Potential screening in South Africa's labour market[*]

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Introduction

The human capital (HC) theory postulates that schooling equips students with potential skills which are usable at the workplace (Wolpin, 1977:949). Theoretically, HC entails a proportionate correlation between the marginal returns and the marginal cost of schooling. The primary feature of HC is the fact that more educated workers should receive higher wages, i.e. there are positive returns to education. The result is due primarily to the fact that education is assumed to impart marketable knowledge.

Screening and signalling (SS) theories, on the other hand, assume that education is used to separate individuals from each other. SS are based on productivity differences among workers, which are identified through actions that are correlated with the schooling outcome. The correlation is often modelled as a difference in the relative marginal cost of schooling. For example, an individual with certain innate abilities might find it easier to attend school, and, therefore, will receive more education. If those innate abilities are rewarded in the market, then a more educated individual will receive higher wages, not because schooling itself is valued, but because the innate abilities correlated with schooling are valued. Again, the result of SS is a positive return to education.

Due to the predictive similarities of the two models, it is not always easy to estimate whether labour markets reward education due to the explicit value of learning or because of the implicit value of learning. This research empirically contributes towards the debate regarding whether returns to education are due to primarily human capital accumulation or to market signalling and screening mechanisms, where education attainment is used to ascertain the underlying skills and abilities of workers, especially those workers engaged in production that is not easily measured. The rest of the paper is organised as follows: In a background section, the primary literature surrounding the debate is discussed, including a brief summary of previous empirical investigations conducted in South Africa. Following the background, a brief theoretical model is outlined and an appropriate empirical mechanism is introduced. The two data sources are described in a data section, and the empirical mechanism is applied to that data in a results section. The paper then concludes and provides thoughts on future research.

Background

There are two basic types of SS theories. One of these categories of theories indicates how ones innate qualities and abilities (good or bad private information) can be revealed by education attainment (or some other costly activity), such that education is perceived as a filter that reveals differences in workers' abilities, which, in turn, account for wage differences. Empirical tests of the information revelation mechanism assumed in these SS theories are characterised under the weak screening hypothesis (Spence, 1973; Arrow, 1973; Stiglitz, 1975). Another broad category of SS theories is used to explain recruitment into specific professions (Berg, 1970; and Thurow, 1970). In these SS theories, based only on credentials (e.g. a PhD is needed to become a professor), no relationship is assumed between schooling, wages or productivity. Empirical tests of the credentials view are characterised by the strong screening hypothesis (Psacharopoulos, 1974).

It is likely that education, by itself, has value in the labour market, but it is also likely that screening is used to screen workers for job openings. Arrow (1973:194) is in favour of such a complementary view of SS and HC, rather than a purely antagonistic view. Similarly, Weiss (1995) and Chatterji et al. (2003:191) argue that screening theories augment the basis laid down in the HC theory. Weiss (1995) maintains, however, that a consensus does not exist on whether returns to education are determined by education because it is a screening device or because it has intrinsic value.

As can be gathered by the lack of consensus specified by Weiss (1995), past empirical tests of either screening hypothesis have yielded equivocal results (e.g. Riley, 1979:S229). For example, Altonji and Pierret (1998 and 1999 as reported in Bauer and Haisken-Denew, 2001:162) show that returns to years of schooling register an independent or even decreasing relationship with a worker's experience in the labour market, but an increasing one with measures of natural ability. However, Bauer and Haisken-Denew (2001), using panel data, realise a positive relationship in both cases. Although Bauer and Haisken-Denew find no evidence of employer learning regarding a white-collar worker's productivity, they do find evidence of employer learning for blue-collar workers, whose work efforts primarily yield tangible, and, therefore, measurable output. The preceding papers are representative of the results in the literature.

Brown and Sessions (1999 and 1998) postulated that the difference in the representative results might be due to the nature of the institutions within a specified region, as well as with the indigenous cultures of the workforce involved. To this effect, estimates from Japan (Sakamoto and Chen, 1992), Israel (Ziderman, 1992) and Australia (Miller and Volker, 1984) have registered support for screening. Those in the Netherlands (Oosterbeek, 1992), however, have not. Psacharopoulos (1974) and Layard and Psacharopoulos (1974) have obtained mixed results for the United Kingdom and the USA.

