How does bank competition affect industrial growth and stability at different banking sector capitalization levels? Lessons from South Africa

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How does bank competition affect industrial growth and stability at different banking sector capitalization levels? Lessons from South Africa

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Abstract

This paper investigates how bank competition and regulatory capital affect output growth and stability, using data for 21 manufacturing industries in South Africa between 2005 and 2020. The analysis employs fixed-effects models, two-step system generalized method of moments, and quasi-maximum likelihood estimation techniques. Output growth is measured by the growth of real gross output, while output stability is captured by the standard deviation of this growth across manufacturing industries. Bank competition is measured using four indicators: the inverse of the three-bank concentration ratio, the number of commercial bank branches per 100,000 adults, the number of commercial bank branches per 1,000 km², and a composite banking sector competition index derived from principal component analysis of these indicators. The analysis reveals that higher bank regulatory capital is associated with reduced output growth and increased output volatility, whereas greater bank competition leads to higher growth and lower volatility. Additionally, the study finds that the interaction between bank competition and regulatory capital positively influences both output growth and stability. Consequently, while increased bank competition boosts growth and reduces volatility, it also mitigates the negative effects of higher regulatory capital on these outcomes. This conclusion, consistent across various competition measures and estimation methods, has important implications for policy. While maintaining sufficient capital buffers is crucial for financial stability, it is equally important for policymakers to encourage competition within the banking sector to prevent capital requirements from unintentionally stifling industrial growth and stability. By fostering a competitive and well-capitalized banking sector, policymakers can create a financial environment that supports sustainable industrial growth and economic resilience.

JEL classification: G21, G28, L10

Keywords: Manufacturing growth, manufacturing stability, bank competition, bank regulatory capital

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1. Introduction

Over the past three decades, the South African banking system has undergone a series of liberalization reforms aimed at creating an efficient and competitive banking industry to stimulate industrial and economic growth and stability. These reforms included eliminating credit ceilings and interest rate controls in 1980 to promote bank competition. For similar reasons, between 1983 and 1985, bank liquidity requirements were significantly reduced (Odhiambo, 2011). In 1990, the Banks Act was introduced, allowing foreign banks to establish branches in South Africa with prior authorization from the Registrar of Banks. Furthermore, in March 2005, the National Credit Act was signed into law by the President of the Republic of South Africa. The primary aim of this act was to promote a fair, transparent, competitive, sustainable, responsible, efficient, effective, and accessible credit market and industry (Republic of South Africa, 2005). Despite the liberalization efforts to increase competition in the banking market, the banking sector remains dominated by the five largest banks in the country (see Figure 1), with low competition indicated by metrics such as the Boone indicator and Panzar–Rosse H-statistic (Rapapali and Simbanegavi, 2020; Mlambo and Mthuli, 2011). This market concentration limits credit availability for small and medium-sized enterprises (SMEs), including those in the manufacturing sector (Rapapali and Simbanegavi, 2020; Mlambo and Mthuli, 2011).

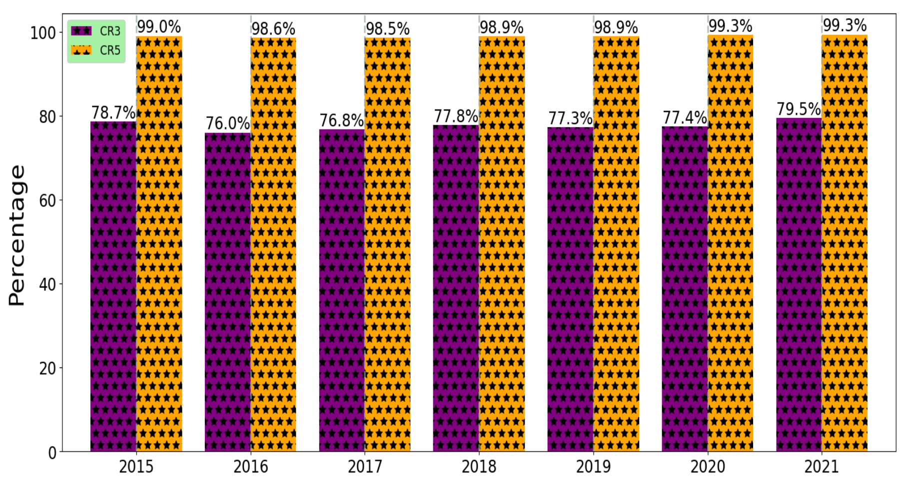
The concentration conditions have caught the attention of policymakers and regulators[1], leading to discussions about whether high bank concentration undermines or fosters industrial and economic growth (Liu and Zhao, 2024; Ratti et al., 2008). The issue of how bank concentration and competition affect real economic activities has also become a focal point of numerous theoretical and empirical discussions, particularly in emerging markets and developing countries with bank-based financial systems (Khan and Kutan, 2023). However, these discussions often yield mixed results (see Section 2). For this reason, it is crucial, particularly for policymaking, to delve into the role of other factors on the competition and real economy relationship, as existing theories and empirical studies are inconclusive, with conflicting predictions and results. In this context, our current study explores the relationship between bank competition (Comp) and industrial growth, with a specific focus on the role of bank capitalization. While many studies have concentrated on the influence of Comp on economic activity, we hypothesize that bank capital may also play a contributing role. We posit that banking sector capitalization and competition can interact and have

[1] As an example, in August 2006, the Competition Commission of South Africa set up the Banking Enquiry to investigate certain aspects of competition within South Africa's retail banking sector.

an amplifying effect on industrial growth and stability. Our rationale for this hypothesis is that if business and growth are indeed influenced by bank competition, banks with higher capital are more likely to provide loans to increase their market share (Gambacorta and Shin, 2018), thereby contributing more to industrial growth and stability. While competition can sometimes lead to aggressive lending practices, well-capitalized banks are better equipped to absorb losses from high-risk ventures, thus reducing the likelihood of financial crises that could disrupt manufacturing output.

Additionally, well-capitalized banks are more resilient in the face of economic shocks, allowing them to maintain lending levels without significant reductions (Berger and Bouwman, 2013). This stability is crucial in a competitive environment, as it ensures that the manufacturing sector continues to receive the necessary capital for growth and stability, even during economic downturns. Furthermore, because well-capitalized banks are generally viewed as less risky by investors and depositors, they tend to have lower funding costs (Flannery and Rangan, 2008). In a competitive banking market, these savings can be passed on to borrowers, including manufacturing firms, in the form of lower interest rates, which in turn can stimulate investment and output growth.

Figure 1: Concentration ratios



Note: CR3=3-bank asset concentration ratio, CR5=5-bank asset concentration.
Source: Global Financial Development Database

The influence of banking sector capitalization and competition on the real sector holds considerable interest for policymakers, owing to its substantial impact on policy decisions. A few empirical studies (including Liu et al., 2014; Xue, 2020), however, have examined this issue in relation to manufacturing output growth and stability. This is a topic that deserves attention in South Africa, where the banking sector is relatively highly capitalized (see Figure 6), and high concentration prevails (see Figure 1). The South African manufacturing output – after falling by a revised 1.8% in November 2022 – decreased by 4.7% in December 2022 compared with December 2021 (see Reuters, 2023). After a year-on-year decline of 4.7% in December 2022, the manufacturing output grew by 1.5% in the first quarter of 2023, contributing 0.2 percentage points to GDP growth (Statistics South Africa, 2023). In view of this trend, it is important to examine the macroeconomic implications of bank concentration as well as the effects of regulatory changes stemming from the implementation of the Basel capital requirements in South Africa[2].

Even though some interesting studies (including the aforementioned literature) have investigated the impacts of banking sector capitalization on economic activity or competition on economic activity, they typically do not integrate the influence of capitalization and concentration/competition. This study aims to fill this gap in the literature by examining the interactive effects of banking sector capitalization and competition on manufacturing output growth and stability in South Africa. This subject is particularly important for South Africa, where the banking sector is well-capitalized, and the banking market remains highly concentrated. Although existing studies (see, among others, Gwatidzo and Simbanegavi, 2024; Banya and Biekpe, 2017; Mlambo and Ncube, 2011; Rapapali and Simbanegavi, 2020) highlight that the South African banking sector operates with low competition and oligopolistic concentration, explicit quantitative analysis linking banking competition, capitalization, and manufacturing sector growth or stability remains scarce, particularly in the post-COVID-19 era or in light of significant reforms.

In view of the above, this study seeks to empirically answer the following questions: First, does banking sector competition enhance industrial sector growth and stability? Second, does the relationship between bank competition and industrial growth/stability vary with different levels of the banking sector capitalization? We expect positive effects of competition on industrial growth and stability to be more pronounced with higher levels of banking sector capitalization. The rationale behind this expectation is that well-capitalized and financially stable banks are more likely to originate new credits and finance new projects than unstable and poorly capitalized banks. To the best of our knowledge, this is the first study to bring to the fore that the relationship between bank competition and industrial growth and stability may depend on the levels of the banking sector

[2] As at September 2016, South Africa – the only African country that is a member of the Basel Committee on Banking Supervision (BCBS) – had started the implementation of the Basel III accord (BCBS, 2016).

capitalization. Identifying the nature of these interactive effects is not only of academic interest but is also valuable for shaping policies aimed at promoting economic growth and stability.

