

**Essays on the economic and financial challenges
facing South Africa's commodity sector**



**UNIVERSITY OF
CAMBRIDGE**

Gracelin Christina Baskaran

Lucy Cavendish College

This thesis is submitted for the degree of

Doctor of Philosophy

November 2020

Abstract

This thesis is comprised of three standalone articles, each exploring a different dimension of South Africa's platinum group metals (PGM) sector. The PGM sector is an insightful case study given that it is a microcosm of a deeply unequal country, marked by distrust between three distinct spheres – political, business and labor. The first article explores the governance dimension, by examining the extent to which PGM resources revenues have been used to advance economic growth and development. The second article takes an organizational economics approach, examining how firms have responded to endogenous and exogenous supply and demand shocks by shifting their strategies to both protect their core business activities while also meeting the expectations of stakeholders to improve shared-value outcomes. The third article examines the labor economics dimension by exploring how quantitative and qualitative job security vary amongst different sociodemographic groups as the PGM mining sector shifts from labor-intensive to capital-intensive mining through adoption of automated technology.

Article 1

The term 'natural resource curse' is used to describe a potential paradox that natural resource generated wealth could generate weak economic growth, rather than economic prosperity. Literature has shown that natural resources can lead to relatively slow economic growth, inequalities, corruption, embedded poverty and the creation of a rentier state. However, in the case of South Africa, the dual presence of both mineral wealth and the Apartheid legacy makes it difficult to isolate the impact of resources. When excluding petroleum, it is the wealthiest mining jurisdiction in the world, with a non-energy mineral reserved value upwards of US\$2.4 trillion. But South Africa is also home to Apartheid policies, which led to a highly skewed distribution of both land and productive assets and has left behind a legacy of exclusion that has fueled the contestation of resources, slowed growth and fueled corruption. To understand how extraction has affected economic and social outcomes, independent of Apartheid, a sub-national comparison between mining and non-mining provinces is critical. This paper seeks to answer the question 'Is there evidence of a sub-national resource curse in post-Apartheid South Africa?' It answers this question by using four indicators at a sub-national level– two economic dependence indicators (economic growth, contraction of the manufacturing sector) and two governance indicators (education expenditures and access to basic infrastructure). This article finds that there is no indication for a resource curse when examining the economic dependence indicators, but a mild curse when examining the governance indicators, indicating that further policy attention is required on how to address these disparities.

Article 2

With platinum prices declining due to a seismic demand shift and firms grappling with the high cost of labor and prolonged production-stopping labor strikes, the financial sustainability of platinum group metals

(PGM) firms has come under duress since 2012. This article seeks to understand how mining firms have reshaped their business strategies to ensure financial sustainability while also meeting external expectations of increasing shared-value outcomes by assessing how firms are deploying buffers and bridges. Firms use buffers when they seek to protect core business activities from external influences, such as volatile demand and pricing, by shifting their overall business strategy and bridges to conform with external expectations of improve shared value outcomes. The article constructs a case study using five sets of data to assess (i) what supply and demand shocks firms are facing; (ii) how they are reshaping their strategies and undertaking activities to protect the firm from these shocks; (iii) what challenges firms face with reaching shared-value outcomes; and (iv) how firms are undertaking activities to improve shared-value outcomes. This article finds that although buffering activities have been successful at increasing the financial sustainability of mining activities, bridging activities have been less successful given that royalties are vulnerable to maladministration, the impact of corporate social investments often short-lived and insular and local procurement is limited to low value-added activities, particularly in the context of mechanization. This article seeks to contribute to the body of literature on how extractive firms are responding to supply and demand shocks and argues that a paradigm shift may be necessary in which traditional bridging activities become part of protecting core business activities to ameliorate the risk of losing a firm's social license to operate.

Article 3

South Africa's platinum group metals (PGM) sector is undergoing major changes as firms move towards mechanization. In October 2019, Minerals Council South Africa then announced that 90,000 of 168,000 jobs in the PGM sector – or 54 percent of the sector's employment – was now at risk. This article assesses perceptions of quantitative job security, which refers to employees' concerns regarding the continuity of the job, and qualitative job security, which focuses on security about valued aspects of their job, such as training opportunities, ease of communicating with management, and fairness of the promotion process. Using quantitative data from a novel survey, findings show deep disparities in both quantitative and qualitative job security, along the lines of race, gender, and age, suggesting that although quantitative job security is inevitably low given the shift from labor-intensive to capital-intensive mining, there is substantial room for the firm to improve its human resource practices to improve qualitative job security, which is particularly low for black respondents. This article contributes to the body of knowledge on the relationship between labor and automation, and how firms can mitigate the associated challenges, particularly in the South African context where racial tensions are rampant in the post-Apartheid era.

Declaration

This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the Preface (at the end of this declaration) and specified in the text.

It is not substantially the same as any that I have submitted, or, is being concurrently submitted for a degree or diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text. I further state that no substantial part of my thesis has already been submitted, or, is being concurrently submitted for any such degree, diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text.

It does not exceed the prescribed word limit for the relevant Degree Committee.

The second article of this thesis includes some material that I wrote in a publication that I co-authored with Marek Hanusch and Javier Aguilar, for “*World Bank. 2019. Digging Beneath the Surface: An Exploration of the Net Benefits of Mining in Southern Africa. World Bank, Washington, DC. © World Bank.*

Table of contents

Contents

Abstract	2
Declaration	4
Table of contents	5
List of Tables	9
List of Figures	10
Abbreviations	11
Acknowledgements	12
Introduction	15
1.1 Overview of South Africa’s mining sector	17
1.2 Contextualizing the Political Economy of South Africa’s Mining Sector	19
1.3 Contextualizing the Platinum Group Metals Sector.....	29
1.3.1 Overview.....	29
1.3.2 The Political Economy of South Africa’s Platinum Group Metals Sector	30
1.3.3 Market Dynamics	32
1.3.4 Sectoral Dynamics	33
1.4 Structure and Methodology of the thesis	38
1.5 Conclusion	40
Article 1: Is there Evidence of a Sub-National Resource Curse in Post-Apartheid South Africa	42
Abstract.....	42
2.1 Introduction.....	42
2.1.1 Literature Review.....	42
2.1.1.1 Overview.....	42
2.1.1.2 Existence of sub-national resource curses.....	45
2.1.1.3 Deployment of the ‘resource curse’ conceptual framework	46
2.2 Background	46
2.2.1 To what extent is the resource curse seen in South Africa	46
2.2.2 The role of industrial policy.....	48
2.2.3 Non-resource factors that may affect outcomes.....	51
2.2.3.1 A declining manufacturing sector	51
2.2.3.1 Investment landscape	51
2.2.3.1 Economic migrants, urban hubs, and their impact on economic growth.	53
2.2.4 Limitations to the national resource curse approach in South Africa	53
2.3 Methodology	54

2.3.1 Selection of case studies	54
2.3.1.1 Mining Provinces: North West and Limpopo	56
2.3.1.2 Non-Mining Provinces: Gauteng and Western Cape	57
2.3.1 Selection of indicators.....	57
2.3.1 Methods.....	59
2.4 Analysis.....	60
2.4.1 Economic growth.....	60
2.4.2 Dutch Disease and Crowding Out.....	60
2.4.3 Education	62
2.4.4 Access to basic services and infrastructure	65
2.4.4.1 Water.....	65
2.4.4.2 Electricity	66
2.4.4.3 Toilets	67
2.4.4.4 Internet	67
2.5 Discussion	68
2.5.1 Mining revenue mobilization to finance development.....	69
2.5.2 The use of public-private partnerships to finance development	71
2.4.1 Reducing exposure to sub-national revenue volatilities.....	72
2.5 Conclusion	73
Article 2: Firms' Approach to Bridging and Buffering to Mitigate Risks in the Platinum Group Metals Sector	75
Abstract.....	75
3.1 Introduction.....	75
3.1.1 Background	75
3.1.2 Impact of Technological Changes on PGM demand	76
3.1.3 Literature Review.....	77
3.1.4 Literature Gap	78
3.2 Methodology	79
3.2.1 Methods.....	81
3.3 Analysis.....	82
3.3.1 Supply and demand risks that require buffering	82
3.3.1.1 Supply-side risk: High labor volatility	82
3.3.1.2 Supply-side risk: High labor costs	84
3.3.1.3 Demand-side risk: Shift in global demand.....	85
3.3.2 Buffering Strategies	87
3.3.3 Risks that Require Bridging.....	88
3.3.3.1 Land encroachment	89

3.3.3.2 Environmental consequences	90
3.3.3.3 Health consequences	91
3.3.3.4 Pressure to improve shared value outcomes	91
3.3.4 Bridging Strategies.....	92
3.3.4.1 Royalties	92
3.3.4.2 Corporate social responsibility.....	93
3.3.4.3 Local Procurement	94
3.4 Discussion	95
3.5 Conclusion	96
Article 3: An analysis of quantitative and qualitative job security amidst widespread mechanization in South Africa’s platinum group metals sector.....	99
Abstract	99
4.1 Introduction.....	99
4.1.1 South Africa’s Employment Background	99
4.1.2 Historical Risk	100
4.1.3 How mine workers have handled risk.....	103
4.1.4 The mechanization of South Africa’s mining sector.....	105
4.1.5 The impact of mechanization on labor.....	106
4.1.6 Gap in Literature	108
4.2 Methodology	109
4.2.1 Methods.....	113
4.3 Analysis.....	114
4.3.1 Quantitative Job Security	114
Impact of automation/technology on job security.....	114
4.3.2 Qualitative job security	115
4.3.2.1 Training.....	115
4.3.2.2 Promotions	117
4.3.2.3 Open Communication	119
4.4 Discussion	120
4.5 Conclusion	122
Chapter 5: Conclusion	125
5.1 Summary of findings.....	125
5.2 Policy implications.....	127
5.3 Areas for future work.....	129
References.....	132
Appendix 1	145

List of Tables

Table 1: Key mining industry statistics in South Africa, 2002-2018.....	19
Table 2: Common mineral ownership models	26
Table 3: Percentage distribution of the population by place of birth and province	53
Table 4: Indicators for assessing resource abundance and dependence.....	55
Table 5: Mining sector contribution to provincial GDP (constant prices).....	56
Table 6: Potential indicators for assessing a resource curse	58
Table 7: Provincial real GDP, millions of rand.....	60
Table 8: Sectoral contributions to real GDP, 2001-2008.....	61
Table 9: Growth rates in in sectoral contributions to real GDP, 2001-2008.....	62
Table 10: Share of education expenditures in provincial education budgets	63
Table 11: Fiscal revenue from the South African mining sector	69
Table 12: European Union’s digital infrastructure subsidy model	72
Table 13: Cost competitiveness of PGM mines.....	84
Table 14: Palladium deposits at various PGM mines	88
Table 15: Impact of automation on quantitative job security, disaggregated by race and age	114
Table 16: Impact of automation on quantitative job security, disaggregated by gender and race	115
Table 17: Impact of training on firm loyalty, disaggregated by age and racial groups	117
Table 18: Impact of training on firm loyalty, disaggregated by gender and racial groups	117
Table 19: Fairness of promotions, disaggregated by age and race.....	118
Table 20: Fairness of promotions, disaggregated by education level	119
Table 21: Fairness of promotions, disaggregated by gender.....	119
Table 22: Perceptions of consequences for communicating concerns, disaggregated by race	120
Table 23: Perceptions of consequences for communicating concerns, disaggregated by educational attainment.....	120

List of Figures

Figure 1: Distribution of Minerals Amenable to ASM Activities.....	28
Figure 2: Import/export data for mining machinery	35
Figure 3: Structure of the thesis	38
Figure 4: Sectoral contributions to national real GDP, 1993-2017.....	47
Figure 5: Domestic v Foreign Acquisitions, made by South African Investors	52
Figure 6: The SACCI Business Confidence is indicative of the market-related business climate, 2010-2019	52
Figure 7: Assessing provincial resource dependence in South Africa, 2017	56
Figure 8: Secondary school dropout rates, 2016.....	64
Figure 9: Share of population without any schooling	64
Figure 10: Distribution of learners, educators and schools in the independent school funding type, as a percentage of provincial totals, 2016	64
Figure 11: Access to safe drinking water.....	66
Figure 12: Access to electricity.....	66
Figure 13: Access to flush or chemical toilet.....	67
Figure 14: Percentage of households with access to the Internet at home, or for which at least one member has access to, or used the Internet any place via a mobile cellular phone.	68
Figure 15: Sources of provincial government revenue for 2016/7.....	70
Figure 16: Sources of revenue for Cape Town Municipality (2018/9).....	70
Figure 17: Impact of 2014 Industrial Action on Mine Revenue	83
Figure 18: Perceptions of labor regulations/employment agreements and labor militancy/work disruptions	84
Figure 19: Share of PGM mines that were loss making by 2015.....	84
Figure 20: Production costs of PGM Mines.....	85
Figure 21: Impact of Chinese emissions standards on PGM demand.....	86
Figure 22: Platinum prices between 2008 and 2020	87
Figure 23: Palladium prices between 2008 and 2020	87
Figure 24: Impact of PGM mining on communities across the life of a mine.....	89
Figure 25: Sample response to communication question.....	113

Abbreviations

AMCU	Association of Mineworkers and Construction Union
AMD	Acid Mine Drainage
Amplats	Anglo Platinum
ANC	African National Congress
ATM	Automated Teller Machine
CAGR	Compound Annual Growth Rate
CAPI	Computer Assisted Personal Interviewing
COSATU	Congress of South African Trade Unions
CS	Community Survey
CSR	Corporate Social Responsibility
DBE	Department of Basic Education
DMRE	Department of Mineral Resources and Energy
EITI	Extractive Industries Transparency Initiative
ESG	Environmental, Social, and Corporate Governance
GDP	Gross Domestic Product
HDSAs	Historically Disadvantaged South Africans
HIV	Human Immunodeficiency Virus
HS Code	Harmonized System Codes
IFC	International Finance Corporation
Implats	Impala Platinum
MPRDA	Minerals and Petroleum Resources Development Bill
MSME	Micro, Small & Medium Enterprises
NUM	National Union of Mineworkers
PGM	Platinum Group Metals
R&D	Research and Development
RDO	Rock Drill Operator
S&P	Standard and Poor's
SA	South Africa
SLO	Social License to Operate
TB	Tuberculosis

Acknowledgements

First and foremost, I would like to thank Dr Shailaja Fennell, who was my supervisor for both my MPhil and PhD. Her guidance, thoughtfulness and sense of humor have shaped my journey over the last five years, and I am immensely grateful for that. She has given me both the freedom and space to challenge conventional ideas while encouraging my interest in research-driven policymaking.

I am thankful to Dr Richard Sidebottom, who has been an excellent sounding board throughout my PhD and provided invaluable guidance on conceptualizing the thesis, from start to finish. Sincere thanks to Tony Addison, whose mining expertise and feedback added value to this thesis.

Conducting research in the mining sector in the aftermath of the Marikana Massacre was no small undertaking. I am deeply indebted to those who helped me collect the 12 sets of data that this thesis draws in. Sincere thanks to Brian Kidson and Thinus Ferreira at Anglo Platinum. Brian went to extraordinary lengths to help me secure data, including accompanying me to mines in remote areas and crawling underground with me. I am grateful for William Mdluli from Impala Platinum, who took me underground and was a sounding board throughout my fieldwork. I am also thankful for Chris Prinsloo at Impala Platinum and Katlego Mabote from Anglo Platinum, both of whom helped me secure invaluable data; Inez McGregor from the South African Historical Archives, for helping secure historical data on South African mining labor; and Professor Lawrence Hamilton, for providing a research exchange at the University of Witwatersrand.

This PhD would not have been possible without the financial support from the Cambridge Political Economy Society, who generously provided me with a full scholarship for four years to undertake my PhD. I am also thankful to the Smuts Memorial Fund, Mary Euphrasia Mosely Grant, Lucy Cavendish College and POLIS, all of whom provided additional funding for field work and to present this research at conferences in London, Seoul, Harare and Vienna.

My sincere gratitude to those who shaped my PhD journey profoundly, both professionally and personally. I am thankful to Tirelo Molotlegi from the Royal Bafokeng Nation, who has been a dear friend and sounding board throughout this research; Wandile Sihlobo who has been a close friend, brilliant intellectual sparring partner and someone I have been privileged to collaborate and co-author various pieces on economic policy; and Marek Hanusch, who first hired me at the World Bank and has been a mentor in the deepest and truest sense. I am grateful for friends and colleagues that made the PhD journey more enjoyable, including Scott Sheridan, Eileen Nugent, Ali Farazhenafar, Kiryl Zach, Luke Withey, Jaysen Sutton, Barry Maher, Tijs van den Brink, Michael Elliott, Stephanie Craig and Jostein Hauge. Their friendship and encouragement were central to completing this thesis.

I am thankful to my parents, Mark and Inthumathi. My dad taught me what a strong work ethic looks like and I am grateful that he instilled the importance of being a lifelong learner. I am also very grateful to my

grandmother, Nalini, who, despite spending her life in a village in India, was deeply passionate about education. I am honored to be her granddaughter and thankful that she modelled what being a strong and independent woman looks like.

And finally, I owe an enormous amount of gratitude to Greg, Sarah, Vivian and Winston Knight – my ‘Cambridge family.’ Thank you for your endless encouragement, laughter, and joy over the last five years. You have given me a sense of home and for that, I am most grateful. I am indebted for the many meals, cups of tea and coffee, late night chats and reminders that I need to finish my PhD. It’s finally done!

Introduction

This thesis is comprised of three standalone articles, each exploring a different dimension of South Africa's platinum group metals (PGM) sector. The PGM sector is an insightful case study given that it is a microcosm of a deeply unequal country, marked by distrust between three distinct spheres – political, business and labor. The first article explores the governance dimension, by examining the extent to which PGM resources revenues have been used to advance economic growth and development. The second article takes an organizational economics approach, examining how firms have responded to endogenous and exogenous supply and demand shocks by shifting their strategies to both protect their core business activities while also meeting the expectations of stakeholders to improve shared-value outcomes. The third article examines the labor economics dimension by exploring how quantitative and qualitative job security vary amongst different sociodemographic groups as the PGM mining sector shifts from labor-intensive to capital-intensive mining through adoption of automated technology.

This thesis acknowledges that a single commodity affects different stakeholders differently. The author has not come across research offering a multi-stakeholder analysis of a single commodity in other countries or commodities. South Africa is the wealthiest mining jurisdiction in the world, when excluding petroleum with reserves upwards of \$2.4 trillion, so it's an important mining market, though not mining-dependent, PGMs recently surpassed coal as the largest contributor to national mining revenue, generating 28% of the country's mineral revenue. PGMs also account for 36.5 percent of all mining employment, nearly twice the next highest contributor, coal (20.4 percent). And PGMs are the biggest contributor to mining exports (25.6 percent), Thus it's a key commodity in one of the biggest mining markets in the world, making it an important commodity, both from an economic and utility point of view, given its role in automotive – and a stakeholder analysis at this level of depth has never been done before.

The need for the stakeholder analysis was largely a gap that needed filling after the author saw the impact of the Marikana Massacre that took place in 2012 – it triggered a cataclysmic shift within the sector, and it was always the elephant in the room while doing field work. But firms, workers, communities, and government interviews signaled that it changed labor relations, government-firm and worker-community relations in a permanent way. To dissect that, the author needed to go in and analyze these challenges through the lens of different stakeholders.

Article 1

The term 'natural resource curse' is used to describe a potential paradox that natural resource generated wealth could generate weak economic growth, rather than economic prosperity. Literature has shown that natural resources can lead to relatively slow economic growth, inequalities, corruption, embedded poverty and the creation of a rentier state. However, in the case of South Africa, the dual presence of both mineral

wealth and the Apartheid legacy makes it difficult to isolate the impact of resources. When excluding petroleum, it is the wealthiest mining jurisdiction in the world, with a non-energy mineral reserved value upwards of US\$2.4 trillion. But South Africa is also home to Apartheid policies, which led to a highly skewed distribution of both land and productive assets and has left behind a legacy of exclusion that has fueled the contestation of resources, slowed growth and fueled corruption. To understand how extraction has affected economic and social outcomes, independent of Apartheid, a sub-national comparison between mining and non-mining provinces is critical. This paper seeks to answer the question ‘Is there evidence of a sub-national resource curse in post-Apartheid South Africa?’ It answers this question by using four indicators at a sub-national level— two economic dependence indicators (economic growth, contraction of the manufacturing sector) and two governance indicators (education expenditures and access to basic infrastructure). This article finds that there is no indication for a resource curse when examining the economic dependence indicators, but a mild curse when examining the governance indicators, indicating that further policy attention is required on how to address these disparities.

Article 2

With platinum prices declining due to a seismic demand shift and firms grappling with the high cost of labor and prolonged production-stopping labor strikes, the financial sustainability of platinum group metals (PGM) firms has come under duress since 2012. This article seeks to understand how mining firms have reshaped their business strategies to ensure financial sustainability while also meeting external expectations of increasing shared-value outcomes by assessing how firms are deploying buffers and bridges. Firms use buffers when they seek to protect core business activities from external influences, such as volatile demand and pricing, by shifting their overall business strategy and bridges to conform with external expectations of improve shared value outcomes. The article constructs a case study using five sets of data to assess (i) what supply and demand shocks firms are facing; (ii) how they are reshaping their strategies and undertaking activities to protect the firm from these shocks; (iii) what challenges firms face with reaching shared-value outcomes; and (iv) how firms are undertaking activities to improve shared-value outcomes. This article finds that although buffering activities have been successful at increasing the financial sustainability of mining activities, bridging activities have been less successful given that royalties are vulnerable to maladministration, the impact of corporate social investments often short-lived and insular and local procurement is limited to low value-added activities, particularly in the context of mechanization. This article seeks to contribute to the body of literature on how extractive firms are responding to supply and demand shocks and argues that a paradigm shift may be necessary in which traditional bridging activities become part of protecting core business activities to ameliorate the risk of losing a firm’s social license to operate.

Article 3

South Africa's platinum group metals (PGM) sector is undergoing major changes as firms move towards mechanization. In October 2019, Minerals Council South Africa then announced that 90,000 of 168,000 jobs in the PGM sector – or 54 percent of the sector's employment – was now at risk. This article assesses perceptions of quantitative job security, which refers to employees' concerns regarding the continuity of the job, and qualitative job security, which focuses on security about valued aspects of their job, such as training opportunities, ease of communicating with management, and fairness of the promotion process. Using quantitative data from a novel survey, findings show deep disparities in both quantitative and qualitative job security, along the lines of race, gender, and age, suggesting that although quantitative job security is inevitably low given the shift from labor-intensive to capital-intensive mining, there is substantial room for the firm to improve its human resource practices to improve qualitative job security, which is particularly low for black respondents. This article contributes to the body of knowledge on the relationship between labor and automation, and how firms can mitigate the associated challenges, particularly in the South African context where racial tensions are rampant in the post-Apartheid era.

1.1 Overview of South Africa's mining sector

When excluding petroleum, South Africa is the wealthiest mining jurisdiction in the world, with a non-energy mineral reserved value upwards of US\$2.4 trillion. Historically, mining has been a key driver of economic growth. The Johannesburg-Pretoria metropolitan area, which functions as the region's financial and economic hub, developed on the back of the local gold supply (World Bank, 2019). After gold was first discovered on a farm in 1886, the region became the largest gold producer in the world. Within a decade, a large town had called Johannesburg developed around the gold mining industry. This town grew to become South Africa's largest city within twenty years.

Since 2008, the mining industry in South Africa has faced a variety of shocks that have hindered the industry's growth and overall performance. Internationally, the 2008 global financial crisis caused a major economic slowdown that weakened global demand while locally, the country has faced various economic issues including unfavorable rand exchange rate, strict mining regulations, infrastructure constraints and rapid increases in input prices, particularly electricity and labor costs.

Overall, mining's share of total GDP shrunk substantially, from 21.3 percent in 1980 to 7.3 percent in 2019 (Statistics SA). However, despite the fact that the sector's contribution to national GDP has fallen to single-digit numbers, it remains a central component of South Africa's economy (Department of Trade and Industry, 2020). The mining sector has also been prioritized in the Government of South Africa's Covid-19 Recovery and Reconstruction Plan. This is partially for the livelihood benefits generated by the sector. Although the number of people employed in the mining industry has dropped steadily from 518,725 people

in 2008 to 456,438 people in 2018, representing only 6.2 percent and 4 percent of total private non-agricultural employment and total non-agricultural employment, respectively, each worker directly employed by the sector supports ten dependents. As a result, in 2017, the mining industry alone supported an additional 4.5 million dependents (Minerals Council 2018; 2019a). Additionally, each mining job indirectly creates two additional jobs in downstream supporting industries (Kane-Berman, 2018). When accounting for those directly employed by the sector as well as the dependents they support, approximately 10 percent of South Africa's population is reliant on the mining sector for livelihoods.

The mining sector is also an important contributor to exports, investment, and government revenue. In 2018, the mining sector contributed R350 million or 7.3 percent to national GDP and accounted for 26.7 percent of total exports. Over the same period, the mining industry contributed R91 million to fixed investment, which constituted 15 percent of private sector fixed investment and 10 percent of total investment, respectively. Another way that the mining industry contributed is to national revenues via royalties and company tax, as well as personal income tax and various indirect taxes such as value-added tax (VAT). In the 2017/2018 fiscal year, the mining industry paid R7.6 billion in royalties, R22.0 billion in company taxes and R21.0 billion in income taxes (Minerals Council, 2019a).

Table 1: Key mining industry statistics in South Africa, 2002-2018

Description	2002	2004	2006	2008	2010	2012	2014	2016	2018
Gross domestic product									
Mining's share of total GDP (in real terms) (%)	7.2	7.0	6.4	8.5	8.4	7.7	7.5	7.3	7.3
Fixed investment									
Direct contribution of mining to fixed investment (in nominal terms) (R millions)	19,802	17,917	27,715	59,084	63,555	72,106	85,615	53,864	91,098
Mining's share of private sector fixed investment (%)	15.7	10.8	11.7	16	19	18	17	10	15
Mining's share of total investment (%)	11.5	7.9	8.6	11	12	12	11	6	10
Sales and exports									
Total primary mineral sales (in nominal terms)	139,452	125,307	194,358	300,763	300,891	363,757	386,350	424,042	498,706
Primary mineral exports as share of total South African exports (%)	26.8	22.7	24.3	34.6	33.9	33.1	26.8	26.4	26.7
Employment									
Mining industry direct Employment	415,988	448,909	456,337	518,725	498,907	524,869	492,931	458,291	456,438
Mining's share of total private non-agricultural employment (%)	10.3	8.8	7.3	8.1	8.2	8.1	7.4	6.5	6.2
Mining share of total non-agricultural formal employment (%)	7.5	6.7	5.8	5.1	5.2	5.1	4.6	4.2	4.0

Source: Minerals Council SA

1.2 Contextualizing the Political Economy of South Africa's Mining Sector

1.2.1 Effect of Apartheid on mining

The Apartheid government facilitated the expansion of capitalist production by restructuring the occupational division of labor. Nearly all underground mining operations were run by skilled white miners and unskilled black workers (Crankshaw, 1996:38). Apartheid-era legislation and institutional structures reinforced the demarcation between skilled white workers and non-skilled black workers. One example was The Mines and Works Act of 1911, often referred to as the “Color Bar,” which was created to keep segregation in place by making skilled labor exclusively available to whites. This came partially as a result of mine owners preferring to hire black workers, because they were cheap labor and because black workers were paid the same wage, regardless of the work they undertook (Powell et al, 2016). Additionally, black miners were forced to work in degrading and inhumane conditions (Crush and Tshireke, 2001).

Intermittent contracts obliged black mine workers to abandon their families and be housed in cramped single-sex compounds, while earning an extremely low real wage that did not rise for at least two generations (Wilson, 2001).

The bifurcated labor structure was partially rooted in a fear. In January 1981, a newspaper article noted that “Any further tampering with white (mine) workers’ rights in favor of blacks and the scrapping of Apartheid on any level would be strongly resisted and would force them to resort to a general strike.” This came after Mr. P. C. C. de Jager, president of the Mineworkers Union, urged white workers in the industry to join a general strike if blacks were granted blasting certificates, racially mixed unions were forced on whites, and more rights were granted to black workers. de Jager went on to threaten the government,

I want to warn the government that if it tampers with the Mines and Works Act, thereby granting black blasting certificates, the results flowing from this will solely be the responsibility of the state – and specifically, I am thinking of a repeat of 1922. If blacks can get blasting certificates, there are no reasons why they cannot be mine captains and shift bosses. And then no white will be sure of his job any longer, and no one left to fight for the future of your children.¹

The event of 1922 referred to by de Jager was the Rand Rebellion, an armed uprising of white miners in the Witwatersrand region of South Africa. Triggered by a fall in gold prices, companies cut their operating costs by decreasing wages and weakening the Colour Bar to enable the promotion of cheap black miners to skilled and supervisory positions.

This attitude was pervasive for much of the twentieth century. In the early 1980s, The White Miner Workers’ Union vehemently came out against any job advancement for blacks, with the head of the union calling his men out to protest the promotion of two colored men to jobs previously done by whites.

Though the unions protested, mining firms preferred black migrant labor – it was cheap and they protested less than black South Africans. In 1974, the Chamber of Mines reported that the mining industry was experiencing an “almost embarrassing flood” of black work seekers owing to rising unemployment. It also noted that these job seekers were being turned away in “considerable numbers” because the mines, with the support of the governments, preferred to hire a quarter of a million foreign workers. A newspaper article entitled “The Unwanted: SA’s Jobless Blacks” added that the South African mining industry was doing recruitment in countries such as Malawi and Angola, rather than hiring domestically. This was largely because the mines had to find or create a labor supply where they were competing neither with peasant agriculture nor with higher paying industrial jobs. In Southern Africa, this took the form of migrant labor, where workers had a link with a rural land base. This allowed mining firms to buy black labor of the peasant-worker class below value, since subsistence requirements of the worker and his family was produced outside the sphere of capital production. In 1980, South Africa’s Department of Cooperation and

¹ Article entitled ‘Mineworkers warn govt over black rights,’ published on January 20, 1981 and located in the South African Historical Archives.

Development announced that there were 320,232 Lesotho nationals working in South Africa's mining industry – this accounted for nearly half of all mining employment.² And wage suppression enabled increased profitability for firms. When gold prices were \$35 per ounce in the 1960s, there was a view that cheap migrant labor was needed and preferable to closing mines. However, a nine-fold increase in gold prices in the 1970s did not translate to an increase in wages for black gold miners, who earned less than \$35 per week. A newspaper article available in the historical archives argued that the “Industry still has no doubts that for a variety of economic, strategic and security reasons, it is right to keep recruiting foreign workers from neighboring African countries at the expense of South Africans.”³

But even as firms recruited black labor for low skill jobs, there was a perception that black workers inherently had low productivity. In 1943, the Chamber of Mines concluded that “the native laborer underground as an individual was no more efficient than he was 30 years ago” (Wilson, 1972:96-97).

The simple idea that the black labor force consisted not of an undifferentiated mass of black labor units but individual, sometimes bewildered, human beings who would respond to training and opportunities for advancement took a long time to sink into the minds of men who lived in the social environment of South Africa. (Wilson 1972:94).

One of the most critical steps towards improving labor efficiency came in 1945, with the introduction of a system to grade recruits, based on their abilities, before training them. Prior to this, black labor had been viewed as an undifferentiated mass of interchangeable units – it was essentially a throw of the dice that decided whether a man would spend his life sweeping the floors or operating a mechanical scraper. This made the job placement process a matter of luck and chance. In 1947, the Government Mining Engineer revealed that on an experimental basis, one gold mine was developing tests to improve efficiency of labor allocation. In 1948, with a new hiring wave of 75,000 recruits that had no prior mining experience, the Government Mining Engineer pointed out that although the aptitude testing was in its infancy stage, the results were promising and that further experimentation would likely yield positive results (Wilson, 1972). By the mid-1960s, there was pressure to build the supply of skilled labor. The industry had a shortage of about 2,000 miners, when led to a vacancy rate of nearly 5 percent. Thus, some mining firms began to examine the possibility of allowing black ‘boss boys’ to take over some of the supervisory functions of white ‘gangsters’ (Crankshaw, 1996). By 1967, 45 mines had tested two million recruits. The tests placed men into three categories: potential “boss boys,” potential semi-skilled workers, and those who scored poorly on education and intelligence tests were put into an unskilled labor group (Wilson, 1972).

² Article entitled ‘Basotho travel clampdown,’ published on February, 1, 1980 and located in the South African Historical Archives

³ Article entitled ‘The Unwanted: SA’s Jobless Blacks’ located in the South African Historical Archives (n.d.).

Apartheid era policies hampered efficient labor management and by extension, productivity. There are two important elements of labor management: allocating the labor in an optimal manner, and ensuring that the labor, once allocated, reaches its full potential. While firms tried to achieve both goals, it was difficult to allocate labor efficiently given legal barriers on hiring non-whites. In terms of enabling workers to achieve their full potential, there are three key factors affecting this: their experience in that job, the incentives provided for harder and better work, and the degree to which employees feel that they are a part of the larger enterprise.

One indicator for assessing experience within a firm is turnover rate. And turnover amongst black workers was very high, partially because firms generally provided short contracts and could justify wage suppression by arguing that it was not their permanent livelihood. In 1954, the Gold Producers Committee of the Transvaal Chamber of Mines gave the following evidence to the Theron Commission:

It is the young unmarried native who makes up the bulk of the Mine Native laboring force and the number of times native comes forward for employment on the mines rarely exceeds ten. After completing several (short) contracts on the mines he would, in due course, settle down at home as a married man and useful member in a farming community. His various contracts on the mines will have led to an increase of flow of money to the Native areas, thus benefitting the community in which the Native Laborer resides.⁴

In terms of workers' incentives for harder and better work, there were relatively few for black workers during the Apartheid era. The Colour Bar kept a low maximum wage for black workers and a high minimum wage for white workers, thus augmenting wage suppression and reducing the incentive to work hard.

And finally, when it came to the degree that workers felt like a larger part of the enterprise, there was improvement over time during the Apartheid era. Employers began to understand the value of effective personnel management. Firms made a stronger effort to welcome workers, show them around, and help acclimate them to the new work environment. In September 1954, the Transvaal and Orange Free State Chamber of Mines prepared a course in Native Administration to address common errors encountered in the daily handling of natives and suggestions on correct procedures to help make black workers feel welcome.

It is probably an apparent lack of sympathy, possibly quite unconsciously conveyed, that has been the cause of engendering a great deal of resentment among the individuals of the Native labor force. It is not possible to stress too greatly the natural fears and doubts which individuals, miles away from their homes and in completely strange surroundings, must feel. If we add to this emotional stresses that they undergo, their need for sympathetic handling should be apparent. Requests should, therefore, be carefully be considered, and, should they not be readily allowable, the reasons for declining them should be carefully explained. A brusque refusal, without adequate explanation, would invariably be regarded as inconsiderate, if not unjust, and would, at best result in personal dissatisfaction, the ultimate effect of which might well persuade the laborer to seek employment elsewhere.⁵

⁴ Neil Coleman Collection, South African Historical Archives

⁵ Neil Coleman Collection, South African Historical Archives.

Still blacks did not receive the same treatment. The migrant labor system coupled with the nature of transactional contracts made it difficult to reduce turnover rates below 100 percent per year. Because long periods of time often lapsed between contracts and technology and organizational practices were constantly changing, it was difficult for workers to pick back up where they left off. Turnover was costly; in 1941, for every 20 percent of turnover, it cost the industry 1 percent of the total wage bill. Since there was no labor union to represent the interests of black miners and firm management perceived that they were unable to directly collaborate with black workers, there was little to no conversation between top management, who were white, and a large number of miners, who were black (Wilson, 1972). Research shows a strong positive link between job insecurity and turnover; employees are more likely to withdraw from stressful situations and feel less loyalty to employers who cannot ensure security (Cavanaugh and Noe, 1999; Ashford et al, 1989; Cheng and Chan, 2008). The absence of a black labor union made the concept of bargaining with employers for higher wages was non-existent. And gold mine workers around Johannesburg were suffering for it. In 1959, one year before the infamous Sharpeville Massacre took place, a study on the economic well-being of blacks living there found that 80 percent lived at or below the poverty line. This was even lower than Soweto, the notoriously poor township in Johannesburg, where 68 percent earned less than the living cost

The tension turned fatal at various points of the twentieth century. In September 1973, police opened fire at a strike at Western Deep Mine. An article after the shooting noted:

Wage grievances do not usually result in riots, though ugly scenes are not uncommon. Yet a fatal riot developed at Western Deep. Why? Did the miners turn to violence because communication with management were inadequate? Does this riot in any way reflect a growing alienation of black workers from their employers and from an economic system which separates them from their families and houses them in single-sex compounds? Perhaps the malaise goes even deeper. It could even reflect a sense of alienation from a society in whose bargaining processes, industrial and political. Black workers have virtually no voice.⁶

Apartheid played an immensely influential role in shaping the present-day mining sector. The third article of this thesis shows how many of the challenges facing black workers between the 1940s and 1990s - including 'Apartheid of speech,' wage frustrations and promotion difficulties - are still experienced by black workers today. And they are experienced by black workers in disproportionately higher levels than white workers, indicating that in many ways, the Apartheid legacy is still active in the mines. Understanding how deeply historically embedded these dynamics are is important to understanding why mines have begun shifting away from labor-intensive operations.

⁶ Article entitled "After the Shooting" published on September 14, 1973 and located in the South African Historical Archives.

1.2.2 The role of the minerals-energy complex in development

The South African minerals-energy complex (MEC) is largely accepted as a barrier to equitable development (Sharife and Bond, 2011). The MEC is an accumulation of several key sectors – mining, energy, financial and a number of associated sub-sectors of manufacturing – that has played a determining role on the pattern of industrialization and macroeconomic performance. The development has been shaped by the relationship between English and Afrikaner fractions of capital through the state, and have played a key role in the development of a conglomerate form of corporate structure (public and private) that straddles the encompassed sectors. Rustonjee (1993) argues that the MEC precluded the adoption of industrial policies to promote diversification away from non-MEC sectors. Over time, the MEC has been shown to cripple diversification, both institutionally and sectorally and congregate growth in a narrow set of sectors. Thus, growth of large-scale capital came in MEC sectors and via a conglomerate form, that impeded diversification (ibid).

Fine and Rustonjee (1997) argue that the MEC is a system that can be traced back to the emergence of mining in the 1870s and remains evident to present day. The impact of the MEC is still seen through the lack of legalization of artisanal and small-scale mining and government's commitment to coal mining as a form of energy. During the course of this research, interviews were carried out with the Council of Geosciences and Department of Mineral Resources and Energy. There was a consistent aversion to diversifying away from a reliance on coal, given the substantial endowments of it even though the banks (both commercial and multilateral), do not finance it. In fact, there was a strong argument that the lack of financing for coal would cripple low and middle-income countries such as South Africa. Thus, it could be argued that though the MEC, first emerged 150 years ago, created a sense of path dependency. Despite some degree of economic diversification, the conglomerate structure and preference for coal (despite a global push for renewables), indicate that some elements of the MEC persist.

1.2.3 Labour unions

The Communist Party of South Africa (CPSA) played an important role in building the trade union movement in the 1940s. It set up the Congress of Non-European Trade Unions (CNETU) which claimed a membership of 158,000 workers in 119 affiliated trade unions by 1945. Between the 1930 and 1960, there were many attempts to create a strong labor union movement. However, the movement was vulnerable and faced a myriad of challenges including: (i) the African working class primarily lived in towns, which made organization difficult and fragmentation pervasive. A high turnover of jobs; (ii) migrant workers were difficult to organize because they were inherently unstable due to short-term contracts that forced them to return to the homelands when their contract ended. Subsequent contracts were often in different locations; and (iii) unions for black workers were not recognized and strikes were illegal. The government reacted harshly towards any kind of union activity from them. Black workers were also not allowed access to industrial councils where important decisions were made (white unions were active in the councils. Black

workers were also not allowed to sit at wage board determinations. Racially mixed labor unions were prohibited. And the Minister of Labour had the right to reserve any job for a specified racial group (Basebenzi, n.d.)

In 1979, the Federation of South African Trade Unions (FOSATU), a trade union federation, was formed bringing together many smaller unions. The same year, as a result of the Wiehahn Commission, black labor unions were recognized for the first time. This meant that black workers were now allowed to organize and had the right to strike. But registered unions faced government restrictions. For example, unions had to be registered on a racial basis and migrant workers, who made up the majority of the workforce, were prohibiting from joining the labor unions (Basebenzi, n.d.)

