Coordination Failure

and

Employment in South Africa

David Fryer
Department of Economics and Economics History
Rhodes University, Grahamstown, South Africa

Désiré Vencatachellum
HEC Montreal, Université de Montréal
Montreal (Quebec) Canada H3T 2A7
dv@hec.ca

Abstract

South Africa lost more than 890,000 jobs, but saw an increase in the number of skilled workers from 1989 to 1999. We argue that 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 labour, and (ii) there are too few semi-skilled *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 of this points to a missing market for semi-skilled workers. Wealth redistribution and public investments in both the quantity and quality of education are shown to be Pareto-improving.

Acknowledgements

Policy Research Unit
Tel: +27 21 650 5705
Fax: +27 21 650 5711
Information about our Working Papers and other
published titles are available on our website at:
http://www.commerce.uct.ac.za/dpru/

Table of Contents

There is no place for him [a black man] 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 the formal sector jobs were lost between 1989 and 1999 (SAIRR 2002), new jobs were created for highly skilled workers.[1] 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 diminish (Human Sciences Research Council 1999). This implies that South Africa is moving away from using semi-skilled labour towards skilled labour intensive processes in the formal sector, and very low skill work in the informal sector.

Such a technological choice has serious implications because most blacks are not sufficiently educated to work in skilled jobs.[2] 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".

---

[1] 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.

[2] 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.

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 (semi-skilled and unskilled) workers. A lack of appropriately trained workers explains why South African firms have chosen technologies that rely on skilled (mainly white) workers. In equilibrium firms do not change to a new technology which uses both semi-skilled and skilled workers unless it is Pareto-improving for current skilled workers. There is an *endogenous* threshold level of black human capital when this is the case. Any firm which changes technology below the threshold would loose all its skilled workers and perish. Below the threshold, firms continue using the exclusively skilled-technology and they have no demand for semi-skilled workers. Such workers only find unskilled jobs, namely menial jobs in the formal sector or in the informal sector. 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 labour market distortions for the poor labour market performance, cannot explain the extent of
the collapse of semi-skilled 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 macroecononomic 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. We solve for the equilibrium share of black skilled workers in Section 3. Section 4 discusses human capital and technological choice in South Africa in greater detail. Finally section 5 summarises our results, discusses policy implications and concludes. All figures and proofs are in the Appendix.

2. Model

Consider a two-period economy populated by blacks and whites, where each agent lives for two periods and dies at the end of the second period. In addition, each agent is endowed with one unit of non-leisure time in each period, and a units of wealth which for simplicity yields units of the consumption good.[3]   Wealth endowment is distributed over a bounded support $[\underline{a}, \overline{a}]$ for blacks and $[\underline{a}, \overline{a}]$ for whites. For simplicity we assume that no white is poorer than any 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).

One consequence of apartheid-era policies is the stark difference between educational attainment of blacks and whites (Fedderke and Luiz 2002). Using the 1993 Project for Statistics on Living Standards and Development, we calculate that 71 per cent of black labour 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 less-skilled, while all whites are skilled. In other words, whites are wealthy enough, and benefited sufficiently from apartheid-era policies, to have acquired enough training. Of the less-skilled, the semi-skilled have some education or training, but insufficient for skilled work. Such individuals may have primary and even some secondary education.

Unskilled workers are assumed not to have completed primary education and cannot acquire any further education. This may occur because their human capital is too low, and the costs to educate them so that they can undertake further education are prohibitively high.[4] We can therefore focus on education decisions for semi-skilled blacks. In the first period, a black semi-skilled agent can either allocate all of his time to produce a numéraire good or acquire full-time training (i.e. attend school). Those who attend school can work as skilled workers in the second

---

[3] Our framework is similar to Dessy and Vencatachellum (2003) who investigate how coordination failure impacts on child labour.

[4] This assumption allows us to focus on semi-skilled workers. Future work may investigate the simultaneous decisions of semi-skilled and unskilled workers to obtain training. This would endogenise the measure of semi-skilled workers. Such a change 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. However, we do not anticipate that it would change the qualitative properties of our results because a coordination problem will still arise.

period. Attending school here means that the agent acquires sufficient education to be a skilled worker.

