Wage effects of labour market experience and job tenure for black South African male workers

Abstract

There exists a wealth of theory and empirical literature detailing and illustrating the importance of on-the-job training for human capital formation. To proxy and measure the associated rate of capital formation, labour economists have largely focused on the effects of labour market experience and job tenure on expected wages over the life-cycle. A key finding of this literature suggests that average individual wages increase at a decreasing rate with additional years of both labour market experience and job tenure.

This research agenda has, unfortunately, to a large extent confined itself to developed country labour markets. Developing country labour markets are often characterised by high rates of unemployment, especially among the youth. More broadly speaking, labour market conditions in developing countries are systematically different to those faced in developed country labour markets. These conditions in developing country labour markets may present new sources of bias in the estimation of the wage effects of on-the-job training.

The goal of this paper is to better understand the role of on-the-job training in the accumulation of human capital in a developing country context. More specifically, the paper will attempt to estimate the causal effect of labour market experience and job tenure on the expected wages of black South African male workers.

To identify the labour market experience and job tenure effects, the paper makes use of Altonji and Shakotko's (1987) instrumental variables procedure and Topel's (1991) two-stage differencing estimation procedure in addition to Pooled OLS estimation. These additional estimation procedures are also useful in addressing the heterogeneity bias that accompanies the estimation of the wage effects of labour market experience and job tenure. Stats SA's LFS Panel data set is used to implement these estimation procedures.

1. Introduction

The distribution of earnings is a key area of research in labour economics. Over the past couple of decades, the estimation and interpretation of earnings functions has been at the centre of this research agenda. The study of earnings functions has, for example, highlighted and empirically illustrated the importance of schooling and on-the-job training in accounting for some of the observed variation in individual earnings (Mincer, 1974). This insight forms the basis of the analysis undertaken in this paper. The paper hopes to contribute to a better understanding of the dynamic structure of wages within the South African labour market by estimating the causal effect of labour market experience and job tenure on the expected wages of black South African men.

Wage-experience and wage-tenure profiles are the fundamental components of the dynamic structure of wages (Williams, 1991). The estimation of these profiles gives us insights into the importance of labour market experience and job tenure in the accumulation of human capital. Current research in South Africa places greater emphasises on education as the key determinant of human capital formation. The paper, therefore, hopes to complement this research by concentrating on labour market experience and job tenure.

The estimation of the wage effects of labour market experience and job tenure are, however, complicated by the existence of unobserved heterogeneity in the quality of individual workers and in the quality of worker-firm matches (Abraham and Farber, 1987; Altonji and Shakotko, 1987; Garen, 1989; and Topel, 1991). These unobserved heterogeneities are argued to be correlated to both labour market experience and job tenure and thus introduce bias in the OLS estimation of these variables. The empirical analysis implements Altonji and Shakotko's (1987) instrumental variables procedure to address this bias.

Bias in our empirical analysis may also arise from the substantial unemployment reality that characterises the South African labour market. Furthermore, high unemployment may widen the gap between actual and potential labour market experience since South African labour market data contain only measures for potential labour market experience. These issues are less of a concern in developed country labour markets and have consequently not been addressed in the literature. The task at hand is therefore to estimate the wage effects of labour market experience and job tenure while accounting for unobserved heterogeneity; and sample selection bias and possible measurement error arising from the high unemployment rates observed in the South African labour market.

The rest of the paper is organised as follows. Section 2 reviews related theoretical and empirical literature on the effects of job tenure and labour market experience on wages. The methodology

used in the empirical analysis is presented in section 3. Data used for the estimation is discussed in section 4. The empirical analysis is presented in section 5. The last section provides the concluding remarks.

2. Literature review

The research question of this paper focuses on the causal effect of labour market experience and job tenure on the expected wages of black South African men?[1] A large body of theoretical and empirical literature suggests that average individual wages increase at a decreasing rate over the course of a worker's working career. This section provides a review of this literature.

2.1 Theoretical models

Rising individual wages at a decreasing rate over the life cycle is a key prediction of several theoretical models. Interestingly, these models offer different explanations for the trajectory of expected wages over the life cycle. Underlying the differences in these models is the role assigned to individual worker productivity growth as the key driving force behind the observed pattern of individual wages over the life cycle. As such we will classify the different models into *productivity-based* and *non-productivity based* models.[2] This is a crude classification that groups models based on their reliance and emphasis, or lack thereof, on productivity growth as the key parameter influencing the growth of individual wages over the life cycle. This classification is used mainly as a convenient tool for organising the different models to be discussed.

The discussion of the productivity-based models will focus on the contributions of the human capital model to the literature on life cycle wages. Briefly, this model asserts that wages reflect a worker's productivity, from which it follows that earnings growth over the life cycle reflects productivity-enhancing investments in human capital (see for example Becker, 1962; Ben-Porath, 1967; and Mincer, 1974). The models considered under non-productivity based models emphasise the importance of imperfect information, implicit contracts and principal-agent considerations in the employer-employee relationship. We begin the discussion with the human capital model.