On December 1, 1985, the Congress of South African Trade Unions (COSATU) the largest federation of trade unions in South Africa, was formed. COSATU, like FOSATU, committed itself to being non-racial and worker focused. Under the banner of “One Industry, One Union”, COSATU aimed to create a strong union in every industry, by trying to unite smaller unions into a single one. Within five years it had consolidated 33 unions into 13 larger and stronger unions with over 700,000 workers. united the original 33 unions into 13 larger and much stronger unions, with a membership of over 700,000 workers (Basebenzi, n.d.). COSATU organized workers in areas where unions were not yet legally recognized, such as farmers, in household services and the public sector. Importantly, COSATU made the decision to join the anti-apartheid alliance with the United Democratic Front (UDF), an anti-apartheid body that was launched in Mitchells Plain in 1983 and brought together many anti-apartheid organizations. COSATU is explored further in 1.3.2.

1.2.4 Land Encroachment

Land encroachment is an inherent structural challenge of mining globally given that mining firms are extracting from land that is home to communities. In South Africa, the land encroachment struggle is even more complex, because of its Apartheid legacy. Because the mining industry inherited a deeply racial legacy, mining firms are often perceived as ‘white’ and mining communities as ‘black.’ Although compensation is paid in the form of royalties, these often do not make it to intended beneficiaries. Additionally, the perception of being pushed off tribal lands by a ‘white’ firm – even with compensation – is a driver of conflict. This is aligned with the cognitive dimension of institutional theory, which takes into account the cognitive dimension of decision-making. It builds on Max Weber’s premise that action is social to the degree that the actor attaches meaning to the behavior. To understand any action, one must consider not only the objective conditions, but also the actor’s subjective interpretation (Scott, 2014:67). While firms feel ‘fair’ and ‘justified’ given their efforts to avoid land grabbing by offering compensation, the subjective interpretation of communities is one that is rooted in the ‘unfairness’ of Apartheid, where blacks were unable to own land and were legally confined to peripheral locations.

Although the mineral ownership regime has evolved substantially from the Apartheid era where only whites were allowed to own the land and the minerals underneath, there have been cross-cutting challenges across mineral ownership models that been used in South Africa. Belinkie (2015) highlights three types of models – state ownership, a lease system and land ownership (

Table 2). For most of the Apartheid era, South African common law utilized the model in which landowners also owned any deposits below the surface. Mineral rights holders could extract the minerals and/or sell their mineral rights. However, the Group Areas Act of 1950 both limited blacks access cities and precluded blacks from acquiring land or mineral rights. Under this model, the government only got involved if the rights holder needed authorization to undertake explorations. Depending on the mineral that was being prospected, officials would give the authorization and there were no other government controls in place. In fact, the Minerals Act of 1991 stated that, “Common law rights to minerals were not subject to termination by a public authority for non-compliance with the Minerals Act or on any other grounds.”

Table 2: Common mineral ownership models

Model	Ownership dynamics
State ownership	Government holds property rights to all mineral resources “on behalf of the people.”
Lease or ‘regalien’ system (Used in most countries)	The state holds all permanent mineral rights and mining firms must apply for and pay the state for tenured rights to mine specific minerals
Landowner has mineral ownership	Grants the owner of the land surface corresponding rights “to hold, extract, or dispose of the [underlying] minerals.” Prospectors have the right to obtain private mineral rights by discovering minerals and registering a claim

Source: Belinkie (2015)

However mineral ownership changed sharply in 2002 when the Mineral and Petroleum Resources Development Act (MPRDA) was passed. The MPRDA changed the mineral ownership regime to the lease system – the state became the custodian and offered conditional licenses. But across both the Apartheid and post-Apartheid mineral ownership models, there was an intensifying struggle over communal land. Chiefly authorities often disproportionately benefitted from mining licenses, as they often become major shareholders or recieved royalty payments with little accountability. For example, in the late 1960s, Amplats Union had come to an agreement to pay the Bakgatla tribal chief to extract from the Spitskop Mine. However, local residents were angry, claiming that they had not been consulted about the agreement or compensated for the loss of their grazing and farming lands. This mine became known as the ‘Sinkgalaleng’ mine, which translates to ‘Don’t undermine us.’ By the late 1990s, the village’s youth protested that the village had never benefited from infrastructure development or employment from the mine. Tensions remerged in 2006 when rumors circulated that Chief Nyalala was in negotiations for a direct equity stake in Union, via a conversion of the tribe’s royalty stream. Infuriated, villagers argued that they

didn't know that Spitskop Mine had been paying royalties. To exacerbate things, it then emerged that Union had been illegally encroaching on land outside of the parameters of the lease area (Capps and Mnwana, 2015).

Likewise, in 2007, residents of Ga Puka and Ga Sekhaolelo filed a lawsuit in the High Court Transvaal Provincial Division against Potgietersrust Platinum's Ltd, a wholly owned subsidiary of Anglo Platinum and nine other defendants (including the South African Government). The plaintiffs requested an injunction prohibiting Anglo Platinum from interfering with the residents' land rights in an area where they were expanding their mining activities. The plaintiffs sought to set aside the relocation agreement Anglo Platinum made by arguing that the institution that was supposed to represent residents was under the influence of Anglo Platinum. The plaintiffs also argued that Anglo Platinum was forcibly relocating residents because individual householders signed relocation agreements under duress. Though the case was dismissed by the court, it is indicative of the tension arising from land encroachment.

Land encroachment by mining firms has ripple effects, beyond loss of land. For example, after 1994 when mines began paying living-out allowance for those who did not want to live in the hostels provided by Union, many workers began establishing informal settlements on land surrounding the mining operations. Capps and Mnwana (2014:619) note that the, "Incursion of the mine has increasingly been experienced as an incursion of 'foreigners,' who are not only 'stealing' the village lands, but also the jobs that should be reserved for locals in 'compensation' for the loss of rural livelihoods."

The land encroachment struggle has intensified with mechanized mining, which has drastically increased the rate of extraction. At Mogalakwena, open pit mechanized mining takes out 85,000 tons in ones shift, and there are four shifts each day. Conventional mining takes out 85,000 tons each month. As a result, the expansion into neighboring communities has been expedited.

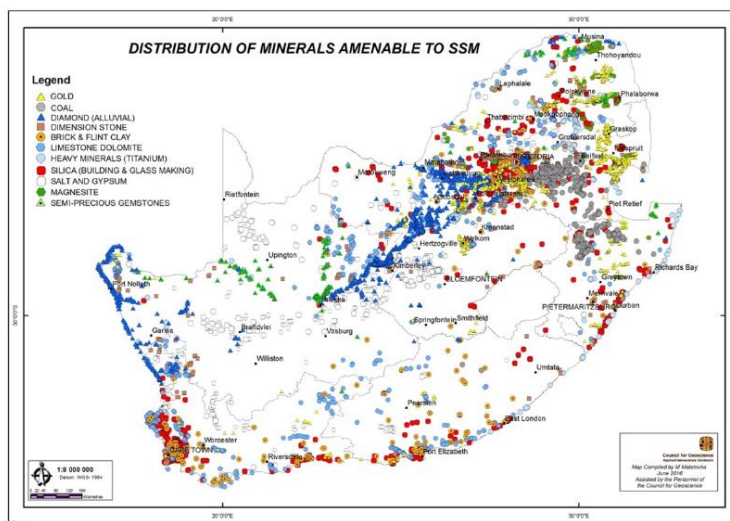
1.2.5 The lack of artisanal and small-scale mining

The governance of South Africa's mining sector favors large firms. Artisanal and small-scale mining (ASM) was formally recognized as a potential platform for ensuring the sustainability and expansion of rural livelihoods and income as early as 1994, and articulated more fully in the 1998 White Paper on Minerals and Mining Policy for South Africa. The White Paper has a chapter on small-scale mining which is intended to encourage the small and medium sized operators, "To the benefit of employment and the overall economy." The policy, while taking a positive view of ASM's potential for inclusive economic growth, also laid out constraints and challenges to its realisation including insufficient access to: i) mineral rights, land, and finance; ii) management, marketing and technical skills; iii) access to formal mineral markets; and iv) or the absence of functional support mechanisms to assist ASM development.

However, the subsequent legal and regulatory framework was mostly silent on ASM and lacked distinction between large scale and ASM in terms of licensing, safety and environment. This meant that the reporting,

technical and financial requirements to achieve formality or compliance were too onerous to be met by typical artisanal miners. Consequently, most ASM activities remained “informal,” “unauthorized” and outside the gambit of the law. Since commodity prices began falling in 2010, numerous mines have closed or drastically reduced operations across commodities, which has increased the opportunities for ASM. Additionally, slow economic growth and high unemployment have increased the number of people engaging in ASM. Between 2008-2019, the number of people in South Africa who cannot find work or have given up looking, increased by 58 percent from 6.5 million people to 10.3 million people. As a consequence, although ASM is largely illegal, it has become increasingly tolerated on the basis that it is driven primarily by economic need, and provides a livelihood. But not all ASM is “innocent.” “Zama zamas” are illegal miners who are part of criminal syndicates and are often heavily armed, have explosives, and can use violent mechanisms such as ambushes and traps for employees, security personnel and rival groups of miners (Minerals Council, 2019b). The Government of South Africa is currently working with development partners to try and create a more conducive and safer environment for ASM.⁷ To support this process, South Africa’s Council of Geosciences, a state-owned entity, undertook a mapping of the distribution of minerals amenable to small-scale mining – platinum group metals (PGMs), which are the focus of this thesis, are not included given the complexity of extraction. Coal, gold, diamonds, and silica are the primary commodities amenable to small-scale mining (Figure 1).

Figure 1: Distribution of Minerals Amenable to ASM Activities



Source: South African Council of Geosciences

⁷ Dialogue with South Africa’s Department of Mineral Resources and Energy

1.3 Contextualizing the Platinum Group Metals Sector

The motivation for focusing on a single commodity is that important dimensions of shaping mining policies that will boost socioeconomic development are dependent on a variety of factors including supply/demand dynamics; whether mines are active, on reduced operations or closed; the type and scale of mining operations and the value of minerals extracted. (Addison et al, 2017).

1.3.1 Overview

There are six platinum group metals (PGMs) – ruthenium, rhodium, palladium, osmium, iridium, and platinum. The PGMs are comprised of coupled elements that, due to chemical similarities, are always found together in deposits (Wellmer, 2008). PGMs include light metals (ruthenium, rhodium and palladium) and heavy metals (iridium, osmium and platinum). Metals within the group have a wide range of industrial and high technology applications making them desirable in various industries including jewelry, autocatalysts, chemical, electrical, medical, glass and petroleum, but their primary function is as catalysts in the chemical and automotive industries for the cleaning of exhaust emissions. They are chemically similar, and thus, are co-precipitated in the ore creation process. As a result, they are found, mined and processed together (Renner and Wellmer, 2019). The share of each metal in a deposit can vary. Each element is produced in different quantities, depending on the characteristics of the ore deposits. However, these ratios are rarely aligned with market needs (Kelser, 1994).

Within the PGM group, the driver has historically been platinum. Until 2018, platinum prices were always higher than palladium prices. However, pricing for these metals has shifted as a result of technological development in the automotive sector. Platinum is largely used for catalytic converters in diesel cars, while palladium is used in gasoline engines. After the diesel emissions scandal in 2014 in Europe, there has been a significant decline in demand for diesel vehicles.⁸ Thus, prices for palladium have over tripled between 2016 (average \$614/oz) and 2020 (average \$2074 per ounce) while prices for platinum have declined from a high of \$2,167 per ounce in 2008 down to a low of \$618 in 2020. Likewise, Rhodium increased from \$1,000 per ounce in 2015 to \$14,800 in 2020. The thesis focuses largely on platinum and palladium, which is because rhodium typically accounts for less than 10 percent of the PGM ounces mined, while palladium and platinum account for 89-94 percent of PGMs mined. Thus, despite the high price of rhodium, firms interviewed focused more on palladium, which is currently in its ninth consecutive year of having a global deficit. Palladium has largely taken over as the drivers for the PGM group, with demand increasing faster than production and is currently in its ninth consecutive year of having a global deficit. Given that platinum and palladium are largely utilized for the automotive industry, markets for these metals will be shaped by political decisions on the future of diesel and gasoline cars, as well as consumer behavior.

⁸ 'Platinum prices hit by Volkswagen scandal' published on April 23, 2015 in the Financial Times.

The demand for vehicles may permanently change as a result of the Covid-19 pandemic. It is possible that even after the pandemic is over, more people will work from home and overall commuting will decline as the world has gotten used to a ‘new norm.’ For example, during Covid-19 traffic declined by around 80 percent in many European cities, which meant that a typical car was only in use 1 percent of the time (Fengler, 2020). This could lead to a long-term decline in demand for automobiles. Inversely, an increase in demand clean vehicles could prevent a long-term secular decline. Fuel cells generate electric power – and they are similar to a battery but do not need recharging and can run indefinitely when supplied with fuel. The cells produce electricity by combining hydrogen (the fuel) and oxygen (from air) over a catalyst such as platinum or palladium.

1.3.2 The Political Economy of South Africa’s Platinum Group Metals Sector

The PGM sector is a microcosm of a deeply unequal country, marked by distrust between three distinct spheres – the political, labor and business. While the Government has worked to facilitate the social and economic transformation of the country through such efforts as broad-based black economic empowerment (BEE), a government policy implemented to advance economic transformation and enhance the economic participation of historically disadvantaged South Africans (HDSAs), it has yielded limited results. South Africa has the highest Gini coefficient in the world – a 0.66 – indicating high degree of income inequality. Wage inequality is even more extreme, with a Gini coefficient of 0.81. The top 10 percent of wealthy South Africans own 70.9 percent of total household net wealth, while the poorest 10 percent own 0.1 percent and the poorest 50 percent own just 4.2 percent. Wealthier households have an average of nearly 10 times more wealth than poor households (World Bank, 2018).

The Government of South Africa has tried to address inequality within the mining sector legislatively through the MPRDA, which was established to facilitate equitable access to and sustainable development of the nation's mineral and petroleum resources and the Mining Charter, which sets out quantified goals aimed at redressing racial segregation within the sector in six areas - ownership, mine community development, employment equity, human resource development, inclusive procurement and supplier and enterprise development and housing and living conditions – but progress has remained limited, as evidenced by repeated strikes and several lawsuits against mining firms alleging growing wage inequality.

The mining sector – particularly the PGM sector – is rife with conflict (Capps, 2015; Dunbar Moodie, 2015). On August 16, 2012, the South African Police Service killed 34 striking miners and injured another 78 during a wildcard strike at Lonmin’s Marikana PGM Mine near Rustenburg. It was the most lethal use of state police force against civilians since 1976. Meanwhile, the highest paid chief executive officers on the Johannesburg Stock Exchange are heads of mining companies – the same ones who argue that an increase in the minimum wage would be too much. The cataclysmic Marikana Massacre highlighted the state of post-Apartheid labor relations. On the surface, the 2012 strikes were driven by a demand for a large

wage increase to make R12,500 the basic wage for low skill workers such as rock drill operators (while the highest paid chief executive officers on the Johannesburg Stock Exchange are heads of mining companies – the same ones who argue that an increase in the minimum wage would be too much). However, on a deeper level, the strikes also represented a rejection of the National Union of Mineworkers (NUM), the union affiliated with the Congress of South African Trade Unions (COSATU), which was aligned with the ruling party, the African National Congress (ANC). NUM had been the dominant union within the mining sector since Apartheid ended. Although the union and mining houses had collaborated to make some improvement to wages and living conditions, there was an overall loss of confidence in the union. There were two reasons for this loss of confidence: (i) a failure to transform and ameliorate a deeply racialized industry, in which migrant workers lived in shacks while firms profited during the resource boom of 2008-2010 and (ii) rampant allegations of corruption, as union representatives were accused of being in cahoots with mine management, as some union representatives received pay increases and in-kind benefits such as cars. As a result, striking miners refused to communicate their demands to firm management through their typical communication channel – NUM. They demanded an end to “Apartheid of speech,” in which black workers were unable to speak directly to white managers. The breakdown of the NUM channel gave rise to the more militant Association of Mineworkers and Construction Union (AMCU), who labeled itself apolitical and non-communist and claimed it focused on the workplace. AMCU started as a breakaway faction of the NUM and formally registered as a union in 2001. But it was the PGM strikes that triggered a substantial and rapid expansion of AMCU’s member base. By 2013, AMCU had managed to expel NUM from the three biggest platinum producers – Amplats, Impala and Lonmin - and became the sole representative of the workers through closed shop agreements.⁹

Second, the Marikana Massacre also highlighted the high degree of dissatisfaction with the ANC’s neoliberal economic policies that failed to transform the mining industry, particularly high wage inequality and skewed racial distributions at senior levels of mine management. There have also been clear conflicts of interest that have blurred the line between the interests of government and interest of the mining sector. South African President Cyril Ramaphosa is a founder of NUM and while he was Deputy President, he was also a shareholder in Lonmin. Ramaphosa was accused of making the phone call for police intervention at Marikana - the precursor to the Marikana Massacre. Julius Malema, leader of the Economic Freedom Fighters political party, has sought to use the mine workers industrial action to stage a political challenge of the ANC’s post-Apartheid economic policy. Though the sharp decline in NUM membership is unlikely to unseat the ANC, the continued labor unrest is the, “Most significant internal crisis that has faced the ruling Tripartite Alliance composed of the ANC, COSATU, and the South African Communist Party (SACP) – since it came to power twenty years ago” (Botiveau, 2014:129). The magnitude of the

⁹ A closed shop agreement is a contract between an employer and a labor union that requires that an employer will only hire workers from a specific union and those workers can only remain with that employer while they are a part of the union that the agreement covers.

dissatisfaction was highlighted by the decision of the National Union of Metalworkers to withdraw support for the ANC.

Third, the Marikana Massacre – as well as the wildcard strikes that occurred during 2011 and 2012 and the 152-day strike in 2014 – revealed a deep level of social fragility that became the driver of violence. There was substantial violence towards both strikes and union representatives. Five people were killed during the Impala Strike and 11 during a strike at Marikana, before the Marikana Massacre killed a further 34. Additionally, rivalry between NUM and AMCU triggered violence between the unions, with nearly a dozen assassinations in the two years after the Massacre.

1.3.3 Market Dynamics

1.3.3.1 Impact of a Monopoly

Conflict is rampant in the PGM sector, but another interesting dimension to examine is the extent to which firms have exited the market. There are various circumstances unrelated to mineral deposits that can trigger a departure of firms from their respective jurisdictions. This includes (i) when governments impose policies that make mining unprofitable, including requirements for higher local ownership, local beneficiation, higher taxes; and (ii) when a mining jurisdiction has high frequency of production-stopping labor strikes. One such example is the Indonesian Bauxite story. Bauxite is a sedimentary rock that is the principal ore of aluminum. Indonesia is home to large bauxite deposits. The country's state-owned mining company, Aneka Tambang, exports the ore, it is then processed in China, before the country's only aluminum manufacturer, Asahan Aluminum, imports the processed alumina (the main constituent of aluminum), from China. China is the world's largest aluminum producer (60 percent), and Indonesia had been its largest supplier of bauxite, providing 70 percent of China's bauxite.

However, in 2009, the Indonesian Government passed a law that mandated mining companies to build local smelter facilities and process bauxite locally, with a looming threat of a raw mineral export ban that would go into effect in five years. The policy was designed to develop local linkages. However, neither domestic nor foreign companies developed their refining capacity - this was partially because they thought the Government would back down and partially because there was uncertainty as to whether the country had enough high-quality bauxite deposits left to justify the long-term capital investments in processing capabilities. Instead, Chinese operators focused on exploring for Bauxite elsewhere. The ban went into effect in January 2014 and Chinese operators turned to the Republic of Guinea in West Africa. Although the Indonesian government loosened its ban on bauxite exports in January 2017 to alleviate the adverse effects on local mining firms, Indonesia's position in the global bauxite market had permanently changed and the government had little power. In Guinea, mining exports increased by 79 percent year-on-year in 2017, as a result of higher bauxite production. Foreign direct investment in the mining sector stood at 13 percent of GDP in 2018.

Despite the political economy challenges within the platinum mining sector, PGM firms have not exited the industry in South Africa,¹⁰ though other mineral sectors such as gold have seen a departure of firms.¹¹ This is because South Africa has significant bargaining power when it comes to PGM production given its near monopoly on the market. South Africa is the largest platinum producer in the world, accounting for 80 percent of global reserves. Its reserves are 52.5 times bigger than the next two largest producers – Russia and Zimbabwe, respectively. Despite the many challenges facing mining firms in South Africa - including frequent labor strikes, uncertainty around the Mining Charter, which articulates a number of reforms designed to distribute mining-generated benefits more equitably, and complex relations with mining unions - firms have not left the market in favor of another platinum market. The share of PGMs that sits within South Africa gives it an essential monopoly and by extension, bargaining power.

1.3.4 Sectoral Dynamics

1.3.4.1 Shift to mechanization

There are three primary types of PGM mining – conventional underground, underground trackless mobile, mechanized mining (TM3) and open-pit trackless mobile, mechanized mining (TM4). Although other regions of the world started mechanizing their mining operations a century ago in the 1910s and 1920s, South Africa started much later. This was largely the result of an environment with a rigid labor structure in which social and political spheres did not view capital-intensive mining favorably (Forrest, 2015). Gold Fields South Deep Mine became one of South Africa’s first fully mechanized mines. At a depth of 3 km and a life-of-mine of over 70 years, it is the world’s second largest gold mine and one of the deepest mines in the world. Gold Fields has invested R32 billion into the mechanization of the mine since 2006. However, this did not translate to a profitable operation – a combination of endogenous and exogenous factors made it difficult to control costs. For example, when expensive imported machinery fails deep underground, it is both costly and difficult to repair. As a result, South Deep has not been able to come close to the production levels it had hoped for. The mining company has also cited a range of operational challenges, including higher operating costs, poor equipment reliability, poor maintenance, low labor productivity, need for expensive infrastructure and high depreciation costs as contributing factors to loss making. As of 2019, South Deep has yet to yield a sustainable profit. Gold Fields has tried various measures, including changing mining methods, training employees, bringing in expert consultants, reducing management by 25 percent, and other cost saving initiatives but is still losing approximately R100 million each month. As a result, 44

¹⁰ Lonmin remains the exception. Despite a 100 year history, Lonmin was unable to recover from the Marikana Massacre. On March 12, 2017, the Sunday Times ran an article entitled “Five years after Marikana, Lonmin fights for Survival.” On June 2019, Sibanye-Stillwater completed the acquisition of Lonmin Plc.

¹¹ In 2020, gold mining giant AngloGold Ashanti sold its final South African assets and exited the market while Gold Fields continued reducing operations.

percent of the workforce was retrenched at the end of 2018, negatively affecting workers and local communities.

For the PGM sector, the mechanized model picked up traction after the 152-day strike in 2014. During this time, the mines lost 48.5 percent of platinum production, taking 440,000 ounces out of production. The three largest producers suffered revenue loss of R24.1 billion during the strike and workers took a further loss of R10.6 billion in wages. Five of the largest PGM mines - Marikana, Rustenburg, Impala, Amandelbult, and Rasimone – lost between 48 and 64 percent of revenue for the year, as compared to the previous year.

Following the 2014 strike, Anglo Platinum announced plans to sell its most unprofitable PGM assets in South Africa, including its Rustenburg Mine, Union Mine, and two other joint ventures, so it could focus on less-labor intensive operations. Most notably, Anglo Platinum focused on the expansion of its highly mechanized Mogalakwena operation, often called the ‘crowned jewel’ of the firm’s portfolio for its high production and low operating costs. Other large mining houses have undertaken similar moves. In 2017, Royal Bafokeng Platinum announced that there would be a retrenchment of over 500 workers as the firm restructured its unprofitable Bafokeng Rasimone Platinum Mine (McKay, 2017). During this same time, it was expanding its Styldrift Mine, a fully mechanized underground operation, to produce 230,000 tons per month with a life of mine over 30 years. In 2018, Impala Platinum, the world’s second largest platinum producer announced the closure of five unprofitable conventional operations in the Rustenburg area and announced the retrenchment of 13,000 workers, amounting to one-third of its total workforce. However, the company has been simultaneously investing in the construction of the Waterberg Project, a fully mechanized mine in Limpopo that will use 400 trackless machines to carryout operations.

The shift to mechanization can yield positive environmental benefits. Mudd and Glaister (2009) found that the low cost of energy at Potgietersrust (21 MJ/t rock) is due to it being an open-pit mine, while the deep (~2km) underground conventional Northam underground mine had the highest mining unit energy consumption (1,268 MJ/t rock). The results showed that electricity is the dominant (indirect) energy input overall, with underground mining being the major user (related to the narrow reef mining techniques used). The power grid in South Africa, where the bulk of production considered in this study takes place, relies heavily on burning hard coal, leading to relatively high carbon dioxide emissions: more than 90 percent of electricity is generated that way. Due to the high proportion of electricity use in primary PGM production, a considerable shift to renewable energy projects like solar thermal or photovoltaics to progressively replace existing coal-based electricity could result in a significant reduction in emissions – but this is generally beyond the power of PGM producers. Although a relatively small percentage of Bushveld ore is derived from open cut mines, many PGM producers have planned expansions to incorporate open cut mines in the future. Comparison of underground to open cut mines shows that there is a trade-off between the energy used in underground versus open cut mining (ie. MJ/t rock) and the solid wastes produced, since open cut mining produces large volumes of waste rock.

1.3.4.2 Impact on fixed investment

Table 1 highlighted fixed investments in the mining sector between 2002 and 2018. The direct contribution of the mining sector to South Africa's total fixed investment increased from R 19 billion in 2005 to R 59 billion in 2008 to R91 billion in 2018. Although the sector contributed just 7.3 percent to GDP, it has contributed between 15 and 20 percent of South Africa's fixed investment. Though this is less than continental comparators,¹² it is still substantial. In 2018, greenfield foreign direct investment (FDI) in Africa's mining, quarrying and petroleum sector amounted to \$16.7bn – a year on year growth of 58 percent. The sector received 34 percent of all FDI into Africa.

1.3.4.3 Impact on import/export trends for mining machinery

In the era of conventional mining, several domestic manufacturing companies were able to supply the mining sector. However, as mines became more capital-intensive, South African mining operations turned to overseas companies to provide the necessary technology, and sometimes, the labor to run the technology. Across all commodities in the mining sector, trade balances for mining machinery have experienced a sharp shift. In 2006, imports and exports were nearly equal - \$11 million and \$10.7 million, respectively. Within three years, the value of exported machinery declined from \$10.7 million to \$9.6 million while the value of imports doubled from \$11 million to \$22 million. By 2012, value of imported mining machinery nearly double again to \$41 million, while value of exports experienced a more moderate increase to \$22 million. Between 2006 and 2012, there was a substantial increase in the development of capital-intensive, mechanized mines in South Africa, which contributed to a greater sourcing of machinery from overseas.

Figure 2: Import/export data for mining machinery



Source: Author's calculations using Comtrade data

¹² Total mining deals between multinational miners and African partners amounted \$48 billion in 2018. Region by region, mining transactions sees an interesting disaggregation: West Africa - \$16.2 billion; Southern Africa - \$14.7 billion; North Africa - \$14 billion; East Africa - \$1.6 billion; and Central Africa - \$0.2b billion

The mechanization of the PGM operations has contributed to the larger trend of shifting sectoral trade balances. For example, Anglo Platinum's flagship Mogalakwena mine made capital investments to improve the effectiveness of the mine's drills, explosives, diesel, shovel and mining trucks during this time period. These upgrades translated to substantial efficiency improvements – since 2012, drill penetration has improved by 36 percent while mining truck utilization has strengthened by 15 percent. In 2014, Mogalakwena produced over 370,000 ounces of refined platinum – an increase of more than 70,000 ounces from 2012.

Prior to the onset of mechanization, many inputs were sourced domestically, from companies like Bafotech. The transition to capital-intensive mining has led to a reliance on foreign inputs and reduced backward linkages in the domestic economy. Underground field visits showed that most new machines being tested are being imported from the United States, Sweden, Croatia, and Japan, and include Caterpillar, Epiroc, Komatsu, Atlas Copco and Terex. Additionally, labor has been imported to manage some of this technology. I was able to see the ultra-low profile (ULP) bolter in action underground. Prior to mechanization, each bolt would be drilled overhead into the ceiling to prevent the rock from collapsing as the miners blasted panels. The driller would stand directly below and hand drill each bolt, such that if it collapsed, he would be severely wounded or killed. With the introduction of the ultra-low profile (ULP) bolter, the remote-controlled machine can now simultaneously drill two bolts in less than ten minutes. The ULP bolter is manufactured by Doking, a Croatian company, and exported to South Africa. The R&D and operations of it is being done by Croatians, who, by visa regulations are required to return for a period of 30 days every 12 months. Anglo Platinum realized that when the Croatians left to comply with visa regulations, all operations came to a stop. The company addressed this by creating a rota to ensure that not all workers left at the same time. But this model is vulnerable to any changes in visa regulations.

The importation of mining technology has not gone without difficulty. In late 2016, the MN220, a new rock cutter made by Sandvik, a Swedish company, was introduced into the Twickenham mine. I saw the machine sitting idly underground. The cutter was designed to replace the need for explosives – making it far safer than having a miner blast the rock, in which case hanging walls of rock can collapse. When the machine was brought in, it was expected to cut 100 meters of rock every month. However, when it arrived from Sweden, it was unable to cut any rock, because the machine was designed under conditions of Sweden's softer rock, whereas South Africa's rock is much harder. In the following 2 years, it cut a mere 20 meters. The machine was eventually retired.

South African firms are ill-equipped, in terms of skill and capacity, to produce mechanized technology. GHH Mining Machines is one of the only mining technology companies in the country. When asked why companies don't utilize GHH's machinery, there was a unanimous agreement across all mines interviewed – GHH does not produce user-friendly devices nor do they produce machines that can handle production pressures, thus often breaking or leaking; the R&D is poor and machines are designed above ground and

are sent out without being tested underground; and many of the parts are low quality – and replacing them makes the machinery cost prohibitive.

1.3.4.4 Gender

The impact of mechanization on labor has largely been negative, given large-scale retrenchments. However, there has been one notable area of positivity. Mechanization has largely improved the representation of women by reducing the barriers they face, in terms of physical strength and safety. Historically, women have faced many challenges with entering the mining industry. In 1935, the International Labor Organization adopted Convention 54 which prohibited the employment of women in underground mining work. However, over time, many countries that initially ratified the convention, have denounced it, including Canada (1978), Australia (1988), Chile (1997), and South Africa (1996). In 1995, the ILO passed Convention 176, the Safety and Health in Mines, which covered the rights of all workers.

Still, the industry in South Africa has not been safe or friendly for women, particularly in deep underground mining. This largely stemmed from four factors. First, the physical demands of conventional mining – tasks like heavy lifting and hoisting a rock drill for long periods of time made it difficult for women to do autonomous work. Second, person protective equipment such as overalls, boots, and goggles were rarely made to fit women, which increased the risks they faced. Third, women faced high rates of gender-based violence. When women were introduced underground ten years ago, rape and murder of women became frequent. This was exacerbated by working conditions – many shafts only had centrally located toilets for men, so women often had to travel far to poorly lit areas to use the bathroom and this journey could be dangerous. Given that women were several kilometers underground, there was little they could do. And fourth, the mining sector has a deeply embedded patriarchal culture; most interviewees, regardless of race, said it is very difficult for men to take instructions from a woman, particularly if she was younger. These factors contributed to low female participation in the mining sector. In some conventional mines, less than 5 percent of underground workers were female.

The introduction of mechanization into mining has yielded positive benefits for women. Management at three of the world's largest PGM firms interviewed as part of this research reported that women tend to perform higher than men on fine motor skills testing, which make them well-suited for operating mechanized machinery. They also noted that women were generally more attentive, more detail oriented, and had a lower risk tolerance profile. At Mogalakwena, women now make up 50 percent of machine operators – and many of the women trained are from surrounding communities. The transition from conventional to mechanized mining has reduced or eliminated three of the four challenges facing women. First, what used to be a physically arduous task was now done with a remote control. Second, remote controls are often operated centrally or above ground, which reduces potentially hostile and dangerous situations for women. On that point, mines have also implemented further measures to increase safety for

women. At most mines, fingerprint access is required to enter bathrooms and dressing rooms, there is strong illumination throughout the mine, and women have centrally located toilet and ablution facilities. Third, as more women have entered the sector, companies have ensured PPE is designed for women.

These changes have helped increase the number of women in the sector. Between 2002 and 2018 – South African female labor force participation increased from 40.8 percent to 48.4 percent, demonstrating an 18.6 percent increase (Minerals Council SA). In comparison, the female employment in the mining sector increased from 11,400 women to 54,154, demonstrating a 375 percent increase (Statistics SA). Women now represent 11.9 percent of South Africa’s mining workforce – whilst a large improvement, this is still below the global average of 17 percent. There are still a number of labor-intensive underground platinum and gold mines in South Africa, which tend have lower percentages of female employees.

1.4 Structure and Methodology of the thesis

This thesis is comprised of three standalone articles, each exploring a different dimension of the PGM sector – governance, organizational economics and labor economics (Figure 3).

Figure 3: Structure of the thesis

	Governance	Organizational Economics	Labour economics
Research Questions	Article 1: Is there Evidence of a Sub-National Resource Curse in Post-Apartheid South Africa?	Article 2: What risks do PGM firms face and how do they undertake bridging and buffering activities to reduce their exposure to these risks?	Article 3: How does quantitative and qualitative job security vary amongst sociodemographic groups amidst widespread mechanization in South Africa’s PGM sector?

The first article, titled: *Is There Evidence of a Sub-National Resource Curse in Post-Apartheid South Africa?* adopts a comparative approach to examine the impact of ‘resource dependence’ on provincial development in South Africa. It replaces the multidimensional indicator for extractives-based development (MINDEX) used for country level analysis with a measure of the mining’s contribution to provincial GDP. This enables us to understand to determine sub-national resource abundance versus resource dependence through the relative contribution of the mining sector to the total value of all goods and services produced at the provincial level. By analyzing national accounts data, sectoral contributions to provincial GDP, educational expenditures on the provincial level, and the level of basic service and infrastructure provision, the article assesses whether resource-dependent provinces are affected by a natural resource curse. This article makes a first-time attempt at doing a within-country analysis on the resource curse debate in South Africa.

The second article titled: *Firms' Approach to Bridging and Buffering to Mitigate Risks in the Platinum Group Metals Sector*, examines what risks undermine the financial sustainability of PGM firms and what risks threaten relationships between firms and external stakeholders, particularly mining communities. By addressing how firms have used “buffers” to protect core business activities from external influences, such as volatile demand and pricing, and “bridges” to conform with external expectations - such as sharing mining-generated benefits with surrounding communities. Building on Simon (1947) who proposed a theory of human choice and decision making, this article uses a variety of data sources to construct a case study on how PGM firms have undertaken decision-making amidst a range of supply and demand shocks. It uses a mixed methodology approach for both complementarity (seeking elaboration from results from a single method) and expansion (to extend the breadth and range of inquiry beyond a single method) Greene et al (1989). It uses market intelligence data for examining buffering, and trade data for examining bridging, as well as primary data acquired through interviews undertaken at three underground and open-pit mines with mine workers and mine-level management as well as with c-suite, human resource development and sustainability executives at headquarters offices of four of the largest PGM mining firms. It also uses data from the Neil Coleman Collection at the South African Historical Archives, as well as data set constructed from both internal and external reports and presentations shared by respondent firms. This article brings deploys five data sets to construct a new case study. It is the first to deploy Fennell and Alexander (1987)'s instruments, buffers and bridges, to understand the behavior of mining firms after a commodity boom, and brings together an analysis of supply and demand shocks, how firms are responding to those shocks, an analysis of challenges facing communities and qualitatively assesses the efficacy of firms' efforts to improve shared-value outcomes.

The third article titled: *An Assessment of Quantitative and Qualitative Job Security Amidst Mechanization: Case of South Africa's Platinum Group Metals Sector* employs a cross-sectional embedded research design. The embedded design mixed different data sets – quantitative and qualitative - at the design level, with one type of data being embedded within a methodology framed by the other data type (Caracelli & Greene, 1997). The primary data set for the analysis was done through a survey - a novel questionnaire was developed, deployed, and analyzed by the author. During the period between June-August 2018, primary data was gathered through 202 questionnaires (300 were distributed, indicating a 67.3 percent return rate), with each questionnaire asking 105 questions. The survey sought to quantify perceived quantitative and qualitative job security and assess how it varied between various groups, along the lines of race, gender, age and education level. Primary data was collected through questionnaire that had five sections (found in Appendix 1). Additionally, between March 2018 and February 2019, 71 semi-structured interviews were conducted with various levels of mine employees, including unskilled workers, mid-level engineers and chief executive officers, to get a more descriptive and granular understanding of qualitative job security.

1.5 Conclusion

The objective of this introductory chapter was to provide an overall political economy analysis of both the mining sector and PGM sector in South Africa, which is helpful to gain a contextual understanding of the sector. There may be some repetition between the introductory chapter and the individual articles – this is because the articles are intended to be able to stand alone, while the introductory chapter has aimed to lay out the overarching context and common threads for all three. Overall, this thesis seeks to make a novel contribution to the field of mineral economics by doing a commodity-specific case study and analyzing it through the governance, organizational economics, and labor economics lenses.

The Covid-19 pandemic has made the mining sector more important than ever. As policymakers work to map out an economic recovery, mining can play a key role. Covid-19 has compelled decision-makers to make large fiscal injections to protect households and firms across sectors. To ensure debt sustainability, attention is beginning to shift to how to generate the revenue need to finance the Covid-19 recovery as well as longer term development objectives. Mining should be a central part of this strategy.

On one hand, attracting productivity-enhancing inputs is important to widening the tax base. In 2018, greenfield foreign direct investment in Africa's mining, quarrying and petroleum sector amounted to \$16.7bn – a year on year growth of 58 percent. The sector received 34 percent of all FDI into Africa. The productivity gains from such investments can be substantial. For example, in the PGM mining sector, mechanized mines can produce 11 times what a conventional mine can. Thus, strategically attracting investment into improving productivity in the primary commodity sector can be a key revenue generator.

On the other hand, evidence in these three articles makes a compelling case that if governments and firms work together, they can help improve the economic and social development at the sub-national level, improve shared value outcomes and ensure that the workforce benefits from an improved work environment rather than a historically suppressive one. This thesis seeks to augment the academic body of knowledge while also giving policymakers and firm executives insight to improve the governance, economic, and social impact of the mining industry. It is rooted in Addison and Roe (2018:10)'s idea that extractive “Strategies should be guided by realism: neither euphoria nor despair is helpful.” Maximizing the benefits of the sector for overall economic and social development requires, “Well-grounded realism that involves, above all, trying to learn from, and then avoid, the mistakes of the past, being cautious and avoiding over-optimism, while recognizing that extractive industries (EIs) if well managed can certainly support sustainable development” (ibid).

Article 1: Is there Evidence of a Sub-National Resource Curse in Post-Apartheid South Africa

Abstract

The term ‘natural resource curse’ is used to describe a potential paradox that natural resource generated wealth could generate weak economic growth, rather than economic prosperity. Literature has shown that natural resources can lead to relatively slow economic growth, inequalities, corruption, embedded poverty and the creation of a rentier state. However, in the case of South Africa, the dual presence of both mineral wealth and the Apartheid legacy makes it difficult to isolate the impact of resources. When excluding petroleum, it is the wealthiest mining jurisdiction in the world, with a non-energy mineral reserved value upwards of US\$2.4 trillion. But South Africa is also home to Apartheid policies, which led to a highly skewed distribution of both land and productive assets and has left behind a legacy of exclusion that has fueled the contestation of resources, slowed growth and fueled corruption. To understand how extraction has affected economic and social outcomes, independent of Apartheid, a sub-national comparison between mining and non-mining provinces is critical. This paper seeks to answer the question ‘Is there evidence of a sub-national resource curse in post-Apartheid South Africa?’ It answers this question by using four indicators at a sub-national level— two economic dependence indicators (economic growth, contraction of the manufacturing sector) and two governance indicators (education expenditures and access to basic infrastructure). This article finds that there is no indication for a resource curse when examining the economic dependence indicators, but a mild curse when examining the governance indicators, indicating that further policy attention is required on how to address these disparities.

2.1 Introduction

2.1.1 Literature Review

2.1.1.1 Overview

There has been substantial debate on the relationship between natural resources and economic development, with some optimism and some pessimism. The term ‘natural resource curse’ was introduced by Richard Auty (1993) to describe a potential paradox that natural resource generated wealth could generate weak economic growth rather than economic prosperity. Sachs and Warner (1995, 1997) empirically confirmed this, showing a significant inverse relationship between the share of natural resource exports in real GDP and economic growth. Auty (2001) found that per capita income grew slower in countries with large deposits of natural resources. On the other hand, Bravo-Ortega and De Gregorio (2005) found that although natural resources have a positive effect on income, they have a negative effect on growth. Collier (2008) asserts that dependence on natural resources often leads to short-run increases but have detrimental long-

term effects on the growth of low-income countries with large natural resources. In general, these studies conclude that countries with large natural resource endowments are more to have weaker economic development than countries without large endowments, partially because fiscal inflows from extractives give way to market and government failures that slow growth and industrialization (Bhattacharyya and Hodler, 2010; Gylfason, 2001).

