshold level  $\tilde{x}$ . An example of such a policy is for the government to enforce compulsory training laws. It can also improve the provision of the quality of education. Hence, the important factors are the low aggregate human capital of blacks, and firms' reluctance to adopt new technologies unless it is Pareto improving for skilled (mostly white) workers.

## 4 Human Capital and Technological Choice in South Africa

We now give evidence that the coordination failure described in Sections 2 and 3 is a good explanation for the current employment situation in South Africa. We acknowledge other explanations which include: rigidities from labor market institutions (Boccaro and Moll 1997), and the changing structure of South Africa industry in response to such factors as trade liberalization (Edwards 2001). Resolving the coordination failure which is highlighted in this paper should only be viewed as a *necessary* condition for there to be a demand for less-skilled workers in the formal sector.

We start with a brief description of early apartheid South Africa in Section 4.1. This serves two purposes. First, South Africa's current problems are largely a function of its history. Second, as Verwoerd's words suggest, conditions in early apartheid illustrate the coordination failure demonstrated in Section 2. We then show in Section 4.2 that blacks have low human capital and wealth, and in Section 4.3 that South African firms are using more skill intensive technology nowadays.

## 4.1 Apartheid

Early apartheid (up to around 1930) was buttressed by a coordination failure as we describe in sections 2 and 3. Mining and agriculture were the dominant sectors (Nattrass 1981). For technological reasons the mines required large quantities of skilled labour and even larger quantities of unskilled labour (Austen 1987, p. 165). The requirement for skilled labour was largely met by whites. In order to meet its unskilled labour requirement, the mining houses, with the assistance of the state, engineered a monopsonistic labour market for black labour. This system worked by repressing economic alternatives of blacks (for example by restricting the amount of land available to them), by exerting close supervision both on the job and in black workers urban quarters, and by maintaining a system of circular migration from rural areas rather than allowing blacks to settle permanently in urban areas.<sup>7</sup>

Agriculture presented a similar picture (Nattrass 1981, p. 106-107). Apart from the repression of subsistence and market oriented black agriculture, white farms (which employed an increasing black workforce) required mainly unskilled labour and made use of the same methods of labour control as the mines. In manufacturing, which began to emerge as a significant sector after 1910 (Bell and Madula 2002), early production was dominated by the craft system (Webster, 1985: 32-39). Blacks were confined to unskilled jobs, with white craft unions monopolizing access to skilled work directly through closed shop arrangements and indirectly through and control of the apprenticeship system. The technology was such that there was very little semiskilled work. Thus the technology in those three sectors is well approximated by our existing (old) technology described in assumption 1.

In this period, black educational attainments remained low. Even by 1970, 82% of black males had not received any secondary education (Nattrass 1981, p. 47). The principle factor does not seem to be direct government repression. Rather, the early apartheid economy simply did not

need skilled or semiskilled blacks. Neither the government, nor individual blacks, had any strong incentive to invest in black education. Apart from its effects in reinforcing prejudice, the racial casting of blacks as disenfranchised, unskilled, rural “uncivilized” labour Lipton (1985, p. 20, 261-64), meant that employers had little incentive initially to adopt new technologies. This is consistent with our model in that the share of educated black fell below the threshold for firms to benefit from changing technology.

However, technological change in the manufacturing sector had occurred in other countries to the extent that by the 1930s craft work had been replaced by repetitive, machine-based semiskilled work (Webster, 1985: 45). This change happened gradually in South Africa. This together with the increasing importance of manufacturing implied a large demand for semiskilled and skilled workers which could only be met by blacks. Allowing such a change would have meant that the level of black human capital would have exceeded the threshold. Thus, it was only by the 1950s that it began to translate to significant gains for blacks. Firstly, “deskilling” was initially successfully resisted by the craft unions (Webster 1985, p. 39). Secondly, because of the significant poor white problem (Wilson and Ramphela 1989) the new semiskilled operator jobs could initially be filled mainly with white labour.<sup>8</sup> Thirdly, semiskilled jobs could apparently be filled by workers with little education.<sup>9</sup>

However, these factors merely delayed matters. By the end of World War II, white unions had lost most of their power, and most importantly, economic growth had created a labor shortage which could not be filled by poor whites as the “poor-white” problem had been solved (see Wilson and Ramphela, 1989: 318). Thus, while before the 1940s whites accounted for about forty percent of manufacturing jobs, by 1950, blacks were beginning to dominate semiskilled jobs and were even penetrating skilled occupations in significant numbers (Industrial Legislation Commission, quoted by Lipton, 1985: 39).

