

Returns to Education in South Africa: Evidence from the Machibisa Township*

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Abstract

We develop a model where blacks in the private sector earn no returns to education if there are relatively too few educated blacks. Using a sample of black females in the late apartheid Kwa Zulu to control for labor market specific effects, we find that more than a fifth of labor market participants are self employed. There are no returns to primary education and positive returns for the first two years of secondary education. Further education allow females to find employment in the government sector where they earn a wage premium. Only secondary education is a predictor of earnings status, and new migrants are most likely to be unemployed. Our analysis therefore contributes to challenging the consensus on high returns to primary education in developing countries.

JEL Classification: D45, L10

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The policy of mission education to train young black girls in domestic skills, such as sewing and cooking, had a further impact. It is against this backdrop that women's dominance in sewing, catering, and small commercial businesses focussed on these items must be understood. [Friedman and Hambridge (1991, p. 170)]

1 Introduction

The economic development literature argues that there are high returns to schooling in developing countries. Reviewing the literature on returns to investment in education, Psacharopoulos and Patrinos (2002, Table 4, p. 14) report an average rate of return to schooling of 9.9 and 11.7 per cent for Asia and sub-saharan Africa respectively. However, work by Behrman and Deolalikar (1993) in Indonesia, and studies in South Africa (Pillay 1992, Schultz and Mwabu 1998), find low returns to primary education. Furthermore, these returns in South Africa virtually disappear once community fixed-effects are accounted for (Moll 1998, Butcher and Rouse 2001). Moll (1996) explains this by the poor quality of schooling and the adverse role played by trade unions and Industrial Councils.

While the returns to education (net of transaction costs) should not differ across regions when labor is mobile, it may be strongly influenced by regional characteristics such as the historical restrictions on the mobility of labor in South Africa (e.g. the pass laws). However, to our knowledge, most of the analysis on wage determinants in South Africa treat labor market characteristics as a fixed effect, yet do not allow the returns to education to vary across regions. This occurs because national surveys contain too few observations by community to include both a community dummy and its interaction with the number of years

of education as explanatory variables in wage equations.¹ Heckman, Layne-Farrar and Todd (1996) show that in the U.S., regional labor markets affect the economic returns of unskilled workers, and that returns to education should be non linear. This omission in the studies of the rate of returns to education in South Africa may bias the estimates.

In this paper, we investigate the possibility of an education threshold for the employment of black women in the Machibisa township of Kwa Zulu *and* estimate the returns to schooling for this population. This question is of interest because: (i) using data from one region allows us to account for labor market specific factors, (ii) females, as in other developing countries, are the most affected by poverty (Bhorat, Leibbrandt, Maziya, van der Berg and Woolard 2001), and (iii) a large share of the black population lives in townships. While in national data sets (e.g. the 1993 South Africa Project for Statistics on Living Standard and Development (PSLSD)) less than one per cent of females are self-employed, this is not the case for Machibisa females where slightly more than one in five is self-employed. Furthermore, most Machibisa women hold jobs which use domestic skills such as domestics or self-employed hawkers. Our analysis is also relevant for other developing countries as women in those countries share some of the same characteristics as those in our sample.

We first set up a simple model where black workers in the private sector earn no return to education. If the average human capital externalities of blacks are too low, then a white worker's wage will be greater under a technology which uses only skilled whites. Our estimates suggest that the returns to education are: (i) nil for those with only primary education, (ii) positive for the first two years of secondary education, and (iii) highest for

¹The same critique may apply to much of the returns to education literature. For example Trostel, Walker and Wolley (2002) do not control for sectoral and cluster specific effects. These omissions may bias the estimates of the returns to education upwards as shown in Michaud and Venctachellum (2002).

those in the government sector. Furthermore, only secondary education is found to be a significant predictor of employment status and we also find that new migrants to Machibisa are most likely to be unemployed. These results may arise because of apartheid policies, skill-biased technologies used in nearby Pietermaritzburg as well as the low quality of effective education. Our results confirm Wilson and Ramphela's (1989, p. 148) claim that age, gender and previous experience are more relevant than education for most blacks. In a broader perspective, our analysis contributes to challenging the consensus on high returns to primary education in developing countries.

