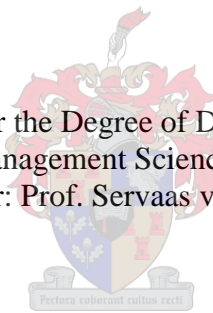


An economic perspective on school leadership and teachers' unions in South Africa

by

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Declaration

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Abstract

This dissertation considers two factors that are considered critical to disrupting an existing culture of inefficiency in the production of learning in South Africa, namely school leadership and teachers' unions.

This first part of the dissertation positions itself within a growing discourse in the economics literature, and in local policy circles, on the importance of harnessing the role of school principals as a route to educational progress. Using a unique dataset constructed by matching administrative datasets in education, the study aims to provide greater specificity to our understanding of the labour market for school principals in South Africa. Chapter two constructs a quantitative profile of this market with implications for policy reforms in raising the calibre of school leadership. It identifies existing inequalities in the distribution of qualified and experienced principals across poorer and wealthier schools, gender disparities in principal positions, low levels of principal mobility across the public education system and high tenure. Together, the evidence points to the need for policies aimed at improving the initial match of principals to schools while developing incumbent principals over their length of tenure. The findings highlight that improving the design and implementation of policies guiding the appointment process for principals is a matter of urgency. A substantial and increasing number of principal retirements are taking place across South African schools given a rising age profile of school principals. Selection criteria need to be amended to identify relevant expertise and skills, rather than relying on principal credentials as captured in payroll data which are shown to be poor signals of principal quality.

While the rising number of principal retirements presents an opportunity to replace weaker principals with better performing ones, this will be accompanied by various challenges including recruiting, selecting and hiring suitable candidates. Moreover, it takes time for school principals to have their full effect on school environments and initially, school performance may decline in response to a leadership succession. Using a fixed effects estimation approach, chapter three suggests that principal changes are indeed initially detrimental to school performance, especially in poorer schools. These results are robust to using an alternative estimation strategy following the work of Heckman, Ichimura and Todd (1997) to control for additional sources of estimation bias. The chapter also considers two mechanisms through which school leadership changes may impact on school performance, namely through rising promotion rates and teacher turnover.

After the discussion on school leadership, chapter four shifts its focus to measure teacher union impacts on educational outcomes by investigating a disruption hypothesis that student learning is lost as a direct consequence of teacher participation in strike action, particularly the intensive public sector

strike of 2007. The study exploits heterogeneity that exists within schools in the level of teacher union militancy to control for confounding factors that may bias estimates of strike effects. An across-subject within-student analysis, following an approach by Kingdon and Teal (2010), suggests that teacher strike participation negatively affects learning for students in the poorest three quarters of schools in South Africa. However, the discussion reveals difficulties in isolating out, specifically, unobserved teacher characteristics that may bias the observed strike effect. There is suggestive evidence that the most marginalised students in rural areas, and those that are weaker academically, are most at risk of learning losses as a result of teacher strikes. In this respect, industrial action has implications for widening existing inequalities in student achievement across the South African education system.

Opsomming

Hierdie proefskrif oorweeg twee faktore wat krities geag word om die huidige kultuur van ondoeltreffendheid in Suid-Afrikaanse onderwys te verbeter, naamlik skoolleierskap en onderwysvakbonde.

Die eerste gedeelte van die proefskrif sluit aan by die groeiende debat in die ekonomiese literatuur en in plaaslike beleidskringe oor die belangrike rol van skoolhoofde in opvoedkundige vooruitgang. Met gebruik van 'n unieke datastel wat saamgestel is deur administratiewe data te integreer, poog die studie om 'n duideliker insig in die arbeidsmark vir Suid-Afrikaanse skoolhoofde te kry. Die tweede hoofstuk skep 'n kwantitatiewe profiel van hierdie mark en bespreek beleidsopsies om skoolleierskap te verbeter. Uit die hoofstuk blyk die bestaande ongelykhede in die verspreiding van gekwalifiseerde en ervare skoolhoofde tussen armer en ryker skole, geslagsongelykhede in skoolhoof-poste, lae mobiliteit van skoolhoofde en uitgerekte ampstermyne. Ontleding hiervan dui op die behoefte aan 'n beleid wat skoolhoofde se aanvanklike plasing in poste verbeter, en dat dié skoolhoofde terselfdertyd nuwe skoolhoofde moet oplei en vir die amp bekwaam. Die bevindinge dui daarop hoe belangrik dit is dat sowel die ontwerp as die implementering van beleid dringend verbeter. Gegewe die stygende ouderdomsprofiel van Suid-Afrikaanse skoolhoofde, staan baie van hulle op of naby aftrede. Aanstellingskriteria moet daarom aangepas word om toepaslike kundigheid en vaardighede te identifiseer, eerder as om op 'n skoolhoof se kwalifikasies staat te maak, wat 'n bewese swak aanwyser van die bevoegdheid van 'n skoolhoof is.

Terwyl die stygende aantal aftredes van skoolhoofde 'n geleentheid bied om swakker skoolhoofde te vervang, is daar uitdagings in die werwing, keuring en aanstelling van gepaste kandidate. Verder neem dit ook tyd vir skoolhoofde om hulle volle impak op die skoolomgewing te maak en skoolprestasie mag aanvanklik afneem as gevolg van die verandering in leierskap. Hoofstuk 3 se vaste-effek beramingsmodel dui daarop dat 'n verandering van skoolhoof aanvanklik nadelig is vir skoolprestasie, veral in armer skole. Dieselfde resultate word ook verkry deur van 'n alternatiewe beramingsmetode van Heckman, Ishimura en Todd (1997) gebruik te maak, wat moontlike nie-parallele tendense in skoolprestasie in ag neem. Die hoofstuk oorweeg ook twee meganismes waardeur leierskapsveranderinge skoolprestasie mag beïnvloed, naamlik deur versnelde promosie van leerlinge tussen grade en deur hoër onderwyseromset.

Na die bespreking van skoolleierskap, skuif die klem in hoofstuk vier na die meting van die impak wat onderwysvakbonde op opvoedkundige uitkomstes het, deur ondersoek in te stel na 'n ontwigtingshipotese, dat die leerproses negatief beïnvloed word deur die ontwigting wat onderwyserstaking inhou. Meer spesifiek word die invloed van die uitgebreide staking in die publieke sektor in 2007 in hierdie hoofstuk ontleed. Hierdie ontleding gebruik die heterogeniteit binne

skole in onderwysers se deelname aan stakings om te kontroleer vir ander kompliserende faktore wat sydigheid in die gemete effekte van stakings mag veroorsaak. In navolging van 'n metode van Kingdon en Teal (2010) word 'n analise gedoen van die verskil in die prestasie van leerders in verskillende vakke wat deur verskillende onderwysers aangebied word. Die resultate dui daarop dat betrokkenheid van onderwysers by stakings 'n negatiewe invloed het op hoeveel studente in die armer drie-kwart van Suid-Afrikaanse skole leer. Tog wys die bespreking daarop hoe moeilik dit is om die effek van onwaargenome eienskappe van onderwysers, wat sydigheid in die meting van die effek van stakings mag meebring, te isoleer. Daar is egter wel aanduidings dat gemarginaliseerde leerders in landelike gebiede, asook dié wat akademies swakker vaar, 'n hoër risiko loop van swakker leeruitkomste as gevolg van onderwyserstakings. Gegewe die resultate lyk dit asof onderwyserstakings ongelykhede in leerderprestasie in die Suid-Afrikaanse onderwysstelsel vergroot.

Dedication

The topic of this dissertation was inspired by one school on which I served on its School Governing Body for three years. This school exposed me to another schooling reality, distinctly different from the privileged learning experience I had accessed just four kilometres away. While the school I had attended was building an Olympic size swimming pool and a replacement aquatic centre, they were struggling to find enough rands and cents to pay for paper and chalk. Yet even if there had been more resources, I am not sure the situation would have been any different. The levels of sustained staff conflict, principal leadership disruptions, and union politics combined with individual rent-seeking imposed a binding constraint to the realisation of professional community and meaningful education. It still does. Sadly, amongst the chaos are some good teachers and even better children who are waiting, hoping, and longing for a school reality that would resemble something marginally closer to mine. This research is dedicated to them.

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Acronyms

ACE	Advanced Certificate in Education
ANA	Annual National Assessment
CIA	Conditional Independence Assumption
COSATU	Congress of South African Trade Unions
DBE	Department of Education
DET	Department of Education and Training
DiD	Difference-in-difference
ELRC	Education Labour Relations Council
EMIS	Education Management Information System
FET	Further Education and Training
HOA	House of Assemblies
HOD	House of Delegates
HoD	Head of Department
HOR	House of Representatives
HSRC	Human Sciences Research Council
IIA	Independence of Irrelevant Alternatives
IQMS	Integrated Quality Management System
MNL	Multinomial Logistic Regression
NAPTOSA	National Professional Teachers' Organisation of South Africa
NDP	National Development Plan
NEEDU	National Education Evaluation and Development Unit
NSC	National Senior Certificate
NQF	National Qualifications Framework
OECD	The Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OSD	Occupation Specific Dispensation
PAM	Personnel Administrative Measures
PEU	Professional Educators Union
PIRLS	Progress in International Reading Literacy Study
PSM	Propensity score matching
REQV	Relative Educational Qualifications Value
RCTs	Randomized Control Trials
SACE	South African Council of Educators
SACMEQ	Southern and Eastern Africa Consortium for the Monitoring of Educational Quality
SADTU	South African Democratic Teachers' Association
SAOU	Suid-Afrikaanse Onderwysersunie (South African Teachers' Union)
SES	Socio-economic status
SGB	School Governing Body
TALIS	Teaching and Learning International Survey
TIMSS	Trends in International Mathematics and Science Study

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Chapter 1

What appears to constitute the major difference in the performance of educational systems in producing outcomes is the effectiveness with which people in those systems - students, teachers, administrators, parents - use resources. In low-effectiveness systems, no amount of additional resources that is not accompanied by a substantial increase in the effectiveness with which people work can achieve the education countries strive for (Pritchett, 2013: 113).

Introduction and overview of research questions

Twenty one years into its democracy, South Africa faces a crisis in offering quality basic education to the majority of its youth. Despite significant changes that were implemented to rectify education inequalities entrenched through apartheid ideologies, these have not translated into appreciable improvements in a core outcome of concern: educational quality. In the transition to democracy, South Africa's education reform efforts in addressing social injustices were applauded internationally (OECD, 2008). Interventions included the unification of racially segregated education departments, the extensive teacher rationalisation programme, equalisation of teacher pay structures across race and gender groups and a large redistribution of education spending to formerly disadvantaged schools (Chisholm, 2012; Jansen and Taylor, 2003). Additionally, school governance has been decentralised, there have been substantial curriculum revisions, access to pre-primary education has expanded and a nutrition programme has been rolled out to the majority of school-going children (NPC, 2012: 308). Despite these efforts, specifically in redressing input equalities, this has not been met with commensurate levels of learning. This is particularly the case for the majority of formerly disadvantaged youth.

Despite access to schooling, children are failing to acquire even the most basic levels of literacy while inequalities in learning closely follow historical patterns of poverty and privilege (Spaull, 2013a). This is troubling when cognitive skills are a strong determinant of labour market outcomes. At the individual level, the quality of schooling has a fundamental impact on future labour market trajectories and life outcomes (Van der Berg and Burger, 2011). At the collective, national level, it is a key determinant of social and income equality and economic growth (Hanushek and Woessmann, 2007). At this juncture, securing a good future for South Africans depends critically on addressing the education crisis. Yet this is a deeply challenging task for government, policy-makers and society at large where systemic problems and their solutions extend beyond a matter of mere spending on

resources. As noted by Carnoy, Chisholm and Chilisa (2012) in referring to identified policy steps for improvement;

...the steps may be evident but making them in the South African political and social context may be exceedingly difficult. This will require changing a now deeply ingrained culture of inefficiency in producing learner achievement. Most schools in the South African educational system have, plainly and simply, organised themselves to produce something that is not student achievement (ibid, 2012: xviii).

This dissertation considers two factors that are critical to addressing this ‘culture of inefficiency’ and reorganising the focus of schools to the core business of teaching and learning. The first is school leadership and the second is the involvement of teacher trade unions in the school environment. Before introducing the three chapters to follow and their associated research objectives, it is useful to position their dialogue within a wider literature on schooling in South Africa - a literature that is moving towards prioritising efficiency arguments in informing wider policy-making in education.

1.1 Moving from an input focus to efficiency solutions

The dire state of basic education in South Africa is undeniable, repeatedly confirmed through a number of reports and cross-national tests of student achievement in which South Africa has participated since 1995 (OECD, 2013; Spaull, 2013b). We have become accustomed to the disconcerting reality that South African children are consistently ranked last or near to last in the TIMSS and PIRLS¹ international tests of reading literacy and numeracy (Reddy et al., 2015; Howie et al., 2012). Our rankings and levels of student achievement have seldom improved over cycles of testing or with the introduction of new participating countries. In PrePIRLS 2011, an easier test than PIRLS, one in three grade four students in South Africa could not reach the low international benchmark for literacy and reading competency; in other words they are deemed completely illiterate and unable to decode text in any language (Howie et al., 2012). With respect to mathematics literacy, TIMSS 2011 results revealed that over three quarters of grade nine students still had not acquired a basic understanding of whole numbers, decimals, operations or basic graphs at the secondary school level (Reddy et al., 2015). Moreover, when observing achievement gaps between language or race groups or by the wealth status of students participating in these tests, one faces the stark reality that substantial inequalities in educational achievement characterise the system.

¹ The International Association for the Evaluation of Education Achievement (IEA) established two sets of studies to assess student learning across the world. The Trends in International Mathematics and Science Study (TIMSS) assesses mathematics and science knowledge and was first conducted in 1995. The Progress in International Reading and Literacy Study (PIRLS) is an international study of reading achievement typically among fourth grade students. In South Africa, grade fours and fives are tested.

What stands out is the very high inequality in test performance between schools in comparison to the variability in test performance within schools (Gustafsson, 2005; Van der Berg and Louw, 2006).² Relative to overall inequalities as measured by asset-based indices of students' socio-economic status, inter-school inequalities in performance are greater. One would need a reversal of this pattern for schooling to have an equalising effect on society. Notwithstanding notable educational reforms in the transition to democracy, the delivery of education as it stands perpetuates the very cycles of inequality it had hoped to transform (Taylor and Yu, 2009; Van der Berg et al., 2011).

There are various factors that are considered as contributing to poor student performance in South Africa, many of which are ascribed to the historical inertias of apartheid. Education was distorted as an instrument of political subjugation of non-whites under apartheid ideologies (Fiske and Ladd, 2004). In the aftermath of resistance to this regime, where teaching and learning was intentionally disrupted, a culture of dysfunctional schooling has persisted, particularly in former Black schools. Today these institutions are more likely to be characterised by infrastructural backlogs and lower levels of access to learner support materials, higher grade repetition and drop outs, ill-discipline, mismatches between students' home language and the language of teaching and learning in the foundation phase, low parental involvement and elusive accountability (ibid, 2004; Spaul, 2013a).

Where society and the provision of education were segregated by race, this being closely linked to socio-economic disadvantage, strong attribution is typically given to socio-economic status (SES) in explaining the low levels of learning among South African children. Certainly, SES is a very strong predictor of learning outcomes in educational production functions internationally and especially in South Africa with its strong convex relationship with school performance (Taylor and Yu, 2009). Notwithstanding this reality, the performance of poor South African children often falls below that of equally poor children in other countries (Carnoy, Chisholm and Chilisa, 2012; Van der Berg et al., 2011). This is observed when comparing, for example, the performance of South African students to students in other sub-Saharan African states or in Latin American countries (Kotze and Van der Berg, 2015). Poverty alone cannot fully account for low levels of performance. Moreover, low levels of learning emerge despite education spending per child that often exceeds that in benchmarking countries (Van der Berg and Louw, 2006; Van der Berg et al., 2011). Evidently, the solution to this service delivery crisis will not come through increasing resources alone. Policy and action must challenge a culture of inefficiency in the provision of education.

The work of Crouch and Mabogoane (1998) brought to the fore the importance of shifting our discourse from one of increased input resources to how we use them more effectively in their

² This is reflected in an intra-class coefficient (the share of the overall variance in scores that is between rather than within schools) in South Africa of over sixty per cent which far exceeds calculated averages for developing countries at thirty per cent (Gustafsson, 2005: 25).

elegantly titled work, “When the residuals matter more than the coefficients”. In modelling student performance in South Africa using an education production function framework, they noted a large remaining residual or unexplained component, despite controlling for a variety of school resources. This is especially the case in the historically disadvantaged system of schools. Across two different studies they quantified this unexplained portion as being over thirty per cent (Crouch and Mabogoane, 1998; Crouch and Mabogoane, 2001). They posited that school quality, and particularly management, accounted for this unexplained residual, noting that “South Africa has done much too little on this score so far, and what little it is doing seems half-formed” (ibid, 2001: 65).

Subsequently, a consistent discussion emerging in South Africa’s economics of education literature is that it is not necessarily the presence of school resources that matters for learning outcomes, but rather the ability of schools to convert these resources into outcomes (Taylor, 2010; Van der Berg, 2008). This agrees with international findings, where reviews of hundreds of production function studies do not reveal a strong or systematic relationship between observable school inputs and student performance (Hanushek and Woessmann, 2007; Pritchett, 2013). This is not to say that resources are not important at all. Across the literature in developing countries and in South Africa there are scattered findings of positive resource effects, but “the main message is still not one of broad, resource-based policy initiatives” (Hanushek and Woessmann, 2007: 67). What is more important is getting the institutional structures right.

Internationally, this position has encouraged further exploration into currently unmeasured aspects of efficiency in the schooling environment or institutional factors that may provide more insight into what really matters for learning. Studies have experimented with teacher incentives, increasing school choice through private models of school funding, decentralising education functions through forms of school-based management and improving accountability in school systems with better information flows and more centralized testing (Bruns, Filmer and Patrinos, 2011; Hanushek and Woessmann, 2007). There is growing evidence that these factors are important for explaining student performance differentials across countries where, specifically, systems with higher levels of accountability are typically better at converting existing resources into educational outcomes. In addition to accountability, studies find that the level of teacher union influence on the school system, and conflict between the state and teachers unions, is a significant predictor of state variations in student performance (Alvarez, Moreno and Patrinos, 2007). In recent years, studies have also quantified the contribution of school leadership and management practices to explaining student performance in both developed and developing country contexts (Bloom et al., 2015; Branch, Hanushek and Rivkin,

2012; Tavares, 2015).³ Quality school leadership and good management practices are indeed identified as important factors for school performance. Specifically, the cross-national study by Bloom et al (2015) reveals that school management practices vary significantly across and within countries and are strongly linked to student outcomes. They identify however that about half of this variation in school management is at the country level – a larger share than what is found in studies of management in manufacturing for example. They argue that “this finding suggests that differences in the institutional environment have particularly important effects on the way schools are managed (Bloom et al., 2015: 648).”

In the local setting, research continues to confirm that institutional environments and ‘school quality’ play a significant role in raising the achievement of students. Gustafsson and Taylor (2013), for example, using a natural experiment of provincial boundary changes that caused random changes in schools’ provincial administration authorities identify that the effectiveness of provincial administrations impacts of student performance at the school level. Furthermore, work by Shepherd (2015a) and Von Fintel (2015) identify that very large effects of school quality are identified in explaining the performance of formerly disadvantaged black students after controlling for various selection issues that may drive this result. Although we lack specificity on what these quality factors may be, few would argue that at the centre of the school quality debate are teachers (Hanushek and Woessmann, 2007; Hanushek, Piopiunik and Wiederhold, 2014). They are the key providers of education at its point of delivery, or what Elmore (2000) refers to as the ‘instructional core’. Education production function analyses in South Africa have failed to appropriately capture the influence of teacher quality on learning outcomes at the classroom level. This likely forms part of the ‘school quality’ residual observed, or what may have been attributed to management alone (Crouch and Mabogoane, 2001).⁴ However, rectifying problems of teacher quality are extremely challenging. Internationally, there is little evidence that teacher quality is systematically related to common measures of salary, education experience or certification. Furthermore, the characteristics of good teachers are not described well, making it very difficult to legislate or regulate them (Hanushek and Woessmann, 2007). However, supposing that qualifications can raise teacher quality, current pre-service university and college programmes will have to be redesigned or substantially altered. If successful, this will only lead to a slow transformation in the teaching corps. Furthermore, there is no

³ Furthermore, a growing body of research explores how corruption factors into the production of education, capturing inputs along the value chain of service delivery and undermining educational improvements (Patrinos and Kagia, 2007).

⁴ School surveys in South Africa have seldom tested teacher content knowledge so that teacher quality has been proxied for by measures of academic qualifications or indicators of pre-service training. Where surveys have tested teachers, as in the SACMEQ III test, it is not clear that teacher quality is adequately captured in these teacher content knowledge tests (Shepherd, 2015b).

evidence of a proven in-service training programme that has appreciably raised the content knowledge and pedagogical skills of incumbent teachers in South Africa (Taylor, 2014).

Where policy-makers are confronted with a conundrum in addressing teacher quality constraints, aspects of efficiency can be leveraged to improve the transmission of *existing* teacher and school resources into higher levels of learning. Particularly where performance is coming off a low base, research in South Africa and other developing countries indicates that higher achievement gains can be made with existing teacher resources, simply through utilising them better (Carnoy, Chisholm and Chilisa, 2012; Gustafsson, 2005; Tavares, 2015). At the most basic level this starts with protecting time-on-task, addressing teacher absenteeism and late-coming from school and the classroom. It also involves improved classroom management, the use of data to track student performance and to set improvement targets, and higher levels of monitoring and support for teachers in using available resources and delivering what content knowledge they have in the most effective way (Gustafsson, 2005; Hoadley and Ward, 2009; Taylor, 2011; Taylor et al., 2012; Tavares, 2015). Of course, policy may have little leverage in directly affecting these factors. As noted by Elmore (2000) in his insightful dialogue on “Building a New Structure for School Leadership”:

The closer policy gets to the instructional core – how teachers and students interact around content - the more policy-makers lose their comparative advantage of knowledge and skill, and the more they become dependent on the knowledge and skill of practitioners to mould and shape the instructional core (ibid, 2000: 26).

Considering this problem in the context of a principal-agent model, however, policy can leverage the role and functions of those literally titled as principals to indirectly influence service delivery through agents - in this case teachers. Labour unions also play a strong role in influencing the behaviour of these agents with the power to capture or enhance their efficiency in influencing student learning (Hoxby, 1996). This is explicitly recognised in an important planning document in South Africa known as The National Development Plan (NDP) (NPC, 2012: 308-311). The document establishes the need to improve efficiencies in the education sector through various strategies, including *inter alia*; improving school management and leadership as represented by school principals and encouraging teacher unions to embrace a professional concern for improving the quality of education. Addressing these two areas as a priority in education is reiterated in reports by the National Education Evaluation and Development Unit (NEEDU) - South Africa’s independent body tasked with evaluating educational progress in South Africa (Taylor, 2013; Taylor, 2014) .

In the remaining part of this chapter, I discuss the approach this study takes and the contribution it makes to a growing discourse on how these two sets of actors, namely school principals and teachers’ unions, influence the effectiveness with which school inputs are converted into learning outcomes in the South African education system.

1.2 School leadership

In recent years, significant contributions to the economics of education literature have confirmed claims in a larger number of qualitative studies in education that principals are only second to teachers in terms of their importance for learning (Branch, Hanushek and Rivkin, 2012; Coelli and Green, 2012; Grissom, Kalogrides and Loeb, 2015; Leithwood et al., 2004). Considering the work of Branch, Hanushek and Rivkin (2012) in the United States, chapter two recognises that raising the quality of a principal presents an opportunity for educational improvement that potentially outweighs the impact of raising the quality of an individual teacher in a school. While an individual teacher can influence a few students they instruct, the work of principals (while mediated through teachers and features of the school organisation (Hallinger and Heck, 1996)) can influence all children in a school. While addressing teacher quality constraints is no less important, targeting principal quality as a route to educational improvement is substantially less costly with far fewer principals than teachers in the system. Moreover, implementing policies and actions to raise the quality of school leadership is arguably less likely to attract insurmountable resistance from unions to altered conditions of service where this affects fewer of its members. Despite this, the role of principals as key actors in enhancing efficiencies in education has not been duly harnessed in education policy-making both locally and in the international context (Weinstein, Munoz and Raczynski, 2011; Hanushek, 2013).

Given the data intensive nature of estimating causal effects of principal quality on schooling outcomes, the South African economics of education literature is still far off from being able to do this. Nevertheless, proceeding from the assumption that principals are important catalysts for school functionality and establishing a culture of teaching and learning in schools, existing administrative datasets can be used to gather various insights about what is referred to as ‘the labour market for school principals’ (Clotfelter et al., 2007; Loeb, Kalogrides and Horng, 2010). For this study, a longitudinal dataset was generated by integrating South African educator payroll data with national data on public schools and school performance as reflected in matriculation examination data. This is a challenging process given that the datasets are managed by two different national departments and were not designed to be linked together or analysed over time. Nevertheless, investing time in integrating administrative data provides opportunities for research that goes beyond what is possible with school survey data.

The research that follows confirms that there is much value to be realised, more generally, from administrative data in contributing to our understanding of important relationships in education and the factors that influence learning. This is especially the case when analysing factors and relationships at the school rather than the student level, requiring larger sample sizes than what is typically provided in school survey data. For example, Crouch and Mabogoane (1998, 2001) were able to challenge an input-focused ideology, raising the importance of management or school quality in

explaining differential performance across schools using administrative data. They relied on a cross-sectional dataset of payroll linked to national data on schools. In this study, adding a longitudinal dimension to a similar dataset opens up new avenues for systems' level analyses.

The first chapter of this thesis contributes a quantitative overview of the population of school principals in South Africa, informing what has been predominately a qualitative-based discourse on school leadership in the local context. Moreover, the evidence presented is used to directly inform, support and debate recent policy developments in the area of school principals, and particularly in considering the recommendations of the NDP to raise the quality of school principals. This chapter is broadly divided into three analytical sections. In an exploratory analysis of the constructed dataset, it starts off by simply considering the demographic characteristics of principals. An analysis of the age profile of principals, in particular, reveals a striking reality that the public school system is facing a substantial and increasing number of principal retirements. Supported with the right incentives, a new generation of school leadership may assist in reinstating a culture of teaching and learning in schools. Furthermore, it may reshape distorted perceptions of Principalship as a position of bureaucratic control over teachers (Steyn, 2002).

Moreover, imminent vacancies in leadership posts present a window of opportunity to appoint good leaders in a context where teachers and school managers are seldom dismissed for poor performance (Wills, 2015). However, where the appointment of principals in some provinces has been subject to teacher union interference, nepotism and corruption (City Press, 2014; Taylor, 2014), urgent steps need to be taken to i) improve the monitoring of this process and ii) ensure that the best candidates are appointed. Furthermore, much needs to be understood about this principal labour market before the right set of policies can be crafted to alter the way it works. The second part of chapter two considers patterns of mobility in the labour market for principals and how this may contribute to exacerbating existing inequalities in the distribution of principals across schools in terms of their levels of qualifications and experience. It provides suggestive evidence of principals' preferences for certain types of schools by exploring their mobility patterns within the system.

With a wave of new principal appointments to be made, policy-makers may want to know whether they can rely on observed credentials as a signal of principal quality in selection and hiring processes. The third part of the chapter explores the relationship between principals' credentials - as captured in education payroll - and school performance outcomes. Following the work of Clark, Martorell and Rockoff (2009), the estimation strategy exploits the panel nature of the dataset to control for unobserved school characteristics that may confound estimates of this relationship. The results are instructive in challenging existing policies that guide appointment processes and the remuneration of school principals. The findings from each of three analytical sections complement each other in the

final section of the chapter to inform policy recommendations on how to improve the stock of quality school principals in South Africa.

The third chapter narrows its focus to consider the possible short run implications of principal replacements for the school environment. Although there are likely to be many benefits of principal replacements, this also poses substantial challenges for education planners, provincial administration and districts. Employee turnover is commonly considered a costly process in the short run in terms of recruiting and training new replacements. High levels of employee turnover, particularly in managerial positions, is also considered disruptive for organisational improvements or ‘business-as-usual’, even where good quality replacement leaders are appointed (Beteille, Kalogrides and Loeb, 2012; Miller, 2013). By contrast, stability in leadership is typically identified as a defining feature of healthy organisations and improving education systems (Mourshed, Chijioke and Barber, 2010).

The literature notes that there is an adjustment period associated with a leadership succession, where school performance tends to decline following a principal turnover and only stabilises after three to four years (Coelli and Green, 2012; Miller, 2013). Furthermore, it is argued that it takes time for principals to have an impact on the school environment, where principals and staff members must adjust to a new socialisation of the school organisation (Hart, 1991). This is likely to be particularly challenging in the South African context where school management is intended to be strongly democratised through the role of School Management Teams (SMTs) and School Government Bodies (SGB). The system of school management and governance is set up in such a way that successful implementation requires educational managers who are able to work in democratic and participative ways to build relationships (Steyn, 2002). In addition, this principal adjustment period may be further extended where unions exert external influence over schools and resist new forms of control (Heystek, 2015).

Again, using the administrative panel dataset constructed for this study, chapter three proceeds to estimate the impact of principal leadership changes on student performance. The results are aimed at providing policy-makers and planners with greater specificity on the implications that leadership changes present for the schooling system in the period following the leadership succession. This in turn informs the extent to which districts should engage in managing and supporting schools that are anticipating or undergoing a leadership succession to prevent unnecessary learning losses. Much of the discussion in the chapter centres around disentangling the impacts of a leadership change on learning from various sources of endogeneity that may influence both school performance and a principal’s decision to leave a school (Beteille, Kalogrides and Loeb, 2012; Miller, 2013). Subsequent to investigating how leadership changes may impact on school performance, the analysis explores one potential mechanism by which leadership changes impact on learning; namely through increased turnover among teachers in a school (Branch et al, 2012; Beteille et al, 2012; Miller, 2013).

1.3 Teachers' unions and industrial action

Attempts to harness principal leadership as a route to higher levels of accountability and school performance are likely to be subject to the powerful influence of teachers' unions and particularly, the South African Democratic Teachers' Union of South Africa (SADTU).⁵ More generally, the extent to which teacher unions can exert control over education systems, and the level of conflict that exists between them and the government, are significant factors explaining differential student performance across and within countries (Alvarez, Moreno and Patrinos, 2007; Murillo et al., 2002).

Chapter four of the dissertation shifts its focus from school leadership, considering how teachers' unions enter into the production of education in South Africa. It commences by describing how teacher unions and industrial action are defining features of the education landscape. At the national level, SADTU as a dominant union has substantial leverage on South Africa's sector specific Education Labour Relations Council (ELRC), especially where the scope of the ELRC was expanded to include agreements on *all* issues pertaining to education personnel (de Clercq, 2013). In light of chapter two, the final design and implementation of policies, including those influencing the quality of school leadership, typically rests on the position of SADTU in ELRC negotiations or the level of mobilisation they can muster to contest the implementation of agreed policies.⁶ There is increasing consensus that at the province and district level, the extent to which the right principal appointments are made will depend on reducing the undue influence of interested parties in this process (NPC, 2012: 308; Jansen, 2015) and curbing corruption (City Press, 2014). At the school level, principal effectiveness may also be limited by the overt control of unions on the school environment (Heystek, 2015).

The excessive control of teacher unions on education in South Africa has been heavily criticised and this criticism is no more prevalent than in periods of industrial action. In recent years, the country has experienced the most intensive industrial activity among teachers in post-apartheid history, either in the form of full-blown strike action or 'work-to-rule' behaviour. The aim of the chapter is to contribute to a wider discourse on the influence of teachers' unions in the education system, with a specific focus on investigating the extent to which industrial action impacts on student achievement. Specifically, I investigate a disruption hypothesis that strike action limits learning in schools. In a context where South Africa's ruling party - the African National Congress (ANC) - tabled a proposal in 2013 for the

⁵ SADTU is politically aligned to the ruling party as an affiliate of the Congress of South African Trade Unions (COSATU). Together with the South African Communist Party (SACP), COSATU forms a tripartite ruling alliance with the African National Congress (ANC).

⁶ In ELRC negotiations on the formulation of a new teacher pay and evaluation system known as the Occupation Specific Dispensation (or OSD), catalysed through the public service strike of 2007, SADTU blocked noteworthy policies to introduce new performance management systems for school principals (Smit, 2013)

declaration of teaching as an 'essential service' (McKaiser, 2013), it contributes to a wider discussion on limiting teachers' right to strike.

Following an approach by Kingdon and Teal (2010) in exploring union membership effects on learning in private schools in India, an across-subject within-student analysis is applied to the third survey administered by the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ III). SACMEQ was administered in South African schools in September 2007 shortly after the intensive public sector strike that year. This strike catalysed the largest amendments to the remuneration structure for educators since the reforms of the early 90s (Gustafsson and Patel, 2008). Having considered the contemporaneous impacts of the public service strike, the chapter also briefly considers the long-run impacts of the strike for educational improvement which *a priori* could be positive or negative, depending on the outcomes of negotiations in establishing a new pay system and in turn the impacts this has on the education system.

Overall, the research provides a quantitative contribution on teacher union influence on schooling in South Africa and the developing world more generally. Research by, amongst others, Francine de Clercq (2013), Linda Chisholm (1999) and Logan Govender (2004) have provided in-depth qualitative insights into the influence of teacher unions on the South African school environment. However, there are no local quantitative studies of the impacts of teacher unions on student achievement. Moreover, only a handful of studies have explored teacher union and strike impacts on learning in developing countries (Alvarez, Moreno and Patrinos, 2007; Kingdon and Teal, 2010; Murillo et al., 2002), although a growing literature investigates the impacts of teacher absenteeism on learning outcomes (Duflo, Hanna and Ryan, 2012; Patrinos and Kagia, 2007).

While the focus of this chapter is investigating the impacts of strike activity on learning, it is recognised that teacher unions are an integral and largely indispensable component of any democratic approach to the provision of education (Cowen and Strunk, 2014). On the one hand, academics, policy-makers and citizens are increasingly aware of the constraints that unions pose for educational improvement in South Africa at all levels of the schooling architecture.⁷ To some extent these negative perceptions of teacher union interference in schooling are augmented when it is difficult to disentangle their influence from forms of corruption that latch onto union politics. Furthermore traditional economic theory also contends that teacher labour unions are monopolistic groups, taking advantage of an inelastic demand function for teachers and impose a union 'tax' as they use their collective bargaining power to raise teacher wages. On the other hand, there is a growing literature that acknowledges that unions may be efficiency-enhancing (Bennett and Kaufman, 2007).

⁷ This has been most recently expressed in current stand-offs between SADTU and the Department of Education in administering the Annual National Assessments (Nkosi, 2015).

Alternative economic positions on labour unions provide another view of their economic contribution as they provide “voice” to workers and reduce employer power in monopsony labour markets such as teaching (Kaufman, 2007). Moreover, research on country cases studies of education reform identify that when collaborations between governments and teacher unions are strong and policy advocacy among teachers’ unions is directed towards efficiency-enhancing policies, unions can play an instrumental role in educational improvement (Gindin and Finger, 2014; Grindle, 2004).⁸ South Africa’s National Development Plan (NDP) explicitly recognizes that teacher unions are a key interest group in the process of educational improvement while acknowledging that “without a good level of professional expertise among union leaders, it is difficult to get unions to move beyond the issue of salary increments to the core professional concern of improving the quality of education” (NPC, 2012: 308).

1.4 Conclusion

The challenge education reformers now face is to address the crisis in the provision of educational *quality* - distinguished intentionally from the provision of access to schooling. In addressing this challenge, solutions extend far beyond the features that characterised the social reform processes of the early 90s. Historical and international evidence have shown that required improvements will not materialise through an increase in spending on input resources alone. This is a necessary, but not sufficient condition for improvement. We need to invest in improving efficiencies in education, achieving more with what we currently have in the form of teacher and physical resources. This is consistent with an ‘efficiency’ agenda required more broadly across the South African economy.⁹ In this context, the thesis proceeds to provide a quantitative contribution to our understanding about two sets of actors with the potential to affect efficiencies in basic education, namely school principals and teachers’ unions.

⁸ In a review of case studies of the politics of education reform in a number of Latin American countries, Grindle (2004) argues that a common thread in successful education reform processes is that the state has worked together with unions, overcoming teacher opposition to reform processes throughout the design, passage and implementation phases of reform. In the South African context, the role teacher unions played in transforming an unjust education system in the transition to democracy cannot be discounted.

⁹ In international efficiency ratio rankings which attempt to quantify how effectively input resources are converted into outputs at the economy wide level, South Africa fares substantially below international averages and below fellow trade partners in BRICS (Cornell University, INSEAD, and WIPO, 2014).

Chapter 2

The labour market for school principals in South Africa: Evidence to inform policy

2.1 Introduction

Despite both anecdotal evidence that school principals matter for learning and convincing international quantitative evidence that supports this notion, often too little policy attention is given to harnessing the benefits of school leadership for educational improvements. In reference to Chile, José Weinstein and colleagues sum up the problem well, noting that “Principals form part of a strategic sector that has not been duly explored in its potential for contributing to education progress” (Weinstein, Munoz and Raczynski, 2011: 298). In South Africa, however, there have been notable shifts in the past decade that raise the value of school leadership and management as critical levers for learning gains and in increasing accountability within the education system. This has been expressed in amendments to legislation, statements and actions of the Department of Basic Education (DBE) and in national policy plans.

In particular, with the release of The National Development Plan (NDP) in 2012, the need to strengthen the policy framework governing principals has arguably gained traction as it explicitly identifies that strengthening school leadership is a national priority (NPC, 2012: 309-310). The NDP proposes policy improvements for school principals in three broad areas: the principal appointment process, managing their performance and providing them with greater powers over school management (ibid:309-310).

Concurrently, quantitative research has failed to keep abreast with needed policy improvements governing school principals. There is a lack of empirical evidence in the local context to guide and support policy implementation in this area; this is particularly problematic when politically interested groups are likely to have convincing arguments against proposed reforms. In this chapter, the overarching quantitative characteristics of the labour market for principals in South Africa are highlighted to inform, support and debate recent policy developments involving school principals. In light of these findings, NDP policy proposals to raise the calibre of school leadership are considered with additional policy recommendations proposed. The intention is to identify the seeds of a better

future system of policies while considering current provisions already made to improve school leadership.

In understanding the characteristics of South Africa's principal labour market, five research objectives were established at the outset of the analysis. These objectives also form the structure around which this chapter develops. The first was to simply understand who has been appointed to assume responsibility for leading schools and engaging in the extensive and significant range of responsibilities this position requires. What formal preparation and experience have they had to assume such responsibilities? For example, what are their qualification levels and years of experience?

A second and related objective is to identify whether principal characteristics systemically differ across poorer and wealthier parts of the schooling system. In brief, the analysis shows that principals are unequally distributed across schools with typically less qualified and less experienced principals overly represented in poorer schools. The third objective seeks to identify whether these patterns of principal sorting are driven by initial matching of principals to schools and/or the systematic transfer of principals across the system. Understanding the mechanisms informing principal sorting provides insights for designing more suitable policies to improve the distribution of principals across schools.

A fourth objective is to explore dynamics in the principal labour market, identifying the amount of churning among principals both in terms of attrition related moves and within system transfers. The analysis also explores whether incentives exist in the system that direct the transfer of principals across schools in ways that aggravate existing inequalities in the distribution of principals.

The fifth objective is to determine whether credentials, as measured in terms of qualifications and experience, provide a signal of principal quality in South Africa. Local and international evidence on teachers and principals provide mixed evidence that credentials are actually useful signals of quality (Clark, Martorell and Rockoff, 2009; Clotfelter, Ladd and Vigdor, 2010; Hanushek, 2007; Van der Berg, 2008). Yet, credentials form the basis for determining teacher pay and in guiding their promotions in most education systems, including South Africa's (Hanushek, 2007; RSA DoE, 2003a). This study investigates whether qualifications and experience can be used as an appropriate signal of principal quality in the South African context by identifying whether a relationship exists between principals' credentials (as observed in payroll data) and the performance of the schools they lead. The final section collates the evidence that emerges from tackling each of the above research objectives with the intention of informing policy developments affecting school principals.

2.2 Background literature on principals, school leadership and policies influencing leadership in the local context

International evidence on principals' effectiveness and their distribution across schools

For years, a large education administration literature, located primarily in the United States and Europe, has purported that school leaders are critical to school effectiveness and student learning. For example, Leithwood *et al* (2004) in their review of case studies on school leadership note that principals are only second to teachers in terms of their importance for student learning and school effectiveness in general. In this literature, much of the anecdotal evidence elucidating the importance of principals has unfortunately been dampened through quantitative analyses noting very small effects of leadership on school outcomes (Witziers, Bosker and Kruger, 2003). These small effects are attributed to the non-representative samples used in analyses, inadequate quantitative methodologies adopted and narrow definitions used in measuring school leadership (Hallinger and Heck, 1996; Robinson, Lloyd and Rowe, 2008).

In the economics literature, a new and emerging evidence base using large-scale datasets and value-added models provide convincing evidence that school principals matter considerably for student learning (Branch, Hanushek and Rivkin, 2012; Chiang, Lipscomb and Gill, 2012; Coelli and Green, 2012; Grissom, Kalogrides and Loeb, 2015). Value-added models identify the additional value that principals bring to student learning after partitioning out the contributions of individual teachers, the school and the ability and backgrounds of individual students. Widely cited research by Branch *et al* (2012) in Texas schools suggests that highly effective principals can raise the achievement of the average student in these schools by between two and seven months of learning in a school year; ineffective principals lower achievement by the same amount. These are educationally significant effects, second only to the direct effects of individual teacher quality on student learning. But the difference between teachers and principals is that principals affect *all* students in a school rather than just the students a single teacher instructs. The overall impact from increasing principal quality therefore substantially exceeds the benefit from a comparable increase in the quality of a single teacher (Branch, Hanushek and Rivkin, 2013). The obvious implication of this international evidence is that the effective placement and distribution of principals across schools really matters for school effectiveness and student learning.

Research on school principals which has been concentrated in the United States finds that principals are unequally distributed across schools, with less qualified and less experienced principals disproportionately represented in the poorest parts of the schooling system (Beteille, Kalogrides and Loeb, 2012; Clotfelter *et al.*, 2007; Gates *et al.*, 2006; Branch *et al*, 2012; Clark *et al*, 2009; Loeb, Kalogrides and Horng, 2010). Loeb *et al* (2010) explore the mechanisms that lead to this unequal

distribution. They identify that these patterns of principal sorting across schools are attributed not only to initial principal school matches but to the systematic transfer of principals to different types of schools. In other words, the effective distribution of principals across schools depends not only on the initial placement and hire of principals, but the patterns by which they move across schools. Their research emphasises the importance of understanding these dynamics for designing policies that address unequal distributions. Policy has an important role to play in ensuring that principals are distributed as equitably as possible across the school system, ensuring that the right principals are appointed and in raising the performance of existing leadership.

School leadership and policies influencing leadership in the local context

There is currently little systematic evidence linking school principals or their competencies to school performance in the South African context and in developing countries more generally. To date, the most focused quantitative study on school leadership and management is reflected in work by Stephen Taylor (2011) using a school panel, namely the National Systemic Evaluation Study (NSES). He identifies indicators of school management and leadership that may proxy for quality leadership in a school.

However, a larger number of qualitative case studies from the educational literature highlight the importance of leadership as an enabling condition for learning in our schools. Christie, Butler and Potterton (2007) for example, conducted case studies of 18 schools that achieved good to excellent results in the matric certificate. Their research concluded that effective leadership, which may be dispersed across heads of departments (HoDs) and other teachers, was a critical factor characterising schools with higher levels of student achievement. Sound curriculum leadership, monitoring and evaluation of student outcomes and teacher practices, protecting time-on-task, strategic resourcing, promoting teacher professionalism through reduced absenteeism and improved punctuality are some of the identified characteristics of good leadership in the South African context (Christie, et al 2007; Hoadley and Ward, 2009; Taylor 2011; Taylor et al., 2012). Nevertheless, it is argued that more specificity is still required in terms of what distinguishes quality leadership from typical leadership beyond broad notions of 'instructional leadership'. Hoadley and Ward (2009) in their review of literature on school management and leadership reiterate earlier remarks by Bush et al (2006) that our understanding is limited of how the actions and behaviours of school leaders in South Africa are contributing to or detracting from school functionality, particularly with respect to producing learning outcomes. One reason for this is that reliable quantitative research is hampered by the lack of a comprehensive instrument for capturing the school leadership and management (SLM) construct in analyses. Considerable strides need to be made in measuring the SLM construct. Furthermore, engaging in causal analyses to isolate out the contribution effect of principals to learning from other

teacher, home background and external factors is inhibited by the lack of representative data linking teachers and principals to students over time.

Despite the slow progress made in understanding how school leadership enters into the production of education in South Africa, some progress (albeit slow) has been made in the policy environment in attributing greater importance to school leadership and management and imposing increased requirements and standards of expectation on school leaders to achieve learning gains.

With promulgation of the Education Laws Amendment Act in 2007, accountability for school performance was increasingly placed in the hands of principals as legislation required them to plan for academic improvements in schools and report progress against school plans (RSA, 2007). A recent example of how this legislation is used at a provincial level to improve accountability is a recent gazette released by the Western Cape Government Department that imposes binding performance indicators on schools, holding principals responsible for setting performance targets and implementing plans to achieve these targets (Western Cape Government, 2015). The concern, however, is that policies of this nature may not produce the kinds of behavioural change required for school improvement. There is considerable evidence that the majority of principals are complying and developing improvement plans and performance reports in line with legislation (Taylor, 2014). An analysis of the School Monitoring Survey of 2011 indicates that as many as 88 percent of schools had school improvement plans, 78 percent had academic improvement plans and a further 94 percent had academic performance reports (RSA DBE, 2014b: 24). Whether these documents are actually meaningful, of good quality and implemented to improve learning outcomes is another question. Accountability mechanisms must have substance in terms of clear links to school improvement rather than just mimicking a form of accountability that imposes another compliance burden on the system, but is divorced from the object of our attention, improving learning (Pritchett, 2013; Taylor, 2014). This should be key a consideration in the design and implementation of performance management systems affecting principals' work.

For the most part, principals' performance is still assessed in terms of the Integrated Quality Management System (IQMS) agreed to in 2003 (ELRC, 2003). There are a number of weaknesses with this system both in terms of its design and implementation, which impede its ability to introduce the levels of accountability initially intended. It has not provided sufficiently clear standards against which to assess the work of principals (Smit, 2013). Attaining good ratings has been too easy (RSA DBE, 2012b). Moreover, many principals have often not been evaluated by their immediate supervisors (circuit managers) as initially proposed by the agreement. In the sample of schools visited by IQMS moderators in 2011/12 only 41 percent of principals had been evaluated by their circuit manager (*ibid*, 2012b: 44).

Finally, the ‘carrots and sticks’ of IQMS are arguably ineffective in inducing changes in behaviour. In particular, its capacity to introduce notable threats to job security is stifled in the face of stringent labour legislation and substantial union involvement which create significant barriers to dismissals. Van Onselen (2012) indicated that between 2000 and 2011 a total of just 97 educators were permanently struck-off the register by the South African Council of Educators – an average of less than ten a year. Estimations using 2011 terminations data from the DBE point to much larger numbers of dismissals at roughly 350 per year across provincial departments. As a percentage of educators this is still low at about 0.1 percent, although this percentage varies across provincial departments.¹⁰ For example, in a province such as the Western Cape, an educator is six times as likely to be dismissed compared to an educator in a province such as Limpopo. Using the same data, roughly 22 principals were dismissed in 2011, less than 0.1 percent of principals in South Africa. It’s quite apparent that once a position is obtained in a school, job security is mostly guaranteed, even for school managers.

A number of statements have been made by national DBE to hold principals accountable for school performance through the introduction of new performance contracts (Khumalo, 2011; Phakathi, 2012). Additionally, proposals for introducing new performance management systems for principals and their deputies have been drafted. For example, as proposed in collective agreement no. 1 of 2008 of the Education Labour Relations Council (ELRC), principals and deputy principals were to be subject to new performance standards with clear assessments linked to leading and managing schools and performance outcomes linked to a notable monetary incentive structure (ELRC, 2008). This agreement proposed very favourable accelerated pay progression for principals assessed at levels at or above ‘fully effective’. This proposal, however, was terminated a year later with the ELRC collective agreement no. 4 of 2009. Another draft performance agreement for principals was then proposed by the DBE in June 2011 which would hold principals accountable for the performance of teachers and also student test results. Unfortunately, as identified in a succinct description by Louise Smit (2013) of these ELRC negotiations in the past ten years, introducing more effective performance management for principals has been resisted by teacher unions in the ELRC, where the June 2011 proposal was withdrawn in 2012 (Smit, 2013).

In a context of weak existing accountability systems for school principals, the NDP reiterates the need to introduce performance contracts for principals and deputy principals aimed at improving their performance and targeting their training needs. It also advocates replacing underperforming principals; a proposal supported by current legislation. The Education Amendment Act of 2007 makes provision for tackling poor leadership in poorly performing schools through i) identifying underperforming schools and ii) taking action to either counsel principals of these underperforming

¹⁰ In the United States, roughly 21 out of 1 000 teachers are dismissed annually for low performance (Aritomi, Coopersmith and Gruber, 2009).

schools or to appoint academic mentors to take over their functions and responsibilities for a period of time as determined by provincial Head of Departments (RSA, 2007). In addition, the Employment of Educators Act makes provision for the dismissal, after an inquiry, of an educator who is unfit for the duties attached to his or her post.

Importantly, the NDP also stresses the importance of making the right principal appointment at the outset. Nationally, processes and short-listing criteria governing teacher and principal appointments are expressed in the Personnel Administrative Measures (PAMs) (RSA DoE, 2003a). Standard national minimum criteria as specified in the PAMs are meant to be used in sifting candidates that apply for positions which are advertised in vacancy bulletins released by provincial education departments. The national minimum criteria include i) a Relative Educational Qualification¹¹ Ranking (REQV) of 13, roughly equivalent to a three-year degree including education specific training and no different from an entry level teaching post requirement and ii) seven years of experience. Together the two national minimum criteria provide little to no value in sifting out unsuitable candidates. Suppose one raises the REQV level requirement to 14, then 87% of all educators in 2012 (excluding principals) held this qualification and seven years of experience. Nevertheless, after sifting applications that meet minimum appointment criteria (where the sifting process must be verified by trade unions), policy requires that interviews are conducted at schools by a panel consisting of parents, the principal, a department representative (who may be the principal) and a union representative whose role is only to “observe” that due process is followed. The panel then submits recommendations of their choice of candidate to the Head of Department who makes the final appointment decision (ibid: 21). In recent years, various reports have highlighted the undue influence of unions in selection processes beyond mere observation. There have also been allegations of bribery, cronyism and concerns that School Government Bodies (SGBs) do not possess the necessary capacities to interview and select the right person for the job (City Press, 2014; NPC, 2012: 309; Taylor, 2014; ELRC, 2014). In improving the appointment process for principals, the NDP recommends reducing the undue influence of unions in the appointment process while providing increased support to SGBs to fulfil their general mandate. It also suggests raising entry level requirements for principals where a prerequisite for principal promotion should be an Advanced Certificate in Education (ACE) in School Management and Leadership. This is an idea that entered the school leadership discourse well over a decade ago. In addition to raising the minimum entry level criteria for principal appointments, the NDP proposes augmenting the appointment process with competency-based assessments for principal applicants to determine their suitability and identify the areas in which they would need development and support.

It is worth mentioning that the NDP proposals are not just lofty ideals. As discussed, there have been notable attempts to implement more effective performance management systems for principals.

¹¹ A fuller description of the REQV level system is provided in section 2.3 of this chapter.

Raising minimum criteria for entry into principal positions was also considered many years ago, as early as 2007, through the initial introduction of the ACE programme in school management and leadership and its later review and redesign (Bush et al., 2009; NPC, 2012). More recently, the DBE has set in motion a series of additional actions towards implementing policies in line with the NDP recommendations. In August 2014, a national gazette of a draft policy stipulating the Standard for Principalship was released for public comment (RSA DBE, 2014c). The document outlines the qualities and competencies school leaders should have.¹² As noted by Christie (2010), the setting of “professional standards” for principals forms part of the broader drive for accountability. These standards are likely to form the framework upon which competency tests and any forthcoming improved performance management systems for principals are based. Moreover, provincial education departments in the Western Cape and Gauteng have already embarked on a process of piloting competency tests in the principal appointment process (RSA, 2015). This is administered by an independent contractor which prevents political interest groups from interfering in this process. The DBE’s commitment to this goal was also expressed in their 2015 Annual Performance Plan where the number of new principal appointments involving competency-testing was introduced as a key performance indicator in tracking the attainment of DBE goals expressed in their Action Plan 2019: Towards Schooling 2030 (RSA DBE, 2015b: 46; RSA DBE, 2015a). At the most basic level this provides more control of the appointment process of principals which has been identified as fraught with irregularities.

Despite the steps taken to accelerate policy developments to raise the calibre of school leadership, the findings of the proceeding analysis identify that progress toward implementing these goals has been too slow in light of the aging profile of school principals in South Africa.

2.3 Method and data

The primary dataset used in this study is a panel of schools and their principals, constructed by matching South African payroll data on educators (referred to as Persal data) to administrative data collected on schools including the Annual Survey of Schools (ASS) data, Snap¹³ survey data as well as the EMIS master list of schools. Payroll data of individuals working in the public education sector

¹² The document is a marked improvement in establishing clarity around the role and function of the principal where the job descriptions as outlined in PAMs (and reflected in IQMS) do not prioritise the role of the principal as an instructional leadership. The Standards for Principalship move beyond outlining a principal’s job description in terms of compliance and administrative functions to explicitly identify the main role of the principal as one of establishing a culture of teaching and learning.

¹³ Snap data has recently been made publically available to researchers through the DataFirst Portal. This data is collected to inform EMIS and includes information on the numbers of learners per school by grade and gender and the numbers of educators disaggregated by employment status. It was originally known as “the tenth school day survey” which provides a snapshot of the education system as on the tenth day of the school year. The Snap data, available through the DataFirst Portal, is a time series covering the period 1997 to 2013.

was made available to the author for the months September 2004, October 2008, October 2010 and November 2012.¹⁴

Connecting the administrative datasets is a challenging task. EMIS and payroll data are managed and collated by two distinct national departments and the different datasets were never designed to be used for analyses over time or for linking them together. Furthermore, systems for identifying schools are not common across the two datasets. Payroll-school links are largely possible by matching across two codes in payroll that point to school establishments. The reader is referred to the appendix of the thesis for a more comprehensive discussion of the matching process. For the total school sample, the number of successful matches is identified in Table 2.1. In each year, the number of ordinary public schools is identified in the EMIS master list, followed by the number of schools that are matched to at least one principal in payroll. In some schools there may be more than one principal identified in payroll, but the analysis that follows is concerned with the clear institutional leader. A small number of principals that could not be distinguished as the clear institutional leader in a school using the payroll post level rankings or salary indicators are excluded from the analysis. For each year, between 79 and 89 percent of ordinary public schools in EMIS are matched to principals, with the number of successful matches increasing in recent years. Roughly six to ten percent of the non-matching is likely accounted for by principal vacancies in schools as identified in the appendix discussion.

The final constructed dataset includes variables identifying the characteristics of principals and the schools they lead. School characteristics include, *inter alia*; enrolment numbers, school location, the racial composition of the school, teacher numbers and a proxy for school poverty level as measured by the DBE's official quintile ranking. The DBE classifies schools into 'wealth' quintiles where the infrastructural development of schools' surrounding areas proxies for the wealth of the enrolled students. Identified as the poorest schools, quintile one to three schools are non-fee paying while quintile four and five schools receive much smaller state funding allocations but are left to determine the amount of school fees charged in consultation with parents.¹⁵

¹⁴ Access to PERSAL data was obtained through the Department of Basic Education in order to assess the degree to which different datasets could be merged with a view to monitoring the movement of staff across schools over time. Access to other non-public datasets were obtained through participation in a research project conducted by The Presidency and titled Programme to Support Pro-poor Policy Development (PSPPD). Assistance from Dr Martin Gustafsson at the Department of Basic Education in understanding the data is acknowledged.

¹⁵ Although quintile rankings provide an imperfect measure of poverty, student performance profiles using official school quintile rankings roughly follow profiles where school poverty is more accurately quantified through asset-based measures of student poverty (Spaull, 2013a).

Table 2.1: Matching Persal and the EMIS master list of schools

	2004	2008	2010	2012
Number of ordinary schools	25 847	25 014	24 761	24 502
Schools matched to at least one principal	20 531	22 296	22 148	21 939
% of schools matched to at least one principal	79.4	89.1	89.4	89.5
Schools matched to a 'main' principal	20 359	22 260	22 120	21 808
% of schools matched to a 'main' principal	78.8	89.0	89.3	89.0

Source: EMIS master list and Persal. **Notes:** Educators in the Persal data are identified as principals if their rank title specifies that they are a principal. Where there are two or more principals in a school, only the main i.e. clear institutional leader (identified as having highest post level among principals in a school or the highest salary) is retained in the sample. Schools are identified as public ordinary schools if they are either primary, intermediate, combined or secondary schools. The reader is referred to the dissertation's appendix for a fuller treatment of the matching process.

The dataset also includes information on principal credentials, including traditional qualifications and total experience. In the education payroll data, qualifications of educators are identified using the Relative Educational Qualifications Value (REQV) system which is a value ranking on a scale of 10 to 17. The determination of the REQV ranking is based primarily on the number of recognised full-time professional or academic years of study at an approved university, technikon or college of education while taking into account the level of school education attained (RSA DoE, 2003a). Higher rankings are assigned to more advanced qualifications with implications for promotions, the status of contracts and salary levels. A REQV 10 level, for example, is associated with having at most a Grade 12 academic qualification and no teachers' qualification. At the other end, a REQV level 17 is equivalent to having Grade 12 plus seven years relevant training, which includes at least a recognised master's degree. The minimum requirement for entry into a permanent teaching post is REQV 13 – a grade 12 qualification plus three years of relevant training, which is typically a three year teaching diploma.¹⁶

In the payroll data, 'years of service' is the only available measure of experience. This is not the same as total work experience in the education sector as individuals may have moved in and out of public education. Nevertheless, it provides a close proxy for total experience in the teaching profession. The payroll data available to the author is very thin in terms of other experience variables. Years served as a principal or a principal's tenure in a school is not directly identifiable. For this reason, the information captured through the questionnaire administered to principals of schools participating in

¹⁶ The PAMs identify the minimum qualification criteria for a permanent entry level teacher appointment as a REQV 13 (RSA DoE, 2003a). In practice, however, this has increased to a REQV 14 level. This implies that teachers should possess a four year bachelor degree in teaching or a three year degree in another subject area and one additional year specialising in education.