To accomplish the aim of this study, we use fixed-effects, two-step system generalized method of moments (system GMM), and quasi-maximum likelihood (QML) estimators on a balanced panel dataset of 21 manufacturing industries in South Africa over the 2005-2020 period. Our dependent variables are the growth of real gross output and the standard deviation of this growth in specific manufacturing industries.

This study extends the existing literature by using seasonally adjusted (2015=100) gross output growth to measure manufacturing industry growth, and the standard deviation of the seasonally adjusted (2015=100) gross output growth to measure manufacturing industry stability. Our main independent variables are bank regulatory capital and competition. Many existing studies on bank competition often use the Lerner index (LI), the Boone indicator (BI), or the Panzar–Rosse H-statistic (PRH) to measure competition. The LI is defined as the markup of price over marginal cost, with a higher value indicating lower competition in banking markets. Conversely, the BI evaluates competition by looking at the link between efficiency and profitability. It is based on the principle that competitive markets favour efficiency, which creates a negative correlation between efficiency and profits. The PRH measures the level of competition by examining the sensitivity of a bank's revenue to changes in input prices. An H-statistic value approaching one indicates perfect competition, while a value close to zero or negative suggests monopolistic conduct. These three metrics require detailed and often unavailable data, such as marginal costs, profits, revenue, and input prices, which are difficult to obtain and susceptible to measurement errors. Their dynamic characteristics and sensitivity to short-term fluctuations and external shocks also make them less reliable for assessing the long-term competitive environment. To avoid these issues, we contribute to the existing empirical literature by using the number of bank branches per 100,000 adults and per 1,000 km^2 as proxies for competition. To ensure robustness, we also use the inverse of 3-bank asset concentration ratio to capture bank competition. We consider higher values of the inverse of the 3-bank asset concentration ratio, the number of commercial bank branches per 1,000 km^2, and bank branches per 100,000 adults as indications of higher competition, and vice versa.

Additionally, to enhance the robustness of our results, we use principal components analysis to construct a competition index from the three different indicators. With this index, we are able to mitigate possible problems that could be associated with using just only one of the three indicators. We are not aware of any study that uses the variables to construct a competition index. This is one of the novel contributions of this paper, and it is a useful empirical contribution to the literature on bank competition, a topic that has been explored by a long list of literature.

Although the increasing prevalence of online banking challenges the use of branch density as a competition measure, it remains relevant for capturing the historical footprint and market presence of banks. Nonetheless, this study excludes online banking data due to a lack of adequate information for South Africa in the World Bank database[3], which inhibits meaningful regression analysis.

We find that bank regulatory capital reduces manufacturing output growth and stability, while bank competition is found to enhance output growth and stability. Our results also reveal that the negative effect of bank regulatory capital on output growth and stability is mitigated by higher bank competition. These findings hold significant policy implications for regulators and policymakers seeking a banking regulatory framework that supports both growth and stability. To promote manufacturing output growth and stability, our results underscore the importance of banking sector competition, especially in an economy where banks are subject to high regulatory capital requirements.

The subsequent sections of this paper are organized as follows: Section 2 provides an overview of bank competition, capitalization, and the growth of manufacturing output in South Africa, along with a review of the relevant literature. Section 3 discusses the research methodology, data, and provides preliminary data analyses, laying the groundwork for the main empirical findings. Section 4 presents the empirical results. Finally, in Section 5, we encapsulate our key findings and offer essential policy recommendations based on our results, emphasizing their significance for regulators and policymakers.

2. Backgrounds and literature

2.1 Overview of bank competition, capitalization, and manufacturing output growth in South Africa

Market concentration in the banking sector refers to the extent to which a small number of banks dominate the market. In South Africa, this sector is highly concentrated, with a few major banks – Standard Bank, FirstRand (FNB), Absa Group Limited, Nedbank, and Investec – controlling the majority of the market share (see BusinessTech, 2021). These five banks collectively hold over

[3] See https://www.worldbank.org/en/publication/globalfindex/Data

90% of the total banking assets in the country (see BusinessTech, 2021). As of 2020, World Bank data (graphed in Figure 1) indicate that the 5-bank asset concentration (CR5) is 99.30% in the country. As per the World Bank data, the 3-bank asset concentration ratio (CR3) is 75.99% in 2016, 76.76% in 2017, 77.76% in 2018, 77.28% in 2019, 77.36% in 2020, and 79.45% in 2021. Over this period from 2016 to 2021, the CR3 remains relatively stable, fluctuating around 77.00%. The increase from 75.99% in 2016 to 79.45% in 2021 suggests that the three largest banks have gained a stronger hold on the banking sector. Although the overall trend is upward, there were minor fluctuations, such as a small dip from 77.76% in 2018 to 77.28% in 2019 before the ratio climbed again. These slight changes could be attributed to factors such as competition from smaller banks, shifts in regulatory policies, or economic conditions that temporarily affected the market shares of the top banks.

Bank capital requirements can play a role in regulating bank competition by influencing how banks operate, manage risks, and allocate resources (Almazan, 2002). South Africa began implementing Basel III in 2013, which introduced stricter capital requirements, enhanced risk management practices, and improved transparency. This trend reflects a global move towards more robust regulatory frameworks to strengthen financial stability but also can influence the competitive dynamics within the sector.

Looking at Figure 6, we can observe that between 2007 to 2008, bank regulatory capital to risk-weighted assets (RWAs) in South Africa increases from 12.80% to 13.00%. The ratio jumps to 14.10% in 2009. The ratio continues to rise, reaching 14.88% in 2010, 15.05% in 2011, and 15.88% in 2012. The ratio slightly decreases to 15.58% in 2013. The ratio continues to decrease to 14.76% in 2014 and 14.20% in 2015. This trend may indicate a period of stabilization as banks adjusted to the Basel III requirements and optimized their capital structures (BCBS, 2015). The decline may also be linked to changes in the calculation of RWAs (see IMF, 2015). The ratio rises again to 15.93% in 2016, 16.27% in 2017, and 16.09% in 2018. The ratio increases further to 16.58% in both 2019 and 2020. This rise aligns with international standards, particularly the Basel framework, which requires banks to hold a higher percentage of their assets as capital to ensure stability and resilience against financial shocks.

While bank competition and capital regulation can pose challenges, they also present opportunities for banks to innovate and impact the economy. The capital levels in the banking sector can impact the broader economy, influencing the cyclical nature of manufacturing sector's growth and value added. In South Africa, real manufacturing gross value added contracted by 0.65% in 2014 after the commencement of the implementation of Basel III capital requirements, contracted by 0.19% in 2015, but increased by 0.45% in 2016 (Figure 2). Growth following the global financial crisis remained weak (Mnguni and Simbanegavi, 2020).

Figure 2: Real manufacturing gross value added (annual % growth)

Note: Data on real manufacturing gross value added (annual % growth) for South Africa is obtained from the World Development Indicators (WDI) database.

2.2. Literature review

The review is motivated by ongoing debates in the literature regarding the impact of bank competition and capitalization on the real economy. Traditional economic theory teaches us that high bank market concentration, as opposed to perfect competition, leads to stricter financing constraints, higher lending rates, and reduced credit supply. These factors can, in turn, decrease private consumption, stifle entrepreneurship, lower investment in new projects, and ultimately hinder industrial and economic growth. From another perspective, Yin (2021) explains that competition reduces inefficiencies and monopoly rents, favouring a decrease in bank lending rates and then an increase in investment and economic growth. Furthermore, the prevailing wisdom suggests that lower lending rates not only stimulate economic growth but also make loan repayment more manageable for borrowers, resulting in a lower default rate.

However, some argue that low bank competition can enhance access to credit. This view is presented in the context of relationship banking, which posits that reduced competition incentivizes banks to more efficiently screen and monitor their customers, thereby reducing information asymmetries (Leroy, 2019). As a result, lower information asymmetries in banking markets can positively impact access to bank credit, promoting increased investment and, in turn, fostering growth. Marquez (2002) contends that high banking competition can lead banks to screen borrowers less rigorously and charge higher interest rates, potentially reducing the availability of credit to the real sector of the economy. The standard competition-fragility theory also posits that financial instability in the banking sector increases with a higher level of market competition. The argument here is that competition can erode banks' profits, weakening their financial stability and their ability to withstand failures and losses. In a scenario of heightened financial instability, banks have fewer incentives to increase credit supply, which can undermine economic activities and growth. Keeley (1990) adds that high competition reduces the incentives for financial intermediaries to act prudently when taking risks. There is little doubt that while high competition can have some benefits, it can also be detrimental to the economy by reducing charter value and encouraging banks to take excessive risks (Keeley, 1990).