There are both political (rent-seeking, conflict, corruption, a rentier state) and economic (Dutch disease, boom and bust cycles, slow economic growth) explanations (Lebidioui, 2019). However, it is important to note that recent studies have found the resource curse to be weak (Lederman and Maloney, 2008; Janes, 2015). Existing literature has found that the phenomenon is more common in Sub-Saharan African countries such as Nigeria, Chad and the Democratic Republic of the Congo (Porter and Watts, 2017; Omeje, 2013; Sala-i-Martin and Subramanian, 2013; Yorbana, 2017; Tsabora, 2014). In contrast, many middle-income and upper-income countries appear to have escaped the natural resource curse, such as Australia and Canada (Fleming et al, 2015; Frynas et al, 2017).

There are three key economic explanations for the resource curse: Dutch disease, commodity price volatility, and the enclave thesis (Ross, 1999; Lebidioui, 2019).

The term ‘Dutch Disease’ was initially developed to describe the observed contraction of the Dutch manufacturing sector after the discovery of natural gas in 1959. The Dutch Disease hypothesis suggests that an exogenous increase in resource prices or in resource output will result in (i) a real exchange rate appreciation caused by a sharp rise in exports and (ii) the booming resource sector will pull labor and capital away from the manufacturing sector (Corden, 1984; Corden and Neary, 1984). Sachs and Warner (1997, 2001) popularized this concept and states that it was the key growth-impeding factor for resource-rich countries. Importantly, however, Ross (1999) notes the underpinning assumption of the Dutch Disease that the supply of capital and labor are fully utilized prior to a boom. In the case of South Africa and many developing countries, there is a labor surplus (though maybe not a capital surplus).

Commodity volatilities can be damaging for both commodity producers and can impede poverty reduction efforts as a decline in prices reduces government revenues, wages, and community expenditures (Brown et al, 2008). But with good governance, there are a range of instruments that can be utilized to minimize the effects of commodity price volatility including stabilization funds, fiscal rules to smoothen government expenditure and offset the boom-and-bust cycles associated with commodity revenues (Lebidioui, 2019).

A third explanation is that the mining sector is an ‘enclave’ and does not promote linkages to non-resource sectors, particularly when foreign firms lead extractive activities and repatriate profits. In the South African context, a review of the 10 largest mines, in terms of revenue generation, 9 are fully South African owned and 1 is a joint venture between an Australian and South African firm. The enclave thesis emerged given that minerals are capital intensive, concentrate ownership and generae fewer linkages than more diffuse

resources, like agriculture. But Albert Hirschman (1958) proposed that natural resources were not an enclave, but rather there were three linkages that could connect it to the larger economy. The first was financial linkages, which he defined as a measure of resource rents that are appropriated by the government and used to promote industrial development in unrelated sectors. The second was consumption linkages, which he defined as the demand for domestic production, stemming from the incomes earned in the resource sector. And the third was production linkages, which are forward and backward linkages with the commodities sector. He argued that production linkages were the best way for resource-rich countries to diversify and engage in equitable wealth distribution. Governments have the capacity to develop linkages (like the Motor Industry Development Program discussed later in this paper), but this can be constrained by skills (discussed in article two).

Political explanations: while there is some debate on why some countries fall to the curse and others escape, researchers cite various of political factors that may play a role, including: poor institutions, lack of rule of law, increased corruption, voracious rent seeking and civil conflict, limited incentive to provide educational opportunities and infrastructure; and slower accumulation of skills (Prebisch, 1950; van der Ploeg, 2011; Hausmann and Rigobon, 2003; Isham et al, 2005; Birdsall et al, 2001; Wood and Berge, 1997; Wick and Bulte, 2006; Mehlum et al, 2006; Collier and Hoeffler, 2009).

Ascher (1999) takes weak governance to a more granular level, noting that poor resource rent management policies are more nuanced than ignorance of good resource management or greed. Because resource rents provide an easy source of financing, governments may use it for specific objectives such as financing a controversial development program, elite capture patronage, or maintenance of the status quo. One of the frequently cited explanations of resources undermining equitable growth is that high rents incentivize political and economic agents to pursue rent-seeking behavior that promotes rent distribution, which is substantial and immediate, rather than wealth creation, which is a long-term task and can be captured by successors. It promotes corruption, as rents are often funneled into patronage markets, rather than investment and savings. It also leaves markets dependent on primary commodities, which in turn, leaves them vulnerable to price shocks and the volatilities. It can lead to a high rural labor surplus and because job creation is low and unemployment high, the surplus of labor depresses the wages of the poor (Auty, 1998).

Resource optimism: development economists such as Viner (1952) and Lewis (1955) advocated that resource abundance could help developing countries who had labor surpluses and capital shortage. Over the last twenty years, a number of studies have found a positive correlation between resource abundance and economic indicators (Davis, 1995; Bravo-Ortega and De Gregorio, 2007; James, 2015).

Additionally, more research has questioned the statistical credibility of the resource curse. Lebidoui (2019) notes that the negative correlation between economic growth and natural resource wealth found in Sachs and Warner (1997) was based on calculations of the share of resources output/exports out of total output/exports. This measurement can be misleading because it reflects resource dependence rather than

resource abundance ('resource-rich'). Much of the literature in this debate is that homogenizes countries as 'resource-rich' which makes it difficult to capture various country contexts. Gylfason (2011:10) offers one way to distinguish between resource abundance from resource dependence. He states that abundance relates to the amount of natural capital that a country has at its disposal (ie quantity of mineral deposits), while dependence refers to the extent to which these natural resources are relied on for livelihoods. Without applying this delineation, it is easy to misclassify poor countries with few mineral resources, such as Chad and Mali, as being 'resource-rich' because resources account for a large share of their export earnings (Gylfason, 2011:10). These countries are resource-dependent rather than resource-abundant. Lebidoui (2019:72) notes that the demarcation between resource dependence and resource abundance is particularly important because statistical confusion can lead to a selection bias that ignores successful resource-based development experiences. He notes that when doing a historical examination, several now-industrialized resource-abundant countries such as the United States, Canada and Australia began as resource dependent economies but successfully diversified, such that they do not qualify as 'resource dependent' anymore. Lederman and Maloney (2007) show that when using a different indicator of resource abundance - net resource exports per capita – rather than the share of natural resources in GDP) - high-income countries such as Australia, Canada, Finland, New Zealand and Norway are amongst the most resource-intensive economies globally, rather than DRC and Papua New Guinea as Sachs and Warner (1997).

2.1.1.2 Existence of sub-national resource curses

Studies of within-country effects of resource wealth can help guide policymakers through several key avenues. First, the effects of resource wealth are of policy relevance due to its scale. Mineral extraction is associated with spatially concentrated production that can have significant adverse social, economic and environmental consequences for the locality where it occurs. And second, resource wealth can be used to mitigate spatial and income inequality. Research shows that within-country effects of resource wealth can lead to divergent outcomes and can form an important transmission channel for any aggregate resource curse (Cust and Viale, 2016:6). Given that South Africa has a relatively decentralized fiscal system¹³, understanding how development outcomes have varied between provinces can help the government develop policy solutions to reduce the divergence that may exist between resource-rich and resource poor regions

In recent years, some research has been undertaken using econometric techniques to assess within-country effects of the extractive sector. The limited body of comparative works on the sub-national effects of resource extraction are from Canada and the United States (Cust and Viale, 2016). For example, an analysis of panel data for 50 states in the United States and over 3,000 countries showed that resource extraction has a negative impact on sub-national economic growth. Another study used a county-level panel dataset of oil and gas production in the US and found that growth rates in producer counties increased less than those

¹³ "Fiscal decentralisation" refers to the percentage of total government expenditure executed by subnational governments.

in non-producer counties, also pointing to a resource curse at the county level (James and Aadlund, 2011; Allcot and Keniston, 2014). But other papers have not found evidence of negative effects of extraction at the county and state level. Michaels (2011) found evidence that oil booms have long term agglomeration benefits to resource producing counties, even after oil production has ended. Research on sub-national resource curses in developing countries is scarce at best. Data availability is a significant limitation at the sub-national level, which makes it very difficult to control for other variables.

2.1.1.3 Deployment of the ‘resource curse’ conceptual framework

As this section has shown, the term ‘resource curse’ encompasses the substantial social, economic and political challenges that have been linked to resource extraction in a range of countries. The previous section demonstrated how many of these challenges have been shown to inhibit economic and social development. Thus, the resource curse offers a well-established framework to assess the link between mining and social and economic development in South Africa. This paper benefits from using a well-established framework, given the relatively novel sub-national analysis it seeks to undertake in a developing country where data is limited, thus making indicator selection more challenging.

2.2 Background

2.2.1 To what extent is the resource curse seen in South Africa

South Africa is home to the world’s richest mineral deposits, with a non-energy mineral reserved value upwards of US\$2.4 trillion and is the wealthiest mining jurisdiction in the world (if petroleum reserves are excluded). South Africa is a top producer of a range of commodities, including gold, diamonds, platinum group metals (PGMs), coal, and iron ore. The mining sector is still one of the largest export sectors (28 percent of total exports) and is a key generator of foreign exchange for South Africa. In 2016, exports amounted to R294 billion.

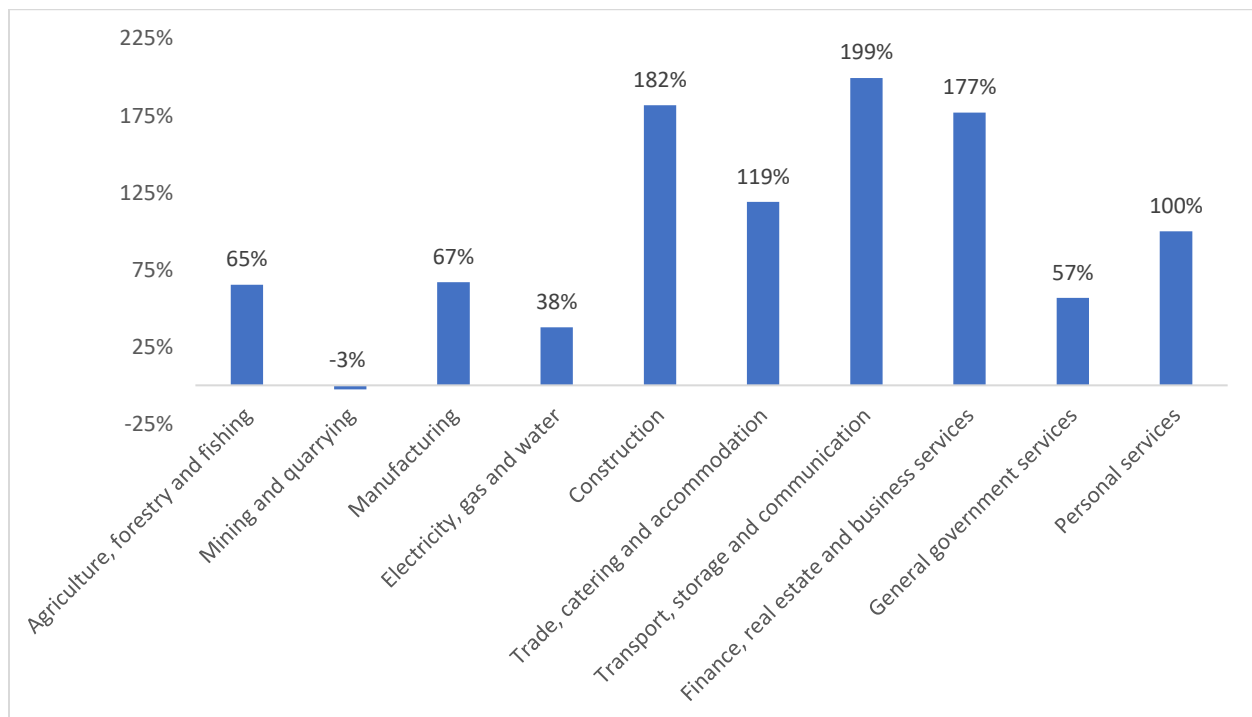
Elbra (2013) argues that South Africa has experienced many of the symptoms outlined in the resource curse literature including relatively slow economic growth, inequalities, corruption, embedded poverty and the creation of a rentier state. Elbra concludes that South Africa has failed to benefit from natural resource wealth and can be classified as a resource cursed state.” However, Elbra also asserts that throughout South Africa’s Apartheid and post-Apartheid periods, the country has ‘relied heavily’ on its mining sector for growth and that ‘a reliance remains today.’ But reliance is an overstatement – South Africa’s mining and quarrying sector contributed just 7.3 percent to GDP in 2019 – down from 21 percent in 1980. In reality, South Africa is resource rich but not resource dependent.

Additionally, Elbra (2013) does not disaggregate the impact of natural resources from the impact of Apartheid, the latter of which led to a highly skewed distribution of both land and productive assets and contributed heavily to high inequality and poverty. This legacy of exclusion has fueled the contestation of

resources, which has increased policy uncertainty and deterred investments, thus slowing growth and fueling corruption (World Bank Group, 2018). The lines on which inequality is drawn indicates that it is largely a product of Apartheid. According to South Africa’s statistical agency, in 2015, using the upper poverty line, 64.2 percent of black South Africans were poor, compared with 41.3 percent of colored, 5.9 percent of Indian, and 1.0 percent of white South Africans.

Given the long history of Apartheid – and the continued impacts of its legacy – it is better to look at mining-specific indicators like the degree to which mining has crowded out tradable sectors, rather than broad indicators like GDP or inequality that could be due to Apartheid. On a national level, mining has not crowded out tradable sectors. In fact, when using real GDP figures, mining is the only sector that declined between 1993 and 2017 (contracted 3 percent). During the same time period, most tradable sectors grew - agriculture, forestry and fishing grew by 65 percent while manufacturing increase by 67 percent. Some definitions of ‘tradeable sectors’ also include financial services (Mano and Castillo, 2015: 22). The financial sector grew by 177 percent between 1993 and 2017 (Figure 4).

Figure 4: Sectoral contributions to national real GDP, 1993-2017



Source: Statistics South Africa

Given that South Africa has diversified significantly over the last 25 years, with finance, real estate and business services; construction; and the transport, storage and communication sectors experiencing the most growth (and mining being the only sector to contract in real terms). it is worth assessing the extent to which industrial policy – or state-led efforts - have been used to facilitate this diversification. Industrial policy is

a controversial topic within academic and policy spheres, but is important to understand whether the efficacy of diversification is a result of state or market forces.

In the case of South Africa, there was a combination of state and market forces that led to diversification

The construction sector has been the second fastest growing sector during the 1993-2017 period, experiencing a growth rate of 182 percent in real terms. This came through active state intervention. The post-apartheid state implemented measures to foster growth of the construction sector – the Construction Industry Development Board was established, a Register of Contractors was created, significant amounts of public finances were allocated to and spent through the Medium Term Expenditure Framework process, and support programs were developed to support emerging black contractors. The post-apartheid government became the construction sector's biggest client, as they sought to redress the unequal distribution of social and economic infrastructure (Cottle, 2015).

2.2.2 The role of industrial policy

Given that South Africa has diversified significantly over the last 25 years, with finance, real estate and business services; construction; and the transport, storage and communication sectors experiencing the most growth (and mining being the only sector to contract in real terms), it is worth assessing what role industrial policy has played. It is equally important to assess the extent to which industrial policy has been utilized to develop linkages with the mining sector. But before delving into these questions, unpacking the literature on industrial policy is important.

Glykou and Pitelis (2011) define industrial policy refers as actions taken by the government to influence industry in a way that helps achieve a larger government objective. Rodrik (2004) argues that industrial policy is as much about obtaining information from the private sector on bottlenecks and their possible solutions as it is about implementing appropriate policies. Donges (1980) states that industrial policy encompasses all governmental actions that affect industry, whether it is domestic and foreign investment, foreign trade, research and development activities, labor absorption, access to capital markets, amongst others. Tyson and Zysman argue that industrial policy is the suite of aggregate policies, market promotion policies and sectoral-specific policies. Latsch (2008) stated industrial policy is a set of policies aimed at improving the global competitiveness of domestic firms, industries, or sectors.

Chang (1998) broadly categorizes industrial policy thinkers into three groups. The first is those who define it very broadly - government policy that affects industrial performance, including macroeconomic, infrastructural, and education policies. In the middle is a group of thinkers who see the core of industrial policy as targeted sectoral support as well as non-sector specific policies such as research and development and industrial training. The third group takes the narrowest approach to industrial policy, only including sector-specific support.

Cohen (2006) identified three approaches to industrial policy. The first is aligned with the neoclassical approach, where the debate focuses on market failures. The second is the structural approach, where the debate is centered on conditions for global competitiveness. And the third is the pragmatic approach, where the debate focuses on the practical conditions needed for making public and private actors better able to address the challenges of the economy. Valila (2006) added a fourth objective – improving equity by lending support to uncompetitive sectors or firms on the basis of social or regional income distribution rather than economic efficiency. Similar to Valila, Cave (1987) suggested that industrial policy should be defined as public sector interventions aimed at changing the distribution of resources across economic sectors and activities.

South Africa's engagement with industrial policy has largely been aligned with Cave (1987) and Valila (2006). Since the end of Apartheid, the Government of South Africa has largely focused its efforts on transformation – or changing the structure of the economy to ensure historically disadvantaged groups are included in the economic and social structure. Transformation is at the heart of the South African Constitution and the National Development Plan. National Treasury's 2017 Budget Review notes:

To realise the vision of the Constitution, South Africa needs transformation that opens a path to inclusive economic growth and development... Government's objective is not merely to transfer ownership of assets or opportunities to contract with the state: it is to change the structure of the economy. Broad-based transformation should promote growth, mobilise investment, create jobs and empower citizens. It must create new resources to support social change, including assets and livelihoods for the majority, and strengthen South Africa's constitutional foundations.

The construction sector is an example of this. It has been the second fastest growing sector during the 1993-2017 period, experiencing a growth rate of 182 percent in real terms. This came through active state intervention. The post-apartheid state implemented measures to foster growth of the construction sector – the Construction Industry Development Board was established, a Register of Contractors was created, significant amounts of public finances were allocated to and spent through through the Medium Term Expenditure Framework process, and support programs were developed to support emerging black contractors. The post-apartheid government became the construction sector's biggest client, as they sought to redress the unequal distribution of social and economic infrastructure (Cottle, 2015).

The focus on transformation over industrial policy is seen clearly in the mining industry. In 2020, the South African Economic Reconstruction and Recovery Plan has committed to using industrial policy instruments to support the development of a comparative advantage in hydrogen fuel cell technology, which uses PGMs, given that the sector employs 38 percent of the mining labor force.

This is not the first time the Government has used industrial policy to develop linkages with the PGM sector. In September 1995, the South African government introduced the Motor Industry Development Programme (MIDP) to help make the South African automotive industry competitive amidst a climate of

trade liberalization, globalization, rapid technological change, rising customer expectations and markets with increasing demand. The MIDP was designed to help the industry adjust and increase its competitiveness in the new post-apartheid trade policy environment. The program had four core pillars:

- A gradual reduction in import duties on both vehicles and components;
- An export-import complementation scheme under which vehicle and components exporters can earn tradable “Import Rebate Credit Certificates” (IRCCs) to offset duties on imported vehicles and components;
- Access to the standard duty drawback program for exporters, under which all import duties paid on components and intermediate inputs used in exported vehicles and components can be rebated;
- A duty free allowance on imported components of 27 percent of the value of vehicles produced for the domestic market.

The MIDP provided significant subsidies. Between 1996 and 2003, automobile producers received and used IRCCs worth over R55 billion. In 2002 and 2003 alone, their value exceeded R15 billion per year. This is approximately equivalent to South Africa’s total customs revenue collections and is double the national government’s total annual expenditures on higher education. These amounts do not include the subsidies received in the form of duty drawbacks, duty free allowances or productive asset allowance nor do they include the implicit subsidy paid by consumers for domestically produced vehicle purchases as a result of the protection provided by import duties and the functional ban on used car imports (Flatters, 2005:4).

The catalytic converter industry in South Africa primarily developed as a result of the MIDP, which was discontinued in 2013. The current projections for local PGM beneficiation via catalytic converters in South Africa reflect a downward trend, due to production being moved to other countries as a result of policy uncertainty around government incentive programs. The industry is capacitated to support 23.7 million units per annum. At full capacity the industry would represent 19 percent of global auto catalyst production (Kok, 2008; Dewar, 2012). However, South Africa currently manufactures just 8 percent of the world’s catalytic converters despite holding 38 percent of the world’s palladium and 75 percent of the world’s platinum. Although the global market for catalytic converters is expected to grow at a CAGR of ~2.9 percent over the next five years, South African PGM producers have opted for long-term contractual agreements with major refineries and manufacturers in Europe (UK, Germany, Switzerland), Japan, China and North America (Absolute Reports, 2019).

This section has aimed to provide an overview of some of the many debates on industrial policy, how it has been utilized by the Government to facilitate transformation in the post-Apartheid era, and a brief overview of how it has been used to facilitate economic diversification and economic linkages.

2.2.3 Non-resource factors that may affect outcomes

Given the data limitations, it is difficult to quantitatively control for other variables that can mimic some of the effects of natural resource curse (ie Dutch Disease, infrastructure development, economic growth). This section seeks to explore some of these variables qualitatively.

2.2.3.1 A declining manufacturing sector

The 2008 Global Financial Crisis and the adverse impact it had on the economies of South Africa and its long-term trading partners coupled with competition from rapidly growing emerging markets triggered a precipitous decline of the manufacturing sector in South Africa. Over 300,000 manufacturing jobs have been lost or outsourced to other countries since the beginning of 2008, with most going to China. Concurrently, administered prices have declined by over 36 percent in other BRICS countries (Brazil, Russia, India and China), while electricity costs have increased by over 170 percent in South Africa (and are continuing to rise at double the forecasted inflation rate). (Deloitte, 2013).

South Africa's manufacturing competitiveness has worsened over time. In 2010 South Africa was ranked 22nd (out of 38 countries) in terms of the Global Manufacturing Competitiveness Index. Deloitte (2013). predicted that South Africa would move up to the 19th position within 5 years. But by 2016, South Africa had dropped to 25th. It's no surprise that mining's contribution to total GDP has declined substantially. In 1994 manufacturing accounted for roughly 20% of South Africa's GDP, it is currently sitting at around 14% of GDP and the decline continues (Stats SA).

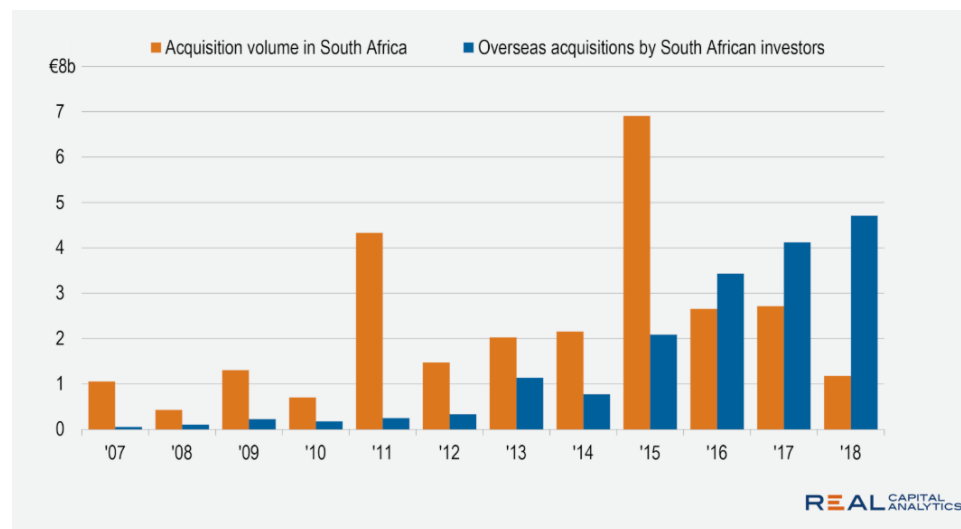
2.2.3.2 Investment landscape

To exacerbate these challenges, the South African business environment has worsened. In 2019, South Africa ranked 84th globally in the World Bank's Ease of Doing Business Rankings, 52 spots lower than it fared in 2008. The South African Chamber of Commerce and Industry Business Confidence declined between 2010 and 2019, and is reflective of the market-related business climate and economic developments that affect private sector growth and business perceptions (Figure 6).

Weak economic growth coupled with a reduction in private investment has had an adverse impact on job creation. The current macroeconomic climate has come with declining private investment, both domestic and foreign direct investment (FDI). Between 2013 and 2017, FDI inflows dropped by 37 percent. In 2017, developing countries saw a 2 percent increase in FDI, while South Africa saw a decline of 41 percent (World Bank Group, 2019). On the domestic front, an analysis by Real Capital Analytics showed that South African investors are putting more money into foreign markets than ever before. In 2016, overseas acquisitions exceeded domestic investments. Since then, the gap between domestic and outward investments has widened substantially. Between 2017 and 2018, domestic acquisition volume declined by more than 50 percent as

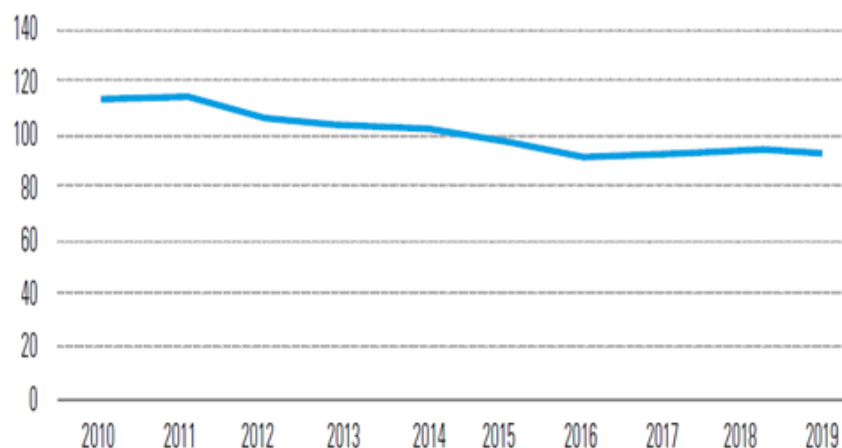
listed companies withdrew and became net sellers¹⁴. In 2018, South African investors spent quadruple their domestic investments on international acquisitions (Figure 3).

Figure 5: Domestic v Foreign Acquisitions, made by South African Investors



Source: Real Capital Analytics

Figure 6: The SACCI Business Confidence is indicative of the market-related business climate, 2010-2019



Source: SACCI

According to the World Bank Group's Country Private Sector Diagnostic for South Africa, policy remains a key constraint to attracting investment. Key constraints identified include: a) lack of institutional clarity – investors must deal with many institutions with overlapping mandates, which can make it difficult for the private sector to secure the information and sources needed to develop an investment project; b) new firms and MSMEs are particularly affected by costs and delays when conducting business; c) regulatory barriers

¹⁴ RCA Analytics. June 25, 2019

that inhibit competition. Government interventions can create high barriers to entry, enable collusion and make it difficult to compete with large, vertically integrated firms and conglomerates, which limits MSMEs and entrepreneurs; and d) limited integration into regional and global value chains. Improving the business climate requires supporting policies that promote competition, productivity, and integration into value chains. Limited investment can extend into infrastructure development.

2.2.3.3 Economic migrants, urban hubs, and their impact on economic growth.

Gauteng and Western Cape are the ‘economic engines’ of South Africa and thus, people tend to move to these provinces in search of employment. Gauteng has the largest share of migrants in South Africa. In the 2011 census, only 56 percent of the people counted were born there, with the majority being from Limpopo (10.8 percent), followed by those born outside South Africa (9.5 percent) and KwaZulu-Natal (5.9 percent). In the Western Cape, 71.9 percent of people counted there were born in the Western Cape. The majority of migrants to Western Cape were born in Eastern Cape (16.2 percent) and outside South Africa (4.5 percent). Migrants are flocking to areas with high volumes of economic activity. Given that Western Cape is home to Cape Town (which generates 71 percent of the city’s revenue) and Gauteng to Johannesburg and Gauteng, these urban centers boost economic growth for the whole province (Stats SA, 2011). World Bank (2020) found that more than 80 percent of global GDP is generated in cities, and African cities are not an exception to disproportionately high rates of economic growth compared to counterparts.

Table 3: Percentage distribution of the population by place of birth and province

Place of birth	EC	FS	GT	KZN	LP	MP	NW	NC	WC
EC	94,0	2,5	4,5	2,9	0,4	1,6	2,7	2,0	16,2
FS	0,4	87,3	3,2	0,4	0,3	1,2	2,9	1,9	0,8
GT	1,2	2,7	56,0	1,3	2,5	4,7	4,9	1,6	2,9
KZN	0,7	1,0	5,9	92,0	0,2	2,8	1,0	0,8	1,2
LP	0,1	0,6	10,8	0,2	90,9	4,2	2,8	0,3	0,3
MP	0,2	0,5	4,3	0,4	1,6	79,9	1,2	0,3	0,4
NW	0,1	1,1	3,5	0,2	0,6	0,8	78,3	3,7	0,3
NC	0,4	1,0	0,8	0,6	0,1	0,7	1,3	85,2	1,5
WC	1,7	0,8	1,5	0,3	0,4	0,4	0,5	2,5	71,9
Outside RSA	1,2	2,5	9,5	1,7	3,0	3,7	4,4	1,7	4,5
RSA	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: Statistics SA

2.2.4 Limitations to the national resource curse approach in South Africa

Lahn and Stevens (2018:2) note that the concept of the “the resource curse fails as a generic explanation on account of the huge diversity in country contexts, so does the one-size-fits-all governance solution, which international aid agencies, industry, and banks have promoted in support of ‘extractives-led growth’ since the early 2000s.” Rather, this article assesses how natural resources have been linked to economic gains on a more nuanced sub-national level, to assess where shortfalls are that need to be addressed.

Empirically, most studies analyzing the natural resource curse have relied on cross-country examinations to estimate national effects and inform national policy. While this may be useful, it may mask challenges faced at the local or regional level. A regional or sub-national natural resource curse can still emerge in a region surrounding extractive industries, such as mining activity (Ivanova, 2014), and therefore, the scale of effects of the resource curse may be national or regional (Fleming et al, 2015). It is important to recognize that while symptoms of the resource curse may operate on a national level though macroeconomic changes, they “can have distinctive regional consequences beyond their national effects” (Fleming et al, 2015: 626). On a macro level, there is also the serious problem of endogeneity around the relationship between observed resource wealth and economic or political factors, which is very difficult to account for. Thus, moving away from cross-country and macroeconomic analyses, towards a within country analysis, offers new perspectives on the resource curse debate and can help overcome concerns regarding endogeneity (Cust and Poelhekke, 2015). This paper seeks to answer the question ‘Is there evidence of a sub-national resource curse in post-Apartheid South Africa?’

2.3 Methodology

2.3.1 Selection of case studies

Rather than the homogenous ‘resource-rich’ country approach, this analysis focuses on comparing resource-dependent and non-dependent provinces. The multidimensional indicator for extractives-based development (MINDEX) consists of six different indicators to assess both resource abundance and dependence. These indicators can be broadly grouped into three areas: contribution to the export basket (mineral exports; share of mineral exports in total exports), fiscal linkages (government revenue from mineral rents; share of mineral revenues in total government revenue) and resource reserves and exhaustibility (mineral reserves; mineral rents) (

Table 4) (Lebidioui, 2019). However, none of these indicators are suitable for a sub-national analysis in South Africa given data limitations. Thus, to select provinces for analysis, this article proposes using mining's contribution to provincial GDP. This enables us to understand the relative contribution of the mining sector to the total value of all goods and services produced at the provincial level.

Table 4: Indicators for assessing resource abundance and dependence

	Indicator	National	Provincial	Firm level
Mindex	Contribution to the export basket			
	Mineral exports	Export data only assessed at national level.	Unavailable	
	Share of mineral exports in total exports			
	Fiscal linkages			
	Government revenues from mineral rents	Revenue collected at national level	Unavailable	
	Share of mineral revenues in total government revenue			
	Resource reserves and exhaustibility			
	Mineral reserves	Available		
		Good measure of resource abundance rather than dependence.		
	Mineral rents	Available	Difficult to disaggregate from national data given that resource rents vary substantially by mining methodology (highlighted in Article 2)	Available
Given the data limitations of using the MINDEX indicators for a sub-national analysis, this article uses a different indicator of resource dependence at a provincial level.	Resource dependence			
	Mining’s contribution to GDP	Available	Available	Not available
		Shows mining’s contribution to the total value of all good and service produced at the national level	Shows mining’s contribution to the total value of all good and service produced at the provincial level	

Source: Author's elaborations

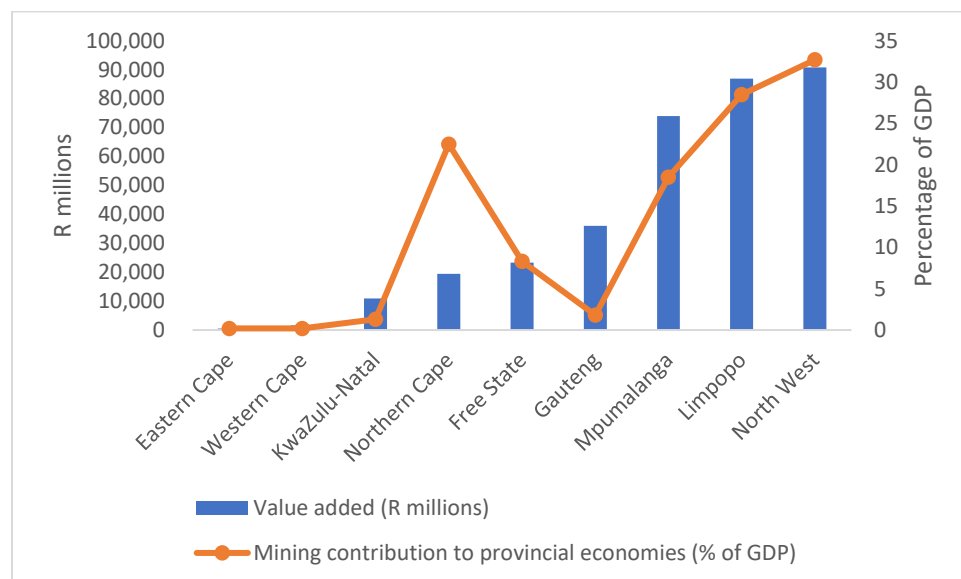
An analysis using national accounts data shows that Limpopo and the North West are the most resource-dependent provinces in South Africa, on the basis of mining's contribution to provincial GDP (Figure 7). Mining contributed to 32.7 percent and 28.5 percent of the North West's and Limpopo's GDP in 2017, respectively (Table 5). Thus, Limpopo and North West were selected as the 'mining provinces' for their relatively high degree of resource dependence.

Interestingly, Gauteng, while extracting R36.1 billion (ranked fourth of nine provinces) in 2017, the mining sector contributed to just 1.8 percent of GDP. Gauteng is home to some of the world's largest gold mines, including TauTona Mine (the world's deepest mine at a depth of 3.9 km with over 800 km of tunnels), Kloof Mine and South Deep Mine (the world's seventh deepest mine, with a depth of 3 meters). The mining

sector's relatively small contribution to provincial GDP is reflective of a diversified economy, making the province resource-abundant but not resource-dependent.

To select comparator provinces for the sub-national analysis, two economically diversified provinces were selected. The Western Cape and Gauteng were selected given that neither are resource-dependent and are amongst the largest contributors to national GDP, together accounting for 48.8 percent.

Figure 7: Assessing provincial resource dependence in South Africa, 2017



Source: Author's own, using data from Statistics South Africa and Minerals Council South Africa

Table 5: Mining sector contribution to provincial GDP (constant prices)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gauteng	3.3	3.2	3.3	3.2	3.2	2.9	2.7	2.3	2.6	2.5	2.4	1.8
Limpopo	31.2	28.4	29.2	30.9	29.5	29.4	28.0	26.7	28.3	28.5	28.3	30.3
North West	36.5	34.8	35.9	37.7	32.9	35.7	34.4	33.3	34.0	33.6	33.0	34.1
Western Cape	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.2

Source: Minerals Council (2019)

2.3.1.1 Mining Provinces: North West and Limpopo

The North West Province is home to the Western Limb of the Bushveld Igneous Complex, a rich mineral formation. Mines in the province produce half of the platinum produced in the world, and 55 percent of South Africa's PGMs. The North West also produces 70 percent of dimension stone and granite, 32 percent of chrome and 20.7 percent of the gold of South Africa. Other minerals produced in the province include diamonds, vanadium, slate, limestone, nickel, silica, manganese, phosphate, fluorspar, zinc and andalusite. The province is home to 300 active mines and the mining sector accounted for 34.1 percent of provincial

GDP in 2019. The sector employed 193,177 workers and paid out R45.7 billion in compensation to employees.

Limpopo Province also has robust mineral reserves, which include the largest copper, diamond, and open-pit platinum mines in South Africa and the biggest vermiculite mine in the world. The province has 41 percent of South Africa's PGMs, 90 percent of South Africa's red-granite resources, and approximately half of the country's coal reserves. The mining sector contributed to 30.3 percent of provincial GDP, employed 48,782 workers and paid out R39.7 billion in compensation in 2019.

2.3.1.2 Non-Mining Provinces: Gauteng and Western Cape

Gauteng has South Africa's largest provincial economy, contributing to 34.9 percent of national GDP. Home to both Pretoria, the capital of South Africa's executive branch, and Johannesburg, the financial capital, Gauteng is a hub of political, economic and social activities. However, the region's economy grew on the back of the gold mining industry. Gold was first discovered on a farm in 1886, and the region became the largest gold producer in the world. Within a decade, a fully town had developed around the gold mining industry and within two more decades, it became South Africa's largest city - Johannesburg. Gauteng diversified early on – the manufacturing and financial sectors took off and mining share of Gauteng's total mining output continued to shrink. In 2019, Gauteng's mining sector contributed to just 1.8 percent of its GDP – far below the North West (34.1 percent), Limpopo (30.3 percent), Northern Cape (24.1 percent) Mpumalanga (19.5 percent), or the Free State (8.7 percent)

The Western Cape has the third biggest provincial economy in South Africa, contributing to 13.9 percent of national GDP. It has a very small mining sector, contributing just 0.3 percent to GDP and employing just 1,531 workers in 2019. The Western Cape played a different role in the mining value chain – it was often the port of exit. For example, the Sishen–Saldanha railway line, also known as the Ore Export Line (OREX), is an 861-kilometer heavy-haul railway line in South Africa that connects Sishen in the Northern Cape with the port at Saldanha Bay in the Western Cape. It transports upwards of 60 million tons of iron ore annually and does not carry passenger traffic. Although the Western Cape has played an important role in the value chain, its share of extraction is miniscule.

For the remainder of the article, 'mining provinces' refers to the resource dependent provinces of the North West and Limpopo while 'non-mining provinces' refers to the non-dependent provinces of Gauteng and the Western Cape.

2.3.1 Selection of indicators

Lahn and Stevens (2018) categorized the various effects discussed in resource literature into two broad groups. The first relates to the impacts of economic dependence on a primary sector with volatile market prices: long-term decline in the terms of trade, revenue volatility, Dutch disease, crowding-out effects. The

second is associated with how mineral wealth is governed: the increased roles of the state, and socio-economic and political impacts. The two groups are not mutually exclusive. The first group could be mitigated with better policy and spending decisions. The second largely focuses on why this does not happen and how resources can affect socio-political conditions, which results in a reinforcement of negative economic effects.

Although slow economic growth is not included in Lahn and Stevens categorization of resource curse symptoms, this article includes it in the economic dependence category (Table 6). In various countries, research shows that non-extractive producing areas experiencing slower growth than producing areas. For example, Zuo and Schieffer (2014) demonstrated that in China, a provincial sub-national resource curse developed as a result of crowding out research and development and education expenditures. Likewise, an analysis of panel data for all 50 US states and 3,000 counties found that resource extraction had a negative impact on subnational economic growth (Cust and Viale, 2016).

Table 6: Potential indicators for assessing a resource curse

	Definition	Measurable at sub-national level?
Economic dependence		
Long-term decline in the terms of trade	A decline in the terms of trade means the price of exports falls relative to imports. Imports become more expensive.	No
Revenue volatility	The extent to which revenue fluctuates over a period. It can be a challenge for both firm and fiscal sustainability.	Yes. Article 2 examines firm-level revenue volatility
Dutch disease	Real exchange rate appreciates	No
Slow economic growth	Slow (or no) increase in in national/sub-national income/output	Yes
Crowding-out effects	A decline in manufacturing output	Yes
How mineral wealth is governed		
Increased role of the state	Expansion of government powers	Not in the case of South Africa, as most policymaking and revenue collection is done at national level
Socioeconomic impacts	Low economic growth; unequitable growth, underdeveloped financial systems, civil conflict, limited incentive to provide educational opportunities and infrastructure, slower skills accumulation.	Dependent on the indicator

Source: Author's elaborations

A key criterion for selecting indicators was data availability at the provincial level – there is a significant narrowing of available data when shifting from a national to sub-national analysis.