Verification-ANA in 2013 is used to supplement the analysis.¹⁷ Roughly 2 000 school principals responded to a questionnaire providing individual details on, *inter alia*, academic qualifications and experience.

In addressing the five research objectives, a combination of descriptive and econometric methods are applied to the constructed dataset, although the unit of analysis oscillates between the school and principal level depending on the research question. For example, in assessing the role of the initial match of principals to schools, the characteristics of first-time principals across different types of schools are compared by treating schools as the unit of analysis. However, in examining principal transfer, the principal is the unit of analysis as multivariate analysis is used to identify factors associated with their probability of turnover.

In the final analysis, the panel nature of the dataset is again exploited in estimating the relationship between principal credentials and school outcomes. Where schools participated in the grade 12 (matriculation) certification examinations in years 2008, 2010 and 2012; their school level examination data was linked to the matched payroll-EMIS dataset. The author drew on a school level examination series dataset constructed and used by Gustafsson and Taylor (2013) in modelling the impact of South Africa's 2005 provincial boundary changes on school performance. Further details on the school outcome measures used and the estimation strategy adopted are provided later. For now, the discussion moves to profiling the characteristics of principals in schools.

2.4 A motivation for policy improvements: The rising age profile of school principals

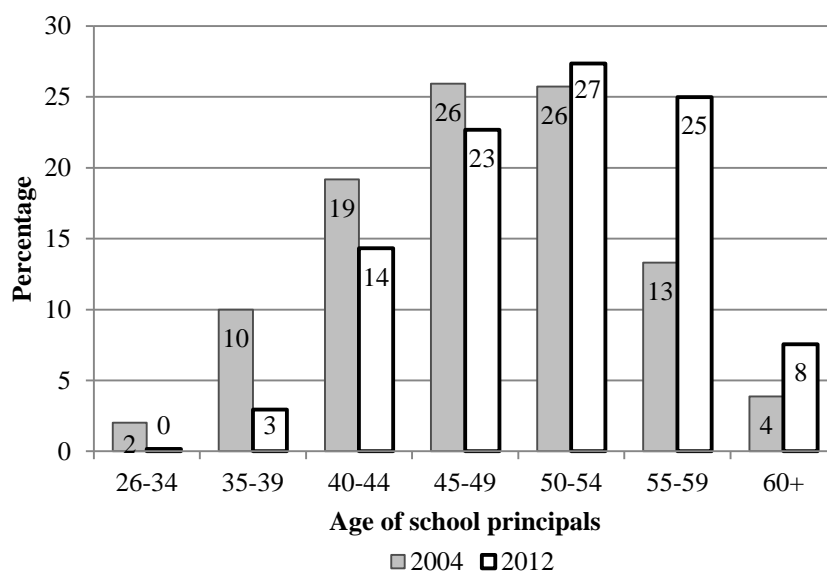
Despite the steps taken to accelerate principal policy developments, the recommendations of the NDP to improve the principal appointment process have not been formally implemented in policies. A substantial number of new principals have been appointed in recent years as explained below. For the most part, this has occurred in the absence of new legislated policies governing the principal appointment process.

Internationally, teachers and principals are getting older and South Africa is no exception in this regard (Pont, Nusche and Moorman, 2008). The average principal was aged 48 years in 2004. In 2012 this average increased to 51 years, closely approaching the average age at 53 years of principals in

¹⁷ The Annual National Assessment (ANA) tests curriculum specific mathematics and language proficiency among all students in grades one to six and grade nine. It functions as a strategic tool for monitoring and improving the level and quality of basic education in South Africa. The Universal ANAs are administered by teachers. By contrast, the Verification-ANAs are administered by an independent service provider and tests only grade three, six and nine students in a selected sample of schools in order to verify the credibility of the Universal ANA results. In addition to testing students, a student background questionnaire, an educator questionnaire and a principal questionnaire were administered as part of the 2013 Verification-ANA process.

OECD countries (OECD, 2014). Figure 2.1 compares the age distribution of principals in 2012 to that in 2004. Whereas 17 percent of school principals were aged 55 or older in 2004, one third was this age by 2012. In absolute terms if almost a third of principals were 55 years or older in 2012, and we assume they are likely to retire at sixty years¹⁸, as many as 7 000 outgoing principals will have to be replaced between 2012 and 2017 for retirement reasons alone. As a yearly average, this equates to about 1 400 principal replacements for retirement per year over this period, which is roughly equivalent to the *total* number of principal replacements for retirement between 2004 and 2008 (see Table 2A.4 in the chapter appendix). For the next ten years, principal replacements for retirement are likely to be at least 1 000 per year.¹⁹ Replacement requirements in primary schools are particularly large because there are more primary schools than secondary or combined schools in the system and a slightly higher proportion of principals in primary schools are near retirement age (see Figure 2A.1 in the chapter appendix). The number of principals required to replace retiring principals in primary schools comprises over sixty percent of all anticipated principal replacements for retirement reasons.

Figure 2.1: The age distribution of South African public sector school principals, 2004 and 2012



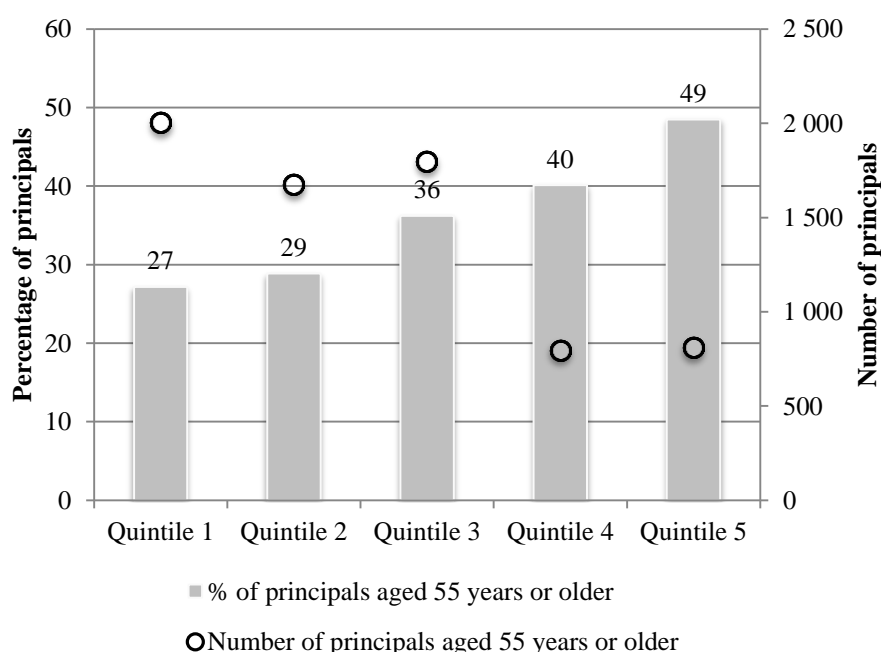
Source: Persal-EMIS matched dataset. **Notes:** Calculations are based on a sample of principals in Persal that could be matched to a school and are identified as the clear institutional leader of the school. Educators in the Persal data are identified as principals if their rank title specifies that they are a principal. Where there are two or more principals in a school, only the clear institutional leader (identified as having the highest post level ranking among principals in a school or the highest salary) is retained in the sample. The 2004 sample includes 20 359 principals and the 2012 sample 21 808 principals.

¹⁸ Mandatory retirement age for educators in South Africa is 65 years. However, where pensions are accessible at earlier ages the majority of teachers retire well before 65 years.

¹⁹ Although the age profile of principals has risen relative to their age profile in 2004, earlier data is required to assess whether this is likely to be a reversion to a more normal profile if there was a specifically young intake of principals in the early 90s.

Another important observation is that the absolute number of principal replacements required in lower quintile schools substantially outweighs that in wealthier schools because there are simply more poor schools. Despite the use of the term ‘quintile’ in the ranking of school wealth by the DBE, there is an unequal share of schools represented in lower quintiles.²⁰ Proportionally, however, more principal retirements are anticipated in wealthier schools given differences in the age profile of principals across schools. In 2012, nearly a half of quintile five schools had incumbent principals aged 55 years or older as opposed to 27 percent of quintile one schools as identified in Figure 2.2.

Figure 2.2: Incumbent school principals in 2012 aged 55 years or older by school quintile



Source: Persal-EMIS matched dataset. Notes: see Figure 2.1.

An additional complication in finding suitable principal replacements relates to the uneven age profile of teachers. In the recently released report on teacher demand and supply by the Centre for Development and Enterprise, an uneven spread in the age profile of teachers is apparent which has implications for the future supply of school leaders. The report provides an estimated teacher age profile in 2025 on the basis of the 2013 age profile of educators in South Africa, attrition rates and patterns of teacher retirement (CDE, 2015). It then notes that there is a dip in the current population of

²⁰ Official school quintile denominations provided by the DBE are not equal, with an unequal share of schools represented in lower quintiles. Since the original disaggregation of schools into wealth quintiles, a larger share of schools has been positioned in lower quintiles, taking advantage of higher allocations per student.

teachers of at around thirty to 34 years who will move through the system. By 2025, the smallest number of teachers will be forty to 44 years old, which is

...the age at which teachers typically have sufficient experience to be eligible for senior management positions, such as principal, deputy-principal and HoD²¹. The very small pool from which they can be drawn means that less experienced teachers may have to be promoted to those positions (ibid: 18).

However, this statement is based on the premise that experience is a valid signal of principal quality and should guide the selection process. This notion is challenged in later discussions.

In summary, the public education system is facing a substantial number of principal retirements. Finding suitable replacements and managing leadership transitions poses a notable challenge for schools, provincial administrations and national education planners. The next chapter focuses, specifically, on investigating the implications of these leadership replacements for the school environment in the short term. However, the rising number of principal retirements also presents an opportunity to raise the calibre of school leadership through the right appointments. As explained in a report on improving school leadership in OECD countries,

The imminent retirement of the majority of principals brings both challenges and new opportunities for OECD education systems. While it means a major loss of experience, it also provides an unprecedented opportunity to recruit and develop a new generation of school leaders with the knowledge, skills and disposition best suited to meet the current and future needs of education systems (Pont, Nusche and Moorman, 2008: 29) .

It is in this context that the chapter proceeds to identify additional characteristics of the labour market for principals to inform much needed policy improvements in the area of appointment processes for new principals and in raising the calibre of existing ones.

2.5 Principal's demographic characteristics: Race and gender

Race

As observed by Loeb et al (2010) the sorting of principals to schools is likely to depend on a combination of principal preferences for vacant positions and recruitment and appointment processes. Unique to the South African context is that in addition to the above two mechanisms, the sorting of principals to schools has also been institutionally driven by apartheid policies. Society and the education system were strongly divided along racial lines. The race of teachers and school leaders

²¹ Stands for head of department.

would have been matched to the race of the students in their schools with separate education departments formed to administer these segregated schools. Policies also favoured the educational advancement of the white race group over others, which meant that white educators would have been exposed to more training and academic opportunities than educators of other races. Although racial controls on schooling were lifted in 1994, state imposed sorting of both teachers and principals across schools has had persistent effects today. The inertia of apartheid policy influences on patterns of educator sorting is particularly strong in the case of principals given that the average principal in 2012 entered the education system 25 years previously, seven years before democratic freedom.

Table 2.2: Principals' race by schools' former department classification, 2012

	All schools	Schools' former education department classification					
		Black		White (HOA)	Indian (HOD)	Coloured (HOR)	New/unknown
		DET	Homeland				
Black	83%	94%	99%	7%	8%	11%	94%
Indian /Asian	2%	1%	0%	2%	87%	1%	1%
Coloured	7%	1%	0%	6%	2%	82%	2%
White	8%	4%	1%	85%	3%	6%	3%
Total	100%	100%	100%	100%	100%	100%	100%

Source: Persal-EMIS matched dataset. Data year is 2012. **Notes:** Department of Education and Training (DET) and homelands were responsible for administering black schools. White schools were administered under the House of Assemblies (HOA). Indian and Asian students attended schools administered by the House of Delegates (HOD). The House of Representatives (HOR) administered schools for coloured students. The category 'New/unknown' includes schools opened in post-apartheid or schools for which their former department classification was missing in the EMIS data.

It is not surprising that the racial distribution of principals across schools still closely matches schools' former education department classification. The majority of principals are black at 83 percent of all principals in 2012, but majority race differs considerably across schools. For example, in former Department and Education Training (DET) and homeland schools serving black students, as many as 94 percent and 99 percent of these schools still had black principals in 2012. In schools formerly serving white (House of Assemblies), Indian (House of Delegates) and coloured (House of Representatives) students 85 percent, 87 percent and 82 percent of these schools had incumbent principals that were of the originally matched race as reflected in Table 2.2.

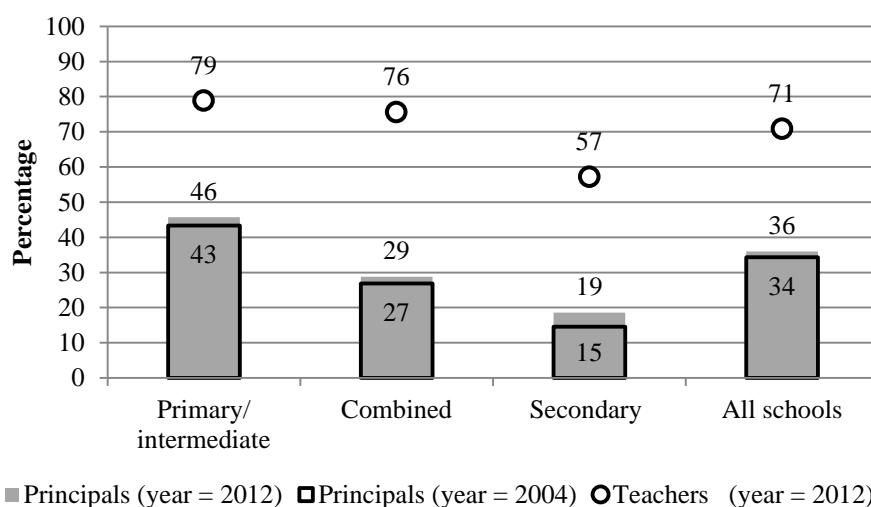
There has been little integration of other race groups into leadership positions in schools that were formerly classified as black or coloured. However, quite a bit of integration has occurred in schools formerly administered under white and Indian departments. This is consistent with shifts in the racial composition of students in these schools. Former white schools have seen a decline in the percentage of principals that are white from 93 percent in 2004 to 85 percent in 2012 as larger proportions of both black and coloured teachers lead these schools. Similarly, in former Indian schools the percentage of

principals who are Indian in these schools declined from 91 percent in 2004 to 87 percent in 2012 as a larger proportion of black principals fill these leadership posts.

Gender

Before turning to identifying the qualifications and experience of principals, brief attention is given to the striking gender disparity in school leadership positions which has been noted in other local studies. It is acknowledged at the outset that gender and its intersection with race inequality in the principal labour market requires a fuller research treatment than this overview allows. Gender equality in leadership more broadly is a complex issue that needs to be tackled within the cultural discourses that informs them. Studies, by amongst others, Moorosi (2010, 2006), Chisholm (1999, 2001) and a compilation of research in Chisholm and September (2005) offer a fuller description of these complexities, expounding on gender discrimination experienced by education personnel in South Africa. Nevertheless, for the purpose of this chapter the data supports the quantification of gender inequality in school leadership providing more specificity to widely held views that women have been under represented in school leadership.

Figure 2.3: The percentage of principals and teachers who are women by school phase level



Source: Pearsal-EMIS matched dataset. **Notes:** Teachers include deputy principals and heads of department.

Despite the feminisation of the teaching profession, school leadership positions are dominated by men. In 2012, 71 percent of all teachers (including heads of department and deputy principals) were women but they held a mere 36 percent of school principal positions as reflected in Figure 2.3. The extent of this disparity is augmented when one considers that female teachers are on average more

qualified than the pool of male teachers in South Africa.²² Furthermore, there has also been little gender transformation in school leadership positions over the eight year period for which data is observed. The percentage of principals who were women only improved by two percentage points from 34 percent in 2004 to 36 percent in 2012.

Women are particularly poorly represented in secondary school principal positions at only 19 percent in 2012. One reason for this may relate to the inertia of apartheid pay schedules for teachers which favoured men over women, and explicitly discouraged the appointment of men at the primary level in order to cut costs (Chisholm, 1999: 113).

Gender inequality in principal leadership extends across race although it is most pronounced among former white schools. Only 23 percent of all principals in these schools were women in 2012 compared to 41 percent of principals who were women in former Department of Education and Training schools serving black students.

The observed gender leadership gap in schools is not unique to South Africa. In the 2013 Teaching and Learning International Survey (TALIS) of over thirty OECD and participating countries, on average nearly half of principals in lower secondary schools were women compared to an average teacher population comprised of 68 percent women across the countries surveyed (OECD, 2014). The TALIS findings also identify that internationally women are the most underrepresented in secondary schools.

In spite of strides that have been made in improving material benefits for women teachers in post-apartheid, a patriarchal and exclusionary relationship between male and female teachers exists, which manifests in low representation of women in school leadership positions and also in teacher union leadership roles (Govender, 2004: 274). This is juxtaposed against suggestive research that there may be important benefits to educational improvement from having more women in school leadership. Some studies identify that women teachers fare better than students taught by male teachers, even after controlling for qualifications, across a number of cross-sectional studies of learning in South Africa (Gustafsson and Patel, 2008: 3). In chapter four, an aside finding from the estimation of strike impacts on student achievement is that a student's performance is lower in a subject taught by a male teacher. Furthermore, recent cross-national research by Bloom et al (2015) identify that female principals have statistically higher management scores than male principals.

From a policy perspective, however, it is not clear as to what approach should be taken to address this issue. Our Constitution and The Employment Equity Act enshrine equal opportunity to employment

²² In the 2012 PERSAL data, a larger proportion of female educators than male educators have REQV levels of 15 or more. Specifically, 22.6 percent of female educators (excluding principals) had REQV levels of 15 or more compared to 17.2 percent of male educators (excluding principals).

and promotion. Moreover affirmative action policy, which applies directly to promotion appointments in education, should give preference to women over men in selection processes. However, Moorosi (2010) appropriately comments that “the law does not address the stereotypes and subtle practices of discrimination suffered by women in the work place and at home (ibid:548),” and that “gendered cultural factors impact substantially on the implementation of anti-discriminatory mandate of the law (ibid:555).” Her qualitative work confirms earlier studies that women in education face discrimination at various career points including at the level of preparation, access into Principalship as well as during their employment as newly appointed school principals. She argues that we need policies to promote the growth of a pool of female principal candidates, not just in improving the implementation of appointment processes and existing affirmative action policy which favours their hire. The gender disparity in school leadership positions in South Africa may in part be attributed to fewer female teachers²³ actually applying for leadership positions in schools rather than merely reflecting the unequal appointment of men over women. In addition to the need for training and sensitisation towards women in management for those who participate in the appointment process, policies should target the preparation of female teachers for leadership through organised networking and formalised mentorship programmes and targeted career development coaching.

In general, more research is required in the area of women in school leadership – a potentially an untapped opportunity for educational improvement in South Africa.

2.6 The unequal distribution of principals in terms of qualifications and experience

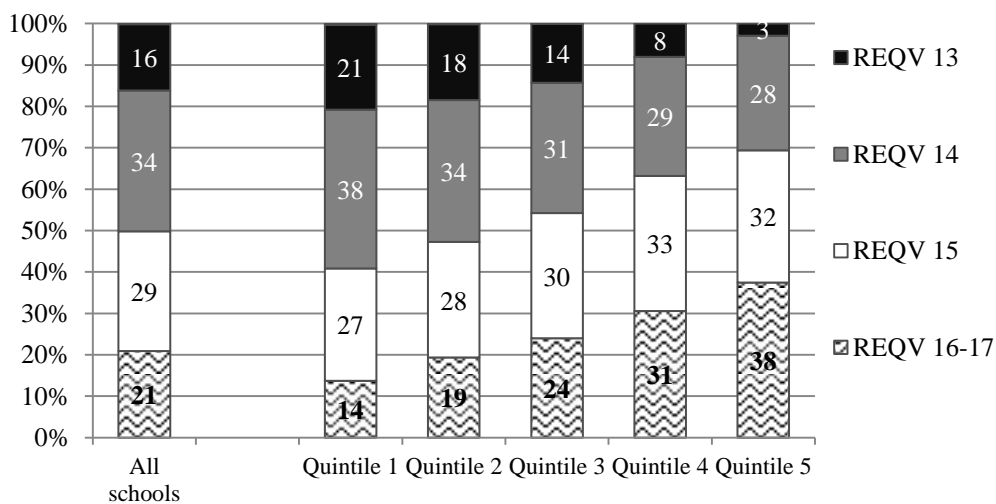
A defining feature of South Africa’s labour market for principals is that they are unequally distributed across schools with typically less qualified and less experienced principals overly represented in poorer schools. Figure 2.4 illustrates the stark differences in the qualification levels of principals depending on the wealth status of schools to which they are appointed.

In 2012, roughly 34 percent of principals matched to schools had REQV 14 signalling a four year bachelors’ degree, 29 percent had REQV 15 and 21 percent were very well-qualified with REQV 16 or 17, equivalent to a post-graduate degree. A further 16 percent of schools had principals with a qualification ranking equivalent to an entry level requirement for a permanent teaching post (REQV 13). The poorest schools are significantly less likely to have well-qualified principals than wealthier schools. For example, 38 percent of quintile five schools have very well-qualified principals compared with only 14 percent of quintile one schools.

²³ Individual preferences may in turn be informed by a more complex gender politics in schools and teacher unions which Govender (2004: 278) identifies as an area requiring more research.

In part, this unequal distribution is attributable to historically imposed policies that matched teachers and principals to schools along racial lines. However, in the absence of apartheid controls on patterns of principal sorting, newly appointed principals in poorer schools continue to have substantially lower qualifications than those appointed in wealthier schools. This is shown in Figure 2.5 which presents the qualifications by school quintile of principals newly appointed (incoming) in the period 2008 to 2012 and those of principals exiting the system (outgoing) over the same period. A second feature of the figure is that with the exception of quintile five schools, newly appointed principals have fewer qualifications than outgoing principals. This suggests that principals are increasing their qualifications on the job (a point to which the author returns in the later discussion on credentials as a signal of quality). Wealthier schools have historically had more qualified principals and continue to appoint increasingly better qualified candidates in comparison to poorer schools.

Figure 2.4: Principal qualifications (REQV), 2012

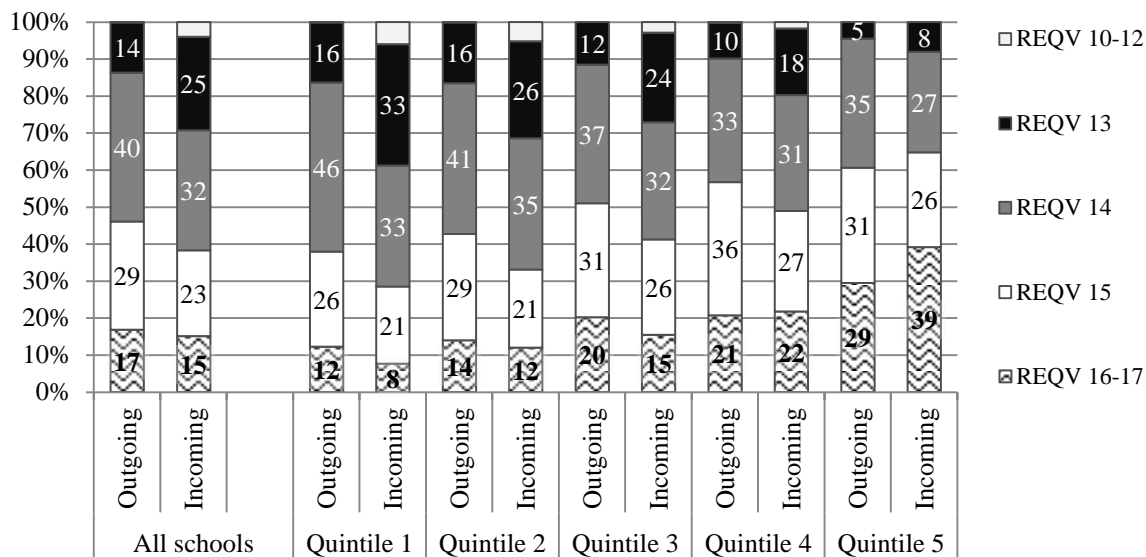


Source: Persal-EMIS matched dataset. **Notes:** Not shown in the figure are almost negligible percentages of principals in each quintile that have a REQV level less than 13 (i.e. under-qualified). Specifically 0.24% (18) of principals in quintile one schools, 0.09% (5) of principals in quintile two and 0.04% (2) of principals in quintile three schools have a REQV level less than 13 (i.e. under-qualified). Percentages add up to one hundred percent in each sub-group.

The observed differences in appointment across poorer and wealthier schools are mirrored in the years of experience of newly appointed principals. The typical educator in South Africa has roughly twenty years of experience before accessing a principal position for the first time, as shown in Figure 2.6. On average they will serve ten years of Principalship before exiting the system, as implied through differencing the years of service of newly appointed (incoming) principals from that of outgoing principals. In the poorest (quintile one) schools, however, principal positions can be reached on

average three years earlier compared with positions in quintile four and five schools.²⁴ Access to principal promotion posts in poorer schools is therefore possible with lower qualifications and fewer years of experience. This finding holds even when controlling for compositional differences (including primary and secondary level, school size and teacher numbers) across schools.²⁵

Figure 2.5: The qualifications (REQV) of outgoing and newly appointed principals



Source: Persal-EMIS matched dataset. **Notes:** Outgoing principals are those (identified as the clear institutional leader) who leave the public education system either between 2008 and 2010 or between 2010 and 2012. Incoming principals are principals appointed in either 2010 or 2012 that were not identified as principals in Persal in previous periods. The graph shows the percentage of principals in each sub-group of schools who have a specific REQV level. Percentages add up to one hundred percent in each sub-group.

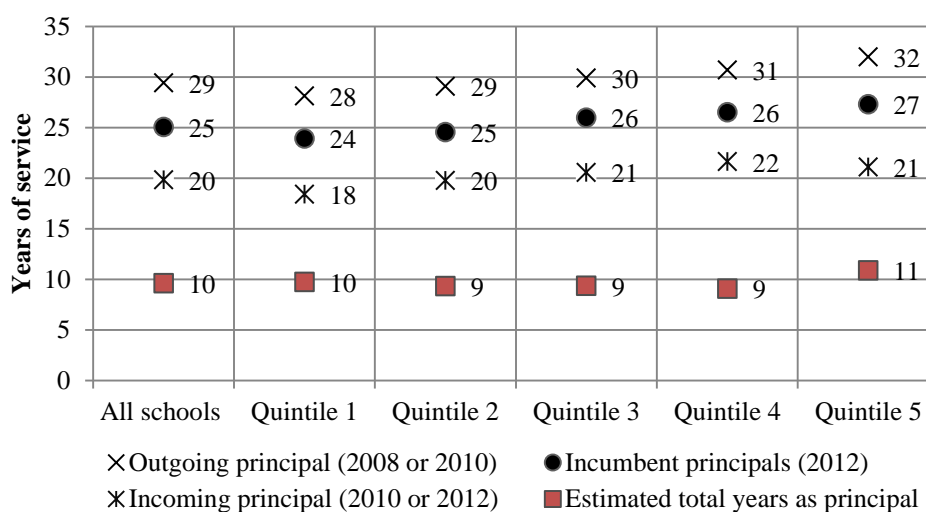
In designing policies to address this inequity, it is necessary to distinguish between two factors underlying the unequal principal sorting patterns. First, it is likely driven by the preferences of individuals for posts in wealthier schools as expressed in applications for advertised posts. There may simply be a larger pool of good candidates available for posts in wealthier schools, particularly where teachers are more qualified in these schools. Second, there could be variations in the recruitment and

²⁴ While principal positions are accessed earlier in poorer schools, these principals are no more likely to remain in this position for longer periods than principals in wealthier schools. Principals exiting the system from quintile one schools had served on average 28 years of service compared with 32 years served by principals exiting quintile five schools.

²⁵ It may be argued that the unequal distribution in principal credentials across schools is observed given compositional differences of schools in each quintile. Schools in lower quintiles on average have fewer students, with fewer teachers competing for posts. Moreover, where the size of a school is also linked to principal post rankings and salary levels, smaller schools may provide less desirable positions than being in larger schools. It follows that it may simply be easier to access promotion posts in certain schools due to their compositional characteristics. To test this, REQV levels and years of service of new incoming principals were regressed against a number of school characteristics. The results are presented in Table 2A.1. The coefficients on school quintile still favour wealthier schools, supporting the hypothesis that access to principal promotion posts in poorer schools is possible with fewer years of experience and lower qualifications.

selection process across schools if wealthier schools impose more stringent appointment criteria and/or are more likely to follow due process. Due to data constraints it is not possible to disentangle how much each factor weighs on the patterns observed; nevertheless, policies need be targeted at both factors to improve the initial matching of principals to schools.²⁶ Identifying approaches to directing a good pool of applicants to poorer schools is particularly important, not only for improving the distribution of principals across schools, but to meet a much larger demand for new principals in these schools.

Figure 2.6: Average years of service of outgoing, newly appointed and incumbent principals



Source: Persal-EMIS matched dataset. **Notes:** Incumbent principals are those who were identified as the clear institutional leader in 2012. Outgoing principals are those principals who leave the public education system either between 2008 and 2010 or between 2010 and 2012. Newly appointed (incoming) principals are those principals appointed in either 2010 or 2012 that were not identified as principals in Persal in previous periods. Years of service in public education are not necessarily equivalent to total years of experience in teaching/school leadership if principals worked outside of the public education sector. However, it is likely to provide a close proxy.

Inequities in the observed credentials of principals across different parts of the schooling system point to resourcing inequities and are clearly important to track given the historical legacy of apartheid policies. Moreover, if qualifications and experience are a signal of principal quality then the sorting patterns noted above pose concerns about the capacity of school leaders in the underperforming part of the school system to execute their roles and responsibilities.

²⁶ To disentangle how much each source weighs on the patterns observed, additional data is needed on the following: vacancies, the number of applications received for specific principal posts and the credentials of those that applied. A survey of principal (and teacher) preferences for certain types of posts would also help to explain how their preferences impact on sorting patterns.

The next section turns to consider dynamics within the principal labour market. The discussion considers how much turnover there has been and then explores possible determinants of principal moves, and whether the systematic transfer of principals across schools aggravates existing inequalities in the initial sorting of principals to schools.

2.7 Principal labour market dynamics

Low levels of turnover

South Africa's labour market for principals is defined by low levels of turnover. Although this has started to change in recent years, public sector principal turnover rates (which include both attrition and mobility related movements) have historically been low. The average rate of turnover²⁷ among principals identified ranged between five to eight percent between 2004 and 2012 as reflected in Table 2.3. These rates of turnover are not dissimilar to those observed among teachers²⁸ in general; but compared to employee turnover benchmarks in the local public sector and internationally they are comparatively low (see Table 2A.2). For example, using 12 months of public sector payroll data over a one year period, Pillay, de Beer and Duffy (2012) calculate annual employee turnover rates across 33 South African public sector departments that range between nine percent and 32 percent. As an international benchmark, between twenty to thirty percent of public school principals leave their positions each year in the United States (Miller, 2013: 71; Beteille et al, 2012).

A key reason for low levels of principal turnover is that principal moves within the system are uncommon. Rather the majority of the turnover is accounted for by attrition (i.e. moves out of the public education system for retirement or non-retirement reasons including taking up positions in the private sector). Between 2004 and 2008, attrition accounted for two thirds of principal turnover. This rose to three quarters between 2008 and 2012 given the aging profile of school principals (see Table 2A.4). With little churning across schools, principal tenure among incumbent school principals closely follows their total years of principal experience. In the Verification-ANA 2013 questionnaire presented to roughly 2 000 school principals from a nationally representative sample of schools, principals were asked about their years of principal experience and tenure as a principal in their

²⁷ Table 2.3 provides a description of how the turnover rate was calculated.

²⁸ Martin Gustafsson's report produced for the Department of Basic Education in 2009 entitled "Teacher supply patterns in the payroll data", identifies six percent year-on-year attrition for educators in South Africa. However, he finds that attrition is halved if you exclude those that exit then return to public education. Depending on the definition of attrition used and the data years considered in calculations, rates of attrition may vary notably. Multiple years of data are required to fully account for multiple joining and leaving (Gustafsson, 2009). The turnover rates that have been calculated in this chapter for principals and other educators only consider turnover between two points of data but there may be churning that occurs within these data points.

current school. The median years of total principal experience was nine years, only one additional year than the median total years served in their current school (Table 2A.3).

It is worth noting two additional features of the low levels of mobility in the sector. There is little cross-provincial movement of school principals. Less than three percent of principals who moved within the system between 2008 and 2012 took up a post in another province. Moreover, over half of newly appointed principals (55 percent) are promoted from within the same school. Table 2.4 identifies the positions in year t-2 from which newly appointed principals in year t are promoted. As expected a large proportion of newly appointed principals (41 percent) are promoted from deputy principal roles, and a third from head of department roles. Surprisingly, as much as 23 percent of new principals were only in a teaching post two years prior to the appointment. Another interesting point to note is that less than one percent of principals were not in the payroll data at all two years prior to appointment. This potentially provides an upper bound estimate of the amount of movement of principals from the private sector to the public education system.

Table 2.3: Turnover rates for principals and other educators

	Principals		Other educators [^]	
	Turnover for the period	Average yearly turnover rates (lower bound) over the period	Turnover for the period	Average yearly turnover rates (lower bound) over the period
2004-2008	23.4%	5.8%	-	-
2008-2012	28.7%	7.2%	-	-
2008-2010	13.6%	6.8%	16.1%	8.1%
2010-2012	16.6%	8.3%	16.7%	8.3%

Source: Persal-EMIS matched dataset. **Notes:** A principal is identified as transitioning by determining whether the school institution at which they held a principal post in the first period was different to their position in the second period. Therefore the calculation considers both mobility and attrition related turnover. Using principals as the unit of analysis, the turnover rate is calculated by dividing the number of principals who transition as a proportion of all identified principals in the first period. Excluded from the denominator and numerator are principals who were identified in the payroll data in the second period but could not be matched to a school. This prevents ratios being inflated due to data matching problems. Yearly rates are arguably lower bound estimates as some principals may have moved more than once in each period. [^]Other educators include teachers, departmental heads and deputy principals who can be matched to an ordinary school in EMIS data.

There are likely to be various reasons for low levels of principal mobility, such as low relocation benefits, language and cultural factors or nepotistic appointment arrangements. The international literature also indicates that low mobility may be related to a lack of accountability measures informing principals' work.²⁹ Clotfelter et al (2007) identify that in North Carolina in the United

²⁹ Low levels of principal mobility pose limitations for future attempts to estimate principal quality effects on learning outcomes in South Africa using value-added methodologies employed by Branch et al (2012); Grissom, Kalogrides and Loeb (2015) and Coelli and Green (2012). In these value-added approaches to measuring principal effectiveness, the estimation strategy relies critically on identifying school leadership changes, that is,

States, there was a sharp increase in rates of principal turnover in response to the introduction of the state's test-based accountability system. When hard-stakes performance management systems are in place with principal performance evaluations based on school performance, job security concerns incentivise principals to move schools. To avoid low performance ratings, they are more likely to move from worse to better performing schools, which usually involves moving from poorer to wealthier schools (Branch et al, 2012; Beteille et al, 2012; Clotfelter et al, 2007; Gates et al., 2006; Young and Fuller, 2009).

Table 2.4: Positions from which newly appointed principals are promoted

	Percentage
Position two years prior to appointment	
Deputy principal	40.8
Head of department	34.2
Teacher	23.0
FET/ABET lecturer	0.1
Administration post	1.0
Not in the public education system	1.0
Total	100
Position two years prior to appointment	
Promoted from within the same school	55.3
Promoted from a different institution	44.7
Total	100

Source: Persal-EMIS matched dataset (2008, 2010 and 2012). **Notes:** Calculations are for 5 262 newly appointed (incoming) principals who are identified in either 2010 or 2012 as principals but were not identified as principals in Persal in previous periods (2008 and/or 2004).

Where the current design of performance management systems for South African principals in IQMS is only weakly linked to threats of job security, or favourable monetary rewards, it is unlikely to have induced mobility related principal moves. But there may be other incentives at play that influence principal transfer decisions. For example, principals may view positions in wealthier schools or urban schools as more attractive if the associated working conditions in these schools are better than in poorer or rural schools. Furthermore, where salaries are linked not only to qualifications but to school size, principals may seek positions in larger schools as opposed to smaller ones. In the analysis that

instances in which one principal replaces another at a school to assess within-school changes in student outcomes induced by these leadership transitions. Principal effectiveness estimates cannot be generated for all principals; effects are only comparable within small groups of schools connected by principal transfers (Chiang, Lipscomb and Gill, 2012). The comparison groups of schools become limited when there is little mobility of principals across schools, as is the case in South Africa. Much longer panels of data are then necessary to identify enough school-to-school transitions.

follows, an attempt is made to identify whether some of the incentives described above influence mobility patterns in the principal labour market.

Identifying factors associated with principal turnover: empirical strategy

Understanding which principal and school factors are associated with the probability of either leaving the system or moving within the system is an analysis problem best handled in a multivariate regression framework. Relying solely on simple descriptive cross-tabulations of turnover rates can provide misleading associations. For example, a cross-tabulation of principal turnover rates by school quintile status indicates that wealthier schools have much higher principal turnover rates than poorer schools. This erroneously implies that principals are more likely to leave wealthier schools when this result is merely an artefact of age differences. Principals in wealthier schools are older on average and are leaving in larger proportions for retirement reasons than those posted in poorer schools as shown earlier in Figure 2.2.

Initially, principal turnover is modelled using a logistic regression. Then principal turnover is distinguished into two types: leaving the public education sector (i.e. attrition) and within-sector mobility, including school-to-school moves and transfers to other positions in public education. Usually these two flows are treated as separate components in modelling turnover as certain factors may be differentially associated with each form of turnover (Stuit and Smith, 2012; Boyd et al., 2008). For example, working conditions may be more important for informing a principal's decision to move schools than to move out of the system altogether. Distinguishing between the two data flows requires an estimation technique suitable for modelling a polytomous dependent variable. Typically a multinomial logit model (MNL) is used in this context.³⁰ Here principal i is faced with J different choices and is expected to choose the alternative that maximises his or her utility. The probability of making choice j is conditional on observed school and principal characteristics, X_i .

$$\Pr(j|X_i, \alpha_i) = \frac{\exp(X_i\beta_j + \alpha_{ij})}{\sum_{k=1}^J \exp(X_i\beta_k + \alpha_{ik})}$$

It is noted that choice probabilities are also conditional upon α_i , which represent unobserved individual principal effects. Simple multinomial logits are not able to control for the confounding effects of unobserved heterogeneity on predicted probabilities. MNL also imposes the assumption of

³⁰ The use of a multinomial logit regression follows Hanushek, Kain, and Rivkin (2001) in examining teacher mobility across schools and districts in Texas and by DeAngelis and Bradford (2011) in examining principal turnover in public Illinois schools. Authors have also used discrete-time competing risks models to analyse teacher or principal transitions where models include one observation for each year that a teacher or principal was "at risk" of making a transition (Loeb et al, 2010; Gates et al., 2006). The limited number of years and irregular spaced intervals of data on principals available to the author renders the use of a competing risks framework infeasible.

the independence of irrelevant alternatives (IIA). This requires that an individual's evaluation of an alternative relative to another should not change if a third alternative is added or dropped from the analysis. For example, if a principal is twice more likely to leave the public education system than to stay, adding in the possibility of moving from their current school to another should not alter the former probability. When IIA is violated, the MNL model is incorrectly specified and produces biased and inconsistent estimates. In this application, tests of the IIA assumption are clearly violated.³¹

Unfortunately, the application of available methods³² that account for the impact of unobserved principal heterogeneity on conditional probabilities and relax the IIA assumption are limited given the nature of this dataset. The panel has a limited time dimension³³ and includes no alternative specific explanatory variables that are necessary in application of, for example, a nested logit or mixed logit model. Where α_i may confound estimates of choice probabilities and the IIA assumption is violated, it is not possible to make causal statements from the MNL results. For this reason, the estimation that follows fulfils a merely descriptive exercise where associations are identified by conditioning on other factors such as age that may be driving certain correlations.

However, the robustness of the results to the violation of the IIA assumption is addressed somewhat by also estimating a sequential logit model. Here the process of principal turnover is modelled as a two stage process. In the first stage, a principal makes the decision between transitioning (i.e. turnover) and staying in his or her position. This is equivalent to a simple logistic regression of principal turnover. In the second stage, among those who transition there are two alternatives – moving positions within the system or alternatively leaving the public education system (see the chapter appendix for more details on the model). While modelling the decision to transition in the

³¹ Using a seemingly unrelated regression, akin to applying a Hausman test, results reject the assumption that coefficients are equal across restricted and unrestricted models. Similarly the assumption of equal coefficients is rejected using a small Hsiao test.

³² Haan and Uhlenborff (2006) propose a strategy for estimating multinomial logit models with unobserved heterogeneity using maximum simulated likelihood. The method allows for the inclusion of random effects in the model which relaxes the IIA assumption and allows for the inclusion of unobserved heterogeneity. However, as a standard feature of the random effects models, the unobserved heterogeneity included is required to be independent of the explanatory variables. In this application, where unobserved principal characteristics are most likely correlated with both observed school and principal characteristics, it is not clear that Haan and Uhlenborff's method is likely to yield notable gains over the standard MNL in effectively controlling for the impact of α_i on the conditional probabilities. It also acknowledged that the multinomial probit model is often assumed to be a better alternative to a multinomial logit in the case of IIA violations. However, evidence suggests this is not necessarily the case. Typically, multinomial probit estimates are very similar to multinomial logit estimates in the case of IIA and some authors argue that the multinomial logit model actually outperforms the multinomial probit model even in the most severe violations of IIA (Kropko, 2008).

³³ The available four waves of panel data for the estimation are further reduced where the outcome variable in question is principal turnover. A principal's post in one period relative to the next is used to calculate the outcome variable, whether they leave their school (i.e. turnover). This reduces the number of waves available for the estimation by one.

sequential logit framework overcomes some limitations of the MNL model, intuitively the MNL model is favoured as it provides a more realistic decision choice framework than viewing a principal's transition decision as a two stage process. Nevertheless, key results are only discussed where the two models provide agreeable results.

Multinomial logit models are run to predict choice alternatives as identified in year $t+4$ for incumbent principals in year t . The variable controls included in the regressions are informed by the set commonly used in studies predicting teacher and principal turnover within the constraints of those available in the administrative dataset. Individual controls include the gender, age and race of the principal. Furthermore, interactions between the gender and age of the principal are included because decisions to move out of a school may differ over the career life cycles of men and women. School controls include its location (urban versus rural), phase level (primary/intermediate, secondary or combined), wealth quintile status, former education department classification, number of teachers per one hundred students, total enrolment expressed in hundreds and provincial indicators. To account for the possibility that principals may move schools in response to the racial composition of the student body, interactions between the race of the principal and a dummy variable that takes on a value of one if the majority of the student body is black are included. In the 2008 payroll data available to the author additional principal controls are present compared with the 2004 data. This motivates a separate specification for incumbent principals in 2008. These additional controls include educational qualifications as measured by the principal's REQV level, the principal's salary expressed in R1 000s, years of service and its square, sick leave days taken which may proxy for motivation, and an indicator for whether the principal moved in the previous period.

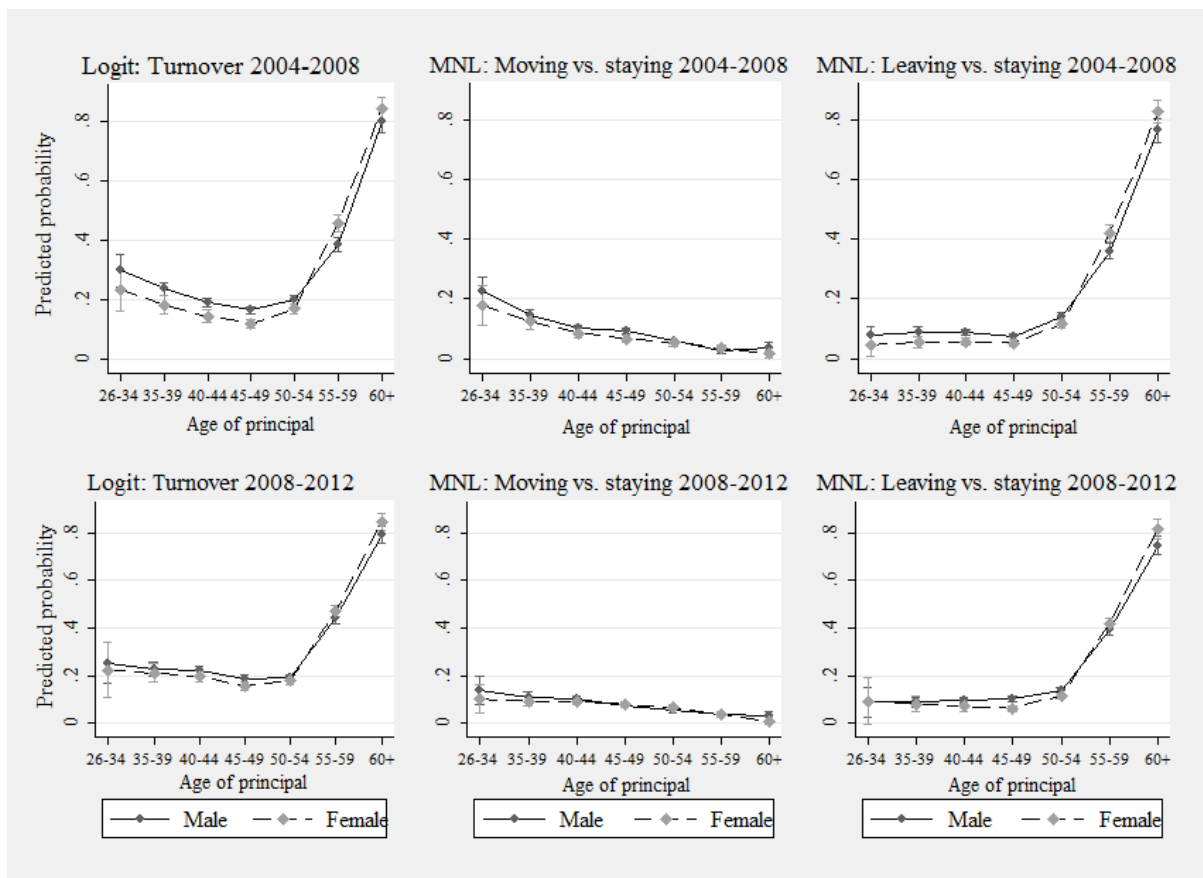
Multinomial logit results and for reference, the sequential logit results are presented in Table 2A.6. Although the coefficients and their significance provide a clear indication of the direction of observed correlations between turnover probabilities and individual principal or school factors, the size of the coefficients are not directly interpretable. For this reason, predicted probabilities of key associations are plotted graphically to aid interpretation.

Gender and the U-shaped probability of principal turnover by age

A dominant finding from a logistic regression of principal turnover is the U-shaped pattern observed with respect to principal age. Initially, the probability that a principal will move out of a school declines with age until they reach 45 to 49 years as shown in Figure 2.7. This decline is attributed to the decreasing probabilities of moving within the system as principals get older as suggested by both the multinomial and sequential logit models. As principals near retirement age, however, predicted probabilities of turnover rise dramatically. This U-shaped principal turnover pattern is consistent with that found in the international literature on teacher turnover (Harris and Adams, 2005; Ingersoll, 2001). Interestingly, women who are principals are significantly less likely to move out of their

positions at younger ages compared with their male counterparts. This is contrary to expectations that women would be more likely to leave the principal labour market at younger ages to care for children.

Figure 2.7: Probabilities of turnover by principals' age and gender



Notes: The first panel of the figure plots the marginal predicted probabilities of principal turnover from the first stage of the sequential logit regression model. The second and third panels of the figure plot marginal predicted probabilities of principal turnover flows from a multinomial logit (MNL) regression. The associated estimation results are presented in Table 2A.6.

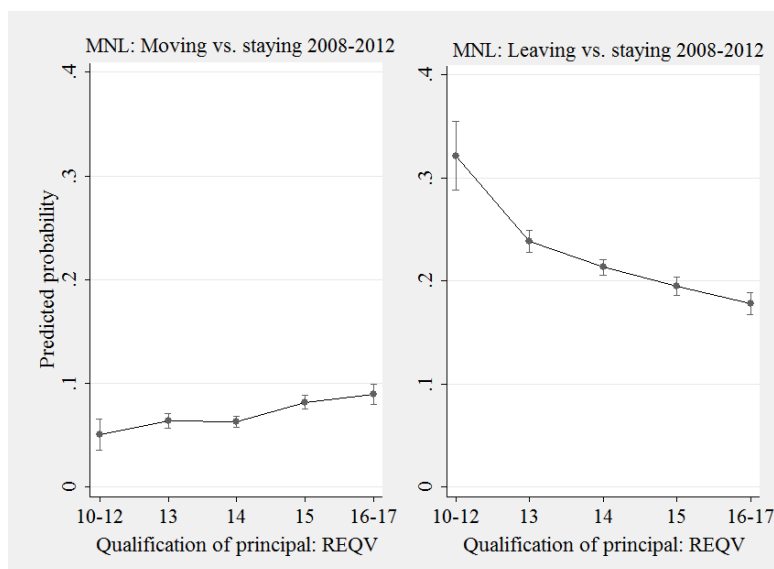
Qualifications and the probability of principal turnover

A question that may concern policy-makers is whether those principals that leave the system are likely to be the most qualified. On the contrary, the results indicate that principal transfer patterns are possibly improving the qualification stock of incumbent principals in the public education system. Predicted probabilities of leaving the public education system are highest among principals with fewer qualifications as illustrated in the second panel of Figure 2.8.³⁴ By contrast, the first panel of the figure indicates that the probability of moving within the system, as opposed to staying in the same school, is higher among principals that are very well-qualified compared with principals with fewer qualifications. A similar conclusion is reached from the sequential logit results, where those with

³⁴ Where principals' REQV levels are less than 13 these would be temporarily employed principals. Their contracts were possibly not renewed given that their qualifications do not meet minimum criteria for permanent employment.

higher qualifications are more likely to choose to move within the system than to leave the system. Together the results suggest that transfer patterns are not associated with a leakage of the most qualified principals out of the education system. Rather higher qualifications afford principals the opportunity to move within the system, potentially to better schools or to higher paying positions. This is an interesting result where research identifies that non-teaching professions in South Africa provide higher levels of return for a given level of educational qualification, regardless of one's level of labour market experience (Armstrong, 2014: 16). Nevertheless, this phenomenon is not unique to South Africa. The U.S. literature identifies that retention rates in education are highest among principals with higher certification scores where these principals are considered more ambitious in 'moving up the career ladder' (Young and Fuller, 2009).

Figure 2.8: Probabilities of turnover by principals' qualifications (REQV)



Notes: The figure plots the marginal predicted probabilities of principal turnover (or turnover flows) from a multinomial logit (MNL) regression. The full MNL results are presented in Table 2A.6.

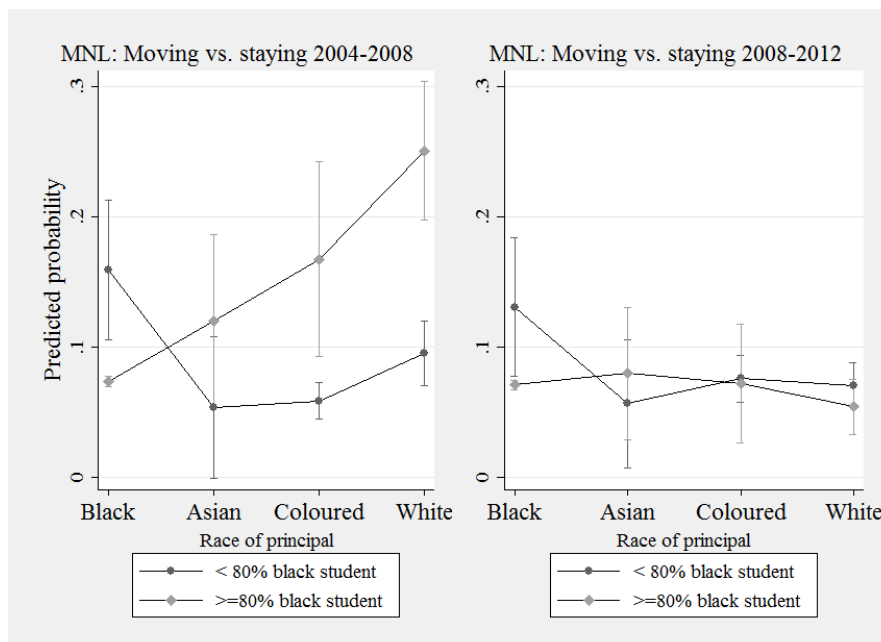
Race and the probability of principal turnover

A clear association exists between the race of the principal and the probability of principal turnover, specifically with respect to the decision to move to another position in the system as opposed to staying in the same school. Compared with black principals, white and Indian/Asian principals are significantly less likely to move within the system. But the association between principals' race and turnover is best interpreted in relation to the racial composition of the student body. For example in the United States, the likelihood that a principal or teacher leaves a school rises as the racial composition of the student body deviates from that of the principal or teacher (Gates et al., 2006; Hanushek, Kain and Rivkin, 2001). In the South African context, there is evidence that the racial

composition of students relative to the principal is significantly associated with principals' decisions to move within the system.

As reflected in Figure 2.9 which plots predicted probabilities of turnover, black principals are more likely to move to another post in the school system if there is non-majority black student enrolment. White principals are more likely to move when the majority race composition of the school is black. In this respect, the historical pattern of principal sorting to schools along racial lines continues to persist through patterns of principal transfers. The significance of this association, however, declined in the second period 2008 to 2012 compared with 2004 to 2008 as evidenced in both the multinomial and sequential logit results.

Figure 2.9: Probability of turnover by principals' race and the student race composition



Notes: The figure plots the marginal predicted probabilities of principal turnover (or turnover flows) from a multinomial logit (MNL) regression. The full MNL results are presented in Table 2A.6.

School characteristics and the probability of principal turnover

In the international literature, principals are identified as using posts in poorer schools as a stepping stone to positions in more affluent schools (Beteille et al, 2012). Therefore, more turnover is expected in poorer parts of the school system. In the South African context, the extent to which school poverty (as measured by DBE quintile status) influences the probability of principal turnover is less clear. Across both the multinomial and sequential logit results, there is no indication that principals are significantly more likely to move out of the poorest quintile one or two schools when compared with principals in quintile four or five schools after conditioning on other covariates. To investigate this further, a transition matrix as reflected in Table 2.5 was generated for the period 2008 to 2012 and

shows the quintiles of sending and receiving schools of principals who move between school principal posts. Lateral movements are most common, comprising 45 percent of all moves followed by upward moves to wealthier schools which account for 31 percent of school-to-school moves. A remaining 23 percent of transitions are downwards to poorer schools. Where upward mobility does occur, this is concentrated at the bottom end with principals in initially quintile one or two schools moving into marginally wealthier schools. Lateral moves are most evident among principals in quintile five schools creating a barrier to upward mobility for principals in poorer schools especially where the number of quintile five schools is considerably smaller than the number of poorer schools. The higher proportion of observations in the corners of the table could be due to floor and ceiling effects.

Table 2.5: Principal mobility: The wealth quintiles of ‘sending’ and receiving schools

		Quintile of receiving school					Total
		1	2	3	4	5	
Quintile of ‘sending’ school	1	221 50.5%	107 24.4%	82 18.7%	24 5.5%	4 0.9%	438 100%
	2	71 27.8%	99 38.8%	61 23.9%	12 4.7%	12 4.7%	255 100%
	3	49 21.1%	56 24.1%	100 43.1%	22 9.5%	5 2.2%	232 100%
	4	7 6.7%	16 15.2%	26 24.8%	34 32.4%	22 21.0%	105 100%
	5	7 7.5%	8 8.6%	14 15.1%	8 8.6%	56 60.2%	93 100%
Total principals		355 31.6%	286 25.5%	283 25.2%	100 8.9%	99 8.8%	1 123 100%

Source: Pearsal-EMIS matched dataset. **Notes:** The transition matrix is calculated for school principals in 2008 (or 2010) who move to a principal post in a different school by 2010 (or 2012). For this group of principals, 1 158 transitions should be observed but data is missing on quintile ranking for some schools. Frequencies are in the top of each cell and percentages are at the bottom. Wealth quintile rankings refer to DBE rankings.

The direction and level of significance on other school characteristics in the regressions point to additional incentives that influence transfer patterns. There is some suggestion that principals are less likely to move to another position in the system if they are initially in an urban school post rather than a rural school post. School size is also associated with transfer patterns. The predicted probability of principal turnover is inversely related to school size where this result is consistent across both the multinomial and sequential logit models. This is expected where principal salaries are higher for positions in larger schools. Principal turnover also varies significantly by school phase. Secondary school principals are considerably more likely to leave the education system or to transfer to another position within the system than principals in primary or intermediate schools. What is interesting is that there is movement of principals between phase levels as shown in Table 2.6. Roughly 17 percent of primary or intermediate school principals that took up a principal position in another school moved

into a secondary school principal role, and 31 percent of moving principals in secondary schools moved to a primary school post.

Table 2.6: Principal mobility: The phase levels of schools ‘sending’ and receiving principals

		Phase of receiving school			Total
		Primary/ Intermediate	Combined	Secondary	
Phase of ‘sending’ school	Primary/ Intermediate	446 67.0%	109 16.4%	111 16.7%	666 100%
	Combined	56 34.1%	77 47.0%	31 18.9%	164 100%
	Secondary	94 31.0%	44 14.5%	165 54.5%	303 100%
Total principals		596 52.6%	230 20.3%	307 27.1%	1 133 100%

Source: Persal-EMIS matched dataset. Notes: see Table 2.5

In summary, this section has identified that the South African labour market for principals is characterised by low levels of mobility. With limited numbers of school-to-school transfers, principal transfers within the system do not pose a substantial threat for widening existing inequalities in the distribution of principals across schools. However, among those principals that do move within the system there appear to be incentives operating in the direction of existing inequalities, specifically where race informs transfer decisions. On a positive note, the analysis indicates that principal transfer patterns are not associated with a leakage of qualified individuals out of the public education system. On the contrary, the least qualified principals are more likely to leave. But a pressing question remains as to whether we should be concerned with principal qualifications at all? Are observed credentials actually a signal for principal quality? This question is addressed in the next section.