[1] Attention here is restricted to the post-schooling phase of the life-cycle, in other words we do not consider experience and tenure accumulated while at school that has been identified as being important in accurately estimating the returns to schooling and labour market experience by Light and Ureta (1995) and Light (1998).

[2] This classification was first suggested by Harris and Holstrom (1982).

2.1.1 Productivity-based models

Under the human capital model, schooling and on-the-job training are two platforms through which individuals make productivity-enhancing investments in themselves. Schooling teaches skills to individuals in preparation for entry into the labour market. Skills learned at school are then adapted, enhanced, and new ones acquired while on the job (Becker, 1962). The increased stock, and efficiency, of skills enables the worker to be more productive. This in turn improves the worker's earnings potential since, under the model, wages are assumed to reflect a worker's productivity. But the investments are not without costs. Perhaps the most important of these costs comes in the form of foregone earnings since the individual's time is diverted away from activities yielding immediate earnings in favour of activities yielding higher earnings in the future.

To study investments in human capital, Becker (1962) drew similarities between the investment decisions faced by an individual to that of a firm investing in physical capital. More specifically, he argued that both the firm's and individual's incentive to expand and improve their capital stock relied on the rate of return expected from those investments. Consequently, capital theory could be incorporated in the analysis of investments in human capital. The analysis then suggests that an individual will devote a large portion of his initial stages of the life cycle investing in human capital. This is because young individuals have a longer expected working period over which to collect the returns on their investments. Subsequent stages will be characterised by gradual decreases in investments until no further investments are made. The rate of investment declines because the opportunity cost of further investments increases and also because the working period over which to enjoy the benefits of further investments becomes shorter and shorter. Further theoretical work by Ben-Porath (1967) illustrates that these incentives produce life cycle productivity profiles that are concave. The model therefore predicts concave wage-experience and wage-tenure profiles.

2.1.2 Non-productivity based models

Other theoretical models have made similar predictions about the growth of individual wages over the life cycle, but with different explanations regarding the process underlying the growth of wages over the life cycle. In Jovanovic's (1979a) job matching model of labour turnover, the productivity of a given worker in a given job is unknown *ex ante* by neither employer nor employee and this gives rise to uncertainty about the quality of the worker-firm match. This uncertainty is resolved through a learning process in which the worker's output is observed by the firm over time. Firms value workers with whom they are well matched with and will offer higher wages to such workers,

while paying relatively lower wages to workers who are revealed to be of low productivity and a poor match with the firm.

In this model, individual wages are an increasing function of job tenure because workers that are well matched will accumulate longer periods of tenure while poorly matched workers move on to other firms. Wages are also predicted to increase with labour market experience since tenure is correlated with labour market experience, and worker movements are expected to result in improved matches over the life cycle. Improvements in the worker's productivity over time are therefore not the factor causing the growth of wages over the life cycle. Instead, the model relies on the prediction that workers gravitate towards firms that they are better matched with as information about their productivity in the current firm is revealed.

In Harris and Holmstrom's (1982) wage dynamics model, the point of departure is similar to that of Jovanovic (1979a). Namely, the authors note that there may be imperfect information about a worker's productivity that may only be resolved by making inferences about the worker's productivity based on the worker's observed output. The authors further note that this learning process may create risks for the worker since observed output does not accurately reflect a worker's productivity. Consequently, long-term implicit contracts arise to shield workers from unfavourable changes in wages resulting from discrepancies between true productivity and perceived productivity. One important implication of the model, for our purposes, is that an insurance effect arises from the implicit contracts that protect workers from fluctuations in perceived productivity. This generates positively sloped wage-experience profiles. This is because the productivity of more experienced workers is more accurately assessed.

In Salop and Salop's (1976) model, it is shown that firms offer wages that increase with tenure over the life cycle as a self-selection mechanism that ensures the credibility of information conveyed by job applicants. Faced with high turnover costs when employees quit, the firm would ideally like to employ those employees with lower inclinations to leave the firm prematurely. By offering initially low – but predictably increasing – wages, the firm induces workers to reveal their privately held quit-propensities and ensures that workers with high quit-propensities self-select themselves out of jobs offering upwardly-sloping wage-tenure profiles. This implies that wages may increase with tenure independently from productivity increases.

The above models emphasise the importance and consequences of imperfect information in the employer-employee relationship. The next model demonstrates that positively sloped wage-earnings profiles may also be accounted for by firms' measures directed at overcoming principal-agent problems that often characterise an employer-employee relationship. In Lazear's (1981) model, it is

showed to be an optimal strategy for a firm to pay lower wages in the early stages of the life cycle or pay junior workers less than their senior counterparts. This incentivises less shirking on the job and ensures that workers supply optimal levels of effort.