Ultimately, two indicators from each of the groups were selected on the basis of data availability and what could be quantified at the sub-national level - for the economic dependence group, real economic growth (Sachs and Warner, 1995; 1997) and the extent to which manufacturing was crowded out were selected (Sala-i-Martin and Subramanian, 2013; Oomes and Kalcheva, 2007). For the governance group, education expenditures (Cockx and Francken, 2016) and access to basic service and infrastructure provision was chosen (Segerstedt and Abrahamsson, 2019). Given the various indicators examined, this article utilized several quantitative data sets.

For economic growth, this article utilized annual accounts data from Statistics South Africa, the national statistical service, on real GDP at a provincial level between 1995 and 2017.

To assess the extent at which mining crowded out tradable sectors, a second data set from Statistics South Africa was utilized on sectoral contributions provincial GDP between 1995 and 2017. However, only the data between 2001 and 2008 was used. This is because the Dutch Disease suggests that increasing mineral prices will translate to contraction of the manufacturing sector. Between 2001-2008 period, platinum prices increased from \$423 per ounce to \$2,132 per ounce, making it a useful time frame to assess the impact on manufacturing. The dataset provided both nominal and real sectoral contributions for ten sectors – agriculture forestry and fishing; mining and quarrying; manufacturing; electricity, gas and water; construction; trade, catering and accommodation; transport, storage and communication; finance, real estate and business services; personal services; and general government services. The nominal data for the manufacturing sector was utilized, as one of the key effects of the Dutch Disease is a decline in manufacturing output rather than value (Oomes and Kalcheva, 2007).

To compare educational expenditures on the provincial level, data was utilized from UNICEF's education public expenditure review. To unpack why educational outcomes were not aligned with expenditures, data from the Department of Basic Education (DBE) on public and private schooling and educational outcomes were used.

And finally, to assess the level of basic service and infrastructure provision, quantitative data from the 2016 Community Survey run by Statistics South Africa is used. The survey was the second intercensal survey since the advent of democracy in 1994. This household-based survey is one of the few available data sources providing data at a provincial and municipal level. All data was collected electronically using Computer Assisted Personal Interviewing (CAPI) system as opposed to the paper collection method used during the first Community Survey in 2007.

2.3.1 Methods

This article examined provincial performance by comparing the data for the four selected indicators in resource-dependent and non-resource dependent provinces to assess whether resource-dependent

provinces were affected by a natural resource curse. The article is also a first-time attempt at conducting a within-country analysis on the resource curse debate in South Africa.

2.4 Analysis

This paper seeks to assess whether the resource curse is present at a sub-national level in South Africa. In particular, it looks at four channels through which literature shows that the curse can manifest – slow economic growth; contraction of the manufacturing sector; low education expenditures and low levels of access to basic services and infrastructure.

2.4.1 Economic growth

One of the core tenants of the resource curse is that mining countries will experience lower growth rates than non-mining provinces. To see if this is evident, real GDP growth is assessed at a sub-national level over a 23-year period. The findings show that economic growth has been larger in mining provinces than non-mining provinces between 1995 and 2017. In fact, Limpopo experienced the highest growth, with provincial GDP increasing by 970.6 percent in real terms. The North West followed, with real GDP increasing by 768.2 percent during the 23-year period. The non-mining provinces experienced slower growth – with the Western Cape and Gauteng growing by 679.7 percent and 727.1 percent, respectively (Table 7). This negates the assertion that mining areas experience slower growth.

Table 7: Provincial real GDP, millions of rand

	1995	2000	2005	2010	2015	2017	Rate of growth
North west	34,724	61,994	106,800	180,221	263,327	301,477	768.21%
Western cape	81,180	133,185	237,406	372,788	552,539	632,990	679.73%
Gauteng	192,709	321,208	563,352	937,178	1,382,409	1,593,874	727.09%
Limpopo	31,783	60,300	108,398	202,196	289,106	340,273	970.60%

Source: Statistics South Africa

2.4.2 Dutch Disease and Crowding Out

The Dutch Disease hypothesis suggests that an exogenous increase in resource prices or in resource output will result in real exchange rate appreciation and a decline in manufacturing (Corden, 1984; Corden and Neary, 1984). Given the sub-national analysis, it is not feasible to assess the real exchange rate appreciation. Instead, this section focuses on the growth of the manufacturing sector during the 2001-2008 period, in which platinum prices increased from \$423 per ounce to \$2,132 per ounce. This time period offers an interesting comparison as over 90 percent of South Africa's PGMS are mined in the North West and Limpopo.

Oomes and Kalcheva (2007) argue that if the resource curse is present, there should be an unambiguous decline in manufacturing output.

When assessing the growth of the manufacturing sector over time, a nominal indicator is a good measure of output while a nominal indicator is a good measure of value, as the former is in constant prices and the latter in current prices. During the 2001-2018 period when platinum increased by 400 percent, manufacturing's share of GDP in nominal terms increased by 28.67 percent in Limpopo and 31.14 percent in the North West (the mining provinces). On the other hand, it increased by 25.34 percent in the Western Cape and 31.67 percent in Gauteng, indicating that Gauteng had the highest increase in manufacturing amongst the four provinces, while Limpopo had the lowest. These numbers do not show absolute de-industrialization (negative manufacturing growth) (Table 8).

While manufacturing does grow relatively slowly between 2001 and 2008 compared to other sectors, ranking 8th in Limpopo and the Western Cape, 7th in Limpopo and 9th in the North West (out of 11 sectors) – this is consistent across mining and non-mining provinces, indicating widespread relative de-industrialization (

Table 9). Nationally, manufacturing's share of GDP increased by 29.4 percent between 2001 and 2008 – while Limpopo, Gauteng, the North West and Western Cape increased by 28.7 percent, 31.7 percent, 31.1 percent and 25.3 percent, respectively. On average, these provinces, increased by 29.2 percent between 2001 and 2008, closely aligned with the national increase on 29.4 percent.

During this same time period (2001-2008), the mining sector experienced contracted in nominal terms in both Gauteng and the Western Cape, at -13.8 percent and -9.4 percent, respectively. On the other hand, the mining sector grew in real terms in both of Limpopo and the North West, at 7.8 percent and 0.7 percent, respectively.

Table 8: Sectoral contributions to real GDP, 2001-2008

	2001	2002	2003	2004	2005	2006	2007	2008	Rate of Change (%)
Manufacturing (millions of rand)									
North West	7603	7938	7643	8080	8683	9206	9752	9971	31.14%
Western Cape	45882	46385	45312	47983	50545	53708	56472	57507	25.34%
Gauteng	118635	122610	121015	126941	135696	144758	152317	156211	31.67%
Limpopo	4466	4538	4468	4692	4894	5231	5573	5747	28.67%
Mining and quarrying (millions of rand)									
North West	57824	54589	59348	60419	60716	62125	60972	58228	0.70%
Western Cape	986	974	986	999	1051	993	961	894	-9.38%
Gauteng	32234	32826	30829	30634	33429	30551	30162	27798	-13.76%
Limpopo	50022	53698	55182	56068	55594	55667	56511	53908	7.77%

Source: Statistics South Africa

Table 9: Growth rates in in sectoral contributions to real GDP, 2001-2008

Industry	Limpopo (%)	Gauteng (%)	North West (%)	Western Cape (%)
Agriculture, forestry and fishing	62.75	19.49	47.67	35.35
Mining and quarrying	7.77	-13.76	0.70	-9.38
Manufacturing	28.67 (ranked 8 th of 11)	31.67 (ranked 7 th of 11)	31.14 (ranked 9 th of 11)	25.34 (ranked 8 th of 11)
Electricity, gas and water	45.92	29.40	39.40	23.68
Construction	65.57	127.84	77.82	133.69
Trade, catering and accommodation	26.61	41.09	32.40	34.20
Transport, storage and communication	50.67	52.04	50.80	50.41
Finance, real estate and business services	48.17	60.16	59.69	58.15
Personal services	33.40	34.09	32.14	30.96
General government services	21.52	28.13	22.60	24.99
Taxes less subsidies on products	31.28	37.10	31.57	36.82
GDP at constant prices	26.07	39.65	23.12	40.72

Source: Statistics South Africa

Based on the data, there is not a case for absolute de-industrialization and a razor thin case for relative de-industrialization during the 2001-2018 period when platinum prices rose by just over 400 percent. Part of this was because of the Motor Industry Development Programme, which was a sector-specific industrial policy that used various protectionist mechanisms to support the automotive manufacturing industry. Catalytic convertors are South Africa's biggest automotive component export segment and the industry is the biggest local beneficiary of the country's PGMs. Hirsch (2005) cites the MIDP as one of the "notable successes" (Hirsch, 2005:159) of post-Apartheid economic policy and notes that "the automobile assembly and component sectors were strongly assisted by a well-designed Motor Industry Development Programme" (Hirsch 2005: 250). The MIDP helped build downstream linkages to ensure that manufacturing did not fall to the wayside as platinum prices increased.

2.4.3 Education

Increases in government education spending are associated with improvement in access to and attainment in schools (Gupta et al, 2002; Baldacci et al, 2003). Contrary to other government expenditures, education expenditures have been associated with growth in both developing and developed countries (Blankenau et al, 2007 and Bose et al, 2007). Baldacci et al. (2008) found that education expenditures positively affects education capital, which translates to higher economic growth in developing countries.

Using a large panel dataset of 140 countries covering the period from 1995 to 2009, Cockx and Francken (2016), found that natural resource dependence is associated with lower public education expenditures relative to GDP. They found that the resource curse on education remains significant even after controlling

for several additional factors (income, aid, age structure) that have been found to play an important role in explaining public education expenditure patterns.

To assess the presence of this on a sub-national level, provincial education expenditures were drawn from a public expenditure review done by UNICEF while provincial GDP was drawn from the same Statistics South Africa data set used earlier. Findings show that Gauteng and the Western Cape – the ‘non-mining’ provinces – had a lower share of education expenditures – than the ‘mining’ provinces of Limpopo and the North West. Between 2004 and 2018, the Western Cape averaged 3.2 percent, Gauteng averaged 2.5 percent, the North West averaged 5 percent and Limpopo averaged 10 percent (Table 10).

Table 10: Share of education expenditures in provincial education budgets

	2014/5 (%)	2015/6 (%)	2017/8 (%)
Western cape	3.2	3.2	3.2
Gauteng	2.4	2.6	2.6
North west	4.9	5.0	5.0
Limpopo	8.9	8.7	12.5

Source: Author’s calculations using Stats SA and UNICEF data.

However, contrary to Gupta et al (2002) and Baldacci et al (2003)’s assertions that increases in government education spending are associated with improvement in access to and attainment in schools, performance was lower in non-mining provinces in two indicators. The first outcome is school dropout rates. Although matric (secondary completion) pass rates were relatively good in the Western Cape (86 percent), Gauteng (85 percent), and the North West (82 percent), compared to Limpopo (63 percent) in 2016, these numbers mask a much deeper problem – high dropout rates. In 2016, the Free State province had the highest Matric pass rate nationally, with 88.2 percent of learners passing. However, the Free State also had more than half (51.6 percent) of its learners drop out between 2014 and 2015, which would make the ‘real’ pass rate far lower than the Western Cape, Gauteng and Mpumalanga. Thus, looking at dropout rates can be a key way to assess educational outcomes. There is a substantial gap in dropout rates between ‘mining’ and ‘non-mining’ provinces, from 33 percent in the Western Cape to 53 percent in the North West (

Figure 8: Secondary school dropout rates, 2016

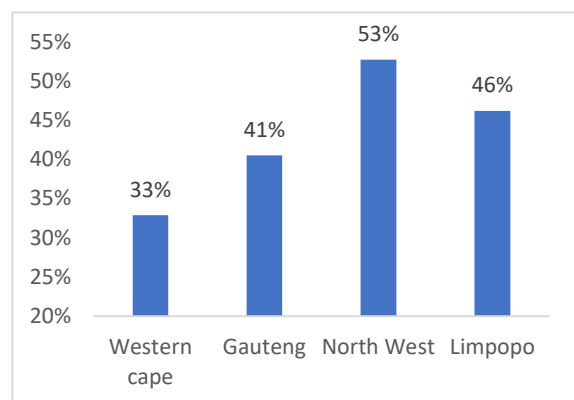
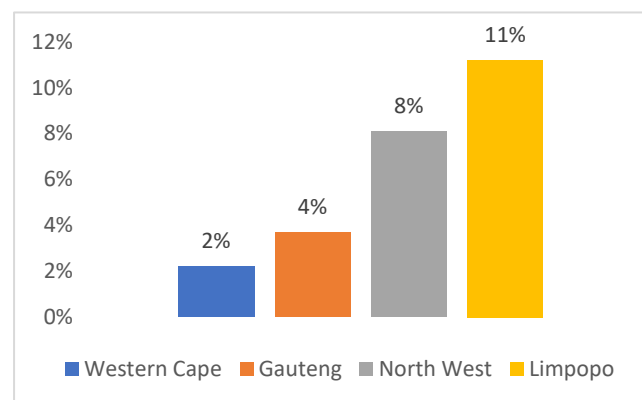
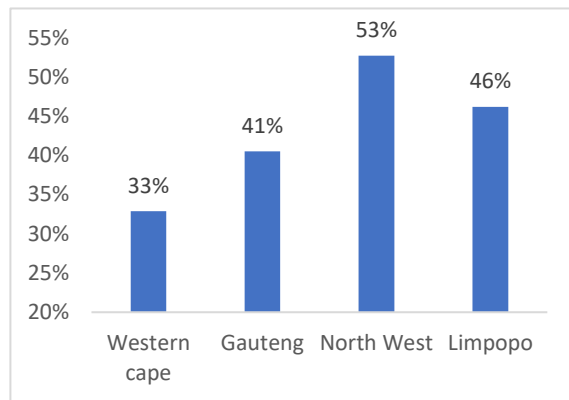


Figure 9: Share of population without any schooling



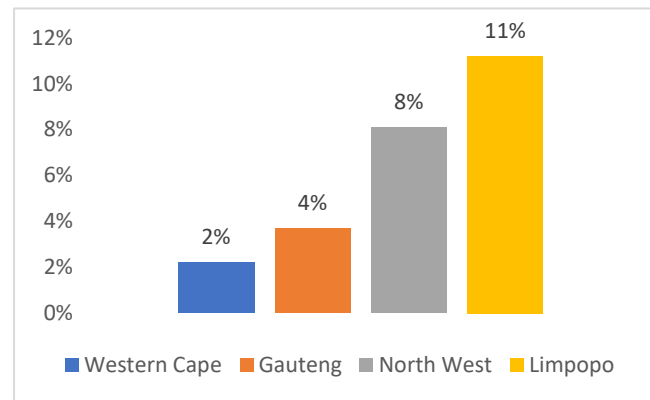
). The second outcome was the share of the adult population without any schooling. Again, there is a substantial gap in the share of the population who has no schooling – from 2 percent in the Western Cape to 11 percent in Limpopo (Figure 9). These two indicators suggest that ‘mining’ provinces have poorer access to, and attainment in, schools.

Figure 8: Secondary school dropout rates, 2016



Source: BusinessTech (2017a; 2017b) using DBE data.

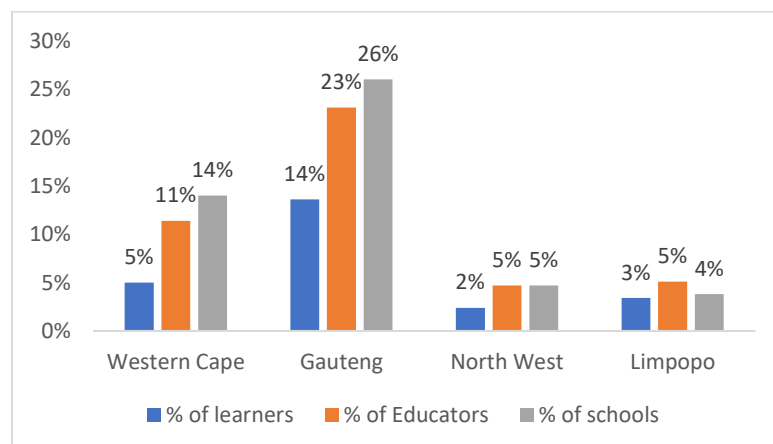
Figure 9: Share of population without any schooling



Source: Statistics South Africa, Community Survey, 2016

A key contributor to this dynamic is the high prevalence of independent schools in the ‘non-mining’ provinces. Education in South Africa is highly dualistic - South African Schools Act (SASA) of 1996 established a national schooling system and recognized two types of schools: public and independent. Public schools are state controlled and independent schools are privately governed. All private schools are independent schools. The Western Cape and Gauteng account for 40 percent of nation’s independent schools and are the two provinces that have the highest rates of learners, educators, and schools in the independent school sector (Figure 10). This is partially owing to higher levels of education and affluence in these two provinces, particularly within cities like Johannesburg, Pretoria and Cape Town. The North West and Limpopo, on the other hand, have just 7.9 percent of the nation’s independent schools. Thus, given a much larger reliance on public education, it is unsurprising that the North West and Limpopo, despite being resource-rich, spend a larger share of their GDP on education (Table 10).

Figure 10: Distribution of learners, educators and schools in the independent school funding type, as a percentage of provincial totals, 2016



Source: Department of Basic Education data

2.4.4 Access to basic services and infrastructure

In theory, ‘mining’ provinces should have reasonably developed infrastructure because the national government should collect taxes on the mines and spend them on the provision of basic services and infrastructure in mining areas. In 2017, the mining sector paid the Government of South Africa R19.9 billion in corporate taxes, which amounted to 9.8 percent of all corporate income tax. Yet, history has excluded rural areas from economic development and local areas are rarely key beneficiaries of mining activities. This is aligned with the staple trap model which suggests that high rents incentivize political and economic agents to pursue rent-seeking behavior promotes corruption, rather than investment and savings. If the staple model holds true, then mining provinces may have lower access to basic services and infrastructure. This article uses four indicators identified as priorities by the United Nations Sustainable Development Goals (SDGs) - clean water, electricity, hygienic toilets, and internet. Though internet may seem more non-essential than the others, the reality is that the internet has become a provider of information and opportunities and is becoming a more ‘essential’ form of infrastructure and is identified as a priority in the SDGs.

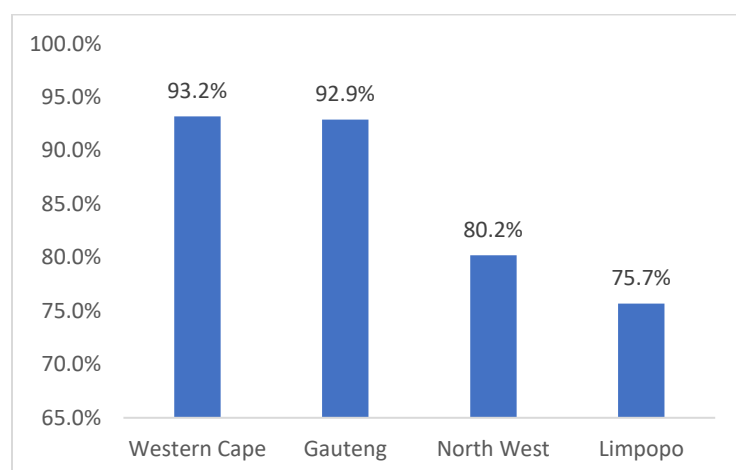
2.4.4.1 Water

Water infrastructure is critical for many of life’s day-to-day activities, including having clean drinking water, bathing, cleaning and for toilets. Goal 6 of the SDGs focuses on universal and equitable access to safe and affordable drinking water, improving water quality, increasing water-use efficiency, and improving water resource management amongst other water-related areas.

In the North West, only 80.2 percent of people have access to clean drinking water. The Community Survey in 2016 (run nationally) showed that 31.4 percent of residents ranked lack of safe and reliable water supply as the leading problem faced by municipalities in the North West, followed by lack of/inadequate employment opportunities (11.1 percent), inadequate roads (10.9 percent), cost of water (5.7 percent) and lack of reliable electricity supply (5.5 percent). There is a perceived lack of effort from Government. Just 4.5 percent of survey respondents in the North West strongly agreed that their municipality was trying to solve lack of safe and reliable water supply compared to 48.9 percent of respondents who strongly disagreed that Government was trying to solve this problem.

Limpopo fared worse. Just 75.7 percent of households have access to clean drinking water. And the Community Survey (2016) showed that 42.2 percent of respondents in Limpopo ranked lack of safe and reliable water supply as the leading problem, followed by inadequate roads (12.2 percent), lack of/inadequate employment opportunities (11 percent), cost of water (7.1 percent) and cost of electricity (4.5 percent). On the other hand, in the Western Cape, despite strong drought conditions, 93.2 percent of respondents have access to clean drinking water, and 92.9 percent of respondents in Gauteng have access to clean drinking water (Figure 11).

Figure 11: Access to safe drinking water



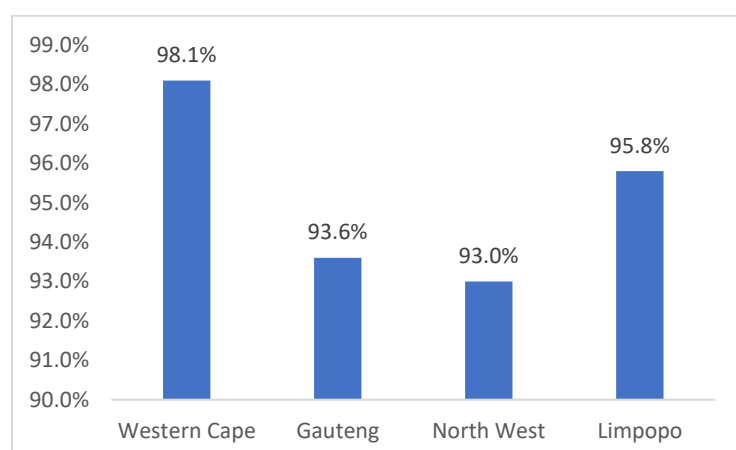
Source: Community Survey 2016

2.4.4.2 Electricity

Rural areas around often the last to get electrified. According to the United Nations, globally, of those getting access to electricity since 2010, 80 percent are urban dwellers. Access to energy is important for all facets of life –as it can help catalyze advancements in health, education, water supply, and improve overall productivity as many sectors become less labor-intensive and more technologically-intensive. Goal 7 of the SDGs is to ensure access to affordable, reliable, sustainable and modern energy for all. But energy access can vary widely.

However, mining provinces do not have lower rates of electricity access compared to non-mining provinces. Using data from the 2016 Community Survey, in the Western Cape and Gauteng, 98.1 percent and 93.6 percent of respondents reported having access to electricity, compared to 93 percent and 95.8 percent of residents in the North West and Limpopo, respectively. Thus, the North West had the highest share of population without access to electricity, followed by Gauteng, Limpopo, and the Western Cape (Figure 12).

Figure 12: Access to electricity



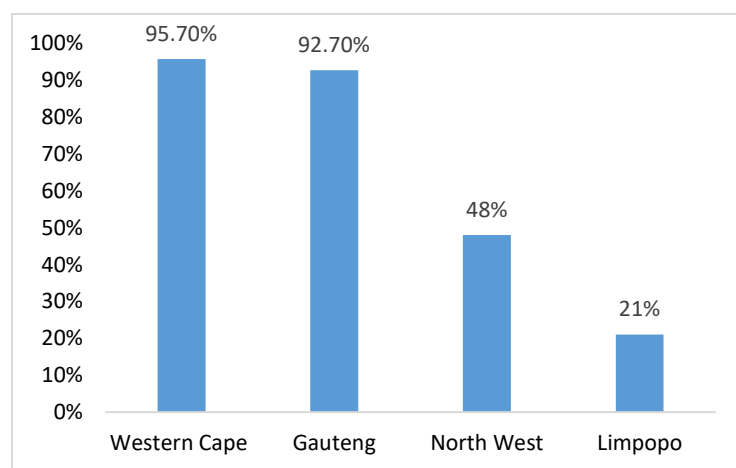
Source: Community Survey 2016

2.4.4.3 Toilets

Goal 6 of the SDGs is to achieve universal access to adequate and equitable sanitation and hygiene and end open defecation by 2030. Proper toilets are critical to protect people and the environment from disease agents. The United Nations notes that when someone has a safely managed sanitation service if they use hygienic toilet facilities that are not shared with other households and where excretions are either separated from human contact and safely disposed of in situ or transported and treated off-site. Although this can include flush/pour flush toilets connected to piped sewer systems, septic tanks or latrine pits, ventilated improved pit latrines, composting toilets; or, pit latrines with slab covers, pit latrines have proved to be problematic in South Africa. In 2018, President Cyril Ramaphosa committed to getting rid of pit latrines in schools after a number of young children fell in and died.

Data shows that in the non-mining provinces of Gauteng and the Western Cape, 95.7 percent and 92.7 percent of households have access to a flush or chemical toilet, respectively, compared to just 48 percent and 21 percent of households in the North West and Limpopo, respectively (Figure 13). This indicates a substantial disparity in sanitation infrastructure.

Figure 13: Access to flush or chemical toilet



Source: Community Survey 2016

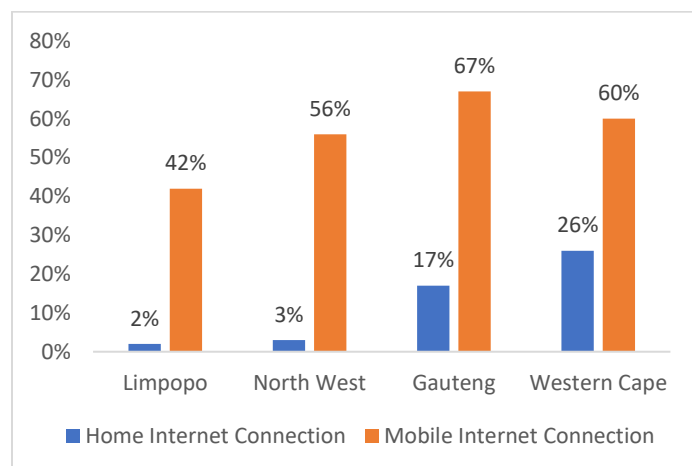
2.4.4.4 Internet

Goal 9 of the SDGs aims to, “Significantly increase access to ICT and strive to provide universal and affordable access to the Internet in least developed countries by 2020.” Digital infrastructure is a key enabler of cluster development – it enables information sharing, which is important for social inclusion; supports education given that individuals can undertake independent training and reskilling to create economic

opportunities; and is important for local enterprise development given that micro, small and medium enterprises (MSMEs) can use digital channels to increase revenue, lower costs, boost productivity, and create jobs. It is also critical for increasing uptake of digital financial services, which can overcome challenges such as long travel times to reach ATM machines and bank branches and serve as a gateway for more sophisticated financial products and services. For example, In South Africa, of the 5.3 million adults who do not have any bank account, 48 percent live in rural areas which makes it difficult to service them with traditional financial products that rely on physical access points (Finmark, 2019).

There is a significant “digital divide” between ‘non-mining’ provinces and ‘mining’ provinces. Just 2 percent and 3 percent of households in Limpopo and the North West have internet connectivity at home, compared to 26 percent and 17 percent in Gauteng and the Western Cape, respectively (Figure 14). South African operators have often avoided connecting rural areas because of high infrastructure costs for both fixed and mobile broadband. Without tax incentives from the government, investors are more likely to focus on areas with high population density. This can widen inequality between mining and non-mining provinces.

Figure 14: Percentage of households with access to the Internet at home, or for which at least one member has access to, or used the Internet any place via a mobile cellular phone.



Source: Statistics South Africa, 2018, General Household Survey

2.5 Discussion

The mining sector has played a key role in reducing poverty. Although the number of people employed in the mining industry has dropped steadily from 518,725 people in 2008 to 456,438 people in 2018, representing only 6.2 percent and 4 percent of total private non-agricultural employment and total non-agricultural employment, respectively, each worker directly employed by the sector supports ten dependents. As a result, in 2017, the mining industry alone supported an additional 4.5 million dependents (Minerals Council 2018; 2019). Additionally, each mining job indirectly creates two additional jobs in downstream supporting industries (Kane-Berman, 2018). When accounting for those directly employed by

the sector as well as the dependents they support, approximately 10 percent of South Africa’s population is reliant on the mining sector for livelihoods. Still these benefits are not necessarily sustainable. In October 2019, Minerals Council SA then announced that in the PGM sector, 90,000 of 168,000 jobs – or 54 percent of the sector’s employment – was now at risk.

2.5.1 Mining revenue mobilization to finance development

The mining sector’s contribution to government revenue has declined substantially – from a high of nearly 29 percent in 1981 (of which 93 percent came from gold) down to just 2.5 percent in 2013/14 with a negligible contribution from gold (IMF, 2015). An analysis that the author contributed to published by the World Bank in 2019 showed that revenue of the mining sector was just 1.3 percent in 2017 – a fraction of the sector’s contribution to GDP (7.3 percent). Payroll taxes exceeded corporate taxes for the mining sector, royalties only accounted for 0.6 percent of total revenue and value-added tax (VAT) collections were negative due to high refunds. Table 11 shows the breakdown of all tax and non-tax forms of revenue generated by the sector. All taxes are paid to the national government, with the exception of a specific royalty. The MPRDA delineates two types of royalties: “state royalties” as the revenue share payable to the government and “contractual royalties” are a payment to the owners of the land for the mining and production operation.

Table 11: Fiscal revenue from the South African mining sector

	ZAR billions	% of total revenue
Total Revenue	1336.2	100.0
Revenue from the mining and quarrying sector	17.0	1.3
Non-tax	7.8	0.7
Mineral royalties	7.6	0.6
Mining leases and ownership	0.2	0.0
Tax	9.2	0.7
Personal income tax	21.1	1.6
PAYE	20.6	1.5
Individuals with business Income	0.5	0.0
Corporate income tax	13.4	1.0
Value-added tax	-25.3	-1.9
Domestic VAT	10.9	0.8
Import VAT	3.6	0.3
VAT Refunds	-39.8	-3.0

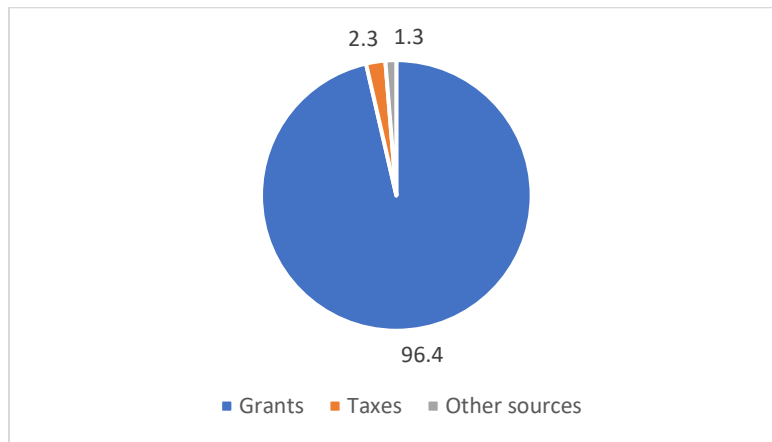
Source: World Bank (2019) using South African Revenue Service Tax Statistics, and National Treasury’s 2019 Budget Review.

South Africa’s institutional architecture is governed by the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) which introduces and sets up the structure of a three-sphere government (national, provincial and municipal), and how cooperation should take place between these three spheres and specifies responsibility in terms of governance and powers for managing the budget at the national, provincial, and municipal levels. The Public Finance Management Act, 1999 (Act No. 1 of 1999) (PFMA)

then specifies how revenue can be raised and how the budgeting process takes place at each level of government.

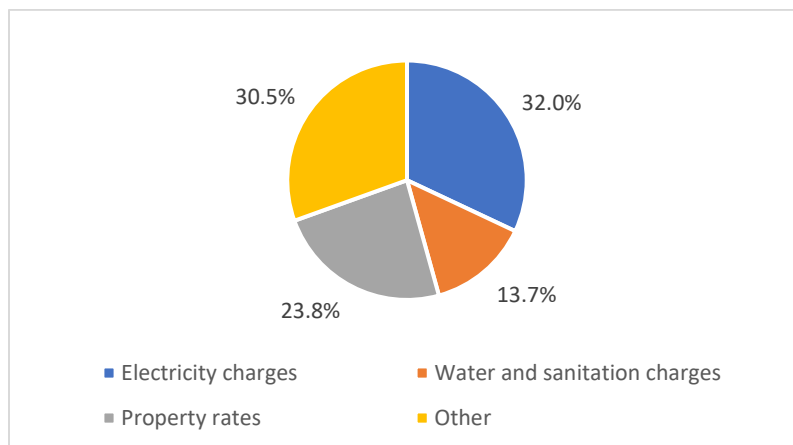
Provincial governments are reliant on transfers from the national government for 96.7 percent of its revenue, raising just 2.3 percent on their own through taxes (Figure 15). Provincial governments tax revenue largely comes from motor vehicle license fees, as well as taxes for specific sources (gambling and betting) and excises taxes (Statistics South Africa). On the other hand, municipal governments are expected to be largely self-financed through revenue raised from electricity sales, water and sanitation charges, and property taxes. For example, the City of Cape Town generates 69.5 percent of its revenue from these three mechanisms (Figure 16).

Figure 15: Sources of provincial government revenue for 2016/7



Source: Statistics South Africa

Figure 16: Sources of revenue for Cape Town Municipality (2018/9)



Source: Simpson et al (2019)

South Africa's intergovernmental fiscal system is largely considered a success of South Africa's democracy. Prior to 1994, the country had a centralized budget process, which made allocations based on racial lines, spending disproportionately less on non-white areas. However, after the advent of democracy,

the country developed a decentralized budgeting system, with significant resources allocated to areas that has been underserved. Over the medium-term expenditure framework (MTEF) period (2020-2023), after budgeting for debt-service costs, the contingency reserve and provisional allocations, 48.2 percent of nationally raised funds are allocated to national government, 43 percent to provinces and 8.8 percent to local government (National Treasury, 2020).

Provincial governments play an important role in addressing spatial inequality and unequitable development outcomes. According to the Constitution, provinces have legislative and executive powers, concurrent with the national sphere, in areas such as regional planning and development, urban and rural development, welfare services, human settlements and education amongst others. Because mining revenue is largely mobilized at the national level and then transferred to the provincial level, there is a need for greater cooperation and oversight to ensure that development objectives are financed effectively.

2.5.2 The use of public-private partnerships to finance development

When it comes to internet infrastructure, the rollout of optical fiber for high speed broadband has traditionally been viewed as being viable in densely populated, high-income areas. As a result, a key governance challenge is digital inclusivity is supporting the roll out in historically excluded areas while preserving private incentives to invest. Global experience has shown us that in areas where returns on investment may be lower (compared to high-income, densely crowded areas), alternative forms of financing have been used to prevent these areas from becoming digitally excluded. This includes direct subsidies (EU, US, and Chile), indirect subsidies, such as lower interest rates or tax breaks (Japan), public private partnerships (Mexico) and publicly built networks (Australia) (OECD, 2014).

The allocation of subsidies must be carefully managed to prevent an adverse effect on the incentives of private firms to invest. For example, if the government provides an operator with a subsidy to build infrastructure where one has already been deployed with private financing, this can reduce the value of the initial investment. To tackle this, the European Union broadband guidelines outline three types of geographical areas and what types of subsidies they can receive. The color-coded zonal model (black, white and gray) is a useful conceptual instrument to differentiate areas where no infrastructure exists (white); where only one infrastructure is in place (gray); and where more than one network operator is present (black) (

Table 12). The white zones require a public intervention to support common interest and therefore state subsidies are sensible. Gray zones require a more detailed assessment, given limited competition. If there is only a single infrastructure-based operator, but multiple active retail providers using this infrastructure network, the area is still categorized as gray. And black zones are assumed to have no market failure given that broadband services are provided under competitive conditions. This zonal classification requires countries to consider existing infrastructure as well as tangible investment plans by telecommunications operators to deploy networks in the short to medium term. The subsidy provision varies - white zones are

eligible for a government subsidy, gray zones are only eligible under specific circumstances, and black zones are ineligible (Elixmann and Neumann, 2013; OECD, 2014; World Bank, 2019)

Table 12: European Union’s digital infrastructure subsidy model

Geographical category	Characteristics	Government subsidy allowed?
White	Areas where no broadband services are available and where network expansion by private investors is not expected for at least 3 years	Yes
Grey	Areas where one network operator is present, and another network is unlikely to be developed in the near future. State support in grey areas is justified if no affordable or adequate services are offered to satisfy the needs of citizens or business users and if there are no less distortive measures available (including ex ante regulation) to reach the same goals	Yes, but only under specific circumstances
Black	Areas where at least two broadband network operators are active.	No

Source: OECD (2014b)

2.4.1 Reducing exposure to sub-national revenue volatilities.

When examining the economic indicators of the resource curse at a sub-national level – GDP growth in real terms and manufacturing output – a resource curse is not present at a sub-national level. Still, given that both Limpopo and North West rely on the mining sector for close to a third of GDP, building linkages and driving economic diversification is important. Without linkages and diversification, they are highly vulnerable to exogenous supply and demand shocks (explored further in the next article). Economic diversification requires attracting investments in key sectors and reskilling labor to work in these sectors. In terms of developing linkages, Hidalgo et al (2007), note that new capabilities can be more easily accumulated if combined with others that exist already. The use of industrial policy incentives may be a key avenue for increasing domestic beneficiation. One of the core linkages for the platinum group metals industry is the manufacturing of catalytic convertors. The catalytic converter industry in South Africa developed largely as a result of the Department of Trade and Industry’s MIDP incentive scheme - which was discontinued in 2013. The current projections for local PGM beneficiation via catalytic converters reflect a downward trend, due to production being moved to other countries as a result of policy uncertainty around government incentive programs. Although the global market for catalytic convertors is expected to grow at a cumulative average growth rate (CAGR) of ~2.9 percent over the next five years, South African PGM producers have opted for long-term contractual agreements with major refineries and manufacturers elsewhere – currently China and Europe are the largest suppliers of automotive catalytic converters, respectively (Absolute Reports, 2019). There is a large opportunity for South Africa to integrate itself into the manufacturing of hydrogen cell fuels (which require PGMs) as vehicle emissions regulations continue to become more stringent.

In terms of the governance indicators, the outcome is different. While education expenditures as a share of GDP are not lower in mining provinces, the outcomes are worse. This is likely because of the highly dualistic education market in both Gauteng and the Western Cape, which are home to 40 percent of the country's independent schools, compared to just 9 percent in the North West and Limpopo. From a policy perspective, this indicates that further attention and resources are required to boost education outcomes in mining provinces. When it comes to provision of basic services and infrastructure, mining provinces fare considerably worse in three of the four indicators – water, toilets and internet infrastructure. For the first two, the provincial governments need to work to ensure efficient use of transfers.

2.5 Conclusion

This article has sought to answer the question “Is there evidence of a sub-national resource curse in post-Apartheid South Africa?” While not all of the traditional ‘curse’ indicators can be used given data constraints at a sub-national level, this article has looked at two economic dependence indicators (real GDP growth and contraction of manufacturing output) and two governance indicators (education expenditures and access to basic infrastructure). From this analysis, it is evident that there is not a clear resource curse on the economic dependence side, whilst a minor resource curse may exist on the governance side. Importantly, many of these challenges can be missed when looking at national level data. Undertaking a provincial level – and perhaps a more granular municipality level – is critical for bridging the development gaps facing mining areas. Industrial policy incentives to create and strengthen economic linkages may not be a priority when looking at national level data, but a provincial analysis shows that if a single sector, such as PGMs faced a significant exogenous shock, both the North West and Limpopo Provinces could be economically devastated. This article has affirmed the importance of a sub-national analysis to identify policy priorities to bridge disparities between mining and non-mining provinces.

Article 2: Firms' Approach to Bridging and Buffering to Mitigate Risks in the Platinum Group Metals Sector

Abstract

With platinum prices declining due to a seismic demand shift and firms grappling with the high cost of labor and prolonged production-stopping labor strikes, the financial sustainability of platinum group metals (PGM) firms has come under duress since 2012. This article seeks to understand how mining firms have reshaped their strategies to ensure financial sustainability while also meeting external expectations of increasing shared-value outcomes by assessing how firms are deploying buffers and bridges. Firms use buffers when they seek to protect core business activities from external influences, such as volatile demand and pricing, by shifting their overall business strategy and bridges to conform with external expectations of improve shared value outcomes. The article constructs a case study using five sets of data to assess (i) what supply and demand shocks firms are facing; (ii) how they are reshaping their strategies and undertaking activities to protect the firm from these shocks; (iii) what challenges firms face with reaching shared-value outcomes; and (iv) how firms are undertaking activities to improve shared-value outcomes. This article finds that although buffering activities have been successful at increasing the financial sustainability of mining activities, bridging activities have been less successful given that royalties are vulnerable to maladministration, the impact of corporate social investments often short-lived and insular and local procurement is limited to low value-added activities, particularly in the context of mechanization. This article seeks to contribute to the body of literature on how extractive firms are responding to supply and demand shocks and argues that a paradigm shift may be necessary in which traditional bridging activities become part of protecting core business activities to ameliorate the risk of losing a firm's social license to operate.