The remainder of the paper is organized as follows. We set up the model in section 2. Section 3 describes relevant apartheid policies and some characteristics of the area surveyed. We analyze the data in section 4, and discuss the estimates of the selection and wage equations in section 5. Finally, section 6 concludes. All tables are in the appendix.

2 Model

Consider an economy populated by blacks and whites.² Assume that agents derive utility only from consumption and are endowed with human capital which they sell on the labor market. We further assume that the average level of human capital of whites (h_w) exceeds that of blacks (h_b) in order to reflect the well known stylized fact for South Africa (Knight and McGrath 1977, Michaud and Venctachellum 2002). In fact, in the 1993 PSLSD more than 72 per cent of the white labor market participants had completed secondary school, while only 16 per cent of blacks had done so (Michaud and Venctachellum 2002, Table 3).

²We omit Indians and coloreds because of their geographical concentration

For simplicity, we also assume that all whites are endowed with sufficient human capital to work as skilled workers, while a positive measure of blacks have sufficient human capital to work at most in semi-skilled occupations but not as skilled workers.

We consider a two-sector economy producing a *numeraire* non-storable good. In the informal sector, firms are perfectly competitive and use labor at wage rate w_u irrespective of the worker's human capital. In the formal sector, firms operate in perfectly competitive labor and goods markets, but have access to two constant returns to scale technologies. The first technology uses only skilled white workers and, as in Lucas (1988), the average level human capital (in this case of whites only) has a positive externality.

$$Y_w = \alpha h_w x_w \tag{1}$$

where α is a positive parameter and x_w is the amount of white skilled human capital.

The second technology, also with human capital externalities, uses a weighted sum of skilled (white) and semi-skilled (black) labor. Following Galor and Moav (2000) we assume the following production function:

$$Y_b = h_w^\gamma h_b^{1-\gamma} (x_w + \mu x_b) \tag{2}$$

where μ captures the degree of substitution between skilled whites and semi-skilled blacks, x_b denotes the amount of semi-skilled black human capital and $\gamma \in [0, 1]$. If $\gamma = 1$ then blacks do not generate any externalities at the aggregate level. Note that (2) simplifies to (1) if the following three conditions hold: (i) the scaling factor α equals 1, (ii) white workers

and black semi-skilled workers are perfect substitutes ($\mu = 1$), and (iii) blacks and whites have the same average human capital ($h_w = h_b$).

Given that firms are perfectly competitive, they earn zero profits under either one of the two technologies. We assume that the technology choice is the outcome of a political process as explained below. Let λ denote the labor market policy adopted by the government. If $\lambda = 0$, the government does not discriminate against semi-skilled blacks, while if $\lambda = 1$, they are barred from the formal sector. Hence, aggregate production in the formal sector equals Y_w if $\lambda = 1$, and Y_b otherwise. Given that utility is defined only over consumption, and that the numeraire good is non-storable, an apartheid government chooses the discrimination level which maximizes a representative white's wages because blacks cannot vote. In equilibrium, human capital is paid its marginal product and all markets clear, such that using (1) and (2) the price of one unit of white human capital equals:

$$\omega_w = \lambda \alpha h_w + (1 - \lambda) h_w^\gamma h_b^{1-\gamma}, \quad (3)$$

and the price of one unit of human capital of semi-skilled black workers equals:

$$\omega_b = \lambda \omega_u + (1 - \lambda) \mu h_w^\gamma h_b^{1-\gamma} \quad (4)$$

From (4), educated blacks could earn returns from human capital even under apartheid provided they could work as semi-skilled workers ($\lambda = 0$). If they are discriminated against ($\lambda = 1$), then from (4) all blacks earn w_u and their human capital is not rewarded. Note that the white wage premium, given by (3) minus (4), is increasing in the average level of human capital of whites for $\mu < 1$. To the extent that whites are skilled workers, and blacks

semi-skilled, this difference is also equal to the skilled-wage premium. From (3), it is optimal for an apartheid government to discriminate against black semi-skilled workers ($\lambda = 1$) if

$$h_b < \alpha^{\frac{1}{1-\gamma}} h_w \quad (5)$$

Hence, when the average level of human capital of blacks is smaller than a threshold, then black workers enjoy no returns to human capital in the private sector.