The discussion of the *non-productivity based* models does not – and is not intended to – deny the relevance of productivity growth in explaining wage growth over the life cycle. Instead the discussion attempts to illustrate the need to search deeper and wider when accounting for and interpreting the pattern of wage growth over the life cycle. Be that as it may, productivity based explanations of wage growth enjoy a lion's share in the theoretical and empirical literature.

2.2 Empirical evidence

The human capital model is the workhorse model for empirical analysis into wage determination as it offers easily testable predictions. The discussion above suggests that the (log) wage received by worker i on job j at time period t, w_{ijt}, can generally be expressed as a function of years of labour market experience, Ex_{it}; years of job tenure (or seniority), Te_{ijt}; and a vector of other personal and labour market characteristics like gender and schooling, $\boldsymbol{Z}_{it}$. Formally, this yields:

$$w_{ijt} = w\left(Ex_{it}, Te_{ijt}, \boldsymbol{Z}_{it}\right) \qquad (1)$$

By incorporating on-the-job training in the schooling earnings function, Mincer (1974) led the way in providing empirical support for the predictions made by the human capital. He specified and estimated the following earnings regression:

$$w_i = \beta_0 + \beta_1 S_i + \beta_2 Ex_i + \beta_3 Ex_i^2 + u_i \qquad (2),$$

where S_i is years of schooling, u_i is the model error term. In the absence of direct measures of on-the-job training, he proxied on-the-job training by labour market experience, which was in turn approximated by potential experience: age minus years of schooling minus six. Within the human capital framework, the coefficient on the schooling variable is interpreted as the return on schooling and the coefficients on the experience variables capture the worker's return to on-the-job training.

He estimated equation (2) by ordinary least squares (OLS) and obtained a statistically significant relationship between wages and labour market experience. The coefficient on the linear experience term was positive and negative for the quadratic experience term. This suggested that individual wages increase at a decreasing rate with additional years of labour market experience. It also confirmed the concave life cycle earnings profile predicted by the human capital model.

The analysis by Mincer (1974), however, did not permit a separate estimation of the returns to general and specific on-the-job training. According to Mincer and Jovanovic (1981) the specification of the earnings regression in equation (2) only allowed for an estimation of the returns to general on-the-job training. Moreover, an OLS estimation of equation (2) produces upwardly-biased estimates of the experience coefficients, since specific training – which is positively correlated to general training – is omitted from this wage specification. The authors, therefore, extended Mincer's (1974) specification by adding years of job tenure and its square to equation (2) to yield:

$$w_i = \beta_0 + \beta_1 S_i + \beta_2 Ex_i + \beta_3 Ex_i^2 + \beta_4 Te_i + \beta_5 Te_i^2 + \beta_6 \boldsymbol{Z}_i u_i \qquad (3)$$

Job tenure is meant to proxy for specific training, while allowing for labour market experience to proxy for general training. But the inclusion of tenure in the wage functions introduced further econometric issues. Mincer and Jovanovic (1981) argue that the estimation of the tenure coefficients may suffer from heterogeneity bias which would cause the estimates to be upwardly biased. The heterogeneity bias arises from the interpersonal diversity in the acquisition of specific on-the-job training. To resolve this issue, the authors incorporate information about the job mobility of workers between different firms prior to their current firm (i.e. frequency of job changes for worker i). This variable together with its interaction with the experience term is captured by $\boldsymbol{Z}_i$ in equation (3).

Mincer and Jovanovic (1981) estimated equation (3) by OLS and obtained results that were consistent with the theoretical predictions presented in the previous subsection. The authors estimated that roughly 20-25% of individual total lifetime wage growth can be accredited to returns to job tenure – specific human capital investment; 25% is due to inter-firm labour mobility over the life cycle; and 50% may be ascribed to general labour market experience, which the authors interpret as general human capital investment.

The analysis by Mincer and Jovanovic (1981) went a long way in providing credence for the empirical importance of both general and specific on-the-job training as measured by labour market experience and tenure, respectively. However, the availability of quality data to researchers and advancements in econometric techniques has called the wage-tenure relation – established by earlier studies – into closer empirical scrutiny. Work by Abraham and Farber (1987), Altonji and Shakotko (1987), Garen (1989), and Topel (1991) suggest that there may be unobservable wage determinants that are specific to the individual, the job or the pairing of a worker to a firm that are related to both tenure and experience. Failure to control for these determinants would produce biased OLS estimates of the returns to job tenure and labour market experience. This is because under

Jovanovic's (1979a and 1979b) job matching model, unobserved heterogeneity in the quality of individual worker-firm pairings and the quality of individual workers are predicted to be correlated to both tenure and labour market experience.