Consistent with a higher demand for skilled and semiskilled blacks, there is evidence of increasing black education from the 1940s onwards (Fedderke and Luiz 2002, Figure 1). An indicator of the recognition of the increasing importance of Black education for economic development was the passage of the National Education Finance Act in 1945. Prior to this, black education had to be financed through money raised through African taxes (Lipton 1985, p. 21). In short, there is evidence that “[t]he black vanguard was overtaking the bottom group of whites ” (Lipton 1985, p. 19). This would be consistent with the economy breaking out of the threshold level of human capital.

Faced with this erosion of apartheid, the newly elected Nationalist Party acted. Verwoerd’s words (quoted at the beginning of the paper) therefore constitute a statement of intent to halt the erosion of apartheid by entrenching it through legislation. The government attempted to subvert both black education and occupational progress through legislation and policies. For instance (i) the Bantu Education Act, which was a direct attempt to undermine black education, (ii) urbanisation policies whereby Africans did not have permanent urban rights, and (iii) the re-entrenchment of the job color bar. The government sought to encourage capital-intensive production through industrial policies, and hence reduce the reliance of industry on black labour. These policies resulted in a highly distorted economy by the end of apartheid. We argue in the next section that these distortions have long run effects on technological choice and black human capital.

## **4.2 Human Capital and Wealth in Post-Apartheid South Africa**

In this subsection we document that post-apartheid human capital and wealth distributions of black South Africans are consistent their aggregate human capital falling below the threshold  $\tilde{x}$  described in Lemma 1. First, the quality of black education was poor under apartheid, and there are indicators that it has not significantly improved subsequently. During that period, Black education was of very

poor quality because of its ideological content, the misallocation of resources by the government, and African schools becoming a center of political resistance rather than learning (Davenport and Saunders 2000). Indeed Chisholm (1992, p. 281) contends that under late apartheid (1960-1994), despite rising black enrollment and education expenditure, illiteracy and innumeracy increased. Borat et al. (2001) also report that numeracy and literacy skills for blacks aged 13 to 18 in 1993 were only about half that achieved by whites. It is unlikely that the quality of education for blacks has significantly improved recently (Case and Yogo (1999) and Hosking (2000)). For instance, Case and Yogo (1999) report that the government has increased black teachers' salaries at the expense of pupil/teacher ratio and other school resources.

It is of interest to quantify the human capital of the cohort educated under apartheid. This group is important because it constitutes the current 30-55 age group and thus most of the black labour force. According to Van der Berg (2002, p.296) within this cohort, even those who attended school to grade 11 on average fail basic literacy and numeracy tests. Using the 1999 October Household Survey, we find that 83 percent of black labour market participants have at most a grade 11 education. It follows that as many as four-fifths of the black labour force may have low levels of skills. There is also evidence that poor training is an important determinant of labour market performance. For instance, in the 1999 October Household Survey, 69 per cent of those who are unemployed say they cannot get a job because of they lack skills or qualifications.

Second, even after apartheid, high enrollment does not necessarily mean an effective education because of high poverty among black households (Bhorat et al. 2001), the quality of education, and parental and peer group effects (Case and Deaton 1999). As approximately half of black households are below the poverty line (Bhorat et al. 2001), very few can afford have their children complete secondary school. An indicator of this is there is significant child labour in South Africa despite it being illegal and education being compulsory. Moreover, schools in poor communities are less

likely to be of decent quality and children in these communities may obtain little support at home (see the maps in Case and Yogo (1999)).