3.1 Introduction

3.1.1 Background

Between 2002 and 2008, platinum prices increased by 354 percent. Given that South Africa owns 75 percent of the world's platinum deposits, firms benefited immensely from this unprecedented rise. For example, Anglo Platinum's earnings rose by 43 percent (\$1.8 billion) between just 2004 and 2005. The majority of platinum mined during this time came from large industrial mines located on South Africa's platinum belt, found in the North West Province near Rustenburg, Marikana and Brits. It was an immensely profitable

time for mining firms.¹⁵ The City of Rustenburg was labelled as the ‘fastest growing city in Africa’ after Cairo (Rajak, 2012). However, by July 2009, the ‘boom’ was starting to fade. Anglo Platinum announced a 69 percent decline in profits, to \$1 billion for the first half of the year, and by the end of the year retrenchments began to reduce operating costs (Rajak, 2011).

Although the boom and bust cycle is not new to Rustenburg, South Africa, or mining towns across the world, this cycle could be permanently disrupted by technological changes to the automotive sector. Without many other high value-added uses for platinum, this decline has the potential to become secular rather than cyclical. In general, the mining sector globally is cyclical in nature, as varying supply and demand factors contribute to cyclical business conditions. A cyclical market is characterized by peak-trough-peak movements – often referred to ‘booms’ and ‘busts’ in mining. On the other hand, a secular market is a long-term event with persistent conditions irrespective of economic slowdowns and cycles. One such example of a secular market is the tin sector in Cornwall. An analysis by Addison and Ghoshray (2020) found that shocks to metal prices tend to be short-lived and cyclical for metal such as lead, manganese, nickel, steel, tin, zinc, and silver. However, for copper, gold and platinum, price shocks are unlikely to dissipate quickly and could be long-lived or permanent.

Consumer behavior and the legislative environment will both shape the future demand for PGMs. The demand for vehicles may permanently change as a result of the Covid-19 pandemic. It is possible that even after the pandemic is over, more people will work from home and overall commuting will decline as the world has gotten used to a ‘new norm.’ For example, during Covid-19 traffic declined by around 80 percent in many European cities, which meant that a typical car was only in use 1 percent of the time (Fengler, 2020). This could lead to a long-term decline in demand for automobiles. If it is indeed a secular market, the implications of these changes would have a significant effect on the nearly 200,000 workers employed by the PGM sector, would face increasing job insecurity. Inversely, an increase in demand clean vehicles could prevent a long-term secular decline. Fuel cells generate electric power – and they are similar to a battery but do not need recharging and can run indefinitely when supplied with fuel. The cells produce electricity by combining hydrogen (the fuel) and oxygen (from air) over a catalyst such as platinum or palladium.

3.1.2 Impact of Technological Changes on PGM demand

The platinum group metals (PGMs) are comprised of coupled elements that, due to chemical similarities, always found together in deposits (Wellmer, 2008). PGMs include light metals (ruthenium, rhodium and palladium) and heavy metals (iridium, osmium and platinum), and their primary function is as catalysts in

¹⁵ An article in the Financial Times highlighted this, noting that ‘mining companies are generating so much cash at the moment due to high metals prices that it sometimes appears hard for them to know how to spend it.’ ”

the chemical and automotive industries, for the cleaning of exhaust emissions. They are chemically similar, and thus, are co-precipitated in the ore creation process. As a result, they are found, mined and processed together (Renner and Wellmer, 2019). The share of each metal in a deposit can vary. Each element is produced in different quantities, depending on the characteristics of the ore deposits. These ratios are rarely aligned with market needs (Kelser, 1994). Within families of coupled metals, there are only one or a few elements that are key drivers for the production level (Renner and Wellmer, 2019).

3.1.3 Literature Review

According to Surujlal et al (2014), between 2000 and 2012, the platinum group metal basket price per platinum ounce sold increased at a cumulative average growth rate (CAGR) of 8 percent in South Africa in rand terms. During the same time frame, industry cash operating costs per platinum ounce increased at a compound annual growth rate of 15–18 percent. The increased operating costs were largely a result of higher-than-inflation input costs including wages, electrical components, electricity, explosives, support material, reagents, and diesel. When coupled with anticipated uncertainty of the operating and market environments in the medium to long-term, the changes required firms to re-evaluate their operating strategies in an oversupplied market. As part of this process, choices and tradeoffs must be undertaken that shift firms to a different operating trajectory while providing stability and sharpening competitive advantage in a largely undifferentiated industry.

Part of reshaping firms' strategies requires addressing both internal and external risks. Internal risk can be addressed by making organizational changes, careful implementation and strong monitoring. External risk, driven by the uncertainty in the environment, is partly mitigated by anticipating potential challenges in the operating environment. A range of tools, techniques, and approaches can be deployed as part of the strategic planning process in the mining industry.

Commencing in 2010, Anglo Platinum, Impala Platinum, and Royal Bafokeng Platinum began struggling with profitability, while Lonmin was unable to recover from the Marikana Massacre and was acquired by Sibanye-Stillwater during the course of this research. According to Fennell and Alexander (1987), there are two 'sets' of instruments that firms have used to reduce risk – bridges and buffers. Firms use buffers when they seek to protect core business activities from external influences, such as volatile demand and pricing, by shifting their overall business strategy. Firms use bridges to manage their environment through various negotiation tools, which can include instruments to improve community relations, such as expanding corporate social responsibility spending, paying royalties, and engaging in local procurement to build linkages with local communities. This paper assesses how PGM mining firms have used bridges and buffers to reduce their risk exposure as the industry has undergone a transformation.

3.1.4 Literature Gap

Little research has been done on how mining firms are responding to fiscal sustainability challenges, while also facing pressure to more equitably distribute mining-generated benefits to communities surrounding the mines, particularly within the South African context. Although work has been done on various bridging mechanisms such as royalties (Manson & Mbenga, 2003) and corporate social responsibility (Rajak 2011, 2012) within the PGM sector, a gap remains with how firms balance protecting their core business activities and profitability, with meeting external expectations for supporting communities. The mining sector is inherently volatile and vulnerable to exogenous factors, such as supply and demand shocks. Understanding how mining firms bridge and buffer amidst commodity cycles offers valuable insight in how the sector can remain sustainable, both financially and in terms of maintaining their social license to operate. In Ernst and Young's 2019-2020 survey of mining firms globally, a social license to operate was ranked the single largest risk facing the mining sector for the second year in a row. In 2018, Paul Mitchell, the firm's mining and metals advisory leader noted,

License to operate has evolved beyond the narrow focus of societal and environmental issues. There are now increasing expectations of shared value outcomes from mining projects. Any misstep can impact the ability to access capital or even result in a complete loss of license – particularly in light of the increased use of social media, which makes potentially negative publicity more globally visible than ever.

Thus, this article aims to understand how PGM firms are utilizing Fennell and Alexander (1992)'s instruments – bridges and buffers – to protect their core business activities in what appears to be an increasingly secular market for platinum while also maintaining their social license to operate at a time when there are increasing pressure for firms to generated shared value outcomes. The main premise of shared value outcomes is that firm profitability and the health of communities are mutually dependent. This article constructs a novel case study and analyzes how firms have responded to endogenous and exogenous shocks by shifting their strategies to both protect their core business activities while also meeting the expectations of stakeholders to equitably distribute mining-generated benefits.

Bridges and buffers are underutilized instrument and can be a difficult conceptual framework to deploy for assessing risk management strategies given the amount of data that is required. It required collecting a substantial amount of data, including annual financial and productivity data and corporate strategies to understand how firms are protecting their core businesses interests, as well as available data on how firms are supporting communities, to understand the extent to which shared value outcomes are being reached. Importantly, assessing the extent to which firms utilize bridges and buffers also required understanding firms motivation for undertaking decisions (mechanizing, retrenching, choosing corporate social responsibility projects, selection of mining assets to sell, etc) which required extensive interviewing with firms and other stakeholders (such as government or traditional authorities). The holistic data set – financial statements, corporate reporting, market intelligence data, trade databases, a review of historical archive data

and interviews – took two years to collect. Thus, while it is very beneficial to understanding how firms balance financial sustainability with achieving shared value outcomes, it is understandable that it is very underutilized.

The article constructs a case study using five sets of data to assess (i) what supply and demand shocks firms are facing; (ii) how they are reshaping their strategies and undertaking activities to protect the firm from these shocks; (iii) what challenges firms face with reaching shared-value outcomes; and (iv) how firms are undertaking activities to improve shared-value outcomes. This is a novel approach to constructing a case study within the extractive sector and offers valuable insight into firm behavior, as they try to balance profitability with improving shared-value outcomes.

3.2 Methodology

Behavioral theory of the firm fits within the field of organizational economics – a multi-disciplinary field that draws from the larger field of economics, while also considering organizational behavior, strategic management, law and other areas. Mahoney (2004) argues that, “If organizational economics and strategic management are to deal with uncertainty, they will have to understand how humans in fact behave in the face of uncertainty and by what limits of information and computability humans are bound” (Mahoney, 2004:50). To understand why firms do what they do, it is important to understand both the rational factors (such as high production costs) as well as the psychology behind it (such as why their strategies of community engagement have been largely ineffective, despite royalty payments). Organizational economics and strategic management are shaped by history of the risks, challenges and consequences that firms have faced over time. In the case of South Africa, this means that firms make decisions based on the history of industrial action and community conflict and their impact on profitability, experiences trying to mechanize existing operations, and experience with supply and demand shocks.

Simon (1947) proposes a theory of human choice and decision making that aims to bring together both rational aspects of choice, that have historically been the primary area of concern for economists and the properties and limitations of the human decision-making mechanisms that have attracted the attention of psychologists. For example, the effect of Apartheid on mining communities must be factored into understanding community-firm challenges. Building on Simon’s approach, this article uses a variety of data sources to construct a case study on how PGM firms have undertaken decision-making amidst a range of supply and demand shocks. It uses a mixed methodology approach to understand how the rational side of decision-making and limitations of human decision making have rendered some bridging and buffering activities more successful than others. It uses multiple data sets for both complementarity (seeking elaboration from results from a single method) and expansion (to extend the breadth and range of inquiry beyond a single method) Greene et al (1989).

Data sets for buffering

The first data set was market intelligence data, acquired from the Metals and Mining service on the Standard and Poor's (S&P) Global Market Intelligence platform. S&P Global Market Intelligence integrates financial and industry data, research, and news into tools that can help track performance, identify investment ideas, understand competitive and industry dynamics, perform valuation, and assess risk. The global metals and mining solution offers a comprehensive source of global exploration budget details, development, production, mine cost analysis, acquisitions activity, commodity market forecasts, credit risk assessments and climate risk evaluation¹⁶ For this article, the platform provided valuable data on production cost breakdowns for many PGM mines as well as firm-level annual revenue data which was important to calculate the cost of strikes, which was important to quantify the cost of industrial action. All S&P data was acquired through a short-term paid membership.

Data sets for bridging

The second data set was trade data from the United Nations Comtrade Database, which is the is a repository of official international trade statistics and relevant analytical tables. Data was used for HS codes 843069 (Machinery; Moving/grading/levelling/scraping/excavating/extracting machinery, for earth/mins./ores (excl. of 8430.10-8430.49), other than self-propelled) and 843050 (Machinery; for handling earth, minerals or ores, self-propelled, n.e.c. in heading no. 8430). This data was valuable to understand the extent of local manufacturing of mining machinery versus utilization of imported machinery. This was a proxy to understand the extent to which downstream linkages have been formed.

Data sets for buffering and bridging

The third data set was acquired through interviews undertaken at three underground and open-pit mines with mine workers and mine-level management as well as with c-suite, human resource development and sustainability executives at headquarters offices of four of the largest PGM mining firms. A total of 71 semi-structured interviews were conducted between March 2018 and February 2019 as part of the larger thesis research – of those, data was drawn from 31 of them for this article. A snowball sampling approach was taken, which is a non-probability sampling technique in which existing contacts recruit future subjects through their social networks. This sampling technique is often used where future subjects are difficult for researchers to access, both due to seniority and/or sensitive topics. In this case, initial subjects were established during previous research, in which the author lived in Rustenburg, the PGM mining hub of the region, for a one-year period in 2014. Interviews for this study were conducted in 2018 and 2019. The snowballing sample approach allowed the researcher to build a stronger level of trust, because she was recommended by someone that they trust. Some topics such as retrenchments are more sensitive and people often prefer anonymity.

¹⁶ S&P Market Intelligence Profile

The fourth data set was data gathered from the Neil Coleman Collection at the South African Historical Archives. The Neil Coleman collection was commissioned by the Labor Research Committee between 1979 and 1981. A team headed by Neil Coleman conducted research on influx control, migrant labor and conditions of the labor force in various industries for the period between 1930 and 1980, inclusive. There were 39 boxes of data within the collection and this information was useful in terms of contextualizing challenges facing firms over time.

The fifth data set was both internal and external reports and presentations shared by firms. A total of 16 reports and documents were analyzed, which included financial and sustainability reporting shared by 4 firms, industry performance reports shared by Minerals Council SA, and internal strategy documents shared by two large PGM producers on labor and mechanization.

3.2.1 Methods

This article brings deploys five data sets to construct a new case study. It is the first to deploy Fennell and Alexander's instruments, buffers and bridges, to the mining sector after a commodity boom.

First, it assesses what supply and demand shocks firms are facing. This was done by first interviewing firms to understand the shocks they are experiencing and then using S&P data on production costs to quantify the cost of labor, S&P data on annual revenue to impute the cost of the strikes, and using metal pricing data to understand how demand for various metals has shifted. The article then assesses how firms are reshaping their strategies and undertaking activities to protect the firm from these shocks. The data for this came through interviews with firm executives as well as Minerals Council South Africa, the primary mining industry association representing mining firms in South Africa. It was triangulated by using firm strategy documents to understand how firms' priorities were shifting.

The article then assesses what challenges firms face with reaching shared-value outcomes. Data for this section came from interviews with firms, workers and some community members and was augmented through an analysis of existing literature on community-firm relations. And finally, the article assesses how firms are undertaking activities to improve shared-value outcomes. Data for this section came from interviews with mining firms (both underground and above ground), and an analysis of existing literature to understand the efficacy of previous community interventions.

This is a novel approach to constructing a case study, as it brings together an analysis of supply and demand shocks, how firms are responding to those shocks, an analysis of challenges facing communities and qualitatively assesses the efficacy of firms' efforts to improve shared-value outcomes.

3.3 Analysis

3.3.1 Supply and demand risks that require buffering

Since platinum prices began declining in 2008, firms in the PGM sector have adopted buffers, which are designed to protect core businesses activities, by developing strategies to increase their overall efficiency by reducing labor costs (thereby also reducing exposure to labor strikes) and increasing productivity. This section focuses on two supply-side risks, high labor volatility and high labor costs, and one demand-side risk, the shift from platinum to palladium, that firms have adopted buffering strategies against.

3.3.1.1 Supply-side risk: High labor volatility

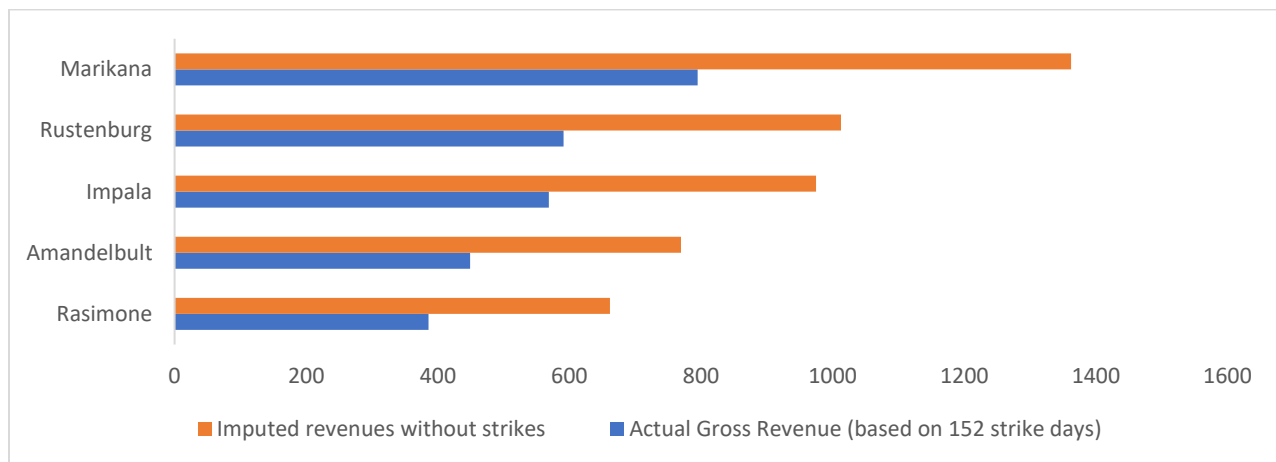
Strikes have been a central part of the mining narrative in South Africa. In 1946, mine workers went on strike for a wage increase. Within a week, 9 were killed and 1,248 were wounded as the police and army viciously attacked strikers. In 1987, 340,000 mine workers went on strike with the National Union of Mineworkers (NUM), who argued for a 40 to 55 percent wage increase, concessions concerning holiday leave, and danger pay and death benefits. The strike became very violent. During three weeks of strikes, 9 were killed, 500 injured and 400 arrested. The strike did not end successfully for workers – Anglo American threatened to fire its entire workforce and workers went back to work defeated (Davenport, 2013). In 2012, the South African Platinum sector made international headlines during the 2012 Marikana Mining Massacre. The strikes began at Impala, where rock drill operators (RDOs), one of the lowest skill jobs in a conventional mine, demanded a wage increase and improved housing. As the strikes progressed, 44 people were killed (11 in the first instance, 33 in the second), making it the largest use of state police force since the 1960 Sharpeville Massacre.

However, the 2014 strike was different in that it threatened both firm financial sustainability and larger macroeconomic stability in a way that previous strikes had not. It triggered a paradigm shift. In January 2014, nearly 70,000 PGM mine workers went on strike, with the majority of them from the three largest mining houses – Anglo Platinum, Lonmin, and Impala – all based in the Rustenburg area of the North West Province. These workers belonged to a newly formed labor union, the Association of Mines and Construction Union (AMCU), and the union demanded a salary increase from R5,000 to R12,500 per month for their workers. However, PGM companies called this request unfeasible and offered a maximum 10 percent wage increase. After five months of striking, the PGM companies and AMCU settlement for a pay increase distributed over three years. The agreement stated that workers earning less than R12,500 would get a R1,000 increase in 2014 and 2015 and an R950 increase in 2016. The new minimum salary would be R8,000 per month (Botiveau, 2014). However, by the time the deal had been struck, it became the longest and most expensive strike in South African history. The strikes lasted 152 days. During this time, the mines lost 48.5 percent of platinum production, taking 440,000 ounces out of production. The three largest producers suffered annual revenue loss of R24.1 billion during the strike and workers took a further loss of

R10.6 billion in wages (SAHO, 2014). The mining strike stifled economic growth – GDP only grew by 0.6 percent during the first quarter of 2014, and GDP declined by 1.3 percent for 2014.¹⁷

Figure 17 shows the impact of the 152-day strike on five large mines – Marikana, Rustenburg, Impala, Amandelbult, and Rasimone. The losses ranged from 48 percent to 64 percent for the year. After the strike, Anglo Platinum announced its plan to sell four mines and two joint ventures. Within 5 years of the strike, Anglo Platinum, Lonmin and Impala had exited most of these operations – Sibanye Stillwater purchased the Rustenburg Mine from Anglo Platinum, acquired the Marikana Mine through its acquisition with Lonmin and Impala announced closure of five of its Rustenburg operations.¹⁸ It was not an end to mining, but rather the tipping point for many firms to move from labor-intensive to capital-intensive mines, for financial sustainability.

Figure 17: Impact of 2014 Industrial Action on Mine Revenue



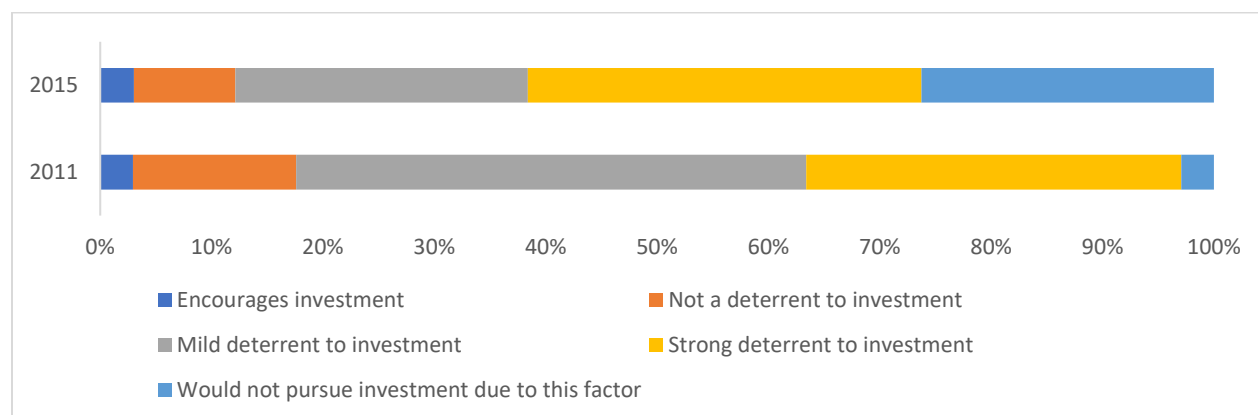
Source: Author's calculations using S&P data

Every year, the Fraser Institute, a Canadian think tank, runs a survey of mining and exploration companies to assess how mineral endowments and public policy factors affect exploration and investment. In 2011, before the Marikana Massacre (2012) and 152-day strike (2014), just 3 percent of mining and exploration firms surveyed reported that they would not pursue investment in South Africa due to labor regulations, employment agreements, and labor militancy/work disruptions. Most viewed it as a minor issue - 45 percent reported that it was a mild deterrent to investing in South Africa. By 2015, over 60 percent of firms cited that labor challenges were a 'strong deterrent to investment' or a reason that they would 'not pursue investment' (Figure 18).

¹⁷ Insight shared by South African Reserve Bank at Monetary Policy Event in 2019.

¹⁸ Based on interviews with executives at Lonmin, Impala and Anglo Platinum, cross-referenced with annual reports.

Figure 18: Perceptions of labor regulations/employment agreements and labor militancy/work disruptions



Source: Fraser Institute

3.3.1.2 Supply-side risk: High labor costs

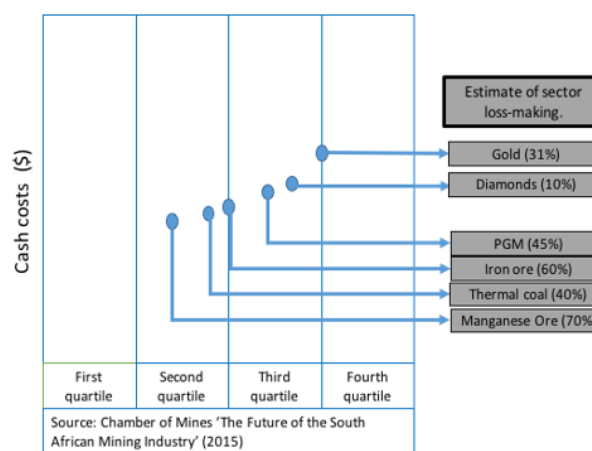
An analysis of S&P Market Intelligence data shows that South African PGM mines have amongst the highest production costs globally. Of the 12 PGM mines in the highest two quintiles for production costs, 10 are located in South Africa. Of the 4 mines that are in the lowest quintile for production costs, just 1 is in South Africa (Table 13). By 2015, 45 percent of all PGM mines in South Africa were estimated to be making a loss by the Chamber of Mines (Figure 19)

Table 13: Cost competitiveness of PGM mines

Production Costs	Number of South African PGM Mines	Number of PGM Mines in the World
First quartile	1	4
Second quartile	4	8
Third quartile	5	7
Fourth quartile	5	5

Source: S&P Market Intelligence

Figure 19: Share of PGM mines that were loss making by 2015.



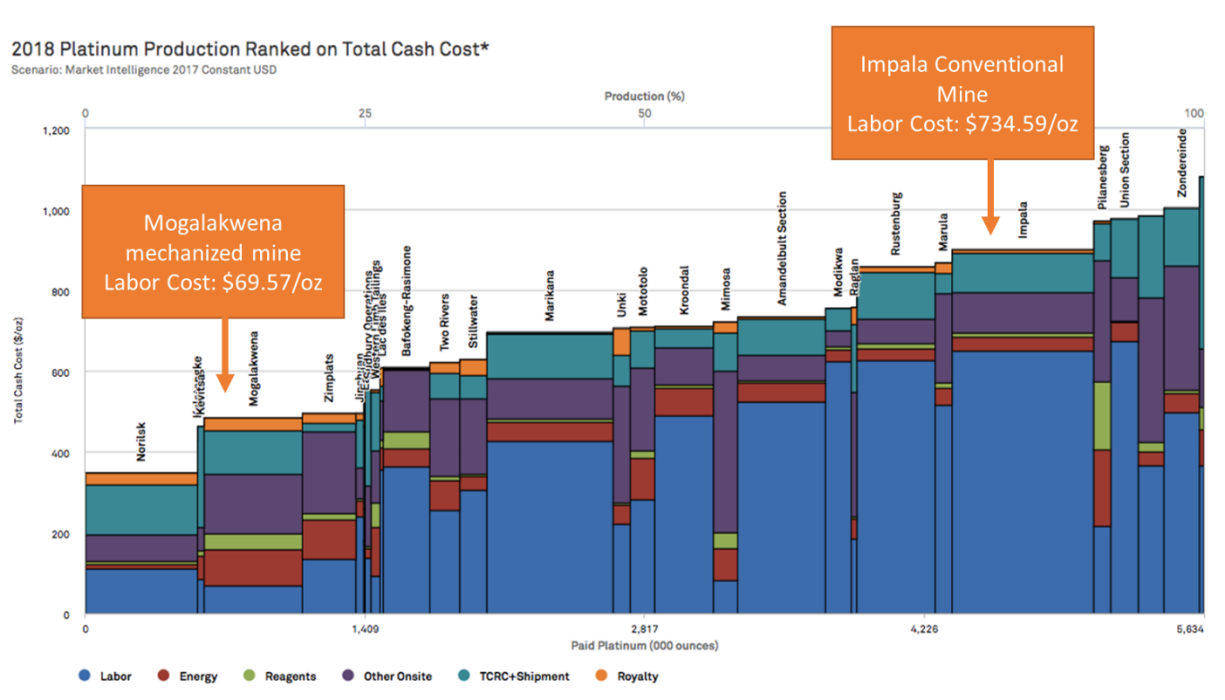
Source: Chamber of Mines (2015)

In light of declining platinum prices and unprofitable operations at a number of mines, a further analysis of production costs reveals that labor costs play a significant role in reducing overall cost competitiveness. At Impala Platinum's conventional PGM mines, labor costs accounted for the biggest production cost, amounting to \$734.59 per ounce in 2018, with total production costs at \$900 per ounce. Comparatively, at

Anglo Platinum’s flagship Mogalakwena operation, which is highly mechanized and has some of the lowest operating costs in the industry, labor costs are just \$69.57 per ounce, with total production costs at \$500 per ounce (Figure 20). Over the last decade, platinum prices have often been below \$900 per ounce, indicating that many conventional mines were grappling with long-term unprofitability.

There is also substantial productivity difference between mining methods. Amandelbult is a conventional mining operation owned by Anglo Platinum. In 2019, the operation employed 15,663 people (9.1 percent of whom were contractors) many of whom are low or semi-skilled and lived proximate to the mine. An average, 57 ounces of PGMs were produced per person employed. At Mogalakwena, the mechanized operation, 2,208 people (12.3 percent of whom were contractors) were employed in 2019. An average of 550 ounces of PGM were produced per employee. Mogalakwena has concentrated its efforts on increasing the efficiency of its capital investments, including drills, explosives, diesel, shovels, and mining trucks. Since 2012, drill penetration has improved by 35 percent while mining truck utilization has increased by 15 percent.

Figure 20: Production costs of PGM Mines



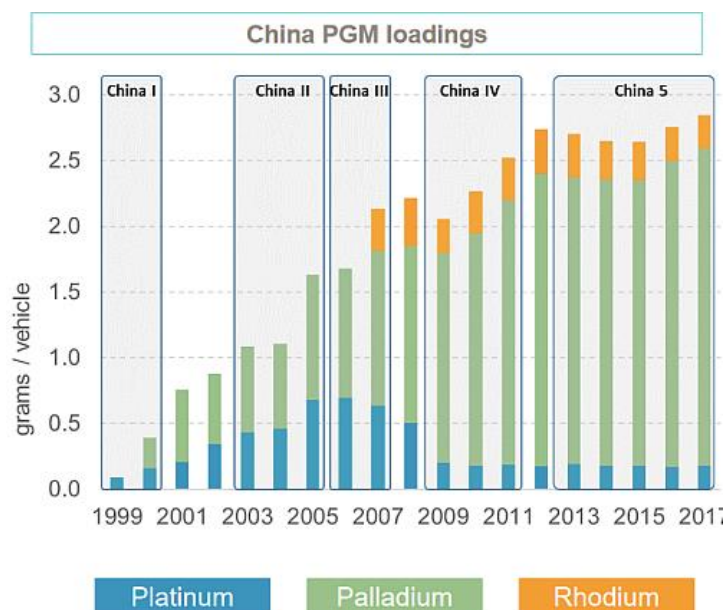
Source: S&P Market Intelligence

3.3.1.3 Demand-side risk: Shift in global demand

Within the PGM group, the driver has historically been platinum. However, over the last decade, the platinum market has been oversupplied for two reasons: first, there has been an influx of recycled platinum from East Asia and second, the push for tighter emissions legislation has favored palladium and rhodium

over platinum. Platinum is largely used for catalytic convertors in diesel cars, while palladium is used in gasoline engines. Since the scandal in 2014, in which software in diesel cars from a number of manufacturers was manipulated to enable vehicles to pass air pollution tests despite producing substantially more pollution than allowed (sometimes more than ten times as much nitrogen oxide than was permitted by European emission limits), there has been a significant decline in demand for diesel vehicles.¹⁹ Figure 21 shows how Chinese emissions standards have had a significant impact on PGM Demand, as palladium loads have exponentially increased while platinum loadings have decreased substantially. Thus, prices for palladium have over tripled between 2016 (average \$614/oz) and 2020 (average \$2074 per ounce) and prices for rhodium increased from \$1,000 per ounce in 2015 to \$14,800 per ounce in 2020 while prices for platinum have declined from a high of \$2,167 per ounce in 2008 down to \$1,384 per ounce in 2014 and a further fall to an average of \$856 per ounce in 2020²⁰ (Figure 22, Figure 23). Although rhodium is substantially more valuable than palladium, firms in South Africa have focused on palladium given that rhodium typically accounts for less than 10 percent of the PGM ounces mined, while palladium and platinum together account for 89-94 percent mined ore. With the exception of Mogalakwena and Waterberg, the latter of which is a brand new operation under construction, palladium typically accounts for 25 to 35 percent of PGM deposits (Table 14) But a number of mining houses mine palladium at close to a 1 to 1 ratio with platinum, indicating that the palladium deposits are being extracted at a disproportionately higher rate compared to platinum.²¹

Figure 21: Impact of Chinese emissions standards on PGM demand



¹⁹ 'Platinum prices hit by Volkswagen scandal' published on April 23, 2015 in the Financial Times.

²⁰ Platinum dropped as low as \$618 per ounce in 2020.

²¹ As assessed through companies annual reports which indicate quantities of each metal extracted.

Source: World Platinum Investment Council

Figure 22: Platinum prices between 2008 and 2020



Source: Macro Trends

Figure 23: Palladium prices between 2008 and 2020



Source: Macro Trends

3.3.2 Buffering Strategies

After platinum prices began declining, mining companies began reassessing their strategies to identify areas to cut costs. Retrenchments became a routine part of the PGM operational discourse around 2010. The 152-day labor strike, which brought production to a halt in 2014, forced many companies to reassess their high reliance on labor. Interviews with executives at the four largest mining PGM companies revealed a reoccurring trend – firms are hesitant to reduce labor at existing operations by modernizing them or mechanizing them, in fear of retaliatory strikes that could stop production. Instead, firms are constructing and expanding operations that were mechanized from the beginning and closing or selling conventional labor-intensive assets. As one chief executive officer stated, “If we start with a mechanized mine, it does not upset people. Communities and workers do not revolt if we build a fully mechanized mine – they revolt if we retrench workers from an existing operation and replace them with technology.”

This strategy has been evident in the operational decisions made by PGM companies. Following the 2014 strike Anglo Platinum announced plans to sell its most unprofitable conventional PGM assets in South Africa, including its Rustenburg Mine, Union Mine, and two other joint ventures, so it could focus on less-labor intensive operations. Most notably, Anglo Platinum has focused on the expansion of its highly mechanized Mogalakwena operation, often called the ‘crowned jewel’ of the firm’s portfolio for its high production and low operating costs. Other large mining houses have undertaken similar moves. In 2017, Royal Bafokeng Platinum announced that there would be a retrenchment of over 500 workers as the firm restructured its unprofitable Bafokeng Rasimone Platinum Mine (McKay, 2017). During this same time, it was expanding its Styldrift Mine, a fully mechanized underground operation, to produce 230,000 tons per

month with a life of mine over 30 years. In 2018, Impala Platinum, the world’s second largest platinum producer announced the closure of five unprofitable conventional operations in the Rustenburg area and announced the retrenchment of 13,000 workers, amounting to one-third of its total workforce. However, the company has been simultaneously investing in the construction of the Waterberg Project, a fully mechanized mine in Limpopo that will use 400 trackless machines to carryout operations.

The share of rhodium and palladium in various locations has also been a key factor in selecting new mine operations. Historically, the platinum group metals family has largely been driven by its namesake, platinum. However, given the shift in global demand resulting from the automotive industry, more firms are opting to pursue operations in areas with high palladium concentrations. Table 14 shows that the flagship operations for the two biggest PGM producers in the world – Mogalakwena for Anglo Platinum and Waterberg for Impala – are much more palladium rich than older operations. Likewise, an article published by Mining Weekly in 2018 entitled “PGM producer focuses on Palladium in Limpopo” states that “Platinum and palladium mining company Platinum Group Metals is refocusing its business on the large-scale, bulk mineable Waterberg project, in Limpopo, South Africa, which is dominated by palladium and has reserves in platinum, rhodium, gold, copper and nickel.” (Breytenbach, 2018). Platinum was positioned as a byproduct to the mainstay of palladium.

Table 14: Palladium deposits at various PGM mines

Mine	Share Of Palladium (%)
Bafokeng Rasimone	26.7
Tumela	29.3 (average of Merensky and UG2 reefs)
Union	29.0 (average of Merensky and UG2 reefs)
Mogalakwena (flagship)	49.3
Waterberg (new flagship under construction)	63.0

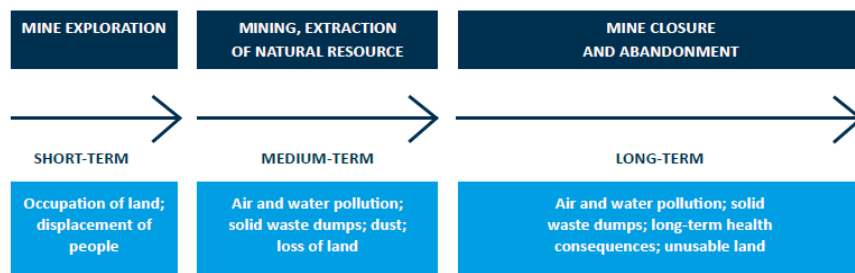
Source: Firm reporting

3.3.3 Risks that Require Bridging

A central challenge of the extractive sector is that benefits accrue predominantly at the national level while disruptions are invariably highly localized close to the resource (Macdonald, 2018:1), including land encroachment, environmental consequences, and adverse health effects across the life of a mine and beyond (Figure 24). The inequitable distribution of risks, impact, and benefits of mining is a driver of community-company conflict. Communities have not perceived that the benefits that they have received from mining activities have sufficiently compensated them for the consequences. However, in recent years, mining companies have intensified efforts to correct this imbalance, partially due to pressure from governments, shareholder and communities.

To ameliorate this imbalance, financial institutions and investors have focused on strengthening environmental, social and governance (ESG standards). Once perceived to as a ‘nice to have,’ ESG and sustainability expectations have become a ‘must have’ in recent years. Although most sectors are scrutinized for ESG, the mining sector is on a deeper level given the negative impact of mining on both people and the planet. A variety of mechanisms have been used to achieve this, including corporate social responsibility (CSR) and the social license to operate, both of which have gained great currency in recent years and are used as instruments to improve of the standard of living of local communities (Macdonald, 2018). Firms engage in bridging activities to adapt their organizational behavior to conform with external expectations and have shared value outcomes from mining projects.

Figure 24: Impact of PGM mining on communities across the life of a mine.



Source: World Bank (2019)

3.3.3.1 Land encroachment

Land encroachment is an inherent structural challenge of mining globally given that mining firms are extracting from land that is home to communities. In South Africa, there has been an intense struggle over communal land. Chiefly authorities often disproportionately benefit from mining licenses, as they often become major shareholders or get royalty payments with little accountability. For example, in the late 1960s, Amplats Union had come to an agreement to pay the Bakgatla tribal chief to extract from the Spitskop Mine. However, local residents were angry, claiming that they had not been consulted about the agreement or compensated for the loss of their grazing and farming lands. This mine became known as the ‘Sinkgalaleng’ mine, which translates to ‘don’t undermine us.’ By the late 1990s, the village’s youth protested that the village had never benefited from infrastructure development or employment from the mine. Tensions reemerged in 2006 when rumors circulated that Chief Nyalala was in negotiations for a direct equity stake in Union, via a conversion of the tribe’s royalty stream. Infuriated, villagers argued that they didn’t know that Spitskop Mine had been paying royalties. To exacerbate things, it then emerged that Union had been illegally encroaching on land outside of the parameters of the lease area (Capps and Mnwana, 2015).

Likewise, in 2007, residents of Ga Puka and Ga Sekhaolelo filed a lawsuit in the High Court Transvaal Provincial Division against Potgietersrust Platinum's Ltd, a wholly owned subsidiary of Anglo Platinum and nine other defendants (including the South African Government). The plaintiffs requested an injunction prohibiting Anglo Platinum from interfering with the residents' land rights in an area where they were expanding their mining activities. The plaintiffs sought to set aside the relocation agreement Anglo Platinum made by arguing that the institution that was supposed to represent residents was under the influence of Anglo Platinum. The plaintiffs also argued that Anglo Platinum was forcibly relocating residents because individual householders signed relocation agreements under duress. Though the case was dismissed by the court, it is indicative of the tension arising from land encroachment.

The land encroachment struggle has intensified with mechanized mining, which has drastically increased the rate of extraction. At Mogalakwena, open pit mechanized mining takes out 85,000 tons in one shift, and there are four shifts each day. Conventional mining takes out 85,000 tons each month. As a result, the expansion into neighboring communities has been expedited.

The loss of land can translate to loss of livelihoods for those who are dependent on it, such as those in the agriculture sector. This loss has been quantified in South Africa's coal sector. A study by the Bureau for Food and Agricultural Policy (2012) found that at the current rate of coal mining, about 12 percent of the South Africa's high potential arable land will be permanently damaged by coal mining with a further 14 percent being subjected to coal prospecting applications. The study found that current coal mining activities could lead to a loss of 284,844 tons of maize a year, with an additional vulnerability coming from 162,736 tons grown in areas that are currently being prospected. This has marked effects on food security – the price of maize in the South African market could increase by 14 percent due to a shrinkage in supply. In fact, if coal mining continues to grow, thereby extending the loss of maize-growing land, 240,000 hectares of land could be lost, which would translate to a loss of 1.2-million tons of maize - enough to make South Africa a permanent maize importer (Baskaran, 2019).

3.3.3.2 Environmental consequences

In addition to a loss of land, which can adversely affect livelihood by taking away land for agriculture, land encroachment also brings dangerous pollution close to home for communities around mines. Environmental pollution stemming from solid waste from tailings and waste rock are felt by mining communities, both in terms of damage to land and water, as well resulting health consequences. Water damage can come from acid mine drainage (AMD), which causes trace metals to leach out from the waste and into the water. Acid is carried from the mine through surface drainage or rainwater and deposited into local streams, lakes rivers and ground water, severely damaging water quality. AMD can continue for hundreds of years. A second form of pollution is processing chemical pollution, which occurs when chemical agents – such as cyanide or sulphuric acid – is used to separate the mineral from the ore – spills, leaks or leaches from the mine site to nearby water bodies. Such chemicals can be highly toxic to both humans and wildlife (World Bank,

2019). Approximately 1.6 million people live in informal and formal settlements on, or near, mine dumps in South Africa. People in these settings tend to be historically disadvantaged and poor. Pollution from the mine can adversely affect the health of nearby residents. PGM mines tend to have high rates of carbon dioxide, sulfur dioxide and dust emissions. There are many health consequences of sulphur dioxide emissions, including decreased lung function, respiratory illness, alterations in pulmonary defenses, aggravations of existing and susceptibility to new cardiovascular disease or chronic lung disease, and daily mortality. There is no safe level of exposure to sulfur dioxide. Consequences of dust exposure include respiratory problems, damage to lung tissue, cancer and premature death (Cairncross, 2014).