The correlation between worker quality and tenure arises if more productive workers, in terms of unobservable characteristics such as ability and motivation, are better remunerated and thus tend to stay longer in their jobs and enjoy longer spells of tenure. The correlation of job tenure and the quality of the worker-firm match was established in the preceding subsection. Attending to this additional source of heterogeneity bias has sparked a debate on the effect of tenure on wages over the life cycle. At the centre of this debate is the determination of the direction of the bias on the tenure coefficients and the most appropriate (econometric) procedure to deal with the bias.

Altonji and Shakotko (1987) and Topel (1991) have separately proposed procedures to overcome these econometric challenges. (A careful discussion of these procedures is reserved for the next section since the empirical methodology of this paper is informed by the insights of these authors.) The methods of these authors have produced contradicting evidence on the effects of job tenure on individual wages over the life cycle. Altonji and Shakotko (1987), implementing their instrumental variables approach, found that wages does not increase much with tenure. They estimated that 10 years of tenure only increases average wages by 6.6% and most of this growth occurs in the first year of employment. They therefore concluded that that the bulk of the wage growth over a career is due to returns to labour market experience and labour mobility.

Topel (1991) on the other hand, used a two-stage differencing estimation procedure to overcome the heterogeneity bias and implemented it using the same data set used by Altonji and Shakotko (1987). In contrast to the previous study, he estimated that 10 years of tenure raises wages by roughly 25% and his estimates were similar in magnitude to previous studies utilising simple OLS estimation without the correction of the heterogeneity bias.

It has become customary in the literature to apply the two techniques together with the use of OLS when estimating the returns to tenure and experience. In applying these three estimators, Bratsberg and Terrell (1998) found that all three estimators conveyed a similar picture about the comparative pattern of wage growth (as deduced from the returns to tenure and experience) over the life cycle for black and white males. They estimated the returns to labour market experience of black men to be significantly lower than those of their white counterparts, while the returns to job tenure for black men were estimated to be roughly equal and in some instances even slightly higher than those of white men. However, the estimates delivered conflicting absolute patterns of wage growth for the two groups of workers. The OLS and Topel estimates showed wage growth due to five years of

tenure for black men to be roughly 19% and 16%, respectively. Similar estimates for white men are 19% and 13%, respectively. The Altonji and Shakotko estimates for wage growth due to five years of tenure are roughly zero for both races. The three estimates (OLS, Altonji and Shakotko, and Topel) predict wage growth due to five years of labour market experience to be 11%, 18% and 9%, respectively, for black men; while white workers' predicted wage growth due to five years of experience is 21%, 31%, and 21%, respectively. It seems to be prudent to consider all three estimates when estimating the returns to tenure and experience since there is no preferred estimator in the literature.

3. Empirical methodology

The goal of this paper is to specify and estimate a wage function for black South African male workers. Of particular interest is the effect of job tenure and labour market experience on individual wages. These will be our variables of interest in the wage regression. The point of departure for our empirical analysis is to estimate the wage regression by pooled OLS. However, we have learned from the proceeding discussions that OLS estimates may be tainted by heterogeneity bias. To illustrate this bias, we rewrite equation (3) from above as follows:

$$w_{ijt} = \beta_0 + \beta_1 S_{it} + \beta_2 Ex_{it} + \beta_3 Ex_{it}^2 + \beta_4 Te_{ijt} + \beta_5 Te_{ijt}^2 + \beta_6 \boldsymbol{Z}_{ijt} + \varepsilon_{ijt} \qquad (4)$$

The bias due to heterogeneity in the quality of workers and worker-firm matches can be formally illustrated by decomposing the error term in equation (4) as follows (Abraham and Farber, 1987; Altonji and Shakotko, 1987; Garen, 1989; and Topel, 1991):

$$\varepsilon_{ijt} = \mu_i + \varphi_{ij} + \alpha_{ijt} \qquad (5),$$

where μ_i is an unobserved fixed individual effect, φ_{ij} is an unobserved worker-firm fixed effect that captures heterogeneity in the quality of job matches[3], and α_{ijt} is a random disturbance term. The standard assumption accompanying equation (5) is that all terms on the right-hand side are mutually orthogonal to one another (Topel, 1991). The bias arises because our variables of interest in equation (4), tenure and experience, are correlated to both the individual and job match error components of equation (5).

[3] The empirical debate on the wage effects of job tenure alluded to in the literature review section is motivated by a difference of opinion on the direction of correlation between job tenure and the worker-firm match quality, φ_{ij}. Altonji and Shakotko (1987) claim that correlation is positive and thus introduces an upward bias in the tenure-wage effect. Topel (1991) on the other hand, argues that the correlation is negative.

Alltonji and Shakotko (1987) proposed an instrumental variables estimator for addressing the bias. Their empirical strategy firstly involved adding $OLDJOB_{ijt}$ – a dummy variable that takes on a value of zero if $Te_{ijt} \leq 1$ and a value of one if $Te_{ijt} > 1$ – to equation (4) as they had concerns about functional forms specified in previous studies. Adding this variable would limit any potential restrictions on the response of wages to the accumulation of the first year of tenure. The authors believed that wage growth resulting from the accumulation of job tenure was more pronounced in the first year of employment.