2.8 Do principal credentials signal quality?

Internationally, qualifications and experience are usually the key criteria guiding the recruitment of teachers and principals and in determining their pay. South Africa is no exception in this regard. Yet international evidence provides mixed evidence that principal credentials have any bearing on actually raising student performance in schools (Branch, Hanushek and Rivkin, 2009; Clark, Martorell and Rockoff, 2009; Eberts and Stone, 1988). Furthermore, teacher credentials provide weak predictors of student performance across both developed and developing country contexts (Clotfelter, Ladd and Vigdor, 2010; Hanushek, 1986; Hanushek, 2007; Harris and Sass, 2011; Hein and Allen, 2013). In reference to principal credentials in the United States, both Eberts and Stone (1988) and Ballou and Podgursky (1995) find a negative correlation between school performance and principal education as

measured by advanced degrees and graduate training. Using a methodology that allows them to obtain more reliable estimates of how principal characteristics impact on student test scores than prior studies, Clark et al (2009) find little evidence of a systematic relationship between school performance and principal education or pre-principal work experience. However, they do find a positive relationship between years of experience in a principal role and school performance, particularly on mathematics test scores and student absenteeism.

Identifying whether observed credentials are a signal of quality has implications not only for designing effective selection processes but it has direct fiscal consequences. Across the board, the qualifications of principals as measured through the REQV system in South Africa have been rising. In just four years between 2008 and 2012, about three percent more schools had principals with a REQV level 16 or 17 - roughly equivalent to a post-graduate degree. In the majority of schools, rising principal qualifications is not due to the appointment of more qualified replacement principals compared with outgoing principals. Instead incumbent principals are acquiring higher level qualifications while on the job through in-service training.³⁵ This was evident in Figure 2.5 presented earlier which compared the qualifications of newly appointed principals and those of principals exiting the system between the periods 2008 to 2012. While some may consider this a positive indicator of professional development and a signal of leadership quality improvements, the acquisition of higher level qualifications is not necessarily a route to improve skills but a way to advance along the salary schedule. Unless qualifications improve the proficiencies of school leaders, this is unlikely to translate into improvements for the core outcome of concern, student learning. Rather the system is at risk of what is termed 'rent extraction' where more value is taken out of the system than what is given (Pritchett, 2013: 127). Principals access higher salaries with higher qualifications but fail to match their increased cost with added value, for example through engaging in behavioural change, increased responsibilities or raising their performance.

Estimation strategy and data

There are various challenges associated with estimating unbiased effects of principal credentials on school performance. First, principals are not randomly sorted across schools as discussed extensively in the previous analysis. Different types of principals are attracted to different types of schools. Moreover, certain principals may attract or be attracted to different types of students. In a straightforward ordinary least squares regression, estimates of how principal characteristics affect school performance may be biased through these very patterns of principal sorting to schools. A commonly used approach in dealing with sorting biases is the inclusion of school fixed effects in a

³⁵ A similar pattern is observed with respect to teachers in general in South Africa who build up their qualifications on the job often over many years (CDE, 2015)

simple regression framework. In the following equation school performance is expressed as a function of school and principal characteristics and the characteristics of a school's student body.

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 PC_{it} + PA_i + \pi_i + \pi_t + \varepsilon_{it}$$

Here Y_{it} is the measure of performance of school i in year t and X_{it} is a vector of time-variant school characteristics. PC_{it} are time-varying characteristics of principals including their credentials and ε_{it} is an idiosyncratic error term which is assumed to be serially uncorrelated over time. The term π_i reflects school-specific fixed effects and year fixed effects are represented by π_t . The school fixed effects essentially purge the estimation of any bias associated with unobserved school characteristics that are time-invariant over the sample period observed. Estimates of the relationship between principal characteristics and school performance are identified by comparing school performance associated with different principals working in the same school.

The regression framework also includes a measure of unobserved time-invariant principal ability, PA_i . As noted by Clark et al (2009: 8), where principal ability is unobserved a regression of school performance on principal credentials would identify the causal effect of the credential in question plus an ability bias generated by any correlation between the credential and unobserved ability. The ability bias could potentially confound the effects of credentials on performance and cannot be remedied through the inclusion of school fixed effects. However, it is not necessary to correct for the ability bias because this "bias" forms part of the effect of interest. When informing principal selection policies, for example, we would want to know whether one candidate will perform better in a given school than another candidate. If those among the set of principals with higher qualifications also have more ability or motivation, this is a signal to inform hiring on the basis of qualifications.

The dataset constructed for this study facilitates the use of a school fixed effects strategy as more than one observation per school is available in a panel. Specifically, the estimation sample used is limited to the subset of schools that had grade 12s in each year and could be connected to grade 12 (or otherwise known as matriculation) examination outcomes in those years. Until recently, the matriculation examination in South Africa has been the only national measure of school performance where "much behaviour has understandably been oriented towards grade 12 indicators, in particular 'pass rates', the percentage of students successfully obtaining the certificate or surpassing minimum thresholds in individual subjects" (Gustafsson and Taylor, 2013: 3). Prior to 2008, students typically wrote a minimum of six subjects as part of the grade 12 senior certificate. This changed to seven subjects given a fundamental change in the curriculum system between 2007 and 2008 which saw the removal of the distinction between higher and standard grade examination papers and the introduction of compulsory mathematical literacy for non-mainstream mathematics takers. Coinciding with the year 2008 when the National Senior Certificate (NSC) examination first replaced the Senior

Certificate system, the dataset used in the analyses is limited to three of the four available ‘waves’ of the constructed panel.³⁶

The first measure of grade 12 performance used is the much talked about percentage pass rate in the NSC, which is a key measure of school success in South Africa. However, where students choose between a plethora of subjects, it may be argued that overall pass rates in the NSC are not directly comparable across schools if students in some schools on average take easier subjects than in others. For this reason, the second performance measure is limited to focus on improvements in one subject area, mathematics. This follows Gustafsson and Taylor (2013) who solely focus on mathematics performance in estimating provincial boundary change impacts on school performance. The average mathematics score out of one hundred obtained by students is a key indicator of improvements with respect to the quality of mathematics teaching and learning. As noted above, there are two streams of mathematics offered at the FET phase³⁷ –mathematics and mathematical literacy which attempts to introduce students to mathematical concepts with everyday practical applications. Only former of the mathematics outcomes are considered here.

Due to changes to the matriculation examination system in 2008, only three of the four ‘waves’ of the constructed panel are used: 2008, 2010 and 2012. A maximum number of 4 503 schools are used in the estimations. It is noted that there are some limitations of these measures of school performance. Tests are not standardised in the usual sense but an independent monitoring board, Umalusi, is in place to monitor the quality of the examinations from year to year. Where these performance indicators may be subject to gaming through limiting the throughput of weak performing grade 11s into grade 12, it is necessary to control for the throughput rate of students in the FET phase in each school in the estimations that follow.

Referred to in the previous sections, two principal credentials recorded in the payroll are considered in the analysis. Principals’ REQV levels are included as a continuous variable ranging from 10 to 17. Years of service in the education sector is used as a proxy for years of experience. The school fixed effects estimation strategy relies on variation in these variables of interest to identify effects. Variation in principal REQV levels within a school over time would be induced by either the entry of a new principal with a different qualification level to the outgoing principal or where a principal upskills on the job. In estimating for example average mathematics scores, roughly 371 (8 percent) of 4 460 schools in the estimation sample experience a change in the REQV level of its principal over two periods (2008 to 2010 or 2010 to 2012).

³⁶ Excluding the 2004 data-year is also prompted by the lower levels of successful matching of Persal to EMIS data in 2004 compared to later years.

³⁷ In this context, FET refers to “Further Education and Training” and is the name given to the curriculum implemented at the level of grades 10 to 12.

Additional time-varying principal controls include their gender³⁸, age and post position in the previous data period observed. Time-varying school controls include total school enrolment and its square, the number of teachers per one hundred students and the percentage of students that are black. Promotion rates are also included where the number of grade 12s in year t is expressed as a percentage of the number of grade 10s in year $t-2$. At the outset, a key limitation of the analysis is noted. Without student level data identifying their performance, background characteristics and whether they switch schools, it is not possible to control directly for biases that may result from student sorting patterns.

Estimation results

Tables 2.7 to 2.9 present the estimation results which are reported for all schools in the data sub-set and then limited to poorer (quintile one to three) schools and wealthier schools (quintile four and five). Where performance is measured as the percentage of examination takers who achieve the NSC, the fixed effects results in Table 2.7 (controlling for time-varying principal and school characteristics) suggest that when schools have a principal with an additional REQV level, the pass rate rises by 1.5 percentage points. Once the year fixed effects are introduced, however, this effect reduces to half of a percent and is statistically insignificant. For the second measure, the average mathematics score, having a principal with an additional REQV ranking also produces roughly half a percentage point increase in the average mathematics score in the final fixed effects estimation. This is a statistically significant effect but clearly small. When the sample is limited to poorer quintile one to three schools, any observed effects in the final fixed effects regressions are small (less than 0.2 percent) and insignificant. The results suggest that REQV levels do not provide a useful signal of quality where school performance is no higher when the principals' qualification levels increase. By contrast, in wealthier quintile four and five schools there is some evidence that school performance is higher when a school is led by a more qualified principal. However, the positive significant effect in quintile four and five schools is only observed when the outcome measure is the school's average mathematics percentage. In these schools, the average mathematics percentage increases by about 1.2 percentage points when the school is led by a principal with one additional REQV level. Where principals in wealthier schools may have been exposed to better pre-service education than principals in poorer schools, this may explain the heterogeneous results across these two groups of schools (Shepherd, 2015b).

³⁸ This varies where a principal leadership change occurred in the school.

Table 2.7: Matriculation examination outcomes and principal credentials, schools offering grade 12 (quintile one to five schools)

	Average mathematics percentage among mathematics takers						Percentage of examination takers who achieve the NSC					
	OLS (1)	OLS (2)	OLS (3)	FE (1)	FE (2)	FE (3)	OLS (1)	OLS (2)	OLS (3)	FE (1)	FE (2)	FE (3)
REQV level (continuous)	1.704*** (0.116)	0.216** (0.091)	0.213** (0.091)	0.739*** (0.252)	0.637*** (0.245)	0.573** (0.240)	2.798*** (0.203)	0.456*** (0.173)	0.445*** (0.167)	1.546** (0.619)	1.506*** (0.579)	0.533 (0.468)
Years of service	0.001 (0.029)	-0.035* (0.020)	-0.041** (0.020)	-0.033 (0.042)	-0.059 (0.041)	-0.085** (0.041)	0.013 (0.045)	-0.075** (0.034)	-0.121*** (0.033)	0.371*** (0.085)	0.244*** (0.079)	-0.112* (0.065)
Principal controls	X	X	X	X	X	X	X	X	X	X	X	X
School controls		X	X		X	X		X	X		X	X
Year fixed effects			X			X			X			X
R-squared	0.045	0.457	0.460				0.043	0.370	0.408			
Within R2				0.008	0.084	0.096				0.040	0.209	0.294
N (school-years)	13 139	13 093	13 093	13 139	13 093	13 093	13 490	13 442	13 442	13 490	13 442	13 442
N (clusters)				4 460	4 460	4 460				4 503	4 503	4 503
F stat	63.513	301.032	277.956	6.215	46.93	49.444	68.838	439.008	409.027	23.955	106.09	187.188

Source: Pearsal-EMIS matched dataset, connected to matriculation examination data. **Notes:** The unit of observation is school-year. REQV is entered as a continuous variable ranging from 10 to 17. Time-varying principal controls include their gender, age and position in the previous data period observed. Time-varying school controls include total school enrolment and its square, number of teachers per one hundred students and the percentage of students that are black. Additional time-invariant school controls are included in the OLS regressions. These are school quintile, former department classification, urban location and provincial indicators. Year dummies are entered for 2010 and 2012. The year reference category is 2008. Statistically significant at * p<0.1, **p<0.05, ***p<0.01. Standard errors are shown in parentheses and are clustered at the school level.

Table 2.8: Matriculation examination outcomes and principal credentials, poorer schools offering grade 12 (quintile one to three schools)

	Average mathematics percentage among mathematics takers						Percentage who achieve the NSC					
	OLS (1)	OLS (2)	OLS (3)	FE (1)	FE (2)	FE (3)	OLS (1)	OLS (2)	OLS (3)	FE (1)	FE (2)	FE (3)
REQV level (continuous)	0.810*** (0.107)	0.241** (0.104)	0.222** (0.104)	0.575* (0.308)	0.517* (0.301)	0.176 (0.273)	1.735*** (0.229)	0.567*** (0.212)	0.489** (0.204)	1.607** (0.813)	1.740** (0.759)	-0.081 (0.584)
Years of service	-0.018 (0.025)	-0.029 (0.024)	-0.048** (0.024)	0.018 (0.061)	-0.023 (0.060)	-0.189*** (0.057)	-0.016 (0.053)	-0.036 (0.048)	-0.116** (0.046)	0.756*** (0.157)	0.601*** (0.144)	-0.172 (0.110)
Principal controls	X	X	X	X	X	X	X	X	X	X	X	X
School controls		X	X		X	X		X	X		X	X
Year fixed effects			X			X			X			X
R-squared	0.011	0.140	0.156				0.019	0.212	0.272			
Within R-squared				0.014	0.100	0.137				0.052	0.225	0.327
N (school-years)	9 787	9 748	9 748	9 787	9 748	9 748	10 073	10 032	10 032	10 073	10 032	10 032
N (clusters)				3 533	3 533	3 533				3 574	3 574	3 574
F stat	11.442	47.003	49.706	7.848	40.788	55.134	21.762	97.009	124.348	20.872	92.975	177.446

Source: Pearsal-EMIS matched dataset, connected to matriculation examination data. **Notes:** The unit of observation is the school-year. REQV is entered as a continuous variable ranging from 10 to 17. Time-varying principal controls include their gender, age and position in the previous data period observed. Time-varying school controls include total school enrolment and its square, number of teachers per one hundred students and the percentage of students that are black. Additional time-invariant school controls are included in the OLS regressions. These are school quintile, former department classification, urban location and provincial dummies. Year dummies are entered for 2010 and 2012. The year reference category is 2008. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are shown in parentheses and are clustered at the school level.

Table 2.9: Matriculation examination outcomes and principal credentials, wealthier schools offering grade 12 (quintile four and five schools)

	Average mathematics percentage among mathematics takers						Percentage of examination takers who achieve the National Senior Certificate					
	OLS 1	OLS 2	OLS 3	FE 1	FE 2	FE 3	OLS 1	OLS 2	OLS 3	FE 1	FE 2	FE 3
REQV level (continuous)	1.445*** (0.273)	0.123 (0.182)	0.047 (0.180)	1.888*** (0.612)	1.440** (0.559)	1.203** (0.512)	1.689*** (0.370)	0.071 (0.268)	0.149 (0.265)	1.710* (0.894)	1.051 (0.827)	1.258 (0.765)
Years of service	-0.056 (0.049)	-0.034 (0.033)	-0.027 (0.032)	-0.064 (0.071)	-0.073 (0.064)	-0.035 (0.053)	-0.069 (0.055)	-0.112*** (0.040)	-0.118*** (0.040)	0.019 (0.059)	-0.05 (0.054)	-0.077 (0.054)
Principal controls	X	X	X	X	X	X	X	X	X	X	X	X
School controls		X	X		X	X		X	X		X	X
Year fixed effects			X			X			X			X
R-squared	0.04	0.596	0.609				0.038	0.511	0.519			
Within R-squared				0.022	0.081	0.16				0.008	0.154	0.18
N (school-years)	3 358	3 345	3 345	3 358	3 351	3 351	3 423	3 410	3 410	3 423	3 416	3 416
N (clusters)				1 313	1 312	1 312				1 328	1 327	1 327
F stat	17.712	172.487	177.671	3.825	10.643	20.605	15.343	128.134	122.171	1.557	12.259	13.774

Source: Persal-EMIS matched dataset, connected with matriculation data. **Notes:** The unit of observation is the school-year. REQV is entered as a continuous variable ranging from 10 to 17. Time-varying principal controls include their gender, age and position in the previous data period observed. Time-varying school controls include total school enrolment and its square, number of teachers per one hundred students and the percentage of students that are black. Time-invariant school controls are included in the OLS regressions. These are school quintile, former department classification, urban location and provincial dummies. Year dummies are entered for 2010 and 2012. The year reference category is 2008. Statistically significant at * p<0.1, **p<0.05, ***p<0.01. Standard errors are in parentheses and are clustered at the school level.

For the full and sub-samples of schools, additional years of service have little bearing on school performance. For the full sample of schools, coefficients on years of service in the final fixed effects specification suggest a statistically significant *negative* effect of about 0.1 percentage points. For the poorer school sample, the negative coefficient rises to just less than 0.2 percentage points while is close to zero in the wealthier school sample. It is entirely possible that years of experience as a principal, specifically, may provide a more useful indicator of a principal's capacity to execute his or her leadership function than years of service – principal experience may matter more than just teaching experience (Clark et al, 2009). Unfortunately, it is not possible to distinguish between years worked in a principal post from overall teaching experience in the public education sector with the data available. This is a limitation of the analysis.

A potential criticism of the fixed effects results is that there may not be enough variation in the REQV indicator within each school over time relative to the between school variation in REQV levels, resulting in relatively imprecise estimators. This is a valid concern as identified by the notably higher standard errors on REQV and years of service in the fixed effects regression results when compared with the OLS results. Only 29 percent of the standard deviation in REQV in the quintile one to five estimation sample is attributed to within-school variation. There is relatively more within-school variation in the variable years of service which accounts for 42 percent of the total standard deviation in total years of service. However, when the fixed effects estimates are considered in relation to the OLS results, the author argues that the substantive conclusions that can be drawn from the results are unlikely to change considerably. Even if the 0.5 percentage point increase in a school's NSC pass rate identified in the third OLS model for the quintile one to five sample were true, this is not an educationally significant effect or commensurate with the anticipated impact that higher quality school principals are likely to have on school outcomes. In future research, however, it would be useful to extend the panel to identify more within-school variation in the variables of interest.

Measurement error

In a fixed effects regression, measurement error in the explanatory variable of interest may induce attenuation bias in the coefficients. In reference to REQV as a measure of qualifications, it is necessary to distinguish between two types of potential measurement error. The first would be related to data capturing mistakes in REQV levels assigned to principals. This is unlikely where the calculation of salaries or cash bonuses is dependent on having correct information on REQV levels recorded in payroll data. Any errors in this field are likely to be checked or verified by educators themselves and are arguably not a major concern for the estimation.

A second type of measurement error is that REQV may be a poor signal of actual qualifications. This is a potential concern where the REQV system is a composite measure of academic qualifications and professional training. As noted in a report by Welch (2009), the awarding of a REQV level is complex

and extends beyond just counting the years of teacher training after matric. She notes, for example, that an additional REQV level can be awarded for a maximum of two approved qualifications at the same NQF level and identifies that “it is not the qualification itself that carries the REQV level. It is the qualification in relation to other qualifications that the teacher has obtained” (ibid: 2).

Summary

In summary, in the majority of schools principal credentials - as measured through REQV levels and years of service - have little observable impact on school performance. Due to the potential concern that REQV levels are not good measures of qualifications, one is cautioned in assuming that educational qualifications of principals are not important. What is clear, however, is that the REQV level system is not an effective signal alone of principal quality in the majority of schools. Nevertheless, in the wealthier school sample, REQVs may provide a weak signal of principal quality. Differential effects across quintiles may be indicative of teachers in poorer schools having relatively poorer quality education themselves.

The findings hold even though it was not possible to control for unobserved principal ability. Rather the ability “bias” formed part of the effect of interest in the school fixed effects regressions. It is also necessary to point out that the non-effect observed for the full and poorer school sample of schools does not imply that principals do not matter for school performance; rather the value they bring to schools is not signalled through their observed credentials as captured in the payroll system. This is an important finding with implications for the design of recruitment policies and pay schedules, which are closely linked to the REQV system.

However, these results should also be considered against the suggestive evidence presented earlier that higher principal retention rates are associated with higher REQV levels. While the current pay schedule for principals is poorly linked to principal quality as it differentiates pay using the REQV system, a differentiated pay system may be important more generally for principal and teacher retention. Moreover what is not unpacked in the analysis is whether the weak links of qualifications to outcomes occurs because they are a necessary condition, but not a sufficient condition for improved school outcomes. For example, principal qualifications may be important for raising their quality but may fail to have the necessary impact unless the principal is motivated.

2.9 Discussion: Evidence informing policy

The preceding discussion has highlighted five overarching characteristics of the labour market for principals. In summary:

- i. The age profile of principals has been rising, indicating the need for a substantial and increasing number of principal replacements. The number of new principals required to replace retiring principals alone is estimated to be well over 7 000 between 2012 and 2017. While proportionally more retirements are taking place in wealthier schools, the absolute demand for principal replacements is highest in the poorest schools. Moreover, the demand for replacement principals is particularly large at the primary and intermediate school level comprising over sixty percent of anticipated principal replacements due to retirement.
- ii. The labour market for principals is dominated by men. While 71 percent of all teachers were women in 2012, they held a mere 36 percent of school principal positions. This gender disparity is most pronounced at the secondary school level and in former white schools.
- iii. Principals are unequally distributed across schools with less qualified and less experienced principals represented in greater proportions in poorer schools. In part, the patterns of unequal principal sorting across schools are attributable to historically imposed policies that matched teachers and principals to schools along racial lines. However, initial matching of new principals to schools continues to persist in line with historical patterns, reflecting either differences in the preferences of prospective principals for certain types of schools or variations in the appointment process.
- iv. In the majority of schools, principal credentials as measured through REQV levels and years of service have little observable impact on school performance as measured by matriculation outcomes. However, in wealthier quintile four and five schools, the REQV system may provide a weak signal of quality.
- v. Despite rising levels of retirement related attrition, low levels of mobility and consequently high levels of average tenure characterise this market. The majority of principal turnover - at roughly two thirds to three quarters - is accounted for by attrition rather than mobility. Low levels of mobility are also expressed in promotion patterns, where well over a half of newly appointed principals are promoted from lower ranks *within* a school. Cross-provincial movements of principals are also uncommon, accounting for less than three percent of all principal moves within the system. Although the number of within sector transfers is low, there is some evidence that among principals who move from school-to-school, transfer patterns tend to exacerbate existing inequalities.

Table 2.10: The National Development Plan proposals to improve school leadership – progress and relevance

NDP proposals for improving the calibre of school leadership	Level of progress to date in converting a plan to policy	Relevance in terms of <i>local and international evidence</i>	Expected resistance to proposed plan
A: Improving the principal appointment process			
Competency-based assessments to inform the appointment process	High. Currently being piloted through the Western Cape and in Gauteng education departments.	High. The unequal distribution of principals across schools is largely due to the initial sorting of principals to schools than to transfer patterns. Initial sorting must therefore be targeted. Address distributional inequalities through improving current appointment processes and limiting union interference. Traditional credentials as measured in payroll (REQV and years of service) are poor signals of principal quality.	Medium
Increase the minimum qualification criteria to include having an ACE in School Management and Leadership	Medium. The ACE has been evaluated and revised (Bush et al, 2009).	Low to medium. No significant improvement in school performance observed in schools with ACE trained candidates (Bush et al, 2009). No link between higher principal REQV levels and school performance. Cannot rule out however, that well-designed training programmes may be of value.	Low
B: Performance management			
Performance contracts for school principals	Medium. Draft performance management agreements to replace IQMS for principals resisted. Green Paper on Standards for Principalship.	High. With low levels of principal mobility in South Africa it is necessary to improve the calibre of incumbent principals over the course of their tenure. Reward performance rather than qualifications and seniority.	High
Replace underperforming principals with better ones	Education Law Amendments Act of 2007.		Very high
C: Provide principals with greater powers over school management	Low to medium. Although policies are supportive of the empowering of principals, there is a strong <i>a priori</i> resistance in government institutions to delegating authority (NPC, 2012: 426).	No local evidence exists that links management powers to increased learning in schools. But international evidence generally supports the decentralisation of decision-making to the school-level in improving school performance (Hanushek and Woessmann, 2007). However, increased autonomy must be packaged with accountability measures.	Medium to high.

In a sector characterised by low levels of mobility and high levels of tenure, policies should be aimed at improving the initial match of principals to schools while developing the effectiveness of incumbent principals over their length of tenure. Moreover, where observed credentials in payroll provide weak signals of quality, policies guiding the selection and rewarding of principals should extend beyond qualifications and experience to identify expertise and skills that may be better signals of quality. In light of this, the relevance of proposed policies in The National Development Plan (NDP) to improve the calibre of school leadership is considered, and for ease of reference summarised in Table 2.10. The findings strongly support proposals to i) introduce competency-based assessment in the appointment process and ii) implement performance management for incumbent school principals aimed at increasing the quality of leadership provided to schools. However, the design and implementation of these policies are important for ensuring they generate the desired outcomes and this warrants additional research. In brief, some issues are discussed in this regard.

There is strong evidence that supports the introduction of competency-based testing in the appointment process. At the very least, it will limit the undue influence of unions in the appointment process, especially where an independent contractor manages this process. It may also help to alleviate potential gender specific discrimination in the appointment process. However, it should be designed to identify competencies that distinguish better quality school leaders from weaker ones. Yet little evidence exists on the types of skills or attributes that matter for school performance in the South African context and in this respect more research is warranted. What is clear though from both local and international literature is the need for principals with a strong instructional focus, prioritising activities that focus on the core business of teaching and learning (Bush et al., 2006; Hallinger and Heck, 1996). It is commonly accepted that principals do not conceptualise their role as leaders of learning where job descriptions and day-to-day activities pivot around fulfilling a compliance and administrative function (Bush and Heystek, 2006; Elmore, 2000). This is emphasised where both job descriptions in PAMs and IQMS prioritise compliance functions over the principal's role as leader of learning. The draft Standards for Principalship (RSA DBE, 2014c) arguably corrects this, re-prioritising the principals' key function as facilitating quality teaching and learning in his or her school. Esteemed competencies in testing must be closely linked to this new prioritisation. Additionally it is noted that attention must be given to ensure that competency tests are gender sensitive, identifying competencies that transcend stereotypes of male dominated attitudes to school leadership.

Improving performance management systems for principals (either in the existing IQMS or in designing a replacement system) is complex, involving issues such as what performance criteria are monitored, who evaluates performance and how it is rewarded. Performance must be assessed in terms of standards for leadership and managerial behaviours that are logically linked to learning

improvements in schools. Alternatively, performance may be directly measured by overall improvements in student learning. A clear weakness with the existing IQMS is that the evaluation of a principal's role is not treated distinctly from his or her role as teacher (Smit, 2013). IQMS is also not linked to measurable indicators of school performance. Of course, identifying suitable learning indicators against which to measure performance is a notable challenge in designing a new system.

While the Annual National Assessments (ANA) provide a useful mechanism for diagnosing learning deficits (and are an important addition to accountability more broadly), in their current form they have notable shortcomings. Much progress is needed in ensuring that the ANA's become a truly standardized test before considering them as measures for tracking learning improvements over time, let alone rewarding schools and principals for these improvements.³⁹ Currently the ANAs are not designed to be compared over time (John, 2012; Taylor, 2013). Furthermore, linking principal performance to student test scores, for example, poses potential threats of introducing perverse incentives. It may increase principal turnover where principals move out of schools with underperforming students and transfer to more attractive schools (Clotfelter et al., 2007). This pattern of transfer typically involves moving out of poorer schools, thereby aggravating existing inequalities in the distribution of principals and reducing the pool of applicants for posts in underperforming schools.

In implementing performance management systems there are also notable challenges. Arranging performance evaluation meetings with principals in over 24 000 public schools is likely to pose logistical problems. This was identified as a clear challenge in the implementation of the existing IQMS, providing few guarantees that direct line managers will conduct evaluations in the future (RSA DBE, 2014d: 98; RSA DBE, 2012b). Increased accountability for principals also goes hand-in-hand with capacity improvements at a district level. This extends beyond just creating the capacity to monitor. Districts also need the capacity to *support* principals in their day to day functions, creating reciprocal accountability arrangements⁴⁰ in the relationship between central administration and educators (Elmore, 2002).

³⁹ At the time of finalising this chapter, a call was made by the DBE to postpone the administration of the ANAs in 2015 until 2016 in the face of extremely strong union resistance to the tests. It remains unclear as to what the future of the ANAs will be.

⁴⁰ As described by Richard Elmore (2002: 5),

For every increment of performance I demand from you, I have an equal responsibility to provide you with the capacity to meet that expectation. Likewise, for every investment you make in my skill and knowledge, I have a reciprocal responsibility to demonstrate some new increment in performance. This is the principle of "reciprocity of accountability for capacity." It is the glue that, in the final analysis, will hold accountability systems together. At the moment, schools and school systems are not designed to provide support or capacity in response to demands for accountability.

Finally, performance management is likely to be met with considerable resistance not only from teacher unions at a national level but from principals themselves if they feel the system is unfair or there are too many variables affecting their performance that they feel are outside of their control (Heystek, 2015). In Jan Heystek's conclusion to recent research on principals' perceptions of the motivational potential of performance agreements, he reflects that these concerns are expressed in a context where principals have no control over the hiring and firing of those they are appointed to lead and where principals' ability to perform is often challenged at the school level by the influence of SADTU on the school environment (ibid, 2015:8). There may also be concerns that implementing a 'one size fits all' approach in assessing principals is unfair given large contextual differences across schools (Christie, 2010). While these may be valid concerns, labour law and union strength is strongly swayed in favour of employees to prevent unfair dismissals.

Improved performance management systems must be packaged carefully to minimise resistance. Proposals are likely to be more palatable where performance evaluations are strongly connected to training and mentoring to actively address areas of non-performance. More generally, carefully crafted packages of policies are necessary to ensure that the individual aims of each are realised. This is particularly relevant in reference to the NDP proposals to delegate more authority to school leaders. Hanushek and Woessmann (2007), in reviewing evidence on strategies for school improvement, note that providing increased decision-making authority to schools has been linked to improved school outcomes, even in developing country contexts. They caution, however, that "Local autonomy without strong accountability may be worse than doing nothing" (ibid 2007:74). Bloom et al's (2015) cross-national analysis of school management lends weight to this finding where they identify that better management of certain types of schools is not linked to more autonomy *per se* but with how autonomy is used in the context of accountability of principals to external governing bodies. The NDP does suggest that more autonomy be given to school principals *conditional* on exhibiting a level of leadership quality. This indirectly implies that this policy be packaged with performance management where a rewarded outcome of satisfactory school assessments is increased autonomy.

The NDP proposal to raise minimum principal qualification criteria to having an Advanced Certificate in Education (ACE) in school leadership and management is less supported by the available evidence. Research has previously evaluated the effectiveness of the ACE programme in raising the quality of school leaders (Bush et al., 2009). While the report by Bush et al makes many positive qualitative links between the programme and its ability to raise principal competencies, preliminary evidence indicated that there was no conclusive improvement in the performance of the schools led by these ACE trained graduates. It is cautioned that unless the revised ACE programme results in improved leadership and management competencies, it is unlikely to act as a useful signal of principal quality. Rather, it may have the unintended consequence of reducing the available pool of potential principal candidates to those who have this certificate. Already the pool of suitable principals is likely to be too

small to meet the demand for the substantial number of retirements taking place. Where policy as set out in the PAMs requires that prospective principals possess an education qualification, this already rules out hiring individuals who have good management skills and experience but who have not qualified as an educator.

It is noted that the ACE programme does make useful provisions for forms of mentoring and on-site training for school principals in raising leadership quality. In light of the evidence presented, the extensive number of principals who are retiring, particularly those from well-functioning schools, provides a pool of available trainers and mentors for growing numbers of newly appointed principals. In this vein, well-developed induction programmes for newly appointed principals are an important consideration given the expected increase in new principal appointments.⁴¹ While efforts have been taken by the DBE to provide induction training to newly appointed principals in the past, there is room for improvement in this regard (Bush and Odura, 2006). In the 2004 and 2007 national Systemic Evaluations, intermediate and foundation phase school principals were asked whether they had received any induction training since their appointment as a principal. Between 62 and 66 percent of principals leading these schools responded positively (see Table 2A.5). Provided that similar patterns of training hold in recent years, another third of principals could be exposed to induction training.

An additional policy that not considered in the NDP, and is relevant in light of the evidence provided, is extending the provision of monetary incentives to improve the available pool of principal candidates applying for posts in hard-to-staff and poor performing schools.⁴² Directing a pool of good applicants to poorer schools is particularly important not only for improving the distribution of principals across schools, but to meet a much larger demand for replacement principals in these schools. In the long-run, however, Clotfelter et al (2007) identify that where the principal labour market is closely linked to the teacher labour market, improvements in the distribution of principals across schools involves altering the labour market for teachers, making high poverty schools more competitive.⁴³

In conclusion, this research has contributed to an evidence-base on principals to inform policy aimed at improving the quality of school leadership and management. In light of the historical levels of

⁴¹ In the United States, exposure to induction training has been identified as reducing the likelihood that newly appointed teachers move to other schools or leave the teaching profession (Smith and Ingersoll, 2004).

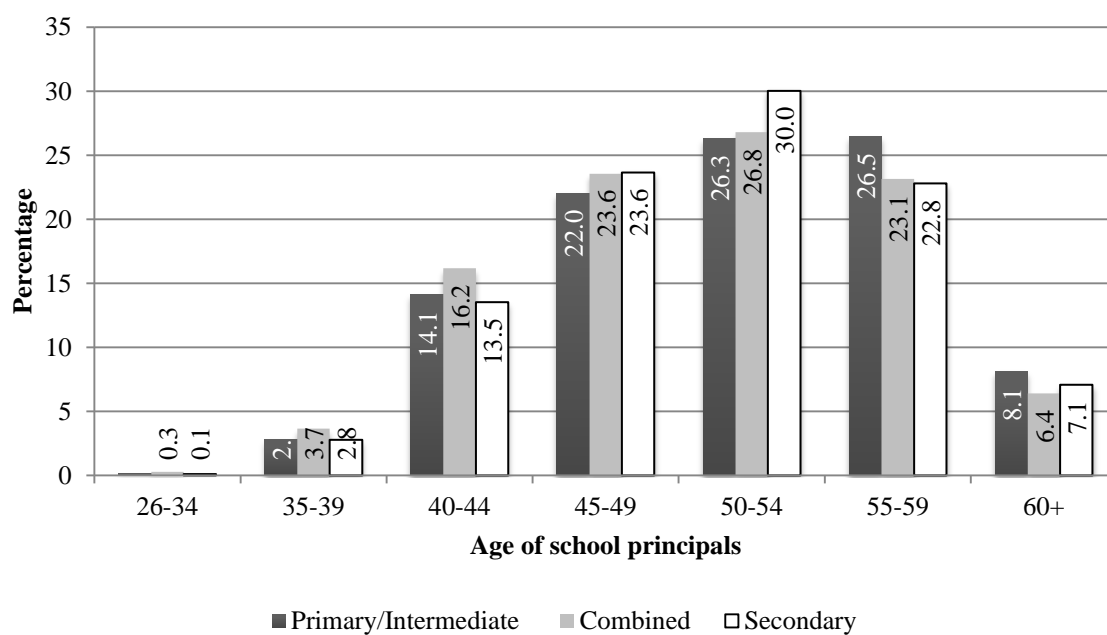
⁴² In recent years, provinces have begun to introduce monetary incentives or otherwise referred to as “rural allowances” for teachers in hard-to-staff schools. This has been beset with implementation challenges, however, with teacher unions strongly contesting the non-payment of these allowances (see for example ELRC-KZN chamber, 2014).

⁴³ This is likely to be challenging given an existing reality where teacher mobility patterns are in the direction of better performing schools (Gustafsson, 2016), even in the absence of test-based accountability measures. It is expected that these better performing schools are also more likely to be wealthier schools.

resistance from teacher unions in agreeing to new performance management proposals, it may take many years before a more effective performance management system for principals is finalised and then implemented. Nevertheless, the urgency to implement policies to support the right appointments of new principals cannot be reiterated enough in light of the substantial and increasing number of principal retirements. With each new principal placement, the leadership trajectory of the average school is established for almost a decade. Evidence-based policy-making has a strong role to play in getting this right.

2.10 Chapter appendix

Figure 2A.1: Age profile of school principals in 2012 by the phase level of the school they lead



Source: Persal-EMIS matched dataset. **Notes:** Calculations are based on a sample of principals in Persal that could be matched to a school and are identified as the principal of the school. Educators in the Persal data are identified as principals if their rank title specifies that they are a principal. Where there are two or more principals in a school, only the clear institutional leader (identified as having the highest post level among principals in a school or the highest salary) is retained in the sample. The 2012 sample includes 21 810 principals - 12 596 in primary schools, 3 617 in combined schools and 5 597 in secondary schools.

Table 2A.1: OLS regressions to identify factors associated with the credentials of newly appointed principals

	Dependent variable: REQV level (continuous)		Dependent variable: Years of service	
<i>DBE wealth quintile:</i>				
Quintile 2	0.029	(0.034)	0.930***	(0.266)
Quintile 3	0.154***	(0.037)	1.623***	(0.290)
Quintile 4	0.033	(0.054)	2.416***	(0.416)
Quintile 5	0.236**	(0.075)	2.897***	(0.585)
<i>School phase:</i>				
Combined	-0.076*	(0.039)	-0.595*	(0.306)
Secondary	0.097**	(0.035)	-0.790**	(0.274)
<i>Former department classification:</i>				
Independent homeland	-0.036	(0.048)	2.073***	(0.373)
Non-independent homeland	-0.026	(0.048)	1.312***	(0.373)
House of Assemblies (white)	-0.019	(0.080)	-1.530**	(0.623)
House of Delegates (Indian)	0.192	(0.120)	5.026***	(0.931)
House of Representatives (Coloured)	-0.133	(0.085)	2.786***	(0.661)
New School Classification Unknown	-0.058	(0.058)	-0.764*	(0.450)
	-0.157**	(0.070)	-0.114	(0.545)
<i>Other school characteristics:</i>				
% students that are black	0.000	(0.001)	0.008	(0.007)
Location: Urban	0.152***	(0.036)	1.385***	(0.277)
Total school enrolment	0.000**	(0.000)	0.001	(0.001)
Number of educators	0.002	(0.004)	0.064**	(0.029)
<i>Provincial location:</i>				
Eastern Cape	-0.319***	(0.075)	3.090***	(0.587)
Free State	0.138	(0.091)	2.332**	(0.710)
Gauteng	0.142*	(0.078)	1.414**	(0.607)
KwaZulu-Natal	0.136*	(0.077)	1.509**	(0.598)
Limpopo	0.069	(0.081)	4.391***	(0.630)
Mpumulanga	0.241**	(0.085)	2.730***	(0.658)
Northern Cape	-0.210**	(0.095)	1.542**	(0.741)
North West	0.106	(0.085)	2.209***	(0.660)
Constant	14.256***	(0.099)	13.054***	(0.771)
R-squared	0.117		0.088	
Number of newly appointed principals	5 235		5 237	
F stat (p-value)	27.678 (0.000)		20.093 (0.000)	

Source: Matched Persal-EMIS dataset. **Notes:** Sample includes all newly appointed principals between 2008 and 2010 or 2010 and 2012. Base categories include quintile one schools, schools that were formerly administrated under the Department of Education and Training (black), rural schools, primary or intermediate schools and schools in the Western Cape province. Statistically significant at * p<0.1, **p<0.05, ***p<0.001. Standard errors are in parentheses.

Table 2A.2: Benchmarks of annual employee turnover rates

	Annual Turnover Rate	Source
SA public sector departments		
Small size (<1000 employees)	31.5% (mobility & attrition)	
Medium size (1001-5000 employees)	22.5% (mobility & attrition)	Pillay, de Beer and Duffy (2012)*
Large (>5000 employees)	9.2% (mobility & attrition)	
Teacher turnover		
Botswana 2001	14% (attrition)	
Swaziland 2002	12% (attrition)	Educators Macro Indicators Report (2009) in Pitsoe (2013)
United Kingdom (2000)	15.3% (attrition)	
Principal turnover		
United States (2005-2009)	20%-30%	Miller (2013); Beteille, Kalogrides and Loeb (2012)

Notes: *Estimates are obtained from monthly payroll (Persal) data.

Table 2A.3: Years of experience and current tenure, principals in Verification-ANA 2013

	Total years of experience as a principal*						Total years as a principal* at current school (tenure)					
	Mean	SD	p10	p50	p90	n	Mean	SD	p10	p50	p90	n
All schools	11.0	8.3	2	9	22	1 713	9.6	7.5	1	8	20	1 705
Quintile 1	12.3	8.6	2	11	23	450	10.9	8.1	2	9	22	447
Quintile 2	11.3	8.4	2	10	22	380	9.7	7.4	1	8	20	378
Quintile 3	10.1	8.3	1	8	22	400	9.0	7.8	1	6	20	398
Quintile 4	9.8	7.3	2	9	20	260	8.5	6.8	1	7	19	259
Quintile 5	11.2	8.0	2	10	21	221	9.5	6.4	2	8	17	221

Source: V-ANA 2013. **Notes:** Not weighted. *Years as principal include being an acting or permanent principal. The sample is limited to individuals who respond that they are the principal of the school. Of a total of 1 937 individuals who responded to the principal questionnaire, only 1 753 indicated that they were the principal responding. A further 40 are missing data on total years as a principal or acting principal while 48 are missing data on years as principal in the current school. SD = standard deviation; p10 = value at the 10th percentile; p50 = value at the 50th percentile (median); p90 = value at the 90th percentile.

Table 2A.4: Principal turnover disaggregated by type

	2004-2008		2008-2012	
	Frequency	Percentage	Frequency	Percentage
Principal turnover	4 746	23.4	6 365	28.7
No principal turnover	15 539	76.6	15 846	71.3
Total	20 285	100	22 211	100
Turnover by type				
Mobility (sub-total)	1 581	7.8	1 618	7.3
<i>Moves to a principal post in another institution</i>	864	4.3	840	3.8
<i>Moves to post in administration</i>	477	2.4	299	1.3
<i>Moves to lower rank in same institution</i>	25	0.1	121	0.5
<i>Moves into lower rank in another institution</i>	215	1.1	358	1.6
Attrition (sub-total)	3 165	15.6	4 747	21.4
<i>Retirement related (>=56 years in base year)</i>	1 455	7.2	2 922	13.2
<i>Non-retirement related (<56 years or less)</i>	1 710	8.4	1 825	8.2
Total turnover	4 746	23.4	6 365	28.7

Source: Persal-EMIS matched dataset. **Notes:** Compulsory retirement age for educators in South Africa is 65 years; but pensions can be accessed at 60 years without reducing take-home pension amounts. It follows that 60 is likely to be the *de jure* retirement age. Where turnover is identified between year t and t+4 then a principal is identified as likely to retire over the period if they are 56 years or older in year t.

Table 2A.5: Induction training for school principals, Systemic Evaluation 2004 and 2007

	Systemic Evaluation 2004 (Intermediate phase)			Systemic Evaluation 2007 (Primary phase)		
	All schools	Poorest 60% of schools	Wealthiest 20% of schools	All schools	Poorest 60% of schools	Wealthiest 20% of schools
Received induction training after appointed principal (%)	61.99 (1.65)	65.18* (2.07)	55.45 (2.69)	65.62 (1.01)	67.30* (1.30)	63.00 (1.65)
N (number of principals)	948	579	369	2 230	1 315	895

Source: National Systemic Evaluations 2004 and 2007. **Notes:** Standard errors are in parentheses. *The mean of the poorest sixty percent of schools is statistically significantly different from the mean of the wealthiest twenty percent schools using a 95 percent confidence interval. The wealth of schools is established by identifying the average socio-economic status (SES) of students in the school using an asset-based index of possessions. Where the number of poor and the wealthier schools do not add up to total schools, school SES is missing. **About the surveys:** The Intermediate Phase Systemic Evaluation in 2004 was conducted between September and October. Its main aim was to provide systems-based information about student performance at the intermediate phase in a sample of 998 schools designed to be representative of schools offering grade six. The survey was conducted to assess the competencies of students at the end of grade six in three learning areas: English, Mathematics and the Natural Sciences. Teacher, principal and home background questionnaires were also administered. The 2007 Systemic Evaluation, however, evaluated performance at the grade three level and 2 342 schools were visited. Schools in this sample are representative of schools with at least 15 grade three students.

The sequential logit model

Following an explanation by Nagakura and Kobayashi (2007), the sequential logit model first suggested by Martin Buis (2008) can be defined in the following way. In the general form, suppose an individual has J alternatives to choose from which can be divided into H sub-choice sets, A_1, A_2, \dots, A_H . The individual's choice process is separated into two stages. In the first stage, individuals choose between one of the H sub-choice sets and then in the second stage choose alternative $j \in A_h$. A multinomial logit model can be applied to model the two stages where the number of J alternatives exceeds three. In this application of the sequential logit model, the principals' decision framework is limited to only three alternatives: staying, moving within the system or leaving. With only three alternatives, each of the two stages in the principal's decision then reduces to a logit model. In the first stage, the sub-choices involve either staying in a position or transitioning out of the school. The second stage involves choosing between moving within the system and moving out of the system. The following models apply:

In the first stage

$$\Pr(y \in A_h) = \frac{\exp(x_i' \delta)}{1 + \exp(x_i' \delta)} \text{ for } h = 1 \text{ or } 2$$

In the second stage

$$\Pr(y = j | A_h) = \frac{\exp(x_i' \gamma)}{1 + \exp(x_i' \gamma)}$$

The same set of x covariates (school and principal characteristics) are applied to each stage but by nature of the model the coefficients on covariates are allowed to vary across each stage.

Table 2A.6: Sequential logit and multinomial logit estimations of principal transitions

	Multinomial logit				Stage 1 sequential logit			Stage 2 sequential logit		
	Moving vs. staying		Leaving vs. staying		logit (1 = turnover/transition out of school; 0 = stays in school)			logit (1 = move within system; 0 = leave system)		
	04-'08	08-'12	04-'08	08-'12	04-'08	08-'12 (1)	08-'12 (2)	04-'08	08-'12 (1)	08-'12 (2)
<i>Principal characteristics</i>										
Female	-0.396*** (0.119)	-0.449*** (0.128)	-0.261** (0.114)	-0.699*** (0.132)	-0.419*** (0.089)	-0.348*** (0.085)	-0.430*** (0.087)	-0.002 (0.173)	0.391** (0.176)	0.348* (0.184)
Age 26-34	1.113*** (0.166)	0.259 (0.232)	0.711** (0.294)	-0.103 (0.421)	0.774*** (0.143)	0.639*** (0.228)	0.399 (0.251)	0.807*** (0.263)	0.991** (0.437)	0.704 (0.531)
Age 35-39	0.568*** (0.098)	0.306*** (0.112)	0.432*** (0.128)	-0.134 (0.151)	0.451*** (0.077)	0.353*** (0.089)	0.265*** (0.100)	0.217 (0.143)	0.755*** (0.172)	0.538*** (0.196)
Age 40-44	0.129 (0.088)	0.221** (0.093)	0.320*** (0.096)	-0.056 (0.102)	0.171** (0.067)	0.181*** (0.068)	0.205*** (0.072)	-0.117 (0.125)	0.557*** (0.133)	0.371*** (0.139)
Age 50-54	-0.430*** (0.097)	0.703*** (0.083)	-0.337*** (0.109)	0.339*** (0.081)	0.234*** (0.064)	0.182*** (0.063)	0.03 (0.066)	-1.159*** (0.125)	-1.212*** (0.130)	-0.807*** (0.140)
Age 55-59	-0.921*** (0.168)	1.920*** (0.086)	-0.420** (0.170)	1.792*** (0.085)	1.173*** (0.071)	1.673*** (0.063)	1.299*** (0.073)	-2.836*** (0.184)	-3.092*** (0.163)	-2.288*** (0.196)
Age 60	0.581** (0.275)	3.833*** (0.140)	0.368 (0.331)	3.477*** (0.138)	3.064*** (0.130)	3.561*** (0.117)	2.953*** (0.129)	-3.209*** (0.269)	-4.200*** (0.333)	-3.230*** (0.326)
Indian/Asian	-1.306** (0.615)	-0.225 (0.458)	-1.150** (0.576)	-1.504*** (0.417)	-0.754** (0.375)	-1.597*** (0.346)	-1.622*** (0.352)	-1.307* (0.723)	-0.127 (0.856)	-0.245 (0.854)
Coloured	-1.176*** (0.280)	-0.004 (0.303)	-0.683** (0.321)	0.005 (0.322)	-0.619*** (0.219)	-0.286 (0.240)	-0.329 (0.239)	-1.075*** (0.376)	-1.009** (0.502)	-0.978* (0.501)
White	-0.637** (0.253)	-0.058 (0.273)	-0.793** (0.311)	-0.252 (0.294)	-0.390** (0.197)	-0.758*** (0.227)	-0.610*** (0.226)	-0.740** (0.357)	-0.476 (0.474)	-0.743 (0.477)
>=80% black students	-1.047*** (0.173)	-0.014 (0.219)	-0.428* (0.251)	0.164 (0.249)	-0.564*** (0.150)	-0.213 (0.190)	-0.14 (0.188)	-1.081*** (0.303)	-0.805** (0.385)	-0.889** (0.392)
Asian * >=80% black students	1.899*** (0.541)	0.415 (0.421)	1.219** (0.543)	0.861** (0.405)	1.114*** (0.338)	1.221*** (0.328)	1.201*** (0.333)	1.536** (0.754)	1.039 (0.824)	1.134 (0.853)
Coloured* >=80% black students	2.195*** (0.356)	0.294 (0.393)	0.729 (0.474)	0.185 (0.400)	1.299*** (0.284)	0.417 (0.321)	0.435 (0.323)	2.127*** (0.521)	1.166 (0.752)	0.99 (0.733)
White* >=80% black students	2.182*** (0.260)	0.217 (0.286)	0.502 (0.356)	0.45 (0.303)	1.180*** (0.209)	0.684*** (0.240)	0.599** (0.239)	2.152*** (0.407)	0.205 (0.524)	0.202 (0.532)

Continued....	Multinomial logit				Stage 1 sequential logit			Stage 2 sequential logit		
	Moving vs. staying		Leaving vs. staying		logit (1 = turnover/transition out of school; 0 = stays in school)			logit (1 = move within system; 0 = leave system)		
	04-'08		08-'12		04-'08	08-'12 (1)	08-'12 (2)	04-'08	08-'12 (1)	08-'12 (2)
REQV 10-12			-0.116 (0.187)	0.796*** (0.117)			0.527*** (0.106)			-0.849*** (0.231)
REQV 13			0.045 (0.084)	0.210*** (0.056)			0.166*** (0.048)			-0.261** (0.115)
REQV 15			0.302*** (0.074)	-0.142*** (0.054)			0.004 (0.045)			0.345*** (0.102)
REQV 16-17			0.394*** (0.088)	-0.297*** (0.066)			-0.083 (0.055)			0.603*** (0.128)
Salary in R1000s in 2008 prices			-0.013*** (0.002)	0.002 (0.001)			-0.004*** (0.001)			-0.010*** (0.002)
Years of service			-0.019 (0.021)	-0.091*** (0.016)			-0.102*** (0.012)			0.037 (0.029)
Years of service squared			0 (0.001)	0.003*** (0.000)			0.003*** (0.000)			-0.002*** (0.001)
Number of sick leave days taken			0.018*** (0.004)	0.035*** (0.003)			0.030*** (0.002)			-0.018*** (0.005)
Moved schools 2004-2008			0.371*** (0.124)	0.228** (0.096)			0.275*** (0.080)			0.121 (0.168)
School characteristics:										
School location: Urban	0.071 (0.075)	0.012 (0.062)	-0.206** (0.084)	0.004 (0.059)	0.036 (0.050)	-0.098** (0.049)	-0.077 (0.050)	0.099 (0.103)	-0.339*** (0.115)	-0.265** (0.118)
School phase: Combined	-0.01 (0.100)	-0.017 (0.080)	0.257** (0.104)	0.085 (0.072)	-0.021 (0.066)	0.106* (0.059)	0.147** (0.060)	-0.028 (0.126)	0.032 (0.142)	0.064 (0.145)
School phase: Secondary	0.501*** (0.070)	0.118** (0.058)	0.609*** (0.080)	0.205*** (0.057)	0.263*** (0.047)	0.198*** (0.047)	0.333*** (0.050)	0.383*** (0.095)	0.404*** (0.103)	0.415*** (0.111)
Number of teachers per 100 students	0.036** (0.014)	0.018 (0.014)	0.064*** (0.023)	0.041*** (0.015)	0.027** (0.011)	0.062*** (0.019)	0.057*** (0.018)	0.014 (0.025)	0.047 (0.032)	0.043 (0.033)
Total enrollment in 100s	-0.044*** (0.011)	-0.015* (0.008)	-0.014 (0.019)	-0.022** (0.010)	-0.025*** (0.007)	-0.045*** (0.008)	-0.016* (0.009)	-0.046*** (0.014)	-0.080*** (0.018)	-0.019 (0.022)

Continued....	Multinomial logit				Stage 1 sequential logit			Stage 2 sequential logit		
	Moving vs. staying		Leaving vs. staying		logit (1 = turnover/transition out of school; 0 = stays in school)			logit (1 = move within system; 0 = leave system)		
	04-'08	08-'12	04-'08	08-'12	04-'08	08-'12 (1)	08-'12 (2)	04-'08	08-'12 (1)	08-'12 (2)
Quintile 2	0.009 (0.075)	-0.032 (0.061)	-0.039 (0.076)	-0.065 (0.054)	-0.015 (0.049)	-0.067 (0.045)	-0.07 (0.045)	0.002 (0.101)	0.017 (0.102)	0.012 (0.105)
Quintile 3	0.157** (0.079)	-0.028 (0.064)	0.04 (0.081)	-0.215*** (0.059)	0.04 (0.052)	-0.153*** (0.048)	-0.137*** (0.049)	0.11 (0.105)	0.072 (0.112)	0.095 (0.115)
Quintile 4	0.249** (0.111)	0.001 (0.091)	0.213* (0.119)	-0.14 (0.085)	0.096 (0.074)	-0.009 (0.071)	-0.021 (0.072)	0.208 (0.150)	0.196 (0.167)	0.211 (0.174)
Quintile 5	0.14 (0.154)	-0.134 (0.123)	0.287* (0.162)	-0.162 (0.118)	-0.032 (0.101)	0.023 (0.098)	0.004 (0.100)	0.028 (0.201)	0.366 (0.233)	0.405* (0.240)
Independent Homeland	-0.289*** (0.103)	-0.230*** (0.085)	-0.379*** (0.116)	-0.241*** (0.076)	-0.275*** (0.069)	-0.326*** (0.065)	-0.291*** (0.066)	-0.192 (0.138)	-0.280* (0.153)	-0.218 (0.158)
Non-independent homeland	-0.339*** (0.105)	0.125 (0.084)	-0.286*** (0.105)	0.191** (0.078)	-0.043 (0.068)	-0.016 (0.064)	0.049 (0.065)	-0.461*** (0.139)	-0.281** (0.142)	-0.148 (0.145)
House of Assemblies	-0.938*** (0.199)	0.062 (0.183)	-0.172 (0.212)	-0.236 (0.171)	-0.364** (0.143)	-0.255* (0.139)	-0.19 (0.140)	-0.943*** (0.256)	-0.348 (0.297)	-0.285 (0.299)
House of Delegates	-0.840* (0.504)	-0.691* (0.380)	0.133 (0.443)	0.521* (0.306)	-0.780** (0.317)	0.333 (0.258)	0.367 (0.266)	-0.289 (0.635)	-0.366 (0.658)	-0.315 (0.623)
House of Representatives	-0.333* (0.200)	-0.219 (0.207)	-0.283 (0.233)	-0.367* (0.204)	-0.263* (0.154)	-0.332** (0.157)	-0.320** (0.160)	-0.201 (0.270)	0.215 (0.321)	0.262 (0.318)
New School	-0.423*** (0.121)	-0.015 (0.109)	-0.280** (0.117)	-0.016 (0.098)	-0.189** (0.085)	-0.163** (0.080)	-0.124 (0.080)	-0.447*** (0.166)	-0.181 (0.166)	-0.179 (0.165)
Former classification unknown	-0.181 (0.216)	0.083 (0.187)	-0.236 (0.186)	0.1 (0.144)	-0.032 (0.148)	-0.087 (0.117)	-0.028 (0.118)	-0.557** (0.282)	-0.403* (0.236)	-0.422* (0.242)
Constant	-0.884*** (0.227)	-2.033*** (0.252)	0.558 (0.490)	-1.953*** (0.372)	-0.704*** (0.182)	-1.176*** (0.234)	0.114 (0.321)	1.502*** (0.359)	0.497 (0.475)	2.903*** (0.653)
Pseudo R-squared	0.137		0.231		0.107	0.159	0.177	0.245	0.381	0.406
Log likelihood	-12 100		-12 800		-9 813	-11 100	-10 800	-2 276	-2 205	-2 091
Number of observations	20 155		22 035		20 155	22 105	22 035	4 733	6 299	6 231

Source: Persal-EMIS matched dataset. **Notes:** Omitted categories are principal is male, principal is aged 45 to 49, principal is black, student composition is non-majority black (<80%), principals with a REQV level of 14, rural schools, primary schools and quintile one schools. Province dummies are included but not shown. Female interactions with age are included but are not shown. Sample sizes vary for the 2008 to 2012 regressions due to missing information on principal characteristics. Standard errors are in parentheses.

Statistically significant at *p<0.10, **p<0.05, ***p<0.01.

Chapter 3

Principal leadership changes, school performance and teacher turnover in South Africa

3.1 Introduction

The rising age profile of school principals in South Africa presents an imminent opportunity for improving the leadership trajectories of schools. However, these principal retirements also pose significant challenges for education planners. Provinces will not only have to expend resources recruiting a substantial number of principal replacements, but there may be other knock-on effects of school leadership changes on the school system.

Although there is an increasing consensus that principals matter for school performance, a growing body of literature explores whether the event of a principal leadership change, or typically referred to as ‘principal turnover’, may initially create instability in school environments mitigating the intended gains expected from principal replacements (Beteille, Kalogrides and Loeb, 2012; Miller, 2013). In this regard, Beteille *et al* (2012) argue that it is unclear whether these leadership changes are likely to have beneficial or detrimental effects on school outcomes. This chapter explores how principal leadership changes affect school performance in the short to medium term in the developing country context of South Africa using the administrative panel dataset constructed for this broader study on school principals.