Motivated by ongoing theoretical debates, many empirical studies have examined the impact of bank market power, concentration, and competition on growth. These studies include Banya and Biekpe (2017), Cetorelli and Gambera (2001), Fernández de Guevara and Maudos (2011), Hamada et al. (2018), Issa et al. (2022), Liu et al. (2014), Pradhan et al. (2020), Diallo (2017), and Fernandez et al. (2010). Using data for 36 manufacturing sectors in 41 countries, Cetorelli and Gambera (2001) investigate the effects of bank concentration on economic growth. The authors observe that banking sector concentration causes a general deadweight loss that dampens economic growth, affecting all firms and sectors indiscriminately. A study by Banya and Biekpe (2017) examines the relationship between bank competition and economic growth in selected frontier African countries. The study uses the Boone indicator to estimate bank competition in 10 African countries over the period 2005-2012. The result suggests that bank competition could be beneficial for economic growth. Hamada et al. (2018) explore the relationship between the degree of imperfect competition in banking and economic growth. They find that as bank competition increases, so does the rate of economic growth. They suggest that removing entry barriers and deregulating the banking industry can encourage fierce competition among banks, leading to higher economic growth rates. Using the Lerner index and the H-statistic of Panzar and Rosse as measures of competition, Fernández de Guevara and Maudos (2011) investigate the industry economic growth effects of banking competition. Their results show an inverted U-shaped relationship between bank market power and economic growth. For the relationship between bank concentration, competition, and non-banking industries, Liu et al. (2014), using 23 industries and 6000 banks from 48 economies, show that bank competition promotes industrial growth. They also find that a competitively driven concentrated banking market can enhance industrial growth.

However, in a study on the impact of bank competition on economic growth and welfare, Rauber and Ritschel (2024) find that monopolistic banking can lead to higher growth and welfare when the manufacturing sector is capital-intensive, while competition is more beneficial in labour-intensive sectors. Additionally, Issa et al. (2022), using data for 16 countries spanning from 2005 to 2014, find that bank market power positively and significantly influences economic growth across the MENA region as well as in other macro-regions. The authors attribute this observation to the relationship lending literature, which indicates that in competitive banking settings, banks might be less willing to extend financing to firms with limited financial transparency.

The debates surrounding the effects of bank capital also deserve attention. Some studies (see, among others, Carlson et al., 2013) document a positive lending effect of bank capital. Yet, there is also an argument that higher bank capital can raise the overall cost of funding for banks, leading to lending restrictions and limiting their ability to fund exuberant economic growth (Boyarchenko et al., 2020). This argument finds support in the works of Aiyar et al. (2014), Peek and Rosengren (1995), Pillay and Makrelov (2024), and Noss and Toffano (2016), which provide evidence of a regulatory capital crunch on bank credit supply. The shortage of capital was identified as a key factor limiting banks' ability to grant loans during the recent global financial crisis (Kim and Sohn, 2017).

Some empirical studies focus on the impact of banking sector capitalization on economic activity, but the findings remain inconclusive and mixed. For example, using global vector autoregressive model and data for 28 EU countries, Gross, Kok, and Zochowski (2016) observe that shocks to bank capital tend to produce negative responses of real economic activities if banks shrink the size of their assets by reducing credit supply. Noss and Toffano (2016) demonstrate that when banks' total capital requirements increase during an economic upturn, lending decreases, although the effect on GDP growth is not statistically significant. In a different approach, Angelini et al. (2011) use a dynamic stochastic general equilibrium (DSGE) model to estimate that a 1% increase in the capital ratio causes a 0.09% decrease in output. A similar study by Slovik and Cournède (2011) finds that higher bank lending spreads resulting from higher capital requirements cause a decline in GDP growth by 5 to 15 basis points. Conti et al. (2025) investigate how bank capital, the availability of lending, and economic performance are interconnected in Italy from 1993 to 2015. Through scenario analysis and Bayesian VAR models, the authors observe that an increase in the

Tier 1 capital ratio results in a decrease in credit extended to firms and households, along with a drop in real GDP. The debate on the effects of banking sector capitalization and competition on the real economy remains ongoing.

3. Research methodology and data

This section uses descriptive techniques to explore the growth and stability trends of 21 manufacturing industries in South Africa. It also utilizes econometric methods to analyze the impact of bank competition and capitalization on the growth and stability of these manufacturing industries. Within this section, we define the variables used in our analysis, offer insights into the data sources, and present our empirical methodology.

3.1 Model specifications

To address our research questions, we conduct preliminary estimations using a static panel model with industry-fixed effects and an interaction term involving bank competition and regulatory capital, as outlined in Equations 1 and 2. We employ the fixed effects (FE) estimator to estimate the models.[4]

$$Growth_{i,t} = \beta_1 Comp_t + \beta_2 BCap_t + \beta_3 (Comp_t * BCap_t) + \sum_{q=1}^{Q} \beta_q ContV_t^q + \lambda_i + \varepsilon_{i,t} \quad (1)$$

$$Std \text{ of Growth}_{i,t} = \beta_b Comp_t + \beta_c BCap_t + \beta_d (Comp_t * BCap_t) + \sum_{e=1}^{E} \beta_e ContV_t^e + \lambda_i + \varepsilon_{i,t} \quad (2)$$

In the above models, subscript $i\ (i = 1,2,3,...,21)$ denotes manufacturing industry i in year t. $Growth_{i,t}$ and $Std \text{ of Growth}_{i,t}$ are outcome variables that, respectively, represent the growth of real gross output and the standard deviation of the growth of real gross output in manufacturing industry i in year t. We include industry-fixed effects, λ_i, because industrial sector growth and stability may be influenced by industry-level conditions, such as industry regulations, competition level, and financing difficulties. $\varepsilon_{i,t}$ represents the error term. $BCap_t$, as defined in the Global Financial Development Database, indicates the level of capitalization in the banking sector. It is measured by the ratio of regulatory capital to risk-weighted assets. This ratio is determined by calculating the weighted average across the entire financial sector, which involves dividing the

[4] The models can also be estimated using random effects (RE) approach. The results from the RE method do not yield different conclusions and can be provided upon request.

total regulatory capital of all banks in a country by their total risk-weighted assets. $Comp_i$ is the level of the banking sector competition, proxied by four different measures (see Section 3.2). We include $Comp_t * BCap_i$ to capture the interactive effects of $Comp_i$ and $BCap_t$. We mean-center the interaction terms because collinearity may exist after including them. $ContV_t$ is a set of control explanatory variables including: banking system development index (BSDev), computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP, and the ratio of bank credit to bank deposits)[5]; government size (GovExp), proxied by real general government final consumption expenditure (% of GDP); inflation (Inf)[6], measured by the GDP deflator (annual %); labour force growth (LForce), proxied by the proportion of the population ages 15-64 that is economically active; economic globalization (EG), captured by economic globalization index; electricity (Electricity), proxied by the total electricity production (GWh); government debt (GovDebt), proxied by government debt (% of GDP). These control variables (BSDev, GovExp, and Inf) are included based on prior research indicating their influence on industrial sector performance (see Huang et al., 2014; Tongurai and Vithessonthi, 2018; Xue, 2020). For example, Huang et al. (2014) find a U-shaped relationship between bank sector development and industrial growth volatility. Xue (2020) demonstrates that inflation and government expenditure have a positive relationship with industrial growth volatility. We expect EG, Electricity and LForce to be positively related to industrial output growth.

Persistence is another important aspect of industrial output growth and stability (Xue, 2020). A common criticism of the static panel (our baseline) model is that it does not account for this feature. In order to address this, we use a dynamic version of Equations 1 and 2 as follows:

$$Growth_{i,t} = \beta_1 Growth_{i,t-1} + \beta_2 Comp_t + \beta_3 BCap_t + \beta_4 (Comp_t * BCap_t) + \sum_{q=1}^{Q} \beta_q ContV_t^q + \lambda_i + \varepsilon_{i,t} \quad (3)$$

$$Std \text{ of Growth}_{i,t} = \beta_b Std \text{ of Growth}_{i,t-1} + \beta_c Comp_t + \beta_d BCap_t + \beta_e (Comp_t * BCap_t) + \sum_{f=1}^{F} \beta_f ContV_t^f + \lambda_i + \varepsilon_{i,t} \quad (4)$$

To estimate the above models, we employ a two-step system generalized method of moments (GMM) technique. This method helps control for the persistence of the dependent variable,

[5] The ratio of deposit money banks' assets to GDP, commonly used as a measure of banking sector development in developing economies (Levine et al., 2000; Gaies et al., 2019), shows the size of the banking sector. Meanwhile, the ratio of bank credit to bank deposits reflects how effectively banks mobilize and channel savings from surplus units to deficit units in the economy (Xue, 2020; Gaies et al., 2019).

[6] The inflation rate can effectively reflect the impact of monetary policies and external shocks, such as fluctuations in oil prices, foreign exchange rates, and trade balances (Xue, 2020).

unobserved heterogeneity, and endogeneity issues. Specifically, the estimator uses lagged values of the dependent variable in differences and in levels as instruments, along with lagged values of the explanatory variables that could potentially suffer from endogeneity. The validity of these instruments is assessed using the Hansen test of overidentifying restrictions. We also utilize the first-order (AR (1)) and second-order (AR (2)) serial correlation tests, as suggested by Arellano and Bond (1991). The GMM estimates remain consistent if there is no AR (2). To ensure the robustness of our findings, we also estimate Equations 3 and 4 using the quasi-maximum likelihood (QML) estimator for fixed effects dynamic panel data, as suggested by Kripfganz (2016).