The second step in their empirical strategy is to instrument for the tenure variables (Te_{ijt}, Te_{ijt}^2, and $OLDJOB_{ijt}$), with "the deviations of the tenure variables around their means for the sample observations on a given job match" as the principal instruments (Altonji and Shakotko, 1987: 439). Define $\overline{Te}_{ij}$ as the individual mean for worker i on job j over the sample. $\overline{Te}_{ij}$ can be formally expressed as follows:

$$\overline{Te}_{ij} = \frac{1}{n} \sum_{v=T\acute{e}_{ijt}}^{Te_{ijt}} Te_v \qquad (6)$$

Where n is the length of the sample survey measured in years; $T\acute{e}_{ijt}$ is the length of the worker's tenure when he is observed in the survey for the first time. The deviation around the mean is then given as:

$$\widehat{Te}_{ijt} = Te_{ijt} - \overline{Te}_{ij} \qquad (7)$$

Define in similar fashion the other instruments: $\widehat{Te}_{ijt}^2 = Te_{ijt}^2 - \overline{Te}_{ij}$ and $\widehat{OLDJOB}_{ijt} = OLDJOB_{ijt} - \overline{OLDJOB}_{ij}$. By construction, "the variation in tenure over the job, in contrast to the variation in tenure across individuals and jobs, is uncorrelated with the fixed individual and job match components of the error term of the wage model" (Altonji and Shakotko, 1987: 438). The authors implement this procedure by way of two-stage least squares (2SLS) estimation and with the use of panel data.

The technique proposed by Altonji and Shakotko (1987) is a creative attempt at estimating unbiased tenure and experience wage effects. This procedure will be implemented by 2SLS and control function approach estimation. In the next section, the data used in the empirical analysis in section 5 is briefly discussed.

4. Data

The analysis in the next section makes use of the Labour Force Surveys (LFSs) conducted by Statistics South Africa (Stats SA). The LFSs are nationally representative cross-sectional household surveys that are designed to monitor developments in the South African labour market. The surveys were conducted twice yearly – March and September – from September 2000 to September 2007 when they were replaced by the Quarterly Labour Force Surveys. The LFSs were designed as a rotating panel of dwelling units with 20% of these units dropped in subsequent waves and replaced with new dwelling units (Stats SA, 2006). The rotations were designed in such a way that a total sample of 30 000 households was maintained in each wave.

For the empirical analysis we pooled together the individual cross-sectional surveys running from September 2001 to March 2004. We focus on these waves because they correspond to Stats SA's Labour Force Survey Panel (LFSP) that is also used for the analysis in the next section. The LFSP was constructed after the collection, processing and release of the individual LFS waves (Stats SA, 2006). The LFPS was constructed afterwards because the original LFSs were only initially intended as a rotating panel of dwelling units and not of individuals or households (Stats SA, 2006).

The pooled LFS data set is used for the pooled OLS estimates of the returns to job tenure and labour market experience that appear in the next section. The LFSP is used for the instrumental variables estimation. Both the pooled LFS and LFSP were restricted to include only black male workers earning less than R200 000 per month and who reported to be employed by someone else. Workers in the informal sector, public sector and subsistence agriculture were also excluded from the analysis.

5. Empirical analysis

This section presents and discusses the results of our empirical analysis of the wage effects of labour market experience and job tenure for black South African male workers.

5.1 Pooled OLS estimation results

Similar to many related previous studies, the point of departure for our empirical analysis is to estimate a log wage regression by OLS. In this regression, (potential) labour market experience, job tenure and their respective quadratic terms are our variables interest. The regression also controls for schooling as a set of exhaustive dummy variables representing each possible level (in years) of

schooling attainment. Specifying schooling in this manner allows for a more flexible specification by allowing the effect of schooling on wages to vary for each possible level of schooling attainment. Additional regressors include marital status, whether or not the individual is the head of his household, province, whether the individual resides in a rural or urban area, and dummy variables for the LFS waves. These variables are meant to control for any other demographic, personal or regional characteristics and survey specific features that may affect the wages of individuals.

The results of the Pooled OLS estimation are reported in Table 1, column 1. This Table only shows the point estimates of the variables of interest. The R-squared for the log wage regression suggest that our explanatory variables are able to account for 45% of the variation in log wages. The sign on the linear coefficients of tenure and experience variables are positive while the sign on the quadratic terms of the two variables are negative. This implies a concave correlation between experience and tenure, on the one hand, and log wages on the other as illustrated by Mincer and Jovanovic (1981). We can therefore, under the human capital framework, interpret the coefficients on the experience variables as measuring the return to general training while that on the tenure variable to be measuring the return to specific training.