3.3.3.3 Health consequences

Beyond the adverse health effects resulting from environmental pollution, there are also other health consequences. Mining communities in South Africa have been epicenters for diseases such as Tuberculosis (TB) and Human Immunodeficiency Virus (HIV). In South Africa, the prevalence of TB among miners and ex-miners is estimated at 2,500-3,000 per 100,000 people (compared with 834/100,000 people in the general population), which is more than 10 times the World Health Organization's threshold for a health emergency (World Bank Group, 2018). A 2014 study by the World Bank found that 82 percent of mining companies gave employees access to a mine clinic or a hospital. However, facilities were lacking in terms of diagnostics – just 67 percent utilized a cough questionnaire (a basic test to identify a nagging cough, which is a key symptom of both silicosis and active TB); and not all companies had access to chest x-ray machines and sputum tests. It is unsurprising that nearly 70 percent of TB cases in the mines are missed or go untreated. Additionally, while many companies have policies that cover diagnostic and treatment for workers, there are still two major gaps in coverage – contractors and family members. The World Bank (2014) study found that contractors did not have the same access as regular employees to health services. Specifically, 33 percent of companies had no written policy in terms of providing TB services for contractors and those without written policies did not necessarily allow contractors to utilize their TB services. Second, only regular employees are generally given access to the free care provided by mining companies' health facilities - their family members are required to purchase separate insurance to be treated there. Given the airborne nature of TB, it's common for it to spread to family members but treatment for them could be prohibitively expensive (World Bank, 2014).

3.3.3.4 Pressure to improve shared value outcomes

Given the many adverse effects that mining communities have faced – losing land to mining operations, facing environmental harm, pressure from labor strikes and mining-related illnesses – without being fully compensated for them, there has been increasing pressure for a transformation of the sector over the last two decades. In 2002, the Minerals and Petroleum Resources Development Bill (MPRDA) was gazetted. One of the objectives of the Act is to “Ensure that holds of mining and production rights contribute towards the socioeconomic development of the areas in which they are operating.” The same year, the Mining Charter

was drafted. One of the core objectives of the Mining Charter was to, “Promote employment and advance the social and economic welfare of mining communities and the major labor sending areas.” Thus, for firms to negotiate their place in post-Apartheid South Africa where transformation of the sector was a priority, they had to increase their support for communities surrounding the mines. A favorable perception of the firm is critical to have social buy-in from local communities. Firms began to increase their bridging efforts. Bridging “occurs as firms seek to adapt organizational activities so that they conform with external expectations.” (Meznar and Nigh, 1995: 976). Firms use bridges to manage their environment through various negotiation tools, which can include instruments to improve community relations, such as expanding corporate social responsibility spending, paying royalties, engaging in local procurement, employing locals, and building infrastructure such as schools, hospitals, and roads.

Without sufficient bridging, mine operations can be halted by protests. One example is Twickenham Mine, an Anglo Platinum mine located in the Sekhukhune District Municipality in Limpopo Province, with the operations area covering Tubatse, Fetakgomo and Makhuduthamaga local municipalities. These are some of the most impoverished communities in South Africa, with less than 25 percent of eligible adults in full employment. Twickenham Mine began development in 2001. By 2014, as platinum prices declined, Anglo Platinum opted to pause its expansion projects for Twickenham and in 2014, chose to suspend operations, placing it on ‘care and maintenance.’ Under this operational level, mine production declined to less than 5 percent - just enough to keep it from going into closure. Anglo Platinum retrenched nearly all of its 2,000 workers, retaining a skeleton staff of 121 people and turned the shaft into a research and development (R&D) laboratory for new mechanized technology. The retrenchment of workers was not taken well by the surrounding community, who vehemently protested the decision. Tires were burned on the single road that provides access to the mine, while protesters tampered with the electricity supply, without regard for anyone who may have been underground. Surrounding communities threatened an armed takeover unless Twickenham Mine employed a minimum of 5,000 locals, which was a far cry from the 121 staff and 500 R&D contractors who worked on site.²² A field visit to Twickenham Mine was undertaken for this research, and fear was a constant theme amongst interviewees – fear that they would be underground when electricity cables were cut by the community, fear of an armed takeover of the mine, and fear that they would not be able to exit the mine if the single road into the mine was blocked off by protestors.

3.3.4 Bridging Strategies

3.3.4.1 Royalties

Royalties are paid to communities who own the land from which minerals are extracted. However, royalty negotiations can be difficult. One of the major wins for communities around PGM mines came in 1999 after

²² Data collected from interviews at the mine in November 2018

a nearly five-year court battle between the Royal Bafokeng Nation and Impala Platinum. Impala settled and the Bafokeng won 22 percent of pre-tax profit as their royalty share. These revenues have been used to finance Royal Bafokeng Sports (RBS), which is responsible for sports development, the Royal Bafokeng Administration (RBA) which works to ensure that infrastructure and services are aligned with the long-term vision, and Royal Bafokeng Institute (RBI), which works to improve education and learning amongst the Bafokeng people.

However, this has not necessarily translated to a satisfied community. Flomenhoft (2019) undertook a survey of people within the Bafokeng community to understand how satisfied they were with the services provided to them by the RBA, financed by mining royalties. The study found that 77.1 percent of people surveyed do not feel they are sufficiently benefitting. Unemployment, poor quality of services and mismanagement of funds were the most common concerns. Less than 3 percent of respondents named problems with mines as the problem. This demonstrates that most survey respondents felt the traditional authorities have not used the royalties to sufficiently improve their quality of life.

This is a larger challenge across PGM mining communities. A report by Corruption Watch in 2019 found that there is a deep distrust in mining communities about royalty distribution. Two Anglo Platinum projects – GaPhasha and Booyesendal – had such tension that community members “were frightened to go on record to speak about what they consider collusion between traditional authorities and mining companies.” The report goes on to say that billions of rand in mining royalties intended to improve socioeconomic development in mining communities are maladministered, squandered or stolen. There is a lack of transparency around negotiation and distribution of royalties with various stakeholders – traditional leaders, government, community members – trying to increase their share of royalties. This leads to mining communities continuing to live in severe poverty despite royalty payments.

3.3.4.2 Corporate social responsibility

The use of CSR is controversial. Rajak (2011:27) argues that it is part of the “ritualized performance of global corporate citizenship, that companies stake their claim to the moral capacity that such a status affords.” It projects firms as more than moral agents, but also as “vehicles” of sustainable development through business and empowerment. On the other hand, Mutti et al (2012:221) notes that it is “patronizing and paternalistic, when companies undermine knowledge and skills of local communities to identify their own needs and priorities. This leads to a lack of adaptation to local conditions, as companies appear to enforce their own vision of community ‘good.’” Although South African PGM firms have actively engaged with CSR, they have largely approached it as “ad hoc charitable donations to good causes” (Hamann, 2014). For example, in its 2019 Sustainable Development report, Impala Platinum highlighted two core CSR projects - the electrification of 130 homes in Ga-Kgwete Village and 77 households in Ga-Mashishi and the firm’s sponsorship of swimming pool containers to curb the risk of drowning among children in disadvantaged communities.

Field interviews showed that when CSR projects conclude, an adverse effect can occur. For example, one mining executive interviewed had been removed from his post for a period of 12 months and given the task of setting up a CSR project to improve the schools around the mines. He found that teachers were often absent and/or disinterested in their teaching and learners were often disengaged from the learning process and very far behind academically. The firm financed and ran a CSR program that placed top math, science and engineering university students in secondary classrooms to teach, learning outcomes improved. However, after the program stopped being run, scores fell again. Recent matric pass rates were 18 percent in technical math and 3.3 percent in pure math. The firm reported that the Department of Education (DBE) asked the firm to give them the money and the Department would implement the program. However, the firm declined given that the DBE has not made meaningful progress in schools in these communities. The executive noted that the education system was a ‘disaster’ in communities around the mines, and although CSR projects could put a ‘dent’ into challenging socioeconomic challenges, they were not sustainable solutions to structural problems.

3.3.4.3 Local Procurement

Local procurement is the purchase of goods and services from local businesses. By integrating local communities into the supply chain, communities can be supported through skills development and job creation. Local procurement is a tool increasingly used by mining companies for four reasons. First, it de-risks company operations because communities are less likely to stop operations with protests if they are part of the supply chain. Second, it enables firms to comply with government regulations on local content requirement, making it easier for firms to get and keep their licenses to operate. Third, it provides benefits for local communities by generating business opportunities for which the mining firm can be the offtaker (IFC, 2011). And finally, it can improve mining companies’ supply chain efficiency by reducing logistics costs.

The 2018 Mining Charter has prioritized the local procurement – it is the highest weighted contributor to overall compliance accounting for 40 of the 100 percent. Interviews with mining firms revealed that local procurement is still largely done through procurement of low-value services such as cooking meals and cleaning. Procurement of mining machinery and other inputs is more difficult and rarer, given the limited manufacturing capacity and skills of local communities. In fact, both upstream linkages, which relates to the procurement of goods and services that mines need to produce, and downstream linkages, which result from further processing of the extracted commodity – have gone down in some areas.

In terms of downstream linkages, data from the United Nation Comtrade International Trade Statistics Database shows that when looking at mining machinery alone,²³ trade balances have experienced a sharp

²³ HS codes 843069 (Machinery; Moving/grading/levelling/scraping/excavating/extracting machinery, for earth/mins./ores (excl. of 8430.10-8430.49), other than self-propelled) and 843050 (Machinery; for handling earth, minerals or ores, self-propelled, n.e.c. in heading no. 8430)

shift. In 2006, mining machinery imports and exports were nearly equal - \$11 million and \$10.7 million, respectively. Within three years, the value of exported machinery declined from \$10.7m to \$9.6m while the value of imports doubled from \$11 million to \$22 million. By 2012, value of imported mining machinery nearly double again to \$41 million, while value of exports experienced a more moderate increase to \$22.2 million. Procurement of domestic services to run this machinery is also more difficult. Domestic skills constraints coupled with new technology have required an increase in foreign labor. In South Africa's mechanized mines, imports include machinery from Sweden's Sandvik and Epiroc, Croatia's Doking and Japan's Komatsu. Given that local staff are not skilled at operating these technologies, foreign labor is being utilized in both underground trackless mobile, mechanized mining (TM3) and open-pit trackless mobile, mechanized mining (TM4). For example, at Anglo Platinum's Twickenham Mine, which is currently a research and development site for mechanized technology, a team of Croatian workers has been on site year-round to operate the imported remote-controlled blasting equipment.²⁴

In terms of upstream linkages, catalytic convertors are the primary end product of PGMs. But local manufacturing of catalytic convertors has also declined over time. The catalytic converter industry in South Africa developed largely as a result of the Department of Trade and Industry's MIDP incentive scheme, which was discontinued in 2013. The current projections for local PGM beneficiation via catalytic converters in South Africa reflect a downward trend, due to production being moved to other countries as a result of policy uncertainty around government incentive programs. The industry is capacitated to support 23.7 million units per annum. At full capacity the industry would represent 19 percent of global auto catalyst production (Kok, 2008; Dewar, 2012). However, South Africa currently manufactures just 8 percent of the world's catalytic convertors despite holding 38 percent of the world's palladium and 75 percent of the world's platinum. Although the global market for catalytic convertors is expected to grow at a CAGR of ~2.9 percent over the next five years, South African PGM producers have opted for long-term contractual agreements with major refineries and manufacturers in Europe (UK, Germany, Switzerland), Japan, China and North America. China is the largest supplier of automotive catalytic converters, with a production market share nearly 28 percent, followed by Europe, which had a market share of nearly 26 percent in 2015 (Absolute Reports, 2019).

3.4 Discussion

In recent years, firms have worked to reduce their exposure to volatility – resulting from both endogenous and exogenous supply and demand shocks – by bridging and buffering. Firms have been very proactive about engaging in buffering to protect their business activities from exogenous factors such as fluctuating

²⁴ Interviews with Anglo Platinum Staff

platinum prices. They have undertaken strategic long-term plans to de-risk their mining portfolio by selling off or closing conventional mining assets and focusing new mechanized operations on areas with high concentrations of palladium. Bridging efforts have been less successful at achieving shared-value outcomes – the findings show that royalties are often vulnerable to maladministration which prevents the benefits from reaching communities; CSR is inherently unsustainable and stopping projects can often trigger adverse rebound effects, as demonstrated by the education CSR project discussed earlier. Additionally, CSR projects are often ad hoc in nature – like creating swimming pool containers - which makes sustainability more difficult; and finally, local procurement is often limited to low value-added services such as cooking and cleaning because of limited manufacturing and skills in surrounding communities. Downstream and upstream linkages have declined over time. Additionally, because of the high regulations in the Mining Charter in six areas – ownership, mine community development, employment equity, human resource development, inclusive procurement and supplier and enterprise development and housing and living conditions – bridging efforts can often feel like firms ‘complying’ to meet requirements, rather than a genuine desire to distribute mining-generated benefits more equitably.

Bridging efforts are further hampered by the fact that mining communities often prioritize employment over other benefits such as service provision. As discussed earlier, at Twickenham Mine, armed protests stemmed from a request to employ a minimum of 5,000 locals. Similarly, Flomenhoft (2019) found that employment was identified as the most important benefit of mining activities in a survey of a PGM mining community. However, in the mechanized era of mining, employment is declining. In October 2019, Minerals Council SA then announced that in the PGM sector, 90,000 of 168,000 jobs – or 54 percent of the sector’s employment – were now at risk. This makes it more important than ever for labor-intensive, non-mining activities such as manufacturing or agriculture to be developed in PGM mining communities.

Firms buffering activities have substantially improved their financial sustainability. After consecutive years of unprofitability and selling loss-making assets, the shift to mechanization and focus on increasing palladium production paid off. In February 2020, Anglo Platinum released full year results for 2019. There was a 145 percent increase in headline earnings to R18.6 bn. The dividend payout was R14.2 bn, which amounted to 76 percent of headline earnings and in one year, was double the amount the firm paid for the previous ten years. However, substantial conflict around some of Anglo Platinum’s operations (such as Twickenham) highlight the need for increased bridging efforts to reduce tensions and make a more equitable distribution of benefits. As the PGM sector continues its shift to mechanization and closes labor-intensive conventional operations, there is likely to be more conflict with surrounding communities.

3.5 Conclusion

This article has assessed what risks PGM firms face and how firms pursue bridging and buffering activities to reduce their exposure to these risks. Compounding supply and demand shocks have become a central

part of the PGM narrative over the last decade. Supply shocks have come from production-stopping strikes while demand shocks have come from a sharp decline in demand for platinum, resulting from an increase of recycled platinum from Asia and the diesel scandal in Europe. Given that this could mark the transition to a secular market, like tin in Cornwall, firms have focused on mining operations that have large deposits of palladium and that require large capital investments but reduce operating costs by upwards of 60 percent. This article found that firms buffering strategies have been more successful than bridging activities. By examining various communities around PGM firms, it has shown how royalties, CSR and local procurement have largely been futile efforts to improved shared value outcomes due to challenges such as corruption and maladministration, short-term projects that are insular and tied to adverse rebound effects upon termination, and limited skills to drive higher value added procurement. This suggests that more attention should be given to how bridging activities can be strengthened to ensure that firms can keep their social license to operate, as a loss would lead to a halt in all business activities. The findings of this research indicate that a paradigm shift may be required, such that “traditional bridging activities” should be viewed central to protecting core business activities. Royalties, CSR and local procurement currently operate in the periphery, rather than as a central part of firms’ business strategies.

Article 3: An analysis of quantitative and qualitative job security amidst widespread mechanization in South Africa's platinum group metals sector

Abstract

South Africa's platinum group metals (PGM) sector is undergoing major changes as firms move towards mechanization. In October 2019, Minerals Council South Africa then announced that 90,000 of 168,000 jobs in the PGM sector – or 54 percent of the sector's employment – was now at risk. This article assesses perceptions of quantitative job security, which refers to employees' concerns regarding the continuity of the job, and qualitative job security, which focuses on security about valued aspects of their job, such as training opportunities, ease of communicating with management, and fairness of the promotion process. Using quantitative data from a novel survey, findings show deep disparities in both quantitative and qualitative job security, along the lines of race, gender, and age, suggesting that although quantitative job security is inevitably low given the shift from labor-intensive to capital-intensive mining, there is substantial room for the firm to improve its human resource practices to improve qualitative job security, which is particularly low for black respondents. This article contributes to the body of knowledge on the relationship between labor and automation, and how firms can mitigate the associated challenges, particularly in the South African context where racial tensions are rampant in the post-Apartheid era.

4.1 Introduction

4.1.1 South Africa's Employment Background

The economic transformation of South Africa hinges on the ability to facilitate inclusive job creation. With a Gini coefficient of 0.63, South Africa has one of the highest inequality levels in the world. Inclusive growth requires large-scale job creation across skill and income levels, in urban and rural areas. South Africa has been ranked as having one of the worst unemployment rates in the world,²⁵ reaching a 15-year high, with an official unemployment rate of 29.1% in the third and fourth quarters of 2019. Only 42% of adult South Africans are working, compared to the 61% average for middle-income countries. Between 2008 and 2019, the number of people who want work but either cannot find it or have given up looking, increased by 58% from 6.5 million people to 10.3 million people.²⁶ Youth unemployment has exceeded 50%, and was identified as a national crisis²⁷, and as the 'biggest'²⁸ problem facing South Africa. For young

²⁵ The Economist Pocket World in Figures 2019

²⁶ Ten million and rising: What it would take to address South Africa's jobs bloodbath. Center of Development and Enterprise. 2020.

²⁷ The President of the Republic of South Africa in his State of the Nation Address, 2019

²⁸ The President of the Republic of South Africa in his State of the Nation Address, 2020

people aged 15-34, actual population increased by 2.2 million between 2008 and 2019, while the number employed during this period fell by more than 500,000²⁹.

Given the pervasive and high level of unemployment, social assistance protection has been an important backstop to reducing poverty. All social grants in South Africa, with the exception of the Foster Care Grant (FCG) and Grant-in-aid, are means-tested. This means that the income and wealth of the person applying for social assistance is evaluated to determine whether they are below a specified threshold. Social grants primarily empower children, the elderly, and the disabled, with the vast majority of recipients being women (85% as of June 2020). Between 2009 and 2018, the total number of grants distributed grew by 38 percent, from 13 million in 2009 to just under 18 million in 2018. There is significant reach of this system in household terms - in 2018, 36.5 million individuals (or 63 percent of South Africa's population) lived in a household where at least one member received a social grant (Baskaran et al, forthcoming)

Under the context of pervasive employment and widespread social assistance payments, a further analysis of employment within the mining sector to understand risks and perceived security is important to understanding how policies can be formulated to reduce uncertainty.

4.1.2 Historical Risk

Mining creates sharp economic variations in wealth and poverty (Bryceson and MacKinnon, 2012). These variations exacerbate the challenging arising from the legacy of Apartheid, which led to wealth and income lines largely being drawn on racial lines. Additionally, psychology has been strongly impacted by Apartheid's systematic exclusion of black people from employment, education, and land, which resulted in the impoverishment of a significant portion of the population (Swartz, 2010).

However, the “mineral revolution” - which refers to the mining-induced rapid industrialization and resulting economic changes that occurred from the 1870s onwards – forced inclusion and began incorporating blacks into the workforce to address a capitalistic problem – production constraints (Marks and Trapido, 1979; Etherington, 1979). But blacks were on from equal footing. In 1911, the government introduced the Mines and Works Act which reserved skilled and semi-skilled work was whites. It also created a bifurcated wage structure. The Colour Bar required high minimum wages for whites and low maximum wages for blacks. Burawoy (1972) noted that in neighboring Zambia, mining companies were viewed as “whites” rather than as “capital.” South Africa was very much the same. And workers and the community were perceived as “black.” But the demand for unskilled labor was high. By 1972, Francis Wilson noted in the capitalist structure of the mining industry was immutable, and that it was black workers who suffered the most under appalling conditions. In 1943, the Chamber of Mines concluded that “the native laborer underground as an individual was no more efficient than he was 30 years ago (Wilson, 1972:96-97).” However, the industry

²⁹ Ten million and rising: What it would take to address South Africa's jobs bloodbath. Center of Development and Enterprise. 2020.

didn't treat black laborers as individuals who could become more productive. "The simple idea that the black labor force consisted not of an undifferentiated mass of black labor units but individual, sometimes bewildered, human beings who would respond to training and opportunities for advancement took a long time to sink into the minds of men who lived in the social environment of South Africa" (Wilson 1972:94). One of the most critical steps towards improving labor efficiency came in 1945, with the introduction of a system to grade recruits, based on their abilities, before training them. Prior to this, black labor had been viewed as an undifferentiated mass of interchangeable units – it was essentially a throw of the dice that decided whether a man would spend his life sweeping the floors or operating a mechanical scraper.

There was fierce resistance to promoting, upskilling or increasing the wages of black workers. In January 1981, a newspaper article noted that "Any further tampering with white (mine) workers rights in favor of blacks and the scrapping of Apartheid on any level would be strongly resisted and would force them to resort to a general strike." This came after Mr P C C de Jager, president of the Mineworkers Union, urged white workers in the industry to join a general strike if blacks were granted blasting certificates, racially mixed unions were forced on whites, and more rights were granted to black workers.³⁰ In real terms, African miners wages were lower in 1972 than in 1911. The ratio of white to black workers employed in the South African gold mining industry was 1:8 while the white to black wage ratio was 17.9:1 in 1969. The strong bargaining position of white miners allowed them to be the only beneficiaries of productivity increases, which led to a wider disparity in income over time (Wilson, 1972).

These factors contributed to a high turnover rate amongst workers. In 1969, black turnover cost the mining industry between three and four million rand. Since there was no labor union to represent the interests of black miners and firm management perceived they were unable to directly collaborate with black workers, there was little to no communication between management, who was white, and underground workers, who were largely black (Wilson, 1972). Research shows a strong positive link between job insecurity and turnover; employees are more likely to withdraw from stressful situations and feel less loyalty to employers who cannot ensure security (Cavanaugh and Noe, 1999; Ashford et al, 1989; Cheng and Chan, 2008). The ability to communicate with management has been a recurrent challenge within the mining sector. During the 2012 strikes that led to the Marikana Massacre, striking miners refused to communicate their demands to firm management through their typical communication channel – the National Union of Mineworkers (NUM). Workers demanded an end to 'Apartheid of speech,' in which black workers were unable to speak directly to white managers. The ability to communicate with managers is explored later on in this article.

Although wage increases have often been used to remunerate for risks, when used alone, it has not proven to be effective in addressing the perceived violations between workers and firms. In fact, wages have increased substantially – between 2003 and 2013, total compensation of employees in South Africa's mining and quarrying sector grew by 228 percent, while the number of people employed by the sector grew by 15.9

³⁰ Neil Coleman Collection, South African Historical Archives

percent. Still, a 152-day strike in 2014 indicated this was insufficient. Rousseau (1989) draws from the example of a bank robber – if a person robs a bank and is caught, returning the stolen money is not perceived as a valid compensation to bring the thief back into good standing with society. The damage is greater than just the money that was stolen; likewise, a violation between employee and employer results in trauma, where trust is undermined. Similarly, the Apartheid government, “Supported a policy of buying off the strikers and encouraged some improvement in African wage rates...though African wage rates have been raised, this does not in itself point to a change in the direction of government policy. These have been raised before at times of unrest, notably between 1958 and 1962, without heralding a liberalization of labor policy” (Guelke, 1975)³¹.

Mine workers have faced many perils. Between 1936 and 1966, more than 19,000 men – 93 percent of them black – died in mine accidents. Between 1967 and 1975, nearly 5,000 more men died. There were 2,993 accidental deaths and 170,169 serious injuries between 1972 and 1975, the overwhelming majority of which were attributable to ‘danger inherent in work or misadventure’ and ‘defective plant and machinery.’³² Occupational illness has also been highly prevalent. In 1914, Sol Plaatjie, first Secretary of the African National Congress, described the lives of black miners in the following terms: "Two hundred thousand subterranean heroes who, by day and by night, for a mere pittance lay down their lives to the familiar 'fall of rock' and who, at deep levels, ranging from 1,000 to 3,000 feet in the bowels of the earth, sacrifice their lungs to the rock dust which develops miners' phthisis and pneumonia."

Although black workers have faced many challenges in the mines (both in terms of working conditions and wages), these challenges were largely ignored in liberal scholarship during much of the twentieth century, as liberal scholarship focused on the bigotry and protected status of the white working class, who, armed with the vote, were viewed as the “principle prop of an illiberal and potentially unstable system” (Freund, 1984:9).

Additional challenges exacerbating labor tensions

Because of the nature of Apartheid-era legislation, blacks were legally confined to poor townships or rural areas, and large, white-owned firms moved onto tribal land. Historically, the South African model used compounds to house mining labor, which proved to be profitable. This limited the development of infrastructure outside of the compound in surrounding rural communities. On the other hand, the Ghanaian open model allowed mineworkers to reside in adjoining towns which led multinational mining companies to provide major infrastructure such as water installations, phone masts, health dispensaries and improved roads for the benefit of town residents (Bryceson and MacKinnon, 2012).

Historically, mining firms have paid a disproportionately low amount of taxes, limiting gains to other parts

³¹ Neil Coleman Collection, South African Historical Archives

³² ‘Secret dossier on mineworkers leaked’ published on July 9, 1978 located in the South African Historical Archives.

of society. South Africa's mining sector has the lowest marginal effective tax rate amongst all sectors. In 2017, the mining and quarrying sector accounted for 7.3 percent of gross domestic product but just 1.3 percent of government revenue – 0.6 percent came from non-tax instruments such as mineral royalties and mining leases while the other 0.7 percent came from tax instruments including personal tax, corporate tax and value-added tax (World Bank, 2019). This means that mining firms were paying a disproportionately low amount of taxes for the revenue they generated. Considering this – and the limited benefits provided to mining companies using these revenues - it is unsurprising that workers felt that the other key benefit, wages, were neither i) proportionate to the risk they were bearing working in dangerous conditions nor ii) commensurate with profits being reaped from tribal land.³³

4.1.3 How mine workers have handled risk

Industrial action has been a frequently used tool to express dissatisfaction with risk level and compensation for engaging with the risk levels. In 1946, mine workers went on strike for a wage increase. Within a week, 9 were killed and 1,248 were wounded as the police and army viciously attacked strikers. In 1987, 340,000 mine workers went on strike with NUM who argued for a 40 to 55 percent wage increase, concessions concerning holiday leave, and danger pay and death benefits. The strike became very violent. During three weeks of strikes, 9 were killed, 500 injured and 400 arrested. The strike did not end successfully for workers – Anglo American threatened to fire its entire workforce, which would have meant an 80 percent membership loss for NUM. Workers went back to work defeated, without an improvement in wages or working conditions.³⁴

In 2012, a series of wildcat strike began at Impala, where rock drill operators (RDOs), one of the lowest skill jobs in a conventional mine, demanded a wage increase and improved housing. The RDOs became angry, given that they were the ones doing the dirtiest and most dangerous work – hand drilling the rock, and as such, are the most vulnerable to rock collapses, but were the lowest paid. The strikes rapidly spread to other mines, including Lonmin's Marikana mine. In addition to dangerous working conditions and low pay, workers were outraged that many of them lived in deplorable conditions in informal settlements without access to basic services. This was in violation of the Social Labor Plan that the mine had committed to. By 2012, only 3 of the 5,500 houses that should have been built by September 2011 had been built (Botiveau, 2014).

On August 16, 2012, the South African mining sector made international headlines when the South African Police Service killed 34 striking miners and injured another 78 during a wildcat strike at Lonmin's Marikana PGM Mine near Rustenburg. It was the most lethal use of state police force against civilians since 1976. The Marikana Massacre occurred when the state police killed dozens of striking miners who were

³³ Neil Coleman Collection, South African Historical Archives

³⁴ Neil Coleman Collection, South African Historical Archives

striking for livable wages. The incident highlighted the state of post-Apartheid labor relations. On the surface, the 2012 strikes were driven by a demand for a large wage increase to make R12,500 the basic wage for low skill workers such as rock drill operators. But in reality, the Massacre illustrated the deep dissatisfaction with not just an unequal wage structure, but also the dominant labor union, who was no longer viewed as representing labor, the perceived collusion between labor unions and mine management (with some union representatives receiving pay increases and in-kind benefits such as cars), the disillusionment with South Africa's ruling party, the African National Congress (who had close ties with the labor union) and deeply embedded social fragility and violence (Botiveau, 2014).

The Marikana Massacre led to a loss of legitimacy for both the labor union, NUM, and the firm, Lonmin. Suchman (1995b:574) defines legitimacy as a, "Generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions." It is "Possessed objectively yet created subjectively" (ibid). To expand this definition, Parsons (1960) added that the focus of legitimation should include the goals of an organization, and the degree to which they align with the values present in society. From an institutional view, legitimacy is not a commodity to be possessed or traded, but a condition reflecting perceived agreement with cognitive-cultural frameworks. Scott (2014) parallels it to oxygen; like other invisible properties, the critical nature of legitimacy becomes acutely painful only if it is lost. And it was painful for both parties – the Marikana Massacre ended NUM's position as the dominant mining union and gave rise to the more militant Association of Mineworkers and Construction Union (AMCU), who labeled itself apolitical and non-communist and claimed it focused on the workplace. AMCU started as a breakaway faction of the NUM and formally registered as a union in 2001. But it was the PGM strikes that triggered a substantial and rapid expansion of AMCU's member base. By 2013, AMCU had managed to expel NUM from the three biggest platinum producers – Amplats, Impala and Lonmin - and became the sole representative of the workers through closed shop agreements³⁵ (Botiveau, 2014). Lonmin fared worse, as demonstrated by an article entitled "Five years after Marikana, Lonmin fights for survival," in the *Sunday Times* on March 12, 2017. Five years after the fatal strikes, Lonmin has failed to keep its head above the surface, after being made illegitimate by ordering the killing of its own workers. Illegitimacy can be destructive to profitability; the last year that Lonmin reported an annual profit was 2013. Unable to keep its head above the water, the firm, which was over 100 years old and listed on the London Stock Exchange, was sold to Sibanye-Still water in June 2019.

By 2014, upwards of 70,000 workers, mostly low-skill workers who were the most vulnerable to occupational hazards, went on strike from all of the major platinum producers. The Commission of Enquiry that was setup by South African President Jacob Zuma to investigate the Marikana Massacre found that

³⁵ A closed shop agreement is a contract between an employer and a labor union that requires that an employer will only hire workers from a specific union and those workers can only remain with that employer while they are a part of the union that the agreement covers.

Lonmin failed to address risk by creating an environment that promoted tension and labor unrest, given that it did meet its housing obligations, amongst other things (Power and Gwanyanya, 2017).

In 2018, Impala Platinum, the world's second largest platinum producer announced the closure of five unprofitable operations and announced the retrenchment of 13,000 workers, amounting to one-third of its total workforce. AMCU took a strong position against letting companies profit while placing the risk of job insecurity on workers. Union president Joseph Mathunjwa, who also led the 152-day strike in 2014, made a statement to the press that the union, who represents 70 percent of Impala's workforce, will ensure that 'not one ounce of platinum will leave the ground' and should consultations fail with the union, secondary industrial action would take place at all of Impala's mines in the North West and Limpopo. He warned that AMCU would 'hit where it hurts the most... the gloves will be off.' But behind closed doors,³⁶ discussions between the union and firm acknowledged this was a necessary move given long-term unprofitability.

4.1.4 The mechanization of South Africa's mining sector

The South African mining sector experienced delayed mechanization, owing partially to substantial disinvestment during the 1980s as the rest of the world grew impatient with the Apartheid system and the speed of policy reform undertaken by the South African government. This triggered foreign disinvestment and the adoption of stringent financial and trade sanctions against South Africa (Chamber of Mines, 2012).

In an analysis on the impact of United States sanctions on South Africa, Knight (1990) notes that 200 companies had divested from South Africa between 1984 and 1990, with US direct investment declining from \$2.3 billion at the end of 1982 to \$1.3 billion at the end of 1998 . This had a heavy impact on the mining sector through a couple of avenues:

First, South Africa was highly reliant on foreign technology, importing 95 percent of all computer equipment, and was unable to build a car, truck or other high technology item without imported technology and parts. As the United States and other countries imposed sanctions on South Africa, obtaining foreign technology – necessary for mechanization or technological upgrading – became very difficult (Knight, 1990).

Second, the continued development of key sub-sectors, particularly gold mining, was dependent on foreign capital. W. I. Car, the London stockbroker, estimated that about 25% of South African gold mining shares, valued at \$2.5 billion, was owned by U.S. citizens. Davis Borkkum Hare, a Johannesburg stockbroker, estimated U.S. ownership in all South African mining shares (not just gold) at 14%, worth \$4.1 billion. During the 1980s, gold accounted for 40 percent of South African exports, making it a mainstay of the economy. But South Africa's gold production declined by 40 percent between 1970 and 1987. To maintain production levels, South African mining companies would have needed to invest substantial amounts of

³⁶ Interview with an official present in the Impala-AMCU negotiations.

money into exploration and new mines. But when South African companies needed to raise money to finance new mines, they usually issued stock, most of which is purchased abroad. But because of sanctions, American citizens (and others) were prohibited from buying new stock which made it difficult for South African firms to afford the necessary expenditure to develop new mines (Knight, 1990). The sector has been slowed by path dependency. Even since the end of Apartheid, it has been difficult to ‘catch up.’ An analysis by McKinsey (2019) of South Africa’s mining sector found that the country’s mines are less mechanized than those in many other regions, with a higher share of conventional labor-intensive underground mines. In sectors outside of PGMs (of which the vast majority are located in South Africa), firms are choosing to leave citing cost competitiveness and challenges with mechanization. In 2020, gold mining giant AngloGold Ashanti sold its final South African assets and exited the market while Gold Fields has reduced its portfolio and only has one South African mine left. And in 2019, South Africa’s biggest gold producer - Sibanye Gold – announced that it would not be spending new capital to grow its South Africa’s operations, citing the investment climate as “not yet conducive to make decisions that require billions of rand (Thompson, 2020).

One of the key challenges facing the sector is the high operational costs resulting from importing mechanized equipment and the labor needed to operate and repair the machinery. Gold Fields South Deep Mine became one of South Africa’s first fully mechanized mines. At a depth of 3 km and a life-of-mine of over 70 years, it is the world’s second largest gold mine and one of the deepest mines in the world. Gold Fields has invested R32 billion into the mechanization of the mine since 2006. But this not led to a profitable mine due to high operations costs. For example, when expensive imported machinery fails deep underground, it is both costly and difficult to repair. As a result, South Deep has not been able to come close to the production levels it had hoped for. The mining company has also cited a range of operational challenges, including higher operating costs, poor equipment reliability, poor maintenance, low labor productivity, need for expensive infrastructure and high depreciation costs as contributing factors to loss making. As of 2019, South Deep has yet to yield a sustainable profit (World Bank, 2019). South Africa has yet to develop its capacity in the manufacturing and maintenance of mechanized equipment.

4.1.5 The impact of mechanization on labor

In organizational research, the term ‘psychological contract’ refers to an individual’s beliefs regarding the terms and conditions of an exchange agreement between an individual employee and the firm (Levinson, 1962). The foundation of a psychological contract is a belief that reciprocity will occur (Rousseau, 1989), where job security is provided by the employer, in exchange for loyalty by the employee. However, this is belief in reciprocity is unilaterally held by the individual and does not hinder how the other parties behaves. Mechanization poses a threat to the psychological labor contract, as workers, some of whom have been

with the firm for many years, are facing heightened job insecurity. Mechanization drastically reduces the number of people needed to operate a mine by up to 80 percent, and even more drastically reduces the amount of un-skilled labor required, such as rock blasters who used to manually detonate explosives and are now being replaced by engineers who do it using remote controlled equipment. High-skill labor has an increased ability to be repurposed in other sectors, but low skill labor may not. Additionally, uncertainty arises given that some conventional labor-intensive mines are continuing to operate, some are being sold and taken over by different management, and others are being closed altogether. In October 2019, Minerals Council South Africa then announced that in the PGM sector, 90,000 of 168,000 jobs – or 54 percent of the sector’s employment – were now at risk.

Greenhalgh and Rosenblatt (1984:438) define job insecurity as a ‘sense of powerlessness to maintain desired continuity in a threatened job situation.’ Heaney et al (1994: 1431) define it as a “perception of a potential threat to the continuity of the current job,” and Sverke et al (2002b: 243) define it as a “subjectively experienced anticipation of a fundamental and involuntary event related to job loss.” Insecure employees tend to experience a discrepancy between the preferred and perceived level of security that their employer provides. A feeling of powerlessness is common (Greenhalgh & Rosenblatt, 1984), and job security is reflective of feelings of helplessness to maintain employment continuity.

Job insecurity affects organizational attitudes and behaviors, and is associated with a decline in organizational commitment (Sverke et al., 2002a; 2002b) and trust in corporate management (Ashford et al., 1989). Job insecurity also tends to strengthen employees’ desire to leave the company (Davy et al., 1997). These attitudinal and behavioral implications of job insecurity can threaten the survival of the organization (Greenhalgh & Rosenblatt, 1984). Additionally, research shows that the best qualified members of the workforce are likely to try and leave the company as soon as possible, because they have better chances of finding a job elsewhere (ibid). Their departure adversely affects companies and creates new costs of required recruiting, onboarding and training. Job insecurity arising from mechanization can be a violation of a psychological contract (Sverke et al., 2002a). Thus, it is imperative that companies find ways to help workers facing potential retrenchment due to mechanization with alternate ways of sustaining livelihoods.

Hellgren et al (1999) distinguished between quantitative and qualitative job insecurity. Quantitative job insecurity refers to employees’ concerns regarding the continuity of the job and whether people will be able to keep their current job or become unemployed. Qualitative job security focuses on insecurity about the valued aspects of their job, such as training opportunities, working hours, their relationship with management. Assessing quantitative and qualitative job security within the PGM sector has not been done to date. Understanding these dynamics can offer insight to the mining sector as it works to reduce industrial action and as it shifts toward mechanization, which is a threat to job security.

4.1.6 Gap in Literature

Research has been done on job security in other sectors in South Africa, including public health (Mafini et al, 2014; Dhanpat, 2019) and migrant labor in education (Manik, 2014). Research has also been done on the impact of skills shortages on the job satisfaction of mine employees within South Africa's gold mining sector (Walt et al, 2016). However, a gap remains at the nexus between job security and mechanization within the mining context. The PGM sector is also an interesting case study because it accounts for the largest share of the mining industry's revenue, exports and employment, but is also undergoing a large transition from labor-intensive conventional mining to capital-intensive mechanized mining, which translates to a large reduction in labor. An analysis by McKinsey (2019) of South Africa's mining sector found that the country's mines are less mechanized than those in many other regions, with a higher share of conventional labor-intensive underground mines. However the ramp up of automated operations has increased significantly in the PGM sector since 2012 (as highlighted in article 2), which makes it an interesting case study for understanding how workers perceive both their quantitative and qualitative job security, as firms integrate technology to become more competitive. Globally, policymakers are scrambling to prepare the workforce for the Fourth Industrial Revolution (Schwab, 2016). But South Africa's shift towards mine mechanization is reflective of the third industrial revolution, which used electronics and information technology to automate production, as well as the fourth, which focuses on developing digitally-enabled mines that turn dangerous, labor-intensive extraction into safer, remote-monitored, autonomous operations.³⁷ The shift to mechanization has been forced by declining global competitiveness, owing partially to high labor costs and lower productivity. Department of Mineral Resources and Energy (DMRE) Minister Gwede Mantashe has publicly criticized the mining sector's plan to implement large scale retrenchments in a weak economy (Faku, 2019).

The South African case study is also interesting because it offers insight on how these perceptions vary by sociodemographic groups. The Government of South Africa has prioritized the transformation of the mining sector to increase the, meaningful participation of Historically Disadvantaged South Africans (HDSAs) in the mining and minerals industry by “deracializing the ownership of the industry, expanding business opportunities for HDSAs, and enhancing the social and economic welfare of employees and mine communities” (Minerals Council South Africa). However, a research gap exists in terms of how these HDSAs³⁸, including blacks and women, experience quantitative and qualitative job security within the

³⁷ The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. The ongoing Fourth Industrial Revolution can be described as the advent of “cyber-physical systems” involving entirely new capabilities for people and machines. The Fourth Industrial Revolution represents entirely new ways in which technology becomes embedded within societies and even our human bodies, such as genome editing, machine intelligence and cryptographic methods such as blockchain (Schwab, 2016).