Generally, empirical tests of the strong screening hypothesis and the weak screening hypothesis commonly employ screened and unscreened sample categorisations (Wolpin, 1977 and Psacharopoulos, 1974), although these samples are not always easy to identify. Results from estimates of these two screening hypotheses have tended to support the weak and not the strong (see for example, Brown and Sessions, 1999 & 1998; Wolpin, 1977; and Riley, 1979), while empirical tests comparing SS with HC theories have registered more support for HC.

A considerable number of studies on returns to investment in human capital have been conducted in South Africa. Although some of them have addressed sample selection within the empirical analysis, none of them have addressed the potential for screening. However, many different aspects of the relationship between wages and education have been researched using South African data. Importantly, most studies have emphasised and thus included arguments such as race, gender, union membership, physical location and years of education as wage determinants, some of which might also influence screening, issues such as education screening/signalling have not been addressed.

The primary method of analysis has focused on estimating Mincerian or related wage functions (e.g. Moll, 1996; Michaud and Vencatachellum; 2001; and Keswell and Poswell, 2004). The quality of the method, however, depends upon the quality of the data, as measurement error leads to a downward bias in the estimates. The primary results of these analyses show that returns to education in South Africa are high relative to similar economies, if there is such an economy, and that these returns are non-linear; in fact, Keswell and Poswell (2004) find strongly convex returns.

One rather relevant, from an interpretational point of view, result is from Hertz (2003), who addresses the issue of omitted variables and measurement errors in Ordinary Least Squares (OLS) estimations of returns to schooling in South Africa. The biases associated with these two causes are known to be opposing, upward and downward, respectively. The impact of the former is expected to be greater in developing countries, thus yielding a net upward bias. After

correcting for the two different problems, the estimated returns of 5 to 6 per cent are about half of those yielded from OLS (11 and 13 per cent). One conclusion is that omitted variables are biasing many of the reported estimates. The research proposed here seeks to address one of those potentially omitted variables, the effect of asymmetric information on returns to education.

A theoretical model

In this section, a theoretical model is outlined and discussed, but not explicitly solved.[1] We begin by assuming, rather heroically, that the market will absorb participants, although where they are absorbed is determined by their preferences as well as the dictates of the market.[2] Essentially, an individual's decision whether to participate or not will be denoted by N. If they choose to participate, then the market will choose whether or not they are self-employed, denoted by S, employed by government, denoted by G, or employed somewhere else in the private sector, denoted by P, or unemployed, which is denoted by U. Theoretically, an individual will participate in the labour market if his/her expected utility from participation exceeds his/her expected utility from non-participation, such that

$$\max_{j \in \{S,G,P,U\}} \left\{ E\left[u^j \right] \right\} \geq E\left[u^N \right], \tag{1}$$

where E is the expectations operator and u represents utility.

Holding all other things constant, we assume that an individual would prefer to participate and work than not participate. Therefore, non-participation is primarily driven by the expectation of low returns to participation, e.g. a worker who has become discouraged about his/her employment prospects is likely to be a non-participant. Therefore, the model considered here will focus on the expected returns to participation.

We consider a market with just two types of workers, who have differing innate abilities. For convenience, we label the workers by their type as $i \in \{h,l\}$, where h represents high quality and l represents low quality, and we assume that the number of h type participants is given by H, while the number of l type participants is given by L. Furthermore, we assume that the labour market has three different employment segments, as described above. We assume that the government sector pays according to level, and, therefore, requires only a certain set of credentials, while the private sector and self-employed sectors pay according to productivity. Preferences are governed by the separable function below.