The point estimate on the linear tenure term is 0.0486 (with a robust standard error of 0.0042) and the estimate on the quadratic term is -0.001 (with a robust standard error of 0.0001). This suggest that an additional year with the same employer is on average associated with roughly a 5% increase in the wage of a black South African male worker, with all else equal. An additional year of labour market experience brings about a similar increase in wages. The point estimate on the linear experience term is 0.0426 (with a robust standard error of 0.0042) and the estimate on the quadratic term is -0.0005 (with a robust standard error of 0.0001). All these coefficient estimates are statistically significant at the 1% level of significance.

The quadratic experience specification has been criticised in the literature (see for example Murphy and Welch, 1990). Others have also voiced concerns about the quadratic tenure specification (see for example Altonji and Shakotko, 1987). We therefore experimented with other functional forms for both experience and tenure.

The log wage results presented in column 1 of table 1 include a tenure dummy variable that takes on a value of zero if tenure is less than or equal to one, and a value of one if tenure is greater than one. This is a specification suggested by Altonji and Shakotko (1987) who argued that the effect on expected wages due to the accumulation of tenure is more pronounced in the first year and that a

quadratic specification may restrict the response of wages to the accumulation of the first year of tenure. In our results this dummy variable comes out statistically insignificant, but it is nonetheless interesting to note that the coefficient has positive sign.

Figure 1 and 2 show the experience and tenure profiles with different specifications on the experience and tenure variables. The graphs specifically depict experience-wage and tenure-wage profiles corresponding to a set of exhaustive dummy variables for tenure and experience specification, quadratic, cubic and quartic specifications of the tenure and experience terms while imputing sample averages for the other control variables. The tenure-wage profile contains an additional curve corresponding to Altonji and Shakotko's (1987) dummy variable specification.

These specifications produce similar wage-experience and wage-tenure profiles. So we will proceed with the quadratic specification for experience. We will proceed with Altonji and Shakotko's (1987) quadratic specification for tenure with the tenure dummy variable to capture any unusual responses in wages due to the first year of tenure.

5.2 IV estimation results

In this section we implement Altonji and Shakotko's (1987) instrumental variables (IV) procedure. This procedure explicitly takes into account the heterogeneity bias that taints the pooled OLS estimates. The bias is addressed by instrumenting for the tenure variables; with the deviations around their individual sample means on a given job match as the principal instruments. The IV estimation results will, hopefully, bring us closer to making causal inferences about the effect of job tenure and labour market experience on expected wages of black South African male workers.

To implement the IV procedure we will make use of two related IV methods – two stage least squares (2SLS) and the control function approach. The two methods should produce identical results since they both rely on the same identifying assumption. The control function approach estimates will, therefore, serve as a robustness check for the 2SLS estimates.

It is important to point out that the implementation of the IV identification strategy requires us to restrict our attention to those individuals remaining on the same job over the course of the survey. This is because deviations in the tenure variables for a given job match is what is used to identify the tenure variables. So the estimates reported here apply only to those individuals. These estimates are summarised in columns 2 and 3 of Table 1.

But before discussing these IV results, we first turn our attention towards Table 2 which reports the first stage results of the IV estimation. In column 1, tenure is regressed on the proposed set of instruments and on the exogenous variables from the Pooled OLS estimation. Column 2 and 3 report similar results for tenure squared and for the tenure dummy, respectively. In column 1, we observe that the first instrument (i.e. "Qtenure" – deviation of tenure around its sample mean) is positively correlated to tenure and the estimated coefficient is statistically significant at the 10% level of significance. The other instruments are individually statistically insignificant. The coefficient on the linear experience variable is positive and statistically significant, whereas the coefficient on the experience squared variable is negative and also statistically significant.

In column 2, all three instruments are individually statistically insignificant in predicting tenure squared. Both the coefficients of the experience variables are positive and statistically significant. In column 3, the tenure dummy variable instrument is the only statistically significant instrument together with the experience variables.

One important condition for the validity of instruments is instrument relevance. The last two rows of Table 2 report results of the F-test for the joint significance of the instrumental variables. The p-values of the test suggest that the instruments are jointly significant in all three regressions, however in the tenure squared regression the null hypothesis is only rejected at the 10% level of significance. This implies that the instruments satisfy the instrument relevance condition.

However, the F-statistics in the first two regressions are quite small (6.02 and 2.13). According to the rule of thumb discussed in Stock et al (2002), the instruments in the first two regressions are deemed to be weak instruments. This is because the F-statistics for the joint significance of the instruments are both less than 10. In other words, the instruments are poor predictors of the endogenous variables even though they may be jointly significant as implied by the p-values. This means we will have to be cautious of the results obtained, and we cannot make any strong casual statements based on these results.

We now turn our attention to the IV results reported in column 2 and 3 of Table 1. In column 2, the 2SLS estimates of the tenure and tenure squared coefficients go in the opposite direction from what we have come to expect from our reading of the literature. But both coefficients are statistically insignificant. These results contradict the pooled OLS estimates that suggest that wages rises with tenure at a diminishing rate. The 2SLS point estimate of the tenure dummy variable is 0.1211, implying that within the first year of a job wages increase by as much as 12%. However, the

standard deviation of this coefficient is 0.0745 which makes the point estimate only marginally statistically significant.