If human capital is acquired through schooling, as is the case in real life, then there are no returns to education for blacks when (5) holds.³ Note that: (i) a similar condition to (5) is obtained if we use more general production functions with human capital externalities, and, (ii) condition (5) may be violated even if the average human capital of blacks is smaller than that of whites ($h_b < h_w$) provided that the scaling factor α is not too high. We now take our model to the data to investigate whether educated blacks earn returns to education.

3 Apartheid and the Machibisa Township

In South Africa, the apartheid regime relied heavily on policies which controlled the mobility of blacks. The 1950 Group Areas Act, which segmented communities, and the Population Registration act, which classified people according to their race, were the cornerstones of legislative apartheid. The mobility of blacks was regulated through a pass system and limited access to the housing market. According to the 1970 Bantu Homelands Citizenship Act, every

³It would be of interest to investigate if (5) is robust in a general equilibrium framework as in Dessy and Vencatachellum (2002). This is not pursued here because we focus on an empirical analysis and establish a necessary condition for the absence of returns to education for blacks in apartheid South Africa.

black was a citizen of one of 10 Bantustans or homelands.⁴ The Housing Regulations for non-Bantustan townships stipulated that all township residents had to be listed on a lodger's permit failing which they would not obtain ID documents from the Department of Home Affairs. Local authorities could remove the "redundant, idle, and unsuitable" from urban areas.

Despite these restrictions, African urbanization proceeded rapidly after the late 1960s (Simkins 1983). The pressures towards urbanization arose because of the push from high unemployment in the homelands (Wilson and Ramphela 1989, p. 93), and the pull of the modern urban sector. Many black workers (mostly males) lived in single-sex hostels near their workplace, in commuting communities on homeland borders, or in townships outside white urban areas (Percival and Homer-Dixon 1995). Most township residents were employed in industries, mines or as domestic laborers. With increased migration from the homelands, large illegal populations settled in squatter camps, in backyard shacks of formal townships, and many women settled illegally in male-only hostels.

While employed black males were accommodated in urban areas, women were regarded as "surplus appendages" who belonged to rural areas (Friedman and Hambridge 1991, p. 161). Female migrants to urban areas were confronted with an acute housing problem. Friedman and Hambridge (1991, p. 169) refer to instances where women were not allowed to live in formal townships and were forced into shack settlements. As a result, apartheid led to a high (low) male/female ratio in urban (rural) areas, and severe racial inequalities, with whites owning 87 per cent of the land (Percival and Homer-Dixon 1995).

⁴These 10 homelands, with the four independent ones enumerated first, were: Bophutatswana, Ciskei, Transkei, Venda; Gazankulu, Kangwane, Kwa Zulu, Kwa Ndebele, Kwa Zulu, Lebowa and Qwaqwa.

Our data is for the Machibisa Township in 1990. According to Simkins (1983) Machibisa was in Kwa Zulu, and lies at about five kilometers west of Pietermaritzburg (PMB) (see the map in Appendix C). Kwa Zulu was poorer and less productive than Natal with lower agricultural yields and cattle raising performances (Bromberger and Antonie 1993, p. 421-422). As in other homelands, the wealth differential with the white urban areas (Natal in this case) prompted Kwa Zulu females to migrate to informal urban satellite settlements to find work as domestics or in service occupations (Nattrass and May 1986, p. 591). Around PMB there are 3 main townships: Vulindlela, Imbali and Edendale. Machibisa is on the eastern (town) side of Edendale.

However, the particularities of land tenancy, and housing controls, made it difficult for females to move to urban areas. For instance, only males could own land in Vulindlela, while Imbali was a formal township where the state rented houses exclusively to employed males. Edendale, including Machibisa, was the only area where blacks had freehold land tenure throughout the apartheid period and where there was a free rental market. Thus Edendale became a port-of-entry for women into the PMB job market. Machibisa, in particular, fits this picture well, because it is located on the “town” side of Edendale which makes it a natural base for commuting and for informal businesses.