³⁸ HDSAs refers to any person, category of persons or community, disadvantaged by unfair discrimination before the Constitution of the Republic of South Africa, 1993 (Act No. 200 of 1993) came into operation.

extractives industry, compared to their white male counterparts, who have long dominated positions of power.

4.2 Methodology

This article employs a cross-sectional embedded research design. The embedded design mixes different data sets – quantitative and qualitative - at the design level, with one type of data being embedded within a methodology framed by the other data type (Caracelli & Greene, 1997). The argument for using an embedded design is that a single set of data is inadequate to answer the different questions. In this case, the questions are on quantitative and qualitative job security – while both are quantified through a novel survey, the qualitative data from semi-structured interviews allows for a more granular analysis of different aspects of qualitative job security, such as fairness of promotions and ease of talking to management without fear of retribution. It is cross-sectional in nature because the survey was carried out at a specific point time, without repeat measures (Creswell et al., 2003). A similar approach was taken in Walt al (2016) which examines levels of job satisfaction of mining-sector employees and the perceived influence of skills shortages on the job satisfaction of these employees. This research approach allows for a more comprehensive analysis, because it utilizes complimentary quantitative and qualitative data sets and enables data triangulation, which allows for validation of data through cross-verification of two or more sources.

The mining sector in South Africa is not a research-friendly environment. Although much work has been done on collecting data on challenging environments, it is largely on fragile, conflict and violent countries. Idris (2019) notes that doing research in fragile contexts can bring challenges such as limited data, poor quality of data, insecurity, making it difficult to access regions/local populations and conduct on the ground research and lack of trust on the part of research participants. When bringing this to the Southern African context, Munyoro (2018) assessed the challenges of doing research on Zimbabwe's Parliamentary Constituency Information Centres (PCICs), which was limited by low response rates, unreliable road access, unsuitable physical locations of PCICs, including politicized locations; political and legal restrictions; time management and financial challenges; and religious and cultural barriers. Munyoro concludes that researchers collecting data in these developing-world environments must be aware of the particular challenges these environments pose, while also tackling the challenges that researcher sin all countries faces, which include the need to ensure strong connections with people based in the local environments in which data collection is to take place.

There is a literature gap on how to handle sectoral research in a post-conflict environment such as Marikana, that this article hopes to contribute to filling. In particular, it finds that 'optimal methodology' such as random sampling at a firm level may not be possible, and that using informal channels, such as going to housing compounds, is likely very unsafe. This is discussed further below.

Primary data set

The primary data set for the analysis is a novel survey – a questionnaire was developed, deployed, and analyzed by the author. During the period between June-August 2018, primary data was gathered through 202 questionnaires (300 were distributed, indicating a 67.3 percent return rate), with each questionnaire asking 105 questions. The survey sought to quantify perceived quantitative and qualitative job security and assess how it varied between various groups, along the lines of race, gender, age and education level.

Respondent Selection and Profile

The human resources development team from one of the world's largest PGM firms agreed to distribute this questionnaire to workers (on the agreement that the firm would remain anonymous, given the sensitivity around labor). Of the 300 questionnaires distributed, 202 were returned. The surveyed workers are based in the North West Province. The final sample consisted of 75.2 percent male respondents, 11.9 percent female respondents, and 12.9 percent did not answer the gender question. All respondents identified with a racial group - 54.5 percent black, 41.6 percent white, 3 percent colored and 1 percent Indian. The respondents surveyed spent an average of 14 years at their current firm. The age distribution was skewed two include three main categories, 32.7 percent of respondents were in the 40-49 age group, 30.7 percent were in the 50-59 age group, and 26.7 percent were in the 30-39 age group. Those aged 18-29 and 60+ accounted for the remaining 9.9 percent.

Assessing how racially representative the survey sample is, is a bit more difficult. There are substantial variations within the demographics of different units within a mine. For example, when looking at the Category 4-8 recognition unit, which is comprised of low skill labor such as the mining team, who install jacks to minimize the impact of seismic events and rock falls; blasting assistants, who carry explosives, charge and drill holes with explosives and connect fuses to the explosives in order to prepare for blasting; winch operators, who typically work night shift and are responsible for sweeping the blasted ore into the ore pass; and rock drill operators, who drill holes required for blasting, drill holes required for roof bolts and any other holes required for safety purposes, it is between 98.5 and 99.5 percent are black.³⁹ However, when getting to the officials recognition unit, which are largely skilled supervisory roles, the racial shift moves to 65-70 percent black, with the remainder being largely white. Likewise, the miners and artisans unit, which is a skilled group of labor, tends to sit at a distribution of 60-70 percent black, with the remainder being white. This survey is not a perfect representation of firms - just over half of respondents were black (54.5 percent) indicating that it is likely that white respondents were somewhat overrepresented. There was little control over the respondent demographics. Still, there are valuable insights as both blacks and whites had significant representation in the survey.

³⁹ Racial composition data provided by 4 firms, on condition of anonymity.

When it comes to gender, the survey is fairly representative of the mining sector. In 2018, 54,154 women accounted for 11.9 percent of total employment in the sector. For this survey, 11.9 percent of respondents identified as female. It should be noted that 12.9 percent did not answer the gender question.

Measuring Instrument

Primary data collected was through questionnaires that had five sections. Section 1 consisted of biographical questions to determine whether biological variables, such as gender, age, race and education, affected qualitative or quantitative job security. Section 2 focused on specific qualitative job security components – education and training opportunities, quantity and consistency of working hours, employment contract type, promotions, evaluations and rewards/consequences for good/bad performance, and perceptions of openness to communicate with managers. Section 3 focused on different aspects of loyalty, and what factors workers prioritized in deciding to stay with the firm. Section 4 focused on how workers perceive racism and sexism in the workplace. Section 5 focuses on job security in the most direct sense and explores whether workers feel their job is threatened by technology/automation, and how prepared they feel, in terms of the skills they have, to find another job should they be retrenched. The questionnaire utilizes a combination of binary yes/no questions, to mitigate the relativity associated with the Likert-scale⁴⁰, multiple choice questions (for example, select the three most important factors when deciding whether you should stay at your current company or move to another company), rank ordering questions which asked participants to prioritize benefits that increase qualitative job security, and a few open-ended questions so participants could describe their experience with training, promotions, and feeling included in the workplace. The questionnaire is in Appendix 1.

Methodological challenges of carrying out the survey

Following the Marikana Massacre, there was a deep distrust that marked the labor landscape. For example, the distrust between NUM and AMCU led to nearly a dozen assassinations in the two years after the Massacre in the Rustenburg area, where this field work was carried out. Of those interviewed as part of this research, 21 opted to be off the record due to a high degree of fear. This was particularly common for those employed underground, whether in management or unskilled labor. At one point, I, as the researcher, had

⁴⁰ Peabody (1962:73) concluded that Likert items “primarily represent response sets, and only to a secondary degree actual differences in intensity.”. He argued that Likert items primarily capture direction (positive or negative) and to a much lesser degree intensity (level of agreement or disagreement). Thus, the binary answer format (offering respondents just a “yes” and a “no” option) represents a good measurement alternative because it captures direction very effectively, but avoids contaminating data with intensity, which is more reflective of response styles than intensity of beliefs. Llaurado (2015) highlights three key weaknesses of the Likert scale: first, two people can get the same value in the Likert scale by having chosen different options; second, it is difficult to treat neutral opinions as “Neither agree or disagree” as respondents are more likely to agree to the statements showed. (acquiescence bias). Additionally, Komorita and Graham (1965) found that the binary answer format is easier to administer and easier to score. Jones (1968) found that binary answer formats were easier for respondents to complete.

to leave South Africa on short notice due to a quote of one of my interviewees (who agreed to an on-the-record interview) landing on twitter and a respective traditional authority phoning him angry, triggering a series of events. Thus, for safety, it was important to utilize formal channels to conduct a labor survey. This was not optimal, but the best that could be done within the high-risk environment. Of the four PGM firms that were asked to participate in the survey, three immediately declined. The fourth agreed after extensive negotiations (with the Head of Human Resource Development) and a six-page confidentiality agreement. The non-disclosure agreement stipulated that I could use the confidential information only for the following purposes:

- Her research doctorate paper at the University of Cambridge in the United Kingdom.
- No data collected from the Disclosure may be shared with third parties who are not directly related to this project.
- The information shall not be processed anonymously for the purposes of data collection.
- The recipient shall share the detailed results of the research which results from this data collection with the Discloser within a period of four weeks from the signature of the agreement.
- The Recipient shall share the general anonymous results/outcomes of the industry/area wide research with the Discloser prior to publication of the paper.

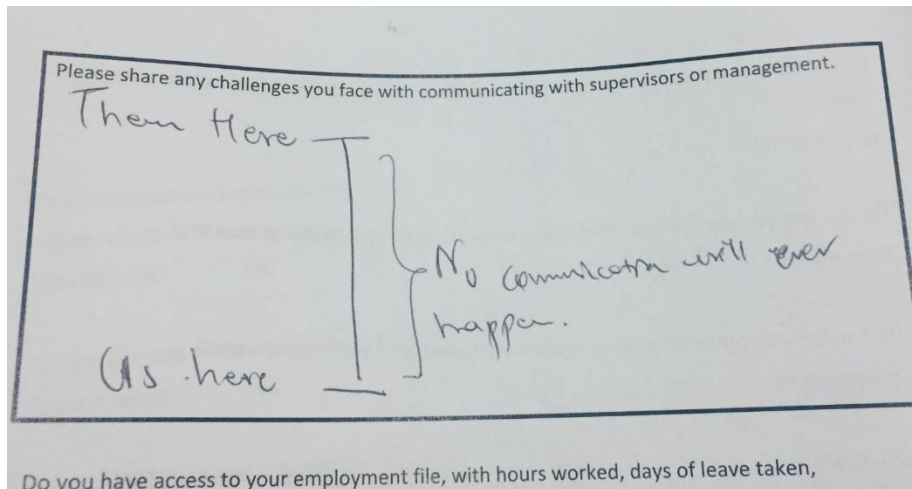
While Spekle and Widener (2018) argue that the use of non-random and/or convenience samples does not pose a significant concern to the vast majority of research studies, random sampling should be used for descriptive research. Unfortunately, random sampling was not an option. The firm stated that the only option was that they would distribute the survey at a selected mine shaft.

After I had the surveys printed, stapled, and dropped off, there were further challenges. Within days, a firm in the area announced substantial retrenchments which set off labor upheaval within the area. AMCU Union President Joseph Mathunjwa made a public statement. "We will closely monitor this... We will even apply for a secondary strike at other Impala operations to make sure that no single ounce of platinum comes up from the ground. Whoever has a business relationship with Impala will be affected." After initially being told, the surveys would be ready to go in 1-2 weeks, it would be another 88 days before I would receive them back.

Given the challenges around doing research in this context – a closed sector, with a very challenging labor dynamic in the aftermath of Marikana with ongoing labor retrenchments and union assassinations – there are naturally limitations to the finding. Beyond the survey representativeness that was discussed earlier, it is important to note that there is no demarcation between skilled and unskilled labor. Another concern is that participants may not have been fully comfortable with being honest on the survey given that it was done within the workplace and handed back to another staff member. Still, answers to open-ended questions suggested that there was still some honesty. For example, when asked "What do you think the most important factors on determining if you will get promoted?" Answers included, "You need to speak

Afrikaans,” “Who you know,” “Race” “Colour and language” and “Marry the company.” For another question, which asked participants to ‘Please share any challenges you face with communicating with supervisors or management,’ the following picture was drawn (Figure 25):

Figure 25: Sample response to communication question



Thus, while limited due to a lack of random sampling, an inability to delineate skills and unskilled labor, a survey administered by the company, and the many delays, this survey offers, to the author’s knowledge, a first time glimpse at quantitative and qualitative job security in the South African mining context, which is rife with conflict and risk.

Secondary data set

Additionally, between March 2018 and February 2019, 71 semi-structured interviews were conducted with various levels of mine employees, including unskilled workers, mid-level engineers and chief executive officers, to get a more descriptive and granular understanding of qualitative job security. The secondary data also allowed for triangulation with the quantitative data. There were no notable discrepancies between the data sets.

4.2.1 Methods

A total of 38 interviews were completed to gain the understanding necessary to develop and deploy a questionnaire. These interviews followed a semi-structured format. It was through these interviews that challenges around communicating with supervisors and lack of transparency around promotions first arose. The questionnaire both triangulated and quantified the findings from the interviews.

4.3 Analysis

The aims of the study were two-fold, namely to (a) measure quantitative job security, as it relates to mechanization and (b) measure qualitative job security, as it relates to several variables – training, promotions, relationships with management, and inclusivity. In this study experiences with racism and sexism is a proxy for inclusivity.

4.3.1 Quantitative Job Security

As mentioned earlier, quantitative job insecurity refers to employees' concerns regarding the continuity of the job and whether people will be able to keep their current job or become unemployed. Respondents answered two questions on job security. The first question asked whether increasing automation increased their likelihood of job loss. Although there was nearly an even split, with 50.5 percent of respondents saying they felt increasing chances of job loss and 40.5 percent saying they did not feel an increase, there were substantial disparities between racial and gender groups. Table 15 shows that 63.3 percent of black respondents perceived an increase in job insecurity, compared to just 35.9 percent of white respondents. Additionally, amongst black respondents, job insecurity generally rose with age – 40 percent of those aged 20-29 said they felt an increased likelihood in job loss, compared to 61.1 percent of those aged 30-39 and 80 percent of those aged 40-49, before dropping back to 55.6 percent of those aged 50-59. The disparity between racial groups was largest for those in the 40-49 age group – 80 percent of black respondents perceived an increase in job insecurity as a result of automation, compared to 15 percent of white respondents.

Impact of automation/technology on job security

Table 15: Impact of automation on quantitative job security, disaggregated by race and age

Do you feel that increasing technology and automation increases chance of job loss?		
N=202		
	No (%)	Yes (%)
Black	36.73	63.27
Ages 21-29	60.0	40.0
Ages 30-39	38.9	61.1
Ages 40-49	20.0	80.0
Ages 50-59	45.5	54.6
White	64.1	35.9
Ages 30-39	71.4	28.6
Ages 40-49	84.6	15.4
Ages 50-59	47.4	52.6
Grand total	48.8	51.1

Source: Author's own

Women perceived a larger risk of losing their jobs as a result of increased automation – Table 16 shows that 63.6 percent of female respondents reported an increased perception of job loss, compared to 52.9 percent of males. Women reported feeling higher levels of insecurity across racial groups. Women remain relatively new to South Africa's mining sector. Between 2002 and 2018, national female labor force participation increased from 40.8 percent to 48.4 percent, demonstrating an 18.6 increase (Statistics SA). During this same time period, female employment in South Africa's mining sector jumped from 11,400 to 54,154, demonstrating a 375 percent increase (Mining Council SA). As a result, women are 'newer' to the mining sector, resulting in lower levels of seniority, which can to higher levels of perceived insecurity.

Table 16: Impact of automation on quantitative job security, disaggregated by gender and race

Do you feel that increasing technology and automation increases your chance of job loss?		
N=202		
	No (%)	Yes (%)
Female	36.4	63.6
Black	33.3	66.7
White	50.0	50.0
Male	47.1	52.9
Black	35.7	64.3
White	60.9	39.1
Grand total	45.2	54.8

Source: Author's own

4.3.2 Qualitative job security

Qualitative job security focuses on insecurity about the valued aspects of their job, such as training, working hours and their ability to communicate with management. Given the high numbers of mining employees who feel an uncertainty in their employment prospects given increasing automation, the questionnaire also assessed how respondents perceived job security in other areas.

4.3.2.1 Training

Throughout the semi-structured interviews with management at mining companies, a reoccurring challenge that was raised was the difficulty retaining skilled black managers. Because demand for black skilled candidates, particularly at senior levels, has increased sharply due to equitable employment legislation, skilled black workers have the ability to easily move between organizations when a new opportunity opens up or a more appealing job offer is received. The phenomena of "job hopping" has become particularly

strong amongst black managers, because they do not trust the firm's intentions with their career development. As a result, they would rather take charge of their own career development by hopping from firm to firm to increase their repertoire of skills and competences (Nzukuma and Bussin, 2011). This questionnaire asked respondents whether a particular aspect of qualitative job security – training – would increase their likelihood of staying. Research shows a strong positive link between job insecurity and turnover; employees are more likely to withdraw from stressful situations and feel less loyalty to employers who cannot ensure security (Cavanaugh and Noe, 1999; Ashford et al, 1989; Cheng and Chan, 2008).

Overall, 80.2 percent of respondents reported that they would be more likely to stay with their currently company if they provided training.

Table 17 shows that across age groups, black respondents were consistently more likely than their white counterparts to report that they would stay with their current company if they were given more training. For the 30-39 age category, 89.5 percent of black respondents reported that they would stay, compared to 57.1 percent of white respondents. For the 40-49 age category, 94.1 percent of black respondents reported they would stay with additional training, compared to 79.6 percent of white respondents.

There was a negligible difference between genders. 81.8 percent of women reported that they would be more likely to stay at their current firm if training was provided, compared to 80.0 percent of men. However, there were substantial differences within genders, when further broken down by race. Table 18 shows that 100 percent black female respondents reported that they would be more likely to stay with their current company if they were provided additional training, compared to 0 percent of white women. The difference was less dramatic for men, but still a stark contrast – 93.1 percent of black men reported an increased likelihood of staying with their current firm if given additional training, compared to 62.5 percent of white men.

Although the sample size is relatively small, this can be of value to mining companies, who reported a major challenge with retaining black talent, especially women. In fact, several major PGM firms reported adopting substantial bonuses for retaining historically disadvantaged racial groups, to combat high turnover rates. The sum of the retention bonus is dependent on the demographic – black women, who tend to be the scarcest in mining, receive the highest bonuses. The findings show that increasing training opportunities could also be a beneficial instrument to increasing retention. Currently, training programs for these groups remained very low – with three of four firms reporting that they had slashed all non-essential training programs, including all external training opportunities.

Table 17: Impact of training on firm loyalty, disaggregated by age and racial groups

Would you be more likely to stay with your current company if they provided more training?		
N=202		
	No (%)	Yes (%)
Ages 21-29	0.0	100.0
Black	0.0	100.0
Ages 30-39	19.2	80.8
Black	10.5	89.5
White	42.9	57.1
Ages 40-49	13.3	86.7
Black	5.9	94.1
White	23.1	76.9
Ages 50-59	29.0	71.0
Black	0.0	100.0
White	45.0	55.0
Ages 60-69	25.0	75.0
Black	0.0	100.0
White	50.0	50.0
Grand total	19.8	80.2

Source: Author's own

Table 18: Impact of training on firm loyalty, disaggregated by gender and racial groups

Would you be more likely to stay with your current company if they provided more training?		
N=202		
	No (%)	Yes (%)
Female	18.2	81.8
Black	0.0	100.0
White	100.0	0.0
Male	20.8	79.2
Black	6.9	93.1
White	37.5	62.5
Grand total	20.3	79.7

Source: Author's own

4.3.2.2 Promotions

A key component of a strong psychological contract in which the employee gives the firm their loyalty in exchange for job security, is the understanding that the employee will be rewarded with fair promotions

and fair pay increases. Overall, over half (55.1 percent) of survey respondents reported that they did not feel the promotion process was fair. Although there was less than a 4.5 percent difference between black and white respondents for those aged 40-59, there was a substantial gap for the two racial groups in the 30-39 age group – Table 19 shows that 85.7 percent of white respondents said the promotion process was fair, compared to 41.2 percent of black respondents.

Answers on an open-ended question on the fairness of promotions highlighted the need to take educational qualifications into account when deciding on promotions to increase fairness. This was backed by survey findings.

Table 20 shows that of those who completed a bachelor's degree, just 38.7 percent of respondents felt the promotion process was fair, compared to 52.7 percent of those without a degree, showing that those with more education felt the promotion process was more unfair.

There was also a substantial difference in responses to the fairness of promotions between male and female respondents. Table 21 shows that 89 percent of female respondents perceived the promotion process to be fair, compared to 44.8 percent of male respondents. This is likely a result of the push to bring more women into the mining sector and increase their representation in various positions.

Table 19: Fairness of promotions, disaggregated by age and race

Do you feel the promotion process is fair?		
N=202		
	No (%)	Yes (%)
Ages 21-29	100.00	0.00
Black	100.0	0.0
Ages 30-39	45.8	54.2
Black	58.8	41.2
White	14.3	85.7
Ages 40-49	57.7	42.3
Black	56.3	43.8
White	60.0	40.0
Ages 50-59	56.0	44.0
Black	55.6	44.4
White	56.3	43.8
Grand total	55.1	44.9

Source: Author's own

Table 20: Fairness of promotions, disaggregated by education level

Do you feel the promotion process is fair?		
N=202		
	No (%)	Yes (%)
No bachelor's degree	47.4	52.6
Completed bachelor's degree	61.3	38.7
Grand total	53.6	46.4

Source: Author's own

Table 21: Fairness of promotions, disaggregated by gender

Do you feel the promotion process is fair?		
N=202		
	No (%)	Yes (%)
Female	11.1	88.9
Male	55.3	44.7
Grand total	48.2	51.8

Source: Author's own

4.3.2.3 Open Communication

Improving communication is critical to ending 'Apartheid of speech' in workplaces, in which black workers were unable to speak directly to white managers. Additionally, open and honest communication is an effective way to increase qualitative job security because it increases the perception that someone is a respected employee and allows them to talk about challenges, which makes the workplace more open. To assess how respondents felt about communicating about challenges, the questionnaire asked respondents whether they believe they will suffer consequences for voicing their concerns. Overall, a third (30.2 percent) of respondents reported that they will suffer consequences for voicing concerns. However, this varied substantially based on education qualifications and gender. Those with more education and who were white reported more comfort with voicing their concerns. Table 23 shows that for those who have not passed matric (the equivalent of a high school diploma in the South African education system), 80 percent of respondents reported that they perceived they would suffer consequences, compared to 36.7 percent of those who have completed matric. Amongst racial groups,

Table 22 shows that 48.1 percent of black respondents reported that they felt they would face consequences for voicing their concerns, compared to just 26.8 percent of white respondents.

Table 22: Perceptions of consequences for communicating concerns, disaggregated by race

Do you feel you will suffer consequences for voicing your concerns?		
N=202		
	No (%)	Yes (%)
Black	51.9	48.1
White	73.2	26.8
Grand total	61.3	38.7

Source: Author's own

Table 23: Perceptions of consequences for communicating concerns, disaggregated by educational attainment

Do you feel you will suffer consequences for voicing your concerns?		
N=202		
	No (%)	Yes (%)
No matric	20.0	80.0
Completed matric	63.3	36.7
Grand total	61.1	38.9

Source: Author's own

4.4 Discussion

The findings of this study show that perceptions of both quantitative and qualitative job security have deep cracks along the lines of race. In general, white respondents were less likely to report feeling job insecurity as a result of automation (34.2 percent compared to 63.5 percent of black respondents), more likely to feel the promotion process is fair (48.6 percent compared to 41.3 percent of black respondents) and be more comfortable with voicing their concerns in the workplace, without fear of retribution (73.2 percent compared to 51.9 percent of black respondents). Additionally, the workplace experience can be substantially different based on identity. For example, female respondents were substantially more likely to report their perception that the promotion process was fair (88.9 percent of women, compared to 44.7 percent of men). Those who were less education (without their matric) perceived much higher likelihood of facing consequences for sharing their concerns.

While South African mines need to automate/mechanize to remain cost competitive (labor accounts for two-thirds of production costs in a conventional mine, compared to 10 percent at mechanized mines), which makes quantitative job certainty difficult to maintain, qualitative job certainty can still be improved. Witte (2005) proposed three ways to reduce the uncertainty and uncontrollability of quantitative job insecurity—open and honest communication (which survey results show is low), enabling workers to participate in the decisions about the organization's future (which is currently done through the unions, rather than direct

participation), and organizational justice, which is the perception that employees are treated fairly by the employer. Although this questionnaire did not assess organizational justice, the finding that 48.1 percent of black respondents fear that there will be consequences if they voice their concerns suggests that employees do not feel they can communicate their concerns if they are not treated fairly, suggesting that organizational justice is sub-optimal.

The phenomena of “job hopping” has become particularly strong amongst black managers, because they do not trust the firm’s intentions with their career development. As a result, they would rather take charge of their own career development by hopping from firm to firm to increase their repertoire of skills and competences (Nzukumana and Bussin, 2011). As South African mining companies increase their efforts to retain workers, the findings suggest that investing in training may be a key avenue for retention (100 percent of black female respondents reported that they would be more likely to stay if training opportunities increased). This is important because historically, women were isolated from teams, given non-core mining or non-production tasks and were alienated from undertaking skilled underground work (Benya, 2015). This was because with conventional, labor-intensive mining, meeting and/or exceeding production targets translated to monthly bonuses between R750 to R12,000. Removing women from the stopes, who were viewed as physically weaker, meant higher bonuses. Mechanized mining has mitigated the need for physical strength, and thus training and integrating women into mining positions is less risk

There are two ways to look at training. The first is that the likelihood of turnover increases as workers develop more skills that are beneficial to a broader labor market. The second is aligned with a relational psychological contract, which have been shown to be the most effective way to improve productivity, retain labor, and ensure future sustainability (Flood et al, 2001). When firms provide continued training and development opportunities, they are more likely to cultivate loyalty, which can in turn reduce high turnover rates. The findings suggest that the latter may be a good solution in the South African PGM mining sector, and that increasing training may be better than the current trend, which has been to drastically reduce training programs amidst the decline in commodity prices. Historically, firms have had procyclical approach to training and other benefits – during the resource boom, firms chose to increase their spending on workers, through both large bonus payouts and increased availability of both internal and external training. When resource prices collapsed, they slashed most non-essential costs, by ending external training, drastically reducing internal training to legally mandated training, and slashing other benefits. While this research does not suggest a countercyclical approach is needed, in which firms increase their spending on training during periods of low commodity price, maintaining a stable level of training opportunities during both boom and bust periods is important to retaining workers, particularly those who are HDSAs.

This research suggests that there are significant differences in quantitative and qualitative job security across sociodemographic factors such as race, gender, age and qualifications. These findings vary from Walt et al (2016) which explored perceptions of job satisfaction in South Africa’s in gold mining sector and did not find substantial differences across sociodemographic groups. The findings of Walt et al (2016) are

aligned with the dispositional perspective that job satisfaction is determined by a person's general life satisfaction, which, in South Africa's mining industry, is generally low, as demonstrated by nature and frequency of industrial action. This shows that how job security is assessed is important and can lead to vary different results.

Bryson, Cappellari and Lucifora (2007) have suggested that increasing reporting of job dissatisfaction is a method used by unions to increase their bargaining power, rather than a strategy to improve actual working conditions and by extension, job security. Only 53 percent of surveyed workers were part of the union – and reports of poor quantitative and qualitative job security were consistent between unionized and non-unionized workers. Further work could be done to understand motives of various groups for reporting job dissatisfaction within the PGM sector.

4.5 Conclusion

This article has assessed how quantitative and qualitative job security vary amongst sociodemographic groups amidst widespread mechanization in the PGM sector. Although the PGM sector has been a key employer in South Africa, the sector has come under duress as a result of declining cost competitiveness, shifting global demand and falling prices. This has forced the sector to cut costs, and given that labor amounts to two-third of production costs at conventional mining operations, companies have moved to reduce the share of conventional shafts in their portfolio, instead investing in mechanized mines that require 10 percent of the labor. This makes quantitative job security very difficult as the sector endeavors to become more competitive.

However, firms can do more to increase qualitative job certainty, by fostering an environment in which employees can communicate openly, in which promotions are merit-based, fair and transparent, and where workers can access training that makes them better employees both within the firm and at other firms, should retrenchments occur. Additionally, targeted efforts are needed to reduce the disparities in reported qualitative job security across various demographic groups. The mining sector has often been pointed to as the legacy of Apartheid. To meaningfully make the workplace more inclusive and less racially divided, improving HDSA's qualitative job security, by being able to communicate concerns safely, experience fair promotion processes and undertake training opportunities is important. This process is critical for facilitating the transformation of the mining sector, by ensuring that HDSA's benefit from the mining sector through structural changes within companies. Rather than simply employing HDSA's to be Black Economic Empowerment (South Africa's affirmative action program) compliant, creating an environment of qualitative job security will drastically improve the quality of their employment, while also likely making it easier to retain skilled labor.

Chapter 5: Conclusion

5.1 Summary of findings

This thesis has undertaken an analysis of the platinum group metals (PGM) sector in three distinct spheres.

The first article explored the governance dimension, by examining the extent to which resource revenues have facilitated economic growth and development in PGM-rich provinces. It analyzed two economic dependence indicators (real GDP growth and contraction of manufacturing output) and two governance indicators (education expenditures and access to basic infrastructure). Both of the economic indicators failed to show the presence of a resource curse, while there is a mild resource curse on the governance side. In particular, though resource-rich provinces tend to spend more on education (potentially because of a significantly less independent school market), their outcomes are still lagging, indicating that further attention is required to improve outcomes. Additionally, there is still a substantial disparity when it comes to access to basic services and infrastructure between mining and non-mining provinces. Because South Africa's intergovernmental fiscal system is largely decentralized, with the national government raising the majority of revenue but allocating 60-65 percent of nationally raised revenue (after debt servicing costs) to provinces and municipalities, provincial policymakers need to reduce fiscal leakages to use these transfers efficiently to ensure their populations have access to hygienic toilets and clean drinking water. When it comes to internet infrastructure, governments could pursue a subsidy system to incentivize private sector investments in rural areas to prevent them from becoming digitally excluded, as highlighted in the discussion section of the first article.

Importantly, the first article concludes that key challenges can be missed when looking at national level data. Undertaking a provincial level – and perhaps a more granular municipality level – is critical for bridging the development gaps facing mining areas. Industrial policy incentives to create and strengthen economic linkages may not be a priority when looking at national level data – in which mining only accounts for 7.3 percent of GDP - but a provincial analysis shows that if a sector, such as PGMs, faced a significant exogenous shock, both the North West and Limpopo Provinces could be economically devastated, given that mining accounts nearly a third of provincial GDP.

The second article assessed the PGM sector through the organizational economics lens, to understand how firms deal with uncertainty, particularly in terms of financial sustainability and pressure to improve shared-value outcomes. This article found that companies with the PGM sector have managed compounding supply and demand shocks by focusing on two buffering activities: (i) reducing and/or selling conventional labor-intensive operations and focusing on expanding mechanized operations with drastically lower operating costs and (ii) shifting their focus to operations with high deposits of palladium, which is in its ninth consecutive year of global deficit, while platinum is relatively oversupplied. This approach of closing labor-intensive operations and opening new mechanized operations is rooted in historical experience of having

production-stopping strikes when labor is retrenched from existing operations and replaced by technology. Firms have seen an overall improvement in their balance sheets as a result of this.

In terms of managing pressure from external stakeholders to improve shared value outcomes, firms have been less successful. By examining various communities around PGM firms, this article has shown how royalties, CSR and local procurement have largely been futile efforts due to challenges such as corruption and maladministration, short-term projects that are insular and tied to adverse rebound effects upon termination, and limited skills that hinder the growth of higher value-added procurement. Royalties, CSR and local procurement currently operate in the periphery, rather than as a central part of firms' business strategies. This article suggests that a paradigm shift may be required, and that these bridging activities should be viewed as central to protecting core business activities to ensure that firms can keep their social license to operate, as a loss would lead to a halt in all business activities. The findings of this research indicate that a paradigm shift may be required, such that 'bridging' should be viewed central to protecting core business activities.

The third article analyzes the PGM sector through the labor economics lens by examining how perceptions of quantitative and qualitative job security vary amongst sociodemographic groups. The findings of this study show that perceptions of both quantitative and qualitative job security have deep disparities on racial lines. When analyzing perceived job security amidst mechanization, this article found that white respondents were less likely to report feeling job insecurity as a result of automation (34.2 percent compared to 63.5 percent of black respondents). In terms of qualitative job security – or security about valued aspects of job – white respondents were more likely to feel the promotion process is fair (48.6 percent compared to 41.3 percent of black respondents) and be more comfortable with voicing their concerns in the workplace without fear of retribution (73.2 percent compared to 51.9 percent of black respondents). Additionally, the workplace experience can be substantially different based on other identity factors such as gender and educational attainment. For example, female respondents were substantially more likely to report their perception that the promotion process was fair (88.9 percent of women, compared to 44.7 percent of men). Those who were less educated (without their matric) perceived much higher likelihood of facing consequences for sharing their concerns.

This article offers insight that can be beneficial to firms. Currently, firms in South Africa have reported that retaining labor from historically disadvantaged groups is the biggest human resource challenge they face. To keep their license to operate, mining firms must meet the employment targets laid out in the Mining Charter. The 2018 Charter introduced higher targets for black representation at board and management level - board and executive/top management must consist of a minimum of 50 percent black persons. And at the junior management level, a minimum of 70 percent is required to be black employees, 25 percent of which must be black women. To meet these targets, PGM firms have adopted a retention bonus system. For example, for black women who stay at the firm for four years, one firm offers a full year's salary as a bonus. The value of the retention bonus is dependent on the demographic – black women, who tend to be the

scarcest in mining, receive the highest bonuses.

This findings of the survey show that improving various aspects of qualitative job security could assist with retention and meeting targets outlined on the Mining Charter. When the last commodity boom ended, most firms cut all external training and all non-mandated internal training. This survey shows that this was likely not a good move – 100 percent of black women reported that they would be more likely to stay with their current company if they increased training. Similarly, bringing greater transparency and objectivity to the promotion process and creating an environment in which workers can comfortably share their concerns with management directly could help improve retention, particularly for skilled labor who are often being headhunted.

5.2 Policy implications

Throughout the research undertaken for this thesis, several key themes emerged. First, firms play a key role in ensuring that the extractive industry can drive equitable growth. The second article shows how firm's efforts to improved shared value outcomes have been relatively unsuccessful and the third article showed that some mining firms have an environment that is still racially divided, preserving 'Apartheid of speech,' offering limited professional development opportunities, and having a lack of transparency and fairness around the promotions process. Changing this requires conscious effort from firms. Externally, firms must prioritize improving shared value outcomes to keep their social license to operate. Internally, firms must change their organizational practices to create a more favorable working environment to increase qualitative job security.

Second, while there is not a strong resource curse at a sub-national level, provincial governments have a key role to play in bridging the disparities in access to basic services and infrastructure as well as educational outcomes. Given that intergovernmental fiscal allocations are made from the national to provincial levels, the latter needs to improve the efficiency of the use of these funds to improve outcomes.

Third, mechanization is inevitably changing the landscape of PGM mining in South Africa – labor is forecasted to continue declining precipitously. The Government of South Africa needs to work with mining firms to strengthen linkages to the industries of tomorrow, for example, through hydrogen fuel cell production. Additionally, the Government should work on developing and implementing a plan to re-skill workers once employed by the sector.

And fourth, the future of PGMs is highly dependent on two factors: (i) technological trends, within the automotive sector and (ii) the level of government's proactiveness in developing hydrogen fuel cell technology. The former is likely to be accelerated by the global push to reduce carbon emissions and adopt more stringent emissions standards for vehicles.

A key potential low-carbon technology not covered in detailed in this analysis is the use of fuel cells and hydrogen in the clean energy transition, primarily for transportation. The use of fuel cells and hydrogen to provide a power source for low-carbon transportation has been explored for some time now because of its potential to lower carbon emissions (assuming green hydrogen is used) and the potential for hydrogen to be used as an energy carrier. Despite this promise, hydrogen deployment has been limited by high costs barriers in providing the fuel cells and the required hydrogen needed to power those cells, along with infrastructure constraints.

Fuel cell transportation has specific features that give it a comparative advantage over batteries and other low-carbon technologies. Fuel cells offer a higher energy density per weight than batteries, allowing for longer distance travel and improved performance in vehicles, such as buses and heavy freight. The point-to-point nature of this form of transportation also helps overcome some of the infrastructure constraints associated with needing to electrify all electric vehicles with transmission infrastructure. All these features combined explain why fuel cells have been emerging predominantly in buses, and medium to heavy freight transportation.

Fuel cells have various sub-technologies, including ones that use a catalyst prominently made out of platinum or ruthenium, but there are two main sub-technologies (World Bank, 2019:69):

Proton exchange membrane fuel cells are the most commonly used hydrogen sub-technology because of their low weight. These fuel cells operate at low temperatures and require a catalyst usually made out of platinum to split the hydrogen and oxygen molecules. This sub-technology also utilizes chromium steel, composed of 18 percent chromium and 8 percent nickel.

Solid oxide fuel cells do not require a catalyst. These fuel cells operate at very high temperatures and are thus not suitable for transportation; they are predominantly used for stationary power generation. Although the solid oxide fuel cell does not need platinum as a catalyst, it uses other minerals such as yttrium, zirconium, lanthanum, and samarium in the anodes, cathodes, and electrolytes.

In January 2020, the United Nations endorsed a new regulation featuring the Worldwide Harmonized Light Vehicles Test (WLTP), which would force the majority of car manufacturers to comply with some of the most stringent emissions requirements in the world. Vehicle manufacturers would be required to acquire a single approval for all major markets adopting to this regulation, including the 58 that are signatories to the 1958 agreement as well as others that unilaterally adopt UN regulations. The regulations would require that vehicles meet stringent emission limits in particulate matter, nitrogen oxides, carbon monoxide and hydrocarbons, and ensure that emissions remain under the set limits regardless of whether the vehicle is being driven in urban (low phase) rural (medium and high phase) and highway environments (extra high phase). Additionally, vehicles will be required to pass an accelerated ageing test to guarantee that new vehicles pollution control devices will be effective up to 160,000 kilometers on the odometer (UNECE, 2020).

In terms of the government's effectiveness in the development of hydrogen fuel cell technology, South Africa has lagged substantially. In 2007, the South African Cabinet approved the Department of Science and Technology's plan to develop Hydrogen South Africa or HySA, a 15-year program within their Research, Development and Innovation strategy that was launched in September 2008. HySA's objective is as follows (2014:1)

This National Flagship Programme is aimed at developing South African intellectual property, knowledge, human resources, products, components and processes to support the South African participation in the nascent, but rapidly developing international platforms in Hydrogen and Fuel Cell Technologies. The programme strives towards a knowledge-driven economy meaning that innovation will form the basis of South Africa's economy; this includes an aggressive capacity-development programme's approach. HySA also focusses on (i) the "Use and Displacement of Strategic Minerals", (ii) ways of harnessing South Africa's mineral endowments to promote both the hydrogen economy and renewable energy use, and (iii) seeking the most cost-effective and sustainable ways of incorporating PGM-based components in hydrogen fuel cell and other technologies, in turns resulting in commercialisation ventures and a viable industry around mineral beneficiation.

As of 2021, HySA has yet to make much progress on the development of hydrogen fuel cells. In 2020, it was an area flagged for development in the South African Economic Reconstruction and Recovery Plan. The Plan committed to using industrial policy instruments to support the development of a comparative advantage in hydrogen fuel cell technology, which uses PGMs, given that the sector employs 38 percent of the mining labor force. However, there is little credibility given the lack of progress since HySA was created 13 years ago. Thus, it is likely that if hydrogen cell fuel technology gains momentum, which is likely, that South Africa will continue to export the metals with the fuel cells manufactured elsewhere.

5.3 Areas for future work

There are several areas where this work would be developed further to create a most holistic understanding of the PGM sector. First, assessing how mining and non-mining provinces fare for other economic and governance indicators, to understand where there are weaknesses that can be improved.

Second, when it comes to understanding the effectiveness of firms' bridging efforts, quantifying the impact of corporate social responsibility, royalties and procurement and measuring these against satisfaction of external stakeholders, such as communities, would be interesting to understand the relationship between these various mechanisms and satisfaction.

Third, for labor, the survey was only done at one firm (one of the three largest PGM producers in the world). Other firms did not agree to participating given the sensitivity around labor issues and the substantial amount of adverse media attention they have received over it. In the future, if management was willing, replicating this survey, disaggregated by recognition units and skill levels, would help with understanding how perceptions of quantitative and qualitative job security vary across job categories.

And fourth, cross-cutting all three of these articles, an analysis on how unions fit into this narrative – in terms of understanding the degree to which they have played a role in advocating for social development in communities, how firms have navigated union challenges over time, how unions have responded to the mechanization transition, and if/how they have advocated for quantitative and qualitative job security. Personally, during this research, there were substantial safety issues around doing informal labor research and a high degree of union conflict that would have been unwise to engage with. At point one, I needed to leave the country on short notice due to a threat. Over a dozen cross-union assassinations took place during this field work. However, there were some benefits to going straight to the workforce. Little research has been published on worker voice post-Marikana. In fact, while working with a colleague at the University of Cape Town on some mining-related work, it became evident that while the dominant labor union advocates heavily for wages, they engage minimally or not at all with issues such as Apartheid of speech promotions, upskilling/re-skilling, etc. Thus, this survey was able to address issues that the union does not typically engage with.