Third, many blacks may have little commitment to education because of the few semi-skilled jobs and the commodity boom, coupled to unionization, which led to high unskilled wages (Bell and Madula 2002, p. 103-104). Indeed, since around 1975, the emergence of massive unemployment at the unskilled and semiskilled levels has meant that only those who complete secondary education have a good chance of getting decent work. Youth unemployment is particularly important in this regard: in 1997, only 55 per cent of black men and 33 per cent of black women aged 26-30 worked in the formal sector (authors' calculation from the 1997 October Household Survey). This would confirm the pessimistic expectations of the current generation of school-goers.

### **4.3 Technological Choice in Post-Apartheid South Africa**

In the years since the end of apartheid, formal sector employment in South Africa has increased in highly skilled categories only. It has decreased at the intermediate and unskilled level. Although these decreases may have been offset to a certain extent by informal sector employment, all indicators are that unemployment is high and rising at the intermediate and unskilled levels.<sup>10</sup> There is also considerable evidence of the underlying processes that are occurring at the firm level. The experience of lower-skilled workers is one of retrenchment and informalisation (Standing, Sender and Weeks 1996, Kenny and Webster 1998, Friedman 2002). As Baskin (1998, p.998) puts it “..unfortunately, many larger firms prefer to go the high wage-high productivity-low staff complement route.” There is also evidence that skills training efforts by firms are extremely low (Vavi 2002), reinforcing the human capital problems we have documented.

Our model is consistent with these trends. It predicts that in South African conditions firms select skill-intensive technologies. Less skilled workers are confined to low skill, informal sector jobs

or unemployment. The labour market does not reward human capital until someone qualifies as a skilled worker. Hence there are no returns to primary education. The most important test of whether South Africa is in such a coordination failure is what is occurring at the semi-skilled level. Declining employment, and high unemployment suggest that there is an excess supply of semi-skilled and unskilled workers. Indeed, compared to other middle income countries South Africa seems to be well endowed at the semiskilled level (Bell and Madula 2002, p. 120). However, we argue that there are too few skilled *and* semi-skilled blacks. Ironically, therefore, although the critical problem is a lack of such workers, the collapse in the demand of semiskilled workers caused by firms' consequent technological choice, induces a surplus of semiskilled individuals.

What distinguishes our explanation from others is its ability to address the evidence that no sector in South Africa has adopted a semi-skilled intensive technology. Other arguments blame either employers implementing discriminating policies, or labour market distortions caused by strong unions and worker-friendly legislation (Baskin, 1998). However, even in sectors where unionization and labour law is minimal, the tendency not to use semi-skilled workers are at least as strong as in more protected sectors. These arguments therefore cannot explain the performance of South Africa's informal sector. Several authors have commented that South Africa's informal sector is small compared to similar countries. What seems to be lacking is a significant tier of intermediate skill activities (Berry 2001).

It is worth noting that the trend highlighted here is partly supported by the experience of other countries. Many countries in Africa, Asia (Brenan 1996), and Latin America (Berry 2001) have similar problems with low skill workers facing either unemployment or poor work in unprotected jobs that do not reward marginal human capital. What is relevant to our analysis is that in many of these cases, labour market institutions are weak. Our analysis would suggest that poverty rates, and the human capital attainments of the less skilled would be decisive factors in the retention of technologies that make use of semiskilled workers. There is some support for this argument. It

has been argued for example that relatively egalitarian distributions of income and relatively high human capital attainments were important preconditions for newly industrialized countries' growth (Wilkinson 1994).

## 5 Policy Implications and Conclusion

We ask why the employment base in South Africa has been contracting yearly since 1989, and why, contrary to most other developing countries, there are no returns to primary education. Using a two-period model where agents invest in education to become skilled workers, we show that unless the aggregate level of blacks' human capital is sufficiently high, skilled workers earn lower wages in a technology which uses all types of labor than in the apartheid-inherited technology. It is therefore not Pareto optimal from the point of view of skilled workers, who are mostly white, that firms adopt the new technology unless the aggregate human capital of black workers is sufficiently high. Any firm which switches unilaterally to the new technology would lose all its skilled workers who would be offered better jobs by firms using the apartheid era technology. Hence in equilibrium, firms are locked into the old equilibrium if a large share of the black population is too poor for them to become skilled workers, or if their expectations are such that a low school enrollment equilibrium is selected.