PMB is the capital of Natal, is part of the Pinetown-Pietermaritzburg-Durban urban hub with close to five million inhabitants, and has a large industrial base. The 1991 manufacturing census finds 27,000 manufacturing jobs in PMB, 13,498 of which were held by blacks. According to this census, most blacks work in the food sector. Although there is evidence of an important footwear industry, such a category does not exist in the census. These workers

may be among the 4,491 in the “other” category. While there seems to be a relatively high demand for skilled workers in PMB, black female migrants are mostly unskilled.

The above situation may reflect a trend of increased demand for skilled labor and a fall in demand for unskilled workers in South Africa (Bell and Cattaneo 1997). Although, influx control and residential segregation were no longer on the statute books by 1990 their effects persisted and other legislations restricting the mobility of blacks were adopted. For instance, the Housing Regulations for non-Bantustan townships were retained, and laws against squatting and slums were tightened (Unterhalter 1987, p. 41). In spite of the many changes which took place in the late 1980s, the Machibisa labor market seems representative for blacks in South Africa from then onwards (May and Rankin 1990). It is against this background that one should view the Machibisa data described next.

4 An Analysis of the Data in the Machibisa Survey

A random sample of 20 per cent of Machibisa households was surveyed between November 1989 and February 1990. The sample consists of 331 households and 1,310 individuals. To construct the sample of female labor market participants, we start with the 522 females who are older than 14. From this we subtract the sick (12), retired (21), scholars (44), housewives (48) as well those who report not participating in the labor force without specifying a reason, leaving us with 385 labor market participants. The sample descriptive statistics are reported in Table 1. We now discuss the variables used in the participation and wage earning equations.

Unemployment The estimated unemployment rate of black females in Machibisa of 39 per cent is lower than that of the 1996 census or the 1993 PSLSD. This difference arises because self-employed females may be classified in other occupational categories, or they may report being unemployed. For example, only 0.3 per cent of female wage-earners are self-employed in the 1993 PSLSD. However, self-employment is the most important category in Machibisa accounting for 35 per cent of all jobs. If we assumed that all self-employed were in fact unemployed, then the Machibisa unemployment rate would increase to 58 per cent, leaving us with the exact number for Kwa Zulu-Natal in the PSLSD. Hence, our sample provides evidence that national data sets may overestimate the unemployment rate because they miscode the self employed.

Selection Only 25 of the 150 unemployed females received job offers in the months prior to the survey. This provides some evidence that the Machibisa labor market is, to a large extent, a buyer's market. However, it is true that some unemployed turned down job offers. The jobs which were declined are, in order of importance: domestic work, manual labor, "shouting at the doors of Indian shops", and sewing shoes. Among the 25 who did receive offers, four reported not wanting the job because the wage offered was too low, while the rest were put off by the nature of the work or the conditions offered. This indicates that wage earners may not be representative of labor market as a whole. In order to avoid potent bias in our estimates, we correct for sample selection when estimating the wage equation.

Age and migration The average labor market participant in our sample is 34 years old. Those who are employed average 36 years of age, while the unemployed average 30 years of age. This age difference may reflect the difficulty which younger and inexperienced women

face in finding employment. Moreover, it may reflect young females migrating in Machibisa because of the poor labor market conditions in the rural areas. Almost 30 per cent of Machibisa women of 25 to 55 years of age had migrated into the area during the five years prior to the survey. The high migration is in line with (Cross, Bekker and Clark 1994) who report that Kwa Zulu experienced high levels of rural migration to urban areas. We expect new migrants in Machibisa to find employment less easily because they have few labor market contacts.

Household size An average household in our sample is composed of 5.7 individuals, with 40 per cent of household members being younger than 15. Young children may require the attention of some care giver, who in most cases is the mother, and may hinder her labor market participation. The number of family members in the household may also matter, especially for self-employed individuals. For instance, fruits and vegetables sellers may benefit from household members who can help her grow, collect, and transport the vegetables to the market place.

Marital status As mentioned by Siphambe and Thokweng-Bawena (2001), being married may mean that an employer is more willing to invest in the human capital of the woman by giving her more training. Siphambe and Thokweng-Bawena (2001) are interested by the formal sector in Botswana where there are high returns to human capital and employers have an incentive to provide on the job training to their employees. Hence, *ceteris paribus*, a married woman is less mobile and has a smaller probability of leaving her job.