References

- Addison, T. & Roe, A.R. (2018). *Extractive industries: The management of resources as a driver of sustainable development*. WIDER Studies in Development Economics. Oxford: Oxford University Press.
- Addison, T. (2018). Climate change and the extractives sector. WIDER Working Paper Series wp-2018-84, World Institute for Development Economic Research (UNU-WIDER).
- Addison, T., Boly, A. and Mveyange, A. (2017). The impact of mining on spatial inequality: Recent evidence from Africa, No wp-2017-13, WIDER Working Paper Series, World Institute for Development Economic Research (UNU-WIDER)
- Allcott, H., and Keniston, D. (2014). Dutch disease or Agglomeration? The local economic effects of natural resource booms in modern America, NBER working paper 20508.
- Ascher, W. (1999). *Why Governments Waste Natural Resources: Policy Failures in Developing Countries*, Baltimore: John Hopkins University Press.
- Ashford, S. J., Lee, C., & Bobko, P. (1989). Content, cause, and consequences of job insecurity: A theory-based measure and substantive test. *Academy of Management Journal*, 32(4), 803-829.
- Auty, R. M. (1993). *Sustaining development in mineral economies: The resource curse thesis*. London: Routledge.
- Auty, R. M. (1998). Resource abundance and economic development: Improving the performance of resource-rich countries. Research for Action 1998/044. Helsinki: UNU-WIDER.
- Baldacci, E., Clements, B., Gupta, S., and Cui, Q. (2008). Social spending, human capital, and growth in developing countries. *World Development*, 36(8), 1317-1341.
- Baldacci, E., Guin-Siu, M. T., and de Mello, L. (2003). More on the effectiveness of public spending on health care and education: A covariance structure model. *Journal of International Development*, 15(6), 709-725.
- Basebenzi, H. (n.d.) Commemorating South Africa's Labour Union. South African Historical Archives.
- Baskaran, G. (2019). Miners' destruction of arable land puts food security at risk. Business Day
- Baskaran, G., Bhorat, H., Kohler, T. and Stanwix B (forthcoming) Testing the Means Test: Social Assistance in South Africa in the Time of COVID-19. Fiscal and Financial Commission.
- Belinkie, S. (2015). South Africa's land restitution challenge: Mining alternatives from evolving mineral taxation policies. *Cornell International Law Journal*, 48. 219-246.
- Benya, A. (2015). Women, subcontracted workers and precarity in South African platinum mines. *Labor Capital and Society*, 48(1&2), 68-91.

Bhattacharyya, S. & Hodler, R. (2010). "Natural resources, democracy and corruption", *European Economic Review*, 54 (4), 608–621

Birdsall, N., Pinckney, T., and Sabot, R. (2001). *Natural resources, human capital and growth*. In R. M. Auty (Eds.), *Resource Abundance and Economic Development*. Oxford: Oxford University Press.

Blankenau, W. F., Simpson, N. B., and Tomljanovich, M. (2007). Public education expenditures, taxation, and growth: Linking data to theory. *The American Economic Review*, 97 (2), 393-397.

Bose, N., Haque, M. E., and Osborn, D. R. (2007). Public expenditure and economic growth: A disaggregated analysis for developing countries. *The Manchester School*, 75(5), 533-556.

Botiveau, R. (2014). Briefing: The politics of Marikana and South Africa's changing labor relations. *African Affairs*. 113 (450). 128-137.

Bourdieu, P. (1965). *Travail et travailleurs en Algerie*. Paris: Editions Mouton.

Bravo-Ortega, C., and De Gregorio, J. (2005). The relative richness of the poor? Natural resources, human capital, and economic growth. World Bank Policy Research Working Paper No. 3484.

Breytenbach, M. (Ed.). (2018, August 24). PGMs producer focuses on palladium in Limpopo. *Mining Weekly*.

Brown, O., Crawford, A and Gibson, J (2008). International Institute for Sustainable Development.

Bryceson, A., Cappellari, L., and Lucifora, C. (2007), Why so unhappy? The effects of unionisation on job satisfaction, Policy Studies Institute, London. [Discussion Paper].

Bryceson, D. & MacKinnon, D. (2012). Eureka and beyond: Mining's impact on African urbanisation. *Journal of Contemporary African Studies*, 30(4), 513-537.

Burawoy, M. (1972). Another look at the mineworker. *African Social Research* 14: 239-87.

Bureau of Food and Agricultural Policy. (2012). The impact of coal mining on agriculture – a pilot study. Pretoria: Bureau of Food and Agricultural Policy.

BusinessTech. (2017a). 2016 matric pass rate climbs to 72.5%. Retrieved from: <https://businesstech.co.za/news/lifestyle/148871/2016-matric-pass-rate-climbs-to-72-5/> (Accessed 8 October 2020).

BusinessTech. (2017b). Shocking drop-out rates: Where in South Africa the fewest kids make it to matric. Retrieved from: <https://businesstech.co.za/news/trending/149291/shocking-drop-out-rates-where-in-south-africa-the-fewest-kids-make-it-to-matric/> (Accessed 8 October 2020).

Bussin, M. (2002). *Retention strategies: remuneration answers*. Randburg: Knowledge Resources

- Cairncross, E. (2014). Health and environmental impacts of platinum mining: Report from South Africa. Retrieved from <http://www.thejournalist.org.za/wp-content/uploads/2014/09/Environmental-health-impacts-of-platinum-mining1.pdf>
- Capps, G. (2015) Labour in the time of platinum. *Review of African Political Economy*, 42:146, 497-507.
- Capps, G. and Mnwana, S. (2015). Claims from below: platinum and the politics of land in the Bakgatla-ba-Kgafela traditional authority area. *Review of African Political Economy*. 42. 606-624.
- Caracelli, V. J., & Greene, J. C. (1997). Crafting mixed-method evaluation designs. In J.C. Greene and V. J. Caracelli (Eds.), *Advances in mixed- method evaluation: The challenges and benefits of integrating diverse paradigms* (pp. 19-32). San Francisco: Jossey-Bass.
- Cavanaugh, M. A., & Noe, R. A. (1999). Antecedents and consequences of relational components of the new psychological contract. *Journal of Organizational Behavior* ,20(3), 323-340.
- Caves RE (1987) Industrial policy and trade policy: the connections. In: Kierzkowski H (ed) *Protection and competition in international trade: essays in honour of W. M. Corden*. Blackwell, Oxford
- Chamber of Mines of South Africa. (2015). *The Future of the South African Mining Industry*.
- Chang. H.J. (1998). Evaluatin the current industrial policy of South Africa. *Transformation*.
- Cheng, G. H., & Chan, D. K. (2008). Who Suffers More from Job Insecurity? A MetaAnalytic Review. *Applied Psychology*, 57(2), 272-303.
- Cockx, L., and Francken, N. (2016). Natural resources: A curse on education spending? *Energy Policy*, 92, 394-408.
- Cohen E (2006) Theoretical foundations of industrial policy. *EIB Papers* 11(1):84–106
- Collier, P. (2008). *The bottom billion: Why the poorest countries are failing and what can be done about it*. Oxford: Oxford University Press.
- Collier, P., and Hoeffler, A. (2009). Testing the neocon agenda: Democracy in resource-rich societies. *European Economic Review*, 53(3), 293-308.
- Corden, W.M. (1984). Booming sector and dutch disease economics: survey and consolidation. *Oxford Economic Papers*, Vol. 36 (November). 359–80.
- Corden, W.M. and Neary, J.P. (1982). Booming sector and de-industrialisation in a small open economy. *The Economic Journal*, Vol. 92. 825–48.
- Corruption Watch. (2018). *Mining Royalties Report 2018*. Johannesburg: Corruption Watch.

Cottle, E. The Transformation of the Construction Sector in South Africa since apartheid: Social inequality and labour. Global Labour University

Crankshaw, O. (1996). Race, class, and the changing division of labor under Apartheid. London: Routledge.
credible planning. *Development Southern Africa*, 33(3), 298-311.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209-240). Thousand Oaks, CA: Sage.

Crush, J., and Tshitereke, C. (2001). Contesting migrancy: the foreign labor debate in post-1994 South Africa. *Africa today*, 49-70.

Cust, J., and Poelhekke, S. (2015). The Local Economic Impacts of Natural Resource Extraction. *Annual Review of Resource Economics*, 7, 251-268.

Cust, J., and Viale, C. (2016). Is There Evidence for a Subnational Resource Curse? Natural Resource Governance Institute Policy Paper April 2016.

Daniel, J. et al., editors. New South African Review 2: New Paths, Old Compromises? Wits University Press, 2011. JSTOR, www.jstor.org/stable/10.18772/22011105416. Accessed 21 Feb. 2021.

Davenport, J. (2013, September 27). The 1987 mineworkers strike.

Davis, G. A. (1995). "Learning to love the Dutch disease: Evidence from the mineral economies". *World Development*, 23(10), 1765-1779.

Davy, J.A., Kinicki, A.J., & Scheck, C.L. (1997). A test of job insecurity's direct and mediated effects on withdrawal cognitions. *Journal of Organizational Behavior*, 18, 323-349.

Deloitte (2013). Enhancing Manufacturing competitiveness in South Africa.

Department of Basic Education. (2018). Education statistics in South Africa 2016. Retrieved from: <https://www.education.gov.za/Portals/0/Documents/Publications/Education%20Statistic%20SA%202016.pdf?ver=2018-11-01-095102-947> (Accessed 8 October 2020).

Department of Trade and Industry. (2020). Investing in South Africa's Mining and Mineral Beneficiation Sector: Creating Shared Value. The Department of Trade and Industry, Republic of South Africa.

Detailed TOC of Global Automotive Catalytic Converter Market 2019 by Manufacturers, Regions, Type and Application, Forecast to 2024. (2011). Absolute Reports.

Dewar, K. (2012). The catalytic convertor industry in South Africa. The Southern African Institute of Mining and Metallurgy.

Dhanpat, N., Manakana, T., Mbacaza, J., Mokone, D., & Mtongana, B. (2019). Exploring retention factors and job security of nurses in Gauteng public hospitals in South Africa. *African Journal of Economic and Management Studies*, 10(1), 57-71.

Dolnicar, S., Grun, B., Leisch, F. and Rossiter, J. (2011). Three good reasons NOT to use five and seven point Likert items <https://ro.uow.edu.au/commpapers/775>

Donges JB (1980) Industrial policy in West Germany's not so market—oriented economy. *World Econ* 3(2):185–204

Dunbar Moodie, T. (2015) Igneous' means fire from below: The tumultuous history of the National Union of Mineworkers on the South African platinum mines. *Review of African Political Economy*, 42:146, 561-576,

EITI. (2020). Chad. Retrieved from: <https://eiti.org/chad> (Accessed on 8 October 2020).

Elbra, A. D. (2013). The forgotten resource curse: South Africa's poor experience with mineral extraction. *Resources Policy*, 38(4), 549-557.

Elixmann, D. and Neumann, K. (2013). The Broadband State Aid Rules Explained an EGuide for Decision Makers: Final Report.” Luxembourg: European Commission.

Ernst and Young (2020). Top 10 business risks facing mining and metals in 2019-20

Etherington, N. (1979). Labor supply and the genesis of South African confederation in the 1870s. *Journal of African History*, 20 (13).

Faku, D. (2019). Mantashe calls out mining industry on planned retrenchments. IOL.

Fengler, W. (2020). The future of mobility: Why your new car is like an electronic typewriter. Brookings Institute.

Fennell, M. and Alexander, J.A. (1987). Organizational boundary spanning in institutionalized environments. *Academy of Management Journal*, 30: 456-576.

Fine, B. and Z. Rustonjee (1997) South Africa's Political Economy: From Minerals-Energy Complex to Industrialisation, Johannesburg: Wits University Press.

Finmark Trust (2019). Measuring Progress: Financial inclusion in SADC.

Flatters, F (2005). The Economics of MIDP and the South African Motor Industry. TIPS

Fleming, D. A., Measham, T. G., and Paredes, D. (2015). Understanding the resource curse (or blessing) across national and regional scales: Theory, empirical challenges and an application. *Australian Journal of Agricultural and Resource Economics*, 59(4), 624-639.

- Flomenhoft, G. (2019) Communal land and the attitudes of the Bafokeng on benefits from mineral rights. *South African Journal of International Affairs*, 26:2, 277-301
- Flood, P. C., Turner, T., Ramamoorthy, N., & Pearson, J. (2001). Causes and consequences of psychological contracts among knowledge workers in the high technology and financial services industries. *The International Journal of Human Resource Management*, 12(7), 1152- 1165.
- Forrest, K. (2015). Rustenburg's labour recruitment regime: shifts and new meanings. *Review of African Political Economy*, 42:146, 508-525,
- Freund, B. (1984). Labor and labor history in Africa: A review of the literature. *African Studies Review*, 27(2), 1-58.
- Frynas, J.G., Wood, G., and Hinks, T. (2017). The resource curse without natural resources: Expectations of resource booms and their impact. *African Affairs*, 116(463), 233-260.
- Glykou I, Pitelis CN (2011) On the political economy of the state, the public-private nexus and industrial policy. *Policy Stud* 32(4):461–478
- Greene J.C., Caracelli V.J., Graham W.F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*. 11(3):255-274.
- Greenhalgh, L. & Rosenblatt, Z. (1984). Job insecurity: Toward conceptual clarity. *Academy of Management Review*, 9 (3), 438-448.
- Gupta, S., Verhoeven, M., and Tiongson, E. R. (2002). The effectiveness of government spending on education and health care in developing and transition economies. *European Journal of Political Economy*, 18(4), 717-737.
- Gylfason, T. (2001). "Natural Resources, Education, and Economic Development.", *European Economic Review*, 45(4–6), 847–59.
- Gylfason, T. (2011). "Natural Resources: A Mixed Blessing?", in R. Arezki, T. Gylfason and A. Sy (eds.) *Policies to Harness the Power of Natural Resources*, 7-34. Washington, DC: International Monetary Fund
- Hajkowicz, S. A., Heyenga, S., and Moffat, K. (2011). The relationship between mining and socio-economic well being in Australia's regions. *Resources Policy*, 36(1), 30-38.
- Hamann R. (2004). Corporate social responsibility, partnerships and institutional change: The case of mining companies in South Africa', *Natural Resources Forum*.
- Hausmann, R., and Rigobon, R. (2003). An alternative interpretation of the 'resource curse': Theory and policy implications. National Bureau of Economic Research Working Paper Number w9424.

Heaney, C., Israel, B. & House, J. (1994). Chronic job insecurity among automobile workers: Effects on job satisfaction and health. *Social Science and Medicine*, 38 (10), 1431-1437.

Hellgren, J. & Sverke, M. (2003). Does job insecurity lead to impaired well-being or vica versa? Estimation of cross-lagged effects using latent variable modelling. *Journal of Organizational Behavior*, 24, 215-236.

Hellgren, J., Sverke, M., & Isaksson, K. (1999). A two-dimensional approach to job insecurity: Consequences for employee attitudes and well-being. *European Journal of Work and Organizational Psychology*, 8 (2), 179-195.

Hidalgo, C. A., Klinger, B., Barabási A. L., and Hausmann, R. (2007). The product space conditions the development of nations. *Science*, 317(5837), 482-487.

Hirsch, A. (2005). *Season of Hope: Economic Reform under Mandela and Mbeki*. University of KwaZulu Natal Press.

Hirschman, A. (1958): *The Strategy of Economic Development*, New Haven, Yale University.

Hydrogen South Africa (2014). Government of South Africa.

International Finance Corporation. (2011). A Guide to Getting Started in Local Procurement.

Isham, J., Woolcock, M., Pritchett, L., and Busby, G. (2005). The varieties of resource experience: natural resource export structures and the political economy of economic growth. *The World Bank Economic Review*, 19(2), 141-174.

Ivanova, G. (2014). The mining industry in Queensland, Australia: Some regional development issues. *Resources Policy*, 39, 101–114.

James, A. (2015). “The Resource Curse: a Statistical Mirage?”, *Journal of Development Economics*, 114 (May), 55–63.

James, A., and Aadland, D. (2011) “The curse of natural resources: an empirical investigation of U.S. counties,” *Resource and Energy Economics*. (33). 440-453

Jones, R.R. (1968). Differences in Response Consistency and Subjects' Preferences for Three Personality Inventory Response Formats. *Proceedings of the 76th Annual Convention of the American Psychological Association*, 247-248.

Kane-Berman, J. (2018). Mining and People: The impact of mining on the South African economy and living standards. *South African Institute of Race Relations*, 2(37).

Kesler S.E. (1994) *Mineral resources, economics and the environment*. Macmilllan, New York.

- Kok, L. (2008). The impact of the Motor Industry Development Programme on the competitiveness of automotive component manufacturers. University of Pretoria.
- Komorita, S.S., & Graham, W.K. (1965). Number ID Scale Points and the Reliability Scales. *Educational and Psychological Measurements*, 25, 987-995.
- Lahn, G. and Stevens, P. (2018). The Curse of the One-size-fits-all Fix. In Addison, T. & Roe, A.R. (2018). *Extractive Industries: The Management of Resources as a Driver of Sustainable Development*, WIDER Studies in Development Economics. Oxford: Oxford University Press.
- Latsch W (2008) The possibility of industrial policy. *Oxf Dev Stud* 36(1):23–37
- Lebdioui, A. A. (2019). *Economic Diversification and Development in Resource-dependent Economies: Lessons from Chile and Malaysia* (Doctoral thesis).
- Lederman, D., and Maloney, W. F. (2007). *Natural resources, neither curse nor destiny*. Washington, D.C.: The World Bank and Stanford University Press.
- Lewis, W.A. (1955). "The Theory of Economic Growth.", *The Journal of Economic History*, 18(01), 70-73.
- Llaurado, O. (2015). Likert scale: what it is and how to use it. Netquest.
- Macdonald, C. (2018). The Role of Participation in Sustainable Community Development Programmes in the Extractive Industries. In Addison, T. & Roe, A.R. (2018). *Extractive Industries: The Management of Resources as a Driver of Sustainable Development*, WIDER Studies in Development Economics. Oxford: Oxford University Press.
- Mafini, C. and Dlodlo, N. (2014). The linkage between work-related factors, employee satisfaction and organisational commitment: Insights from public health professionals. *SA Journal of Human Resource Management*, 12(1), 1-E12.
- Mahoney, J. T. (2004). *Economic foundations of strategy*. Thousand Oaks, CA: Sage.
- Manik, S. (2014). "We are working hand to mouth": Zimbabwean teachers' experiences of vulnerability in South Africa. *Migracijske I Etničke Teme*, 30(2), 171-191.
- Mano, R. C., and Castillo, M. (2015). The level of productivity in traded and non-traded sectors for a large panel of countries. IMF Working Paper 48.
- Manson, A and Mbenga, B. (2003). 'The richest tribe in Africa': Platinum mining and the Bafokeng in South Africa's North West Province, 1965-1999. *Journal of Southern African Studies*, 29(1), 25-47.
- Marks, S. & Trapido, S. (1979). Lord Milner and the South African War. *History Workshop Journal* 8:50

McKay, D. (2017, August 01). RBPlat BRPM shaft restructure delivers fresh blow to SA mining. Mining Mx.

McKinsey & Company (2019). Putting the shine back into South African Mining: A path to competitiveness and growth.

Mehlum, H., Moene, K., and Torvik, R. (2006). Institutions and the resource curse. *The Economic Journal*, 116 (508), 1-20.

Meznar, M. B., & Nigh, D. (1995). Buffer of bridge? Environmental and organizational determinants of public affairs activities in American firms. *Academy of Management Journal*, 38, 975-996

Michaels, G. (2011). The long term consequences of resource-based specialization,

Mineral Production to Soar as Demand for Clean Energy Increases. (2020). World Bank.

Minerals Council. (2011). Minerals Council South Africa: Facts and figures 2010.

Minerals Council. (2018). Minerals Council South Africa: Facts and figures 2017.

Minerals Council. (2019a). Minerals Council South Africa: Facts and figures 2018

Minerals Council. (2019b). Artisanal and small-scale mining.

Mudd, G.M and Glaister, B.J (2009). The Environmental Costs of Platinum-PGM Mining: An Excellent Case Study In Sustainable Mining. Proc. “48th Annual Conference of Metallurgists”, Canadian Metallurgical Society, Sudbury, Ontario, Canada, August 2009.

Mutti, D., N. Yakovleva, D. Vazquez-Brust, and M. H. Di Marco (2012). Corporate social responsibility in the mining industry: Perspectives from stakeholder groups in Argentina. *Resources Policy*, 37: 212–22.

National Treasury. (2020). Division of revenue and spending by provinces and municipalities.

Neergaard, P. 1992 Environment, strategy and management accounting. Proceedings of the Second European Symposium on Information Systems. Versailles: HEC.

Nzukuma, K. C., & Bussin, M. (2011). Job-hopping amongst African black senior management in South Africa. *SA Journal of Human Resource Management*, 9(1).

OECD (2014). Working paper No 2. on competition and regulation. Executive summary of the roundtable on financing of the roll out of broadband network.

Omeje, K. (2013). Avoiding the natural resource curse: Lessons from Nigeria and policy implications. *Africa Insight*, 42(4), 91-103.

Oomes, N. and Kalcheva, K. (2007). Diagnosing dutch disease: Does Russia have the symptoms? International Monetary Fund.

- Parsons, T. (1960). *Structure and Process in Modern Societies*. Glencoe, IL: Free Press.
- Peabody, D. (1962). Two Components in Bipolar Scales: Direction and Extremeness. *Psychological Review*, 69(2), 65-73.
- Porter, D., and Watts, M. (2017) Righting the resource curse: Institutional politics and state capabilities in Edo State, Nigeria. *The Journal of Development Studies*, 53(2), 249-263.
- Powell, M., Reddy, V., & Juan, A. (2016). Skills in South Africa: The journey towards
- Prebisch, R. (1950) The Economic development of Latin America and its principal problems. United Nations Department of Economic Affairs, Economic Commission for Latin America (ECLA), New York.
- Rajak, D. (2011). *In Good Company: An Anatomy of Corporate Social Responsibility*. Stanford University Press.
- Rajak, D. (2012). Platinum city and the new South African dream. *Africa: Journal of the International African Institute*, 82(2), 252-271
- Reeson, A. F., Measham, T. G., and Hosking, K. (2012). Mining activity, income inequality and gender in regional Australia. *Australian Journal of Agricultural and Resource Economics*, 56(2), 302-313.
- Renner, S., Wellmer, F.W. (2019). Volatility drivers on the metal market and exposure of producing countries. *Miner Econ*.
- Rodrik D (2004) Industrial policy for the twenty-first century. Faculty Research Working Papers Series, Harvard University, RWP04-047
- Ross, M. (1999) “The Political Economy of Resource Curse”, *World Politics*, 51 (January), 297-322.
- Rousseau, D. M. (2004). Psychological Contracts in the Workplace: Understanding the Ties That Motivate. *Academy of Management Executive*, 18(1), 120-127.
- Rousseau, D.M. (2000), Psychological contract inventory. Technical report NO 2000–02, Heinz School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, PA.
- Rousseau, D.M., and McLean Parks, J. (1993), The contracts of individuals and organisations. *Research in Organizational Behavior*, 15, 1–43.
- Rustomjee, Z. (1993) The Political Economy of South African Industrialization – the Role of the Minerals Energy Complex PhD Thesis, School of Oriental and African Studies.
- Sachs, J. D., and Warner, A. M. (1995). Natural resource abundance and economic growth. National Bureau of Economic Research Working Paper No. 5398.
- Sachs, J. D., and Warner, A. M. (1997). Sources of slow growth in African economies. *Journal of African Economies*, 6(3), 335-376.

Sala-i-Martin, X., and Subramanian, A. (2013). Addressing the natural resource curse: An illustration from Nigeria. *Journal of African Economies*, 22(4), 570-615.

Sandrine, K., Josef, L., and Yasuhiro, T. (2014). Is Chad affected by Dutch or Nigerian Disease? *Journal of Empirical Economics, Research Academy of Social Sciences*, 3(5), 278-295.

Schwab, K. (2016). The Fourth Industrial revolution: what it means, how to respond. World Economic Forum.

Scott, W. R. (2014). *Institutions and organizations: ideas, interests and identities* (4th ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Segerstedt, E., & Abrahamsson, L. (2019). Diversity of livelihoods and social sustainability in established mining communities. *The Extractive Industries and Society*, 6(2), 610-619. .

Sharife, K and Bond, P. (2011). Above and beyond South Africa's minerals-energy complex. in Daniel, J. Naidoo P., Pillay, D and Southwall, R. New South African Review 2: New paths, old compromises? Johannesburg: Wits University Press.

Simon, Herbert A. (1947). *Administrative Behavior*. New York, NY: Macmillan.

South Africa. (2010), Amendment of the Broad-Based Socio Economic Empowerment Charter for the South African mining and minerals industry, Government Printer, Pretoria.

South Africa. Department of Mineral Resources. (2002), Minerals and Petroleum Resources Development Act 28 of 2002, Government Printer, Pretoria.

South African Historical Archives (2014) South African platinum strike: Longest wage strike in South Africa. Retrieved June 1, 2020.

South African History Online (SAHO) (2014). 2014 South African platinum strike: longest wage strike in South Africa.

Statistics SA (2011). Income dynamics and poverty status of households in South Africa

Statistics South Africa (2017). Breakdown of provincial government revenue for 2016/7.

Statistics South Africa. (2016). *Education series volume III: Educational enrollment and achievement, 2016*. Retrieved from: <https://www.statssa.gov.za/publications/Report%2092-01-03/Report%2092-01-032016.pdf> (Accessed 8 October 2020).

Suchman, M.C., (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review* 20:571-610.

Surujlal, S.N., Manyuchi, K.T., and Smith, G.L (2014). Mining company strategy evolution: an overview and example application in the platinum industry. The 6th International Platinum Conference, The Southern African Institute of Mining and Metallurgy.

Sverke, M. & Hellgren, J. (2002a). The nature of job insecurity: Understanding employment insecurity on the brink of a new millennium. *Applied Psychology: An International Review*, 51 (1), 23-42

Sverke, M., Hellgren, J. & Näswall, K. (2002b). No security: A meta-analysis and review of job insecurity and its consequences. *Journal of Occupational Health Psychology*, 7 (3): 242-264.

Swartz, S. (2009). *Ikasi: the moral ecology of South Africa's township youth*. Palgrave Macmillan US.

Tsabora, J. (2014). Fighting the 'resource wars' in the Democratic Republic of the Congo: An exploratory diagnosis of the legal and institutional problems. *The Comparative and International Law Journal of Southern Africa*, 47(1), 109–128.

Tyson L, Zysman J (eds) (1983) American industry in international competition. In: Zysman J, Tyson L (eds) American industry in international competition: government policies and corporate strategies. Cornell University Press.

UNECE endorses stringent new vehicle emissions regulation (2020). United Economic Commission for Europe.

Välilä T (2006) No policy is an island—on the interaction between industrial and other policies. EIB Papers 11(2):8–33

van der Ploeg, F. (2011). Natural resources: curse or blessing? *Journal of Economic Literature*, 49(2), 366-420.

Viner, J. (1952) International Trade and Economic Development, Glencoe, Illinois: The Free Press.

Walt, F.V.D., Thasi M.E., Jonck, P. & Chipunza, C. (2016). Skills shortages and job satisfaction - insights from the gold-mining sector of South Africa. *African Journal of Business and Economic Research*, 11(1), 143-183.

Wellmer FW. (2008) Reserves and resources of the geosphere, terms so often misunderstood. Is the life index of reserves of natural resources a guide to the future? *Z. dt. Ges Geowiss*, 159,4:575–590

Wick, K., and Bulte, E. H. (2006). Contesting resources—rent seeking, conflict and the natural resource curse. *Public Choice*, 128(3-4), 457-476.

Wilson, F. (1972). *Labor in the South African gold mines: 1911-1969*. Cambridge, UK: Cambridge University Press.

- Wilson, F. (2001). Minerals and migrants: How the mining industry has shaped South Africa. *Daedalus*, 130(1), 99-121.
- Wöcke, A & Sutherland, M. (2008) The impact of employment equity regulations on psychological contracts in South Africa. *The International Journal of Human Resource Management*, 19:4, 528-542.
- Wood, A. and Berge, K. (1997). Exporting manufactures: Human resources, natural resources, and trade policy. *The Journal of Development Studies*, 34(1), 35-59.
- World Bank (2019). Innovative financing models for rural broadband connectivity: The connected communities initiative experience.
- World Bank Group. (2018). Republic of South Africa systematic country diagnostic: An incomplete transition overcoming the legacy of exclusion in South Africa.
- World Bank. (2014). Economic benefits and costs of Tuberculosis prevention and control in the South African mining industry – with implications for Lesotho, Mozambique and Swaziland.
- World Bank. (2019). Digging beneath the surface: An exploration of the net benefits of mining in Southern Africa.
- Yorbana, S.G. (2017). Representations of oil in Chad: A blessing or a curse? *Africa Spectrum*, 52(1), 65-83.
- Yudelman, D. (1984). The emergence of modern South Africa: State, capital and the emergence of organized labor on the South African goldfields, 1902-1939. Cape Town: David Philip Publisher. Zuo, N., and J. Schieffer. “Are resources a curse? An investigation of Chinese provinces,” Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting 2014, (Texas, 2014).

Appendix 1

2018 Mine Employment Survey

This survey is done as part of a study looking at skills development and worker retention in the platinum mining sector. The survey does not ask for your name, birth date, or job title as it is strictly anonymous and all information collected is highly confidential.

The study is carried out by Gracelin Baskaran, a PhD researcher at the University of Cambridge in the United Kingdom. Ms. Baskaran is an independent researcher who does not work for any mining company. She has lived in Rustenburg for various periods over the last 4 years for her research.

You may skip any question you do not feel comfortable answering, but I encourage you to try to answer as much as possible. Thank you 😊

How long have you been at your current company? _____

Gender: (please circle) Male Female

Age:

- | | |
|---|--|
| <input type="checkbox"/> 18-20 years old | <input type="checkbox"/> 50-59 years old |
| <input type="checkbox"/> 21 -29 years old | <input type="checkbox"/> 60-69 years old |
| <input type="checkbox"/> 30-39 years old | <input type="checkbox"/> Over 70 years old |
| <input type="checkbox"/> 40-49 years old | |

Race:

- | | |
|-----------------------------------|---------------------------------|
| <input type="checkbox"/> Black | <input type="checkbox"/> Indian |
| <input type="checkbox"/> Coloured | <input type="checkbox"/> Other |
| <input type="checkbox"/> White | |

Have you passed matric?	(please circle)	Yes	No
Do you have a diploma?	(please circle)	Yes	No
Do you have a bachelor's degree?	(please circle)	Yes	No
Do you have a master's degree?	(please circle)	Yes	No

Do you stay in mine-owned accommodation (please circle) Yes No
at any point in the week?

How often do you see your family? _____

How long does it take you to get to work each day? _____

How do you get to work?

- | | |
|-------------------------------|--|
| <input type="checkbox"/> Car | <input type="checkbox"/> Walking |
| <input type="checkbox"/> Bus | <input type="checkbox"/> Other (specify) _____ |
| <input type="checkbox"/> Taxi | |

Would you move to another job if it paid the same, but was closer to your home? (please circle) Yes No

Have you had health and safety training?

Have you found health and safety training effective? (please circle) Yes No

How often do you get training at work? (please circle) Yes No

- | | |
|--|--|
| <input type="checkbox"/> Weekly (once per week) | |
| <input type="checkbox"/> Monthly (once per month) | |
| <input type="checkbox"/> Quarterly (once every 3 months) | <input type="checkbox"/> Biannually (twice per year) |
| | <input type="checkbox"/> Annually (once per year) |
| | <input type="checkbox"/> Less than once per year |

Please describe any training you have done while employed by your current company:

In the last year:

Have you had training at work? _____

Have you undertaken internal training, at the company training centre or while on the job?

(please circle) Yes No

What did you receive training for? _____

Have you undertaken external training (at a university or school for example)?

(please circle) Yes No

How many days do you think you've spent on training? _____ days

Do you feel you would benefit from more training?

(please circle) Yes No

Do you feel there is any incentive to seek further training?

(please circle) Yes No

Would you be more likely to stay with your current company if they provided more training?

(please circle)

Yes

No

Have you received training on the prevention of sexual harassment?

(please circle) Yes No

Do you feel further training improves your likelihood of: (check all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Technical competence | <input type="checkbox"/> Having more direct communication |
| <input type="checkbox"/> Increased productivity | with management |
| <input type="checkbox"/> Wage increases | <input type="checkbox"/> More respect from colleagues |
| <input type="checkbox"/> Promotions | <input type="checkbox"/> No benefits |
| <input type="checkbox"/> Obtaining a permanent job | <input type="checkbox"/> Other (please specify): - |

How many hours are you expected to work each week? _____ hours

How many hours do you actually work each week?

- | | |
|--------------------------------------|---|
| <input type="checkbox"/> 0-10 hours | <input type="checkbox"/> 31-40 hours |
| <input type="checkbox"/> 11-20 hours | <input type="checkbox"/> 41-50 hours |
| <input type="checkbox"/> 21-30 hours | <input type="checkbox"/> More than 50 hours |

Are you required to work a specific schedule, or are your hours flexible?

(please circle) Specific schedule Flexible hours

Are you a permanent or contractual employee?

(please circle) Permanent Contract Other (please specify)

Are you a part-time or full-time employee?

(please circle) Part-time Full-time Other (please specify)

Do you work standby/on-call hours, where you can be called in if needed?

(please circle) Yes No

Does your job guarantee hours every week?

(please circle) Yes No

Are your hours cut when business is slow?

(please circle) Yes No

If so, how many hours are cut? _____

Have you held any other roles within this company?

(please circle) Yes No

How many other roles have you had within this company? _____

If you have had other roles within this company, did you find the company helped you transition between roles?

(please circle) Yes No

Do you feel you have the ability to move to another unit/division within the company?

(please circle) Yes No

Do you feel you have the ability to get promoted to a higher position?

(please circle) Yes No

Do you know if there is a process to get a promotion?

(please circle) Yes No

Did anyone within the company help you with promotions or job advancement?

(please circle) Yes No

Have you applied for a promotion? (please circle) Yes No

How many promotions have you applied for? _____

How many promotions have you received? _____

Would you be more likely to stay with your current company if you got a promotion?

(please circle) Yes No

Were you successful in getting the promotion?

(please circle) Yes No

Do you feel the promotion process is fair? (please circle) Yes No

What do you think the most important factors are on determining if you will get promoted?

How often are you evaluated?

- | | |
|--|--|
| <input type="checkbox"/> Daily | <input type="checkbox"/> Biannually (twice per year) |
| <input type="checkbox"/> Weekly (once per week) | <input type="checkbox"/> Annually (once per year) |
| <input type="checkbox"/> Monthly (once per month) | <input type="checkbox"/> Less than once per year |
| <input type="checkbox"/> Quarterly (once every 3 months) | <input type="checkbox"/> Other (specify): _____ |

Do you know who evaluates your performance?

(please circle) Yes No

Do you have a good relationship with the person who evaluates your performance?

(please circle) Yes No

When was your last performance review? _____

Do you have meetings with your supervisor to discuss your performance?

(please circle) Yes No

Are there any rewards for high performance?

(please circle) Yes No

Have you been rewarded for high performance?

(please circle) Yes No

Are there any consequences for low performance?

(please circle) Yes No

Have you faced any consequences for low performance?

(please circle) Yes No

How much paid annual leave do you get each year? _____

Would you consider changing companies if another firm gave you the same wages, but offered you more annual leave?

(please circle) Yes No

Does your company allow you to take extra time off if you need (for example because of injury/death of a loved one, divorce, etc)

(please circle) Yes No

Do you feel you can communicate with your supervisor about personal challenges you are facing outside of the workplace?

(please circle) Yes No

Do you get paid maternity/paternity leave for childbirth?

(please circle) Yes No

Please rank order the following benefits, in terms of your decision to stay with a company:

1 should be most important; 9 should be the least important

_____ Transport to and from work	_____ Further training/education
_____ Rest facilities	_____ Medical aid
_____ Housing	_____ Pension/retirement savings
_____ Health and safety conditions	_____ Access to cultural, sporting, and
_____ Care for young children	leisure activities (ie, football tickets)
_____ Assistance with children's education	
costs	

How frequently do you interact with management about concerns?

- | | |
|--------------------------------------|--|
| <input type="checkbox"/> Daily | <input type="checkbox"/> Annually |
| <input type="checkbox"/> Weekly | <input type="checkbox"/> Less than once per year |
| <input type="checkbox"/> Monthly | <input type="checkbox"/> Other (specify) _____ |
| <input type="checkbox"/> Bi-annually | |

Do you feel safe talking to your supervisor and/or management about your concerns?

(please circle) Yes No

Do you feel you will suffer consequences for voicing your concerns?

(please circle) Yes No

Do you feel you can speak directly to your supervisor or management about racism or sexism at work?

(please circle) Yes No

Do you feel you can speak to your supervisor(s) about your professional concerns?

(please circle) Yes No

Do you feel you can speak to your supervisor(s) about your personal concerns?

(please circle) Yes No

Do you feel you can communicate with your supervisor(s) about suggestions to increase productivity?

(please circle) Yes No

Do you feel you can communicate with your supervisor(s) about health & safety issues?

(please circle) Yes No

Do you feel communication is two-way – where you can talk to your supervisor and your supervisor can talk to you comfortably?

(please circle) Yes No

Do you feel you are managed too strictly or closely?

(please circle) Yes No

Does your supervisor make you feel like a valuable part of the team?

(please circle) Yes No

Please share any challenges you face with communicating with supervisors or management.

Do you have access to your employment file, with hours worked, days of leave taken, performance reviews, and disciplinary actions?

(please circle) Yes No

Do you feel your supervisor cares about your well-being?

(please circle) Yes No

Is your supervisor of the same racial group as you?

(please circle) Yes No

Would you prefer reporting to a supervisor of the same racial group?

(please circle) Yes No

Please select **THREE MOST IMPORTANT FACTORS** when deciding whether you should stay at your current company or move to another company.

- | | |
|--|---|
| <input type="checkbox"/> Wages | <input type="checkbox"/> Permanent job with steady hours |
| <input type="checkbox"/> Ability to secure promotions | <input type="checkbox"/> Social support |
| <input type="checkbox"/> Skills development and training opportunities | <input type="checkbox"/> Opportunity to move to different departments |
| <input type="checkbox"/> Open communication between you and management | <input type="checkbox"/> Medical aid |
| <input type="checkbox"/> Working hours | <input type="checkbox"/> Quality of union representatives |
| <input type="checkbox"/> Annual leave | <input type="checkbox"/> Co-workers |

Please circle the **THREE LEAST IMPORTANT FACTORS** when deciding whether you should stay at your current company or move to another company.

- | | |
|--|---|
| <input type="checkbox"/> Wages | <input type="checkbox"/> Permanent job with steady hours |
| <input type="checkbox"/> Ability to secure promotions | <input type="checkbox"/> Social support |
| <input type="checkbox"/> Skills development and training opportunities | <input type="checkbox"/> Opportunity to move to different departments |
| <input type="checkbox"/> Open communication between you and management | <input type="checkbox"/> Medical aid |
| <input type="checkbox"/> Working hours | <input type="checkbox"/> Quality of union representatives |
| <input type="checkbox"/> Annual leave | <input type="checkbox"/> Co-workers |

Do you experience racism in the workplace?

(please circle) Yes No

Do you find BEE policies beneficial to improving racial tensions in the workplace?

(please circle) Yes No

Do you think BEE is effective for improving skills development and leadership development?

(please circle) Yes No

Are you part of the union?

(please circle) Yes No

Do you regularly attend union meetings?

(please circle) Yes No

Do you feel you can raise your concerns to union representatives?

(please circle) Yes No

If you got paid the same for a new job, would you stay in mining or move to another industry?

(please circle) Stay in mining Change industries

If you were retrenched today, do you feel you have the skills needed to succeed in finding another job?

(please circle) Yes No

Do you feel that increasing technology and automation increases your change of job loss?

(please circle) Yes No

Is there anything else you would like to add? If you are open to being further contacted for an interview, please provide your name and contact details. All interview participants will be thanked with a meal at a local restaurant or a gift voucher.

Women only

What department are you in? _____

How many men do you work with on a daily basis? _____

How many women do you work with on a daily basis? _____

Do you feel safe and secure at work?

(please circle) Yes No

Do you feel discriminated against because you are a woman?

(please circle) Yes No

Do you feel your workplace is friendly to women?

(please circle) Yes No

Do you feel your voice/opinion is valued at the workplace?

(please circle) Yes No

Have you experienced sexual harassment – verbal or physical?

(please circle) Yes No

Would you change jobs and take a small pay cut, if you knew it was more friendly for women?

(please circle) Yes No

Would you prefer reporting to a female supervisor?

(please circle) Yes No

If you have had other roles within this company, did you find the company helped you transition between roles?

(please circle) Yes No

What are some policies you feel could make your company a more positive working place for women? (please write)