The chapter proceeds with a review of the international literature on the impacts of principal turnover on the school environment. The estimation sample of schools with grade 12 students is then described, followed by a discussion of the identification strategies used to detect the impacts of principal turnover on school performance. A key theme that emerges in the discussion is the challenge of disentangling the impacts of a turnover event on learning outcomes from various sources of endogeneity that may influence both a principal’s decision to move out of a school and learning outcomes. In exploiting the panel structure of the administrative dataset, a school fixed effects strategy is initially used to control for unobserved heterogeneity at the school level that may confound estimates of principal turnover. The results suggest that leadership instability may be detrimental to school outcomes, particularly where the leadership change is initiated through a principal exiting the

public education system. However, even after conditioning on permanent school characteristics the assumption that principal departures are as good as random may not hold (Miller, 2013). In response, an alternative estimation strategy following the work of Heckman, Ichimura and Todd (1997) is used which combines propensity score matching with difference-in-difference estimation (PSM-DiD) to test the robustness of the fixed effects results. This robustness check provides some support for the conclusions of the fixed effects model.

In exploring potential mechanisms by which principal leadership changes affect student achievement, the final part of the chapter identifies how teacher turnover responds to principal leadership changes. There is suggestive evidence that teacher turnover rises in response to principal leadership changes, at least in the primary school sample. However, rising teacher turnover does not explain the decline in matriculation examination outcomes related to a principal change in secondary schools.

3.2 Background literature on principal turnover effects

Principals play a pivotal role in school functioning, upholding the operational management of schools, coordinating teachers, disciplining and motivating students while providing instructional leadership. As identified in the previous chapter, a growing evidence-base using valued-added models provides convincing evidence that school principals matter for school effectiveness and student outcomes (Branch, Hanushek and Rivkin, 2012; Chiang, Lipscomb and Gill, 2012; Grissom, Kalogrides and Loeb, 2015; Coelli and Green, 2012). Grissom *et al* (2015), in reviewing these studies of principal effectiveness in the United States and Canada, note educationally significant impacts on student performance ranging between 0.05 to 0.16 standard deviations. This research implies that changes in leadership can be beneficial when lower quality principals are replaced with better ones. As succinctly stated by Leithwood et al (2004) in a review of case studies on school leadership and how it influences student learning in the education administration literature,

Indeed, there are virtually no documented instances of troubled schools being turned around without an intervention by a powerful leader. Many other factors may contribute to such turnarounds, but leadership is the catalyst (Leithwood et al., 2004: 7).

Despite considerable consensus that principals matter for school performance by both education scholars and economists, a growing literature explores whether principal turnover may actually create instability in school environments, mitigating the intended gains expected from principal replacements (Miller, 2013; Beteille, Kalogrides and Loeb, 2012; Weinstein et al., 2009). Prior to these studies, organisational stability has been identified as an important aspect of well-functioning

education systems and schools (Hallinger and Heck, 1996).⁴⁴ At a systems level, research has identified that sustained leadership, either in the form of longer tenure or smooth leadership transitions, is a key characteristic of education systems that have experienced sustained learning improvements. The purpose and vision underlying an education system's pedagogy and improvement is argued as being sustained through seamless leadership transitions (Mourshed, Chijioke and Barber, 2010). At the school level, studies on organisational instability in the form of teacher turnover have suggested that frequent changes in teachers can undermine efforts to implement a school's instructional program. In reference to teacher turnover, Ronfeldt *et al* (2011: 2) note that

Turnover may impact student achievement beyond the relative effectiveness of those who stay as compared to those who leave. When teachers leave schools, for example, previously held relationships and collaborations are lost, and new ones form.

Similarly, principal turnover may negatively affect student achievement as it destabilises the school environment. Citing Miskel and Cosgrove (1985), Hart (1991: 451) identifies that a leadership succession is a disruptive event that alters lines of communication, realigns relationships of power within the school, affects decision-making processes and generally disturbs the equilibrium of normal activities. Practically, it may lower employee commitment and morale as teachers may struggle to adjust to the new leaders' ideas and systems. Furthermore, institutional knowledge is potentially removed from the environment as the outgoing principal leaves, and the incoming principal may adjust slowly to the new role and 'social organisation' of the school (ibid, 1991). Ultimately, this can impact on student achievement as school functionality is disrupted or the school's composition is altered. Beteille *et al* (2012: 915) observe that principal turnover negatively affects student achievement because better teachers tend to leave schools when the principal leaves. These better teachers are not immediately replaced where a lack of experience on the part of the new principal or other institutional dynamics constrain principals from hiring effective replacement teachers or providing new teacher hires with the support they need to be effective.

In other organisational contexts, such as private sector firms, positive effects of managerial replacements are commonly observed. Managerial exits are often driven by shareholders replacing poor performing managers with those more suited for the job (Denis and Denis, 1995). By contrast, in the principal labour market the majority of principal exits are likely to be voluntary. These transitions are less likely to mean that outgoing leaders are replaced with those that are more effective (Branch, Hanushek and Rivkin, 2012). This is especially the case in South Africa where less than one in a 1000

⁴⁴ Instability in education policy, curriculum and in key education leadership positions has been identified as a threat to school functioning in the South African context. While it does not mention instability at the school level, the 2013 NEEDU report highlights how frequent changes in leadership positions are a threat to provincial and district level administration and effectiveness (Taylor, 2014).

principals are dismissed per year and the majority of principal leadership changes are due to principal retirements (Wills, 2015).

However, even where lower quality principals are replaced with better ones, school performance may initially decline and only improve with time. Substantial changes and disruptions to 'business as usual' may have to take place before improvements can be realised. Furthermore, research indicates that it may take several years for new school leaders to have their full effect on student learning as identified by Coelli and Green (2012) in British Columbia, Canada. In addition to an adjustment period associated with a leadership succession, delayed leadership impacts may also be attributed to principals having largely indirect effects on learning. Unlike teachers, principals are often not directly engaged with classroom instruction but impact on learning indirectly through three overarching mechanisms: establishing purposes and goals, through people, and through the organisational culture (Leithwood et al., 2004; Hallinger and Heck, 1996). The economics literature is less clear on these mechanisms, but selecting and hiring better teachers while firing under-performers is considered important (Branch, Hanushek and Rivkin, 2012), as well as effective administration and organisational management (Grissom and Loeb, 2011). Yet it takes time to attract and hire better teachers, especially in systems such as South Africa where poor-performing teachers are very difficult to dismiss and school leaders are not directly responsible for the hiring and firing of teachers. Moreover, adopting new policies and procedures may be slow processes requiring buy-in from School Governing Board (SGB) members, staff and school-based union members.

Empirical studies of principal turnover effects on learning, all of which are located across different districts and states in the United States, provide evidence for both negative (Beteille, Kalogrides and Loeb, 2012; Weinstein et al., 2009) as well as positive effects (Miller, 2013). While the mixed evidence may be attributed to actual heterogeneous principal turnover effects across states and samples analysed, it is also entirely plausible that estimations have been compromised by various sources of confounding factors that must be controlled for in isolating the impact of a principal turnover event. Principal departures from a school may be non-random. For example, the decision to move out of a school may be correlated with the unobserved conditions at the school or student ability, which in turn may be correlated with school outcomes. School and student fixed effects models are typically used to deal with these unobserved sources of endogeneity.

Miller (2013) notes, however, that even after conditioning on permanent school characteristics, fixed effects strategies may be inadequate in dealing with non-random principal departures. She also highlights that declines in school and student performance in years preceding a principal departure may compromise the validity of difference-in-difference and fixed effects estimates. In illustrating this problem, Miller (2013) adopts a method by Jacobson, LaLonde, and Sullivan (1993) to measure how schools perform relative to their usual performance before, during, and after a principal change.

In her North Carolina sample, school performance declines in years preceding the principal leadership departure. It continues to decline up until the first two years after the leadership change but then rebounds in the third year. School performance only reaches its level prior to the change from the start of the fifth year of the new principal. Application of the estimation procedure by Jacobson et al (1993), however, is data intensive and is not suited to the short panel dataset available to the author.⁴⁵ As an alternative strategy, I use propensity score matching with difference-in-difference (PSM-DiD) in addressing remaining bias in the estimations.

Another related complication in estimating principal turnover effects is that decisions to move out of a school may be correlated with the existing ability or preferences of the principal, which may also affect school outcomes (Miller, 2013).⁴⁶ It is argued, however, that whether one wants to control for principal ability in estimations depends on the research question at hand. If the researcher is concerned about identifying the *net* impact on learning of leadership changes facing South African schools in general, then it is likely not necessary to isolate out the impact of the leadership change event from the ability of incoming and outgoing principals. However, if policy-makers were monitoring the effectiveness of current recruitment and selection policies, they may want to know whether the quality of new principal replacements has been satisfactory. In this case, it would be necessary to separate out the impact of the leadership change event from principal ability. This is a data-intensive exercise currently not possible with available datasets on schooling in South Africa.⁴⁷ The research that follows is only able to address the first research question, identifying what the *net* impact of principal leadership changes is likely to be on the school environment. What is likely to be more important in answering this research question is establishing the duration over which impact is

⁴⁵ Jacobson et al's (1993) method requires panel datasets linking schools to comparable measures of school performance over many periods and to information on school principals over the same period that identifies their years of tenure in each school that they serve. Neither is available to the author.

⁴⁶ The negative effects of a principal turnover event may be overestimated where the ability of the outgoing principal exceeds that of the incoming principal. Alternatively, it may be underestimated where there is a net increase in principal effectiveness through the leadership change.

⁴⁷ Controlling for the confounding effects of principal quality on turnover decisions requires either an instrumental variable (IV) that is correlated with turnover but uncorrelated with the student performance or a valid 'value-added' measure of principal effectiveness. Due to data constraints, finding a suitable IV is problematic and identifying value-added measures of principal effectiveness is virtually impossible with currently available data in South Africa. This requires sophisticated modelling with large-scale panel datasets that follow students, teachers and principals over time and contain standardised test scores that are both horizontally and vertically comparable to obtain value-added estimates of principals (Grissom, Kalogrides and Loeb, 2015). While considerable data progress has been made in educational research in South Africa in recent years, we are many years away from having data as extensive as this to model the effects of both teacher and principal quality on student outcomes in this way. Even if students and teachers could be tracked across time and across the schooling system, which is becoming increasingly probable with new data systems such as 'Lurits' which stands for "Learner Unit Record Tracking System", we do not have strictly standardised test scores against which to track individual student progress in the majority of provinces. The school level panel dataset constructed for this study moves one step forward, allowing one to track the movement of principals and teachers into, out of and across schools.

measured. Depending on the length of time elapsed between when a principal leaves and when impact is measured, estimates will vary notably (Miller, 2013). Within the constraints of the data available, only short-term impacts within a 0 to 24 month period following the leadership change are considered in this study. *A priori*, these impacts are expected to be negative as any anticipated gains of principal replacements are unlikely to have yet been realised in schools in the short-term.

3.3 Data

To investigate the impact of school leadership changes on school outcomes, a subset is used of the larger administrative panel dataset constructed by linking South African payroll data on educators (referred to as Persal data) to administrative data on schools. Consistent with the analysis of how principal credentials are associated with school performance in chapter two, the full dataset is limited to those schools with grade 12s in each of three years (2008, 2010 and 2012) that can be matched to school performance data as expressed through the matriculation examination results.⁴⁸

Four key school performance measures are used in estimating principal turnover effects as expressed in Table 3.1. The first three measures are indicators of school performance in the National Senior Certificate (NSC). Following the estimation in chapter two, the average mathematics percentage among mathematics takers is used as well as a school's percentage pass rate in the NSC. Additionally, the percentage of mathematics takers who pass this examination is also included as a measure. The reader is referred to the previous chapter for a fuller discussion on these examination outcomes. Additionally, the promotion rate of students from grade 10 to grade 12 is used as a non-examination based school outcome. The promotion rate is expressed as the ratio of grade 12 enrolments in school i in year t to grade 10 enrolments in school i in year $t - 2$ as recorded in the Snap data. In the absence of school switching by pupils, this measure provides a proxy for dropout and repetition which is prevalent in the FET phase.⁴⁹ In this dataset, the average promotion rate was roughly 57 percent over the three waves of data.

A maximum of 4 518 schools are available for the estimations over three 'waves' of data. This represents 77 percent of the total number of 5 865 public ordinary schools that were identified as

⁴⁸ Again, the author drew on a school level matriculation examination series dataset constructed by Martin Gustafsson in modelling the impact of South Africa's 2005 provincial boundary changes on school performance (Gustafsson and Taylor, 2013).

⁴⁹ It may be argued that promotion rates are also amenable to national, provincial and local pressures around the criteria to use when promoting students into Grade 12 from Grade 11 which may change from year to year (Gustafsson and Taylor, 2013). In gaming matriculation results, school principals may artificially raise school performance by holding back weaker students in the grade 10 and 11 years. Towards the end of 2013, a new regulation was gazetted that a student can only fail once in the FET phase (RSA DBE, 2012a). While this regulation would reduce the legitimacy of this promotion rate as a measure of school performance, the national regulation would not yet have applied to the cohort of students considered in this dataset.

having grade 12 enrolment in 2008, 2010 and 2012 in the Snap data. As noted in the appendix to this thesis, connecting the administrative datasets is a challenging task. Of a total number of 5 865 public ordinary schools with grade 12 students, a remaining 23 percent of schools could not be linked to a principal in at least one of the three years in question and are excluded from the estimations. Principal vacancies in some years could account for non-matching. Unfortunately, it is not possible to confirm whether the cause of non-matching is that the principal position is vacant or whether this reflects a problem in linking identifiers across datasets. It is acknowledged that these unmatched schools may be substantively different from those that are linked to a principal in all three waves. This may present sample selection concerns for the estimations that follow.

Table 3.1: School performance measures

	Mean	Standard deviation	P10	P95	N
% who pass mathematics	47.85	28.66	14.29	97.50	12 819
Average mathematics %	31.27	13.45	18.32	54.03	12 819
% who achieve the NSC	63.45	24.27	40.37	98.48	13 458
Grade 10 to12 promotion rate	56.75	24.28	28.02	96.90	13 514

Source: Pearsal-EMIS matched dataset, connected to matriculation examination data. **Notes:** Calculations are based on sample sizes used in the OLS estimations in Table 3.2. P10 = school performance at the 10th percentile, P95 = school performance at the 95th percentile.

In the appendix to this chapter, Table 3A.1 compares the descriptive statistics of schools depending on whether they are connected to a principal in all three waves. It confirms that there are significant differences in the observable characteristics across these two groups. Schools that are not connected to a principal in all three waves are smaller (both in terms of student enrolment and student numbers), are more likely to be located in rural areas, have lower matriculation pass rates in the NSC and have a larger majority of black students. Moreover, principal turnover is less common in schools that could be linked to a principal in all three waves when compared to principal turnover rates calculated using principals as the unit of analysis. For example, in the grade 12 sample dataset connected to a principal in all three waves, principal turnover between 2008 and 2010 was eight percent. However, 15 percent of principals in schools offering grade 12 in 2008 moved out of their schools between 2008 and 2010. In the analyses that follow the sensitivity of the results to the exclusion of schools that are not matched to a principal in each year is considered.

3.4 A school fixed effects estimation approach

Method explained

Fixed effects estimation strategies are typically used to isolate the principal turnover effect from unobserved school and student characteristics that influence not only a principal's decision to leave a

school but school outcomes. The logic of the approach is that the fixed effects absorb these time-invariant differences in school and student factors that confound estimates. As a starting point, a school fixed effects strategy is initially used; then the validity of the estimation results is evaluated in light of the identifying assumptions of the strategy. In the following regression framework, school performance is expressed as a function of school and principal characteristics and the characteristics of a school's student body.

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 D_{it} + \pi_i + \pi_t + \varepsilon_{it}$$

Here Y_{it} is the measure of performance of school i in year t , and X_{it} is a vector of time-variant school and principal characteristics. D_{it} is the 'treatment' indicator which takes on a value of one at time t if the school experiences a principal turnover event between year t' and t where $t' < t$. The term π_i reflects school-specific fixed effects and ε_{it} is an idiosyncratic error term which is assumed to be serially uncorrelated over time. Year fixed effects as reflected in π_t are also included. The parameter of interest, β_2 , measures the within-school effect of a principal leadership change event. Each school serves as its own control group where school performance outcomes following a principal leadership change are compared to performance outcomes in years in which there is no change.

The school fixed effects identification strategy assumes that principal turnover is as good as random, conditional on time-invariant school characteristics. The only source of confoundedness should be fixed over time. However, the likelihood of a leadership change may be affected by time-varying school and student factors that also influence grade 12 performance measures. For example, if principals have preferences for posts in schools with wealthier rather than poorer students, declines in the socio-economic composition of students at their school or falling levels of school resourcing may induce principals to leave their schools.

In response, proxies for time-varying school changes are included in the model. Teacher-to-pupil ratios are used to capture changes in school resourcing. The motivation for this is that higher levels of funding through the collection of school fees (or other donations) enable schools to hire School Governing Body (SGB) paid teachers in addition to their state assigned quota. Student socio-economic composition is proxied by the proportion of all students enrolled at the school that are racially identified as black in Annual Survey of Schools data. Due to historical apartheid legacies, race has been closely tied to socio-economic status where black students have typically come from poorer backgrounds than other race groups.

A noted limitation of the data is that it does not follow students longitudinally to control for individual student fixed effects. In this regard, the identification strategy requires that principals did not move in response to sudden changes in the quality of students and that there is no student sorting in response to principal turnover (Coelli and Green, 2012). Considering the first of two complications, analysis of

teacher movements in South Africa by Gustafsson (2016) suggests that school quality, as measured by matric performance, is associated with teachers' choices about schools. Where the principal labour market tracks the teacher labour market (Clotfelter et al., 2007), principals' decisions to move schools may also be informed by relative differences in the 'quality' of students across schools. However, Gustafsson (2016) finds teachers' decisions to move is based on relatively outdated information on schools' performance rather than recent performance data. This potentially alleviates concerns that decisions to leave a school are made on the basis of sudden changes in the quality of students. Regarding the second complication, it is unclear to what extent student sorting may respond to principal changes at the FET phase. The choice of public school in South Africa is regulated by legislation. Geographic catchment policies technically limit an individual's choice of school to a geographic area; but these rules are not strictly adhered to and catchment areas are often poorly defined. Researchers have documented how students are attending schools outside of their geographical areas to access better quality education (de Kadt, 2011); and at the FET phase there is evidence that students are attending schools that are not the nearest school to which they live (Cosser and du Toit, 2002). Yet little is known about how much students are actually switching schools during, specifically, their last three years of school. If better students leave schools in response to a principal change, this will overestimate the negative effects of a principal change event on school outcomes. Without data that follows students over time, it is not possible to evaluate to what extent this is a problem for the estimations that follow.

Model specifications and heterogeneous effects

With respect to model specifications, two fixed effects regressions are run for each of the four outcome measures considered. Ordinary least squares (OLS) estimates, controlling for a host of principal and school characteristics, are also reported as benchmark estimates.

The regression specifications vary in their inclusion of time-varying school and principal characteristics. In the first fixed effects specifications, only year and school fixed effects are included. The second specification extends the number of controls to include time-varying school characteristics namely; school enrolment, teacher-to-pupil ratios (expressed as the number of teachers per hundred students) and the percentage of students who are black. In the third specification, principals' educational qualifications and proxies for their previous experience in public school management are also included. In the estimations, principal qualifications are based on their Relative Educational Qualifications Value (REQV) recorded in payroll which range from 10 to 17. Indicators for previous management experience are generated using the principals' previous position in 2004. This position could be a school management post as a principal, deputy or head of department, or alternatively a non-management position as a teacher or simply not being in the public education system at all. The international literature notes that it is important to control for experience in

measuring principal turnover effects. As identified by Clark, Martorell and Rockoff (2009), if there are positive returns to principal experience with respect to student learning, any effect of a principal change on school performance may in part be attributable to the lower levels of experience of the incoming principal. Descriptive statistics of the control variables used are provided in the appendix, Table 3A.2.

Initially, estimations are run on the full sample of schools offering grade 12 that could be linked to principal and outcome variables. Estimations are then limited to a sub-sample of poorer schools (quintile one to three schools). A common thread emerging from studies on principal turnover is that marginalised schools are especially at risk of the negative consequences of principal leadership changes. A higher incidence of principal turnover in these schools aggravates existing inequalities in the distribution of quality leaders where poorer and weaker performing schools also struggle more to attract good principals (Beteille, Kalogrides and Loeb, 2012; Loeb, Kalogrides and Horng, 2010; Gates et al., 2006). Contrary to the U.S. literature, there is no clear evidence that poorer schools in South Africa are unequally exposed to principal leadership changes. The sheer number of leadership changes taking place in these schools, however, presents a potential concern for stability. Furthermore, poorer and weaker performing schools may have fewer institutional systems in place or managerial resources to maintain levels of school functionality during a transitional period in school management and leadership. It is also possible that in poorer schools, political disruptions associated with promotion post appointments may result in more destabilising consequences for school functionality. A report by South Africa's independent body tasked with evaluating the provision of education highlights the irregularities associated with the appointment of personnel into promotion posts and associated conflicts where actual appointments do not meet the demands of unions, the recommendations of politicised School Governing Bodies or traditional authorities (Taylor, 2014). These concerns are likely to be more prevalent in the poorer part of the school system which is unequally exposed to the rent-extracting influence of organised interest groups (Wills, 2014).

It follows that the analysis investigates whether principal turnover impacts are larger when the estimation sample is limited to poorer schools that are also characterised by lower levels of school performance. Poorer schools are identified as non-fee paying quintiles one to three schools as per the official quintile classification status provided by the Department of Basic Education.⁵⁰

⁵⁰ There is likely to be some inaccuracy in using quintile classifications to determine a school's wealth status where the quintile classification is determined not on the basis of the socioeconomic status of students in the school but the infrastructural development of the area in which a school is located. Nevertheless, this classification has been found to distinguish worse from better performing parts of the school system in South Africa (Spaull, 2013a) and can probably be regarded as a fair proxy for socio-economic status.

Results

The results of the school fixed effects estimations of matriculation examination outcomes are reported in Table 3.2 for the grade 12 school sample and the limited sample of poorer schools (quintiles one to three). Considering the full grade 12 school sample results, here OLS estimates suggest a statistically significant effect of principal turnover on matriculation outcomes of about a 2.6 percentage point reduction in the percentage of mathematics takers who pass mathematics, a 0.8 percentage point reduction in the average mathematics score and a 2.4 percentage point reduction in the percentage of examination takers who pass the NSC. Once controlling for unobserved school heterogeneity in the three fixed effects specifications, the negative coefficients on principal turnover reduce in magnitude. The coefficients on principal turnover estimates of the percentage pass rate in mathematics and the average mathematics scores are no longer statistically significant after accounting for time-varying school and principal characteristics. However, in a similar estimation of the schools' overall NSC pass rate, a statistically significant effect of about a 1.3 percentage point decline is identified. This suggests that within 0 to 24 months of a principal leadership change, a school will experience a slight reduction in their NSC matriculation pass rate compared with periods in which no leadership transition takes place. An effect of a principal leadership change on the NSC pass rate remains over and above controlling for differences in the experience of the incoming and outgoing principals.

As expected, when limiting the sample to only quintiles one to three schools the magnitude of the negative coefficients on principal turnover are larger and more significant. For example, in the third fixed effects specification for the poorer school sample in Table 3.2, principal turnover is associated with a 2.2 percentage point decline in the school's NSC pass rate. Moreover, principal turnover is found to have a statistically significant negative effect on the percentage of mathematics takers who pass this examination (roughly a two percentage point reduction). A one percentage point decline in the average mathematics score is also identified.

Estimation results using grade 10 to 12 promotion rates as the measure of school performance tell quite a different story as reflected in Table 3.3. Principal turnover is associated with a slight *rise* in promotion rates in both the full sample and in poorer schools. In the OLS regressions a statistically significant increase of 1.4 to 1.8 percentage points in the grade 10 to 12 promotion rate is identified. In the fixed effects regressions, however, the coefficients reduce in magnitude and become statistically insignificant. One possible explanation for this non-negative result is that adjustments to the promotion rate is one mechanism through which matriculation results decline following the introduction of a new principal.⁵¹ If incoming principals are initially less concerned about the schools'

⁵¹ Another argument is that grade promotion rates are longer term indicators of school performance and may be less sensitive to leadership changes if promotion practices are entrenched in school policy or ways of doing

reputation in the matriculation examination, they may be more lenient in promoting students to the next grade. A negative association between promotion rates and performance in the NSC is confirmed when including the promotion rate as an additional control in estimations of the NSC pass rate. As identified in Table 3.4, the magnitude of the principal turnover effect declines after controlling for the promotion rate. Some of the negative impact on school leaving outcomes accompanying the principal leadership change may be attributed to rising promotion rates where a larger group of weaker students are included in a school's examination cohort. The last section of this paper, explores another mechanism through which principal leadership changes may affect the school environment namely, through rising levels of teacher turnover.

As noted in chapter two, principal turnover can be distinguished into two flows: mobility and attrition. Attrition may include exits out of the public education system for retirement or non-retirement reasons including taking up a position in the private sector. To identify whether each flow is likely to have differential impacts on school performance, another set of estimations of matriculation examination outcomes were run as identified in Table 3.5. Significant negative effects of principal turnover are identified on the principal attrition indicator. Principal attrition is associated with a 1.7 percentage point decline in the percentage of mathematics takers who pass and a 1.5 percentage point decline in the schools' NSC pass rate as shown in the third fixed effects specification. For the poorer school sample, much larger and strongly significant negative effects are observed on the principal attrition indicator for all three examination outcomes. The percentage pass rate in mathematics falls by as much as four percentage points, the average mathematics percentage by 1.8 percentage points and the NSC pass rate declines by 3.2 percentage points in response to a principal exit from a school and the public education system. What is interesting is that compared to schools where the principal stays put, schools whose principal moves to another post in the education system do not experience lower matriculation examination outcomes. This result holds regardless of the performance measure considered or whether one limits the sample to poorer quintile one to three schools. This result may be explained by the possibility that those principals who access other positions in the system may be of better quality, establishing good systems and levels of functionality that can withstand a leadership transition.⁵² The non-result could also be attributed to the lack of variation in the principal mobility indicator which results in imprecise estimates.

things and are only likely to change with time. While matriculation outcomes may be sensitive to disruptions to short term learning strategies implemented by the principal such as extra lessons or extended tuition hours, grade promotion rates are possibly less amenable to the principal's leadership approach in the short term. This agrees with work by Coelli and Green (2012) who find that principals have a much larger impact on test scores than on graduation rates in the short run.

⁵² There is an opposing view here as suggested through recent discussions with school district managers in South Africa. Where dismissals for non-performance are very difficult, an approach taken to rid a school of an underperforming principal is to move the principal to an administrative position in the district.

Table 3.2: School fixed effects estimations of matriculation examination outcomes

	Schools offering grade 12 (quintiles one to five)											
	% who pass mathematics				Average mathematics %				% who achieve NSC			
	OLS	FE (1)	FE(2)	FE (3)	OLS	FE (1)	FE(2)	FE (3)	OLS	FE(1)	FE (2)	FE (3)
Principal turnover	-2.643*** (0.726)	-1.141* (0.649)	-1.342** (0.640)	-0.812 (0.754)	-0.807** (0.313)	-0.348 (0.269)	-0.435 (0.265)	-0.212 (0.316)	-2.366*** (0.596)	-1.399** (0.545)	-1.599** (0.531)	-1.271** (0.627)
Principal controls	X			X	X			X	X			X
School controls	X		X	X	X		X	X	X		X	X
Year fixed effects	X	X	X	X	X	X	X	X	X	X	X	X
School fixed effects		X	X	X		X	X	X		X	X	X
R-squared	0.346				0.475				0.378			
Within R-squared		0.011	0.034	0.036		0.015	0.043	0.046		0.136	0.171	0.175
N (school-years)	12 819	12 819	12 819	12 819	12 819	12 819	12 819	12 819	13 458	13 458	13 458	13 458
N (clusters)		4 273	4 273	4 273		4 273	4 273	4 273		4 486	4 486	4 486
F stat	336.525	31.53	37.061	14.322	265.886	47.17	50.845	19.622	383.74	421.606	227.08	85.071
	Poorer schools offering grade 12 (quintiles one to three)											
	% who pass mathematics				Average mathematics %				% who achieve NSC			
	OLS	FE (1)	FE(2)	FE (3)	OLS	FE (1)	FE(2)	FE (3)	OLS	FE (1)	FE(2)	FE (3)
Principal turnover	-4.075*** (0.919)	-1.734** (0.868)	-1.881** (0.856)	-2.075** (0.984)	-1.646*** (0.361)	-0.750** (0.325)	-0.813** (0.320)	-1.087** (0.370)	-3.479*** (0.765)	-2.035** (0.732)	-2.167** (0.717)	-2.219** (0.825)
Principal controls	X			X	X			X	X			X
School controls	X		X	X	X		X	X	X		X	X
Year fixed effects	X	X	X	X	X	X	X	X	X	X	X	X
School fixed effects		X	X	X		X	X	X		X	X	X
R-squared	0.112				0.16				0.223			
Within R-squared		0.026	0.05	0.052		0.058	0.087	0.09		0.177	0.212	0.216
N (school-years)	9 517	9 517	9 517	9 517	9 517	9 517	9 517	9 517	10 045	10 045	10 045	10 045
N (clusters)		3 373	3 373	3 373		3 373	3 373	3 373		3 560	3 560	3 560
F stat	32.511	50.004	41.503	16.175	41.78	115.798	77.984	29.798	88.854	426.164	226.147	84.905

Notes: Principal controls include their age, gender, previous management experience (position in payroll in 2004), years of service and educational qualifications (REQV). Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. In addition, OLS regressions control for the quintile status of the school, urban location, former department and provincial dummies. Standard errors are in parentheses and are clustered at the school level. Statistically significant at *p<0.1, **p<0.05, ***p<0.001.

Table 3.3: School fixed effects estimations of the grade 10 to 12 promotion rate

	Schools offering grade 12 (quintile one to five schools)				Schools offering grade 12 (Poorer quintile one to three schools)			
	OLS	FE(1)	FE (2)	FE (3)	OLS	FE(1)	FE (2)	FE (3)
Principal turnover	1.398** (0.669)	0.892 (0.598)	1.116* (0.577)	0.592 (0.684)	1.778** (0.863)	1.066 (0.830)	1.178 (0.789)	0.919 (0.933)
Principal controls	X			X	X			X
School controls	X		X	X	X		X	X
Year fixed effects	X	X	X	X	X	X	X	X
School fixed effects		X	X	X		X	X	X
R-squared	0.203				0.113			
Within R-squared		0.005	0.072	0.073		0.01	0.083	0.086
N (school-years)	13 514	13 514	13 514	13 514	10 079	10 079	10 079	10 079
N (clusters)		4 518	4 518	4 518		3 585	3 585	3 585
F stat	151.886	13.792	63.355	24.82	42.863	20.596	62.875	24.485

Notes: Principal controls include their age, gender, previous management experience (position in payroll in 2004), years of service and educational qualifications (REQV). Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. In addition, OLS regressions control for the quintile status of the school, urban location and provincial dummies and race of the principal. Standard errors are in parentheses and are clustered at the school level. Statistically significant at *p<0.1, **p<0.05, ***p<0.001.

Sample selection bias due to matching constraints

As mentioned above, an attempt was made to determine whether the results observed are biased due to sample selection concerns where schools connected to principals and school matriculation outcomes across all three waves (2008, 2010 and 2012) are a select group of schools. To test this, estimates from the preceding estimations of principal turnover effects are compared to estimates when re-including schools that are not matched to a school principal in each of the three waves. In re-including unmatched schools, I make the assumption that principal turnover has occurred in these schools in years for which they are unmatched to a school principal. Similar fixed effects regressions are run as in Table 3.2. However, here it is not possible to control for principal characteristics, which are not available if schools are not matched to a principal. The results are reported in Table 3A.3. The results as per the second fixed effects regressions in Table 3.2 do not change substantively when re-including the unmatched schools. Larger differences, however, are observed when limiting this analysis to poorer quintile one to three schools as seen in Table 3A.4. When re-including the non-matched schools into the sample, the magnitude of the negative coefficients actually decrease in size but the overall conclusions of statistically significant negative effects of principal turnover on matriculation outcomes are unchanged. The declining magnitude of the coefficients is surprising where the unmatched sample may include schools that have vacant principal posts following a principal transition with anticipated larger negative effects for school performance. The chapter now turns to investigating the robustness of the results in light of the identifying assumptions of the fixed effects model.

Table 3.4: School fixed effects estimations of schools' NSC pass rate, controlling for the grade 10 to 12 promotion rate

	Quintile one to five schools % who achieve the NSC				Poorer quintile one to three schools % who achieve the NSC			
	OLS	FE (1)	FE (2)	FE (3)	OLS	FE (1)	FE (2)	FE (3)
Principal turnover	-2.032*** (0.589)	-1.089** (0.508)	-1.217** (0.503)	-1.066* (0.595)	-2.999*** (0.750)	-1.672** (0.686)	-1.908** (0.790)	-1.789** (0.682)
Grade 10 to 12 promotion rate	-0.219*** (0.008)	-0.384*** (0.011)	-0.361*** (0.011)	-0.359*** (0.011)	-0.246*** (0.009)	-0.382*** (0.012)	-0.356*** (0.012)	-0.357*** (0.012)
Principal controls	X			X	X			X
School controls	X		X	X	X		X	X
Year fixed effects	X	X	X	X	X	X	X	X
School fixed effects		X	X	X		X	X	X
R-squared	0.416				0.282			
Within R-squared		0.282	0.291	0.294		0.317	0.328	0.326
N (school-years)	13 410	13 410	13 410	13 410	10 004	10 004	10 004	10 004
N (clusters)		4 486	4 486	4 486		3 560	3 560	3 560
F stat	387.978	701.375	371.436	150.051	112.804	662.08	142.658	352.907

Notes: Principal controls include their age, gender, previous management experience (position in payroll in 2004), years of service and educational qualifications (REQV). Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. Standard errors are in parentheses and are clustered at school level. Statistically significant at * p<0.1, ** p<0.05, ***p<0.001.

Table 3.5: School fixed effects estimations of matriculation examination outcomes distinguishing between principal turnover flows

	Schools offering grade 12 (quintiles one to five)											
	% who pass mathematics				Average mathematics %				% who achieve the NSC			
	OLS	FE (1)	FE (2)	FE (3)	OLS	FE (1)	FE (2)	FE (3)	OLS	FE (2)	FE (1)	FE (3)
Principal mobility	-1.938*	0.395	0.25	0.527	-0.724	-0.066	-0.116	0.025	-2.288**	-1.067	-1.257	-0.93
	(1.108)	(1.113)	(1.100)	(1.129)	(0.463)	(0.443)	(0.437)	(0.453)	(0.903)	(0.883)	(0.866)	(0.908)
Principal attrition	-3.083***	-1.991**	-2.223**	-1.716*	-0.858**	-0.504	-0.612*	-0.373	-2.415***	-1.583**	-1.789**	-1.502**
	(0.843)	(0.751)	(0.740)	(0.889)	(0.377)	(0.326)	(0.320)	(0.386)	(0.702)	(0.664)	(0.647)	(0.757)
Principal controls	X			X	X			X	X			X
School controls	X		X	X	X		X	X	X		X	X
Year fixed effects	X	X	X	X	X	X	X	X	X	X	X	X
School fixed effects		X	X	X		X	X	X		X	X	X
R ² / Within R ²	0.346	0.012	0.035	0.036	0.475	0.015	0.043	0.046	0.378	0.136	0.171	0.175
N (school-years)	12 819	12 819	12 819	12 819	12 819	12 819	12 819	12 819	13 458	13 458	13 458	13 458
N (clusters)		4 273	4 273	4 273		4 273	4 273	4 273		4 486	4 486	4 486
F stat	327.98	24.726	33.022	13.827	259.037	35.533	44.651	18.688	373.948	316.27	198.643	80.796
Poorer schools offering grade 12 (quintiles one to three)												
	% who pass mathematics				Average mathematics %				% who achieve the NSC			
	OLS	FE (1)	FE (2)	FE (3)	OLS	FE (1)	FE (2)	FE (3)	OLS	FE (1)	FE (2)	FE (3)
Principal mobility	-3.574**	1.024	0.751	0.469	-1.621**	0.169	0.052	-0.154	-3.139**	-0.728	-0.999	-0.979
	(1.375)	(1.407)	(1.391)	(1.405)	(0.531)	(0.513)	(0.509)	(0.520)	(1.114)	(1.125)	(1.108)	(1.142)
Principal attrition	-4.422***	-3.471***	-3.540***	-4.048***	-1.663***	-1.328***	-1.358***	-1.810***	-3.716***	-2.865**	-2.908**	-3.187**
	(1.095)	(1.026)	(1.014)	(1.210)	(0.439)	(0.395)	(0.389)	(0.462)	(0.935)	(0.912)	(0.894)	(1.039)
Principal controls	X			X	X			X	X			X
School controls	X		X	X	X		X	X	X		X	X
Year effects	X	X	X	X	X	X	X	X	X	X	X	X
School fixed effects		X	X	X		X	X	X		X	X	X
R ² / Within R ²	0.112	0.027	0.051	0.053	0.16	0.059	0.088	0.091	0.223	0.178	0.213	0.216
N (school-years)	9 517	9 517	9 517	9 517	9 517	9 517	9 517	9 517	10 045	10 045	10 045	10 045
N (clusters)		3 373	3 373	3 373		3 373	3 373	3 373		3 560	3 560	3 560
F stat	31.758	39.581	37.182	15.767	40.716	88.724	68.976	28.747	86.601	320.377	197.833	80.672

Notes: Principal controls include their age, gender, previous management experience, years of service and educational qualifications (REQV). Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. OLS regressions control for the school's quintile status, urban location and provincial dummies and race of the principal. Standard errors are in parentheses and are clustered at the school level. Statistically significant at *p<0.1, **p<0.05, ***p<0.001.

Remaining bias

While attempts were made to control for a key assumption of the fixed effects model that all sources of confoundedness are constant over time, it remains possible that principal departures are still non-random even after conditioning on permanent and where possible time-varying school characteristics. For example, motivation levels of school principals appear to be lower among principals that transition out of their schools compared with those that don't. This is suggested by the significantly higher number of sick leave days taken (out of 36 days of paid sick leave available in a three year cycle) by principals who move out of schools compared with those that don't as reflected in Table 3.6. This may also suggest that principals may depart from their schools because of health issues.⁵³ The principal turnover effect will be overestimated where driven by negative selection effects.

Table 3.6: Sick leave days taken by school principals

	Principal does not move out of school between time t and t+2	Principal moves out of school between time t and t+2
Mean number of sick leave days taken in time t	2.068 (5.76)	4.37* (9.01)
N	8 266	719

Source: PERSAL-EMIS dataset connected to matriculation examination data. **Notes:** Calculations are obtained for the sample used in OLS estimation of the grade 10 to 12 promotion rate in Table 3.3. Calculations are for years $t = 2008$ or 2010 . *The mean of turnover group is statistically significantly different from the mean of the non-turnover group using a 95 percent confidence interval. Standard deviations are in parentheses.

Miller (2013) also cautions that the interpretation of fixed effects estimations may be compromised by the presence of non-parallel time trends in performance across schools depending on whether they experience a change in leadership. Although her caution is more applicable where one has a longer panel and is estimating whether a principal transition has longer term *positive* effects for a school⁵⁴, it is instructive to identify that there may be non-parallel trends in school performance.

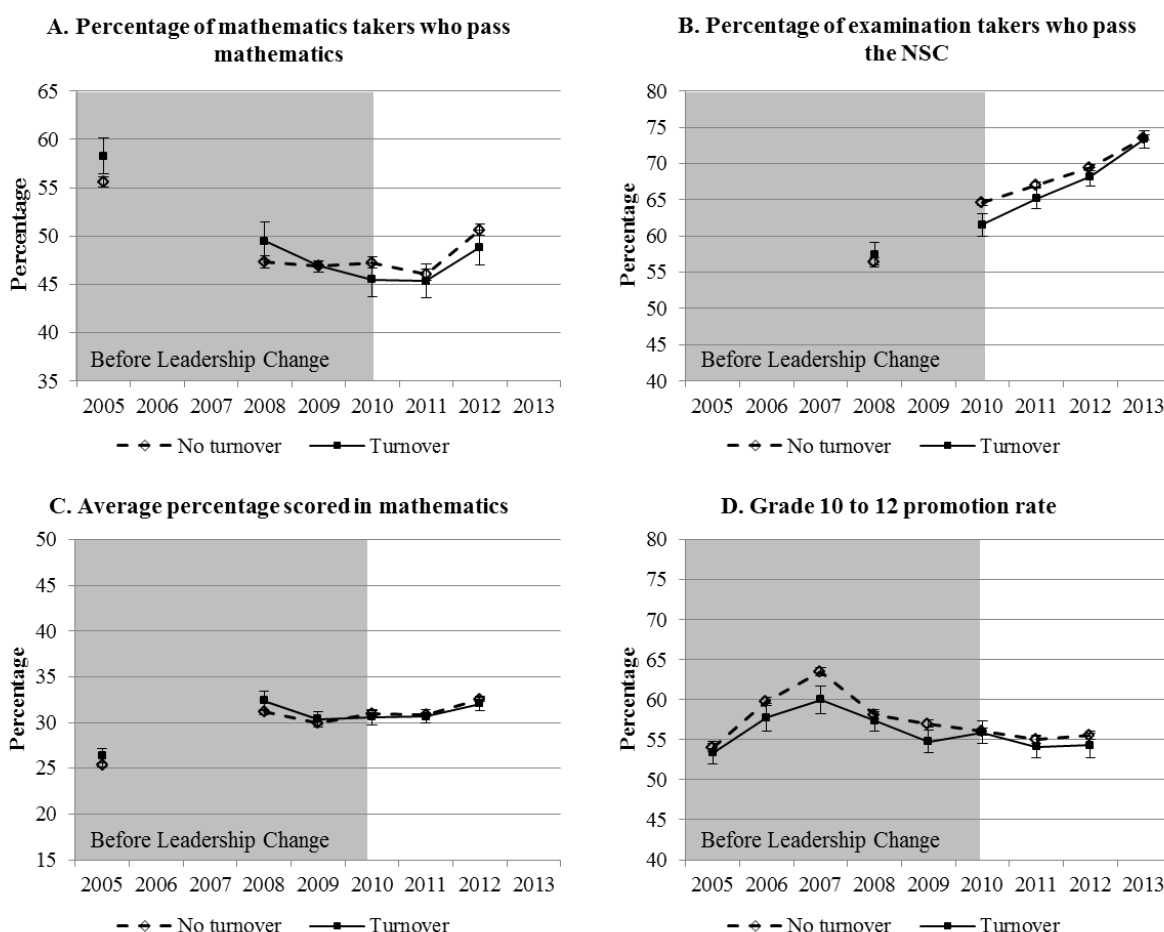
Due to a truncated time series of school performance data available to the author, a clear investigation as to pre-turnover trends in school outcomes is limited. This is further complicated by some schools having missing performance data in some years and difficulties matching across matriculation and EMIS data each year, especially prior to 2008. Despite these constraints, pre-turnover trends in mean

⁵³ Only two years of data on sick leave days taken is available to the author and therefore it cannot be included as a time-varying control in the school fixed effects regressions.

⁵⁴ Drawing on the work of Ashenfelter (1978) in estimating the impact of training programmes on earnings, Miller (2013) argues that dips in school performance preceding a principal departure may be transitory. She notes that "Since the typical school is doing badly relative to its usual performance before a new principal starts, it is entirely possible that the school would have experienced a recovery to its usual performance regardless of whether the principal was replaced (ibid:71)." In establishing whether new principals raise the performance of a school "it is difficult to disentangle the positive effects of having a new principal from what is merely a return to the permanent state of the school (ibid:71)."

school outcomes are compared across schools depending on whether they experience principal turnover between, specifically, 2010 and 2012 as plotted in Figure 3.1. In each sub-plot, samples are limited to schools with outcome measures in each of the relevant data years in the plots. The sample calculation excludes any schools that experience turnover between 2008 and 2010. These schools may have different outcome trends influencing the observed estimates. In plot D there is no evidence of a dip in promotion rates among principal turnover schools in excess of that experienced by non-turnover schools. Plots B and C of the average mathematics result and percentage pass in the NSC are inconclusive on the matter, particularly in plot B where the data time series is very limited. However, in plot A of the percentage of mathematics takers who pass the examination there is a suggestion of a dip in outcomes for schools prior to principal turnover.

Figure 3.1: Performance trends across schools by principal turnover (2010 to 2012)



Source: Persal-EMIS dataset connected to matriculation examination data. **Notes:** A principal change is identified for the period 2010 to 2012. The sample of schools in the calculations correspond to the OLS and fixed effects estimation samples in Table 3.2 but are further limited to i) schools with outcome data for each of the years identified in each graph and ii) schools that do not experience turnover in the earlier period 2008 to 2010. Specifically 3 516 schools are used in plot A, 4146 in plot B, 3 483 in plot C and 4 146 in plot D. Error bars reflect the 95 percent confidence interval about each mean estimate.

Acknowledging the limitations of the school fixed effects estimation in controlling for other sources of bias, I test the robustness of the results by drawing on the work of Heckman, Ichimura and Todd (1997). They propose a strategy that combines the propensity score matching approach with difference-in-difference. The aim is to create a valid counterfactual group of ‘control’ schools using propensity score matching while relaxing the Conditional Independence Assumption (CIA) by taking the difference in school outcomes before and after ‘treatment’. Heckman and Smith (1999) argue that this offers a superior approach over conventional difference-in-difference estimators in reducing estimated selection bias.

3.5 Robustness check: A propensity score matching approach combined with difference-in-difference estimation

Propensity score matching

Propensity score matching is used to identify a suitable counterfactual group of schools that don’t experience a change in school leadership. Under the Conditional Independence Assumption (CIA), schools experiencing a change in principal (the ‘treated’ group) and the selected control group are then comparable conditional on observed characteristics. This assumption implies that selection is solely based on observable characteristics and that all variables that simultaneously influence whether a principal change takes place and school performance outcomes are observed by the researcher (Caliendo and Kopeinig, 2005; Dehejia and Wahba, 1999). This is clearly an untenable assumption in the likely presence of unobserved heterogeneity. However, by limiting the potential sample of control schools to those that *do* experience principal turnover in a *future* period, but not in the treatment period in question, CIA becomes more defensible. The limited control group are likely to be better matched to the treated schools in terms of unobserved characteristics that encourage the exit of principals from schools and in terms of their school performance trends.⁵⁵

Initially, the treatment group are identified as schools that experience principal turnover between September 2008 and October 2010 and the potential sample of control schools is limited to those that experience turnover between October 2010 and October 2012, but not in the earlier period 2008 to 2010. Two other treatment groups are considered as well: schools that have principals who move to another post in the public education system between 2008 and 2010 and schools with principals that exit the public education system over the period. Similarly, each set of treatment schools are matched to schools that experience the same type of principal turnover in the following period.

⁵⁵ A similar approach is used by Allen and Allnut (2013) in estimating the impacts of Teach First on school performance in the United Kingdom. They match programme schools in one period to those who adopt the programme in a later period and then run a fixed effects model on the matched sample.

I estimate one propensity score for each school using a logistic regression of school and principal characteristics on whether a school experiences a principal leadership change between 2008 and 2010. Matching is achieved using a single propensity score that represents the likelihood of a school experiencing a principal leadership change, conditional upon its being selected in the treatment group.⁵⁶ The control group is then restricted to only those observations whose propensity score value falls within the range of the propensity score of the treated group.

Propensity score matching is implemented in Stata using `psmatch2` (Leuven and Sianesi, 2003) where schools are matched on the basis of their characteristics and their principals in 2008. Importantly, the choice of matching variables should be limited to those that are not influenced by the principal turnover event itself or the anticipation thereof (Todd, 1999). The set of pre-treatment variables chosen is largely informed by the set of theoretically appropriate variables typically used in the literature investigating teacher and principal turnover, the most important determinant being principals' age. Characteristics conditioned upon in 2008 include the following: principals' age, gender, race, educational qualification levels, their position in 2004, salary in 2008 prices and sick leave days taken (which proxies for motivation). It is argued that conditioning on sick leave days taken is also important for matching on pre-turnover trends in school performance. School controls include its location (urban vs. rural), total student enrolment, total number of educators per one hundred students and indicators for the former department classification as well as current province. An indicator for whether the school experienced a provincial boundary change in 2005 is also included. The logistic regression results identifying the coefficients on these matching variables are shown in the appendix, Table 3A.5.

Estimating reliable average treatment effects relies critically on i) sufficient overlap between the treated and control groups and ii) balance across the two groups with respect to their observed pre-turnover characteristics. Overlap is evaluated using the `Psgaph` command in Stata; it provides a visual analysis of the density distribution of the propensity score in both groups as well as an indication of the extent of common support. Two-sample t-tests are used to evaluate whether the samples are balanced, identifying if there are significant differences in the covariate means for both groups. After matching, covariates should be balanced, i.e. there should be no significant differences in the mean characteristics across the two groups.

Figure 3.2 presents histograms of propensity scores for the treated and control schools while highlighting schools that are off common support. In the estimations that follow, common support is

⁵⁶ Matching may be implemented non-parametrically by defining cells using discrete matching. However, conditioning on all relevant covariates is limited in the case of a high dimensional vector of covariates, so that Rosenbaum and Rubin (1983) suggest the use of a parametric approach to achieve one propensity score to address this 'curse of dimensionality'.

applied to prevent poor matches from affecting the estimation results.⁵⁷ Fortunately, the proportion of schools disregarded through common support is not large, which does not further complicate the interpretation of the results. Where treatment is identified as principal turnover between 2008 and 2010, eight treatment schools are off common support. Where treatment is identified as principal mobility between 2008 and 2010, 13 schools are off common support while 15 schools are off common support when the treatment is principal attrition between 2008 and 2010. The graphs in panel A of the figure reflect that, in general, the quality of the matching is good in terms of overlap, although somewhat thin in the left tails. Moreover, a very strong match is achieved where balance is obtained across all matching variables when comparing mean estimates across treatment and matched schools. This is shown in the appendix, Table 3A.6, where the treatment in question is principal turnover between 2008 and 2010.

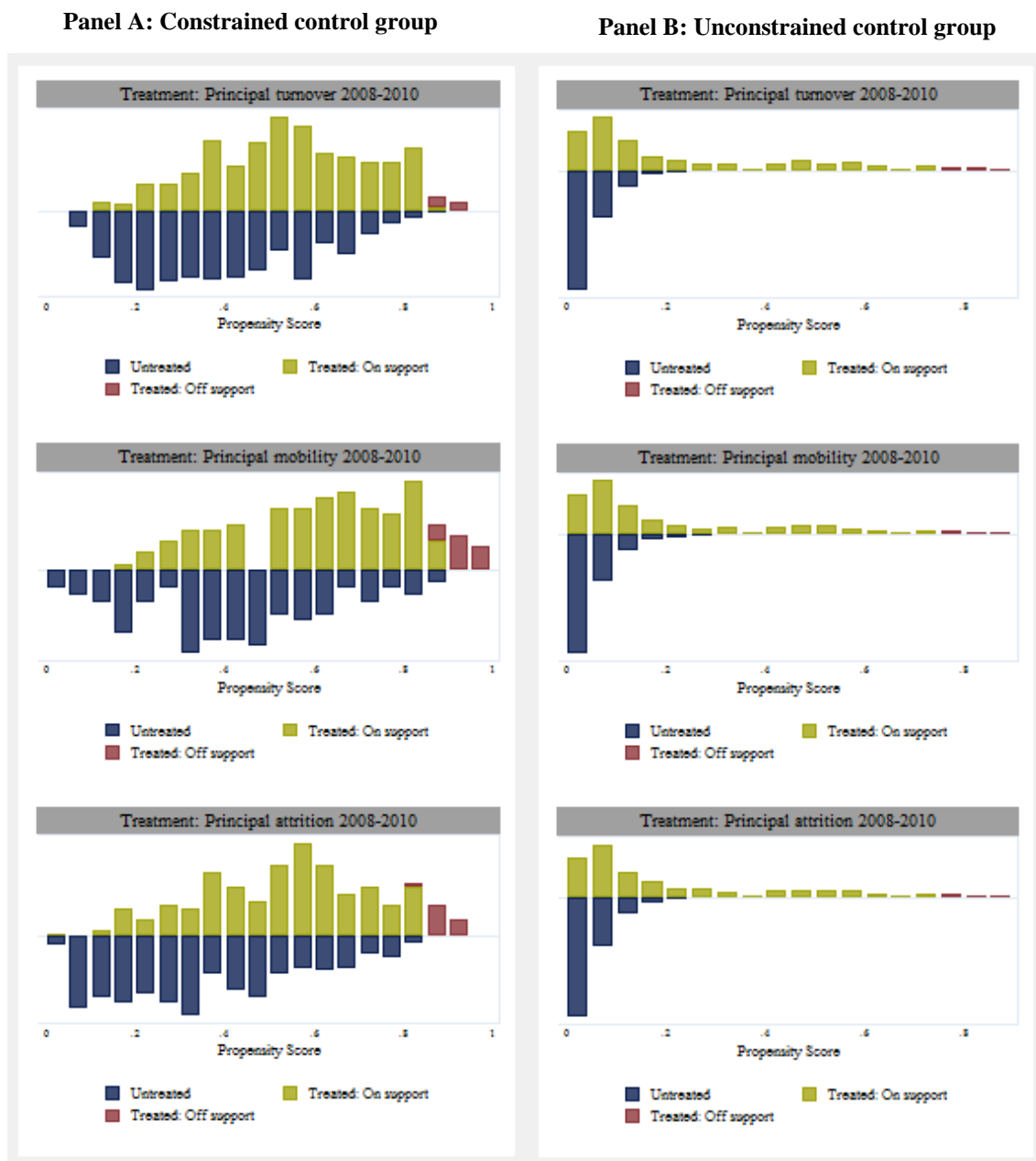
Constraining the control group of schools not experiencing a principal change between 2008 and 2010 to those that experience a change in the later period 2010 to 2012 is critical to the success of the PSM-DiD strategy. This produces a more suitable counterfactual group of treatment schools as evident in the substantially improved overlap in covariates across the treated and control group. The strong overlap when the control group is constrained is graphically identified in panel A of Figure 3.2. This is contrasted against the lack of overlap identified in panel B where the control group of schools is not constrained.

Estimation using the propensity score matched sample

Despite the matching procedure above that aims to create a valid counterfactual group, it remains possible that the Conditional Independence Assumption (CIA) is not met if schools that experience principal turnover in the first period are different from those that experience principal turnover in the second period. This remaining unobserved heterogeneity can be dealt with using difference-in-difference (DiD) estimation. Whereas the matching procedure deals with selection on observable characteristics, the application of the DiD strategy controls for unobserved school level characteristics associated with a principal's decision to leave a school. In this framework, the strong CIA may be relaxed provided that there are now common time trends in the outcomes across the treated and matched control schools. In other words, even if the principal turnover schools are different from the non-turnover schools in unobserved ways, as long as these differences are stable over time, these biases can be eliminated through the specification.

⁵⁷ Here one deletes all observations whose propensity score is smaller than the minimum and larger than the maximum of the opposite group.

Figure 3.2: Histograms of propensity scores



Notes: Treated schools experience a principal leadership change between 2008 and 2010. In panel A, the potential group of control schools are constrained to schools that do not experience a principal change between 2008 and 2010 but do experience a principal leadership change between 2010 and 2012. In panel B, the control group of schools are unconstrained. Propensity scores are calculated using Psmatch2.

DiD is executed by running the school fixed effects estimations of matriculation examination outcomes on a two-year panel of the relevant sample of matched treatment and control schools. The samples correspond to each of the three ‘treatments’ (principal turnover between 2008 and 2010, principal mobility between 2008 and 2010 and principal attrition between 2008 and 2010). The school fixed effects soak up unobserved school characteristics that remain constant over time while time-

varying school and principal characteristics are included as additional covariates intended to account for observed population changes at the school over time. Time-varying principal controls include their age, gender, previous management experience (as proxied by their position in payroll in 2004), years of service and educational qualifications (REQV). Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment.⁵⁸

In addition to using the matched samples of schools, the regressions are weighted using what Li, Morgan and Zaslavsky (2014) refer to as ‘overlap weights’ to improve the balance in the covariates. The overlap weights are derived directly from the propensity score matching phase and weight each unit proportional to its probability of assignment to the opposite group. The overlap weights effectively give more weight to observations in the covariate space where the distribution for the treatment group most overlaps with the control group. These overlap weights are considered a better alternative to inverse probability weights as they have the advantage of being bounded between zero and one.⁵⁹

The estimation results are presented in Table 3.7. Estimates are obtained for the three matched samples which correspond to the three treatments in question: i) any type of principal turnover between 2008 and 2010, ii) turnover due to principal mobility between 2008 and 2010 and iii) attrition related turnover between 2008 and 2010 for retirement or other reasons. As expected, a negative coefficient is identified on each of the indicators, regardless of the performance measure used. The treatment ‘principal turnover’ is statistically insignificant in estimating the average mathematics percentage and the pass rate in the NSC, but weakly significant when the outcome variable in question is the pass rate in mathematics. The lack of significance on the principal turnover indicator is inconsistent with the findings in Table 3.2.

Nevertheless, the results support earlier conclusions that there may be heterogeneous impacts on school performance across the two flows of principal turnover. When the treatment in question is principal mobility, the negative coefficients identified are consistently insignificant. However, small sample size may also be one of the reasons why the effects may not be significant. By contrast, the coefficient on the indicator for principal attrition (including retirement or leaving the public school system for other reasons) is negative *and* statistically significant when the outcome variables are the

⁵⁸ It is arguable that student enrolment and teacher numbers may be influenced by the anticipation of a principal departure from a school. Sensitivity checks were conducted in estimating the results in Table 3.7 where student enrolment and teachers per one hundred students were excluded as matching variables in the propensity score matching phase. The results of Table 3.7 are robust to their exclusion.

⁵⁹ Using these overlap weights, the estimated coefficients reflect the average treatment effect for the overlapping observations or what Li et al refer to as ATO contrasted against the average treatment on the treated group effect (ATT) (Li et al, 2014:10).

two mathematics school performance measures. Contrary to expectations, the magnitude of these negative coefficients are larger than those observed in Table 3.5 at negative seven percent and 2.7 percent respectively although the coefficients are estimated imprecisely. It is noted that the results of Table 3.7 are robust to various sensitivity checks where the matching variables in obtaining the propensity score are varied in their inclusion.⁶⁰

The PSM-DiD approach provides confirmatory evidence of negative and statistically significant effects of principal attrition on school performance. It is confirmed that in the short to medium term school leadership changes - especially when induced by principals exiting public education - have negative impacts on school performance, particularly in the mathematics examinations.