Wages The average Machibisa female earns 82 rands per week which however hides severe disparities: 46 per cent earn less than 50 rands, and 5 per cent earn more than 200 rands per week. These low wages mirror the jobs that females have access to. Moreover the wage variance is quite high for the self employed (see Table 1). For example, a mud block maker earns 7 rands 50 cents per week, while a traditional doctor (Sangoma) reports weekly earnings of 380 rands. Such details are not available in the national surveys and provide an interesting insight into a township's labor market. It is also important to note that self-employment is the most common occupation among the uneducated. This may indicate that those who do not possess the skills to be wage earners are constrained to doing odd jobs or to being hawkers.

Occupation Panel B in Table 1 reports the distribution of occupations. The unprotected sector is composed of those who work mostly under short term contracts and with little chance of being unionized. As for the protected sector, it is composed of tenured semi-skilled and unskilled laborers (Jagannathan 1987, p. 90).⁵ An interesting finding is the importance of self-employed females ranging from food street sellers to micro producers sewing clothes or brewing liquor at home. Indeed, Hart (1991, p. 78) notes that beer brewing is part of women's traditional role and that "A woman must be in a position to entertain her husband and his guests with beer." The magnitude of self-employment is in line with Liedholm and Mead (1998, p. 12), who document the importance of one-person micro-enterprises in urban areas of southern and eastern Africa, and (Rogerson 1996) who finds an expansion of informal retail businesses and hawker operations in South Africa.

⁵In Doeringer and Piore's (1971) terminology, the clerical and protected sectors may be associated to the internal labor market, and the other occupational categories to the external labor market.

Domestic workers constitute the most important occupation and earn the lowest wage. More than 50 per cent of domestic workers have completed primary school which may indicate that they work as domestics as a result of a lack of other opportunities. On the other hand, all those in the clerical sector have at least completed primary education, while more than 75 per cent graduated from secondary school. Furthermore, clerical sector workers earn the highest wages. The occupational distribution in Machibisa is typical for blacks in South Africa from the mid-1980s (Nattrass and May 1986, p. 591), and is a consequence of the South African training institutions and constraints (Friedman and Hambridge 1991, p. 179).

Education While the average labor market participant has completed primary school, 11 percent have never attended school, and less than 10 per cent have completed their secondary education. The average number of years of education for Machibisa females does not differ from the 6.7 average years of education for the Kwa Zulu-Natal province in the 1993 PSLSD. Schooling may have non-linear effects on earnings if there are educational thresholds in skills acquisition. Indeed, May and Rankin (1990, p. 588) state that there is no retention of literacy for less than 5 years of education. Moreover, Wilson and Ramphele (1989, p.148) note that there are important returns to breaking the standard 8 barrier which allows one to find white-collar jobs, while the prospect is bleak for those who fail.

To investigate if the returns to education are constant within an education cycle we modify Moll's (1993) specifications of the education variable following Wilson and Ramphele's (1989) conjecture. The first four years of primary education constitute a lower-primary spline, while the last three years form the upper primary spline. Similarly, we specify a spline for the first two years of secondary education, and another spline for upper secondary and tertiary education. We merge upper secondary and tertiary education because there are

only 3 females with tertiary education. If the returns to education are constant within a cycle, then the coefficients should not differ between the lower and upper cycles. Appendix A formalizes these splines.

Edendale The Machibisa data suggests that there are few job opportunities for women, many of whom earn a living from the informal sector (Gerson 1986, Wilson and Ramphele 1989). However, given that PMB has a greater industrial base than Edendale, those who work in PMB should earn a wage premium relative to those in Edendale. We can now investigate the explanatory power of the variables discussed above in explaining a female labor market participant's employment status and earnings.

5 Estimates

5.1 Employment status

As is standard in the labor literature, we assume that a labor market participant accepts a wage-earning position, or becomes self-employed, if her expected utility from being employed is greater than her expected utility from the alternative (Heckman, Lochner and Todd 2001). However, we do not observe a labor market participant's net expected benefits but only her employment status. We specify a probit model where the dependent variable equals 1 if the labor market participant earns positive earnings, and 0 otherwise, and with the explanatory variables described in the previous section. The results are reported in Table 2.