3.2 Measures of bank competition, industrial output growth and stability

Given that bank competition cannot be captured by a single indicator, we use four different measures. Our first measure is the inverse of the 3-bank concentration ratio (Inverse3Con)[7]. This ratio measures the share of total commercial banking assets held by the three largest banks. We use the inverse of the concentration ratio, such that a higher value implies lower market concentration and higher competition. This aligns with the structure-conduct-performance hypothesis, which suggests that lower market concentration promotes competition. Previous research has also indicated that concentration, in the absence of rivalry, can foster an environment favourable to business collusion and may weaken competition (Liu et al., 2014).

However, while widely used, the 3-bank concentration ratio alone may not fully capture competition levels. (Claessens and Laeven, 2005).[8] One drawback of this measure is its underlying assumption of a direct relationship between market concentration and competition, a relationship that may not always hold. For example, in scenarios where the top three banks fiercely compete, a high concentration ratio could still exist with high levels of competition. Additionally, the competitive dynamics between smaller banks outside the top three are not taken into consideration by this measure (Claessens and Laeven, 2005). To address this concern and account for geographical outreach, we use the number of commercial bank branches per 1,000 km^2 (BranchOutreach) as our third measure of competition. This measure can be viewed as a more direct indicator of the degree of competition because it shows the number of competitors in the

[7] We use the inverse of the 3-bank concentration ratio rather than the 3-bank concentration ratio to maintain a consistent interpretation of the estimated coefficients. This choice is made because the other two indicators of competition, as explained in this section, are direct measures of competition.

[8] Boone (2008) even points out that an increase in competition can result in the reallocation of market share from less efficient firms to more efficient ones, potentially leading to an increase in market concentration.

banking market (Chemmanur et al., 2020). Nonetheless, its main drawback is the tendency for bank branches to be concentrated in urban settings, where demand is greater, potentially skewing the overall picture of competition. For instance, a high concentration of branches in metropolitan areas may not result in effective competition in rural areas, where the density of branches is considerably lower. To address this concern and consider geographical outreach, we use the number of commercial bank branches per 1,000 km^2 (BranchOutreach) as our third measure of competition. This measure reflects the geographic dispersion of bank branches, offering information about the accessibility of banking services, especially in countries with sizable rural populations. But there can be drawbacks to this measure as well. For example, it does not take into consideration changes in population density, and a large number of branches in areas with low population densities may not always be a sign of intense rivalry. Moreover, technological advancements may lead to a decline in both measures (Tongurai and Vithessonthi, 2018). Therefore, it is valuable to also consider the concentration ratio.

Recognizing the drawbacks associated with relying on a single measure, we use Principal Components Analysis (PCA) to create a composite index of competition that incorporates the three indicators: Inverse3Con, Branches, and BranchOutreach. PCA offers a more robust and comprehensive representation of bank competition by merging structural, demographic, and geographical dimensions. By using these four measures, we strive to encapsulate the multifaceted nature of bank competition and enhance the robustness of our analysis. Although each measure has its own advantages, their collective usage and the formation of a competition index through PCA enable us to address their individual limitations, thereby offering a more thorough insight into the dynamics of competition within the banking sector.

The increasing prevalence of online banking challenges the traditional use of branch density as a measure of competition. However, we do not include online banking in our study because the available observations in the World Bank database for South Africa are too small[9] for meaningful regression analysis. Despite the rise of online banking, branch density remains a relevant metric, as it reflects the historical footprint and market presence of banks. Recent studies (Lei et al., 2024; Sun, 2024; Wang and Mao, 2024) have continued to use branch density as an indicator of bank competition.

[9] See https://www.worldbank.org/en/publication/globalfindex/Data

As specified in Equations 1–4, our dependent variables are the growth and the standard deviation of the growth of real gross output in specific manufacturing industries. To calculate the annual growth for each manufacturing industry, we use the Index of Industrial Production (IIP) data at the 2-digit level of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. The IIP data, obtained from the United Nations Industrial Development Organization (UNIDO), is seasonally adjusted with 2015 as the base year (2015=100). This index reflects the level of industrial production in a given month relative to the base year, which is set at 100. An IIP value above 100 indicates an increase in industrial output compared to the base year, representing growth in real gross output. Conversely, an IIP value below 100 indicates a decrease in industrial production, reflecting a contraction in real gross output. Since Equations 1 and 3 require annual data, we calculate yearly growth for each manufacturing industry using the simple average of monthly IIP values. Our proxy for output stability is the standard deviation of the growth of real gross output. For each year and industry, we compute the standard deviation of monthly IIP values, as outlined in Equation 5. This method enables us to assess the variability in output growth, with a higher standard deviation indicating greater instability and a lower standard deviation reflecting more consistent output performance across the industries analyzed.

$$Std \text{ of Growth}_{i,t} = \sqrt{\frac{1}{12}\sum_{m=1}^{12}(y_{mi,t} - \overline{y}_{i,t})^2} \qquad (5)$$

Here $y_{mi,t}$ is manufacturing industry i IIP value for month m in year t. $\overline{y}_{i,t}$ is a twelve-month average of the IIP values of manufacturing industry i in year t. The sum of squared deviations is divided by 12 because we have 12 months in a year. Definitions for all the variables in our analysis, along with the sources of their data, can be found in Appendix A.

3.3 Data description and preliminary analyses

The construction of our dependent variables, annual Growth and Std of Growth, is based on the average and standard deviation of the 12-month IIP index across twenty one (21) manufacturing industries. These 21 industries are classified according to the 2-digit level of the International Standard for Industrial Classification of All Economic Activities (ISIC Revision 4), as detailed in Table 1.[10] The data, disaggregated by industry, come from the United Nations Industrial Development Organization (UNIDO) database, which provides industrial data for a large set of

[10] For detailed classifications of the industries, visit: https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf

countries. The data for our other variables are sourced from various institutions. Total electricity production (GWh) is obtained from International Energy Agency. Economic globalization index is obtained from KOF Swiss Economic Institute. As for our banking sector and macroeconomic variables, we obtain data from the International Monetary Fund (IMF) Financial Access Survey and the World Bank's World Development Indicators and Global Financial Development database (GFDD) over the period 2005–2020. Notably, 2020 is the latest available year for the ratio of regulatory capital to risk-weighted assets (from the GFDD) for South Africa, as of October 24, 2024. The choice of 2005 as the starting year is primarily due to the unavailability of industrial output data for earlier years in the UNIDO database. Additionally, we choose to focus on 21 manufacturing industries due to data availability in the UNIDO database for South Africa. Since data are available for all years for these 21 industries and explanatory variables, we have a balanced panel dataset comprising 336 observations.

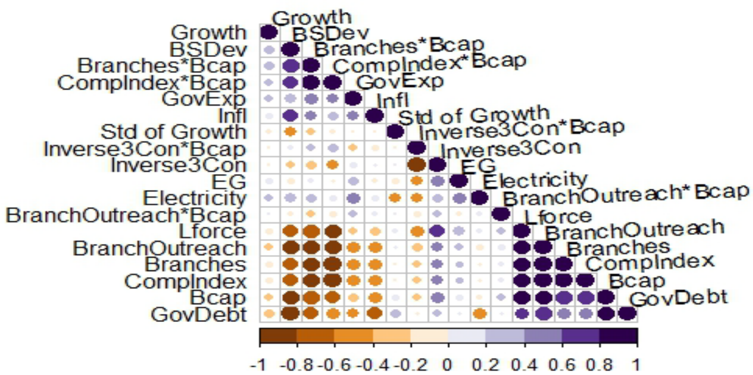
Table 1: List of industries (based on ISIC Revision 4) and the mean statistics

S/N	ISIC Codes	Description	Growth	Std of Growth
1	24	Manufacture of basic metals	110.789	6.467
2	11	Manufacture of beverages	89.875	4.589
3	20	Manufacture of chemicals and chemical products	91.122	2.830
4	19	Manufacture of coke and refined petroleum products	101.018	8.385
5	26	Manufacture of computer, electronic and optical products	89.151	5.410
6	27	Manufacture of electrical equipment	90.512	4.227
7	25	Manufacture of fabricated metal products, except machinery	101.313	5.481
8	10	Manufacture of food products	94.094	2.137
9	31	Manufacture of furniture	96.257	5.051
10	15	Manufacture of leather and related products	91.709	5.434
11	28	Manufacture of machinery and equipment n.e.c.	108.771	5.281
12	29	Manufacture of motor vehicles, trailers and semi-trailers	97.584	10.067
13	23	Manufacture of other non-metallic mineral products	103.700	5.256
14	30	Manufacture of other transport equipment	93.383	8.209
15	17	Manufacture of paper and paper products	96.249	3.458
16	18	Manufacture of printing and reproduction of recorded media	105.898	6.371
17	22	Manufacture of rubber and plastics products (Rubber & PP)	97.416	4.041
18	13	Manufacture of textiles	119.309	5.839
19	14	Manufacture of wearing apparel	100.565	4.932
20	16	Manufacture of wood products, excluding furniture	97.357	4.191
21	32	Other manufacturing	115.914	9.375

Note: This table displays the average values of Growth and Std of Growth for each manufacturing industry in the sample, covering the period from 2005 to 2020. Source: Author's computation using Monthly Index of Industrial Production (IIP) data from UNIDO.

Figure 3 presents the correlation coefficients and indicates that there is no multicollinearity issue among the regressors, except for the high correlation between the mean-centered interaction terms and the variables that are used for their construction. We assume that there is no multicollinearity issue because *Stata 17* retains all the regressors (as shown in Tables 4–9). However, in addressing concerns about collinearity, we incorporate the interaction terms in a stepwise manner and comparing the results with and without these terms.