3.6 Teacher turnover and principal turnover

One of the mechanisms through which principal leadership changes are proposed to influence student learning is in inducing higher levels of teacher turnover in schools (Branch, Hanushek and Rivkin, 2012; Beteille, Kalogrides and Loeb, 2012; Miller, 2013; Young and Fuller, 2009). In North Carolina, Miller (2013) identifies that around the time of a principal leadership change roughly 1.3 percent more teachers leave a school and this rises to 1.6 percent until a year after a new principal is appointed, after which the rate of teacher turnover stabilises.

There are various reasons why teacher turnover may rise in response to a leadership change. Teachers may be unwilling to adjust to what Hart (1991) describes as new “socialisation” of the school organisation induced through the leadership succession process. If they are overlooked in the promotion processes after an incumbent principals vacates a post, they may seek promotion opportunities in other schools. Furthermore, in contexts where principals have control over the hiring and firing of teachers, teacher turnover may rise as incoming principals alter the staff composition of the school. Principals in South Africa, however, do not have control over the hiring and firing of publicly employed teachers. Nevertheless, teacher turnover may still rise in light of the first two reasons.

Rising levels of teacher turnover have been found to negatively affect student achievement by destabilising school environments, but ultimately the effect of teacher turnover on school outcomes depends on whether the best or worst performing teachers leave and the quality of teachers who replace them (Beteille, Kalogrides and Loeb, 2012; Ronfeldt et al., 2011). While it is beyond the scope of this analysis and data to determine how teacher turnover ultimately impacts on school outcomes, I investigate whether teacher turnover rises in response to principal leadership changes.

⁶⁰ In addition to excluding student enrolment and teachers per one hundred students as matching variables in the propensity score matching phase, principals’ years of service was also included as a matching variable. The results of Table 3.7 are robust to these variations in the matching variables used.

Table 3.7: School fixed effects estimations on samples from the propensity score matching approach

	% who pass mathematics			Average mathematics %			% who achieved the NSC		
	PSM matched sample (1)	PSM matched sample (2)	PSM matched sample (3)	PSM matched sample (1)	PSM matched sample (2)	PSM matched sample (3)	PSM matched sample (1)	PSM matched sample (2)	PSM matched sample (3)
Principal turnover	-4.814* (2.687)			-1.539 (1.064)			-2.246 (1.783)		
Principal mobility		-2.979 (4.041)			-0.593 (1.519)			-1.917 (2.313)	
Principal attrition			-6.990** (2.867)			-2.704** (1.304)			-3.328 (2.650)
Principal controls	X	X	X	X	X	X	X	X	X
School controls	X	X	X	X	X	X	X	X	X
Year fixed effects	X	X	X	X	X	X	X	X	X
School fixed effects	X	X	X	X	X	X	X	X	X
Within R-squared	0.091	0.087	0.157	0.095	0.086	0.151	0.105	0.25	0.158
N (school-years)	1 373	673	909	1 373	673	909	1 394	688	919
N (clusters)	693	229	458	693	229	458	698	231	460
F stat	2.981	1.843	4.103	3.487	2.037	4.514	3.394	7.195	4.014

Notes: Estimated on the three matched samples for the years 2008 and 2010. The matched samples are obtained using propensity score matching with the application of common support. Group (1): matched sample includes treatment schools experiencing principal turnover between 2008 and 2010 and matched control schools that experience principal turnover in the later period 2010 to 2012. Group (2): matched sample includes treatment schools whose principals move to another post in public education between 2008 and 2010 and matched control schools whose principals move to another post in public education in the next period 2010 to 2012. Group (3): The matched sample includes treatment schools whose principals move to another post in public education between 2008 and 2010 and matched control schools whose principals move to another post in public education in the next period 2010 to 2012. Time-varying principal controls include their age, gender, previous management experience (position in payroll in 2004), years of service and educational qualifications (REQV). Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. Regressions are weighted using the overlap weights (Li et al, 2014) derived from the propensity score matching approach. Standard errors, in parentheses, are clustered at the school level. Statistically significant at *p<0.1, **p<0.05, ***p<0.001.

A panel dataset of all public sector educators was constructed to examine the relationship between principal turnover and teacher turnover. Personal data for all educators (excluding principals) for the years 2004, 2008, 2010 and 2012 was again linked to the EMIS master list of schools data and Snap data. The panel of educators was then linked to the panel dataset on school principals (the reader is referred to the appendix for more information on the data matching process). Since the outcome measure is now teacher turnover and not school performance, I investigate the relationship between teacher turnover and principal turnover at all school phase levels rather than being limited to schools offering grade 12.

An indicator for whether a teacher moved out of a school between each of the data years is constructed by comparing their linked school identifier across data years. Four years of school identifiers are required to identify three periods of possible transitions; therefore, teacher turnover is identified for only three of the four data years. At most 862 875 teacher-year observations are available for the estimations with some losses in sample size due to missing data on control variables.

A linear probability model⁶¹ is used to predict whether a teacher leaves his or her current school between two adjacent data years as a function of whether the principal leaves the school within that same period as well as other characteristics. In the literature, the relationship between teacher turnover and principal turnover is typically estimated without disaggregating effects across principal turnover flows: mobility and attrition. It is expected, however, that a teacher's decision to move out of a school may differ depending on the reasons for the principal leadership change. For example, if a principal moves out of the school to take up a post in another school, or leaves the public education system for non-retirement reasons, the circumstances surrounding this decision may be more unexpected than an anticipated principal retirement. The former may be more likely to disrupt staff dynamics at a school and more readily induce teacher exits.

In response, the models that follow distinguish principal turnover into its two flows. With a larger number of schools available when compared with the limited matric sample, principal attrition is further distinguished into two types: attrition that is retirement related (identified where a principal's age is close to the common retirement age of 60) and then non-retirement attrition (if the principal is not near retirement age). The model is estimated with the following equation:

$$\Pr(T_{hst} = 1) = \beta_0 + \beta_1 PM_{st} + \beta_2 PR_{st} + \beta_3 PA_{st} + \beta_4 X_{st} + \beta_5 S_t + \pi_t + \pi_s + \epsilon_{hst}$$

⁶¹ Beteille, Kalogrides and Loeb (2012) use a logistic regression to predict the impact of principal turnover on teacher turnover. Incorporating school fixed effects into the logistic regression framework, however, poses challenges for sample size if there is no teacher that moves or all teachers move in a school over the panel. These schools would be dropped from the analysis.

The probability that a teacher h leaves his or her current school s in time t is expressed as a function of whether a principal moves out of the school over the same period where PM_{st} indicates principal mobility, PR_{st} indicates that the principal most likely retired and PA_{st} indicates principal attrition that is non-retirement related (which may include taking up a position in the private sector). The model also controls for a teacher's characteristics (X_{st}), time-varying school characteristics (S_t), year fixed effects (π_t) and in some specifications school fixed effects (π_s). Teacher characteristics controlled for include their age, gender, race, educational qualifications and whether they are a head of department or deputy principal. Time-varying school characteristics include total school enrolment, the percentage of students whose race is black, the number of teachers per one hundred students and the average REQV of teachers⁶² in the school. Additional non-time-varying school controls include indicators for school location (urban and province), former department classification and school wealth quintile ranking. Descriptive statistics of the sample are presented in the appendix, Tables 3A.7 and 3A.8.

Table 3.8: Linear probability model of teacher turnover

	Estimating teacher turnover between 2004 to 2008 or 2008 to 2010 or 2010 to 2012			
	(1)	OLS (2)	(3)	School fixed effects
Principal mobility	0.121*** (0.007)	0.115*** (0.007)	0.081*** (0.006)	0.047*** (0.006)
Principal attrition: retirement	0.003 (0.003)	0.001 (0.003)	-0.006** (0.003)	0.002 (0.003)
Principal attrition: non-retirement	0.035*** (0.004)	0.032*** (0.004)	0.007** (0.003)	0.005 (0.003)
Teacher controls	X	X	X	X
School controls		X	X	X
Year fixed effects			X	X
School fixed effects				X
R-squared/within R-squared	0.041	0.048	0.075	0.056
N-clusters (schools)	-	-	-	23 484
N (teacher-years)	862 875	860 924	860 924	861 976
F stat	1 637 (0.000)	570 (0.000)	784 (0.000)	1 580 (0.000)

Notes: Teacher controls include their age, gender, race and whether they are a deputy or head of department. Time-varying school controls include total school enrolment, the percentage of students that are black and the number of teachers per one hundred students. Additional school controls in the OLS regressions include quintile status, urban-location, school phase-level indicators, the average REQV of teachers in the school, former department classification and province dummies. Standard errors are clustered by school. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

⁶² It was not possible to control for each teacher's REQV level as this results in a loss of too many observations due to missing data where 2004 REQV data was not available to the author or is missing for some educators in other years. With many teachers still in the school four years later, it is possible to impute an indicator for average REQV levels of teachers in the school in 2004 on the basis of the 2008 data.

The estimation results of the described model are in Table 3.8. The dependent variable takes on a value of one if a teacher exited a school over a period in question (2004 to 2008, 2008 to 2010 or 2010 to 2012) and zero if they did not. Principal turnover is distinguished into its three flows reflected in three indicator variables (principal mobility, principal attrition for retirement and principal attrition for non-retirement); the reference category includes teachers in schools in which no principal turnover occurred. The specifications vary in their inclusion of controls and fixed effects. The first model only includes indicators of principal turnover flows and teacher characteristics. The second model compares teacher turnover in schools experiencing principal turnover to schools that are similar in observable ways but do not experience principal turnover by including a number of school control variables. The third and fourth models include year and then school fixed effects. Ideally, a model with school fixed effects is preferred in estimating the relationship between teacher and principal turnover because unobservable school characteristics may confound estimation results. However, an effect will only be obtained from the small variation within schools across the three years of data.

It appears that only leadership changes initiated by the outgoing principal moving to another post within the public education system are associated with higher teacher turnover. In the first column of Table 3.8, the coefficient on principal mobility indicates teachers positioned in schools where the outgoing principal moves to another school post are 12 percent more likely to exit the school over the same period compared to when there is no principal turnover. After adding year fixed effects in the third column, this coefficient on principal mobility reduces to eight percent. In the last column which includes school fixed effects, the coefficient on principal mobility reduces to five percent but remains strongly significant. What is interesting is that retirement related principal exits are not significantly related to teacher turnover; the magnitude of the effect is close to zero. This is in contrast to the estimations of school performance where principal attrition rather than principal mobility had a negative effect on school performance. One explanation for this non-effect is that if a principal exit for retirement purposes is more likely to be anticipated, then staff turnover may occur in an earlier period (not captured here, where principal and teacher turnover are concurrent). Non-retirement related principal attrition also does not appear to be systematically associated with higher levels of teacher turnover. The coefficient on principal attrition for non-retirement reasons is small and insignificant in the school fixed effects regression.

To my knowledge, there are no studies in the public domain that provide direction on the quantitative determinants of teacher turnover in the South African context. Before continuing with the analysis, it is instructive to note where other coefficients on control variables in the school fixed effects regression are significant. Consistent with a U-shaped age profile of the probability of teacher turnover identified in the U.S. literature (Harris and Adams, 2005; Ingersoll, 2001), a similar finding is identified among South African teachers (and principals as identified in chapter two). Initially, the probability of teacher turnover declines with age until 50 to 54 years and then rises. The results also

indicate that female teachers are less likely to move out of their schools than their male counterparts. Compared with black teachers, coloured and white teachers exhibit higher levels of turnover and teachers are more likely to leave schools where the teacher to student ratio is higher.⁶³

Even with the inclusion of school fixed effects, this does not resolve the possibility that a two-way causal relationship may exist between principal turnover and teacher turnover. This would confound the estimates observed. To test the robustness of the results to this endogeneity concern, I re-run the linear probability model of teacher turnover but instead include ‘lagged’ principal turnover indicators to assess whether teacher turnover in a later period rises in response to principal turnover in an earlier period. Teacher turnover between the period 2010 and 2012 is expressed as a function of principal turnover between the periods 2008 to 2010. Again, three indicators for principal turnover are included; the reference category is teachers in 2010 positioned in schools that did not experience a principal change between 2008 and 2010. I also exclude from the sample, schools that experience a principal leadership change between 2010 and 2012 to limit the contemporaneous impact this may have on teacher turnover.

It is not possible to include school fixed effects in this lagged model due to data period constraints. Nevertheless, a number of teacher and school characteristics in 2010 are included in the regression as controls. In addition to the controls used in the OLS regressions in Table 3.8, I control for a teacher’s marital status— a variable which is available to the author only for the year 2010 – where this may inform their career decisions.⁶⁴ I also include a continuous variable reflecting the percentage of teachers in the school in 2008 that had moved out of the school by 2010. This is meant to serve as a control for the impact of unobserved factors on teachers’ decisions to move between 2010 and 2012 although it will absorb part of the principal turnover impact. If working conditions at the school suddenly deteriorate, this may induce both principals and teachers to move out of the school. In which case, unobserved school factors may entirely inform teacher turnover decisions, rather than the principal leadership changes themselves. It is suspected that unobserved factors, such as a decline in working conditions that would have influenced the principals’ decision to leave between 2010 and 2012, would likely be captured by this control variable.

The results presented in the first column of Table 3.9, for the full sample of schools, are consistent with the findings of Table 3.8. The coefficient on the indicator for principal mobility between the

⁶³ The OLS regressions also indicate that relative to teachers in the poorest schools (quintile one), teachers in wealthier schools are less likely to exit their schools. No association is identified between teacher turnover and the urban/rural status of the schools in this multivariate context. What is also noteworthy is the very low level of variance in teacher turnover explained by the control variables in the OLS models. There are clearly unmeasured factors influencing teachers’ job satisfaction and employment decisions which are likely much more important determinants of teachers’ career decisions than what is captured in these models.

⁶⁴ Marital status is expected to be a significant factor affecting their decision to leave or stay in a job.

period 2008 and 2010 is positive and significant, while positive but insignificant coefficients are identified on the two principal attrition indicators. This suggests that compared to teachers in schools that do not experience a principal leadership change in the preceding period (2008 to 2010), teachers in schools that do experience a leadership change in the preceding period are more likely to move out of their schools in the next period observed (2010 to 2012); but only where the leadership change was induced by the outgoing principal moving to another post within the public education system. The magnitude of the coefficient on principal mobility is at only 1.5 percent smaller than that observed in Table 3.8 at nearly five percent.⁶⁵ By the very construction of the estimation using lagged indicators, this is expected. The impact of principal turnover on teacher turnover will likely diminish with time.

Table 3.9: Linear probability model of teacher turnover between 2010 and 2012 in response to principal turnover in the previous period 2008 to 2010

	OLS estimations of teacher turnover between 2010 and 2012				
	All schools	Primary/ Intermediate schools	Secondary	Quintile 1-3	Quintile 4-5
Principal mobility (2008-2010)	0.015*** (0.006)	0.026** (0.010)	0.007 (0.007)	0.015** (0.007)	0.014 (0.011)
Principal attrition: retirement (2008-2010)	0.003 (0.004)	0.008 (0.005)	-0.008 (0.006)	0.002 (0.005)	0.001 (0.007)
Principal attrition: non-retirement (2008-2010)	0.009** (0.004)	0.018*** (0.007)	-0.002 (0.007)	0.008* (0.005)	0.012 (0.008)
Teacher controls	X	X	X	X	X
School controls	X	X	X	X	X
R-squared	0.042	0.046	0.038	0.038	0.057
N (teachers)	261 270	126 399	93 735	186 234	75 036
F stat (p-value)	161 (0.000)	93 (0.000)	57 (0.000)	107 (0.000)	77 (0.000)

Notes: The estimation is run for the year 2010. Teacher turnover between 2010 and 2012 is expressed in relation to principal turnover flows between 2008 and 2010. Principal turnover flows are interpreted in relation to the reference category which includes teachers in schools in 2010 that do not experience a principal leadership change between 2008 and 2010. Excluded from the estimation sample are teachers in schools that experience a principal leadership change between 2010 and 2012 as this may confound the estimates. Teacher controls in 2010 include teachers' age, gender, race, marital status and whether they are a deputy or head of department. School controls include the percentage of teachers in 2008 who left the school by 2010, the percentage of students that are black, total school enrolment, the number of teachers per one hundred students, the average REQV level of teachers in the school, school phase-level, urban-location, quintile status, former department classification and province dummies. Sample sizes vary due to missing data on covariates included. Robust standard errors are in parentheses and are clustered at the school level. Statistically significant at *p<0.01, **p<0.05, ***p<0.001.

Table 3.9 also disaggregates results by sub-samples of teachers, namely teachers in poorer schools (quintiles one to three), in wealthier schools (quintiles four and five), in primary schools and secondary schools. Similar results are observed across teachers in poorer and wealthier school samples. However, when comparing estimates across primary and secondary school teachers, there are notable differences. Principal turnover, in particular, has a significant effect in raising levels of

⁶⁵ It is noted that these estimations are robust to excluding older teachers from the regressions who may be more likely to exit for retirement reasons.

turnover among primary school teachers. Not only are positive effects of principal mobility on primary school teacher turnover identified, but the coefficient on the non-retirement related principal attrition indicators is also positive and significant in this sample. By contrast, none of the indicators for principal turnover flows are significant in the secondary school sample. On the basis of these results, teacher turnover does not provide a useful explanation for why school performance in the matriculation examination declines in response to a change in school leadership.

3.7 Conclusion

With an aging population of school principals in South Africa, leadership changes are gaining momentum in schools, albeit from a very low base. The chapter has provided evidence that these leadership changes indeed result in negative consequences for school performance in the short to medium term. Evidence of significant negative effects of principal turnover on school leaving outcomes was identified through the school fixed effects model, with larger and more significant effects observed in poorer schools. Distinguishing principal turnover into its two flows, it appears that principal attrition (which includes principal retirements or exits for non-retirement reasons including taking on work in the public sector), rather than principal mobility, is driving the negative results observed. In quintile one to five schools offering grade 12, principal attrition is associated with a 1.7 percentage point decline in matriculation mathematics pass rates and a 1.5 percentage point decline in schools' overall NSC pass rates. When limiting the sample to poorer (quintiles one to three) schools, the percentage pass rate in mathematics falls by four percentage points, the average mathematics percentage falls by 1.8 percentage points and the NSC pass rate declines by 3.2 percentage points in response to the school's principal exiting public education.

Acknowledging that the school fixed effects strategy may not sufficiently control for remaining sources of endogeneity, a second identification strategy combining propensity score matching with difference-in-difference estimation was used to check the robustness of the results. The propensity score matching approach generated a well matched control group of schools that are likely to be similar to treatment schools in terms of their unobserved characteristics and pre-turnover trends in school performance. Constraining the potential control group of schools to those experiencing a principal leadership change in a subsequent period was critical to the success of the matching approach. This strategy confirmed that school performance, particularly in the grade 12 mathematics examinations, falls in response to a principal exiting public education. The magnitude of the principal turnover effects when estimated on the propensity score matched sample, were actually larger than in the full fixed effects regressions.

In the short to medium term, school leadership changes are a risk to school performance, especially when initiated by principals exiting public education. This is a concern where a number of principal retirements are taking place across the system. In response, district and circuit managers should

provide support to schools in managing the leadership succession process. This may involve, amongst other things, meeting with soon to retire principals to ensure that they are prepared for a hand-over of their principal position. Preparation may involve documenting and disseminating information to school management teams on existing systems processes and various informal arrangements that affect the day-to-day functioning of a school. This may mitigate losses in institutional knowledge accompanying a principal's exit. District involvement in the leadership succession process may also involve supporting newly appointed principals in their role or encouraging outgoing principals to mentor or coach their successors. Effective induction training may also assist newly appointed principals in adjusting to their roles; particularly in understanding policies, legislation and codes of practice affecting their work and responsibilities. The previous chapter identified that there is place for an increased roll-out of induction training for newly appointed principals.

The study also explored two mechanisms which may explain why school performance declines in response to a principal leadership change. There is some evidence (albeit weak) that rising promotion rates accompany a leadership succession. In this respect, the decline in matriculation outcomes could be accounted for by a slightly weaker group of students sitting the matriculation examination.

Using a full sample of schools (not limited to those offering grade 12), results suggest that teacher turnover is likely to rise in response to a change in principal leadership. In primary schools, in particular, teacher turnover rises in response to a leadership change, regardless of whether this was induced by the outgoing principal moving to another position in the public education system or whether they exited public education for non-retirement reasons. Among secondary school teachers, however, no significant relationship between principal turnover flows and teacher turnover is identified. It follows that rising teacher turnover cannot account for the decline in matriculation examination outcomes following a principal leadership change. In these secondary schools, principal turnover is likely impacting on learning outcomes through disrupting other aspects of school functionality or teacher behaviour.

While the panel dataset constructed for this study provides new avenues for educational research, the analysis would benefit from an extended panel. With a longer panel, event history modelling techniques could be applied to the research problem. Furthermore, only contemporaneous impacts of leadership changes could be considered in this analysis. It may be more instructive to understand how school leadership replacements impact on learning outcomes as time progresses. As evidenced in other research, it takes many years before new school principals can have their full effect on the school organisation (Coelli and Green, 2012).

3.8 Chapter appendix

Table 3A.1: The characteristics of schools offering grade 12, depending on whether the school is connected to a principal in all three waves (2008, 2010 and 2012)

	Schools offering grade 12 in 2008, 2010 and 2012			Principals in schools offering grade 12	
	Connected to principal in all three 'waves'	Connected to a principal in less than three 'waves'	All	in 2010	in 2012
Principal turnover (2008 to 2010)	0.075 (0.004)			0.146 (0.005)	
Principal turnover (2010 to 2012)	0.088 (0.004)				0.152 (0.005)
Grade 10 to 12 promotion rate	56.669 (0.368)	58.779* (0.740)	57.133 (0.330)		
NSC pass rate (%)	64.312 (0.344)	59.369* (0.656)	63.224 (0.306)		
Total school enrolment	673.151 (5.694)	617.236* (10.752)	660.845 (5.040)		
Total number of educators	25.251 (0.203)	23.106* (0.371)	24.779 (0.179)		
School location: urban	0.394 (0.007)	0.369* (0.013)	0.388 (0.006)		
% of students that are black	87.004 (0.439)	90.697* (0.697)	87.817 (0.376)		
N (observations)	4 557	1 286	5 843	5 480	5 458

Source: Persal-EMIS matched dataset. **Notes:** Missing data results in a loss of 22 schools from the available population of 5865 schools with grade 12 students in 2008, 2010 and 2012. *Mean estimate of the sample of schools that are not connected to a principal in all three waves is statistically significantly different from the mean estimate of the sample of schools connected to a principal in all three waves using a 95 percent confidence interval. Standard errors are in parentheses.

Table 3A.2: Descriptive statistics of schools offering grade 12 in 2008, 2010 and 2012 that could be linked to a principal in each year and are used in the estimations

	Mean	Standard deviation
Principal turnover 2004 to 2008	0.171	0.377
Principal turnover 2008 to 2010	0.074	0.261
Principal turnover 2010 to 2012	0.088	0.283
Principal characteristics:		
Age: 26-34 years	0.003	0.053
Age: 35-39 years	0.037	0.189
Age: 40-44 years	0.141	0.348
Age: 45-49 years	0.259	0.438
Age: 50-54 years	0.301	0.459
Age: 55-59 years	0.203	0.402
Age: 60+	0.057	0.232
Gender: Female	0.156	0.363
Race: African	0.799	0.401
Race: Asian	0.032	0.176
Race: Coloured	0.058	0.234
Race: White	0.111	0.314
Educational qualification: REQV	14.920	1.013
Position in 2004: Principal	0.718	0.450
Position in 2004: Deputy	0.125	0.330
Position in 2004: Head of department	0.080	0.271
Position in 2004: Other	0.077	0.267
School characteristics:		
Total school enrolment	680.829	390.025
The number teachers per one hundred students	3.935	1.322
Urban location	0.392	0.488
% of students that are black	87.110	29.480
<i>Former Department Classification:</i>		
Department of Education and Training (black)	0.202	0.401
Independent Homeland	0.134	0.340
Non-independent homeland	0.363	0.481
House of Assemblies (White)	0.101	0.302
House of Delegates (Indian/Asian)	0.027	0.161
House of Representatives (Coloured)	0.050	0.217
New school	0.103	0.304
Unknown	0.021	0.144
N (school-years)	13 548	

Source: Persal-EMIS matched dataset. **Notes:** Descriptive statistics are calculated for the estimation sample used in the OLS regression of the percentage of examination takers who achieve the National Senior Certificate in Table 3.2.

Table 3A.3: School fixed effects estimations of matriculation outcomes including schools not matched to a principal in three waves (quintiles one to five)

	Connected to a principal in all three 'waves'				Connected to a principal in less than three 'waves'			
	% who pass maths	Average maths %	% who achieve the NSC	Grade 10-12 promotion rate	% who pass maths	Average maths %	% who achieve the NSC	Grade 10-12 promotion rate
Turnover	-1.342** (0.640)	-0.435 (0.265)	-1.599** (0.531)	1.116* (0.577)	-1.285*** (0.437)	-0.510*** (0.177)	-1.224*** (0.375)	0.248 (0.405)
Time-varying school controls	X	X	X	X	X	X	X	X
Year fixed effects	X	X	X	X	X	X	X	X
School fixed effects	X	X	X	X	X	X	X	X
Within R-squared	0.034	0.043	0.171	0.072	0.036	0.046	0.166	0.076
N (school-years)	12 819	12 819	13 458	13 514	17 012	17 012	17 461	17 510
N (clusters)	4 273	4 273	4 486	4 518	5 778	5 778	5 829	5 860
F	37.061	50.845	227.08	63.355	51.912	72.502	277.591	82.093

Notes: Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. No principal controls have been included in the sample as schools that are not connected to a principal in a year would be dropped from the estimation. Principal turnover is coded as one in years that schools are not connected to a principal. Standard errors are in parentheses and are clustered at the school level. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

Table 3A.4: School fixed effects estimations of matriculation outcomes including schools not matched to a principal in three waves (quintiles one to three)

	Connected to a principal in all three 'waves'				Connected to a principal in less than three 'waves'			
	% who pass maths	Average maths %	% who achieve the NSC	Grade 10-12 promotion rate	% who pass maths	Average maths %	% who achieve the NSC	Grade 10-12 promotion rate
Principal turnover	-1.881** (0.856)	-0.813** (0.320)	-2.167** (0.717)	1.178 (0.789)	-1.319** (0.543)	-0.522** (0.206)	-1.068** (0.478)	0.109 (0.520)
Time-varying school controls	X	X	X	X	X	X	X	X
Year fixed effects	X	X	X	X	X	X	X	X
School fixed effects	X	X	X	X	X	X	X	X
Within R-squared	0.05	0.087	0.212	0.083	0.051	0.088	0.204	0.087
N (school-years)	9 517	9 517	10 045	10 079	12 814	12 814	13 192	13 217
N (clusters)	3 373	3373	3 560	3 585	4 624	4 624	4 675	4 699
F stat	41.503	77.984	226.147	62.875	58.051	105.047	271.746	82.995

Notes: Time-varying school controls include the percentage of students who are black, the number of teachers per one hundred students and total school enrolment. No principal controls have been included in the sample as schools that are not connected to a principal in a year would be dropped from the estimation. Principal turnover is coded as one in years that schools are not connected to a principal. Standard errors are in parentheses and are clustered at the school level. Statistically significant at *p<0.1, **p<0.05, ***p<0.001.

Table 3A.5: Logistic regressions of the propensity score matching approach

	Estimating principal turnover between 2008-2010 (1)		Estimating principal mobility between 2008-2010 (2)		Estimating principal attrition between 2008-2010 (3)	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Principal characteristics:						
Age: 26-34	0.571	(0.871)	0.186	(0.991)	1.060	(0.955)
Age: 35-39	-0.0389	(0.459)	-0.347	(0.590)	0.756	(0.528)
Age: 40-44	0.261	(0.308)	0.0226	(0.412)	-0.163	(0.440)
Age: 50-54	-0.348	(0.288)	-0.655	(0.468)	-0.442	(0.407)
Age: 55-59	-0.626**	(0.270)	-0.344	(0.576)	0.855**	(0.435)
Age: 60+	0.690**	(0.308)	1.083	(0.950)	1.007**	(0.417)
REQV 10-13	0.519*	(0.314)	0.0952	(0.555)	0.498*	(0.281)
REQV 14	0.148	(0.217)	-0.226	(0.408)	-0.0197	(0.272)
REQV 16-17	-0.229	(0.213)	-0.643*	(0.373)	0.0283**	(0.0112)
Sick leave days taken	0.0260***	(0.00927)	0.0238	(0.0193)	-0.764	(1.003)
Race: Indian/Asian	-1.081	(0.760)	-2.433*	(1.358)	0.526	(0.732)
Race: Coloured	-0.0137	(0.543)	0.285	(1.072)	-0.176	(0.524)
Race: White	-0.0116	(0.435)	0.548	(0.926)	-0.391	(0.297)
Gender: Female	-0.251	(0.232)	0.393	(0.446)	-0.339	(0.470)
Position in 2004: Deputy	-0.535*	(0.322)	-0.920*	(0.481)	-1.508**	(0.704)
Position in 2004: HOD	-1.433***	(0.488)	-1.866**	(0.752)	-0.356	(1.036)
Position in 2004: Other	-0.143	(0.524)	-0.419	(0.697)	-0.00640	(0.00534)
Salary (R 1000's in 2008 prices)	-0.009**	(0.004)	-0.010	(0.007)	0.001**	(0.000)
School characteristics:						
Total school enrolment	0.001**	(0.000))	0.000	(0.001)	0.270**	(0.126)
No. of teachers per 100 students	0.105	(0.101)	-0.290	(0.219)	-0.230	(0.290)
Urban location	-0.0208	(0.239)	0.758	(0.505)	-0.667	(0.465)
<i>Former department:</i>						
Independent homeland	-0.656*	(0.363)	-0.901	(0.699)	0.0352	(0.411)
Non-independent homeland	0.235	(0.328)	0.674	(0.611)	0.00479	(0.578)
House of Assemblies	0.0190	(0.459)	-0.285	(0.943)	-0.0355	(1.032)
House of Delegates	-0.185	(0.860)	-0.281	(1.820)	-0.758	(0.793)
House of Representatives	-0.360	(0.594)	-1.339	(1.158)	0.419	(0.488)
New School Classification	0.545	(0.355)	0.616	(0.603)	1.492	(1.134)
Unknown	0.364	(0.726)	-0.175	(1.058)		

Province:

Free State	0.805*	(0.419)	-0.186	(0.772)	1.578***	(0.547)
Gauteng	0.144	(0.409)	-0.816	(0.814)	0.498	(0.514)
KwaZulu-Natal	-0.418	(0.414)	-0.631	(0.767)	-0.413	(0.551)
Limpopo	0.817**	(0.411)	0.316	(0.775)	1.202**	(0.534)
Mpumulanga	-0.0275	(0.431)	-0.792	(0.827)	0.384	(0.543)
Northern Cape	-0.393	(0.630)	-1.780	(1.250)	0.569	(0.801)
North West	0.599	(0.419)	0.902	(0.890)	0.742	(0.512)
Western Cape	0.553	(0.455)	0.571	(0.842)	0.562	(0.616)
Provincial boundary change	-0.807*	(0.462)	-0.484	(0.927)	-0.869	(0.554)
Constant	1.065	(0.977)	3.602**	(1.706)	-0.905	(1.445)
Observations	712		253		471	
Log likelihood	-436.6		-146.2		-279.2	
Pseudo R-squared	0.113		0.164		0.139	

Notes: Group (1): The estimation sample includes treatment schools experiencing principal turnover between 2008 and 2010 and potential control schools that experience principal turnover in the next period 2010 to 2012 but not between 2008 and 2010. Group (2): The estimation sample includes treatment schools whose principals move to another post in public education between 2008 and 2010 and potential control schools whose principals move to another post in public education in the next period 2010 to 2012. Group (3): The estimation sample includes treatment schools whose principals move out of public education between 2008 and 2010 and potential control schools whose principals move out of public education in the next period 2010 to 2012 but not in the first period. The reference categories are age 45 to 49, REQV 15, principal's race is black, position in 2004 was a principal, former DET (black) schools, Eastern Cape province, no provincial boundary change. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

Table 3A.6: Covariate means estimates before and after propensity score matching (pctest)

<i>Matching variables</i>		Means		%bias	% bias reduction	t-test	
		Treated	Control			t	p>t
<i>Principal characteristics:</i>							
Age: 26-34	Before	0.01	0.01	4.00		0.53	0.60
	After	0.01	0.01	1.10	72.90	0.13	0.90
Age: 35-39	Before	0.05	0.05	1.40		0.18	0.86
	After	0.05	0.04	4.50	-228.70	0.59	0.56
Age: 40-44	Before	0.16	0.13	11.00		1.47	0.14
	After	0.16	0.17	-1.80	83.20	-0.22	0.82
Age: 50-54	Before	0.18	0.20	-5.30		-0.71	0.48
	After	0.18	0.18	1.30	75.10	0.17	0.86
Age: 55-59	Before	0.22	0.36	-31.30		-4.16	0.00
	After	0.23	0.23	0.00	99.90	0.00	1.00
Age: 60+	Before	0.22	0.11	29.40		3.95	0.00
	After	0.21	0.22	-3.50	88.00	-0.41	0.68
REQV 10-13	Before	0.12	0.09	9.30		1.25	0.21
	After	0.11	0.12	-3.40	64.10	-0.41	0.68
REQV 14	Before	0.28	0.25	6.70		0.89	0.37
	After	0.28	0.26	4.80	28.40	0.61	0.54
REQV 16-17	Before	0.24	0.29	-13.00		-1.73	0.08
	After	0.24	0.24	1.10	91.80	0.14	0.89
Sick Leave	Before	5.94	4.45	16.10		2.15	0.03
	After	5.73	4.92	8.70	45.70	1.11	0.27
Race: Asian	Before	0.01	0.04	-14.00		-1.85	0.07
	After	0.02	0.01	0.80	94.20	0.14	0.89
Race: Coloured	Before	0.08	0.08	0.10		0.01	0.99
	After	0.08	0.07	2.30	-2350.20	0.30	0.76
Race: White	Before	0.18	0.16	3.60		0.47	0.64
	After	0.18	0.18	-1.90	46.70	-0.24	0.81
Gender: Female	Before	0.16	0.19	-8.70		-1.16	0.25
	After	0.16	0.16	0.20	97.50	0.03	0.98
Position in 2004: Deputy	Before	0.07	0.10	-9.70		-1.28	0.20
	After	0.07	0.08	-2.50	74.60	-0.33	0.74
Position in 2004: Head of Department	Before	0.02	0.06	-17.50		-2.31	0.02
	After	0.02	0.02	0.30	98.60	0.04	0.97
Position in 2004: Other	Before	0.04	0.02	10.00		1.34	0.18
	After	0.04	0.03	6.60	33.50	0.80	0.42
Salary (R 1000's) in 2008 prices	Before	256.25	257.90	-4.70		-0.63	0.53
	After	256.29	257.23	-2.70	42.70	-0.34	0.73
Total enrolment	Before	0.05	0.06	-5.70		-0.76	0.45
	After	0.05	0.05	0.70	87.50	0.10	0.92
Number of teachers per 100 students	Before	0.13	0.06	23.20		3.11	0.00
	After	0.12	0.09	7.30	68.40	0.88	0.38
Urban location	Before	0.01	0.02	-0.90		-0.12	0.91
	After	0.02	0.01	2.90	-235.80	0.40	0.69
<i>Former department:</i>							
Independent homeland	Before	726.57	710.62	4.00		0.53	0.60
	After	721.63	728.87	-1.80	54.60	-0.23	0.82
Non-independent homeland	Before	3.88	3.86	2.50		0.33	0.74
	After	3.90	3.91	-1.50	38.50	-0.18	0.86
House of Assemblies	Before	0.49	0.48	1.30		0.17	0.87
	After	0.48	0.49	-1.30	-3.60	-0.17	0.87

House of Delegates	Before	0.09	0.15	-18.80		-2.48	0.01
	After	0.09	0.08	2.80	85.00	0.42	0.68
House of Representatives	Before	0.27	0.28	-0.60		-0.08	0.93
	After	0.28	0.31	-6.60	-953.30	-0.83	0.41
New School	Before	0.14	0.14	0.50		0.07	0.94
	After	0.15	0.15	-0.20	64.00	-0.02	0.98
Unknown	Before	0.01	0.03	-12.20		-1.61	0.11
	After	0.01	0.01	-0.60	95.50	-0.09	0.93
<i>Province:</i>							
Free State	Before	0.13	0.08	16.80		2.25	0.03
	After	0.13	0.12	1.40	91.70	0.16	0.87
Gauteng	Before	0.15	0.16	-4.50		-0.60	0.55
	After	0.15	0.15	0.50	89.20	0.06	0.95
KwaZulu-Natal	Before	0.12	0.20	-22.70		-3.01	0.00
	After	0.12	0.13	-2.90	87.40	-0.40	0.69
Limpopo	Before	0.19	0.11	23.70		3.18	0.00
	After	0.19	0.19	2.10	90.90	0.25	0.80
Mpumalanga	Before	0.10	0.13	-11.10		-1.47	0.14
	After	0.10	0.11	-4.50	59.50	-0.59	0.55
Northern Cape	Before	0.02	0.04	-11.10		-1.47	0.14
	After	0.02	0.02	0.60	94.40	0.10	0.92
North West	Before	0.11	0.07	14.50		1.94	0.05
	After	0.10	0.09	3.40	76.20	0.42	0.67
Western Cape	Before	0.11	0.09	8.40		1.13	0.26
	After	0.11	0.11	-1.60	81.30	-0.19	0.85
Provincial boundary change	Before	0.03	0.07	-17.20		-2.27	0.02
	After	0.03	0.02	5.20	69.70	0.92	0.36

Notes: Pstest results are only shown for group (1): the sample includes treatment schools experiencing principal turnover between 2008 and 2010 and control schools that experience principal turnover in the latter period 2010 to 2012 but not between 2008 and 2010. 'Before' estimates are identified before matching and 'after' estimates after matching.

Table 3A.7: Principal and teacher turnover in the teacher-principal dataset

	2004-2008	2008-2010	2010-2012
Teacher turnover	0.316 (0.464)	0.153 (0.360)	0.162 (0.368)
Principal turnover by type:			
Mobility	0.075 (0.264)	0.031 (0.173)	0.032 (0.176)
Attrition: retirement	0.066 (0.248)	0.045 (0.208)	0.068 (0.251)
Attrition: non-retirement	0.079 (0.269)	0.036 (0.187)	0.046 (0.209)
N (teachers)	251 977	295 521	313 426

Source: Pearsal-EMIS matched dataset. **Notes:** Estimates are obtained from the estimation sample used in the third OLS regression in Table 3.8. Standard deviations are in parentheses.

Table 3A.8: Descriptive statistics of the teacher-principal dataset

	Mean estimate	Standard deviation
Teacher characteristics		
Teacher turnover between t and t'	0.204	0.403
Age	42.421	7.999
Female	0.692	0.462
African	0.795	0.404
Indian/Asian	0.031	0.172
Coloured	0.080	0.272
White	0.095	0.293
Is a head of department	0.092	0.289
Is a deputy principal	0.025	0.154
School characteristics		
Percentage of students that are black	84.778	31.756
Total school enrolment	748.589	400.221
Number of teachers per 100 students	3.359	1.141
Average REQV of teachers in the school	13.831	0.462
School phase: Primary	0.512	0.500
School phase: Combined	0.135	0.342
School phase: Secondary	0.353	0.478
DBE wealth quintile: 1	0.244	0.429
DBE wealth quintile: 2	0.202	0.402
DBE wealth quintile: 3	0.260	0.439
DBE wealth quintile: 4	0.157	0.363
DBE wealth quintile: 5	0.137	0.344
<i>Former department classification:</i>		
Department of Education and Training (black)	0.256	0.436
Independent Homeland (black)	0.167	0.373
Non-independent Homeland	0.279	0.449
House of Assemblies (white)	0.094	0.291
House of Delegates (Indian/Asian)	0.030	0.170
House of Representatives (coloured)	0.084	0.277
New school	0.070	0.256
Unknown classification	0.020	0.141
N (teacher-years)		860 924

Source: Pearsal-EMIS matched dataset. **Notes:** Estimates are obtained from the estimation sample used in the third OLS regression in Table 3.8. Province indicators are not shown.

Chapter 4

Teachers' unions and industrial action in South African schooling: Exploring their impacts on learning

4.1 Introduction

In the transition to democracy in 1994, teachers' unions played an important role in advocating for positive transformation in education. In response to the subjugation of non-white students and teachers during apartheid, substantial teacher resistance arose to these injustices (Chisholm, 1999; Govender, 2004). In the early 90's, trade union involvement helped establish a far more equitable salary structure for teachers, equalising salary scales that had disproportionately favoured white and male educators (Van der Berg and Burger, 2010).⁶⁶ They also participated in negotiations related to the restructuring of the education system more widely. Today, however, their impact on the educational landscape is questionable. Critics would argue that the excessive influence of teachers' unions on public education - specifically, the dominant South African Democratic Teachers' Union (SADTU) – presents a binding constraint to improvement, especially in a time when international trends are moving towards implementing higher levels of accountability in education systems.

SADTU are a critical player determining which policies affecting teachers are accepted or rejected at the national level. It follows that they have considerable influence over national policy decisions in education, especially given their historical links with the liberation movement and its large membership. Exerting influence, they were able to expand the scope of the Education Labour Relations Council (ELRC) at its establishment beyond issues related to pay or worker benefits to include agreements on *all* issues pertaining to teachers' work (de Clercq, 2013). This was identified in earlier discussions in chapter two on the role unions will ultimately play in determining the final formation and implementation of policies affecting school leaders. Where teachers' unions mobilise

⁶⁶ Van der Berg and Burger (2010: 11) note that in negotiations in 1995, SADTU “supported the suspension of qualifications and experience related pay increments, and a stronger focus on general pay increases offering greater proportional increments to teachers at the lowest salary levels.” This position was consistent with SADTU's membership comprised of teachers with lower salaries on average due to lower qualifications and years of service. This would have maximised the benefits of its members, and minimised the benefits of historically advantaged teachers represented by other unions.

for the purpose of quality-enhancing policies, extending the scope of bargaining councils could have potentially positive educational outcomes where they take ownership of policies, making their successful implementation more likely (Gindin and Finger, 2014). However, if they have an objective function which differs systematically from that of parents and society at large, they are likely to pose a bottleneck to agreements on efficiency-enhancing policies at the national level and impede on learning progress.

Beyond advocating for improved pay, benefits and conditions of work, SADTU remains strongly opposed to national policies implying forms of monitoring or control of teachers' work even where accountability systems are disconnected from punitive measures (de Clercq, 2013).⁶⁷ They also have considerable decision-making control in the South African Council of Educators (SACE) which introduces various conflicts of interest in an organisation intended to form an independent accountability structure to oversee the teaching profession (van Onselen, 2012; de Clercq, 2013).⁶⁸ At the school level, in addition to lost worker days due to industrial action or union meetings, efficiency losses may take the form of interference in the appointment of school managers, the demand or supply of teachers and the way in which school manager effectiveness is compromised in an environment of union-management tensions (Patillo, 2012; Taylor, 2006; Taylor, 2014; City Press, 2014).

Despite this proliferous involvement of unions in schools and in (arguably) the functioning of the Department of Education, little quantitative research has explored union effects in the South African schooling environment. An exception, however, are studies that have assessed the implications of the introduction of new teacher pay systems catalysed by a combination of industrial action and union negotiations (Armstrong, 2014; Gustafsson and Patel, 2008; Van der Berg and Burger, 2010). The lack of research on teacher union effects in schooling in the local context is, in part, attributable to data limitations in identifying unionised teachers from non-unionised teachers in available school datasets. Yet even if school survey data measured teacher union membership, it is not clear how one would conceive of an approach to identify causal union effects on various educational outcomes given the labour relations and political framework in which unions operate (Alvarez, Moreno and Patrinos, 2007; Murillo et al., 2002). In the United States, studies exploit the differential nature and timing of the introduction of collective bargaining agreements across states and districts to estimate this relationship (Hoxby, 1996). In contrast to this scenario, collective bargaining on issues related to wages and national education policy takes place at a national level in South Africa where the terms

⁶⁷ De Clercq (2013) provides an account of how SADTU has even opposed low stakes accountability efforts, such as the introduction of the Whole school Evaluation of 2001.

⁶⁸ Van Onselen (2012) notes considerable conflicts of interest on the board of SACE, the key organisation tasked with providing an independent accountability structure to enhance the professionalism of teachers in South Africa. A majority of the SACE board members are concurrently SADTU members, holding key positions across both the union and the board of this 'accountability' structure.

and conditions of employment of education sector workers are negotiated at the ELRC.⁶⁹ For the most part, bargaining agreements are not differentially applied across provinces.⁷⁰

However, heterogeneity in teacher unionisation exists within the country, not only at the provincial level but at the school level. This heterogeneity can be exploited in estimating the impacts of unions on non-wage related education outcomes such as promotions, teacher utilisation, school functionality and student achievement. This specific research uses heterogeneity in strike activity among teachers within the *same* school in investigating the impacts unions pose for student achievement through lost learning due to teacher strike participation. This follows the approach by Kingdon and Teal (2010) to estimate union membership effects in India. Their identification strategy is applied here to the third survey implemented by the Southern and Eastern Africa Consortium for Monitoring Educational Quality (henceforth referred to as SACMEQ III).

This research contributes to the discourse on union impacts by investigating a disruption hypothesis that student learning is lost as a direct consequence of teacher strike participation. This is a topical issue in light of a 2013 proposal by South Africa's ruling party, the African National Congress, for the declaration of teaching as an 'essential service' (McKaiser, 2013). In response to escalating industrial action in public education in recent years, this proposal was tabled to prevent further learning disruptions in a system already characterised by some of the lowest levels of student performance, even by middle income-country standards. The notion of teaching as an 'essential service' is not a new concept. In Germany, for example, courts have ruled and accepted that in general public officers do not have the right to go on strike, and that includes teachers as far as they are public officers (Beckmann and Füssel, 2013). Moreover, South African labour legislation makes provision for certain services to be classified as essential services, withdrawing employees' right to strike.⁷¹ However, these essential services are typically limited to jobs related to the preservation of life, personal safety or the health of people. Since the 'essential service' proposal was tabled in 2013, it has gathered little momentum and this is not surprising. In response to apartheid control that suppressed labour rights and industrial activity, our Bill of Rights in The Constitution now enshrines the right to strike

⁶⁹ In South Africa's intergovernmental system, implementation is delegated to nine provincial governments but national government is responsible for policy and financing.

⁷⁰ There are provincial chambers of the ELRC which are responsible for dispute resolution at the provincial level and the monitoring of the implementation of national collective agreements. These provincial chambers engage in collective bargaining on provincially specific matters such as post provisioning, the utilisation of temporary teachers, employee wellness programmes or incentives for educators in hard-to-staff schools. However, when it comes to the more contentious issues of salaries, benefits and national policy in education, this is dealt with in the national chamber.

⁷¹ While employees in essential services are prevented from lawful strike activity, their labour disputes can still be addressed through the process of arbitration, not the power-play of strikes or lock-outs (Botes and Hofmeyr, 2013).

(Hlongwane, 2013).⁷² Where this is threatened, considerable contestation arises as seen in 2007 where health professionals' strongly resisted the delegitimising of their right to strike (von Holdt, 2012). In education, the essential services proposal was premised on the notion that strike activity is harmful for students and the education system more generally; but this has been an untested assumption in South Africa and in developing countries more generally.

The next section provides some background on teachers' unions and industrial action, considering both the international literature and providing a local context on unions and recent strike activity in the education sector. While the research is concerned with identifying the contemporaneous impacts of teacher strike activity on student achievement, proponents of industrial action may argue that longer term analyses may indicate no or even positive impacts of strikes if this leads to negotiations for improved working conditions or better pay that raises the motivations of teachers and attracts higher quality teachers to the profession. Data limitations constrain a dynamic analysis of this kind; nevertheless, possible long run impacts of strike activity and, specifically, the 2007 public sector strike are discussed given the available research. The next section then describes the estimation strategy to be used in the paper, the required data and the model specifications. Results are then presented in section four.

In brief, the student fixed effects estimations provide suggestive evidence that teacher strike activity negatively affects learning for students in the poorest three quartiles of schools in South Africa. There is evidence from these estimations that more marginalised students, both in terms of socio-economic status and academic performance, are most negatively affected by strike action. While the method goes some way in eliminating sources of endogeneity in the estimation, an application of a technique by Altonji, Taber and Elder (2005) in section five indicates that it is not possible to rule out that strike effects may be driven by omitted variable bias, particularly unobserved characteristics at the level of the teacher. This is a major limitation of the analysis.

4.2 Background literature on teachers' unions and industrial action

International literature

In the economics literature, studies more commonly explore the effects of union membership than teachers' industrial action on educational outcomes. Industrial action is just one aspect of what unions do, however, the two sets of literature are closely connected and for the purposes here I briefly consider both.

⁷² Section 23 of The Constitution provides that i) everyone has the right to fair labour practices, ii) every worker has the right to form and join a trade union; to participate in the activities and programmes of a trade union and to strike.

There are diverse strands of economic theories from both traditional microeconomic theory and organizational economics or “new institutional economics” that explain the existence of unions, and what they do (Bennett and Kaufman, 2007). Unions primarily fulfil the role of a bargaining agent, representing the needs of their members and negotiating for higher pay and more benefits. The collective bargaining power of the union is strengthened when they face an inelastic labour demand curve, as is the case of public education. Higher wages can be negotiated without large reductions in employment. This negative monopoly view of union control is aggravated when unions strengthen their bargaining power with threats of strikes or other industrial activity such as work-to-rule behaviour. However, Kaufman (2007) in a review of the economic theory on unions, and in response to earlier work by Freeman and Medoff (1984), identify that there are two other faces to unionism. A contrasting positive view is that in the presence of market imperfections strong union representation results in more efficient economic and welfare outcomes. This is particularly the case when there is one majority employer, as in the case of the teaching profession in South Africa, resulting in a monopsony type labour market. Union membership exists to counterbalance the power of the employer. Assuming that incomplete contracts exist between employers and employees and transactional costs exist in the employment relationship, it is also argued that union “voice” can promote efficiency in a number of ways. Union “voice” may reduce teacher turnover costs, improve working conditions and raise productivity of teachers, result in higher levels of teacher training, provide agency services where the union negotiates with the state (which is more efficient than multiple one-on-one communications of teacher to state) and reduce organizational slack.

As identified by Bennett and Kaufman (2007: 4), however, theory alone cannot decide the issue as to which model best describes the effects of labour unions. Ultimate determination has to come from a weighing and sifting of the empirical evidence. When the outcome in question is educational outcomes, this statement is equally applicable. Consistent with the broader literature on trade union impacts, under different theoretical models teacher unions can lead to improved or worsened educational outcomes. In Hoxby’s (1996) theoretical analysis, she identifies three different pathways by which teacher unions may affect the education production function. First, unionisation may influence the overall budget for school inputs. Second, the budgetary mix across alternative inputs may be manipulated through union demands. The third effect is efficiency related, where the productivity of schools’ inputs is altered through unionised teachers’ daily engagement with school inputs. Ultimately, how altered levels and allocations of inputs translate into student achievement gains or losses depends on whether unionised teachers are ‘rent-seeking’ or ‘efficiency-enhancing’ in their behaviour. Efficiency-enhancing union teachers are assumed to have the same objective function as parents, desiring to maximise student learning; but they have expert knowledge about those inputs and use of inputs that are likely to produce higher student achievement. Rent-seeking unionised teachers are assumed to have a different objective function to parents or their employer, militating for

school inputs and policies that maximise their own objectives rather than those of the students or parents. For example, rent-seeking union members may lobby for higher teacher salaries at the expense of policies that directly benefit student achievement. In the process they may engage in industrial action, reducing their levels of teaching effort and efficiency which results in lower student achievement.

Consistent with theoretical models that may lead to net efficiency gains or losses of unions, mixed evidence exists on the impacts of teacher unions on the education production function (Eberts, 2007; Cowen and Strunk, 2014). In the United States, for example, average negative effects of union membership on high school dropout rates are found by Hoxby (1996), yet positive effects on college entrance scores are identified by Grimes and Register (1991) for black American students. In developing contexts, it is typically argued that teachers' unions contribute to 'quiet corruption', undermining efficiencies in the production of education as they alter the rules of the game and capture gains at the expense of the intended beneficiary (World Bank, 2010). This is particularly the case where monopoly power and discretion on the part of teachers' unions becomes absolute in the absence of strong political leadership, transparency, accountability and systematic monitoring in the education sector (Patrinos and Kagia, 2007). In the context of India, Kingdon and Teal (2010) identify negative effects of union membership on grade ten student achievement scores. Their findings suggest that union membership is inimical to learning in this context where a negative effect size as large as 0.23 standard deviations of student achievement is observed. Alvarez, Moreno and Patrinos (2007) identify that the strength of unions (as measured by their influence over appointments) as well as their relations with state governments are strong predictors of the variation in school performance across Mexican states. Murillo et al (2002) examine the impact of teachers' unions on various education outcomes in Argentina finding mixed evidence of their impact on factors such as teacher tenure, teacher satisfaction, and class sizes.

While theory supports the possibility of positive, negative or no union membership effects on schooling outcomes, both theory and logic predicts that rent-seeking industrial action will be accompanied by contemporaneously lower student achievement. It is expected that if students are not in school or being taught by teachers, learning cannot take place. Empirically, however, international evidence of the contemporaneous effect of teacher strikes on learning is contradictory. Negative strike effects are observed by Baker (2011) and Johnson (2011) in Canada and by Bellot and Webink (2010) in Belgium. However, studies in the United States have also identified no significant effects of strikes on student achievement (Zwerling, 2008).⁷³

⁷³ There is a larger literature on a related issue of teacher absenteeism and its impacts for learning. Patrinos and Kagia (2007) provide a useful review of these studies, exploring teacher absenteeism effects on student achievement in developing country contexts. They argue that regardless of individual motivations, teacher

In reconciling the contrasting results, explanations for no observed effects of strike action on student achievement are at best vague. Some argue that teachers make up for work stoppages so that total instructional time is unchanged and therefore overall student learning is unaffected (Zwerling, 2008). More plausibly, Baker (2011) attributes the lack of identification of negative effects to estimation strategies relying on cross-sectional data that do not sufficiently control for various sources of endogeneity bias. As with most production function estimations, identification problems are common when estimating strike activity effects on student achievement. It is difficult to differentiate between true effects and bias generated through various sources of endogeneity that exist at the district, school, teacher and student level. For example, in school districts where administration is weak, affecting school functionality and ultimately student achievement, strike activity may be more prevalent as teachers attempt to secure better job conditions for themselves. At the school level, unobserved school characteristics that influence a teacher's decision to strike may themselves affect the education production function. As identified by Hoxby (1996), industrial activity in a school may intensify, for example, where school administrators are considered incompetent. Further challenges for estimation are that students may match non-randomly to schools and to teachers, while teachers' unobserved characteristics may themselves be correlated with their decision to strike (Kingdon and Teal, 2010).

Although panel data is typically required to control for some of the aforementioned sources of endogeneity, cross-sectional school survey data that test students in more than one subject can be exploited to achieve some of the gains associated with panel data. This across-subject analysis using student fixed effects is a technical innovation exploited by Kingdon (2006) in estimating the relationship between teacher characteristics and student achievement in India and later applied to identifying teacher union effects on student achievement in India (Kingdon and Teal, 2010).⁷⁴ The approach eliminates some sources of endogeneity bias at the school and student level ubiquitous to education production functions. Before providing a fuller discussion of the estimation strategy and the dataset used, additional background context on teachers' unions and industrial action in South Africa is considered.

Union membership in the South African education sector

During apartheid, the provision of unequal education to race groups was an instituted policy mechanism to suppress the majority of South Africa's black population. Most notoriously, black people

absenteeism is a form of "corruption" as it is a *prima facie* misuse of public resources in that services that have been paid for are not delivered.

⁷⁴ Clotfelter, Ladd and Vigdor (2010) also exploit this strategy to examine the effects of teacher credentials on student achievement in North Carolina, US. Altinok and Kingdon (2012) provide another example of the application of the student fixed effects estimation approach to identify class size effects on learning for a number of countries. They exploit student testing in multiple subjects in available TIMMS data to implement this identification strategy.

were intentionally provided inferior education through the then ruling party's "Bantu education"⁷⁵ policies. Separate education departments, divided along racial lines, implemented not only distinctive curricula for students but distinctive forms of authority over teachers. As noted by Chisholm (1999), control over white teachers was largely professional in nature where they were consulted in the formation of curricula and given a degree of autonomy in work. By contrast, control over black teachers was intentionally bureaucratic and authoritarian in line with state intentions for social control. Black teachers were closely monitored by inspectors, subject advisors and other representations of white subjugation. In the late eighties, however, large political opposition arose to apartheid in general and particularly its unjust education policies (Govender, 2004). The linkage with the apartheid state of bureaucratic controls over teachers generated considerable teacher resistance which persists today.