2.1 Technologies

The homogenous good is produced either in the formal or informal sector. 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's informal sector is predominantly unskilled (see Berry (2001) and Section 4). Unskilled agents can either work in the informal sector or in menial formal sector jobs. Firms in the formal sector use a number of unskilled workers which is determined by their infrastructure. One could think of unskilled workers, for instance, as office cleaners and gardeners who do not contribute to the actual production process. Unskilled workers are viewed here as a fixed cost which must be incurred for firms to operate.

Firms in the formal sector face the following timing of events. They use an existing technology in the first period. They decide whether or not to use a second technology in the second period. Following Lucas (1988) we assume that both technologies exhibit human capital externalities. However, given the historical discriminations in South Africa, and evidence of assymetric human capital externalities (see Michaud and Vencatachellum (2003)), these externalities differ depending on which technology is used. Three assumptions to the model are elaborated below:

Assumption 1 (Existing Technology): *The existing (old) technology uses only skilled labour for production and unskilled workers for menial jobs. Skilled and semi-skilled workers cannot be substituted.*

Aggregate output under the existing technology is as follows:

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

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.[5] 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 is also a function of human capital for blacks. All our results would still hold provided that human capital externalities from black workers are not too high in technology (Assumption 1). Moreover, Section 4.3 provides some reasons why (1) is a good representation of the existing technology in South Africa.

Assumption 2 (New Technology): *The second (new) technology uses both skilled and semi-skilled labour simultaneously as imperfect substitutes in the production process. Unskilled workers do menial jobs.*

Contrary to the existing (old) technology, in the new technology semi-skilled workers contribute actively to the production process where they are paid at their marginal product. As in Dessy and Vencatachellum (2003), let the amount of effective units of labour be equal to:

$$h = l_m + \mu(\mathbf{x})l_s \qquad (2)$$

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 semi-skilled and skilled workers respectively.

Assumption 3 (Labour Productivity): *Skilled workers are more productive than semi-skilled ones:* $\mu(\mathbf{x}) > 1$ *for all* x_b *and* $x_w \in (0,1]$

The second technology is skill-biased and output equals:

$$\bar{y} = \gamma(\mathbf{x})h \qquad (3)$$

where $\gamma(\mathbf{x})$ is a scalar function. One difference between the two technologies is that aggregate human capital externalities arise from the aggregate human capital of both blacks and whites. This occurs because the use of semi-skilled workers

---

[5] The production function (1) could make use of semi-skilled workers. However, with flexible wages and perfect competition on the labour market, one would be unable to explain the collapse of the market for semi-skilled workers. One would need to introduce rigidities on the unskilled labour market only. Although this is clearly a possibility, we choose to use a perfectly competitive framework to show that even in the absence of such rigidities, the market for semi-skilled workers may collapse because of coordination failure. To that extent, resolving the coordination failure highlighted here is only a necessary condition to solving the labour market problem in South Africa as explained in Section 4.

generates a positive externality for all workers. This externality cannot exist in the old technology because it does not use such workers by definition.

Note that (3) does not assume the same external effect of black and white human capital. Indeed, evidence of very high, and different, intra-race human capital externalities is provided by Michaud and Vencatachellum (2003). It is also possible that if there are too few semi-skilled workers then technology (3) 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 semi-skilled workers is exogenous, we will illustrate the possible implications of too few semi-skilled workers for the South African economy in Section 4. Finally, we could also assume that the scalar function $\gamma(\mathbf{x})$ is also influenced by the measure of semi-skilled workers in the economy. Using (1) and (3), and the assumption of perfect competition, we now solve for wages under the two technologies.

2.2 Wages

To guarantee that in equilibrium the total wage bill in the formal sector equals output in that sector, we assume that (i) a lump sum tax is levied on each skilled worker to pay 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 can compare gross wages under the two technologies. Unskilled workers earn their reservation wage which is normalised to 1. This assumption reflects the large supply of unskilled workers in South Africa.

As firms operate in a perfectly competitive environment, their equilibrium profits equal zero, and workers (except those who do menial jobs) are remunerated at their marginal product. It follows from (1) that skilled workers earn a gross wage, denoted w_s, which equals:

$$w_s = g(x_w) \qquad (4)$$

Similarly, wages in the new technology (3) is given by:

$$\tilde{w}_m = \gamma(x) \tag{5}$$

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

where $\tilde{w}_m$ and $\tilde{w}_s$ denote the gross wages of semi-skilled and skilled workers respectively.