Figure 3: Correlation matrix



Note: This figure displays the correlation matrix of the variables used in this study. The intensity of the colours illustrates the direction and strength of the correlations, with deeper shades representing stronger relationships.

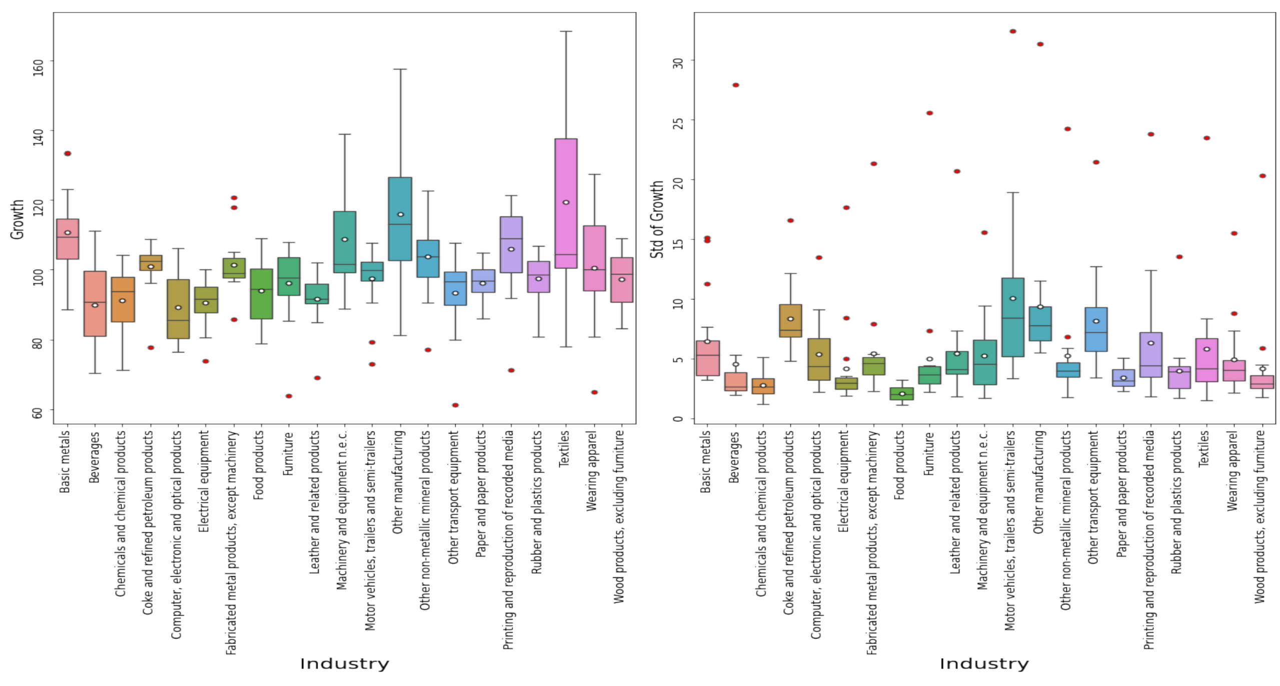
Testing for cross-sectional dependence is important, as our sample includes multiple industries within a single country. For this purpose, we employ four tests: the Breusch–Pagan Lagrange multiplier (LM) test suggested by Breusch and Pagan (1980); the Pesaran cross-sectional dependence (CD) and scaled LM tests suggested by Pesaran (2004), and the Bias-corrected scaled LM proposed by Pesaran et al. (2008). The results of these tests are provided in Table 2, where we observe that the null hypothesis of no cross-section dependence in residuals is rejected in all columns. Given that GMM and QML do not offer a direct option to control for cross-sectional dependence, we estimate our static models using FE with Driscoll-Kraay standard errors and examine whether cross-sectional dependence influences the signs and significance of our GMM and QML estimates. The Driscoll-Kraay standard errors are robust to very general forms of cross-sectional dependence (Driscoll and Kraay, 1998).

Table 2: Residual cross-section dependence tests

	Competition= Inverse3 Con		Competition=Branches		Competition= Branch Outreach		Competition=CompIndex	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Breusch-Pagan LM	1107.015***	628.845***	1057.749***	702.176***	1096.632***	619.253***	1078.021***	645.078***
Pesaran scaled LM	42.745***	19.413***	40.341***	22.991***	42.239***	18.945***	41.330***	20.205***
Bias-corrected scaled LM	42.045***	18.713***	39.641***	22.291***	41.539***	18.245***	40.630***	19.505***
Pesaran CD	-1.366	4.087***	1.263	12.678***	-0.881	5.262***	0.068	9.149***

Note: Growth and Std of Growth are dependent variables in columns (1) and (2), respectively. H_0: No cross-section dependence in residuals. ** and *** indicate the significance level at 5% and 1% respectively.

Figure 4: Box plots of Growth and Std of Growth by sector



Note: This figure shows box plots of manufacturing output growth and the standard deviation of manufacturing output growth across different sectors.

Figure 4 displays box plots of our dependent variables categorized by sector. Table 3 also provides the descriptive statistics for both the dependent and independent variables. BCap, Branches, BranchOutreach, and Inverse3Con have averages of 14.7692, 9.2255, 2.8834, and 1.2738, with standard deviations of 1.4549, 1.4196, 0.5862, and 0.0648, respectively. CompIndex ranges from

-2.3503 to 1.1262 with a standard deviation of 1.0. Regarding our dependent variables, Std of Growth has a standard deviation of 4.69 and a mean of 5.57, while Growth has a standard deviation of 14.82 and a mean of 99.62 for the whole sample. The manufacturing industry with the highest Growth records a value of 168.36, while the lowest has a Growth of 61.22. These figures illustrate substantial differences in the growth and stability of gross output among the 21 manufacturing industries.

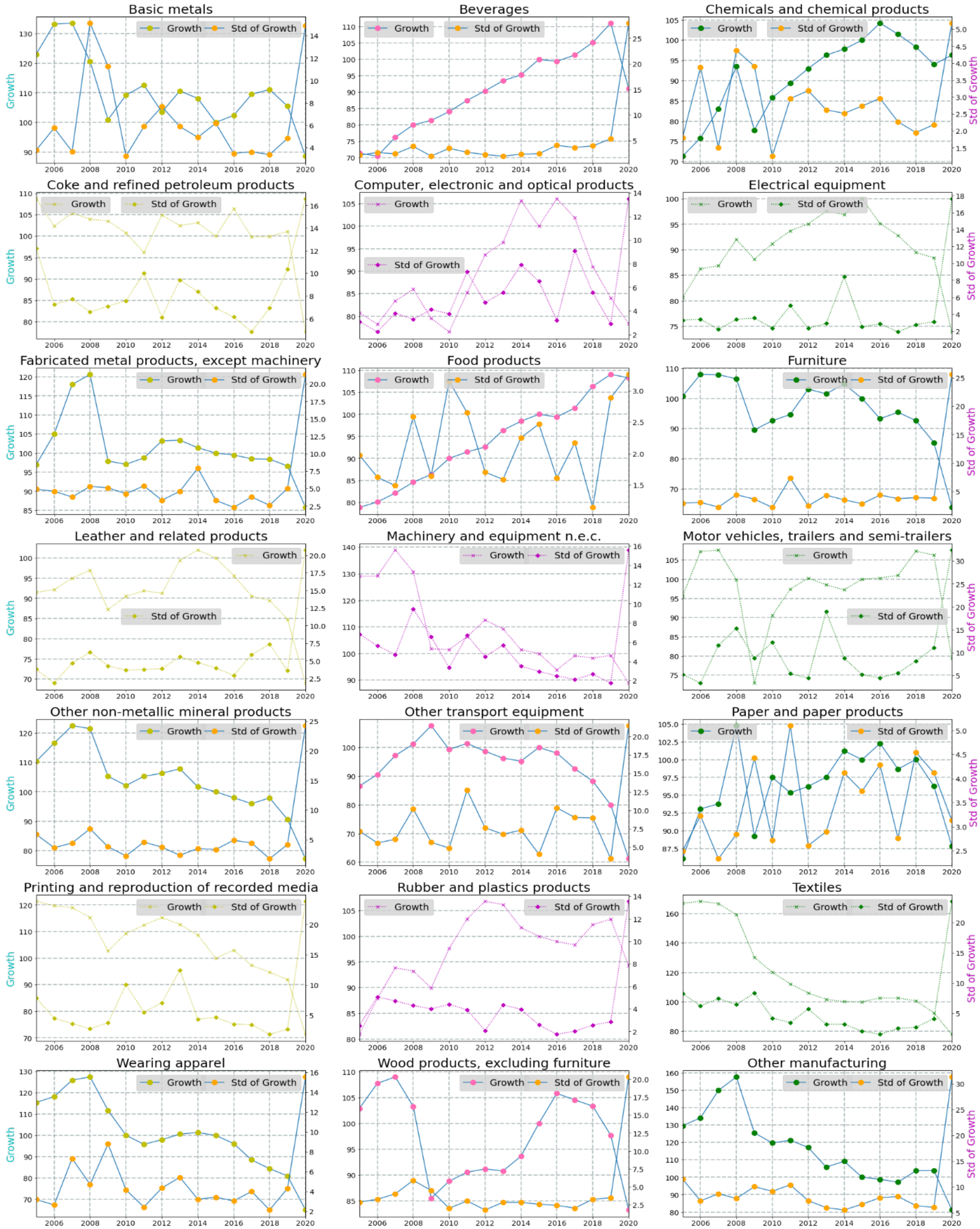
Figure 5 showcases the trends of Growth and Std of Growth for these industries from 2005 to 2020. Notably, with the exception of the chemicals and chemical products sector, Growth in all manufacturing industries declined in 2020, mainly due to the impact of the Covid-19 pandemic. As anticipated, the Std of Growth increased in 2020, except for paper and paper products. The manufacturing of food products, as shown in Figure 5, exhibits an increasing trend from the beginning of 2005 to 2019, suggesting continuous improvement in the gross outputs of food products. The beverages manufacturing industry, while showing a rising trend from the start of 2006 to 2019, experience low volatility in its growth during this period. Conversely, Growth in the manufacturing of textiles (wearing apparel) appears to trend downward from 2006 (2008) to 2020, signifying a continuous decrease in the gross outputs of these two industries. Growth in the remaining 17 manufacturing industries shows varying patterns of both increases and decreases during the same period. For example, while the Growth of basic metals declines from 133.233 in 2006 to 103.492 in 2012 and 111.1 in 2018, the Growth of furniture declines from 108.008 in 2006 to 103.117 in 2012 and 92.667 in 2018. The Std of Growth also differs between basic metals and furniture, with basic metals having Std of Growth of 5.75 in 2006, 7.66 in 2012, and 3.38 in 2018, while Furniture has Std of Growth of 3.11 in 2006, 2.50 in 2012, and 3.95 in 2018, indicating that the furniture industry is more stable than the basic metal industry.