$$u_i^j = v\left(w^j \right) - \phi_i\left(e^j \right). \tag{2}$$

Intuitively, we assume that utility is an increasing but a concave function in w, the wage paid to the worker absorbed in sector j, while utility is decreasing and convex in e, the amount of schooling undertaken by a type i worker, who is absorbed by sector j. It is further assumed that utility decreases faster in education for a low quality worker. In other words, low quality workers need relatively larger compensation for each increase in attempted education than do high quality workers.[3]

Within the private sector and the self-employed sector, it is assumed that profit motives prevail. For the self-employed, it is assumed that profits vary by type and that profits are characterised

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[1] We are currently working to formalise and complete the analysis for the model; comments are welcome.
[2] This footnote is later relaxed, such that non-absorbed participants become the unemployed. Essentially, unemployment is modelled as a remainder category.
[3] The general result of this assumption is such that higher quality workers tend to undertake more education than lower quality workers.

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by a concave function of education, and that concave function, by assumption, has a unique maximum.[4]

$$\overline{e}_i = \arg\max_{e \mid j \in \{S, P\}} \pi_i^j(e) \tag{3}$$

The government sector is assumed to need a fixed number of people, G, to perform the duties and tasks needed.[5]

Equilibrium in this segmented labour market requires that no participant in the market is willing to unilaterally deviate from his/her chosen equilibrium strategy. In this model, individuals are allowed to choose an education level $e \in [0, \infty)$, while sectors choose a wage $w^j \in [0, \infty)$ such that utilities and profits are maximised, subject to participation constraints. Furthermore, equilibrium requires closure, such that $h^G + h^S + h^P + h^U = H$, $l^G + l^S + l^P + l^U = L$ and $h^G + l^G = G$

The proposed equilibrium, although in need of verification and further analysis, should have the following features. Regardless of the information allocation in the market, self-employment ought to be the underlying wage buoy.[6] A person expecting to be self-employed, regardless of worker quality, will choose the level of education that maximises utility.

$$\hat{e}_i^S = \arg\max_e v\left(\pi_i^S\left(e_i^S\right)\right) - \phi_i\left(e_i^S\right) \tag{4}$$

The resulting maximum utility is given by $\hat{u}_i^S$. The self-employment solution then serves to underpin the private sector. Wages in the private sector, as well as the public sector, will offer some insurance against the risk associated with self-employment through fixed salaries. However, the government sector will adjust salaries in order to employ enough people to fill its vacancies. Therefore, the government sector is likely to choose a wage just high enough to attract the appropriate number of people. Due to the fact that government wages are not linked to productivity, the government wage is likely to result in private-sector wage pressures. The result on the private sector is likely to be negative in that wages are likely to exceed their efficient level, which will result in a general reduction in the demand for labour within the private sector. However, the wages in the private sector cannot be bid down either, since they are underpinned by self-employment wages.

In summary, the self-employment sector is likely to have wages that most closely mirror the actual marketable value of education, while the private sector will have to distort its wages upward in an effort to pull the appropriate people out of self-employment and to keep them from joining the government. Meanwhile the government sector, by assumption, only pays enough to fill its vacancies; importantly, however, since a certain level of education is required within the government sector, i.e. certain credentials are expected at certain levels, the effect of the government sector is higher returns to education.

In relation to screening, signalling and human capital, this model predicts a human capital impact as higher profits are associated with higher education. However, the model also predicts a weak and a strong signalling hypothesis as wages in other sectors of the economy are affected by the need to attract the appropriate people to the sectors.[7]

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[4] Even though a specific level of education maximises profits, it is possible that an individual will choose an education level that is lower due to the additional utility cost of education.
[5] At this stage no effort is made to consider the general tendency of the public sector to increase in size, nor is any attempt made to consider tax and budget implications. Further work will do so.
[6] Clearly, differences in preferences towards risk and the willingness to work for others are important factors. Although concave preferences imply risk aversion, risk aversion is not explicitly addressed in the model.
[7] More work on this model is currently underway.