The model fits the data quite well, with 68 per cent correct predictions. However, some of the explanatory variables do not have the expected theoretical sign. The number of years of education should in theory increase the likelihood of finding employment. However, our estimates in Table 2 show that only secondary education is significant in explaining a labor market participant's status. This finding confirms Wilson and Ramphela's (1989) conjecture that primary education is not a determinant of employment for blacks. This result may arise because the labor market for unskilled black females is a buyer's market which finds support in the few unemployed who received job offers during the months prior to the survey. Hence, many Machibisa females are constrained into accepting mostly unskilled positions.

The implications of this result are that, *ceteris paribus*, increasing black females' education will not increase their likelihood of being employed unless they graduate from primary school and acquire some secondary education. Otherwise, the chance to lift those who are trapped in long term poverty, as documented by Carter and May (2001), is small. The likelihood of finding employment may increase even more if labor demand increases with the share of educated females. This may be the case if (i) more skilled workers prompt firms to adopt skill-biased technologies, which in turn increase the demand for skilled workers (Acemoglu 1998, Acemoglu 2002), and (ii) employers do not discriminate against black females.

We also control for a labor market participant's marital status, household size and migration. The married dummy is not significant as a determinant of employment for Machibisa females. This result may arise because females in Machibisa are mostly in unskilled occupations (domestics or self-employed hawkers) which are not human capital intensive.⁶ The

⁶This result differs from Siphambe and Thokweng-Bawena (2001) who analyzed Botswana's formal sector.

effect of household size is not significant. Finally, *ceteris paribus*, our conjecture that it is more difficult for new migrants to find employment is confirmed by our estimates.

5.2 Earnings equation

We next estimate the Mincerian equation using Heckman's (1979) two-step procedure to correct for sample selection. The estimates are reported in Table 3. Given the small sample size, the model fits the data well with an adjusted R-square which varies between 0.37 and 0.38. Five out of seven occupation dummies are statistically significant. It is of interest to note that although no Sangoma (traditional doctor) has completed secondary school, her earnings premium is close to that of someone who works in the clerical sector. It must however be noted that the skills required to be a Sangoma are not acquired through schooling, but are learnt informally. Thus, to this extent, a Sangoma may be considered as a skilled worker who earns an appropriate premium.

We find no returns to primary education irrespective of whether we use the restricted or unrestricted education splines. We do not reject the assumption that the returns to education at the lower and upper primary levels are the same and equal zero. Our results are consistent with Soderbom and Teal (2001) who find no returns to primary education in Ghana. Given the critique that empirical studies using cross-sectional data overestimate the returns to education because of ability bias (Ashenfelter, Harmon and Oosterbeek 1999, Card 1999), we can confidently state that our result provides evidence there are no returns to primary education for females in Machibisa. This result therefore contributes to challenging the consensus on high returns to primary education in developing countries.

We find positive returns at the lower secondary education and no returns at the upper secondary. This suggests that *ceteris paribus* women with upper secondary education earns more than those with only primary education, but not more than those with only lower secondary education. The absence of returns to upper secondary education seems counter-intuitive and may be an artefact of using the clerical and semi-professional dummy in the wage equation. *Ceteris paribus* those in the clerical sector earn the highest premium. However, one must bear in mind that more than 75 per cent of those in this category completed their secondary education and that clerical jobs are not available to most of the other wage earners as their level of education is too low.

The returns to upper secondary education may be biased downwards because models (1) and (2) in Table 3 cannot distinguish between returns to education or returns to occupation. Recall however that from the employment status estimates (Table 2) we know that only secondary education increases the likelihood of being employed. In fact, women who completed their secondary education find employment in the government sector and consequently, earn a wage premium. However, to determine if females who are in the clerical sector earn returns to education we modify the Mincerian wage equation as follows. We interact the 10 and more years of education spline with the clerical sector dummy and include it as an explanatory variable omitting, however, the clerical sector dummy because most clerical females have at least 10 years of education.⁷ The estimates, presented in the last column of Table 3, indicate that clerical workers earn the highest returns to education.