The 2SLS estimates of the experience variables are substantially different from those produced by the pooled OLS estimation. Nonetheless, they too suggest a concave relationship between experience and wages. Wage growth due to the accumulation of labour market experience is, however, much quicker than what pooled OLS would lead us to believe. The point estimate for the linear experience coefficient is 0.0677 (instead of 0.0426), and -0.0009 (instead of -0.0005) for the experience squared coefficient.

These results seem to be in line with the empirical evidence of both Abraham and Farber (1987) and Altonji and Shakotko (1987). These authors found that, after controlling for the heterogeneity bias, wages did not vary much with job tenure. However, correcting for the heterogeneity bias is not the only plausible explanation for the small tenure effect uncovered by our 2SLS estimation. The other possibility is of course that our 2SLS estimates are just simply unreliable due to the presence of weak instruments and that we therefore cannot be sure about the true effect of tenure on wages.

In this analysis we unfortunately do not explicitly address the problem of weak instruments. We instead offer the control function approach estimates as a form of robustness check for our 2SLS estimates. These estimates are reported in the last column of Table 3. Unsurprisingly, the results are basically similar to the ones obtained by 2SLS estimation. However, a key difference in these two sets of estimates comes in the form of lower standard deviations for our parameter estimates. This is more evident with the parameter estimate of the tenure dummy which is now statically significant at the 10% level of significance. The point estimate is roughly the same as in the 2SLS. The residuals from the first stage regressions, which are additional explanatory variables in the control function specification, are all statistically significant. This again justifies our concerns of heterogeneity bias in the pooled OLS estimation.

6. Conclusions

The goal of this paper was to empirically analyse the causal effect of labour market experience and job tenure on expected wages. A large body of theoretical literature dominated by the human capital model suggests that the tenure and experience effects on wages are both concave. However, there seems to be different explanations accounting for these relationships. The empirical literature on the

other hand, reports contradicting evidence on the effect of tenure on wages. Some authors find that tenure does not vary much with wages, whereas others find that the return on tenure is quantitatively and qualitatively as large as the returns to experience.

In this paper, we attempted to address this heterogeneity bias by implementing an IV estimator in addition to pooled OLS estimation. However, the IV estimator presented its own set of challenges that we were unable to explicitly address in this paper. These challenges prohibited any causal inferences to be drawn from the evidence presented in the empirical analysis. Further work remains to be done if we are to empirically measure the rate of human capital accumulation that is associated with the post-schooling phase of an individual's life cycle.

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8. Tables and Figures

Table 1: Main results: Pooled OLS and IV

	(1) Pooled OLS	(2) IV (2SLS)	(3) Control function
Tenure	0.0486 (0.0042)***	-0.04 (0.0471)	-0.0387 (0.0406)
$Tenure^2$	-0.001 (0.0001)***	0.0021 (0.0022)	0.0021 (0.0015)
Experience	0.0426 (0.0042)***	0.0677 (0.0201)***	0.067 (0.0187)***
$Experience^2$	-0.0005 (0.0001)***	-0.0009 (0.0003)***	-0.0009 (0.0002)***
Tenure_dummy	0.0014 (0.0406)	0.1211 (0.0745)	0.1207 (0.0667)*
Residual from IV (1)			0.0901 (0.0407)***
Residual from IV (2)			-0.0031 (0.0015)***
Residual from IV (3)			-0.1652 (0.0844)**
Constant	0.0393 (0.0857)	0.0891 (0.4144)	-0.0867 (0.3335)
Observations	5035	5035	5035
R-squared	0.45	0.39	0.46

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

All regressions also control for education as a set of exhaustive dummy variables representing each possible level educational attainment, marital status, and dummy variables for provinces

Table 2: IV Regression: First stage (LFSP)

	(1) Tenure	(2) Tenure^2	(3) Tenure_dummy
Qtenure	0.6794 (0.4055)*	-5.5758 (16.6773)	-0.0108 (0.0098)
Qtenure2	-0.0023 (0.0209)	0.8005 (0.9191)	0.0001 (0.0003)
Qtenure_dummy	-0.518 (0.7257)	-11.1778 (19.5201)	0.986 (0.0323)***
Experience	0.5784 (0.0372)***	8.0006 (1.3248)***	0.0138 (0.0014)***
Experience^2	-0.0026 (0.0007)***	0.0766 (0.0279)***	-0.0001 (0.00002)***
Observations	5217	5217	5217
R-squared	0.33	0.28	0.38
p-value for joint significance of IVs	0.0006	0.0946	0.0
F-statistic for IVs	6.02	2.13	337.83

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions also control for education as a set of exhaustive dummy variables representing each possible level educational attainment, marital status, and dummy variables for provinces.