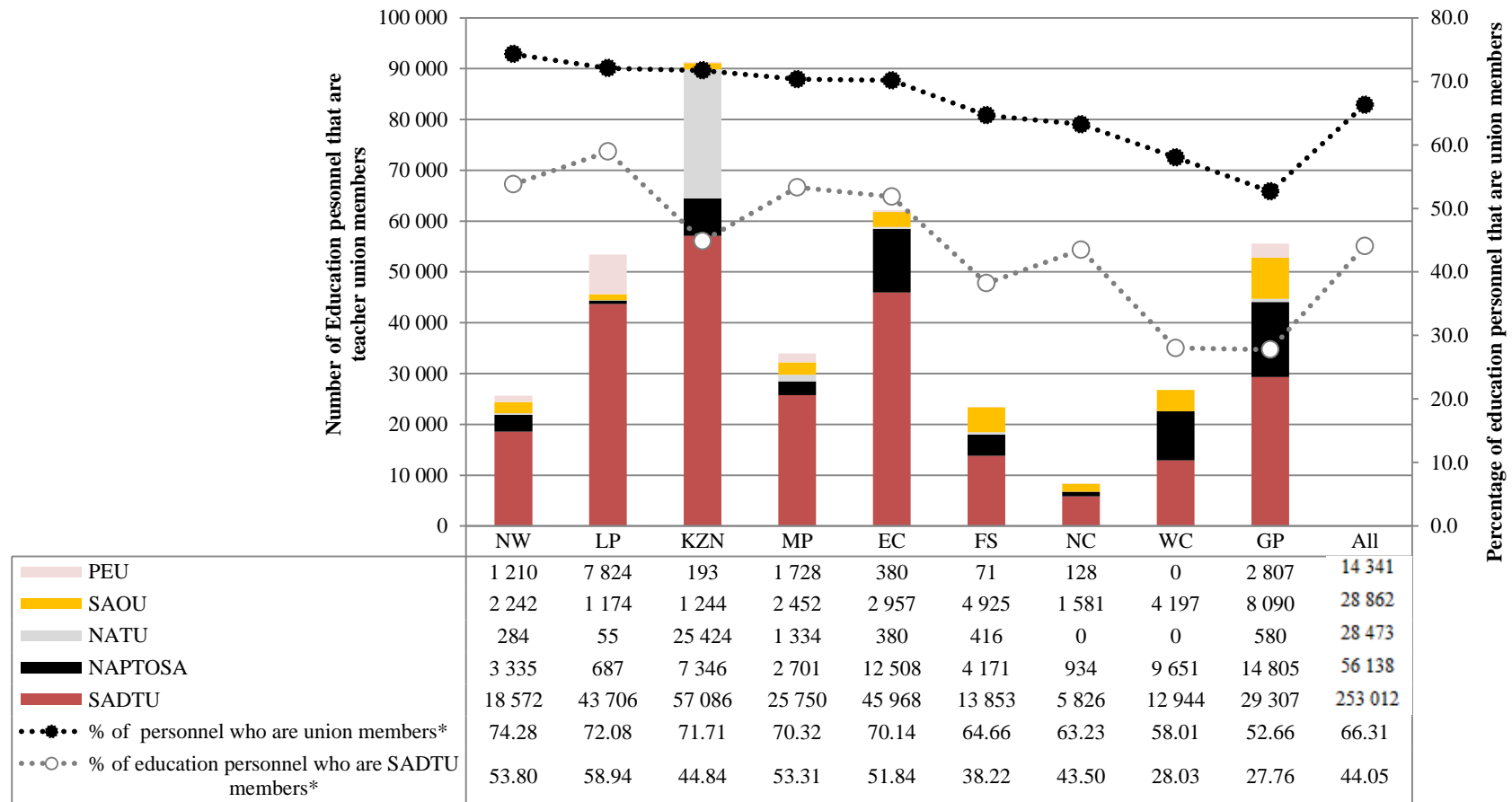
As a rough estimate, two thirds⁷⁶ of all persons in education (including administrators, management, support staff and privately employed personnel in schools in addition to teachers) are formally identified as members of a teacher union in South Africa. In absolute terms, this represents 380 000 members using 2012 data where membership rates and choice of teacher union differ across provinces. If one limits the national teacher union membership estimate to only teachers this estimate is likely to be higher. Armstrong (2014: 4) using the Labour Force Surveys between 2000 and 2007 identified that roughly 76 percent of teachers in South Africa are union members.

It is interesting to note that while unionisation has grown substantially in post-apartheid South Africa, and specifically in the late 90s, recent unionisation rates among personnel are not unusually high when compared with other education systems (Alvarez, Moreno and Patrinos, 2007). Consistent with findings in other developing country contexts (ibid, 2007; Murillo et al., 2002), there is also considerable heterogeneity in unionisation within our education system.

⁷⁵ The Bantu Education Act of 1953 was the designed plan of former Prime Minister H.F. Verwoerd. In his own words he said, "There is no place for [the Bantu] in the European community above the level of certain forms of labour. It is of no avail for him to receive a training which has as its aim, absorption in the European community" (Senate, 1954). The Bantu Education system was established to educate black youth only to a level where they could operate as labourer, worker and servant.

⁷⁶ See the notes of Figure 4.1 for a description of how this figure was estimated relying on union membership figures from the Public Services Bargaining Council (PSBC). Calculating teacher unionisation rates with available data in South Africa is not straight forward, where it is not obvious what groups of education personnel are included in the PSBC figures. On the basis of *a priori* expectations this estimate of 66 percent seems too low but it must be noted that in both the numerator and denominator of the calculation are non-educator personnel such as provincial or district staff, school support staff and privately employed SGB or other staff members at the school level. If one were to limit the numerator and denominator to include only educators, this figure may be higher if more educators than administrators are unionised. It is also noted that some studies have erroneously attributed teacher union membership figures reported by the PSBC as referring to teachers only, when non-teachers in the education sector are also included in these figures. For example, both SADTU and NAPTOSA attract teachers in the public *and private* sector and *other workers* in the education sector to their membership base. If this is not recognised, this results in over inflated estimates of teacher unionisation as high as 90 percent in some studies.

Figure 4.1: Union membership in the South African education sector, 2012



Source: Union membership figures are compiled from figures of the Public Service Co-ordinating Bargaining Council and the Education Labour Relations Council, own calculations are applied. **Notes:** The teacher union membership figures presented apparently include both educators *and* a small number of support staff which may be public servants or employed privately at the school level. *Union membership is then expressed as a percentage *all* education personnel in 2012 that are remunerated by the state and privately. This estimate of all education personnel is derived by identifying the number of personnel in the *entire* education payroll and adding in the number of SGB/privately remunerated staff identified in the Snap 2012 data of ordinary schools disaggregated by province. The total column of numbers is not shown graphically as this distorts the scale of the provincial figures. NAPTOSA = "National Professional Teachers Organisation of South Africa"; SADTU = "South African Democratic Teachers Union"; SAOU = "Suid-Afrikaanse Onderwysersunie"; PEU = "Professional Educator's Union" and NATU = "National Teachers' Union"

What the national estimates do not recognise is the interesting provincial dimension to union membership in the education sector which is highest in provinces such as the North West, Limpopo, KwaZulu-Natal, Mpumalanga and the Eastern Cape but notably lower in Gauteng Province and the Western Cape. Union affiliation also differs markedly across provinces.

There are various different teacher unions in South Africa, but by far the dominant union is the South African Democratic Teachers' Union, most commonly referred to as SADTU. Audited 2012 figures indicate that their membership comprised roughly 253 000 personnel which represents two thirds of all registered teacher union members. SADTU membership has also grown substantially over the past twenty years, with membership figures in 2012 that were 2.5 times that in 1996 (Govender, 2004).⁷⁷ A clear provincial dimension exists to SADTU affiliation. Their proliferation is strongest in the Limpopo Province where figures from the Public Service Co-ordinating Bargaining Council suggest that 82 percent of all unionised education personnel in Limpopo are registered members of SADTU, compared with a figure of 48 percent in the Western Cape. The next largest teachers' union is the National Professional Teachers' Association of South Africa (NAPTOSA) with just over 50 000 members as at December 2012. Affiliation to this union is strongest in the Western Cape and the Gauteng Province when expressed as a proportion of unionised teachers in each province. These provincial differences in union membership are worth noting. They may have implications for differences in the balance of negotiating power across provincial chambers of the ELRC and in the functioning of provincial administration departments of education.

Considering the two largest teachers' unions in South Africa, SADTU and NAPTOSA, both play a role in negotiating conditions of work for teachers in two sets of combined teachers unions⁷⁸ in the sector specific ELRC. Both unions fulfil a primary function as bargaining agents for their members, although on the basis of sheer vote size SADTU's influence in negotiations is considerably more substantive. However, in balancing their secondary functions as political and professional organisations⁷⁹ they are divergent in their ideologies (Chisholm, 1999; de Clercq, 2013). Teacher

⁷⁷ The majority of the growth in SADTU's membership took place between 1996 and 1999 when their membership base grew from 106 000 to nearly 200 000 three years later (Govender, 2004).

⁷⁸ At the ELRC, negotiations and consultation takes place between the Employer (the DBE) and two sets of combined trade unions (CTU). The first is the CTU-SADTU where SADTU membership vote weights are combined with the Cape Teachers' Professional Association (CTPA). NAPTOSA's bargaining power is established through the combined 'Autonomous Teachers Union' (ATU) which includes a number of smaller unions including the Suid-Afrikaanse Onderwysersunie (SAOU), the National Teachers' Union (NATU), the Professional Educators Union (PEU), the Public Servants Association (PSA) and the Health and Other Service Personnel Trade Unions of South Africa (HOSPERA).

⁷⁹ As noted by Cowen and Strunk (2014), there are three main functions of teachers' unions. The first and most dominant role is that of a bargaining agent for member teachers and the second role is that of a political organisation advocating for teachers. As a political organisation, their function is to act as an interest group, "active not only in promoting or opposing particular pieces of legislation or administrative policy, but also as a

unions represented in what is now NAPTOSA existed in the early days of apartheid with typically white leadership and an agenda largely concerned with the professionalism of teachers. By contrast SADTU, having emerged in direct opposition to apartheid, is understandably more militant, political and concerned with the rights of the ‘worker’ than promoting professionalism (Chisholm, 1999). Moreover, SADTU is an affiliate of COSATU – one of the three members in the tripartite ruling alliance – which prioritises their role as a political organisation over their function as a professional body. As a political organisation, their presence is extensive not only in terms of membership numbers. The organisational structure of the union facilitates an on-site presence across almost all school districts and in the majority of schools.

Teacher strikes in post-apartheid South Africa

The earlier discussion has highlighted the powerful influence of teacher unions in the school landscape in South Africa. However, there is no doubt that criticism levelled at teacher unions, particularly SADTU, is strongest in periods of industrial action. The adverse impacts of teacher strikes in South Africa are obvious in terms of school closures, disruptions to teaching programmes and exam timetables. Teacher strikes are also occasionally characterised by riots and outbreaks of violent protest with unionised teachers intimidating schools that remain open or those teachers or principals that resist calls to down tools (Patillo, 2012; von Holdt, 2012). Furthermore, strike action among teachers, specifically militant activities⁸⁰, has created negative sentiment about teachers in a country that can ill-afford the de-professionalization of teaching where capable and qualified teachers are desperately needed. However, a fundamental question remains as to whether and to what extent teacher strike activity actually affects student achievement in South Africa?

In the past decade, the extent of strike activity in the education sector has varied notably from year to year as identified in Table 4.1 which identifies lost workers days⁸¹ in the education sector due to strike activity for three teacher unions in South Africa. The years 2007 and 2010, however, stand out as exceptional where teachers participated in the largest public sector strikes experienced in post-

force in national, state and local elections” (ibid, 2014: 4). The third role is that of a professional organisation, providing support to individual teachers. In particular, where teacher unions embrace their role as a catalyst for the professionalization of the teaching force, this can yield very positive impacts for educational systems. However, this role is not widely explored in relation to its influence on student achievement and altering district/national resources for education (Cowen and Strunk, 2014: 4).

⁸⁰ SADTU’s historically militant culture has translated into uncontrolled and sometimes violent behaviour among members during periods of strike action, threatening not only teaching but the safety of students, teachers and principals in recent years (Patillo, 2012; von Holdt, 2012).

⁸¹ These national statistics of worker days lost do not account for district or school specific experiences of informal ‘work-to-rule’ behaviours by teacher unions such as school lockouts, ‘down’ chalk activities and other protest action in schools. Work-to-rule behaviour in schools often goes unnoticed in the media or even by education administrators, yet it may be just as detrimental to learning as full blown strike action as suggested in the work of Johnson (2011) in exploring industrial action effects in Canadian schools.

apartheid South Africa (von Holdt, 2012). The long and intensive strike in 2007 involved nearly one million public service workers from seventeen unions; including nurses, teachers and other civil servants (ELRC, 2010). Teachers, however, formed a dominant role in this strike. Union members came out in support of a demand for an across-the-board increase of twelve percent in salaries, as well as increases in health and housing benefits. Three years later, the 2010 public sector strike and teachers' involvement in this, would be even more prolific than in 2007.

However, the 2007 public sector strike was significant with respect to catalysing the largest reform of the teacher pay system since the major changes of the mid-1990s brought about to create a new post-apartheid order (Gustafsson and Patel, 2008: 1). Changes to teacher pay were initially reflected in Collective Agreement No. 1 of 2008 of the ELRC, which ushered in what is known as the Occupation Specific Dispensation (OSD). This new teacher pay system would convert a rather flat age-pay slope for teachers (a teaching career disincentive) into one that compared favourably to that of other professionals, and to those of teachers in other countries. It was initially argued that "the level of teacher pay in future years as put forward by the 2008 resolution clearly removes teacher pay as a factor that could inhibit quality improvements, and should clear the way for stronger collaboration between teachers, their unions, the state, and parent communities in tackling poor performance in schools" (Gustafsson and Patel, 2008: 16).

Table 4.1: Estimated worker days lost through the teacher strike activity in South Africa

	2006	2007	2008	2009	2010	2011	2012	2013
<i>Worker days lost</i>	0	1 619 435	0	11 466	4 534 662	0	54	1 993
<i>% of total worker days lost in SA</i>	0	17	0	0.8	22	0	0	0.1

Source: Compilation of figures from the Industrial Action Reports (2006-2013) published by the Department of Labour.
Notes: Figures are likely to be incomplete and the accuracy of days lost is contentious; nevertheless, it provides an indication of the extent of strike activity from year to year. The loss of working days is calculated by multiplying the number of workers involved in each stoppage by the duration of the stoppage in days. For example, if during the reference period there is one stoppage, involving 2 000 workers and lasting three days, working days lost would be computed as 2 000 workers x 3 days = 6 000 working days lost.

The broad intention of the initial system was to link pay and performance⁸² within a broader 'career pathing' model. This system would have enhanced the attractiveness of the teaching profession, rewarding not only experience but more importantly performance. In this respect, the strike could have had positive long-run equilibrium effects for educational improvement. However, the OSD that was eventually agreed to in 2009 was different in its details from the original 2008 proposal. SADTU

⁸² Performance here refers to teacher behavioural factors rather than measures of school or student performance (ELRC, 2008).

were critical of the 2008 agreement, in particular blocking performance-pay proposals of the system.⁸³ More strike activity ensued, and eventually political will resulted in the signing of another agreement in 2009 that terminated proposals that would have provided the intended opportunity for teachers to rise through the salary scale with reasonable speed. In the 2009 agreement, some of the notch progression was exchanged for large once-off increases in the pay of all educators. Nevertheless, Armstrong (2014) identifies that returns to experience for teachers have improved since the introduction of OSD over the period 2008 to 2010, eroding some of the relative unattractiveness of the wage structure faced by teachers. While this is a potentially positive long-run impact of the 2007 strike, OSD has arguably also resulted in a rising educator wage bill in provinces raising concerns for the crowding-out of non-personnel expenditure, including expenditure on textbooks and learner support materials. This poses a threat to learning where textbooks, in particular, are found to be one of the strongest observed input predictors of educational attainment in South Africa (Shepherd, 2015b).⁸⁴ If the strike has an influence on pay and the relative attractiveness of the entire teaching profession, then the long-run impacts of this on educational quality should be observed in improvements in nationally representative indicators of educational achievement. In the case of an incentive programme such as the OSD that spans the entire schooling system, it is difficult (if not impossible) to separate out the improvement effects of the programme from the effects of other factors (Gustafsson and Patel, 2008). However, if there are no improvements in test scores in nationally representative assessments of learning, “then one can be highly certain that the OSD is not working as it should” (ibid: 22).

There is inconclusive evidence to suggest that improvements have yet materialised in the educational performance of students since the introduction of OSD. Considering South Africa’s results in the Progress in Reading and Literacy Study (PIRLS) in 2011, an international test of literacy, there was no statistically significant improvement in the achievement of grade five students between PIRLS 2006 and PIRLS 2011 (Howie et al., 2012). However, the results of grade nine performance in the Trends in International Mathematics and Science Study (TIMSS) across 2003 and 2011 indicate some level of improvement in learning (HSRC, 2012). There are, however, questions about the validity of the scale of this test in tracking performance improvements where the ability of children to answer the

⁸³ This is in contrast to the position of NAPTOA, for example, that supported evaluation linked to pay progression (Smit, 2013).

⁸⁴ In an analysis of educational attainment of grade six students using SACMEQ III data, Shepherd (2015b) identifies that the effect size on textbook provision outweighs that of all other observable classroom and even teacher characteristics including their experience, qualifications and indicators of teacher content knowledge.

test is poorly matched to the difficulty level of the test. Taken together, the PIRLS and TIMSS results provide mixed evidence of any national improvement in learning post 2007.⁸⁵

Having considered briefly the potential dynamic impacts of the 2007 public sector strike, this study focuses on estimating the contemporaneous disruption effects of the strike on learning in primary schools. Further dynamic analyses are constrained by available data. There are currently only three available surveys in South Africa which have included a question on the number of days a school is closed due to a boycott or strike or the number of days a teacher was absent due to strike activity.⁸⁶ These include the Systemic Evaluation 2004, the Systemic Evaluation 2007 and the SACMEQ III survey conducted in the last quarter of 2007. They are all cross-sectional surveys of schooling, however, for additional reasons described later SACMEQ III is uniquely suited to this analysis. Distinct from the Systemic Evaluations, teachers in SACMEQ were asked about their strike participation rather than asking only the principal about the number of days the school had been affected by strike activity. It is possible to explore the impacts of the 2007 strike, even in this cross-sectional framework, because strike participation does not affect all schools and teachers uniformly. While unions may officially call for a month long strike, the number of days individual teachers choose to strike is variable across and within schools. This is consistent with broader research that identifies heterogeneity among union members in South African, specifically COSATU affiliates, in their opinions of and approaches to collective action (Buhlungu and Tshoedi, 2012).

SACMEQ refers to the consortium of 14 ministries of education from southern and eastern African countries, including South Africa.⁸⁷ Since its inception, the consortium has conducted four large-scale, cross-national surveys of schooling at the grade six level together with UNESCO's International Institute of Educational Planning (IIEP). The most recent SACMEQ 2011 results have not been released; nevertheless, SACMEQ III of 2007 is instructive for this analysis. The data was collected for over 61 000 students across the fourteen countries (SACMEQ, 2010). Before describing the estimation strategy, the cross-national nature of the survey also allows for interesting regional comparisons of strike activity and teacher absenteeism more generally.

⁸⁵ The results of the most recent SACMEQ survey, which have not yet been released, could provide a telling indicator of how student performance has changed over time. The TIMSS 2015 and PIRLS 2016 survey results may also provide a source of information on whether there have been improvements in educational quality.

⁸⁶ Furthermore, there are no school surveys in South Africa which ask about teacher union membership. Indicators of teacher union membership, however, can be generated using the Labour Force Surveys; but here union membership indicators cannot be linked to learning outcomes.

⁸⁷ Other education ministry members are from Botswana, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, Tanzania (mainland), Tanzania (Zanzibar), Uganda, Zambia, and Zimbabwe. The mission of the organisation is to support education improvements by providing technical skills, data and research for monitoring and evaluating school quality in the member-based basic education systems. Zanzibar is a territory of Tanzania with its own school education system, therefore only fourteen *countries* are represented in SACMEQ.

Table 4.2: Self-reported teacher absenteeism for strikes and all other reasons in 14 southern and eastern African countries, SACMEQ III 2007

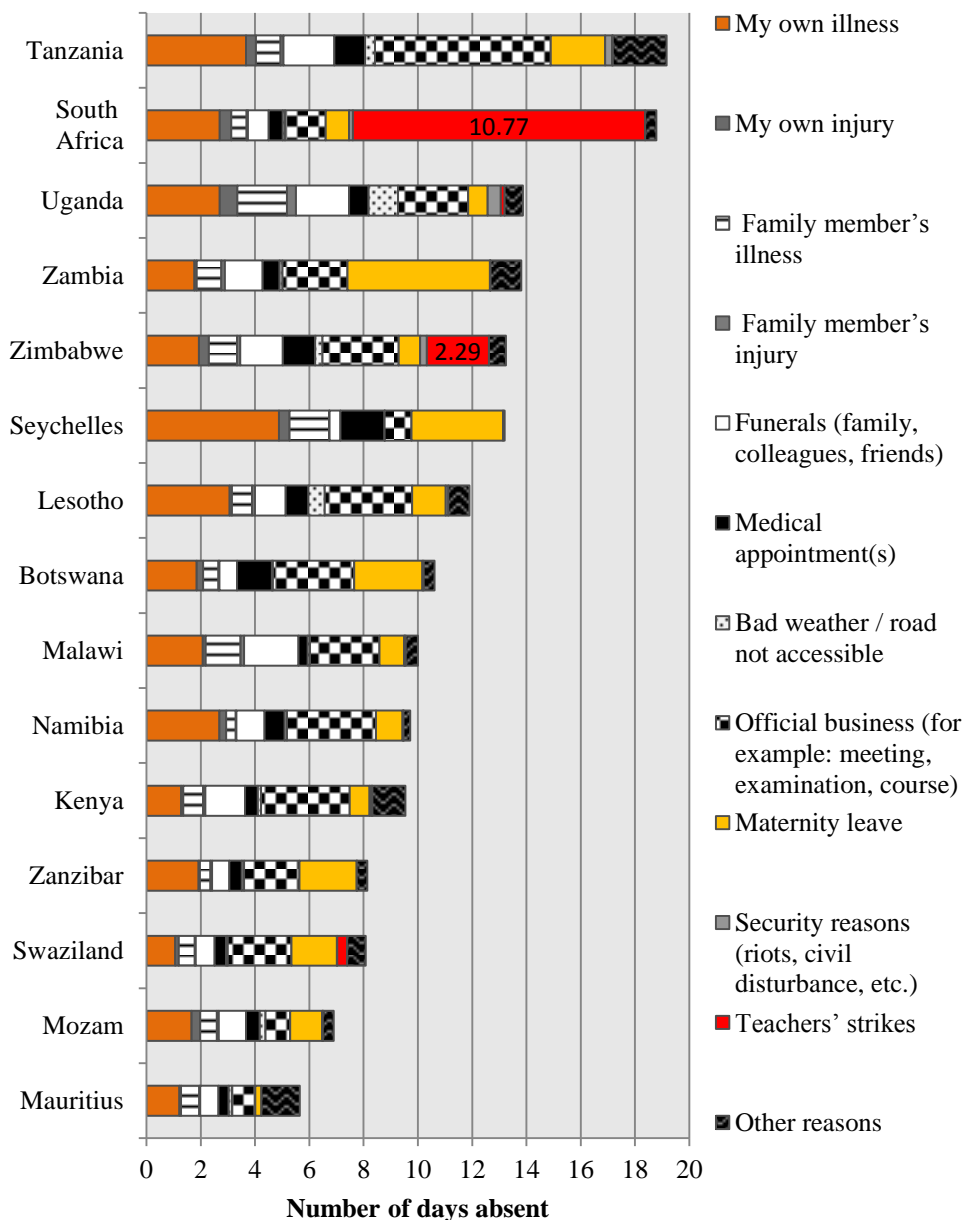
	Days absent for teacher strikes			Total days absent (all absenteeism)		
	Mean	Standard Error	Number of teachers	Mean	Standard Error	Number of teachers
South Africa	10.771	(0.384)	1 158	18.791	(0.784)	1 158
Zimbabwe	2.290	(0.248)	319	13.248	(1.340)	319
Swaziland	0.358	(0.053)	368	8.082	(0.746)	368
Uganda	0.138	(0.072)	741	13.872	(0.941)	741
Kenya	0.039	(0.026)	763	9.538	(0.594)	763
Malawi	0.036	(0.036)	267	10.000	(0.909)	267
Tanzania	0.020	(0.017)	637	19.166	(1.130)	637
Zambia	0.009	(0.009)	279	13.814	(2.078)	279
Namibia	0.005	(0.003)	831	9.714	(0.573)	831
Mozambique	0.002	(0.002)	882	6.899	(0.443)	882
Botswana	0.000	-	421	10.616	(1.106)	421
Lesotho	0.000	-	298	11.894	(0.855)	298
Mauritius	0.000	-	479	5.652	(0.365)	479
Seychelles	0.000	-	115	13.200	(1.971)	115
Zanzibar	0.000	-	710	8.133	(0.840)	710
Regional ave. excl. SA	0.158	(0.019)	7 847	10.608	(0.255)	7 847

Source: SACMEQ III, own calculations. **Notes:** Calculations account for probability weights and stratification by region in sample design. SACMEQ III, conducted in 2007.

The data indicate that strike activity was considerably more prevalent amongst South African teachers in 2007 compared with teachers in 13 other participating countries. Table 4.2 shows that South African grade six teachers were absent for an average of 10.7 days in the 2007 year due to teacher strikes compared with the regional average for other countries of 0.16 days. The second highest occurrence of teacher strike activity was in Zimbabwe, where teachers were absent for about two days. For the remaining thirteen countries, strike activity was virtually non-existent. However, comparing South Africa's teacher strike activity to that in other countries in 2007 is arguably an unfair comparison given the unusual intensity of the public service strike that year. For this reason, estimates of principal reports of the number of days that schools' were closed in 2004 for boycotts or strikes were also obtained from the Systemic Evaluation 2004. Consistent with SACMEQ, this survey was also representative of schools with students at the grade six level.

Estimates from the Systemic Evaluation survey indicate that on average 0.6 days⁸⁸ were lost in schools in 2004⁸⁹ for boycotts or strikes. The average strike days lost is much lower in comparison to the 2007 average for South Africa, but remains higher than the regional average for other SACMEQ countries.

Figure 4.2: A cross-country comparison of teachers' self-reported days absent for various reasons, SACMEQ III 2007



⁸⁸ This is a weighted estimate from the Systemic Evaluation 2004 school questionnaire which surveyed principals in 1 000 schools. Data is missing for 28 of the 1 000 schools on the number of days the school was closed for boycotts or strikes.

⁸⁹ The year 2004 was also characterised by a public sector strike over wages and benefits and involved teachers; but this strike was much shorter in duration and lower in intensity.

A notable feature of Table 4.2 is that the teacher strike of 2007 in South Africa was the dominant reason for high levels of teacher absenteeism⁹⁰ when compared with other countries. By September 2007 when the SACMEQ survey was administered, teachers had been absent for on average nineteen days in that calendar year. However, after excluding days absent for strike participation, teacher absenteeism in South Africa fares well against the regional average. Second to teacher strikes, own illness was the most common reason for absenteeism, followed by ‘official business’, maternity leave and attending funerals. This is seen graphically in the stacked bar chart of Figure 4.2 which presents the total average days that grade six teachers across 14 countries were absent in 2007 for a list of absenteeism reasons.

4.3 Method and data

Having provided a background on teachers’ unions and strike activity in South Africa, the next section describes the estimation strategy used to investigate how strike activity impacts on student performance.

Estimation strategy

Consider the following equation, where achievement scores of student i in subject j and attending school k is modelled as a function of student, school and teacher inputs:

$$A_{ijk} = \alpha + \beta X_{ik} + \gamma T_{jk} + \theta \text{strike}_{jk} + \delta S_k + (\mu_{ij} + \varepsilon_{jk} + \eta_{jk}) \quad (1)$$

A vector of student characteristics for the i^{th} student in school k is represented by X_{ik} and a vector of school characteristics in the k^{th} school is represented by S_k . Where data is available for multiple teachers, teaching different subjects, their characteristics are not subsumed within S at the school level as is the case with many education production function estimations. Within the school, teacher characteristics vary so that teacher characteristics, T , for the j^{th} subject are observed in school k . Furthermore, where teacher characteristics are assumed to be independent of whether they participate in a strike, we observe strike participation of the j^{th} teacher in school k , strike_{jk} . Unobserved characteristics of the student, the subject teacher and the school are reflected in the composite error term $(\mu_{ij} + \varepsilon_{jk} + \eta_{jk})$.

⁹⁰ It is important to note that teacher absenteeism figures, including strike activity absence, are likely to be underestimated in SACMEQ III for two reasons. First, absenteeism is self-reported in teacher questionnaires and is likely to be underestimated. Second, the survey was administered in September 2007 and therefore total recorded teacher absenteeism excluded absence that would have occurred in the remaining three months of the year (the school year coincides with the calendar year in all these countries). Underestimation of absenteeism in SACMEQ III is also suggested when compared with other data. Using the 2008 Khulisa Consortium audit of ordinary schools datasets, for example, an HSRC report provides a ‘conservative’ estimate that on average between twenty and 24 days a year of regular instructional time were lost by each teacher (Reddy et al., 2010).

Initially, ordinary least squares (OLS) regression is used to estimate equation (1) to identify the relationship between teachers' strike activity and student achievement. However, noting the shortcomings of the OLS approach in addressing endogeneity bias, fixed effects estimates are then provided. In a district or school fixed effects equation, observable and unobservable characteristics at the school and district level are differenced out of the equation. This removes some potential correlation bias between unobserved district and school level factors and the variable of interest, namely strike action. However, it does not remove student unobservables from the estimation which may be correlated with teachers' decisions to strike. The student fixed effects approach goes a step further. In this application one estimates an across-subject, within-student achievement production function which is akin to the more familiar panel data fixed effects approach (Kingdon, 2006). In comparison to an achievement production function estimation using panel data where achievement is modelled by considering variations within-students across-time, Kingdon (2006) notes that here a within-student *across-subject* equation is estimated. The advantage of this method is that one controls for all subject-invariant student and family unobservables and examines whether the industrial action of different subject teachers in a school is related to a student's marks across those subjects in a specific year. This approach also has an advantage over panel data estimation in that it avoids the problem of non-random attrition of students or teachers over time (Kingdon and Teal, 2010).⁹¹

As Kindgon (2006) explains, in a simple case of two subjects, unobservables are differenced out of the estimation as follows:

$$A_{i2k} - A_{i1k} = \gamma(T_{2k} - T_{1k}) + \theta(\text{strike}_{2k} - \text{strike}_{1k}) + \{(\mu_{i2} - \mu_{i1}) + (\varepsilon_{2k} - \varepsilon_{1k}) + (\eta_{2k} - \eta_{1k})\} \quad (2)$$

Assuming that school unobservables and student unobservables are subject invariant such that both μ and η do not have a j subscript, then within the k^{th} school equation (2) reduces to equation (3). Student and school (and district) heterogeneity is effectively differenced out of the equation in an across-subject student fixed effects estimation.

$$A_{i2} - A_{i1} = \gamma(T_2 - T_1) + \theta(\text{strike}_2 - \text{strike}_1) + \{(\varepsilon_1 - \varepsilon_2)\} \quad (3)$$

Limitations

This estimation strategy has the advantage of removing some of the confounding effects of unobserved heterogeneity in student and school characteristics. However, it eliminates some but not all sources of bias. In particular, it does not remove heterogeneity in teacher characteristics where

⁹¹ However, a similar attrition arises in the SACMEQ data where some students were not tested in all subjects.

unobserved teacher characteristics ($\varepsilon_1, \varepsilon_2$) may be both correlated with a teacher's decision to strike, $strike_{jk}$, and student achievement, A (Kingdon, 2006; Kingdon and Teal, 2010).⁹²

In other words the requirement that

$$E[(\varepsilon_2 - \varepsilon_1)(strike_2 - strike_1)] = 0 \quad (4)$$

for causal inference is not completely satisfied even using student fixed effects. This is a major limitation of the approach as the estimation of a causal strike effect requires that a teacher's unobserved characteristics be unrelated to his or her decision to strike. Kingdon and Teal (2010), in addressing this concern in the context of union effects, supplement their analysis using a technique proposed by Altonji, Elder and Taber (2005) to investigate the sensitivity of estimates to omitted variable bias. Section five provides a discussion of this technique with application to interpreting the estimation results and reveals that it is not possible to rule out that the strike estimate obtained is overestimated in the presence of unobservable teacher characteristics.

Data

Using this student fixed effects estimation strategy requires a dataset that must satisfy two conditions. First, it requires cross-sectional data with at least two subject test scores per student. Another condition is that there must be reasonable variation in the variable of interest, in this case teachers' strike activity by subject (Altinok and Kingdon, 2012). The SACMEQ III dataset for South Africa satisfies these criteria.

The distinct target population of the SACMEQ III survey was all students at the grade six level in 2007; however, the survey was also concerned with describing schools and grade six teachers.⁹³ In South Africa, 392 schools were sampled and a total of 9 071 students and 1 158 teachers were surveyed. In addition to collecting information on students' background and various school characteristics, the data provides three different achievement scores for students in health, reading and

⁹² Furthermore, the assumption that unobserved student characteristics are invariant across subjects is questionable. Student ability may vary across subjects; for example it is plausible that student ability in language exceeds ability in math. In this case, the μ is not differenced out of the equation and may be correlated with a teacher's strike activity and student achievement. The presence of subject-varying student ability can then remain a source of bias in the estimation (Kingdon, 2006). Another limitation of this approach is that the fixed effects approach effectively differences out variables, where differencing may introduce possible attenuation bias in the coefficients due to measurement error.

⁹³ With respect to the sampling strategy, SACMEQ III was stratified using both explicit and implicit strata. The explicit stratification variable was 'region'; in the South African case this is analogous to the nine provinces. The implicit stratum is school size. To have greater control of the final sample size, sampling of schools was conducted using probability proportional to size, where a simple random sample of a fixed number of students is selected within each school. Data collectors were responsible for the selection of students within a school rather than school managers or teachers who may choose brighter students to participate and bias the sample (SACMEQ, 2010).

mathematics. At the grade six level in South Africa, each of these testing areas are covered in at least three of the eight compulsory subjects as determined by the Revised National Curriculum. Health, specifically, is one of five focus areas in the compulsory subject, Life Orientation, and therefore covered in the school curriculum (RSA DoE, 2003b). The health knowledge test was a true or false test focused primarily on assessing student's knowledge about HIV/AIDs.

In a primary school environment, it is not unusual for one teacher to provide instruction in more than one subject area, which reduces the available across-subject observations in a student fixed effects estimation. This would eliminate the potential for estimating relationships between student achievement and teacher characteristics *within* the school where teacher characteristics do not vary by student but are essentially school level characteristics (Hein and Allen, 2013). Fortunately, the majority of the student sample in South Africa is taught the three subject areas – mathematics, reading and Life Orientation (including health) – by more than one teacher. This is not the case for many other countries in the dataset. Out of a total sample of 9 071 South African students in the sample from 392 schools, only 743 students from 32 schools had a single teacher providing instruction in all the three subjects, while 2 717 students had two different teachers for the three subjects and 5 611 students had three different teachers for the three subjects. Background questionnaires are provided to students' teachers in each of these subject areas so that it is possible to link the characteristics of different subject teachers within a school to the achievement of their students in each subject. For each student there are as many rows of data as they have different teachers for each subject.

To facilitate the comparison of student achievement scores across the three different subjects, scores in each subject are converted to a standardised score. The standardised score is obtained by subtracting the national mean score in that subject from the individual score and dividing it by the standard deviation of the score in that subject. By construction, standardised achievement scores in reading, mathematics and health have a mean of zero and standard deviation of one.

Model specifications and descriptive statistics

Recalling equation (1), two key explanatory variables of interest are used in this study to identify the effect of teachers' strike action, $strike_{jk}$, on student achievement scores and are identified in Table 4.3. The first is a dummy variable that takes on a value of one if a teacher reports being absent due to teacher strikes for at least one day during the year 2007. Using this definition, a total of 73 percent of the South African teachers sampled in SAQMEQ participated in strike activity in 2007. It is noted that this indicator variable for strike participation may also provide a potential proxy for union membership where the proportion of teachers who strike is closely comparable to Armstrong's (2014) estimate of teacher union membership at 76 percent using Labour Force Survey data. However, a continuous variable for strike participation is also used and reflects the total number of days a teacher

was absent due to strikes. The continuous variable is used to compare the magnitude of strike absenteeism effects to other types of teacher absenteeism effects.

The pooled statistics in Table 4.3 disguise considerable differences in the militancy of industrial action across different parts of South Africa's schooling system that were governed by distinct education departments during apartheid. The first is a system of schools serving a previously disadvantaged population of primarily black students and the second is one of historically privileged schools with a predominantly white student population. Schools serving the coloured and to a lesser extent the Indian population during apartheid are less systematically distributed between these two sub-systems. Unfortunately, there are no indicators for the language, race or former education department classification for schools in the SACMEQ III dataset. A commonly used *proxy* to identify these two systems is the average wealth status of the schools' students (measured using an asset-based index of student SES averaged at the school level), distinguishing between the poorest 75 percent and wealthiest 25 percent of schools.⁹⁴

Strike activity is more prevalent in the poorest three quartiles of schools where almost eighty percent of teachers engaged in at least one day of strike activity in 2007 compared with 57 percent of teachers in the wealthiest quartile of schools. The duration of strike activity is also considerably higher in poorer schools where teachers were on average absent for 13.2 days for the strike compared with only 4.3 days among teachers in the wealthiest schools. Figure 4.3 also emphasises the stark differences across the two groups of schools, presenting a cumulative percentage graph of teachers' strike activity. In the wealthiest schools, eighty percent of teachers were on strike three days or less in 2007, while eighty percent of teachers in the poorest schools were on strike twenty days or less. The difference in strike activity behaviour across the poorest and wealthiest schools is consistent with a growing economics literature supporting a bimodal schooling system in South Africa. There is increasing consensus that two separate data generating systems exist where pooling all schools together disguises marked differences in the 'production' of learning across the two systems (Spaull, 2013a; Taylor, 2011; Van der Berg, 2008). Industrial action may also have heterogeneous impacts on student achievement across the two systems. For this reason, OLS and fixed effects regressions are run separately for the poorest 75 percent of schools and the wealthiest 25 percent of schools in addition to the full school sample.

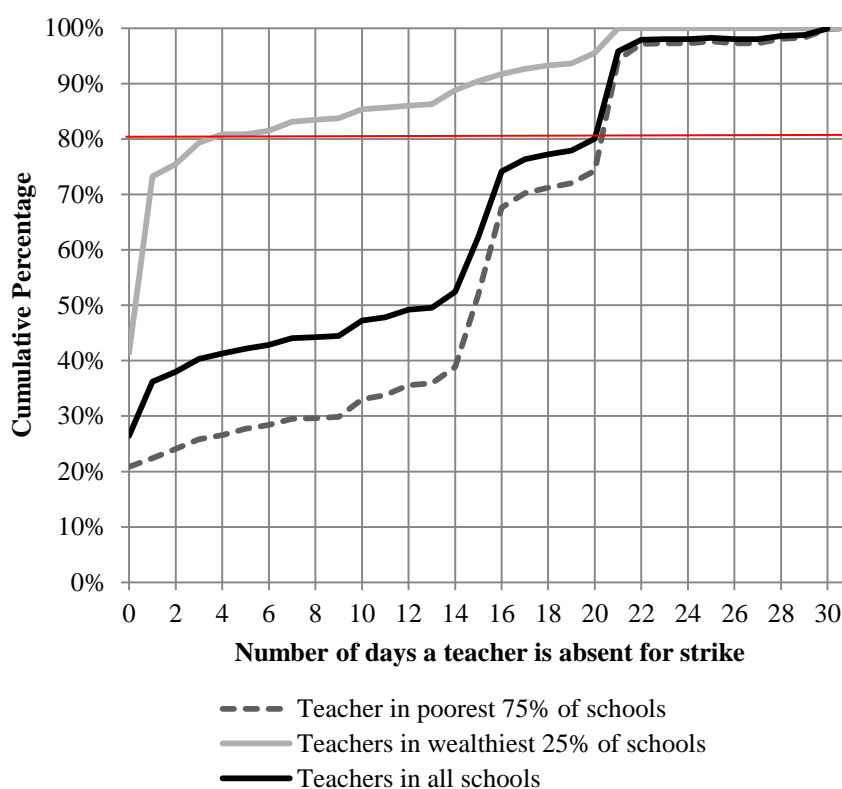
⁹⁴ The socio-economic status (SES) of each student is determined by applying principal components analysis to data on asset-ownership in a student's home to derive an asset-based SES index per student. This is then averaged at the school level to determine the school SES status. By comparing student performance distributions by race and language against distributions by SES using different schooling datasets, Spaull (2013a) finds that student performance in the poorest 75 percent of schools matches closely with that in the previously disadvantaged system of schools.

Table 4.3: Teacher strike participation and absenteeism by school wealth, SACMEQ III 2007

	Teachers		
	in the poorest 75% of schools	in the wealthiest 25% of schools	in all schools
Teacher strike participation (absent for at least 1 day for strike)	0.797 (0.019)	0.572 (0.042)	0.734 (0.018)
Total days teachers are absent for strike	13.253 (0.390)	4.310 (0.841)	10.759 (0.386)
Number of teachers	844	314	1 158
Number of schools	297	95	392

Source: SACMEQ III, teacher and principal questionnaires. **Notes:** Standard errors are in parentheses. All calculations account for probability weights and stratification by province in sampling design. The wealth status of the school is determined by constructing an asset-based socio-economic (SES) index for students and averaging student level SES scores at the school level to determine the schools' wealth status.

Figure 4.3: Cumulative percentage graph of teachers' strike absenteeism by school wealth status, SACMEQ III 2007



Following Kingdon and Teal (2010), teacher characteristics in the regressions are distinguished into two groups: those variables that are most likely determined prior to joining a teachers' union and those determined after unionisation. Motivating this approach is the possibility that teacher characteristics may be influenced by unionisation and the militancy of a teacher's union involvement,

so that including them in the production function could bias the effect of strike action observed. The group of teacher variables most likely to be determined prior to union involvement is represented by T_{jk} :

$$T_{jk} = \{degree_{jk}; male_{jk}; preservice_{jk}; age_{jk}\}$$

where $degree_{jk}$ reflects whether the teacher has completed a tertiary education (at least a first degree), $male_{jk}$ and age_{jk} are self-explanatory. $Preservice_{jk}$ indicates whether a teacher has pre-service training. In SACMEQ III pre-service training is captured as a categorical variable where teachers can report one year or less, two years, three years, or more than three years of training. The majority of teachers have more than three years of training so this has been used as the reference category with indicator variables included for one year or less of training, two years and three years. Information on other teacher characteristics more likely to be determined after unionisation and potentially influenced by union involvement are represented by T'_{jk} :

$$T'_{jk} = \left\{ \begin{array}{l} experience_{jk}; home_{jk}; absenteeism_{jk}; \\ equipment_{jk}; effort_{jk}; testscore_{jk} \end{array} \right\}$$

$Experience_{jk}$ reflects the total number of years of teacher experience and $home_{jk}$ is a proxy for the wealth of the teacher, taking on a value of one if a teacher reports that his or her home is in poor condition or in need of major repairs and zero otherwise. Three continuous variables are included as controls for a teacher's $absenteeism_{jk}$ which include the self-reported number of days they have been absent from school for their own illness, funerals and 'official business' such as courses, meetings or examinations in the current year. Two variables are used to capture teaching $equipment_{jk}$ identified by each teacher in a subject specific class. The first is a standardised index of teaching equipment⁹⁵ as well as an indicator variable for whether there are enough sitting places for students in the classroom. Three different variables have been used as proxies for teachers' $effort_{jk}$, including the total weekly self-reported hours spent on lesson preparation and marking outside of school, an indicator variable for whether a teacher gets parents to sign children's homework and another indicator variable for whether a teacher meets monthly with the school principal for teaching advice or coaching.⁹⁶ Finally, teachers' subject specific test score results in the three subjects (numeracy, literacy and health) are included to account for their teacher content knowledge in the

⁹⁵ The index was constructed by using teachers' responses to questions about what is in their classroom for that specific subject. The list of resources included a green/black/white board, chalk or other markers, a duster or eraser, a chart of any kind, a locker or cupboard, bookshelves, a library or book box, a table and chair for the teacher.

⁹⁶ Teachers were asked 'How often does your School Head advise you on your teaching?' Possible responses were 'never', 'once a year', 'once a term', or 'once or more a month'.

subject of the students' test.⁹⁷ The teacher test scores are directly comparable to the student test scores where Rasch scaling was used to account for differences in the difficulty across questions.

For comparability of subject specific tests, the continuous variable for a teacher's test score takes on the standardised value of their test score for the subject taught. Unfortunately, 164 of 1 558 teachers did not complete the subject specific teacher tests in SACMEQ III, reducing the sample size available for estimations.⁹⁸ Whether a teacher completed the tests may provide information in itself about some unobserved characteristics of the teacher, such as willingness to comply. Therefore, before restricting the sample to include a continuous score, an indicator variable for whether the teacher completed the test is included in a specification. Descriptive statistics of these identified teacher variables are provided in the appendix, Table 4A.1, which shows means and standard deviations of each of the variables described. In addition, the table describes the set of student and school characteristics included in the OLS estimations.

The next section reports the results of OLS and fixed effects estimations. Estimations control for probability weights in sampling and standard errors are corrected for clustering of errors between subjects within a student. The first set of regressions uses the indicator variable for whether a teacher is absent at least one day for strike activity and four specifications are run. In the first specification, the only teacher characteristic included is the variable of interest - teacher strike participation. In the second specification, teacher characteristics presumably determined prior to union involvement (T_{jk}) are included, while the third specification extends the set of teacher characteristics to include additional teacher characteristics (T'_{jk}), except teacher tests scores. The fourth specification limits the sample to those students whose teachers completed a subject specific test and includes this teacher test score as a control. All regressions include indicator variables for the subject test in question where mathematics is the reference category.

⁹⁷ The reader is referred to a paper by Shepherd (2015b) written subsequent to a working paper version of this chapter, which explores the effect of teacher content knowledge on student achievement in the SACMEQ III study.

⁹⁸ In SACMEQ II, administered in 2001, SADTU strongly opposed teacher testing to the point that no teacher tests were administered in South Africa, unlike in the other participating SACMEQ countries. On initial inspection of the subsequent 2007 SACMEQ III teacher test data, it was expected that non-test takers would likely to be a select group of teachers that are more likely to be unionised and engage in industrial action. This is not the case. In support of teacher testing in SACMEQ III, 2007, the then minister of education, Naledi Pandor, simply said that taking the test was not a question of labour relations, but of professionalism. Teachers would be tested even if the unions objected. According to some anecdotal evidence, the unions were perhaps caught off guard and did not raise strong objections to testing. For this reason, union attitudes to testing may not have had such a great effect on who was tested. It is noted that there were only three of 364 schools where not a single teacher wrote the test.

4.4 Results

The effects of teacher strike participation

Tables 4.4 to 4.6 present OLS and fixed effects results for the full sample of schools, the poorest three quartiles and the wealthiest quartile of schools. For brevity sake, the tables only show coefficients on variables common to both the OLS and student fixed effects estimations, namely coefficients on teacher variables and subject dummies. The full set of covariate effects for other student and school characteristics included in the OLS estimations are shown in the appendix, Table 4A.2.

For the full sample of schools, the OLS results in the first specification of Table 4.4 reflect a positive average effect of teacher strikes on student achievement, but the coefficient is insignificant. Moving to the student fixed effects estimation, a statistically significant negative strike effect is observed in specification one. With the inclusion of teacher characteristics in specifications two to four, the fixed effect estimate becomes less negative and statistically insignificant. In contrast to the overall insignificant strike effect, various other teacher characteristics have significant effects on student test scores. Significant positive effects are observed for having a teaching degree and having higher teacher content knowledge test scores in specification four of the fixed effects estimation. Teacher effort, as signalled by hours spent on lesson preparation and marking, is also positive and significant. A surprising result is that having less as opposed to more pre-service teacher training is associated with notably higher student achievement scores. Student achievement is higher when teachers completed two or three years of pre-service training as opposed to three years or more. Negative and statistically significant effects are observed on teacher experience, measures of absenteeism and the indicator variable reflecting that the teacher's home is in poor condition or in need of repair. An interesting result worth noting is that student achievement is higher when teachers engage with the principal to get advice on their teaching. This suggests that within a school, embracing professional community and working with instructional leaders yields positive gains for student outcomes.

As expected, the results for the full sample obscure the separate data generating processes that exist across the two systems of schools. In the privileged quartile of schools, with higher average student achievement and moderate teacher strike activity, there is no evidence of negative average impacts of teacher strike participation on student achievement (see Table 4.5). The student fixed effects estimate for striking at least one day is actually positive and significant in the first two specifications. After controlling for teacher test scores, the average effect size of a teacher striking reduces to positive 0.024 and becomes statistically insignificant.

Table 4.4: OLS and student fixed effects estimations of test scores, grade six students in all schools

Teacher controls:	1) Only teacher strike activity		2) Add: teacher variables determined <i>before</i> unionisation		3) Add: teacher variables determined <i>after</i> unionisation		4) Add: teacher test score (limited sample)	
	OLS	Student FE	OLS	Student FE	OLS	Student FE	OLS	Student FE
Teacher strike participation (0/1 indicator)^	0.0174 (0.039)	-0.0425** (0.016)	0.0345 (0.038)	-0.0223 (0.016)	0.0169 (0.045)	-0.0308 (0.019)	-0.0132 (0.048)	-0.0321 (0.022)
Teacher has a degree^			0.0698** (0.031)	0.0631*** (0.013)	0.0763** (0.031)	0.0687*** (0.012)	0.0601* (0.032)	0.0588*** (0.013)
Teacher is male^			-0.0444 (0.030)	-0.0386** (0.012)	-0.0307 (0.028)	-0.0350** (0.012)	-0.0349 (0.029)	-0.0315** (0.013)
Teacher pre-service training: <=1 year^			0.0795 (0.079)	0.0089 (0.030)	0.0602 (0.076)	0.0129 (0.030)	0.0245 (0.082)	0.0061 (0.033)
Teacher pre-service training: 2 years^			0.0245 (0.056)	0.1728*** (0.025)	0.0209 (0.057)	0.1968*** (0.025)	0.0361 (0.057)	0.2001*** (0.026)
Teacher pre-service training: 3 years^			0.0664** (0.030)	0.0828*** (0.013)	0.0603* (0.031)	0.0799*** (0.013)	0.0550* (0.033)	0.0808*** (0.014)
Teacher's age			-0.0544*** (0.014)	-0.011 (0.007)	-0.0503** (0.015)	-0.0054 (0.007)	-0.0481** (0.016)	-0.0085 (0.007)
Teacher's age squared			0.0006*** (0.000)	0.0001 (0.000)	0.0006*** (0.000)	0.0001 (0.000)	0.0006*** (0.000)	0.0001 (0.000)
Teacher's experience					-0.0035 (0.004)	-0.0026* (0.002)	-0.0059* (0.004)	-0.0030* (0.002)
Days absent: own illness					0.0014 (0.003)	0.001 (0.001)	0.0024 (0.003)	0.0014* (0.001)
Days absent: funerals					0.0044 (0.007)	-0.0050** (0.002)	0.0008 (0.006)	-0.0055** (0.002)
Days absent: official business					-0.0056* (0.003)	-0.0108*** (0.002)	-0.0066* (0.003)	-0.0117*** (0.002)
Hours spent on lesson preparation & marking					-0.0011 (0.002)	0.0016* (0.001)	-0.0007 (0.002)	0.0016* (0.001)

Table 4.4 continued...	1) Only strike activity		2) Add: teacher variables determined <i>before</i> unionisation		3) Add: teacher variables determined <i>after</i> unionisation		4) Add: teacher test score (limited sample)	
Own home is in poor condition/need of repair [^]					-0.0518 (0.034)	-0.0525*** (0.013)	-0.0261 (0.036)	-0.0319** (0.014)
Gets monthly teaching advice from principal [^]					0.0567* (0.029)	0.0600*** (0.013)	0.0736** (0.030)	0.0760*** (0.014)
Enough sitting places in classroom for students [^]					0.0622 (0.040)	0.0383** (0.018)	0.0548 (0.040)	0.0296 (0.019)
Teacher gets parents to sign student work [^]					0.0495 (0.035)	-0.0264** (0.013)	0.0704** (0.036)	-0.0072 (0.014)
Teachers' classroom equipment index					0.0681 (0.111)	0.1145** (0.036)	0.0553 (0.126)	0.0127 (0.043)
Teacher wrote subject specific test [^]					-0.0093 (0.064)	0.0509** (0.024)		
Teachers' test score (std)							0.0779*** (0.015)	0.0532*** (0.007)
Subject Dummy: Reading [^]	-0.0029 (0.017)	-0.0039 (0.008)	-0.0132 (0.018)	-0.0116 (0.008)	-0.0121 (0.018)	-0.0099 (0.008)	-0.0137 (0.018)	-0.0150* (0.009)
Subject Dummy: Health [^]	0.0485* (0.029)	0.0472*** (0.011)	0.0304 (0.031)	0.0306** (0.012)	0.0274 (0.030)	0.0297** (0.012)	0.0268 (0.030)	0.0256** (0.012)
Constant	-0.6789 (0.112)	-0.0137 (0.014)	0.4040 (0.333)	0.1746 (0.148)	0.3722 (0.349)	0.1544 (0.149)	0.2882 (0.363)	-0.0919 (0.154)
R-squared	0.428	-	0.432	-	0.436	-	0.442	-
Within R-squared	-	0.003	-	0.019	-	0.021	-	0.029
F-stat (p-value)	52 (0.000)	11 (0.000)	50 (0.000)	13 (0.000)	48 (0.000)	12 (0.000)	53 (0.000)	16 (0.000)
Subject-student obs. (N)	24 701	24 701	24 701	24 701	24 701	24 701	22 382	22 382
Number of clusters	-	8 254	-	8 254	-	8 254	-	8 144
Number of schools	364	364	364	364	364	364	361	361

Notes: OLS regressions include additional controls for student and school characteristics and provincial dummies. Standard errors were corrected for clustering of errors between subjects within a student (student id as the clustering variable) and probability sampling weights are included. Statistically significant at *p<0.1, **p<0.05, ***p<0.001. Standard errors are in parentheses. [^]Dichotomous 0/1 variable.

Table 4.5: OLS and student fixed effects estimations of test scores, grade six students in the wealthiest 25 percent of schools

Teacher Controls:	1) Only strike activity		2) Add: teacher variables determined <i>before</i> unionisation		3) Add: teacher variables determined <i>after</i> unionisation		4) Add: teacher test score (limited sample)	
	OLS	Student FE	OLS	Student FE	OLS	Student FE	OLS	Student FE
Teacher strike participation [^]	0.0304 (0.050)	0.0667** (0.029)	0.0456 (0.049)	0.0709** (0.029)	0.0412 (0.045)	0.0383 (0.031)	0.0174 (0.046)	0.0243 (0.034)
Teacher has a degree [^]			0.0484 (0.055)	-0.0035 (0.029)	0.0013 (0.052)	-0.0355 (0.032)	-0.0491 (0.050)	-0.0730** (0.035)
Teacher is male [^]			0.0321 (0.048)	0.0332 (0.026)	0.0295 (0.049)	0.0056 (0.027)	0.0202 (0.043)	0.0305 (0.030)
Teacher pre-service training: <=1 year [^]			-0.0476 (0.098)	-0.015 (0.044)	-0.0057 (0.079)	0.0027 (0.043)	-0.0256 (0.081)	0.0336 (0.051)
Teacher pre-service training: 2 years [^]			0.0687 (0.108)	0.3140*** (0.067)	0.2335** (0.103)	0.3531*** (0.069)	0.2154** (0.104)	0.3277*** (0.068)
Teacher pre-service training: 3 years [^]			0.0159 (0.060)	0.1460*** (0.032)	0.0429 (0.051)	0.1382*** (0.031)	0.0717 (0.046)	0.1396*** (0.033)
Teacher's age			-0.0293* (0.017)	-0.0155 (0.010)	-0.0292 (0.018)	-0.01 (0.011)	-0.0431** (0.019)	-0.0212* (0.011)
Teacher's age squared			0.0003 (0.000)	0.0001 (0.000)	0.0004* (0.000)	0.0001 (0.000)	0.0005** (0.000)	0.0002* (0.000)
Teacher's experience					-0.0064 (0.006)	-0.0035 (0.003)	-0.0041 (0.005)	-0.001 (0.003)
Days absent: own illness [^]					-0.0028 (0.006)	-0.0007 (0.004)	-0.0009 (0.006)	0.0088* (0.005)
Days absent: funerals [^]					0.0378** (0.018)	0.0169 (0.011)	0.0353** (0.016)	0.0139 (0.011)
Days absent: official business [^]					-0.0033 (0.011)	0.0016 (0.007)	-0.0053 (0.009)	-0.0099 (0.007)
Hours spent lesson preparation & marking					0.0096** (0.004)	0.0035 (0.003)	0.0105** (0.004)	0.0045* (0.003)

Table 4.4 continued...	1) Only strike activity		2) Add: teacher variables determined <i>before</i> unionisation		3) Add: teacher variables determined <i>after</i> unionisation		4) Add: teacher test score (limited sample)	
Own home is in poor condition/need of repair [^]					-0.1148 (0.084)	-0.0624 (0.046)	0.0037 (0.077)	0.0522 (0.048)
Gets monthly teaching advice from principal [^]					0.2006*** (0.048)	0.0854** (0.033)	0.2423*** (0.050)	0.1439*** (0.035)
Enough sitting places in classroom for students [^]					-0.058 (0.059)	0.1138** (0.042)	-0.0228 (0.054)	0.0936** (0.043)
Teacher gets parents to sign student work [^]					-0.0566 (0.054)	-0.1026** (0.033)	-0.0264 (0.053)	-0.0215 (0.035)
Teacher's classroom equipment index					0.2345** (0.093)	0.2626*** (0.067)	0.2108* (0.111)	0.0116 (0.077)
Teacher wrote subject specific test [^]					-0.1556* (0.079)	-0.0916* (0.050)		
Teachers' test score (std)							0.0895*** (0.021)	0.0905*** (0.014)
Subject Dummy: Reading [^]	0.1217*** (0.036)	0.1237*** (0.018)	0.1171*** (0.034)	0.1116*** (0.019)	0.1174** (0.039)	0.1164*** (0.019)	0.1302** (0.040)	0.1237*** (0.020)
Subject Dummy: Health [^]	-0.1516** (0.058)	-0.1506*** (0.025)	-0.1677** (0.058)	-0.1724*** (0.025)	-0.1639** (0.061)	-0.1664*** (0.026)	-0.1539** (0.062)	-0.1585*** (0.026)
Constant	-1.3880* (0.759)	0.9054*** (0.021)	-0.8008 (0.851)	1.2679*** (0.220)	-0.8419 (0.824)	1.2626*** (0.225)	-0.9045 (0.835)	0.9673*** (0.244)
R-squared	0.375	-	0.380	-	0.392	-	0.395	-
Within R-squared	-	0.051	-	0.076	-	0.081	-	0.103
F-stat (p-value)	68 (0.000)	55 (0.000)	60.55 (0.000)	25 (0.000)	52 (0.000)	14 (0.000)	48 (0.000)	15 (0.000)
Subject-student obs. (N)	5 587	5 587	5 587	5 587	5 587	5 587	4 936	4 936
Number of clusters	84	1 868	84	1 868	84	1 868	83	1 825

Source: SACMEQ III, own calculations. **Notes:** OLS regressions include additional controls for student and school characteristics and provincial dummies. Standard errors were corrected for clustering of errors between subjects within a student (student id as the clustering variable) and probability sampling weights are included. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$. Standard errors are in parentheses. [^]Dichotomous 0/1 variable.