Table 3: Descriptive statistics

Variables	Mean	Median	Std. Dev.	Min.	Max.
Growth	99.6180	99.4167	14.8384	61.2167	168.3580
Std of Growth	5.5731	4.0937	4.6926	1.1421	32.4020
Inverse3Con	1.2738	1.2924	0.0649	1.0275	1.3160
Branches	9.2255	9.8441	1.4217	5.8841	10.8267
BranchOutreach	2.8834	3.1177	0.5871	1.6627	3.4622
CompIndex	0.0000	0.4351	1.0000	-2.3503	1.1262
BCap	14.7692	14.9676	1.4571	12.3000	16.5847
BSDev	0.0000	-0.2965	1.0000	-2.3623	1.6210
GovExp	18.3330	18.9028	1.3919	15.8607	20.6502
Inf	5.9803	5.5713	1.2876	3.9565	8.6630
LForce	65.4479	65.6095	0.3409	64.5069	65.6950
EG	55.0885	55.1879	1.2440	52.4330	56.8847
Electricity	254053.3	254466.0	6005.4	239521.0	263479.0
GovDebt	39.8372	38.8819	12.3153	24.0448	68.8625

Note: Growth is a twelve-month average of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry. Std of Growth is a twelve-month standard deviation of the monthly growth of real gross output. Inverse3Con is the inverse of the market share of the three largest commercial banks (in terms of total assets). Branches is the number of commercial bank branches per 100,000 adults. BranchOutreach is the number of commercial bank branches per 1,000 km^2. CompIndex is an index of bank competition computed through principal component analysis of Inverse3Con, Branches, and BranchOutreach. BCap is the bank regulatory capital to risk-weighted assets. BSDev is an index of banking system development computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP and the ratio of bank credit to bank deposits). GovExp is the real general government final consumption expenditure (% of GDP). Inf is the rate of change in GDP deflator (annual %). LForce is the proportion of the population ages 15-64 that is economically active. EG is economic globalization index. Electricity is total electricity production (GWh). GovDebt is government debt (% of GDP).

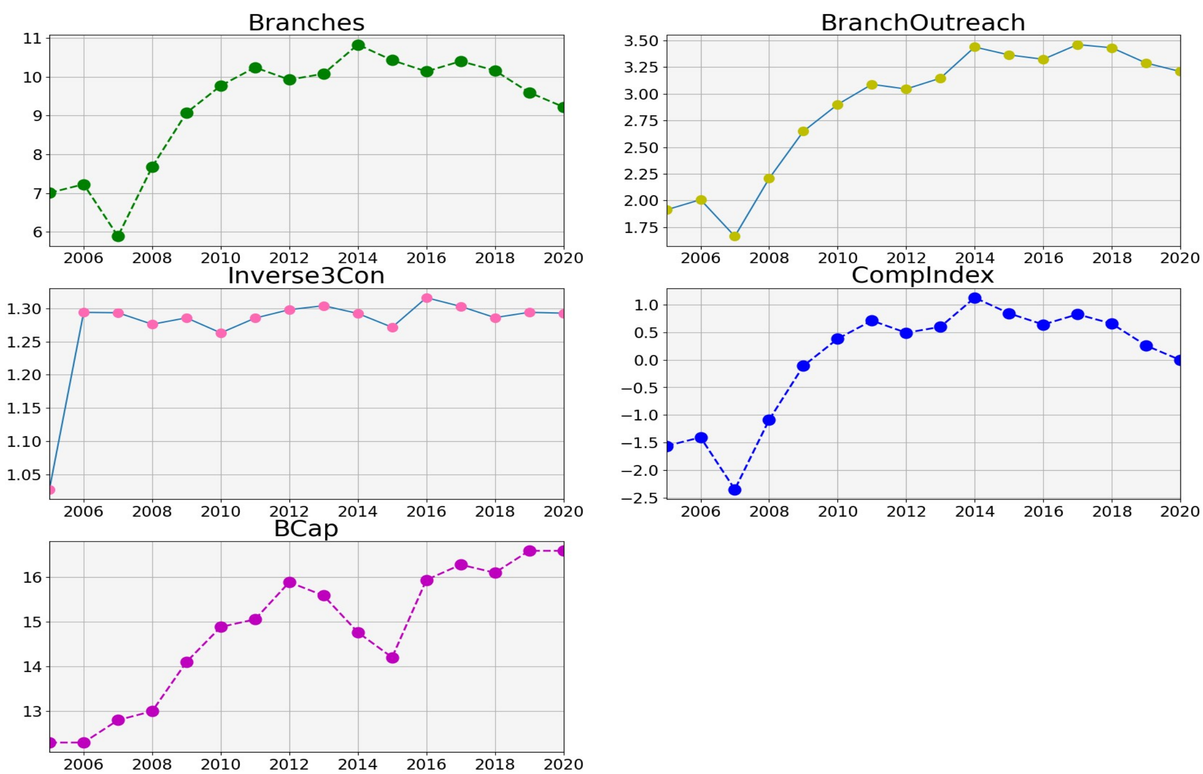
Figure 5: Trend of Growth and Std of Growth by sector



Note: This figure shows the yearly time series of Growth and Std of Growth for each manufacturing industry each year. Definitions of Growth and Std of Growth are provided in the Appendix. Source: Prepared by the author using a twelve-month average of the Monthly Industrial Production Index (IIP) data from UNIDO.

Furthermore, Table 1 shows that the manufacturing of food products, chemicals and chemical products, and paper and paper products exhibits the highest levels of stability. To be specific, on average, manufacturing of food products (2.14), chemicals and chemical products (2.83), and paper and paper products (3.46) have the smallest values of Std of Growth, with Growth of 94.09, 91.12, and 96.25, respectively. On the other hand, manufacturing of motor vehicles, trailers and semi-trailers has the highest Std of Growth, at 10.07, indicating high volatility. While Figure 5 shows that manufacturing of textiles trended downward from 166.97 in 2005 to 77.98 in 2020, Figure 4 and Appendix B show that the manufacturing of textiles (119.31) has the highest average of monthly IIP over the 2005 to 2020 period. It is followed by other manufacturing (115.91) and basic metals (110.78), while manufacturing of computer, electronic and optical products (89.15) has the lowest average monthly IIP, followed by manufacturing of beverages (89.88) and electrical equipment (90.51). Figure 4 highlights the variations in the Growth and Std of Growth across the manufacturing industries.

Figure 6: Trend of competition and regulatory capital



Note: This figure shows the yearly time series of our main variables of interest (Inverse3Con, Branches, BranchOutreach, CompIndex, and BCap). The definitions of the variables are provided in the Appendix Source: Prepared by the author using data from GFDD and IMF Financial Access Survey.

Figure 6 displays the evolution of competition and regulatory capital over the 2005-2020 period. A look at the figure reveals that Inverse3Con sharply increased from 1.027 in 2005 to 1.294 in 2006 but remained relatively stable thereafter. Branches also increased from 7.00 in 2005 to 7.23 in 2006, before trending upward to 10.83 in 2014 and trending downward to 9.22 in 2020. The trend of BranchOutreach closely mirrored that of Branches, hitting its minimum in 2007 when Branches also reached its lowest point in the same year. CompIndex exhibited an increase from 2007 to 2014, rising from -2.350 to 1.126, but declined to -0.004 in 2020. As for BCap, it increased from 12.30% in 2005 to 15.88% in 2012, then declined to 14.20% in 2015, before rising again to 16.58% in 2020.