Recall that firms are already locked into the old technology which was chosen under apartheid, whose main objective was to maximize the welfare of whites. 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.

Given the assumption that all whites are skilled in the first period, and that human capital does not depreciate, it follows that x_w equals 1 in both periods. We therefore need to determine the share of semi-skilled blacks who train to become skilled workers. For notational simplification we drop the b subscript and refer to the share of skilled black workers simply as x in what follows.

Lemma 1 (Threshold): *There exists a threshold level of black workers human capital, denoted $\bar{x}$; 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).

2.3 Preferences and Income

We now turn to (black) semi-skilled 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 agent's consumption in period t is equal to the wage received in that period because the numéraire good is non storable. In the first period the semi-skilled 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 (4) or (6) depending on whether the old or the new technology is respectively used. If the worker has not trained, he works as a semi-skilled 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. In other words, semi-skilled 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 semi-skilled 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:

$$w_2 = ew_s + (1 - e)w_m \tag{9}$$

where w_s is the skilled wage is given by (4) or (6) depending on whether the old or the new technology is respectively used, and w_m is the semi-skilled 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 semi-skilled black agent 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 semi-skilled black agent earns (9) in the second period. The benefit to a semi-skilled black agent of training as a skilled worker, when he expects a share x^e of semi-skilled blacks to attend the training program, equals:[6]

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

where Δ 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 skillbiased technology literature: although the share of skilled workers has been increasing, their wages have also been increasing relative to those of unskilled

---

[6] For notational simplification we drop the subscript in x^e.

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 that $v(\bar{w}_s(x^e)) > v(\bar{w}_m(x^e))$ for all $x^e \in [0,1]$ as a result of assumption 3, and that we assume $w_s > 1$ in the old technology.

As for all $x \in [0,1]$, (i) B_a, 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 semi-skilled 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 $h(x^e) \in [\underline{a}, \overline{a}]$. We will return to this when we discuss the nature of the different equilibria. We are now in a position to advance a definition on the fulfillment of expectations at equilibrium as well as formulate two propositions which lead from our model.

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

$$x = 1 - \Psi(h(x))$$

(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 Brouwer'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 enrolment 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 $\overline{a}$ is sufficiently high. However, it is also the case that 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.[7]

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. The last condition is not likely to hold for poor blacks. In this case, the marginal utility from 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 (see Appendix). There exists a unique equilibrium x_l for an economy whose wealth distribution is given by Ψ. Blacks are not rich enough to generate an equilibrium which is at least as high as the threshold level $\tilde{x}$. In this economy, only policies which increase the wealth of the poorest may be effective in enticing firms to use the new technology. This can be achieved either by economic growth which trickles down, or income redistribution.

---

[7] This means that in South Africa $h(x^e) \in [\underline{a}, \overline{a}]$ for all $x^e \in [0,1]$.

Consider now the effect of income redistribution when the old apartheid-era technology is used. The government performs a mean-preserving Dalton wealth redistribution (Ray 1998). The share of blacks who become skilled workers after such a policy is illustrated by the new cumulative wealth Ψ_d distribution in Figure 1. In this case, for all expectations $x^e \in [0, 1]$ more blacks train to become skilled workers. The function $1 - \Psi_d(h(x))$ shifts up and a new equilibrium, where a larger share of blacks are skilled workers, is obtained. In this example, multiple equilibria arise after depending on black agents' expectations on x^e 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*

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

and some individuals cannot become skilled workers when the expectations are that everyone will become skilled $1 - \Psi_d(h(\hat{x})) \geq \hat{x},$ *. Then such an economy exhibits three school-enrolment 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 $\bar{x}$, (ii) an intermediate unstable equilibrium x_d^i which is also lower than $\bar{x}$, and (iii) a high equilibrium $x_d^h > \bar{x}$. On the one hand, if the x_d^h equilibrium is selected, firms adopt the new technology in the second period and both semi-skilled and skilled blacks and skilled whites are winners. On the other hand if x_d^l or x_d^i is selected, the old technology is retained. Then semi-skilled workers can work only in the informal sector or perform menial jobs. As a result, semi-skilled workers earn no returns to education.