We then provide evidence about human capital stocks, poverty rates, and the nature of technological choice in South Africa. These characteristics were partially inherited from apartheid, but the evidence suggests that neither the gradual decline of apartheid since the 1970, nor the end of apartheid in 1994, stimulated any recovery. South Africa thus appears to fit our coordination failure model well. Moreover, our assessment of the evidence suggests that our explanation complements existing explanation well.

Our analysis has important implications which relate both to the type and scale of the policies. Firstly, if the problem is coordination failure, reform of for example, labour law may be futile. Such reform may make labour cheaper, but if the human capital characteristics of the labour force are wrong, the response to lower labour costs may be very inelastic. Secondly, one is struck by the apparent failure and futility of post apartheid policies that have attempted to address the problems. What our analysis suggests is that a) policy efforts have to be of a sufficient scale to move South Africa above the critical human capital threshold and b) coordinated policy is required to address the factors locking South Africa into the coordination trap.

Education policy illustrates these points. We have presented evidence that returns to education are low for all but those who complete secondary education. The obvious implication is that the government should focus its effort at getting people right through the education system. This is consistent with the observation that there are shortages of highly skilled labour and weak demand for intermediate and unskilled workers. Our analysis highlights that government should not neglect primary and secondary education. Not only the quality of human capital needs to be improved (as other authors have argued) but also its quantity.

The human capital problem may seem the most severe, and addressing it is the most direct way out of the coordination failure. However, our analysis suggest that failure to address the other two factors (the highly skewed distribution of income and the tendency of firms to choose skill-intensive technologies) could result in costly failure. For example, so long as there are so few job opportunities for people who do not complete secondary education, commitment to education is likely to remain low. Technology policy, and efforts to encourage firms to train workers (such as the Skills Development program) therefore have important complementary roles. Similarly, deep poverty is likely to undermine the effectiveness of education.

Finally it is important to comment on both the limitations and the significance of our study. Firstly, we only describe the main elements of the coordination failure. As such we can only indicate which policies are likely to be important. We do not explore the optimal policy mix, although we believe our model provides a useful starting point for such an exploration. Despite these limitations, the paper provides an important insight into the policies that are likely to be successful in South Africa. We show that the scale of the policy effort is likely to be critical.

## Notes

<sup>1</sup>Fedderke, Henderson, Mariotti and Vaze (2000) document the increased skills intensity in the manufacturing sector between 1970 and 1997, and the fall in employment after 1990.

<sup>2</sup>In a case study of a textile manufacturing firm, holding education and other factors constant, Frijters (1999) estimates lower average productivity for black females compared to Asian females.

<sup>3</sup>Our framework is similar to Dessy and Vencatachellum (2003) who investigate how coordination failure impacts on child labour.

<sup>4</sup>This assumption allows us to focus on semiskilled workers. Future work may investigate the simultaneous decisions of semiskilled and unskilled workers to obtain training. This would allow the measure of semiskilled workers to be endogenous. However, this would require the simultaneous solution to a system of two fixed-point equations which would significantly increase the complexity of the model and equilibrium results.

<sup>5</sup>For notational simplification we drop the  $b$  subscript in  $x^e$ .

<sup>6</sup>This means that in South Africa  $h(x^e) \in [\underline{a}, \bar{a}]$  for all  $x^e \in [0, 1]$ .

<sup>7</sup>An indicator of the control achieved over black labour is that black mining wages remained virtually constant in real terms from until 1970 (Hofmeyr 1994).

<sup>8</sup>Indeed on railways, between 1924 and 1932 the number of unskilled white laborers increased from 6 363 to 12 042, while the number of Africans employed fell from 35 532 to 17 467 (Webster, 1985: 47).