Table 4.6: OLS and student fixed effects estimations of test scores, grade six students in the poorest 75 percent of schools

Teacher Controls:	1) Only strike activity		2) Add: teacher variables determined <i>before</i> unionisation		3) Add: teacher variables determined <i>after</i> unionisation		4) Add: teacher test score (limited sample)	
	OLS	Student FE	OLS	Student FE	OLS	Student FE	OLS	Student FE
Teacher strike participation [^]	0.0289 (0.046)	-0.0783*** (0.018)	0.0378 (0.045)	-0.0651*** (0.018)	0.0257 (0.056)	-0.1025*** (0.023)	0.0023 (0.065)	-0.1001*** (0.027)
Teacher has a degree [^]			0.0646* (0.035)	0.0890*** (0.014)	0.0798** (0.033)	0.1038*** (0.014)	0.0804** (0.034)	0.0994*** (0.015)
Teacher is male [^]			-0.0436 (0.035)	-0.0323** (0.013)	-0.0269 (0.032)	-0.0301** (0.013)	-0.0326 (0.033)	-0.0192 (0.014)
Teacher pre-service training: <=1 year [^]			0.1196 (0.097)	0.0082 (0.039)	0.0798 (0.097)	-0.0016 (0.039)	0.0653 (0.100)	-0.0109 (0.040)
Teacher pre-service training: 2 years [^]			0.0326 (0.058)	0.1488*** (0.027)	0.0361 (0.056)	0.1530*** (0.027)	0.0452 (0.057)	0.1503*** (0.028)
Teacher pre-service training: 3 years [^]			0.0761** (0.032)	0.0583*** (0.013)	0.0661* (0.034)	0.0456*** (0.014)	0.0566 (0.038)	0.0360** (0.015)
Teacher's age			-0.0492** (0.024)	0.0133 (0.009)	-0.0450* (0.024)	0.0178* (0.010)	-0.0377 (0.025)	0.0292** (0.010)
Teacher's age squared			0.0006** (0.000)	-0.0002* (0.000)	0.0006** (0.000)	-0.0002** (0.000)	0.0005* (0.000)	-0.0003** (0.000)
Teacher's experience					-0.0061 (0.004)	-0.0030* (0.002)	-0.0084** (0.004)	-0.0035** (0.002)
Days absent: own illness					0.0019 (0.002)	0.0016** (0.001)	0.003 (0.002)	0.0017** (0.001)
Days absent: funerals					0.0021 (0.006)	-0.0051** (0.002)	-0.0005 (0.006)	-0.0055** (0.002)
Days absent: official business					-0.0056* (0.003)	-0.0100*** (0.002)	-0.0061* (0.003)	-0.0103*** (0.002)
Hours spent on lesson preparation & marking					-0.0042* (0.002)	0.0014 (0.001)	-0.0034 (0.002)	0.0015* (0.001)

Table 4.6 Continued...	1) Only strike activity		2) Add: teacher variables determined <i>before</i> unionisation		3) Add: teacher variables determined <i>after</i> unionisation		4) Add: teacher test score (limited sample)	
Own home is in poor condition/need of repair [^]					-0.0511 (0.035)	-0.0307** (0.014)	-0.03 (0.037)	-0.0260* (0.014)
Gets monthly teaching advice from principal [^]					0.0357 (0.032)	0.0634*** (0.014)	0.0476 (0.033)	0.0735*** (0.015)
Enough sitting places in classroom for students [^]					0.0536 (0.042)	0.027 (0.019)	0.0458 (0.043)	0.0181 (0.021)
Teacher gets parents to sign student work [^]					0.0581 (0.040)	0.0167 (0.014)	0.0735* (0.040)	0.0178 (0.015)
Teacher's classroom equipment					0.0351 (0.130)	0.1333** (0.044)	0.0094 (0.142)	0.0343 (0.050)
Teacher wrote subject specific test [^]					-0.0121 (0.073)	0.0876** (0.027)		
Teachers' test score (std)							0.0460** (0.020)	0.0134* (0.008)
Subject Dummy: Reading [^]	-0.0414** (0.019)	-0.0413*** (0.009)	-0.0479** (0.020)	-0.0441*** (0.009)	-0.0503** (0.020)	-0.0443*** (0.009)	-0.0515** (0.020)	-0.0520*** (0.010)
Subject Dummy: Health [^]	0.1111*** (0.033)	0.1076*** (0.013)	0.0907** (0.036)	0.0978*** (0.013)	0.0805** (0.035)	0.0963*** (0.013)	0.0803** (0.035)	0.0889*** (0.013)
Constant	-0.7628*** (0.115)	-0.2876*** (0.017)	0.1915 (0.518)	-0.5599** (0.200)	0.1552 (0.515)	-0.5357** (0.202)	0.1263 (0.529)	-0.8419*** (0.208)
R-squared	0.156	-	0.167	-	0.168	-	0.170	-
Within R-squared	-	0.022	-	0.038	-	0.042	-	0.050
F-stat (p-value)	21 (0.000)	67 (0.000)	18 (0.000)	26 (0.000)	18 (0.000)	17 (0.000)	18 (0.000)	18 (0.000)
Subject-student obs. (N)	19 114	19 114	19 114	19 114	19 114	19 114	17 446	17 446
Number of clusters	280	6 386	280	6 386	280	6 386	278	6 319

Source: SACMEQ III, own calculations. **Notes:** OLS regressions include additional controls for student and school characteristics and provincial dummies. Standard errors were corrected for clustering of errors between subjects within a student (student id as the clustering variable) and probability sampling weights are included. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$. Standard errors are in parentheses. [^]Dichotomous 0/1 variable.

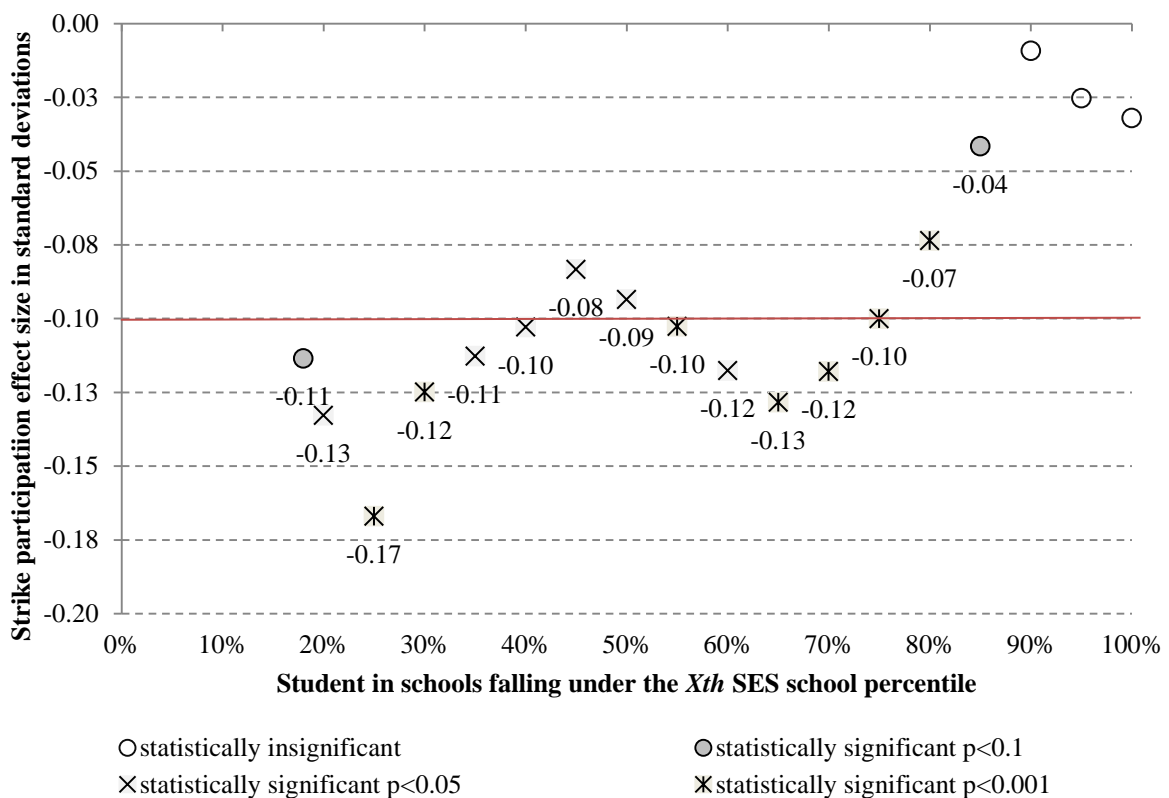
The observed impact of teacher strike participation on student learning in non-privileged schools is markedly different. In these schools, where teacher unions are strongly represented and strike activity is more militant in character, strike participation appears to be detrimental to learning. In the student fixed effects estimations in Table 4.6, the average effect of striking on student test scores is consistently negative and significant. In the first specification, with no other teacher controls, the fixed effect strike estimate is about 7.8 percent of a standard deviation in learning. Controlling for teacher characteristics likely to be determined before joining a union, reduces the estimate slightly to 6.5 percent, but adding the remaining teacher controls increases the negative effect to ten percent in specification four. By contrast, the OLS estimates are consistently upwardly biased, being small in size, positive and statistically insignificant when contrasted against the fixed effects estimates. Therefore, there appears to be evidence of a substantial correlation between teacher strike participation and observable and unobservable school (and student) characteristics. The sensitivity of the results to the inclusion of teacher controls raises questions about the direction of omitted variable bias in the fixed effects estimations. This is a point to which the chapter returns in section five.

The identified effect in the fourth fixed effects specification of Table 4.6 indicates that a student's achievement is ten percent of a standard deviation lower in a subject taught by a striking teacher compared with their achievement in a subject taught by a non-striking teacher. It is noted that the coefficient on strike participation in specification three, which includes an indicator for whether the teacher wrote the subject content knowledge test, is very similar in magnitude to that in the fourth specification which includes the teacher test score but results in the loss of observations in the estimation. This suggests that the negative coefficient of ten percent is not biased through potential sample selection concerns due to missing observations in the fourth specification. Moreover, the result is robust to the split of the sample by the socio-economic status (SES) of students in the school. Student fixed effects regressions using the full specification of variables were run for different SES sample splits. Up until the 80th school SES percentile, effect sizes are concentrated around ten percent of a standard deviation as reflected in Figure 4.4 - a plot of teacher strike participation effects for different SES splits. It however remains possible that the estimates are overestimated where the identification strategy does not adequately control for unobserved teacher characteristics.

At face value, however, the results indicate that the 2007 public sector strike had negative consequences for student learning at the grade six level in the majority of primary/intermediate phase level schools. Using standard rules of thumb for interpreting effect sizes, ten percent of a standard deviation in student learning would be considered a small effect (Cohen, 1988). Hill et al (2008) argue, however, that effect sizes are more appropriately interpreted by comparing them against empirical benchmarks appropriate to the context investigated. For example, the average strike effect size on learning could be compared to the effects of other teacher characteristics or school inputs

malleable to policy-making decisions. Following this suggestion, the average absolute value of the strike effect in the poorest three quarters of schools is roughly comparable to the coefficient on having a teaching degree as opposed to no degree. In which case, strike participation has the potential to counteract learning benefits associated with employing teachers with higher level university skills. A strike effect could also be compared to the effects of other measures of absenteeism. Furthermore, it can be considered in terms of what this means for increasing inequality in schooling or how this compares to how much students learn on average in a year (Hill et al., 2008).

Figure 4.4: Strike participation effects on grade six test scores by school SES sample splits



Strike absenteeism vs. other teacher absenteeism

In the following discussion, the teacher strike absenteeism effect is compared to teacher absenteeism effects for other reasons of absence. To do this, OLS and fixed effects estimations are re-run using a full set of teacher controls but replacing the dummy variable indicator for strike participation with a continuous variable for days absent due to teacher strikes. Consistent with the previous estimations, days absent for own illness, official business and funerals are included as teacher controls. Results are shown in Table 4.7 for the full sample of schools and the poorest 75 percent of schools.

Table 4.7: OLS and student fixed effect estimations of grade six student test scores using a continuous variable for teacher strike absenteeism

Number of days absent for...	All schools			Poorest 75 percent of schools		
	OLS	Student FE	<i>Mean of variable for estimation sample</i>	OLS	Student FE	<i>Mean of variable for estimation sample</i>
Strike	-0.0059** (0.003)	-0.0043*** (0.001)	12.296 (0.407)	-0.0048 (0.003)	-0.0049*** (0.001)	14.667 (0.371)
Own illness	0.0025 (0.003)	0.0014* (0.001)	2.904 (0.323)	0.0031 (0.002)	0.0015* (0.001)	3.031 (0.412)
Funeral	0.0014 (0.006)	-0.0052** (0.002)	0.857 (0.078)	0.0004 (0.006)	-0.0056** (0.002)	0.963 (0.091)
Official business	-0.0068** (0.003)	-0.0117*** (0.002)	1.755 (0.153)	-0.0062** (0.003)	-0.0101*** (0.002)	2.042 (0.186)
R-squared	0.443	-		0.172	-	
Within R-squared	-	0.03		-	0.05	
F-stat	54.637	16.165		18.153	18.018	
N	22 382	22 382		17 446	17 446	
No. of clusters	-	8 144		-	6 319	

Source: SACMEQ III, own calculations. **Notes:** See Table 4.4, specification four for a full list of controls included. Standard errors were corrected for clustering of errors between subjects within a student (student id as the clustering variable). The estimation accounts for probability sampling weights. Statistically significant at * $p < 0.01$, ** $p < 0.05$, *** $p < 0.001$. Standard errors are in parentheses. Sample sizes reflect student-subject observations.

In the poorest schools, the across-subject student fixed effects results reflect that a student's achievement in a subject will decrease by 0.49 percent of a standard deviation if their teacher in that subject is absent for one additional day.⁹⁹ Comparatively, one additional day absent for strike action has roughly a similar negative effect on achievement as absence for attending funerals. A surprising result is the positive and significant coefficient on days absent for own illness at 0.15.¹⁰⁰

An interesting finding in relation to the strike effect is the larger negative effect on days absent for 'official business' in the poorest three quarters of schools. An additional day of absence for 'official business', is twice as detrimental to learning as an additional day of absence for strike activity. It is arguable that the coefficient on days absent for 'official business' may be capturing an effect of union membership on student learning beyond industrial activity. Subsumed within the category 'official

⁹⁹ Following Clotfelter, Ladd and Vigdor (2009), days absent were included in linear form in the estimation but non-linear functional forms may be a more suitable specification.

¹⁰⁰ Compare this with negative effects of sick leave observed in the United States for example, where effect sizes related to one additional day of absence for illness range between -0.003 and -0.001 of a standard deviation on student test scores in OLS and teacher fixed effects estimations using panel data (Clotfelter, Ladd and Vigdor, 2009).

business', reasons for absence may likely include attending union related meetings or activities. This is supported by findings of a research project published by the HSRC investigating teacher absence in South African public schools. Their survey of teachers identified that second to training and curriculum workshops organised by the Department of Education, the most common reason for official business leave was union-related (Reddy et al., 2010: 77). This is expected where provision is made in South African labour law and by the Department of Education for educator paid leave in fulfilling certain union-related activities.¹⁰¹ However, the negative effect on 'official business' absence may also reflect that training and curriculum workshops scheduled during formal teaching time are having unintended negative consequences for learning. This supports recommendations made in the HSRC report and policy brief by Reddy et al (2010) that provincial directorates who request teachers and principals to attend meetings should co-ordinate these workshops outside the formal school day.

The effect of strikes in widening inequalities in learning

With respect to reducing large inequalities in educational quality, as reflected in large achievement gaps between poorer and wealthier students, the strike impacts are further contextualised. Subtracting average test scores in health, reading and numeracy for students in the wealthiest 25 percent of schools from the poorest 75 percent of schools, and dividing by the standard deviation in test scores for the total sample, yields a performance gap of 1.3 standard deviations. In the absence of teacher strikes in 2007, this achievement gap could have been reduced by nearly eight percent where the coefficient on the strike participation indicator variable is ten percent of a standard deviation (see Table 4.8).

The potential repercussions of strike action for augmenting educational inequality is also observed comparing fixed effects estimates for samples of marginalised versus less marginalised students. Strike impacts are anticipated to most negatively affect students who are the poorest and the weakest academically. This has been implied in the different strike effects observed across the poorest and wealthiest schools. It is further confirmed when running estimates on sub-samples of rural versus urban schools and by quartiles of student achievement. Using the full set of teacher controls, and specifically teacher test scores (i.e. specification four), average strike effects for each sub-sample are summarized in Table 4.9. Students in rural schools are adversely affected by teacher strikes compared with their urban counterparts. A negative strike effect as large as 17 percent of a standard deviation is

¹⁰¹ Teachers who are members but neither office bearers nor shop stewards of recognised employee organisations (i.e. unions) are entitled to about eight *hours* absence in a year for membership related activities, while those who are office bearers or shop stewards are entitled to twelve days paid leave per year for activities related to their union position (Reddy et al., 2010: 33).

observed for students in rural schools whereas no significant effects are identified for students in urban schools. As expected, the magnitude of the negative effect increases at lower levels of student achievement. Negative strike effects for students that are in the bottom three quartiles of student achievement are observed while no effect is observed for the top performing quartile of students. This mirrors the results obtained when disaggregating the sample by quartiles of school SES.

Not only is learning among marginalised students disproportionately affected by strike action, but they are disproportionately affected in terms of access to nutrition. South Africa has a comprehensive school nutrition programme. By 2013 it had expanded to 78 percent¹⁰² of school children (roughly nine million children in absolute terms) (RSA DBE, 2014a). Although access to the feeding programme has since expanded, in 2007 when the programme was initially introduced the majority of quintile one to three schools with grade R to grade seven children were beneficiaries of the programme - approximately six million children. Feeding schemes are obviously targeted at schools serving the poorest children, so that poorer households are likely to rely more on schools for providing meals to children. These schools are also closed on average for longer periods during industrial action. This is confirmed using the Systemic Evaluation 2007 data. In schools where grade three students reported that they accessed meals at school provided through a feeding scheme, on average 17 days were lost due to strike/boycott activity in 2007 as opposed to only ten days in schools where a feeding scheme was not offered (see Table 4A.3). While beyond the scope of this study, there may be interplay between the declining student achievement observed in the poorest schools and access to nutrition.¹⁰³ This adds an interesting dimension to debates about teachers' right to strike in developing country contexts where child nutrition is dependent on access to schooling.

The strike effect interpreted in relation to anticipated growth in learning in a year

Alternatively, one could consider the strike participation effect of ten percent of a standard deviation in relation to how much students are expected to learn in a school year. The magnitude of the strike effect is particularly sobering when interpreted in relation to anticipated learning in a year. The National School Effectiveness Study in South Africa suggests that between grade three and grade five students in poorer schools learn approximately thirty percent of a standard deviation a year (Spaull

¹⁰² This figure is derived from the General Household Survey (GHS). The GHS results also indicate that 91 percent of students indicated that they were receiving the meal every school day (RSA DBE, 2014a).

¹⁰³ While numerous studies identify that child health and nutrition are strongly associated with educational outcomes, Behrman (1996) cautions that associations do not imply causality. Good health and nutrition may have more nuanced and qualified effects on schooling success than is often recognized. However, more recently Glewwe and Miguel (2008) identify a number of studies using randomized control trials that provide strong evidence of a positive causal relationship between child health, nutrition (and access to feeding schemes) and school outcomes.

and Kotze, 2015).¹⁰⁴ Using this benchmark, an average strike effect of ten percent of a standard deviation implies that students in the poorest three quarters of schools lost the equivalent of a third of a year's learning in 2007 due to strike action. This raises concerns that the strike effect is overestimated when on average self-reported days that a teacher strikes in these schools was thirteen days, representing only seven percent of about 187 operational school days that year.¹⁰⁵ There are various explanations that may account for this mismatch.

Table 4.8: Achievement gap across grade six students in poorer and wealthier schools

	Mean	Standard Deviation	N
Students in the wealthiest 25% of schools	600.29	101.54	6 748
Students in the poorest 75% of schools	462.97	81.67	20 427
Total	497.54	105.53	27 175
Achievement gap (in standard deviations)		-1.301	
Strike effect size in the poorest 75% of schools (in standard deviations)		-0.1010	
% reduction in performance gap in the absence of strike action		7.76%	

Source: SACMEQ III, own calculations. **Notes:** The achievement gap is calculated as the difference in average student test scores between the poorest 75 percent of schools and the wealthiest 25 percent of schools, divided by the standard deviation in scores for the total sample. Average student test scores are calculated using numeracy, reading and health scores used in the estimations. Calculations account for probability weights in the sampling design. Sample sizes reflect student-subject observations.

Table 4.9: Teacher strike participation effects on grade six test scores, sub-samples

	Urban/rural status of the student's school		Average academic achievement of students in three subject tests			
	Rural	Urban	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Teacher strike participation [^]	-0.1649*** (0.044)	0.0267 (0.024)	-0.1067* (0.055)	-0.0804* (0.044)	-0.0710* (0.039)	0.0276 (0.036)
Within R-squared	0.0779	0.0378	0.0173	0.0826	0.0703	0.0837
F-stat (p-value)	20 (0.000)	11 (0.000)	2.4 (0.000)	15 (0.000)	8.3 (0.000)	15 (0.000)
N	10 290	12 092	5 737	5 820	5 689	5 136
Number of clusters	3 700	4 500	2 100	2 100	2 100	1 900

Source: SACMEQ III, own calculations. **Notes:** See Table 4.4, specification four for a full list of controls. [^]Teacher strike participation is included as a dummy indicator variable. The constant is included but not shown. Standard errors were corrected for clustering of errors between subjects within a student (student id as the clustering variable) and probability sampling weights are accounted for. Samples are not limited to the 75 percent poorest schools but all schools are considered in the different samples. For example, urban schools may include schools in the top SES quartile. Statistically significant at *p<0.1, **p<0.05, ***p<0.01. Standard errors are in parentheses. Sample sizes reflect student-subject observations.

¹⁰⁴ This is consistent with literature on learning in the United States, where between the third and fifth grade students are expected to learn between 36 and 40 percent of standard deviation for reading and 50 percent of standard deviation in mathematics (Hill et al., 2008).

¹⁰⁵ There were 196 official school days in 2007. Subtracted from this *de facto* total is the average number of reported days schools were closed due to disruptions as reported by principals in the poorest 75 percent of schools at nine days. It is likely, however, that 187 remains a considerable overestimation of total teaching days. On average schools may have closed for more days than reported by school principals, closing early or suspending teaching during periods of testing and marking.

It is likely that strike absenteeism was underestimated by teachers in SACMEQ III. When consulting the foundation phase level Systemic Evaluation 2007, a survey of grade three learning, principal reports of the number of days lost for boycotts and strikes was more prevalent than what teacher responses in the SACMEQ study suggests. In the poorest three quarters of schools, principals surveyed in the Systemic Evaluation 2007 reported that nearly 19 days were lost on average due to boycotts or strikes and 12 days were lost in the wealthiest quartile of schools. The Systemic Evaluation 2007 was conducted just after SACMEQ III where principal reports may be a more accurate reflection of lost days of learning where teacher's responses may be underestimated by a self-reporting bias. A second possible reason is that strike activity in these schools may have had further negative spill-over effects. In the month of June when the 2007 public sector strike occurred, most schools write mid-year tests and then marking of tests and writing of school reports is often executed during the winter break. If tests were postponed into the second half of the year, test revision may be prioritised over teaching of new curriculum before tests recommence. Furthermore, teaching time and lesson preparation may be reallocated for postponed marking and report writing.

The result is also possibly conflating a union membership effect with a strike effect. Suppose this provides a proxy for the impacts of union membership on student learning, then this effect is notably smaller when compared with Kingdon and Teal's (2010) estimate that the achievement of students taught by unionised teachers in India is lower by 0.23 standard deviations. Furthermore, they argue that this is a lower bound estimate of union impacts. A more pressing issue, however, is that the effect size may be overestimated.

4.5 Omitted variable bias

The fixed effects estimates have identified an educationally significant, negative effect of strike action on learning in the poorest three quartiles of schools with implications for aggravating inequality in the provision of education. However, it is not possible to rule out that fixed effects estimates are compromised by omitted variable bias. The student fixed effects estimations controlled for unobserved school characteristics and student family backgrounds but did not explicitly control for unobserved heterogeneity in teachers' characteristics. In addressing this remaining issue, instrumental variable estimation is typically used to identify variation in the treatment that is exogenously related to the outcome, student learning. However, there is no available instrument for strike action in the SACMEQ III data that informs a teacher's decision to strike but is uncorrelated with student learning.

Acknowledging the limitations of social research to make causal inferences from cross-sectional data Altonji, Taber and Elder (2005) developed a technique to draw conclusions about potential omitted variable bias. Their method proceeds by carefully examining the selection on the observable characteristics as a guide to selection on unobservables. Given that the independence of unobservables

assumption in OLS (and in fixed effects estimation) is likely to be violated, Altonji et al's approach identifies how large the bias from selection on unobservables would be if that selection is in the same order as the selection on observables. The equality of selection on observables and unobservables is reflected in the following condition,

$$\frac{Cov(v, strike)}{Var(v)} = \frac{Cov(\gamma T, strike)}{Var(\gamma T)} \quad (5)$$

where the error term, v , reflects teacher unobservables. The relationship between strike participation and the index of observed teacher characteristics (normalised by the size of the variance in that index) is equated to the relationship between strike participation and the unobservable part that determines student achievement. Under the equality of selection assumption, it is possible to estimate the size of the asymptotic bias. If v and T are orthogonal then $Cov(v, strike)$ is equivalent to $Cov(v, \widetilde{strike})$, where the tildes over the strike variable denote the residuals from a regression of that variable on teacher characteristics. The asymptotic bias in the estimate of interest is reflected as follows:

$$plim \hat{\theta} \approx \theta + \frac{Cov(\widetilde{strike}, v)}{Var(\widetilde{strike})} = \frac{Cov(strike, v)}{Var(\widetilde{strike})} \quad (6)$$

Substituting from equation (5), the bias in equation (6) can be written as:

$$\frac{Cov(strike, v)}{Cov(\widetilde{strike})} = \frac{Cov(\gamma T, strike)}{Var(\gamma T)} \frac{Var(v)}{Var(\widetilde{strike})} \quad (7)$$

Calculating this bias requires a three step process (Freier and Storck, 2012). The first step is to estimate an OLS (or fixed effects) model of student achievement on all explanatory variables except the treatment, i.e. $strike$, which is excluded from the regression. From this estimation it is possible to generate the first component necessary for the bias calculation, namely $var(v)$ – the variance in student achievement that cannot be explained by the observed control variables. This is simply the variance of the residual of the equation. This estimation is also used to get the predicted index of observable teacher characteristics, $\gamma\hat{T}$. In the second step, the predicted index of observables from the previous estimation, $\gamma\hat{T}$, is regressed on the treatment variable, $strike$. The coefficient on the predicted index in that regression gives the term, $\frac{Cov(\gamma T, strike)}{Var(\gamma T)}$. The third step is to generate the last component $Var(\widetilde{strike})$ needed to calculate the bias. This is the variance of the residual from a regression of the treatment on all teacher characteristics, T .

Following equation (7), the three components are used to calculate what the implied bias would be under the assumption of equality of selection on unobservables and observables. The calculation is applied in relation to estimates of strike participation effects in the poorest 75 percent of schools,

where significant negative strike effects were observed (recall Table 4.6). In addition to calculating the implied bias, Altonji et al also recommend calculating the ratio of the main OLS treatment effect divided by the implied bias. This provides a measure of how strong the selection on unobservables would have to be, relative to selection on observables, to explain the entire treatment effect. Table 4.10 identifies the bias and ratio as well as summarising the relevant strike effects from the fixed effects estimations in Table 4.6.

Table 4.10: Altonji bias on the strike effect estimate, students in the poorest 75 percent of schools

	Only strike activity (1)	Add: teacher var. determined <i>before</i> unionisation (2)	Add: teacher var. determined <i>after</i> unionisation (3)	Add: teacher test score (limited sample) (4)
	Student FE	Student FE	Student FE	Student FE
Teacher strike participation [^]	-0.0783*** (0.018)	-0.0651*** (0.018)	-0.1025*** (0.023)	-0.1001*** (0.027)
Subject Dummies	Yes	Yes	Yes	Yes
Within R-squared	0.022	0.038	0.042	0.05
F-stat	67.242	17.623	16.76	18.082
Subject-student obs. (N)	19 114	19 114	19 114	17 446
Number of clusters	6 386	6 386	6 386	6 319
Estimated Bias (Eq. 7)	-	-1.535	-0.5723	-0.43
Ratio ^a	-	0.051	0.179	0.233

Source: SACMEQ III, own calculations. **Notes:** See Table 4.6 for a full list of control variables used. [^]Teacher strike participation is included as a dummy indicator variable. Standard errors were corrected for clustering of errors between subjects within a student (student id as the clustering variable) and probability sampling weights are accounted for. Statistically significant at *p<0.1, **p<0.05, ***p<0.001. Standard errors are in parentheses. The constant is included but not shown in these results. ^aThis is the ratio of the coefficient on the strike participation indicator and the estimated bias. The bias is only calculated for the estimations where strike effects were significant and where additional controls are included for teacher characteristics.

Both the direction and size of the implied bias is important for interpretation. The direction of the implied bias is negative and its size is multiple times larger than the observed strike effect. Together this suggests that the estimated negative strike effect in the poorest 75 percent of schools is overstated, where omitted variable bias could potentially account for all of the observed strike effect. It is noticeable that the implied bias reduces in size after adding more teacher controls; nevertheless it remains substantially larger than the strike effect. The calculated ratio is 0.23 in specification four. In other words, selection on unobservables would only have to be about 23 percent stronger than selection on observables to explain away the entire strike effect. Therefore, the ability to make causal inferences is compromised due to omitted variable bias.

Altonji et al, however, caution against inferring too much from the implied bias given the rigid assumptions on which their technique is based.¹⁰⁶ Assuming that selection on unobservables is the same as selection on observables, this bias is likely to reflect an upper bound of the influence of unobservables and the actual degree is likely to fall short of that (Freier and Storck, 2012). Furthermore, one may also question the assumption that selection into strike participation on the basis of observed teacher characteristics is the same as selection into strike participation based on unobserved teacher characteristics.

The findings of Kingdon and Teal (2010) offer a discussion point in this regard if we assume that the average effect for teacher strike participation in South Africa offers a proxy for a union membership effect on learning. In their case, causal inference is supported through a *positive* Altonji bias; and the positive sign on the bias is due to a positive relationship between observed teacher characteristics and union membership. By contrast, an inverse relationship between observed teacher characteristics and strike participation in South Africa drives the implied negative bias. The conclusion one is inclined to draw from this is that teachers who strike are of lower quality than teachers who do not strike. The observed data, however, do not provide substantive evidence to support this. For the sample of teachers in the poorest 75 percent of schools, a school fixed effects regression of observed teacher characteristics on whether or not a teacher participates in a strike is provided in Table 4A.4.¹⁰⁷ Contrary to expectations, some proxies for teacher quality are *positively* correlated with strike participation. Within a school, grade six teachers who get parents to sign homework, for example, are more likely to strike and those school teachers who have more equipment or resources in their classrooms also have higher levels of strike participation. Moreover, there is no observed relationship between strike participation or the number of days a teacher strikes and his or her content knowledge in a subject. This result holds even if allowing for a non-linear relationship between strike participation (or the number of days striking) and teacher content knowledge. Teacher results on subject content knowledge tests may provide a poor proxy for overall teacher quality. Shepherd (2015b) in estimating student test scores, finds that in the poorest eighty percent of schools there is no observed pattern of increasing returns to teacher subject knowledge in terms of student learning. Where the transmission of teacher knowledge is hindered in these school environments, quality teachers likely possess additional capabilities and pedagogical expertise that extend beyond content

¹⁰⁶ Drawing conclusions about selection on unobservables from selection on the observables requires that the observables are large in number, have considerable explanatory power and are a random selection of all possible factors influencing the outcome. Although a large number of variables have been included, the explanatory power of the fixed effect estimations here is low, largely because differences in student achievement occur across students rather than within individual students.

¹⁰⁷ Striking teachers are typically older and are also more likely to be male and mathematics teachers as opposed to literacy/reading or life skills teachers.

knowledge alone.¹⁰⁸ The measure of teacher cognitive skills used is also not capturing teacher job satisfaction or motivation. It may be the case that striking teachers have lower levels of motivation or job satisfaction. Supporting this hypothesis, strike participation is higher among teachers who spend less time outside of school time preparing for lessons and marking. This is consistent with Murillo et al (2002) who find a negative relationship between teacher union membership and job satisfaction in Argentina. Finally, it remains possible that the data do not provide enough evidence to make conclusions about teacher unobservable characteristics on the basis of observed teacher characteristics. This then raises questions about the validity of the assumptions of the Altonji technique and the conclusions it presents that estimation results are very sensitive to omitted variable bias.

4.6 Conclusion

This research investigated a disruption hypothesis that student learning was lost as a direct consequence of teacher participation in the 2007 public service strike. Using a within-student, across-subject fixed effects strategy, results suggest that there are heterogeneous impacts on student achievement of teacher participation in the strike. In the privileged upper quartile of schools, where strike participation is less common and the duration of strike action limited, little to no negative teacher strike effects were identified. By contrast, in the bottom three quartiles of schools where participation in the strike was widespread, militant and typically long in duration, strike activity appears to be detrimental to learning. Here a student's performance in a subject taught by a striking teacher was about ten percent of a standard deviation lower than his or her performance in a subject taught by a non-striking teacher.

Fixed effects estimations also identified larger strike effects for students attending rural as opposed to urban schools and for students who are weaker academically. These results imply that unionisation and industrial action may augment existing inequalities in the provision of education in South Africa. The potential implication of strike activity for widening already unacceptable levels of inequality in learning in the South African education system adds an important dimension to debates about teachers' 'right to strike'. Furthermore, children in poorer schools are also disproportionately affected by strike activity in terms of access to nutrition, where feeding schemes are more prevalent in the very schools that are closed for longer durations due to industrial action. In this respect, debates about teachers' 'right to strike' in developing country contexts extend beyond examining learning impacts to vital issues of child nutrition.

¹⁰⁸ In cross-national tests of the relationship between teachers' cognitive skills and student outcomes, Hanushek, Piopiunik and Wiederhold (2014) note that teacher cognitive skills as measured in tests of content knowledge are actually *negatively* correlated with measures of instructional practice. In this respect, pedagogical expertise is not captured in teacher cognitive tests.

Unfortunately, questions remain about the extent to which the estimates of strike effects are subject to omitted variable bias. The magnitude of the strike participation effect in the poorest 75 percent of schools is roughly equivalent to a third of a years' lost learning in these schools, despite the average strike duration in these schools representing a much smaller fraction of official school days. This mismatch may be attributable to a number of reasons including under-reporting of strike absenteeism, spill-over effects of strike activity on learning or the calculated effect size may be overestimated in the presence of teacher unobservables. Application of a technique by Altonji et al (2005) indicates that it is not possible to rule out that the negative strike effects observed in the poorest schools may be entirely due to the confounding effects of omitted variable bias. An inverse relationship between observed teacher characteristics and strike participation in South Africa drives the implied negative bias. The conclusion one may be tempted to draw from this is that teachers who strike have less ability than teachers who do not strike. The observed data, however, do not provide substantive evidence that this is the case. It may be more probable that they lack motivation or exhibit lower levels of job satisfaction.

Although it was not possible to investigate the dynamic impacts of the 2007 public sector strike on learning, it is identified that over time industrial action of this kind could lead to educational improvements if teachers access better working conditions, negotiations introduce incentives that promote higher levels of effort, or better quality personnel are attracted to the teaching profession in response to more favourable pay profiles. Armstrong (2014) identified that the introduction of the 2009 Occupation Specific Dispensation (OSD) exposed teachers to a somewhat better age-pay profile than prior to OSD, but there is little evidence to suggest that this has since translated into higher levels of learning. Further research, however, is warranted to explore these long-run equilibrium impacts of teacher unions and industrial action on student performance.

4.7 Chapter appendix

Table 4A.1: Descriptive statistics of variables in estimations

Variable	Definition	All Schools	Poorest 75%	Wealthiest 25%
<i>Student characteristics</i>				
Young (<11y 3m) *	Student is young for grade 6 (younger than 11 years and 3 months old)	0.026 (0.002)	0.029 (0.003)	0.016 (0.005)
Old (>over 12y 8m) *	Student is old for grade 6 (Older than 12 years & 8 months old) . Reference category: grade correct age.	0.429 (0.011)	0.499 (0.011)	0.202 (0.015)
Female*	Student is female	0.509 (0.006)	0.502 (0.007)	0.53 (0.014)
Student SES	Index of students socio-economic status calculated from 31 assets of household ownership using principal components analysis	2.138 (0.130)	1.043 (0.090)	5.688 (0.159)
SES squared		15.245 (0.846)	7.708 (0.268)	39.688 (1.730)
Lived with parents*	Student lives with their parents	0.73 (0.010)	0.695 (0.011)	0.846 (0.022)
3 or more siblings*	Student has 3 or more siblings	0.541 (0.012)	0.622 (0.011)	0.278 (0.021)
misses 1 daily meal*	Student normally misses at least on meal per week	0.242 (0.008)	0.241 (0.010)	0.242 (0.015)
misses 2 daily meals*	Student normally misses at least 2 meals per week	0.118 (0.006)	0.13 (0.008)	0.077 (0.008)
misses 3 daily meals*	Student normally misses at least 3 meals per week	0.045 (0.003)	0.05 (0.004)	0.028 (0.005)
More than 10 books at home*	Student indicates that they have more than ten books at home	0.282 (0.014)	0.182 (0.010)	0.606 (0.028)
Mother or father has matric*	Student indicates that either mother or father (or both) has completed secondary education	0.428 (0.011)	0.362 (0.012)	0.642 (0.020)
Mother or father has degree*	Student indicates that either mother or father (or both) has a degree.	0.125 (0.009)	0.075 (0.006)	0.286 (0.024)
Speaks English always*	Student indicates speaking English outside school all or most of the time (Reference category: 'never')	0.141 (0.013)	0.073 (0.007)	0.363 (0.036)
Speaks English sometimes*	Student indicates speaking English outside school sometimes (Reference category: 'never')	0.628 (0.014)	0.654 (0.015)	0.542 (0.032)
Double orphan*	Student indicates that both parents are deceased.	0.089 (0.009)	0.099 (0.010)	0.057 (0.023)
Gets help with homework sometimes*	Student gets help with homework sometimes	0.577 (0.014)	0.542 (0.017)	0.692 (0.019)
Gets help with homework most of the time*	Student gets help with homework most of the time.	0.342 (0.014)	0.371 (0.017)	0.247 (0.020)
> 5 days absent*	Self-reported student absenteeism	0.028 (0.006)	0.03 (0.007)	0.024 (0.004)

Variable	Definition	All Schools	Poorest 75%	Wealthiest 25%
Preschool - <= 1 year*	Student attended preschool (includes kindergarten, nursery or reception) for a few months or 1 year	0.37 (0.010)	0.401 (0.012)	0.27 (0.023)
Preschool - 2 years*	Student attended preschool for 2 years	0.154 (0.007)	0.135 (0.008)	0.212 (0.014)
Preschool - 3 years*	Student attended preschool for 3 or more years (Reference category: never attended preschool)	0.207 (0.009)	0.147 (0.007)	0.402 (0.029)
Repeated a grade once*	Self-reported number of times a student has repeated a grade (including grade 6) since they started school. Reference category: never repeated.	0.202 (0.007)	0.225 (0.009)	0.125 (0.011)
Repeated a grade twice*		0.051 (0.003)	0.062 (0.004)	0.013 (0.004)
Repeated a grade 3 or more times*		0.03 (0.004)	0.037 (0.004)	0.007 (0.002)
<i>School characteristics</i>				
Urban*	School is located in urban area. Reference category: rural location.	0.508 (0.025)	0.385 (0.026)	0.906 (0.040)
School SES	Average socio-economic status of grade 6 students in that school.	2.138 (0.130)	1.043 (0.090)	5.689 (0.157)
School SES squared		10.307 (0.824)	3.027 (0.180)	33.917 (1.856)
Building Index (std)	Standardised index of school buildings based on the underlying variable 7 school buildings	0.123 (0.067)	-0.341 (0.061)	1.628 (0.100)
Equipment Index (std)	Standardised index of school buildings based on underlying variable of the 18 items	0.865 (0.049)	0.577 (0.055)	1.798 (0.068)
No class library*	Student's classroom does not have a library.	0.57 (0.028)	0.631 (0.032)	0.371 (0.065)
Class size => 40*	Class size equal to or greater than 40 students, as reported by the school principal.	0.564 (0.028)	0.634 (0.031)	0.337 (0.063)
Principal has degree*	School principal has a tertiary education - at least a first degree	0.656 (0.028)	0.632 (0.033)	0.734 (0.054)
Teaching hours of principal	Total hours the principal reports teaching at the school.	7.361 (0.354)	8.461 (0.428)	3.793 (0.433)
Principal experience as a school head	Principal's total years of experience as a school principal or acting principal.	10.613 (0.475)	11.01 (0.567)	9.325 (0.795)
Principal is female*	School principal is female.	0.355 (0.029)	0.393 (0.034)	0.231 (0.055)
Principal instructional leadership*	Principal prioritises discussing educational objectives with the teaching staff and their professional development	0.489 (0.030)	0.436 (0.034)	0.661 (0.064)
<i>Teacher characteristics</i>				
Teacher has degree*	Teacher has a tertiary education - at least a first degree	0.458 (0.020)	0.413 (0.022)	0.602 (0.041)
Teacher is male*	Teacher is male	0.34 (0.018)	0.357 (0.020)	0.284 (0.038)

Variable	Definition	All Schools	Poorest 75%	Wealthiest 25%
Teacher preservice training: <=1 year*	Teacher has 1 year or less of teacher pre-service training.	0.037 (0.007)	0.026 (0.007)	0.075 (0.017)
Teacher preservice training: 2 years*	Teacher has 2 years of pre-service training.	0.078 (0.011)	0.09 (0.013)	0.042 (0.021)
Teacher preservice training: 3 years*	Teacher has 3 years of pre-service training. <i>Reference category: more than 3 years of pre-service training.</i>	0.438 (0.019)	0.515 (0.022)	0.187 (0.028)
Teacher's age	Teacher's age.	41.663 (0.313)	41.565 (0.330)	41.98 (0.763)
Teacher's experience	Total number of years a teacher has been teaching.	15.632 (0.353)	15.357 (0.378)	16.523 (0.809)
Teacher strikes at least one day*	The teacher reports being absent for a strike for at least one day.	0.777 (0.018)	0.833 (0.018)	0.595 (0.047)
Number of days absent: teacher strike	Total number of days absent for strike in 2007.	11.639 (0.388)	13.906 (0.379)	4.288 (0.876)
Number of days absent: own illness	Total number of days absent for own illness.	2.784 (0.331)	2.936 (0.424)	2.291 (0.317)
Number of days absent: funerals	Total number of days absent for funerals.	0.83 (0.076)	0.945 (0.091)	0.457 (0.121)
Number of days absent: official business	Total number of days absent for official business (e.g. meeting, examination, course)	1.643 (0.140)	1.923 (0.170)	0.738 (0.174)
Hours spent lesson prep & marking	The total average weekly hours teacher spends on lesson preparation & marking for school, outside school hours	10.022 (0.321)	9.642 (0.383)	11.252 (0.550)
Home in poor condition/needs repairs*	Teacher indicates that his/her home is in poor condition or need of major repair.	0.262 (0.019)	0.315 (0.022)	0.088 (0.021)
Teacher gets teaching advice from principal*	Teacher indicates that school head gives him/her advice on teaching at least once a month.	0.458 (0.022)	0.476 (0.026)	0.401 (0.044)
Enough sitting places in classroom for students*	Number of sitting places in classroom as indicated by teacher is equal to or exceeds total number of students in class.	0.562 (0.025)	0.503 (0.028)	0.755 (0.054)
Teacher gets parents to sign student work*	Teacher gets parents or guardians to sign that students have completed their home assignments.	0.589 (0.022)	0.562 (0.026)	0.679 (0.041)
Teacher's classroom equipment index	Summative index of the number of teaching support items a teacher reports having in his or her classroom.	0.726 (0.012)	0.691 (0.014)	0.839 (0.020)
Teacher wrote subject specific test*	Teacher completed SACMEQ teacher test for his/her subject taught.	0.902 (0.012)	0.906 (0.014)	0.891 (0.023)
Observations		24 701	19 114	5 587

Source: SACMEQ III, own calculations. **Notes:** Variables marked with a * are dichotomous indicator variables. Standard errors are in parentheses. Means of all variables calculated using the student-subject dataset. A seven school buildings include school library, school or community hall, teacher/staff room, separate office for School Head, store room, special area for guidance and counselling, and cafeteria/shop/kiosk. B. first aid kit, clock, telephone, typewriter, duplicator, electricity (mains or generator), radio, tape recorder, TV, audio cassette player, CD, player, VCR machine, DVD player, fax machine, photocopier, overhead projector, computer(s), computer room. C. Usable writing board, chalk (or other markers), board duster/eraser, wall chart, cupboard or locker, bookshelves, classroom library or book corner, teacher table, teacher chair.

Table 4A.2: Full OLS estimation results of grade six student test scores

	All Schools				Wealthiest 25% of schools				Poorest 75% of schools			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Teacher strike participation	0.0174 (0.039)	0.0345 (0.038)	0.0169 (0.045)	-0.0132 (0.048)	0.0304 (0.050)	0.0456 (0.049)	0.0412 (0.045)	0.0174 (0.046)	0.0289 (0.046)	0.0378 (0.045)	0.0257 (0.056)	0.0023 (0.065)
Subject Dummies												
Subject test: Reading	-0.0029 (0.017)	-0.0132 (0.018)	-0.0137 (0.018)	-0.022 (0.019)	0.1217*** (0.036)	0.1171*** (0.034)	0.1302** (0.040)	0.1022** (0.043)	-0.0414** (0.019)	-0.0479** (0.020)	-0.0515** (0.020)	-0.0513** (0.020)
Subject test: Health	0.0485* (0.029)	0.0304 (0.031)	0.0268 (0.030)	0.0314 (0.031)	-0.1516** (0.058)	-0.1677** (0.058)	-0.1539** (0.062)	-0.1200** (0.059)	0.1111*** (0.033)	0.0907** (0.036)	0.0803** (0.035)	0.0831** (0.037)
Student Characteristics												
Young (<11y 3m)	-0.0805* (0.047)	-0.0851* (0.046)	-0.0824* (0.045)	-0.0907** (0.045)	-0.0414 (0.132)	-0.0552 (0.129)	-0.0383 (0.129)	-0.0398 (0.128)	-0.0544 (0.051)	-0.0551 (0.050)	-0.0541 (0.048)	-0.0649 (0.050)
Old (>over 11y 3m-12y 8m)	-0.1218*** (0.020)	-0.1214*** (0.019)	-0.1201*** (0.019)	-0.1235*** (0.018)	-0.1478*** (0.043)	-0.1483*** (0.043)	-0.1396** (0.043)	-0.1322** (0.045)	-0.1052*** (0.021)	-0.1058*** (0.021)	-0.1048*** (0.020)	-0.1088*** (0.020)
Female	0.0813*** (0.015)	0.0805*** (0.015)	0.0819*** (0.015)	0.0817*** (0.015)	0.0610** (0.026)	0.0596** (0.026)	0.0583** (0.025)	0.0593** (0.027)	0.0804*** (0.016)	0.0803*** (0.016)	0.0803*** (0.016)	0.0821*** (0.017)
SES status	0.0041 (0.005)	0.0046 (0.005)	0.0048 (0.005)	0.0047 (0.006)	0.0445** (0.022)	0.0451** (0.022)	0.0411* (0.022)	0.0395* (0.024)	0.0095* (0.005)	0.0095* (0.005)	0.0093* (0.005)	0.0095* (0.005)
SES status squared	0.0008 (0.001)	0.0008 (0.001)	0.0008 (0.001)	0.0008 (0.001)	-0.0022 (0.002)	-0.0023 (0.002)	-0.0019 (0.002)	-0.0018 (0.002)	-0.0012 (0.001)	-0.0011 (0.001)	-0.0011 (0.001)	-0.0013 (0.001)
Lived with parents	-0.019 (0.020)	-0.0193 (0.020)	-0.0164 (0.020)	-0.0151 (0.021)	0.0095 (0.053)	0.0062 (0.052)	0.0154 (0.051)	0.005 (0.055)	-0.0262 (0.021)	-0.0253 (0.021)	-0.0203 (0.021)	-0.0166 (0.022)
3 or more siblings	-0.0677*** (0.017)	-0.0670*** (0.017)	-0.0634*** (0.017)	-0.0612*** (0.018)	-0.0630** (0.029)	-0.0620** (0.030)	-0.0626** (0.029)	-0.0698** (0.031)	-0.0492** (0.021)	-0.0484** (0.020)	-0.0455** (0.020)	-0.0464** (0.020)
misses 1 daily meal at least 1x per week	0.0356 (0.022)	0.0346 (0.022)	0.0336 (0.021)	0.0322 (0.022)	-0.0449 (0.036)	-0.0442 (0.037)	-0.0404 (0.036)	-0.0389 (0.038)	0.0687** (0.025)	0.0664** (0.025)	0.0628** (0.024)	0.0605** (0.025)
misses 2 daily meals at least 1x per week	-0.0853** (0.029)	-0.0852** (0.029)	-0.0894** (0.028)	-0.0785** (0.028)	-0.1779** (0.070)	-0.1801** (0.068)	-0.1838** (0.067)	-0.1746** (0.074)	-0.0553* (0.030)	-0.0545* (0.030)	-0.0608** (0.029)	-0.0565* (0.029)

Table Continued...	All Schools				Wealthiest 25% of schools				Poorest 75% of schools			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
misses 3 daily meals at least 1x per week	-0.0889** (0.043)	-0.0813* (0.043)	-0.0837** (0.041)	-0.0587 (0.043)	-0.2861*** (0.072)	-0.2798*** (0.073)	-0.2733*** (0.071)	-0.2500** (0.076)	-0.0466 (0.046)	-0.0417 (0.046)	-0.0479 (0.045)	-0.0249 (0.046)
More than 10 books at home	0.0831*** (0.023)	0.0817*** (0.023)	0.0849*** (0.022)	0.0864*** (0.023)	0.1102** (0.033)	0.1138*** (0.032)	0.1152*** (0.033)	0.1300*** (0.032)	0.0481* (0.029)	0.0471* (0.028)	0.0508* (0.028)	0.0506* (0.029)
Mother or father has matric	0.1052*** (0.019)	0.1030*** (0.019)	0.1009*** (0.019)	0.1017*** (0.018)	0.0935** (0.042)	0.0950** (0.041)	0.0993** (0.042)	0.1071** (0.043)	0.0978*** (0.020)	0.0955*** (0.020)	0.0934*** (0.020)	0.0904*** (0.020)
Mother or father has a degree	0.2075*** (0.029)	0.2004*** (0.029)	0.1960*** (0.028)	0.1856*** (0.029)	0.1988*** (0.044)	0.1986*** (0.044)	0.1925*** (0.044)	0.1973*** (0.046)	0.1704*** (0.042)	0.1613*** (0.041)	0.1550*** (0.041)	0.1454*** (0.041)
Speaks English at home always	0.3284*** (0.047)	0.3146*** (0.045)	0.3094*** (0.045)	0.2879*** (0.046)	0.4256*** (0.065)	0.4191*** (0.064)	0.4287*** (0.057)	0.3956*** (0.063)	0.1294** (0.054)	0.1297** (0.052)	0.1292** (0.051)	0.1320** (0.052)
Speaks English at home sometimes	0.1985*** (0.028)	0.1973*** (0.028)	0.1929*** (0.026)	0.1905*** (0.026)	0.2003*** (0.052)	0.1983*** (0.051)	0.1925*** (0.047)	0.1791*** (0.050)	0.2013*** (0.030)	0.1997*** (0.029)	0.1940*** (0.028)	0.1958*** (0.028)
Double orphan	-0.04 (0.035)	-0.0383 (0.034)	-0.0412 (0.034)	-0.0454 (0.034)	-0.1183 (0.120)	-0.1092 (0.125)	-0.1901 (0.120)	-0.2134 (0.131)	-0.0261 (0.037)	-0.0235 (0.036)	-0.0175 (0.036)	-0.0166 (0.035)
Gets help with homework sometimes	0.1665*** (0.038)	0.1631*** (0.038)	0.1603*** (0.038)	0.1525*** (0.037)	-0.0844 (0.079)	-0.0867 (0.079)	-0.0743 (0.076)	-0.0872 (0.082)	0.2085*** (0.039)	0.2081*** (0.038)	0.2063*** (0.039)	0.1975*** (0.037)
Gets help with homework most of the time	0.1156** (0.045)	0.1136** (0.045)	0.1127** (0.043)	0.1083** (0.044)	-0.2627** (0.081)	-0.2663** (0.080)	-0.2592** (0.078)	-0.2821*** (0.081)	0.2053*** (0.045)	0.2052*** (0.044)	0.2047*** (0.043)	0.1987*** (0.044)
> 5 days absent	0.1418 (0.131)	0.1375 (0.127)	0.1396 (0.123)	0.1405 (0.128)	-0.0147 (0.080)	-0.0118 (0.080)	-0.005 (0.077)	-0.0304 (0.080)	0.151 (0.146)	0.1517 (0.142)	0.1514 (0.133)	0.163 (0.137)
Preschool - <= 1 year	0.0919** (0.030)	0.0877** (0.029)	0.0896** (0.029)	0.0896** (0.030)	0.2075*** (0.050)	0.2069*** (0.050)	0.2027*** (0.053)	0.2086*** (0.053)	0.0623** (0.030)	0.0585* (0.030)	0.0619** (0.030)	0.0657** (0.030)
Preschool - 2 years	0.1105*** (0.031)	0.1066*** (0.030)	0.1129*** (0.030)	0.1124*** (0.029)	0.2454*** (0.054)	0.2448*** (0.054)	0.2312*** (0.057)	0.2249*** (0.055)	0.0645* (0.033)	0.0620* (0.032)	0.0713** (0.031)	0.0801** (0.032)
Preschool - 3 years	0.1274*** (0.028)	0.1252*** (0.029)	0.1278*** (0.028)	0.1214*** (0.027)	0.2518*** (0.043)	0.2510*** (0.042)	0.2438*** (0.045)	0.2560*** (0.047)	0.0766** (0.032)	0.0743** (0.032)	0.0769** (0.031)	0.0647** (0.030)

Table Continued...	All Schools				Wealthiest 25% of schools				Poorest 75% of schools			
Specifications	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Repeated a grade once	-0.1655*** (0.022)	-0.1665*** (0.022)	-0.1608*** (0.021)	-0.1574*** (0.021)	-0.2602*** (0.058)	-0.2608*** (0.058)	-0.2640*** (0.057)	-0.2620*** (0.056)	-0.1346*** (0.021)	-0.1348*** (0.021)	-0.1327*** (0.021)	-0.1285*** (0.021)
Repeated a grade twice	-0.2374*** (0.032)	-0.2383*** (0.032)	-0.2323*** (0.031)	-0.2391*** (0.031)	-0.2246** (0.112)	-0.2287** (0.110)	-0.2413** (0.101)	-0.2077** (0.093)	-0.2207*** (0.031)	-0.2212*** (0.030)	-0.2185*** (0.030)	-0.2293*** (0.031)
Repeated a grade three or more times	-0.3968*** (0.048)	-0.3922*** (0.047)	-0.3863*** (0.048)	-0.3886*** (0.052)	-0.6321*** (0.163)	-0.6299*** (0.167)	-0.6231*** (0.170)	-0.6113** (0.206)	-0.3343*** (0.045)	-0.3322*** (0.045)	-0.3336*** (0.048)	-0.3442*** (0.051)
<i>School Characteristics</i>												
Urban	0.0496 (0.057)	0.0423 (0.056)	0.0345 (0.054)	0.0294 (0.055)	0.0137 (0.107)	0.025 (0.113)	0.0024 (0.097)	-0.0915 (0.093)	0.1179** (0.057)	0.0996* (0.058)	0.0899 (0.056)	0.0879 (0.057)
School SES	0.0138 (0.027)	0.0117 (0.027)	0.0097 (0.025)	0.0054 (0.025)	0.319 (0.258)	0.3306 (0.248)	0.3629* (0.213)	0.4391** (0.212)	-0.0015 (0.033)	-0.0018 (0.032)	-0.0071 (0.029)	-0.0111 (0.029)
School SES squared	0.0198*** (0.004)	0.0197*** (0.004)	0.0197*** (0.004)	0.0196*** (0.004)	-0.0165 (0.022)	-0.0171 (0.021)	-0.0196 (0.017)	-0.0237 (0.017)	0.0207* (0.012)	0.0230** (0.012)	0.0235** (0.011)	0.0279** (0.011)
Building Index (std)	0.0377 (0.030)	0.0324 (0.030)	0.0275 (0.029)	0.0187 (0.028)	0.1009* (0.060)	0.0954 (0.059)	0.072 (0.047)	0.0458 (0.046)	-0.0074 (0.032)	-0.0065 (0.032)	-0.0109 (0.031)	-0.0079 (0.032)
Equipment Index (std)	0.0315 (0.037)	0.0407 (0.036)	0.0294 (0.036)	0.0324 (0.037)	0.2313** (0.092)	0.2243** (0.093)	0.1592** (0.072)	0.1246* (0.071)	0.0268 (0.037)	0.0355 (0.037)	0.0256 (0.037)	0.0266 (0.039)
No class library	-0.0147 (0.039)	-0.0241 (0.037)	-0.0196 (0.036)	-0.0368 (0.037)	-0.0149 (0.051)	-0.0297 (0.053)	0.0035 (0.043)	-0.0039 (0.048)	-0.0443 (0.044)	-0.0449 (0.043)	-0.0456 (0.042)	-0.0439 (0.045)
Class size => 40	0.0224 (0.046)	0.0192 (0.045)	0.0289 (0.046)	0.0321 (0.047)	-0.0444 (0.074)	-0.0484 (0.074)	-0.0625 (0.062)	-0.0605 (0.065)	0.0419 (0.054)	0.0425 (0.053)	0.0524 (0.053)	0.0562 (0.056)
Principal has tertiary degree	-0.0223 (0.043)	-0.0303 (0.042)	-0.0325 (0.041)	-0.0255 (0.042)	-0.1308** (0.063)	-0.1427** (0.062)	-0.1557** (0.052)	-0.1229** (0.056)	-0.0236 (0.044)	-0.0344 (0.044)	-0.0363 (0.044)	-0.0454 (0.046)
Teaching hours of principal	0.004 (0.005)	0.0049 (0.005)	0.0036 (0.005)	0.0046 (0.005)	0.0151 (0.011)	0.0167 (0.011)	0.0152 (0.010)	0.011 (0.011)	0.0054 (0.005)	0.0061 (0.005)	0.005 (0.005)	0.0056 (0.005)
Years principal has been a school head	-0.0011 (0.002)	-0.0012 (0.002)	-0.0011 (0.002)	-0.0014 (0.002)	-0.0021 (0.005)	-0.0025 (0.005)	-0.0008 (0.004)	-0.0012 (0.005)	-0.002 (0.002)	-0.0023 (0.002)	-0.002 (0.002)	-0.0027 (0.002)

Table continued...	All Schools				Wealthiest 25% of schools				Poorest 75% of schools			
Specifications	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Principal is female	0.0332 (0.043)	0.0407 (0.041)	0.0257 (0.041)	0.0153 (0.042)	0.0631 (0.067)	0.0794 (0.068)	0.1079* (0.057)	0.1030* (0.055)	0.0445 (0.045)	0.0468 (0.044)	0.0323 (0.044)	0.0214 (0.047)
Principal engages in instructional leadership	-0.0022 (0.035)	0.0045 (0.034)	-0.0024 (0.035)	-0.0031 (0.036)	-0.0007 (0.058)	0.0036 (0.060)	0.0344 (0.051)	0.0348 (0.055)	-0.022 (0.039)	-0.0128 (0.039)	-0.0191 (0.039)	-0.0234 (0.041)
<i>Teacher Characteristics</i>												
Teacher has degree		0.0698** (0.031)	0.0763** (0.031)	0.0601* (0.032)		0.0484 (0.055)	0.0013 (0.052)	-0.0491 (0.050)		0.0646* (0.035)	0.0798** (0.033)	0.0804** (0.034)
Teacher is male		-0.0444 (0.030)	-0.0307 (0.028)	-0.0349 (0.029)		0.0321 (0.048)	0.0295 (0.049)	0.0202 (0.043)		-0.0436 (0.035)	-0.0269 (0.032)	-0.0326 (0.033)
Teacher pre-service training: <=1 year		0.0795 (0.079)	0.0602 (0.076)	0.0245 (0.082)		-0.0476 (0.098)	-0.0057 (0.079)	-0.0256 (0.081)		0.1196 (0.097)	0.0798 (0.097)	0.0653 (0.100)
Teacher pre-service training: 2 years		0.0245 (0.056)	0.0209 (0.057)	0.0361 (0.057)		0.0687 (0.108)	0.2335** (0.103)	0.2154** (0.104)		0.0326 (0.058)	0.0361 (0.056)	0.0452 (0.057)
Teacher pre-service training: 3 years		0.0664** (0.030)	0.0603* (0.031)	0.0550* (0.033)		0.0159 (0.060)	0.0429 (0.051)	0.0717 (0.046)		0.0761** (0.032)	0.0661* (0.034)	0.0566 (0.038)
Teacher's age		-0.0544*** (0.014)	-0.0503** (0.015)	-0.0481** (0.016)		-0.0293* (0.017)	-0.0292 (0.018)	-0.0431** (0.019)		-0.0492** (0.024)	-0.0450* (0.024)	-0.0377 (0.025)
Teacher's age squared		0.0006*** (0.000)	0.0006*** (0.000)	0.0006*** (0.000)		0.0003 (0.000)	0.0004* (0.000)	0.0005** (0.000)		0.0006** (0.000)	0.0006** (0.000)	0.0005* (0.000)
Teacher's experience			-0.0035 (0.004)	-0.0059* (0.004)			-0.0064 (0.006)	-0.0041 (0.005)			-0.0061 (0.004)	-0.0084** (0.004)
Days absent: own illness			0.0014 (0.003)	0.0024 (0.003)			-0.0028 (0.006)	-0.0009 (0.006)			0.0019 (0.002)	0.003 (0.002)
Days absent: funerals			0.0044 (0.007)	0.0008 (0.006)			0.0378** (0.018)	0.0353** (0.016)			0.0021 (0.006)	-0.0005 (0.006)
Days absent: official business			-0.0056* (0.003)	-0.0066* (0.003)			-0.0033 (0.011)	-0.0053 (0.009)			-0.0056* (0.003)	-0.0061* (0.003)

Table continued Specifications	All Schools				Wealthiest 25% of schools				Poorest 75% of schools			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Hours spent on lesson preparation & marking			-0.0011 (0.002)	-0.0007 (0.002)			0.0096** (0.004)	0.0105** (0.004)			-0.0042* (0.002)	-0.0034 (0.002)
Own home in poor condition/ need of repair			-0.0518 (0.034)	-0.0261 (0.036)			-0.1148 (0.084)	0.0037 (0.077)			-0.0511 (0.035)	-0.03 (0.037)
Gets monthly teaching advice from principal			0.0567* (0.029)	0.0736** (0.030)			0.2006*** (0.048)	0.2423*** (0.050)			0.0357 (0.032)	0.0476 (0.033)
Enough sitting places in classroom for students			0.0622 (0.040)	0.0548 (0.040)			-0.058 (0.059)	-0.0228 (0.054)			0.0536 (0.042)	0.0458 (0.043)
Teacher gets parents to sign student work			0.0495 (0.035)	0.0704** (0.036)			-0.0566 (0.054)	-0.0264 (0.053)			0.0581 (0.040)	0.0735* (0.040)
Teacher's classroom supplies index			0.0681 (0.111)	0.0553 (0.126)			0.2345** (0.093)	0.2108* (0.111)			0.0351 (0.130)	0.0094 (0.142)
Teacher wrote subject specific test			-0.0093 (0.064)				-0.1556* (0.079)				-0.0121 (0.073)	
Teachers' test score (std)				0.0779*** (0.015)				0.0895*** (0.021)				0.0460** (0.020)
Constant	-0.6789 (0.112)	0.4040 (0.333)	0.2882 (0.363)	0.2607 (0.387)	-1.3880* (0.759)	-0.8008 (0.851)	-0.9045 (0.835)	-0.936 (0.795)	-0.7628*** (0.115)	0.1915 (0.518)	0.1263 (0.529)	-0.0221 (0.547)
R-squared	0.428	0.432	0.436	0.442	0.375	0.378	0.392	0.395	0.156	0.160	0.168	0.170
F-stat	52 (0.000)	50 (0.000)	48 (0.000)	53 (0.000)	68 (0.000)	61 (0.000)	52 (0.000)	48 (0.000)	21 (0.000)	20 (0.000)	18 (0.000)	18 (0.000)
Subject-student obs. (N)	24 701	24 701	24 701	22 382	5 587	5 587	5 587	4 936	19 114	19 114	19 114	17 446
Number of schools	364	364	364	361	84	84	84	83	280	280	280	278

Source: SACMEQ III, own calculations. **Notes:** OLS estimates also include provincial controls not shown. Standard errors that are in parentheses were corrected for clustering of errors between subjects within a student (student id as the clustering variable) and probability sampling weights are accounted for. Statistically significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

Table 4A.3: Number of school days lost in primary schools in 2007 due to strikes/boycotts by whether students access a school feeding scheme, Systemic Evaluation 2007

The number of school days that have been lost at school as a result of strikes/boycotts. Principal's response.