Figure 1:

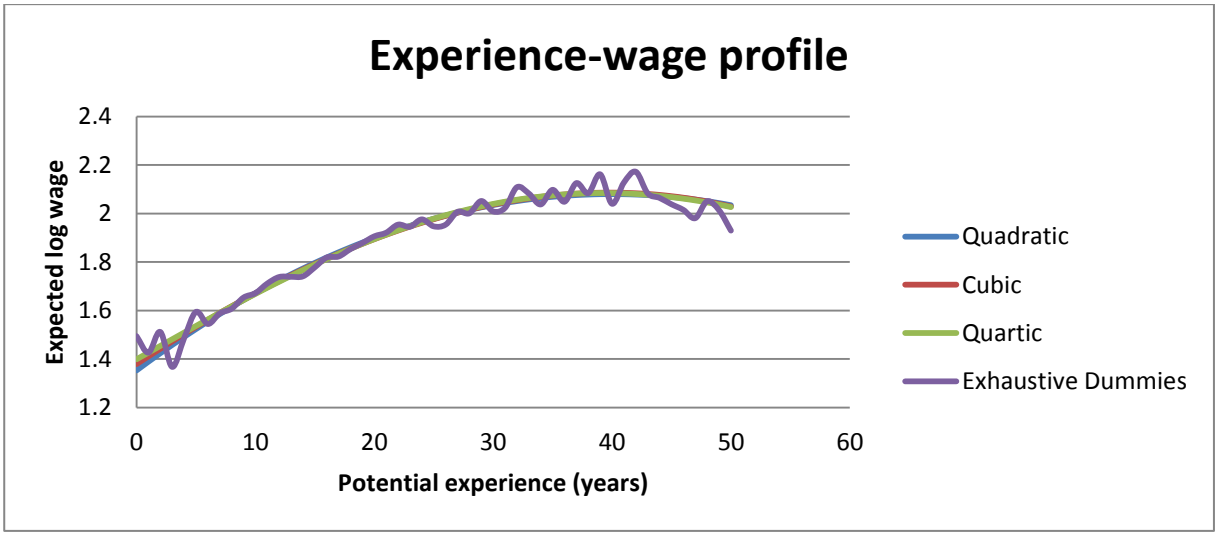
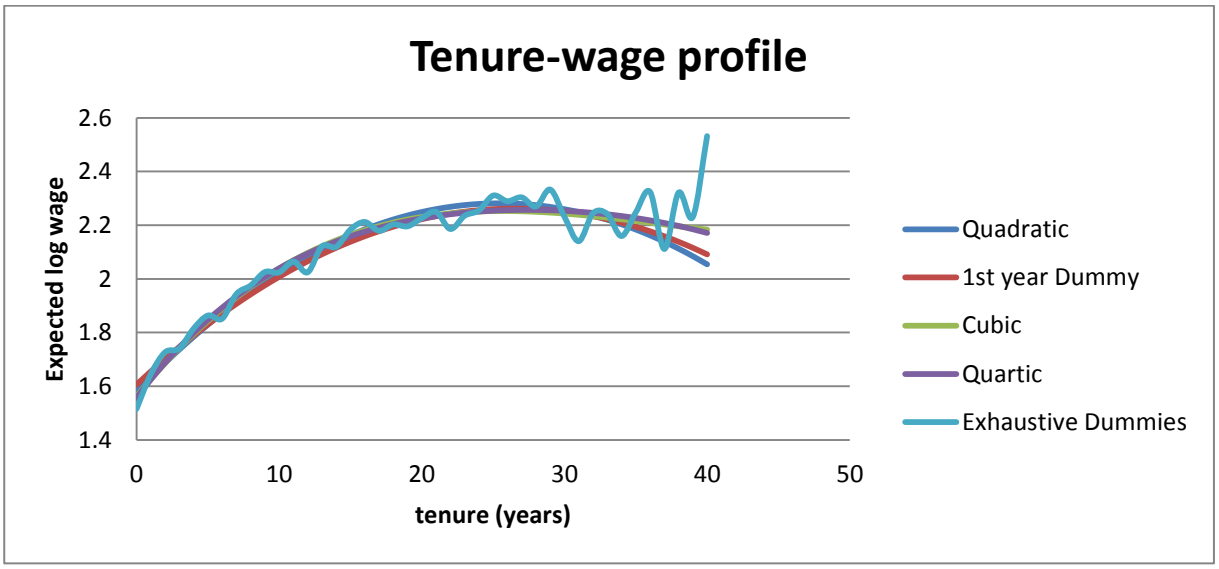


Figure 2:


Tenure-wage profile
Expected log wage
2.6
2.4
2.2
2
1.8
1.6
1.4
0
10
20
30
40
50
tenure (years)
Quadratic
1st year Dummy
Cubic
Quartic
Exhaustive Dummies