<sup>9</sup>Webster (1985: 61) comments that "[by the late 1940s] although Africans had moved into semiskilled jobs, they were largely unskilled laborers".

<sup>10</sup>South Africa emerged from apartheid with a capital and skill intensive production structure which is at odds with abundant unskilled labor. Post-apartheid skill and capital deepening seem to have continued as evidenced by (i) increased employment of skilled workers, (ii) a fall in semi and unskilled employment in the mining, construction and manufacturing sectors, and (iii) increased capital intensity in the last three sectors (see Bell and Madula (2002, p. 119) for a survey of the evidence, Edwards (2001) and Samson, MacQuene and van Niekerk (2002)). These authors agree that South Africa is different from other developing countries in the extent of these distortions.

## References

Acemoglu, Daron (2002) 'Technical change, inequality and the labor market.' *Journal of Economic Literature* 40(1), 7-72

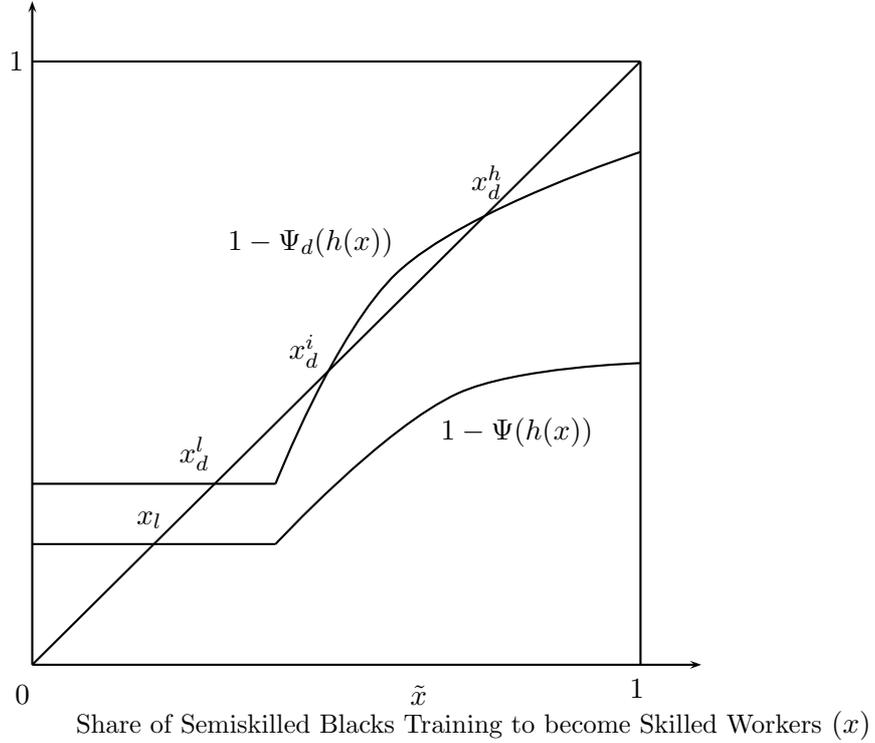
- Austen, Ralph (1987) *African economic history: international development and external* (London, U.K.: James Curry)
- Azariadis, Costas, and Allan Drazen (1990) 'Threshold externalities in economic development.' *Quarterly Journal of Economics* 105(2), 501–26
- Bell, R. Trevor, and Nkosi Madula (2002) 'The manufacturing industry.' In *The Decline of the South African Economy*, ed. Stuart Jones (Cheltenham, U.K.: Edward Elgar) chapter 6
- Berry, Al (2001) 'The role of the small and medium enterprise sector in Latin America: Lessons for South Africa.' Technical Report 5, Trade and Industrial Policy Strategies (TIPS), <http://www.tips.org.za/research/papers/>
- Bhorat, H., M. Leibbrandt, M. Maziya, S. van der Berg, and I Woolard (2001) *Fighting Poverty: Labour Markets and Inequality in South Africa* (University of Cape Town Press)
- Boccaro, B., and Peter G. Moll (1997) 'Labor market flexibility and industrial councils in South Africa.' The World Bank, African Region
- Brenan, Jan (1996) *Footloose labour: working in Indias informal economy*. (London: Cambridge University Press)
- Butcher, Kristin F., and Cecilia Elena Rouse (2001) 'Wage effects of unions and industrial councils in South Africa.' *Industrial and Labor Relations Review* 54(2), 349–374
- Case, Anne, and Angus Deaton (1999) 'School inputs and educational outcomes in South Africa.' *Quarterly Journal of Economics* 114(3), 1047–1084
- Case, Anne, and Motohiro Yogo (1999) 'Does school quality matter? returns to education and the characteristics of schools in South Africa.' Department of economics Princeton University
- Chisholm, Linda (1992) 'Education in the era of negotiations.' In 'South African review 6: Red Friday to CODESA' (Johannesburg: Ravan)
- Davenport, Rodney T., and Christopher Saunders (2000) *South Africa : A Modern History* (Macmillan..)
- Dessy, Sylvain E., and Désiré Vencatachellum (2003) 'Explaining cross-country differences in policy response to child labour.' *Canadian Journal of Economics*. Forthcoming
- Dessy, Sylvain E., and Stéphane Pallage (2001) 'Child labor and coordination failures.' *Journal of Development Economics* 65(2), 469–476
- Edwards, Lawrence (2001) 'Trade and the structure of South African production, 1984-97.' *Development Southern Africa* 18(4), 471–491
- Fedderke, J. W., and J. M. Luiz (2002) 'Production of educational output: Time-series evidence from socioeconomically heterogeneous populations—the case of South Africa, 1927–1993\*.' *Economic Development and Cultural Change* 51(1), 161–187
- Fedderke, Johannes, Simon Henderson, Martine Mariotti, and Prbhat Vaze (2000) 'Changing factor market conditions in south africa: The labour market - a sectoral description of the period 1970 - 1997.' Working Paper 5, University of the Witwatersrand, Department of Economics, Johannesburg, South Africa
- Friedman, Steven (2002) 'Equity in the age of informality: labour markets and redistributive policies in South Africa.' Technical Report 160, Institute of Development Studies, Sussex
- Frijters, Paul (1999) 'Discrimination and expected productivity in a South African clothing firm.' *Oxford Economic Papers* 51(2), 345–354
- Hofmeyr, Julian (1994) (Durban: Economic Research Unit, University of Natal)
- Hosking, Steven (2000) 'Government-induced teacher failure in South Africa - causes and analysis.' *Development Southern Africa* 17(5), 641–665
- Human Sciences Research Council (1999) 'Skills needs of South African labour market: 1998-2003'
- Kenny, B., and E. Webster (1998) 'Eroding the core: Flexibility and the re-segmentation of the South African market.' *Critical Sociology* 24(3), 216–243
- Lipton, Merle (1985) *Capitalism and Apartheid: South Africa, 1910-84* (Totowa, New Jersey: Rowman and Allanheld)