To summarize, our results show that the returns to education: (i) equal 0 for the 0 to 7 years of education category, (ii) are positive for the first two years of secondary education

⁷Including both variables would lead to near-perfect correlation.

and (iii) are highest for those in the clerical sector. This pattern of educational returns may arise for reasons which are consistent with our model presented in section 2. First, firms in PMB used skill-biased technologies. Those who did not complete primary school may not qualify to occupy semi-skilled positions in PMB. The technologies were chosen to maximize white workers' wages and may have required specific training. In other words, condition (5) was met when firms chose the technology and educated blacks could not.

Second, the poor quality of education in South Africa also explains this result. During apartheid, black education was underfunded (Thomas 1996), and black students absentee rates were high since the 1976 Soweto uprising. Consequently, a primary school drop-out may not have acquired more human capital than someone who never attended school. Furthermore, most blacks are in families with few job contacts and thus may not have access to information necessary to find employment. Thus, unless educated workers work in the government sector, they earned no returns to education because of apartheid.

6 Conclusion and Discussion

We estimate the returns to education for black females in South Africa. We first set up a model where an apartheid government prevents blacks from working as semi-skilled workers if whites are penalized. This arises when the average level of blacks' human capital is relatively low which would force firms to use a technology where whites would earn low wages. Under such condition, blacks earn no returns to human capital investments.

Using data from the Machibisa township, to control for labor market specific factors, we find that primary education is not a predictor of employment status and secondary

schools graduates are more likely to find jobs in the government sector. We also find that new migrants to Machibisa are most likely to be unemployed. Our estimates of the wage equation suggest that the returns to primary education are 0, 30 per cent for the first two years of secondary education and highest for those in the government sector.

Our results have important implications in light of the skill-biased technology literature (Acemoglu 2002, Azariadis and Drazen 1990), especially if the technological choice is irreversible. If this is the case, and if black females drop out before secondary school, then one should expect the wage gap between black females and other wage earners to increase. Hence the government should implement an education policy which not only maximizes school enrolment, but ensures an education of good quality, and that students complete at least primary school. As a result, it may then be possible to reduce the 50 per cent current black unemployment rate (South Africa Institute of Race Relations 2002).⁸ Therefore, in light of our results, we can conclude that the returns to primary education in developing countries may be overestimated when regional labor market specific factors are not accounted for.

⁸According to the strict (official) definition of unemployment, 36 per cent of blacks were unemployed in 2001 (South Africa Institute of Race Relations 2002).

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A Appendix: Education Splines

Let s denote the number of years of schooling. We define the following four education splines:

$$\text{Lower primary} = \min[s, 4] \tag{6}$$

$$\text{Upper primary} = \max[\min[s - 4, 3], 0] \tag{7}$$

$$\text{Lower secondary} = \min[\max[s - 7, 0], 2] \tag{8}$$

$$\text{Upper secondary and tertiary} = \max[s - 9, 0] \tag{9}$$

Lower primary education reaches its ceiling at four years. Those who complete lower primary education can then accumulate more skills up to a maximum of seven years which constitutes the number of years of primary school. The same reasoning applies for the construction of the secondary and post-secondary variables, equations (8) and (9) respectively.

Appendix B: Tables

Table 1: Descriptive statistics for Machibisa female labor market participants

Panel A					
Number of females in the labor force					383
Number of females with positive earnings					233
Unemployment rate					39%
Number of females not in the labor force					136
Average age of labor market participants					34
Average number of individuals in a household					5.7
Panel B		Weekly gross earnings (in rands)		Years of education	
Sectors	Number	Mean	Std	Mean	Std
Clerical	17	207	94	11	1.7
Protected	47	103	47	8	3.1
Unprotected	40	75	47	7	3.0
Domestics	36	38	20	6	3.2
Self employed Sangoma (traditional doctor)	8	161	118	4	4.0
Self employed hawkers	29	82	69	6	3.7
Self employed other	44	47	40	6	3.7
Any	4	21	10	2	2.6
Unknown	6	104	54	9	2.3
All females with positive earnings	231	83	70	7	3.6