4. Results

We examine the effects of bank competition and capitalization on output growth and stability in the manufacturing industry. We use four different indicators of competition: the Inverse3Con, Branches, BranchOutreach, and CompIndex. In Table 4, we provide results where competition is measured by Inverse3Con; in Table 5, we use Branches; in Table 6, we use BranchOutreach, and in Table 7, we report the effect of the general competition index constructed through principal component analysis of Inverse3Con, Branches, and BranchOutreach. Columns 1 to 6 of these tables present models where Growth is the dependent variable, while columns 7 to 12 focus on its standard deviation (Std of Growth). The even-numbered columns display estimations with interaction terms, whereas the odd-numbered columns provide estimations without the interaction terms. In all 12 regression results in Table 4, the coefficients on Comp are significantly positive (except columns 1 and 4) with Growth and negative with Std of Growth (except columns 7 and 10). Quantitatively, column 2 of Table 4 indicates that a 1 percentage point increase in the inverse of the 3-bank concentration ratio is linked to an increase of about 1.64 units in Growth (measured by the IIP index), holding all other factors constant. Column 8 of Table 4 quantitatively suggests that a 1 percentage point increase in the inverse of the 3-bank concentration ratio is associated with a decrease of approximately 2.02 units in the standard deviation of the 12-month IIP index. This suggests that lower bank concentration (indicating higher competition) enhances manufacturing output growth and stability. The positive link between bank competition and output growth could imply that a competitive banking environment promotes manufacturing by reducing interest rates and improving credit access. This helps firms expand, adopt technology, and innovate. Small and medium-sized enterprises, which are crucial for manufacturing growth, especially benefit from easier credit access. Competition also ensures more effective allocation of credit, contributing to industry growth. The negative relationship between competition and output volatility underscores its stabilizing role. Competing banks are likely to diversify their loans across industries, thereby reducing credit concentration risks and enhancing stability. Our findings align with the research of Deidda and Fattouh (2005), who document that a 3-bank concentration ratio reduces industrial and per-capita income growth in low-income countries. Similarly, a study by Cetorelli and Gambera (2001), which uses data for 36 manufacturing sectors in 41 countries, finds a negative influence of bank concentration on economic growth that affects all firms and sectors indiscriminately.

Further analyses using Branches, BranchOutreach, and CompIndex (as shown in Tables 5–7) yield consistent results, confirming that in South Africa, a more competitive banking environment supports manufacturing output growth and stability. This observation aligns with traditional economic theory, which suggests that greater competition in the banking sector, as opposed to imperfect competition, reduces financing constraints, lowers lending rates, and increases credit supply, thereby promoting higher investment and subsequent growth. Additionally, an increase in bank branches improves access to banking services for non-banking sectors, potentially enhancing their productivity. While competition has advantages, regulators should monitor aggressive risk-taking by banks to prevent excessive credit growth that could lead to financial instability.

When significant, the coefficients on BCap are negative for Growth and positive for Std of Growth, indicating that higher bank regulatory capital restricts manufacturing growth and stability in South Africa. Quantitatively, column 2 of Table 4 shows that a 1 percentage point increase in the bank regulatory capital to risk-weighted assets ratio leads to an 8.561-unit decrease in the average 12-month IIP index. Column 8 of Table 4 suggests that a 1 percentage point increase in the bank regulatory capital to risk-weighted assets ratio is associated with a 7.308-unit increase in the standard deviation of the 12-month IIP index. While this may contradict our prior expectations, it aligns with the view that higher bank capital raises funding costs, leading to lending restrictions and reduced credit supply to industries (Boyarchenko et al., 2020). Restricted access to credit may hinder industries from investing and expanding, ultimately slowing output growth. The notion that higher capital leads to lending constraints is further supported by Pillay and Makrelov (2024), who document the negative effects of increased regulatory capital requirements on bank lending in South Africa. As recommended under Basel III requirements, regulators may implement countercyclical capital buffers by reducing capital requirements during recessions to facilitate credit availability, while raising them during economic expansions to maintain financial stability.

An examination of the significant interaction terms in Tables 4–7 reveals that the negative (positive) relationship between BCap and Growth (Std of Growth) reverses as banking sector competition intensifies. This finding suggests that higher bank regulatory capital enhances manufacturing output growth and stability only in a highly competitive banking sector. One possible explanation is that increased bank competition may expand bank services, including a greater loan supply to non-banking sectors. This, in turn, could mitigate the adverse impacts of bank regulatory capital on manufacturing sector output growth and stability. These insights underscore the need to establish a banking system that ensures both credit efficiency (through competition) and financial stability (through adequate capitalization), fostering sustainable industrial growth and stability. Furthermore, the findings have important implications for shaping bank competition and regulatory capital policies. Specifically, while various factors influence bank regulatory capital, our results suggest that the South African Reserve Bank can enhance manufacturing output growth and stability in the face of high bank regulatory capital by implementing policies that promote competition in the banking sector. This approach helps mitigate the negative effects of stringent capital requirements and creates a more conducive environment for manufacturing industries.

When assessing the impacts of the control variables across all specifications, we observe that the coefficients on BSDev are positive with Growth. This implies that the size of the banking sector and its role in mobilizing and channeling savings from surplus to deficit units in the economy play a significant role in fostering the growth of manufacturing industries. Consistent with Xue (2020) and Huang et al. (2014), we find that banking sector development significantly reduces output volatility. This effect could stem from the capacity of a well-developed banking system to efficiently allocate resources to high-potential sectors, which in turn decreases misallocation and reduces output instability. The coefficients for LForce, when they are significant, show a negative relationship with Growth (except in columns 6 of Table 4) and a positive relationship with the Std of Growth (except in Table 4). These findings suggest that the manufacturing sector does not benefit from an increase in the labour force. An increase in the working-age population without sufficient job opportunities may result in higher unemployment or underemployment, which in turn can reduce productivity and output. If industries are unable to absorb the growing labour force, this can generate economic pressures and contribute to output volatility. Across Tables 4 through 7, the coefficient signs for both inflation (Inf) and government expenditure (GovExp) are inconsistent. This inconsistency suggests that the signs of these variables may vary depending on different model specifications. The coefficients for Electricity in columns 1 to 6 are positive, indicating that electricity production significantly enhances industrial output growth. The coefficients in columns 7 to 12 are negative, suggesting that greater electricity production is associated with reduced volatility in industrial output. In other words, stable electricity production contributes to the stabilization of industrial performance by minimizing output fluctuations. These findings underscore the importance of electricity production for industrial growth in South Africa, as it not only enhances average output but also helps to stabilize the industrial sector. For EG, the positive coefficients in columns 1 to 6 (except column 2 of Table 4) indicate that economic globalization is advantageous for South Africa's industrial sector by increasing overall industrial production. This benefit likely stems from enhanced access to international markets, improved technology transfers, and more efficient resource allocation as a result of global integration. The coefficients in columns 7 to 12 are negative (with the exception of Table 4), suggesting that South Africa's connection to the global economy provides a buffer against shocks and fluctuations.[11] This can be linked to the diversification of export markets, access to a wider variety of inputs, and stronger supply chains.

In all GMM and QML analyses, the coefficients for the lagged dependent variables are predominantly significantly positive, demonstrating the appropriateness of using a dynamic model as our main specification. At the bottom of the tables, we provide the diagnostic statistics for the GMM estimates. The Hansen test results presented in the tables mainly show that there are no over-identifying restrictions. This indicates that our instruments, employed to address endogeneity, are valid and do not create over-identification problems. Furthermore, the insignificance of AR(2) in the error term for most specifications suggests that there is no second-order serial correlation, indicating that the error terms do not exhibit a systematic pattern of correlation beyond the first lag. However, the significance of AR(2) in columns 9 and 10 of Tables 5–7 raises concerns about second-order serial correlation in these two columns/models.

In order to address possible endogeneity issues, this paper performs a robustness check using one-year lagged values for all the explanatory variables. The results from these robustness checks, available upon request, align with the main findings discussed in this section.

[11] We base our inference on the results that are reported in Tables 5 to 7.