An empirical model

Given that no earlier study of the returns to education for South Africa has addressed the possibility of screening as discussed above, this paper aims at empirically contributing towards the debate between schooling's productivity boosting and innate abilities-unveiling qualities. It is assumed that screening, if it does exist, will not be symmetric across the different education certificates. The analysis considers three different categories of workers: Those who are employed in the private sector, those employed in the public sector, and those who are self-employed. Although imperfect, the rationale, as discussed above, is based on the fact that self-employed people base their education decisions on the marginal cost and marginal benefit calculus, while individuals in the private sector are more likely to be screened and the public sector is more likely to base hiring decisions on credentials. It is also expected that the potential for sample selection bias associated with the inability to obtain employment will need to be accounted for in the analysis.[8]

Initially, two empirical models were examined. One of the models examines various aspects of participation, while the other examines the returns to education across the different sectors of the economy. The aspect of participation is considered within the context of discrete choice modelling and is estimated via multinomial logistic regression. The returns to education are estimated via traditional Mincerian wage functions using OLS. The initial estimate of screening is based on separate wage functions, initially contributed by Wolpin (1977), such that screening is assumed to create returns to education that exceed the underlying market value of education as underscored by self-employment.

The multinomial logit model is based on the fact that only the actual market segment of the individual is known. Since, as already discussed, there are four mutually exclusive sectors,[9] it is assumed that everyone must be in one of the four categories, and, therefore, a probability function can potentially describe the patterns within the data. Defining p_i^j as the probability that individual of type i is absorbed in sector j, then

$$\sum_{j \in \{S,G,P,U\}} p_i^j = 1 \,. \tag{5}$$

Furthermore, that probability is assumed to be a function of various individual characteristics, primarily amongst them is the individual's level of education. In addition, as many personal characteristics as available were used in the regressions to control for preferences as well as the quality of the worker and other market factors.[10] The probabilities within the model, treating unemployment as the base category, are given in the following equation for each worker type:

$$p_i^j = \frac{e^{X_i \beta_i^j}}{1 + \sum_{j \in \{S,G,P\}} e^{X_i \beta_i^j}} \quad \text{and } p_i^U = \frac{1}{1 + \sum_{j \in \{S,G,P\}} e^{X_i \beta_i^j}} \tag{6}$$

The categorical outcomes are then used within this model to determine estimates of the quality and sector specific parameters. Such a model requires the data to be separated by worker quality, which has not yet been done, and will require further investigation.

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[8] However, at this stage, sample selection issues are not examined.

[9] It is possible to consider multiple job employees, but that feature is ignored for now.

[10] The actual variables used include: Completed education dummies; gender and racial dummies; age and age-squared (to proxy for experience); variables describing household make-up, such as the number of children under age 5, the number of children under age 14, and the number of household members above age 60; as well as variables describing the general health of the household.

The Mincerian wage equations are based on the standard Mincerian wage regression for each sector and each type, except for the unemployed sector, since no wages are observed for the unemployed.

$$\ln w_i^j = Z_i \gamma^j + \mu \qquad (7)$$

The data and preliminary results

The data used in the analysis are taken from the 2003 South African General Household Survey.[11] The members of nearly 30 000 households were interviewed for this survey, but earnings information, even in categories, was available for at most 14 000 workers. Mean weekly wages for those employed in each sector are included in Table 1. The general picture is one where poorer educated people receive better wages in the government sector than in all others, while the average wage of the better educated self-employed individual is higher than the others.

Table 1: Mean weekly wages by employment sector

Educational qualification	Self employed	Government	Private sector
No education	206	365	204
Incomplete primary	301	435	269
Complete primary	268	464	302
Incomplete secondary	529	662	465
Matric	1 159	1 099	975
NTC and certificates	1 817	1 365	1 509
Bachelors	3 419	1 938	2 802
Postgraduate	3 181	2 258	2 927

The results of the multinomial logit regression paint a slightly different picture. The results presented in Table 2 show that the probability of employment in each of the sectors is increasing in the level of education. Furthermore, completed schooling has a stronger effect within the government sector than within the private or self-employed sectors, a result that provides empirical support for the hypothesis that government employment is strongly determined by credentials.[12]