Therefore, if the new economy generates multiple equilibria, and selects that 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 $\bar{x}$. An example of such a policy is for the government to implement and enforce compulsory training laws. It could also endeavor to reduce the cost of training borne by the individuals. Hence, the important factors are the low aggregate human capital of blacks, and the reluctance of firms to adopt new technologies unless it is Pareto-improvi ng for skilled (mostly white) workers.

Note that in theory economic growth which has a trickle down effect under the old technology would be another way to remove the coordination failure. For this to occur, the wages and wealth of the poor blacks would have to increase sufficiently. This cannot happen in our model because poor blacks work as unskilled workers and earn their constant reservation wage. However, one could think of a dynamic setup where the wages of unskilled workers increase over time and their children would be able to afford to train as skilled workers. However, such a situation is not realistic for South Africa because unemployment of unskilled workers is increasing, and unskilled wages have not shown significant real gains during the past 10 years (SAIRR 2002).

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 labour market institutions (Boccara and Moll 1997), and the changing structure of South African industry in response to such factors as trade liberalisation (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 Sections 2 and 3. We then show in Section 4.2 that blacks have low human capital and wealth, and in Section 4.3 that South African firms nowadays are using more skill intensive technology.

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.[8]

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 monopolising access to skilled work directly through closed shop arrangements and indirectly though the control of the apprenticeship system. The technology was such that there was very little semi-skilled 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 percent 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 semi-skilled 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 "uncivilised" labour Lipton (1985, p. 20, 261- 64), meant that employers had little inc entive initially to adopt new technologies. This is consistent with our model in that the share of educated blacks fell below the threshold for firms to benefit from changing technology.

---

[8] An indicator of the control achieved over black labour is that black mining real wages remained virtually constant until 1970 (Hofmeyr 1994).

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 semi-skilled work (Webster, 1985: 45). This change happened gradually in South Africa. This together with the increasing importance of manufacturing implied a large demand for semi-skilled 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. However, it was only by the 1950s that it begun 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 Ramphele 1989) the new semi-skilled operator jobs could initially be filled mainly with white labour.[9] Thirdly, semi-skilled jobs could apparently be filled by workers with little education.[10]

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 labour shortage which could not be filled by poor whites as the "poor-white" problem had been solved (Wilson and Ramphele 1989, p. 318). Thus, while before the 1940s whites accounted for about forty percent of manufacturing jobs, by 1950, blacks were beginning to dominate semi-skilled jobs and were even penetrating skilled occupations in significant numbers (Industrial Legislation Commission, quoted by Lipton (1985, p. 39)).

Consistent with a higher demand for skilled and semi-skilled 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 though 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.

---

[9] 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).

[10] Webster (1985: 61) comments that [by the late 1940s] although Africans had moved into semi-skilled jobs, they were largely unskilled laborers "

15

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 and policies. For example (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 colour 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, black human capital and wealth.

4.2 Human Capital and Wealth in Post-Apartheid South Africa

We now document that post-apartheid human capital and wealth distributions of black South Africans are consistent their aggregate human capital falling below the threshold $\bar{T}$ described in Lemma 1. First, the quality of black education was poor under apartheid, and there are indicators that it subsequently has not improved significantly. 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).[11] It is unlikely that the quality of education for blacks has significantly improved recently (Case and Yogo (1999) and Hosking (2000)). Case and Yogo (1999), for instance, report that the government has increased the salaries of black teachers 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. Van der Berg (2002, p.296) contends that within this cohort, many of those who attended school to grade 11 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 a large share of the black labour force may have low levels of skills. There is also evidence that poor training is an important determinant

---

[11] Chisholm (1992, p. 281) contends that under late apartheid (1960-1994), despite rising black enrolment and education expenditure, illiteracy and innumeracy increased. Bhorat 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.

of labour market performance. For instance, in the 1999 October Household Survey, 69 percent of those who are unemployed say they cannot get a job because they lack skills or qualifications.

Second, even after apartheid, high enrolment 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 to have their children complete secondary school. An indicator of this is the significance of child labour in South Africa (Budlender and Bosch 2002), 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 unionisation) 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 semi-skilled 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 percent of black women aged 26-30 worked (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.[12] The experience of low-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 may seem to be well endowed at the semi-skilled 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 semi-skilled workers caused by firms' consequent technological choice, induces a surplus of semi-skilled 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 unionisation and labour law is minimal, the tendency not to use semi-skilled workers is 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).