- Lucas, Jr. Robert E. (1988) 'On the mechanics of economic development.' *Journal of Monetary Economics* 22(1), 3–42
- Marais, Hein (2001) *Limits to Change: The Political Economy of Transition.*, second ed. (Cape Town: Juta)
- Michaud, Pierre-Carl, and Désiré Vencatachellum (2003) 'Human capital externalities in South Africa.' *Economic Development and Cultural Change*. Forthcoming
- Moll, Peter G. (1998) 'Primary schooling, cognitive skills and wages in South Africa.' *Economica* 65(258), 263–284
- Nattrass, Jill (1981) *The South African Economy* (Cape Town: Oxford University Press)
- Psacharopoulos, George, and Harry Anthony Patrinos (2002) 'Returns to investment in education: A further update.' Working Paper 2881, World Bank, Washington D.C., September
- Ray, Debraj (1998) *Development Economics* (Princeton, New Jersey: Princeton University Press)
- SAIRR (2002) 'Labour trends.' Technical Report 04, South Africa Institute of Race Relations, P.O. Box 31044, Braamfontein Johannesburg South Africa, April
- Samson, Michael, Kenneth MacQuene, and Ingrid van Niekerk (2002) 'Capital/skills-intensity and job creation: An analysis of policy options.' Technical Report, Trade and Industrial Policy Strategies (TIPS), <http://www.tips.org.za/research/papers/>
- Standing, G., G. Sender, and J. Weeks (1996) *Restructuring the Labour Market: The South African Challenge* (Geneva, Switzerland: International Labour Organization)
- Van der Berg, Servaas (2002) 'Differentiation in black education.' *Development Southern Africa* 19(2), 289–306
- Vavi, Zwelinzima (2002) 'Address to the saccawu 7th national congress.' COSATU. <http://www.cosatu.org.za/speeches/2002/zv020710.htm>
- Webster, Eddie (1985) *in a racial mould: labour process and trade unionism in the foundries* (Johannesburg: Raven)
- Wilkinson, Barry (1994) *Labour and industry in the Asia-Pacific: Lessons from the Newly Industrialized Countries* (Berlin: Walter de Gruyter)
- Wilson, Francis, and Mamphela Ramphele (1989) *Uprooting poverty: the South African Challenge* (New York and London: W. W. Norton and Co.)