Notes

Sector composition

The clerical sector is composed of nurses, teachers and clerks

The protected sector is composed of those who have a long term contract: hospital cleaners, labourers in a company, packers, petrol attendants and drivers

Unprotected sector is composed of casual workers such as shoe sewers (who usually work from home for a company), shop assistants, waitresses and cashiers

Self employed hawkers sell food and clothes

Self employed others are akin to small producers who for instance brew beer or sew clothes at home

The 'Any' category is composed of those who work in any available occupation

Table 2: Machibisa Females' Labor market participation (a)

Explanatory variables	Estimate
Constant	-1.30 *** (2.98)
Household head dummy	0.58 *** (3.05)
Number of individuals in the household	-0.01 (0.53)
Dummy equals one if married	0.27 (1.22)
Age	0.02 * (1.90)
(b) Urbanisation spline	0.22 *** (3.50)
Primary education spline variable	0.01 (0.28)
Secondary education spline variable	0.11 * (2.09)
Tertiary education spline variable	-0.31 (0.53)
Number of observations	333
Percentage of right predictions	68%
Log likelihood	-198

Notes

- (a) The dependent variable equals to 1 if the labor market participant reports positive earnings in the past week, 0 otherwise. The identifying variables are Household head dummy, Number of individuals in the household, Married dummy and Urbanization spline. A *, ** and *** indicates that the parameter is statistically different from 0 at the 10%, 5% and 1% respectively.
- (b) The urbanisation spline equals the number of years since the labor market participant has moved to Machibisa for those who do not exceed 4 years, it equals 4 otherwise

Table 3: Females' earnings functions in Machibisa

Dependent variable: logarithm of weekly earnings

Explanatory variables	(1)	(2)	(3)
Constant	3.60 *** (9.87)	3.60 *** (9.9)	3.67 *** (8.4)
Number of years of primary education	0.01 (0.28)	--	--
Spline from 0 to 4 years of schooling	--	0.00 (0.1)	0.00 (0.0)
Spline from 5 to 7 years schooling	--	-0.03 (0.4)	-0.02 (0.2)
Number of years of secondary education splines	0.14 *** (3.35)	--	--
Spline for 8 and 9 years of schooling	--	0.28 *** (3.1)	0.27 *** (2.8)
Spline for 10 and more years of schooling	--	0.02 (0.3)	0.00 (0.0)
Number of years of experience	0.01 (0.91)	0.01 (1.0)	0.01 (0.8)
Number of years of experience squared, divided by 100	-0.02 (0.85)	-0.02 (0.9)	-0.02 (0.7)
Occupation dummies (a)			
Domestic	-0.43 *** (3.08)	-0.41 *** (2.9)	-0.47 *** (2.8)
Protected	0.49 *** (3.75)	0.51 ** (3.9)	0.46 *** (2.8)
Sangoma	1.00 *** (3.65)	1.02 *** (3.9)	0.95 *** (3.4)
Self employed other	-0.31 * (1.80)	-0.29 * (1.7)	-0.36 *** (2.3)
Self employed hawker	0.09 (0.39)	0.07 (0.4)	0.03 (0.1)
Other occupation	-0.60 (1.09)	-0.44 (0.7)	-0.49 (0.9)
Clerical	0.87 *** (5.14)	1.02 *** (5.5)	-
Edendele dummy (b)	-0.23 *** (2.05)	-0.23 * (1.8)	-0.20 (1.7)
Clerical times 10 and more years of schooling spline			0.35 *** (3.4)
Inverse of Mill's ratio	0.12 (0.41)	0.14 * (0.50)	0.11 (0.3)
Number of observations	199	199	199
R-Squared	0.42	0.43	0.42
Adjusted R-Squared	0.38	0.38	0.37
Log-likelihood	-202	-201	-206
Test that the returns to the 2 secondary education splines are the same			
F-Test: returns to lower and upper secondary education are equal		3.1 *	3.1 *
P-Value		0.08	0.08

Notes

(a) The reference occupation is unprotected as defined in the note of Table 1

(b) A *, ** and *** denotes that the parameter is statistically different from 0 at the 10%, 5% and 1% respectively

Appendix C: Location of the area surveyed