---

[12] 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.

The trend highlighted for South Africa, and our explanation, is partly supported by the experience of other countries. Many countries in Asia (Breman 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. Our analysis suggests that poverty and aggregate human capital attainments are decisive factors in the retention of technologies that make use of semi-skilled workers. There is some support for this argument. It has been argued for example that relatively egalitarian income distributions and relatively high human capital attainments were important preconditions for the growth of the newly industrialised countries (Wilkinson 1994).

5. Policy Implications and Conclusion

We ask why South Africa has lost close to one million jobs 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 labour than in the apartheid-inherited technology. It is therefore not optimal for 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 as a large share of the black population is too poor to become skilled workers. Redistribution is not sufficient to solve the coordination failure problem if multiple equilibria exist and expectations are such that a low school enrolment 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 of post-apartheid policies that have attempted to address the problems. Our analysis suggests 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 nil for all those with less than secondary school 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 skilled labour and weak demand for intermediate and unskilled workers. Our analysis highlights that the 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, as 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. We only describe the main elements of the coordination failure and 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.

6. 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 (2 001) '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, Haroon, Murray Leibbrandt, M. Maziya, Servaas van der Berg, and Ingrid
    Woolard (2001) Fighting Poverty: Labour Markets and Inequality in South
    Africa (University of Cape Town Press)

Boccara, B., and Peter G. Moll (1997) 'Labor market flexibility and industrial
    councils in South Africa.' The World Bank, African Region Breman, Jan
    (1996) *Footloose labour: working in India's informal economy*. (London:
    Cambridge University Press)

Budlender, Debbie, and Dawie Bosch (2002) 'South Africa child domestic workers:
    A national report.' Technical Report, International Labour Organization,
    Geneva, Switzerland, May 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 Probhat 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) An analysis of African wage movements in South Africa (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 mec hanics 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 51(3)

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 cretion: 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 Guyter)

Wilson, Francis, and Mamphela Ramphele (1989) *Uprooting poverty: the South African Challenge* (New York and London: W. W. Norton and Co.)

7. Appendix

7.1 Figure

Figure 1: Equilibrium Shares of Skilled Blacks
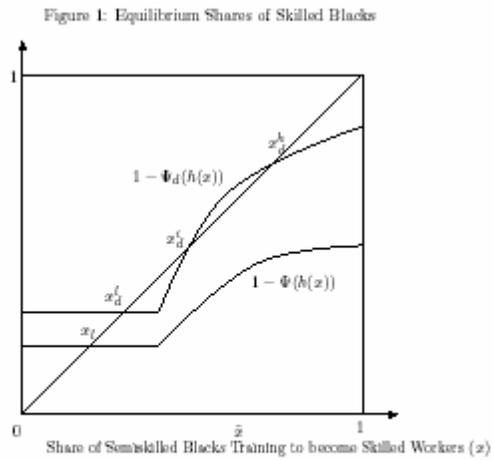
Ψ and Ψ_d are two wealth distributions where there are fewer poor people in the latter. For instance one can move from Ψ to Ψ_d by performing mean-preserving Dalton transfers from Ψ (Ray 1998). The Ψ−economy exhibits a unique low equilibrium denoted x_ℓ. The Ψ_d−economy exhibits three equilibria: a low one x_ℓ^d, an intermediate one x_i^d, and a high one x_h^d.

7.2 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:

$$\gamma(x)\mu(x) > g(x_w) \qquad\qquad (13)$$

Note that both $\mu(x)$ and $\gamma(x)$ are monotone increasing in x_b; while the right handside of equation (13) is a constant because x_w is at its maximum level by assumption. If follows that there are two possibilities. Either μ 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 $\bar{x}$ which holds for all $x_b \in (\bar{x}, 1)$. For example it is sufficient for $a(1,1) > g(1)$ for such a threshold to exist.

7.3 Proof of Proposition 1

Since the functions u, v and g are 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) $\Psi : [0,1] \longrightarrow [0,1]$, and (iii) Ψ is continuous, we can appeal to Brouwer's fixed point theorem which guarantees a solution to (11).

7.4 Proof of Proposition 2

We first construct a more equal economy than the benchmark one by performing Dalton transfers. Let $\varepsilon \in \Re_+$. The more equal economy is constructed from Ψ 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.