## 6 Appendix

### 6.1 Figure

Figure 1: Equilibrium Shares of Skilled Blacks



$\Psi$  and  $\Psi_d$  are two wealth distributions where there are fewer poor people in the latter. For instance one can move from  $\Psi$  to  $\Psi_d$  by performing mean-preserving Dalton transfers from  $\Psi$  (Ray 1998). The  $\Psi$ -economy exhibits a unique low equilibrium denoted  $x_l$ . The  $\Psi_d$ -economy exhibits three equilibria: a low one  $x_d^l$ , an intermediate one  $x_d^i$ , and a high one  $x_d^h$ .

### 6.2 Proof of Lemma 1

A white skilled worker's wage under the new technology is higher than under the old technology if and only if:

$$a(\mathbf{x})\mu(\mathbf{x}) > g(x_w) \quad (13)$$

Note that both  $\mu(\mathbf{x})$  and  $a(\mathbf{x})$  are monotone increasing in  $x_b$ , while the right hand side of is a constant because  $x_w$  is at its maximum level by assumption. It follows that there are two possibilities. Either  $\mu$  and  $a$  are not increasing enough in  $x_b$  in which case skilled workers wages in the new technology can never exceed those under the old one. Second, those two functions are increasing enough in  $x_b$  such that there exists a threshold level  $\tilde{x}$  which holds for all  $x_b \in (\tilde{x}, 1)$ . For example it is sufficient for  $a(1, 1) > g(1)$  for such a threshold to exist.

### 6.3 Proof of Proposition 1

Since the functions  $u$ ,  $v$  and  $g$  are by continuous by assumption, it follows that the implicit function  $w^*(x)$  is also continuous. Since (i)  $[0, 1]$  is by definition non empty, compact and convex, (ii)  $\Psi : [0, 1] \rightarrow [0, 1]$ , and (iii)  $\Psi$  is continuous, we can appeal to Brouwer's fixed point theorem which guarantees a solution to (11).

### 6.4 Proof of Proposition 2

We first construct a more equal economy than the benchmark one by performing Dalton transfers. Let  $\varepsilon \in \mathfrak{R}_+$ . The more equal economy is constructed from  $\Psi$  and has as wealth support  $[\bar{a} + \varepsilon, \bar{a} - \varepsilon]$ . The transfers are such that those who choose to train as skilled workers prior to the transfers still choose to become skilled workers. As for those who did not choose to train as skilled workers previously, some are now made rich enough that they choose to become skilled workers. Hence, for each value of  $x$ , more people choose to train as skilled workers and  $1 - \Psi(\cdot)$  shifts upwards to  $1 - \Psi_d(\cdot)$ . Three equilibria exist if there exists at some value  $\hat{x}$  such that  $1 - \Psi_d(h(\hat{x})) > \hat{x}$  as illustrated in Figure 1.