Modal response of grade three tested students to the question "I eat food from the feeding scheme at my school"	Mean	Std. Err.	Lower CI	Upper CI	Median	N
Everyday	17.30	0.18	16.94	17.66	18	1 434
Most of the day	17.82	0.51	16.83	18.81	20	157
Some of the days	17.76	0.43	16.92	18.61	20	225
Never	10.64	0.48	9.70	11.57	11	344
All schools	16.32	0.16	16.01	16.62	17	2 160

Source: Foundation Phase Systemic Evaluation 2007. **Notes:** Students in 2 342 schools were surveyed in the Systemic Evaluation 2007 which is a nationally representative survey of grade three student performance. In question 36 of the student questionnaire, tested students were asked about how often they eat food from the feeding scheme at school during a normal school week. Due to missing data, it was not possible to ascertain a modal student response to the question for 180 schools. Calculations account for probability weights and stratification in survey design.

Table 4A.4: Estimating strike participation, teachers surveyed in the poorest 75 percent of primary schools

	Estimating strike participation (indicator variable)		Estimating the number of days absent for strike	
	OLS	School fixed effect	OLS	School fixed effect
Subject: Reading/literacy [^]	-0.041* (0.022)	-0.053** (0.023)	-0.783* (0.438)	-1.122** (0.481)
Subject: Health [^]	-0.058** (0.026)	-0.050* (0.029)	-1.101* (0.587)	-1.691** (0.741)
Teacher has a degree [^]	-0.041 (0.027)	-0.01 (0.028)	-0.762 (0.692)	-0.539 (0.639)
Teacher is male [^]	0.068*** (0.023)	0.060** (0.025)	0.340 (0.627)	0.382 (0.625)
Teacher preservice training <=1 year [^]	-0.045 (0.094)	0.014 (0.063)	0.650 (2.057)	1.222 (1.903)
Teacher preservice training: 2 years [^]	-0.006 (0.063)	-0.134** (0.067)	0.416 (1.341)	-2.533* (1.469)
Teacher pre-service training: 3 years [^]	0.009 (0.028)	-0.063** (0.029)	0.205 (0.738)	-0.184 (0.834)
Teacher's age	0.042* (0.024)	0.074*** (0.023)	1.511*** (0.478)	1.398** (0.632)
Teacher's age squared	0.000 (0.000)	-0.001*** (0.000)	-0.016*** (0.006)	-0.016** (0.008)
Teacher's experience	-0.005 (0.003)	0.001 (0.004)	-0.253*** (0.084)	-0.01 (0.077)
Days absent: own illness	0.001 (0.001)	0.000 (0.001)	0.030 (0.027)	-0.039 (0.036)
Days absent: funerals	0.008* (0.005)	0.011** (0.005)	0.169 (0.120)	0.22 (0.166)
Days absent: official business	0.002 (0.006)	-0.003 (0.006)	0.086 (0.129)	0.004 (0.145)
Hours spent on lesson preparation & marking	-0.003 (0.002)	-0.004** (0.002)	-0.091** (0.042)	-0.073** (0.036)
Own home is in poor condition/need of repair	0.04 (0.028)	0.038 (0.032)	1.597** (0.728)	0.779 (0.841)
Gets monthly teacher advice from principal [^]	-0.057* (0.033)	-0.058 (0.036)	-0.968 (0.706)	-0.386 (0.671)
Enough sitting places in classroom for students [^]	0.031 (0.030)	0.054 (0.044)	-0.833 (0.709)	1.243 (0.931)
Teacher gets parents to sign student work [^]	0.004 (0.030)	0.060* (0.032)	-0.493 (0.690)	1.141 (0.727)
Teacher's classroom equipment index	0.058** (0.025)	0.075* (0.043)	1.025** (0.463)	1.540* (0.837)
Teacher content knowledge test score (std)	0.035** (0.017)	0.011 (0.015)	0.282 (0.370)	0.316 (0.323)
R-squared/ Within R- squared	0.092	0.166	0.095	0.133
N (Number of clusters)	17 465 (278)	739 (289)	17 465 (278)	739 (289)
F-stat (p-value)	2.016	1.898	3.148	1.934

Source. SACMEQ III, own calculations. **Notes:** Standard errors are in parentheses and account for clustering. Probability sampling weights are accounted for in the estimations. Constant included but not shown. [^]Indicator variable. Statistically significant at ***p<0.01, **p<0.05, *p<0.1.

Chapter 5

Summary

In the face of a formidable challenge to improve the provision of educational quality in South Africa, this thesis has considered two previously under-researched factors that are considered critical to disrupting the existing culture of inefficiency in our schools. Starting with the assumption that school principals are essential to school functionality and that their quality matters for learning outcomes (Branch, Hanushek and Rivkin, 2012), chapters two and three provided greater specificity to our understanding of the labour market for school principals in South Africa. In providing quantitative evidence on a previously unexplored topic in the local context, these chapters highlighted the significant contribution that administrative data brings to opening up important avenues for research and in turn informed policy development. The fourth chapter then explored how teacher unions enter into the production of education, quantifying their impacts on student performance through lost learning days due to industrial action.

The following discussion summarises the key conclusions and contributions of each of the chapters. It concludes with a discussion on potential avenues for extending this research and the value that administrative data provides in this regard.

5.1 Chapter two: A profile of the labour market for school principals in South Africa. Evidence to inform policy

While South African education policy developments have increasingly attributed value to the role of school principals in realising educational improvements, there has been little understanding about the nature of our school principal labour market to inform and support policy developments to raise the quality of school leadership. By constructing a longitudinal dataset of educator payroll data linked to national data on schools and school matriculation examination results, chapter one provided an overview of the overarching characteristics of this principal labour market.

The first, and probably most significant finding in exploring the dataset, is the aging profile of school principals in South Africa. With just over 24 000 public ordinary schools, South Africa faces a substantial and an increasing number of school leadership replacements. As many as 7 000 principals would have to be hired between 2012 and 2017 for retirement reasons alone. The absolute demand for

principal replacements is greatest in higher poverty schools and at the primary or intermediate phase level. This presents an opportunity to improve the quality of school leadership. In a context where dismissals for non-performance are very uncommon, and are likely to be strongly resisted by teachers' unions, it is predominately at times of voluntary principal departures that schools can access new school leadership. In a historical context where the position of the principal has been distorted as an instrument of bureaucratic control over teachers in non-white schools (Steyn, 2002), recruiting a new generation of school leaders also presents the possibility of renewing perceptions on their role. Where the average school leader in South Africa had 25 years of service in 2012, they would have been positioned into schools well before democratic freedom, and specifically in a period of considerable political disruption in education. Furthermore, where much of the poor performance we observe in the system emanates from low levels of learning at the foundation phase (Spaull and Kotze, 2015), recruiting better quality school leaders at this foundation phase level, in particular, could provide a significant opportunity to realising educational improvements.

Nevertheless, while an aging profile of school leaders may present an opportunity for the system, finding suitable replacement principals is challenging given the existing characteristics of this principal labour market. In addition to identifying a notable gender disparity in the appointment of principals, the analysis revealed substantial inequalities in the distribution of principals across schools. Less qualified and less experienced principals are overly represented in poorer parts of the school system. These patterns are partly attributed to the historical inertias of state imposed controls on teacher sorting, but patterns of sorting continue to persist in line with historical inequalities. The wealthiest schools have hired the most qualified principals and continue to hire better qualified principals, while newly appointed principals in poorer schools are considerably less well-qualified and have fewer qualifications than those they replace. On average, a principal promotion post in the poorest (quintile one) schools can be accessed on average three years earlier than similar posts in wealthier schools. These distributional inequalities are likely perpetuated through a combination of factors. A larger pool of qualified and experienced principals is available for promotion in wealthier schools and these schools are likely to attract a larger pool of well-qualified and experienced candidates from outside the school. Furthermore, variations may exist in appointment processes and selection criteria applied across the system.

Another key feature of this principal labour market is that there are low levels of principal mobility when compared with local and international benchmarks of employee turnover. An added dimension to this finding is that over half of principals are appointed from within the ranks of the schools. Among those who do move, cross-provincial mobility accounts for only three percent of within system moves. There are two noteworthy implications of low levels of mobility. First, with few school-to-school moves, the systematic transfer of principals across the system is unlikely to substantially exacerbate existing distributional inequalities. It follows that policies that target the

initial matching of principals to schools are most important and this is all the more relevant when the system is facing a large number of principal replacements. Despite low levels of mobility, however, existing patterns of movements tend to operate in the same direction as historical inequalities. There is suggestive evidence that the race of the principal relative to the race of the student body is associated with principals' decisions to move out of a school. In terms of school wealth, principals that do move between schools, more commonly make lateral or upward moves than downward moves to poorer schools. Where a larger pool of suitable replacement principals needs to be directed at poorer schools, developments and revisions to existing policies are required in altering the way this principal labour market works and making high poverty schools more competitive institutions of work (Clotfelter et al., 2007). In the long-run, attracting good principals to these schools involves altering the way the teacher labour market works where principals are commonly promoted from within the ranks of the school. In future research, it would be interesting to explore whether the introduction of incentives for teachers in hard-to-staff schools will increase the competitiveness of these schools.

Low levels of mobility are also indicative of long principal tenure. With each principal replacement, the leadership trajectory of the average school is established for almost a decade. On the one hand, this is a positive feature of our principal labour market where research suggests that it takes many years for principals to have their full effect on schools and short tenure implies increased exposure to principal leadership changes (Beteille, Kalogrides and Loeb, 2012; Clark, Martorell and Rockoff, 2009; Coelli and Green, 2012). On the other hand, if poor quality principals are appointed, long tenure also presents a constraint to improvement where labour legislation, the strength of unions and a lack of performance contracts for principals limits the dismissal of underperforming principals.

Finally, the chapter explored whether qualifications and experience are instructive in informing the right selection and hires of school principals by estimating the relationship between principals' traditional academic credentials – as captured in payroll –and school performance as measured by matriculation examination data. For the majority of schools, the estimation results stand in contrast to current principal selection criteria and remuneration systems that centre on rewarding qualifications and seniority (RSA DoE, 2003a). The system of Relative Educational Values (REQVs) – a composite measure of academic and professional qualifications – shows little systematic relationship with school performance in poorer (quintiles one to three) schools. Years of service, as a proxy for experience, was identified as being negatively related to school performance in most estimations. Credentials, and particularly REQV levels, are clearly not signalling what policy would like them to in the majority of schools. This is juxtaposed against the reality that principals are increasing their qualifications on the job, the department has paid for these higher qualifications (Heystek, 2015) and yet there is little return in terms of improved school performance. By design, the system has set itself up for rent-extraction (Pritchett, 2013).

Saying this however, there is suggestive evidence that access to higher levels of qualifications afford principals the opportunity to move within the system to potentially higher paying positions. Moreover, holding various school and principal characteristics constant, those principals with higher levels of qualifications display lower probabilities of exiting the public education system than those with fewer qualifications. In this respect, current policies that reward higher qualifications may be useful for the retention of principals (and teachers more generally) in the public education system. A differentiated pay schedule is necessary, but differentiating on the basis of quality, not credentials, may lead to more desirable outcomes. Establishing increased accountability in the schooling system more generally, may hinge on introducing a revised system of rewards for principals on the basis of performance. This echoes the broader sentiments of economists internationally who are advocating for incentives that are linked to performance, not certification.

The scope of this research did not extend to describing a high performing principal which leads to some policy dilemmas. As Eric Hanushek (2013:6) identifies, “if one cannot readily describe what is desired, it is hard to improve principals from regulation or certification”. Nevertheless, the notion of competency-based testing as suggested in The National Development Plan (NDP), and reiterated in the 2013 NEEDU report on “Teaching and Learning in Rural Schools”, is appealing in our context. While it may be challenging to correctly specify what distinguishes a better candidate from another, at the very least, competency-based testing - particularly when managed by an independent third party - introduces more control over the appointment process, limits the undue influence of unions or other organised interest groups on this process and could help alleviate some of the apparent gender bias associated with principal appointments. The analysis certainly highlights that urgent action is required in monitoring and improving the existing appointment process for school principals. The Western Cape and Gauteng are two provinces that have already forged ahead in spear-heading competency-based testing.

However, improving the principal appointment process is a necessary, but not sufficient condition for improving the quality of school leadership. With long tenure, the design of policy must support the development of principals over the duration of their Principalship. The Advanced Certificate in Education (ACE) in school management and leadership, which has been the existing approach to improving the quality of incumbent school leadership, is unlikely to produce the level of improvement required. Resuming stalled negotiations at the ELRC to implement performance management contracts for school principals is also necessary. Furthermore, additional exploration is required of innovative ways to monitor the development of principals and provide the coaching, mentoring and support they need to be effective.

5.2 Chapter three: Principal leadership changes, school performance and teacher turnover

Supported by the right design and implementation of policies, the retirement of school principals presents a potential opportunity to appoint better school principals. However, initially there may be direct costs and efficiency losses associated with the principal replacement process. Chapter three narrowed its focus to investigate the implications that a rising number of principal replacements may present for the school environment in the short to medium term. Using the matched payroll-EMIS dataset, the chapter investigated how school performance responds to a principal leadership change. Due to the short length of the administrative data panel, it was only possible to investigate these impacts within a period of 0 to 24 months following the leadership change. Furthermore, in the absence of data to construct useful measures of principal quality the research could not identify whether better or lower quality principals have been appointed in recent years. Nevertheless, the analysis does contribute to our understanding of how these school leadership changes, on average, are impacting on school performance.

A key challenge in addressing this research question was isolating the impact of a principal leadership change from other factors that may be correlated with both a principal's decision to leave a school and learning outcomes. Exploiting the panel nature of the constructed dataset, a school fixed effects strategy was used to isolate out time-invariant unobserved factors at the school level that may bias the relationship, while controlling for observed time-varying school and principal characteristics that may also bias the results. A negative relationship between principal turnover and matriculation examination outcomes is identified in these estimations. However, the negative effect is typically only observed where the leadership change resulted from the outgoing principal exiting public education for retirement or non-retirement reasons, not to take up a post in another school. Principal attrition is associated with a 1.7 percentage point decline in the percentage of mathematics takers who pass this examination and a 1.5 percentage point decline in a school's percentage pass rate in the National Senior Certificate (NSC). As expected, the magnitude and significance of effects is larger in the sample of poorer schools (quintiles one to three). In these schools, the percentage pass rate in mathematics falls by four percentage points, the average mathematics result falls by 1.8 percentage points and the NSC pass rate declines by 3.2 percentage points in response to a school's principal exiting public education. The larger effects identified in the poorer sample of schools present the following interpretations. Principal leadership changes may have more destabilising consequences in these schools, for example, if principal appointment processes are politically charged events (Patillo, 2012; Taylor, 2014). Alternatively, it may suggest that principal leadership is particularly important in establishing the conditions necessary for learning in these schools.

Acknowledging the limitations of the fixed effects strategy in effectively controlling for endogenous factors that may bias estimates of the principal leadership change effect, I drew on an approach by Heckman, Ichimura and Todd (1997) and Heckman and Smith (1999) as a robustness check of the fixed effects results. A well matched set of schools was generated by constraining the potential group of control schools (those not experiencing a principal turnover event between 2008 and 2010) to those that do experience a principal turnover event in a subsequent period (2010 to 2012). Applying this constraint was critical to the success of the matching strategy in realising overlap and balance in the covariates. A school fixed effects regression was then applied to the matched sample of schools to relax the assumption of conditional independence which typically limits the validity of causal estimates generated through traditional propensity score matching approaches. The school fixed effects estimations were also weighted using overlap weights as proposed by Li, Morgan and Zaslavsky (2014). The aim here was to give more weight to observations in the area of the distribution where there was most overlap between control and treatment schools in the covariate distribution. This robustness check confirmed the findings of the initial school fixed effects strategy. Negative effects of principal turnover induced by principal exits from education result in significant declines in school performance when measured by matriculation mathematics outcomes.

The chapter also explored two potential mechanisms by which school performance declines following a principal leadership change, namely through rising promotion rates and higher levels of teacher turnover. There is suggestive evidence (albeit weak) that grade 10 to 12 promotion rates tend to rise with a new principal appointment. This implies that the declines in school performance in the matriculation examination may be partly attributable to a potentially weaker cohort of students sitting the examination. Then in the final section of the chapter, attention was given to understanding the relationship between principal turnover and teacher turnover. Consistent with U.S. literature (Beteille, Kalogrides and Loeb, 2012; Miller, 2013), there is suggestive evidence that in South African schools teacher turnover rises around the period of a principal leadership change. In primary schools, principal mobility and principal attrition (for non-retirement reasons) is related to an increased probability that a teacher will exit a school. By contrast, rising turnover in response to principal turnover is not observed among secondary school teachers; in which case changes in the composition of teachers in these schools does not offer a suitable explanation for why schools' matriculation outcomes decline in response to a principal turnover event.

In the short to medium term, school leadership changes, in general, present negative consequences for school performance, especially when initiated by principals exiting public education. This is a concern given the number of principal replacements taking place in the system for retirement reasons. International evidence does suggest that school performance stabilises after three to four years following a principal replacement and may start to rise in the principals' fifth year of tenure (Coelli and Green, 2012; Miller, 2013). In the interim, there may be a role that districts can play in mitigating

potential losses in learning by providing support to schools in managing the leadership succession process. This may involve engaging with the outgoing and incoming principals and their school management teams and providing a combination of coaching, mentoring or induction training for newly appointed principals. This appears to be particularly necessary in the poorer part of the school system where larger negative effects of principal leadership changes are observed.

5.3 Chapter four: Teachers' unions and industrial action in South African schooling - Exploring their impacts on learning

After exploring the labour market for school principals in South Africa, the discussion shifted its focus to teachers' union as an institutional determinant of educational progress in South Africa and specifically, affecting learning through industrial action. The chapter commenced with a brief background on teachers' unions, providing estimates of the extent of unionisation in the South African education system. While unionisation has grown substantially in post-apartheid, and specifically in the late 90s, unionisation rates among personnel are not unusually high when compared with other education systems (Alvarez, Moreno and Patrinos, 2007). Consistent with findings in other developing country contexts (ibid, 2007; Murillo et al., 2002), there is also considerable heterogeneity in unionisation within our education system. This is evident in cross-provincial comparisons of the proportion of education personnel that are unionised and their union affiliation. This heterogeneity is likely to imply differential effects of teacher unions on the functioning of provincial departments of education and on school performance in these provinces. While not the focus of the analysis, this presents an interesting avenue for further research.

The level of militancy among teacher union members, as expressed in strike activity, also varies across the system and even within schools. Exploiting the within-school variation in teacher strike activity observed, this chapter investigated a disruption hypothesis that student learning is negatively affected as a direct consequence of teacher strike participation. Using SACMEQ III data, the chapter explored to what extent the intensive strike action of 2007 affected student achievement at the primary school level in South Africa. Following an approach by Kingdon and Teal (2010) in estimating union membership effects on learning in private schools in India, an across-subject within-student analysis was used to control for confounding factors that may bias estimates of strike effects. At face value, the results of this estimation strategy suggest that there are heterogeneous impacts of teacher strike participation on student achievement. In the wealthier quartile of schools, where strike participation is less common and the duration of strike action limited, little to no negative teacher strike effects were identified. By contrast, in the poorer three quartiles of schools where participation in the strike was widespread, militant and typically long in duration, strike activity appears to be detrimental to learning. Here a student's test score in a subject taught by a striking teacher was about ten per cent of a standard deviation lower than his or her test score in a subject taught by a non-striking teacher.

These results suggest that industrial action may augment existing inequalities in the provision of education in South Africa. This is reiterated where estimations identify larger strike effects for students attending rural as opposed to urban schools and for students who are weaker academically.

In interpreting the magnitude of the strike participation effect at ten percent of a standard deviation in learning in the poorest three quarters of schools, this was compared to various benchmarks. This exercise provides greater clarity about the implications of the strike for learning, but concurrently raises concerns that the coefficient is overestimated where the identification strategy does not adequately control for unobserved characteristics at the level of the teacher.

Supposing the effect size captures a union membership effect in these schools then this is small in comparison to Kingdon and Teal's union membership effect at negative 0.23 standard deviations. However, in relation to the amount that primary school children typically learn within a year in poorer schools, at thirty percent of a standard deviation (Spaull and Kotze, 2015), the effect size implies that students lost the equivalent of a third of a year's learning in 2007 due to strike action. This is high when on average self-reported days that teachers strike in these schools was only a small fraction of operational school days that year. It is, therefore, acknowledged that the coefficient on the strike participation indicator may be overestimated.

To evaluate the potential sensitivity of the results to omitted variable bias, an approach by Altonji, Taber and Elder (2005) was applied to the results. This approach used selection into strike participation on the basis of observable teacher characteristics to understand how sensitive the results were to selection on unobservable teacher characteristics. In calculating the Altonji bias estimate, the direction of the implied bias is negative and its size is multiple times larger than the observed strike effect of ten percent of a standard deviation in the poorest three quartiles of schools. An inverse relationship between observed teacher characteristics and strike participation in South Africa drives the implied negative bias. At first, this implies that teachers who strike are of lower quality than teachers who do not strike. On further investigation, however, the data do not provide substantive evidence that this is the case. Contrary to expectations, various observed proxies for teacher quality are *positively* correlated with strike participation or the number days a teacher strikes. In particular, there is no observed relationship between strike participation (or the number of days a teacher strikes) and a teacher's content knowledge in a subject. It may be more plausible to assume that striking teachers are less motivated or have lower levels of job satisfaction (Murillo et al., 2002). It is also possible that *observed* teacher characteristics do not provide enough evidence to make conclusions about the influence of unobserved teacher characteristics on the results. This in turn raises questions about the validity of the assumption underlying the Altonji technique in this application, and the conclusions it presents that the estimation results are very sensitive to omitted variable bias.

As an aside finding, a descriptive analysis of the Systemic Evaluation survey of 2007 identified that strike activity disproportionately affects poorer children in terms of their access to school feeding programmes. The very schools that were beneficiaries of the National Nutrition Programme in 2007 also experienced higher levels of school closures for industrial action in 2007 compared with schools without a feeding scheme. This adds another dimension to debates about teachers' 'right to strike' in developing country contexts where child nutrition is dependent on attending school.

This chapter has considered one way in which unions may influence educational outcomes in South Africa, namely through industrial action. However, the influence of teacher unions on the educational landscape extends beyond industrial action; this is the culmination of a much larger process of negotiations and political power plays.

Cowen and Strunk (2014: 3), in a review of the literature on unions in the United States address the obvious reality, equally applicable to the South African context, that teacher unions are prolific, unionisation has grown substantially and that "in short, it is likely that unions are here to stay". The policy discourse should accept this, identifying ways in which teacher unions can be encouraged to embrace their role as professional organisations. This role involves active engagement in teacher development, grappling with issues of teacher retention or how to attract better quality candidates into teaching. It also involves engaging in value-adding research and critical dialogue to support good and well-tested policy-making (Gindin and Finger, 2014). In contrast to 'rent-seeking' behaviour, this role produces the kind of 'efficiency-enhancing' union impacts referred to by Hoxby (1996). It requires that a collective teacher union body assumes the same objective function as parents and the broader citizenry, desiring to maximize student learning, while using their expert knowledge about those inputs and use of inputs that are likely to produce higher student achievement.

However, reshaping the historical ideologies of specifically, SADTU - a teacher union with dominant power in the educational landscape - is unlikely to be an easy feat. Chapter four recognised the historical reality that SADTU was established at a time when their main role was one of a social movement against the unjust policies of apartheid. This prioritised their role as a political body over their function as an organisation concerned with professionalising the teaching force (Chisholm, 1999; de Clercq, 2013). While the overt prioritization of a political agenda over a professional one was commensurate with the aims of SADTU at formation, it is no longer commensurate with the current aims of effective education delivery. A paradigm shift is required in the direction of fulling their role as a professional rather than merely political organisation. This is necessary to addressing critical shortfalls in system capacities to convert input resources into the key outcome of concern, learning. At the heart of current capacity constraints are education personnel, the very agents they represent.

5.4 Using administrative data to inform policy

It is appropriate before concluding the dissertation to highlight the value that administrative data has brought to this research process. Having access to administrative datasets with the support of the Department of Education presented the opportunity to explore aspects of critical importance to education in South Africa. Without having to spend financial resources on additional data collection, the very information that is collected during the course of “business as usual” contributes significantly to a debate on school leadership and policy development. Furthermore, chapters two and three highlight how large scale administrative data, generated by merging different datasets in education and payroll data, presents opportunities for research that *extends* beyond the scope of what is possible with smaller scale survey snapshots. This is particularly the case when exploring school level issues such as management, requiring a larger number of schools for analysis purposes than what is typically collected in school survey data. The power of the data increases substantially where it is integrated to other datasets and the time or panel dimension of the dataset is augmented.

In the appendix chapter entitled “Integrating administrative dataset in education: The case of educator payroll and national data on schools” I provide more discussion on the benefits of administrative data, listing the research questions that could be answered in this dissertation alone using the constructed dataset. The Department of Education and other government authorities are encouraged to establish systems that support research access to administrative data while striving for higher levels of data integrity. With continued access to administrative data of this kind, a significant number of additional research questions of education planning and policy relevance could be addressed.

5.5 Research extensions

A key contribution of this thesis has been to provide a quantitative foundation to inform further work on the principal labour market and teachers’ unions in South Africa. More broadly, the work provides greater specificity to the economics literature on school principals and teacher union effects in a developing country context. Each of the research chapters, but particularly the work on school principals in chapters two and three, naturally lend themselves to more in-depth analysis. Additional analysis and augmentation of the existing school-principal dataset would open up new avenues for research. Mixed methods analysis would also shed light on the topics in question and particularly the strongly interplay that is likely to exist between school leadership and unions. I briefly consider a few possibilities in this regard.

Across both chapters two and three, extending the administrative panel dataset used for the study would support more rigorous quantitative research. Given the intervals of payroll data currently available, school leadership changes could only be identified over four or two year periods. With the availability of payroll data for intermediary years (2007, 2009 and 2011) and subsequent years (2013

and 2014), this would substantially enhance the robustness of the analyses. As more variation is introduced, specifically identifying more leadership changes across time, this assists in the identification of more robust relationships of interest and at the sub-national level. This in turn may provide an indication of how sufficiently the principal leadership succession process is managed by provinces (responsible for the implementation of national policy), if larger negative impacts are identified in some provinces and not others.

The analysis could also be augmented by linking it to educator terminations data which would provide more information to distinguish leadership changes depending on the specific reasons for principal departures. A principal who retires early, for example, may have very different motivations for leaving than a principal who retires at mandatory retirement age. It may also aid in exploring the extent of mobility of principals (and teachers more generally) across the public and private sectors. Alternatively tracer studies that track moving educators would yield interesting insights in understanding the linkages between public and private sector schooling in South Africa.

From an education planning perspective, more recent educator payroll data needs to be used to track age profiles among principals, identifying provincial and district dimensions to the wave of principal retirements that face the country while interrogating reasons for additional principal departures from the system. This may assist districts and schools in preparing for the leadership succession process.

An obvious question that could not be addressed in the thesis is whether the quality of new principal appointees is improving. This is an increasingly pressing question as principal retirements escalate but presents various technical challenges in answering. However, with more years of payroll data the analysis of principal turnover impacts on school performance could be extended to measure the achievement at schools that *will undergo* a principal transition, *are undergoing* a principal transition and *have completed* a principal transition as adopted in Miller's (2013) analysis of principal turnover effects. This would allow one to determine at what point school performance stabilises following the school leadership change and this in turn may provide a suggestion as to whether lower or better quality principals are being appointed on average across the system.

As discussed in chapter two, attention needs to be given to understanding what competencies and expertise distinguish better quality leaders from poorer quality ones. In efforts to improve the appointment process, it is necessary that we have clearer evidence on what characterises good leadership and management and what can be done to stimulate higher levels of performance among school principals. Are there certain conditions that support better leadership and management and how do union and related conflict intersect in the leadership domain? Qualitative studies, akin to the case studies on school management in South Africa by Taylor et al 2012, would contribute significantly to our understanding. Mixed methods research could also support efforts to understand the extent of the

potential crisis we face in finding a suitable pool of replacement principal candidates and in turn exploring strategies to mitigate this potential concern.¹⁰⁹

Furthermore, the persistence of gender disparity in principal leadership requires further interrogation. Additional quantitative work using administrative data could contribute to the existing qualitative literature on gender discrimination in education. For example, data on applications made for promotion posts could provide revealing information on the extent to which suitable female candidates have been overlooked in principal promotions while identifying what proportion of women teachers are actually applying for these positions. This would help target policy interventions at the right point along the teaching career path. Strategies to increase the pool of female candidates may be just as important as addressing discrimination affecting the appointment process.

5.6 Conclusion

A unifying theme across the chapters is that quantifying how school leadership and teachers' unions enter into the production of education is a challenging task. Even where large-scale panel data are available or 'quasi-panels' of survey data can be constructed (using an across-subject within-student approach), it is still difficult to isolate out the contribution of efficiency factors - such as a principal turnover event or strike participation - from other unobserved factors that may also influence learning outcomes.

In further research on how institutional factors and aspects of efficiency influence learning outcomes, it will be necessary to rely on natural experiments to identify exogenous variation in key variables of interest. However, instrumental variables are difficult to come by using administrative data with limited variables. Finding suitable instrumental variables relies, for example, on identifying interesting policy nuances such as the 2005 provincial boundaries changes exploited by Gustafsson and Taylor (2013) in estimating the influence of provincial administrations on school performance. The identification of causal effects could also be supported through lengthening administrative panel datasets, tracking students and teachers over time (and across the system) and linking teachers to the students they teach. Currently, there are no existing datasets in South Africa that both follow teachers over time *and* link them to their students.

Randomised control trials (RCTs) also provide an approach to identifying causal relationships between institutional efficiency factors and learning outcomes, but the external validity of RCTs presents its own challenges. Relevant to this study, Bold et al (2013) in scaling-up a project to implement short-term teacher contracts in Kenya identified that the positive effect on test scores of

¹⁰⁹ It is noted that the recent introduction of monetary incentives for teachers in hard-to-staff schools (in certain provinces) presents an opportunity for exploring whether incentives are effective in altering the dynamics of the principal labour market, attracting a better pool of principal candidates to these schools.

this programme when run by non-government organisations was lost when implemented at scale by the national government. Anticipated positive treatment effects were absorbed in the context of weak public institutions and strong teacher union interactions. These findings are instructive in qualifying the strong attribution that has been given through RCT studies to various interventions and forms of incentives in improving teacher motivation or quality in educational systems. The effectiveness of such treatments must be considered within the context of the strength of public institutions and external political factors.

In this thesis, improving the quality of school leadership has been identified as a ‘treatment’ or route to educational improvement, yet the caution by Bold et al is equally applicable. In chapters two and three, the role of teachers’ unions interweaves into the dialogue in raising the quality of school leadership or influencing how they affect the school environment. While principals can exert influence on the work of teachers, teacher unions can influence the work of both teachers and their school leaders. Similarly, weak administrative institutions and policy design may limit or constrain the influence principals can have in some contexts. Certainly, recruiting a new generation of school leaders provides an opportunity for educational improvement, but realising this opportunity is likely to be dependent not just on increasing the supply of good leaders, but the extent to which their influence is mitigated or enhanced by union control or the strength of administrative institutions.

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Appendix

Integrating administrative datasets in education: The case of educator payroll and national data on schools

Introduction

In the past 15 years there have been important developments in the collection of and access to data on education in South Africa which provides new possibilities for research. For example, schools and students have participated in an increasing number of international and local tests of numeracy and literacy. In addition to the increasing availability of international school survey data, access to local administrative data collected by the Department of Basic Education (DBE) has opened up exciting new avenues for research and improved education planning. Providing a very useful inventory of the available datasets on education in South Africa, Chris Van Wyk (2015) makes the important point that research possibilities are further extended when *integration* between administrative datasets is possible. For example, being able to connect school data to information on individual students, their performance in matriculation examinations or Annual National Assessments and other data on educators opens up opportunities for research that extends beyond the scope of what is possible with smaller scale survey snapshots. This is particularly the case when exploring school level issues such as management, requiring a larger number of schools for analysis purposes than what is typically collected in school survey data.

The following discussion documents a process in integrating some administrative data in education, specifically educator payroll information (referred to as Persal), with other national data on schools. The outcome is a four “wave” panel of schools connected to information on their principals, teachers and student performance measures as captured through matriculation data. This is the main dataset that has been used in chapters two and three of this study. Although this discussion is strongly focused on identifying the process of connecting, specifically, school principals in payroll to national data on schools to support the study, the insights provided are also intended to provide a resource for two groups of people. The first are researchers and education planners interested in pursuing similar research. The second group are administrative personnel involved in data management with the intent of improving education data quality in South Africa.

Integrating payroll data with the EMIS master list of schools

Payroll data of individuals working in the public education sector was made available to the author for the months September 2004, October 2008, October 2010 and November 2012. This was then matched to the EMIS national master list of schools and then to parts of the Annual Survey of Schools data, Snap survey data (available through the Data First porthole) as well as matriculation examination data.¹¹⁰ The most challenging, yet most crucial part of matching payroll data on educators to administrative data is connecting this to the EMIS master list of schools. The EMIS master list of schools is a data table that is available through the DBE (and typically accessible through their website) which contains a number of important identifiers, including the national EMIS number of the school (Van Wyk, 2015). Once a national EMIS number (NatEMIS) can be linked to an educator, then integrating payroll with other administrative data collected by the DBE becomes relatively simple as these datasets typically contain a school's unique identifier.

However connecting payroll data to the EMIS master list is a challenging task. EMIS and payroll data are managed and collated by two distinct national departments and the different datasets were never designed to be used for analyses over time or for linking them together. Simply, payroll data does not directly identify the school at which an educator works by including the associated unique school identifier (NatEMIS). Payroll-school links are only possible more indirectly through matching using two institutional identifiers across the payroll and EMIS master lists of schools. The first is referred to as a *component number* and the second is a *paypoint number*. However, EMIS contains inconsistent and inaccurate 'component numbers' which are not always unique per school and especially not across provinces. They are also not consistent over time, especially with provincial boundary changes in 2005 and the devolution of combined schools resulting in less successful matching of the earlier data. For this reason, it was also necessary to use component description names in payroll and clean these up to be matched to school names in the EMIS master list if matching was not possible using component and/or paypoint numbers.

Connecting principals in payroll to the EMIS master list of schools

A useful place to start in matching payroll data to the EMIS master list is limiting the payroll data to only school principals. If one expects that each school has a principal, then finding the links between the principal in payroll and the school in the EMIS master list is a far more manageable task than piecing together nearly 400 000 educators to school data. Dealing with fewer observations allows one

¹¹⁰ Access to PERSAL data was obtained through the Department of Basic Education in order to assess the degree to which different datasets could be merged with a view to monitoring the movement of staff across schools over time. Access to other non-public datasets were obtained through participation in a research project conducted by The Presidency and titled Programme to Support Pro-poor Policy Development (PSPPD). Assistance from Dr Martin Gustafsson at the Department of Basic Education in understanding the data is much appreciated.

to engage more readily in cross-checking the accuracy of the links. Moreover, linking just one principal to the school will provide the links necessary to connect all of a school's educators in the payroll to a particular school. A second useful approach in this matching process is to exploit data for more than one year to aid the matching process. Provided that data inconsistencies are not consistent over time, then links found in one year can be used to find those links in another year which were initially not identified. With relatively little churning of school principals over time, cross-checking matching links across more than one 'wave' can be executed to identify the accuracy of the links.

Table A.1: Matching Persal to the EMIS master list

	2004	2008	2010	2012
Number of ordinary schools	25 847	25 014	24 761	24 502
School matched to at least one principal	20 531	22 296	22 148	21 939
% of schools matched to at least one principal	79.4	89.1	89.4	89.5
Schools matched to a 'senior' principal	20 359	22 260	22 120	21 808
% of schools matched to 'senior' principal	78.8	89.0	89.3	89.0
Unmatched principals in Persal	2 011	669	205	206
Shortfall of principals to schools	3 305	2 049	2 408	2 357

Source: EMIS and Persal. **Notes:** Principals in the Persal data are identified as such if their rank title specifies that they are a principal. Where there are two or more principals in a school, only the clear institutional leader (identified as having the highest post level ranking among principals in a school or the highest salary) is retained in the sample. Schools are identified as public ordinary schools if they are primary, intermediate, combined or secondary schools.

The number of successful principal to school matches is identified in Table A.1. In each year, the table shows the number of ordinary public schools followed by the number of schools that are matched to at least one principal in payroll. For some schools more than one principal is identified in the payroll but for the purpose of this research the analysis was concerned with identifying the main school leader. A small number of principals that could not be distinguished as the clear institutional leader in a school using the payroll post level rankings or salary indicators are excluded from the analysis. For each year, between 79 to 89 percent of ordinary public schools in EMIS are matched to a clear institutional leader (principal) where more successful matches are possible in more recent years.

How much of the non-matching of schools to a principal is accounted for by principal vacancies?

A puzzling result from Table A.1 is the shortfall of available principals in Persal data to the number of ordinary schools. It is expected that each school should have a principal but in 2012 for example, the best matched set of data, there were a total of only 22 145 (21 939 + 206) principals in the payroll in November yet 24 502 ordinary schools. It is likely that this ten percent shortfall of principals at 2 357 reflects i) principal post vacancies in schools or ii) the unreliability of administrative data links.

Having consulted school surveys as a reference point in identifying leadership vacancies in schools, it is argued that a large proportion of the non-matching is accounted for by the first reason.

The Systemic Evaluation 2007, a nationally representative survey of learning at the grade three level surveyed students, teachers and principals across 2 000 schools at the primary phase level. A principal questionnaire contained the information “are you acting in your current position?” About ten percent of respondents to the principal questionnaire responded that they were ‘acting’ in their current position. In the earlier Systemic Evaluation 2004, a nationally representative survey of schools with students at the grade six level, a similar question was asked. Here as many as 15 percent of respondents to the principal questionnaire indicated that they were ‘acting’ in their position. However, the estimates of vacancies in the Systemic Evaluation questionnaires are possibly over-estimated if non-principals fill out the questionnaire intended for completion by school principals.

Table A.2: Percentage of schools with principal vacancies, School Monitoring Survey 2011

	School type	Mean	Std. Error	95% confidence interval		n
				Lower	Upper	
	All schools	5.8	0.55	4.71	6.88	2 003
Phase level	Primary/Intermediate	4.2	0.61	3.01	5.39	1 198
	Combined	7.86	1.62	4.68	11.04	318
	Secondary	8.23	1.31	5.66	10.8	487
School Wealth	Quintile 1	5.56	0.96	3.67	7.44	651
	Quintile 2	5.19	1.10	3.02	7.35	447
	Quintile 3	7.65	1.26	5.19	10.11	486
	Quintile 4	5.59	1.62	2.41	8.77	221
	Quintile 5	3.27	1.37	0.58	5.96	198

Source: School monitoring survey 2011, principal questionnaire. **Notes:** Weighted estimates. Missing data from principal questionnaire for two schools. School wealth quintiles follow the DBE classification of schools.

The School Monitoring Survey (SMS) 2011, a nationally representative survey of schools, includes a more reliable question on the number of allocated school posts that are vacant, whether at the entry level teacher post or at the position of principal. Nearly six percent of principal posts were identified as vacant, where principal vacancies are more prevalent in secondary schools than in earlier school phase levels as shown in Table A.2. The wealthiest schools (quintile five) also have fewer occurrences of principal vacancies than poorer schools, particularly schools in quintile three. It is noted, however, that a preceding question in SMS 2011 was asked about the number of principal posts that had been allocated to a school. About 85 of 2 004 schools (4.2 percent) with non-missing principal questionnaires reported that no principal post had been allocated to the school. In this respect, vacancies in allocated principal posts to schools are contributing to the shortfall of principals in

linking principals in the payroll to the EMIS master list. It is not unreasonable to assume that at least six percent of the non-matching in the data years 2010 and 2012 is due to a principal vacancy or to the non-allocation of a principal post to a school.

Furthermore, given the large number of ‘acting’ principals identified in the 2004 Systemic Evaluation data, it is also not unreasonable to assume that a larger proportion of the non-matching of the 2004 data is accounted for by principal vacancies. Although using school surveys can provide some useful indication of the extent to which non-matching is attributed to vacancies, this unfortunately does not resolve the problem of distinguishing an actual principal vacancy from other matching constraints.

How does the matching of schools to principals vary across provinces?

Since EMIS and payroll data are collected by provincial departments and only then collated nationally, an obvious question to ask is whether there are differences in matching successes across the datasets by the province in which schools are located. Indeed, there is substantial variation across provinces in the success of matching principals in payroll to the EMIS master list as reflected in Table A.3. Regardless of the year chosen, matching is consistently the worst in the Free State followed by the Eastern Cape. For example, in 2012 only 77 percent of schools in the Free State were successfully matched to a school principal compared with 95 percent of schools in Mpumulanga or 94 percent of schools in the Western Cape.

Table A.3: Successful matching of ordinary schools in EMIS to principals in payroll by province

	2004	2008	2010	2012
Eastern Cape	71.1	85.6	86.1	88.7
Free State	66.9	79.6	86.1	77.4
Gauteng	86.4	91.5	91.5	92.7
KwaZulu-Natal	88.1	91.7	89.1	91.0
Limpopo	80.8	90.5	90.7	86.2
Mpumulanga	76.9	93.5	94.4	95.2
Northern Cape	87.8	85.5	90.2	91.7
North West	81.5	89.4	90.1	90.3
Western Cape	91.9	91.7	93.5	94.2

Source: EMIS and Persal. Cells are highlighted if the matching success rate is lower than eighty percent.

To investigate whether the lower levels of matching in certain provinces is accounted for by higher levels of principal vacancies in schools in these provinces, the School Monitoring Survey of 2011 was consulted again. Contrary to expectations, the occurrence of principal vacancies in the Free State school sample of the School Monitoring Survey is actually quite low when compared against other provinces as shown in Table A.4. This suggests that the matching problems for Free State schools are due to other issues of inconsistent identifier links in either payroll or the EMIS master list of schools.

In the Eastern Cape, however, about six percent of the non-matching observed in the 2010 or 2012 years is likely accounted for by principal vacancies.

Table A.4 Percentage of schools with principal vacancies, School Monitoring Survey 2011

	Mean	Std. Error	95% confidence interval		n
			Lower	Upper	
Eastern Cape	6.43	1.33	3.83	9.04	342
Free State	3.49	1.40	0.74	6.24	172
Gauteng	3.06	1.23	0.64	5.48	196
KwaZulu-Natal	5.82	1.23	3.40	8.24	361
Limpopo	6.25	1.47	3.37	9.13	272
Mpumulanga	5.43	1.68	2.15	8.72	184
Northern Cape	6.57	2.12	2.40	10.74	137
North West	9.94	2.29	5.44	14.44	171
Western Cape	3.57	1.44	0.76	6.39	168

Source: School Monitoring Survey 2011, principal questionnaire. **Notes:** Weighted estimates. There is missing data from the principal questionnaire for two schools in the total School Monitoring Survey sample. The cells are highlighted if the vacancies identified exceed six percent. The denominator in the calculations does not exclude schools where no principal was identified as allocated to the school.

Which schools are harder to match to school principals?

In addition to the differences in matching observed across provinces, it is necessary to note that there are systematic differences in the characteristics of those schools that are matched and not-matched to a principal in payroll. Table A.5 identifies the observed characteristics of these two groups of schools in 2012. Non-matched schools are statistically significantly smaller, both in terms of student enrolment and educator numbers. They are less likely to be in urban schools; they have a larger composition of black students and are more likely to be poorer schools as measured by the DBE quintile rankings. One reason for this could be that these schools are more likely to have principal vacancies. However, it is noted that similar data integration challenges for students in these types of schools are identified by Hendrik van Broekhuizen (2015) in matching higher education management information systems (HEMIS) data to Western Cape matriculation data at the student level.¹¹¹ It is therefore not necessarily higher levels of vacancies in these types of schools driving the non-matching observed, rather increased challenges in collecting reliable data for these types of institutions.

¹¹¹Broekhuizen analyses the trends and underlying correlates of first-time enrolments and graduations in initial teacher education (ITE) programmes in the public higher education system between 2004 and 2013. His paper is another example of informative research to assist education planning processes that is possible when administrative datasets can be integrated together.

Table A.5: Characteristics of matched and unmatched schools in 2012

	Schools matched to a principal				Schools not matched to a principal			
	Mean	Std. Err.	95% CI		Mean	Std. Err.	95% CI	
Lower			Upper	Lower			Upper	
Total school enrolment	501.36	2.570	496.32	506.39	374.77**	7.020	361.00	388.53
No. of educators (SNAP)	16.67	0.083	16.51	16.84	12.514**	0.221	12.08	12.95
School location: urban	0.35	0.003	0.35	0.36	0.29**	0.009	0.28	0.31
Students who are black	0.89	0.002	0.889	0.893	0.934**	0.004	0.009	0.009
Quintile 1	0.34	0.003	0.33	0.34	0.42**	0.010	0.40	0.43
Quintile 2	0.27	0.003	0.26	0.27	0.24	0.009	0.23	0.26
Quintile 3	0.27	0.003	0.26	0.27	0.24	0.009	0.23	0.26
Quintile 4	0.09	0.002	0.09	0.10	0.07**	0.005	0.06	0.08
Quintile 5	0.08	0.002	0.07	0.08	0.05**	0.004	0.04	0.06
	21 746				2 480			

Notes: Pearsal-EMIS dataset. **Mean estimate is statistically significantly different from the matched school sample estimate using a 95 percent confidence interval (CI). Observations differ somewhat from Table A.1 due to missing information in some variables. The denominator in the calculations does not exclude schools where no principal was identified as allocated to the school.

Connecting educators in the payroll to the EMIS master list of schools

Having connected school principals to the EMIS master list, the component links were used to match all other educators to schools. Where the principal-EMIS matching procedure did not identify necessary links, additional matching using component numbers and paypoint numbers was conducted. A satisfactory level of matching was achieved in linking all educators (excluding principals) to schools. Between 94 and 98 percent of educators (excluding principals) were matched to an institution in the EMIS master list of schools as identified in row B of Table A.6. Again the most successful matching was for the later data years, 2010 and 2012, suggesting that there have been improvements in data quality over time.

For the purpose of this study on school principals and principal turnover effects in chapters two and three; however, the teacher population of interest was those that could be matched to school with a matched principal and over multiple years. The dataset on educators used in chapter three to identify the impacts of principal turnover on teacher turnover is limited to those educators matched not only to a school but to a school linked to a principal in four years of data. As a result a maximum of 81 to 85 percent of educators (excluding principals) in payroll data are available for estimations in chapter three.

Table A.6: Matching of other educators (excluding principals) in payroll data to the EMIS master list

		2004	2008	2010	2012
A.	Educators (excl. principals) identified in Persal	335 878	364 803	374 970	387 132
B.	Educators in payroll matched to an institution in EMIS				
	Frequency:	315 885	351 542	366 595	374 111
	Expressed as % of (A):	94.0%	96.4%	97.8%	96.6%
C.	Educators matched to an institution that is matched to a principal in 2004, 2008, 2010 & 2012				
	Frequency:	272 958	316 652	325 095	332 712
	Expressed as % of (A):	81.3%	86.8%	86.7%	85.9%
D.	Educators matched after dropping poor matches from the observations identified in (C).				
	Frequency:	271 835	311 861	321 691	328 724
	Expressed as % of (A):	80.9%	85.5%	85.8%	84.9%

Notes: Educators here refer to teachers, heads of department and deputy principals.

Table A.7: ‘Quick’ checks of the accuracy of matching educators in payroll to the EMIS master list

	2004	2008	2010	2012
Average number of educators in payroll matched to schools (A)	14.18 (10.61)	14.88 (10.69)	15.46 (11.09)	16.03 (11.55)
Average number of educators in a school as per SNAP data (B)	15.27 (11.05)	15.80 (11.61)	16.27 (11.86)	16.61 (12.25)
Correlation coefficient between A and B	0.83	0.93	0.94	0.95

Notes: Educators here refer to teachers, heads of department, deputies and school principals. Standard deviations are in parentheses.

For the set of schools linked to a principal across all four years of data and then matched to other educators in the payroll, a few quick checks of the level of accuracy of the matching was conducted. First, the average number of educators matched to schools using the payroll data is compared to the average number of educators in the school as identified in Snap data. Table A.7 provides a comparison of the results. It shows that the two sets of averages closely follow each other, particularly in the later years of data. The correlation between schools’ educator figures as recorded in Snap and the number of educators matched from the payroll provides another indicator of the accuracy of matching. Correlation coefficients range between 0.83 in 2004 to 0.95 in 2012.

The benefits of an integrated longitudinal dataset

A useful aspect of this dataset is that it is possible to identify not only the static characteristics of educators or schools at one point in time but to understand educator dynamics and the changing nature of schools and their educators. For example, chapter two in this study explored not only whether there

was a change in leadership within schools across years but whether the outgoing principal moved within or out of the public education system and from what ranks the incoming principal was promoted. It is also possible to explore interesting relationships between educators, schools and their students where the ability to identify these relationships is increasingly supported with data that is longitudinal in nature. Extending the length of the data panel adds more power to the analyses of relationships of interest and the possible research questions that can be explored.

This study has identified a subset of a much larger number of possible research questions that can be answered using a dataset of this type. Below is a summary of some of the research questions that have been addressed in this study using the constructed dataset.

- Who has been appointed to assume responsibility for leading schools?
 - What are their demographics?
 - What are their qualification levels and years of experience?
 - How have these characteristics changed over time?
- Do principal characteristics systemically differ across poorer and wealthier parts of the schooling system?
- How long does it take for an educator to be promoted into a principal post? Does this differ across different parts of the schooling system?
- How much principal turnover has there been both in terms of attrition related moves and within system transfers?
- Are the most qualified principals more likely to move out of the public education system than less qualified principals after controlling for other factors?
- Do incentives exist in the system that direct the transfer of principals across schools in ways that aggravate existing inequalities in the distribution of principals?
- Do credentials, as measured in terms of qualifications and experience, provide a signal of principal quality in South Africa?
- Do principal leadership changes in schools pose negative consequences in the short to medium term for school performance?
- How does teacher attrition and mobility respond to changes in school leadership?

Conclusion

In documenting this administrative data integration process, what is clear is that there is still room for improvement with respect to matching payroll to the EMIS master list. There is also room for more ‘cleaning’ of the data and ‘filling-in’ of missing information on variables within datasets. However given time constraints, researchers must reach a point at which they are willing to move forward with analysis rather than achieve mere incremental improvements in data quality. This being said, the

analyst should be well aware of the matching challenges and the possible selection issues that matching deficiencies present for analysis and the estimation of descriptive statistics or causal effects. Moreover, the matching challenges themselves may provide useful insights into the functioning of administrative systems. It is possible that the difficulties or ease of connecting data across different types of schools, districts or provinces provides a proxy for the functionality of parts of administrative departments or even individual school institutions that have a key role to play in supplying quality EMIS data to provinces.

At the administrative level, however, some of the challenges experienced by analysts in integrating datasets could be circumvented. A critical action in this regard is maintaining the integrity and consistency of unique institutional identifiers across educational datasets and ensuring that these unique institutional identifiers are present across all relevant administrative datasets on schooling and even in the payroll data. The payroll data has arguably been under-utilised for education planning purposes where its use is hampered further when it is not easy to connect with school data.

Despite these challenges, the panel dataset described provides another example of how data integration is increasingly enabling large-scale research on education. As a start, this has facilitated a wider study on school principals and, specifically, their movements within and out of the education system which has not been previously possible using school survey data.