Table 2: Multinomial logit parameter estimates

Educational qualification	Self employed	Government	Private sector
No education	N/A	N/A	N/A
Incomplete primary	~~-0.155~~	~~-0.125~~	~~-0.158~~
Complete primary	~~-0.147~~	0.471	~~-0.230~~
Incomplete secondary	~~-0.126~~	0.559	-0.347
Matric	~~0.229~~	2.181	~~-0.025~~
NTC and certificates	0.645	3.485	0.467
Bachelors	1.196	4.361	0.884
Postgraduate	1.016	4.222	0.654
Own illness	~~0.158~~	~~0.123~~	~~0.010~~
Family illness proportion	~~0.028~~	~~0.055~~	~~0.021~~
Pseudo R-sq	*0.10*		

[11] Additional analysis has been undertaken with the September 2004 Labour Force Survey. In future, the appropriate Labour Force Survey will be linked with the 2003 GHS to provide a better empirical picture of the labour market in South Africa.
[12] Standard errors are available from the authors, although all estimates in the table are significant unless the number has a strike through it.

Within a sector, the actual wages paid are strongly determined by education. As can be seen in Table 3, the returns to education are generally rising across all sectors. Furthermore, the returns to education are higher in the private sector than in either the public sector or the self-employed sector.[13] This result is supportive of screening in the private sector; people in the private sector, who could be screened, receive higher returns to education than the self-employed people, who do not need to screen themselves, since they know their own quality. However, there does not appear to be a strong difference between the returns to education for the self-employed relative to the government sector.[14] Taking all the results together, one possible, although not the only, scenario is that the private sector bids away the higher quality people in the market, while the government only takes a certain number of employees. However, the government (a) requires a certain set of credentials for employment and (b) pays only enough to keep the people in government so that they do not run their own businesses. Furthermore, since only the highly educated self-employed were different from the unemployed (see the parameter significance for the poorly educated self-employed in Table 2) it is also plausible that a large number of the self-employed are so because they have poor employment prospects, lending some support to the theoretical model outlined above regarding which sectors employ which individuals.

Finally, as expected, the regression fit associated with self-employment is better, a result that lends some credence to the fact that there are imperfections in the labour market, and those imperfections could be information based.

Table 3: Mincerian wage regressions

Educational qualification	Self employed	Government	Private sector
No education	N/A	N/A	N/A
Incomplete primary	0.282	0.148	0.458
Complete primary	0.213	0.374	0.669
Incomplete secondary	0.678	0.538	1.011
Matric	1.045	1.233	1.581
NTC and certificates	1.316	1.495	1.763
Bachelors	1.923	1.710	2.223
Postgraduate	1.739	1.796	2.349
Own illness	-0.246	~~-0.060~~	~~-0.010~~
Family illness proportion	-0.362	~~0.086~~	~~0.020~~
R-sq	*0.49*	*0.33*	*0.37*

Comments and conclusions

Preliminary research into the possibility that the South African labour market is segmented and that segmentation involves screening, has been reported in this paper. Within the paper, a theoretical model was outlined and discussed, an empirical model was proposed and data from the 2003 South African General Household Survey were examined with those models in mind. The preliminary results point to market segmentation, especially regarding the government sector's emphasis on credentials when employing its workers. Furthermore, the results point to a general distortion in the marketplace regarding the relationship between wages and education in both the government and private sectors, although there may be less distortion in the latter.

All the ideas and results presented here, as already stated, are preliminary, and, thus, require further analysis. Future work will entail a tightening of the theoretical model, as well as a workable analytical equilibrium. Once the model is completed, a more careful examination of the

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[13] A formal test of that difference is available from the authors upon request.
[14] It should be noted that no attempt has been made to account for potential selection bias within these wage estimates, and, therefore, they should be considered only to be preliminary in nature.

data can and will be undertaken so that the empirical approach more clearly matches the theoretical model. In addition to these obvious improvements, additional data will need to be gathered to provide additional statistical verification of the ideas presented here.

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