Table 4: Regression results (Competition = Inverse3Con)

	Dependent variable = Growth						Dependent variable = Std of Growth					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FE	FE	GMM	GMM	QML	QML	FE	FE	GMM	GMM	QML	QML
L. Dep. variable			0.867***	0.897***	0.958***	0.939***			0.442**	0.425***	0.367***	0.254***
			(0.064)	(0.058)	(0.049)	(0.040)			(0.224)	(0.124)	(0.106)	(0.092)
Comp	11.225	164.352***	68.331***	24.721	115.525**	103.127**	18.192	-202.992***	-41.521***	0.000	-183.612***	-174.469***
	(14.924)	(25.559)	(23.874)	(24.341)	(47.051)	(45.692)	(15.129)	(13.374)	(15.570)	(0.000)	(25.470)	(23.480)
BCap	-4.179***	-8.561***	-1.943*	-3.474***	-3.196**	-5.572***	0.978	7.308***	2.556***	2.813***	4.987***	7.187***
	(1.157)	(1.529)	(1.024)	(1.079)	(1.433)	(1.515)	(0.601)	(0.685)	(0.541)	(0.265)	(0.772)	(0.778)
Comp*BCap		72.402***		108.467***		143.982***		-104.582***		-69.015***		-132.756***
		(15.629)		(17.088)		(37.611)		(6.022)		(12.140)		(19.395)
Inf	0.517	-0.795	-1.026***	-1.702***	-2.063***	-3.020***	1.117*	3.012***	1.089***	1.181***	2.290***	3.177***
	(0.428)	(0.547)	(0.223)	(0.278)	(0.482)	(0.530)	(0.580)	(0.264)	(0.200)	(0.238)	(0.256)	(0.270)
BSDev	3.725***	3.969***	0.864	1.583**	1.432	1.953**	-5.338***	-5.689***	-4.753***	-4.872***	-5.395***	-5.817***
	(0.993)	(0.893)	(0.678)	(0.776)	(0.934)	(0.912)	(1.371)	(0.505)	(0.380)	(0.302)	(0.501)	(0.465)
GovExp	12.551**	7.219	2.199*	0.913	-1.958	-5.363*	-2.817	4.885**	-5.966***	-4.504***	1.866	5.205***
	(4.771)	(5.252)	(1.327)	(1.337)	(2.798)	(2.847)	(2.481)	(1.996)	(0.706)	(0.510)	(1.471)	(1.439)
LForcce	-30.218**	-3.241	-4.411***	-2.379***	12.254	20.702**	-2.124	-41.091***	3.435***	2.049***	-31.887***	-40.104***
	(12.529)	(15.318)	(0.776)	(0.763)	(9.194)	(9.166)	(7.214)	(5.893)	(0.524)	(0.423)	(4.896)	(4.665)

EG	1.712***	-0.051	1.409***	1.465***	0.590	0.277	-0.252	2.295***	0.365**	0.120	1.796***	2.104***
	(0.411)	(0.602)	(0.366)	(0.366)	(0.634)	(0.620)	(0.320)	(0.221)	(0.180)	(0.087)	(0.343)	(0.318)
Electricity	0.001***	0.001***	0.001***	0.000***	0.001***	0.001***	-0.000**	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GovDebt	-0.221	0.111	-0.056	-0.017	0.235*	0.363***	-0.054	-0.533***	0.025	-0.009	-0.354***	-0.492***
	(0.153)	(0.177)	(0.077)	(0.080)	(0.134)	(0.134)	(0.142)	(0.086)	(0.045)	(0.031)	(0.073)	(0.070)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	336	336	315	315	315	315	336	336	315	315	315	315
R-squared	0.2398	0.2487					0.4830	0.6376				
AR(1)			-3.51***	-3.38***					-2.76***	-3.85***		
AR(2)			-0.18	-1.01					-0.96	-0.82		
Hansen test			19.20	22.34					18.07	19.54		
Instruments			71	72					64	65		
Industries	21	21	21	21	21	21	21	21	21	21	21	21

Note: The dependent variables are Growth and Std of Growth. Growth is a twelve-month average of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry. Std of Growth is a twelve-month standard deviation of the monthly growth of real gross output. Comp is the inverse of the market share of the three largest commercial banks (in terms of total assets). BCap is the bank regulatory capital to risk-weighted assets. BSDev is an index of banking system development computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP and the ratio of bank credit to bank deposits). GovExp is the real general government final consumption expenditure (% of GDP). Inf is the rate of change in GDP deflator (annual %). LForce is the proportion of the population ages 15-64 that is economically active. EG is economic globalization index. Electricity is total electricity production (GWh). GovDebt is government debt (% of GDP). Standard errors are reported in parentheses. We estimate all the static regressions using FE with Driscoll-Kraay standard errors. ∗∗∗, ∗∗ and ∗ denote statistical significance at the 1%, 5% and 10% respectively.

Table 5: Regression results (Competition = Branches)

	Dependent variable = Growth						Dependent variable = Std of Growth					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FE	FE	GMM	GMM	QML	QML	FE	FE	GMM	GMM	QML	QML
L. Dep. variable			0.823***	0.862***	0.956***	0.957***			0.035	0.259***	0.340***	0.338***
			(0.072)	(0.088)	(0.043)	(0.044)			(0.168)	(0.047)	(0.097)	(0.102)
Comp	1.788*	1.845*	1.902***	2.111***	2.574***	2.538***	-3.490***	-3.420***	-2.566***	-2.668***	-3.115***	-3.081***
	(0.915)	(0.873)	(0.338)	(0.359)	(0.659)	(0.670)	(0.513)	(0.538)	(0.454)	(0.262)	(0.502)	(0.382)
BCap	-3.358*	-3.669**	0.284	-0.036	0.011	0.309	0.135	-0.247	0.638**	0.709***	0.220	-0.061
	(1.724)	(1.640)	(0.496)	(0.565)	(0.872)	(0.890)	(0.803)	(0.804)	(0.282)	(0.137)	(0.363)	(0.634)
Comp*BCap		0.608		0.293		-0.561		0.745		-0.150		0.535
		(0.696)		(0.335)		(0.459)		(0.447)		(0.171)		(0.502)
Inf	1.472**	1.151*	-0.438*	-0.561***	-0.236	0.064	-0.429	-0.822*	-0.210	-0.048	-0.154	-0.444
	(0.554)	(0.613)	(0.225)	(0.218)	(0.415)	(0.468)	(0.332)	(0.418)	(0.151)	(0.092)	(0.181)	(0.391)
BSDev	3.852***	3.639***	1.303***	1.552***	1.179	1.352	-4.714***	-4.974***	-4.635***	-4.404***	-5.124***	-5.291***
	(1.020)	(1.036)	(0.409)	(0.429)	(0.831)	(0.876)	(0.951)	(0.878)	(0.725)	(0.413)	(0.601)	(0.515)
GovExp	9.295*	9.304*	-3.339***	-2.261***	-1.792	-1.716	-0.860	-0.849	0.000	0.000	1.001	0.913
	(4.592)	(4.611)	(0.926)	(0.860)	(2.241)	(2.261)	(3.433)	(3.413)	(0.000)	(0.000)	(1.109)	(1.405)
LForcce	- 30.186***	- 24.912**	-2.429***	-2.604***	-12.146**	- 17.477***	12.890*	19.353**	2.309***	1.905***	2.731	7.859
	(8.327)	(9.923)	(0.310)	(0.287)	(5.853)	(6.608)	(7.348)	(8.083)	(0.412)	(0.203)	(3.390)	(6.355)
EG	2.173***	1.839***	2.087***	1.951***	2.288***	2.600***	-0.814**	-1.223***	-0.532***	-0.364***	-0.697***	-0.996***
	(0.565)	(0.425)	(0.246)	(0.226)	(0.407)	(0.432)	(0.280)	(0.313)	(0.158)	(0.066)	(0.098)	(0.367)
Electricity	0.001***	0.001**	0.000***	0.000***	0.001***	0.001***	-0.000	-0.000*	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GovDebt	-0.016	-0.076	0.177**	0.147**	0.214*	0.263**	-0.220*	-0.293**	-0.275***	-0.204***	-0.275***	-0.322***
	(0.135)	(0.154)	(0.069)	(0.058)	(0.121)	(0.112)	(0.103)	(0.125)	(0.067)	(0.039)	(0.047)	(0.080)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	336	336	315	315	315	315	336	336	315	315	315	315
R-squared	0.2429	0.2432					0.5883	0.5913				

AR(1)			-3.24***	-3.62***					-2.18**	-3.20***		
AR(2)			0.09	-0.07					-2.67***	-2.64***		
Hansen test			16.95	17.37					21.61	21.63		
Instruments			126	85					83	59		
Industries	21	21	21	21	21	21	21	21	21	21	21	21

Note: The dependent variables are Growth and Std of Growth. Growth is a twelve-month average of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry. Std of Growth is a twelve-month standard deviation of the monthly growth of real gross output. Comp is the number of commercial bank branches per 100,000 adults. BCap is the bank regulatory capital to risk-weighted assets. BSDev is an index of banking system development computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP and the ratio of bank credit to bank deposits). GovExp is the real general government final consumption expenditure (% of GDP). Inf is the rate of change in GDP deflator (annual %). LForce is the proportion of the population ages 15-64 that is economically active. EG is economic globalization index. Electricity is total electricity production (GWh). GovDebt is government debt (% of GDP). Standard errors are reported in parentheses. We estimate all the static regressions using FE with Driscoll-Kraay standard errors. ∗∗∗, ∗∗ and ∗ denote statistical significance at the 1%, 5% and 10% respectively.

Table 6: Regression results (Competition = BranchOutreach)

	Dependent variable = Growth						Dependent variable = Std of Growth					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FE	FE	GMM	GMM	QML	QML	FE	FE	GMM	GMM	QML	QML
L. Dep. variable			0.883***	0.795***	0.950***	0.952***			0.536*	0.242***	0.313***	0.311***
			(0.022)	(0.029)	(0.041)	(0.042)			(0.285)	(0.047)	(0.097)	(0.097)
Comp	6.762**	7.899***	4.566***	5.670***	7.331***	6.971***	-11.436***	-10.548***	-7.085***	-8.239***	-10.385***	-10.082***
	(2.397)	(1.922)	(0.733)	(0.987)	(1.907)	(1.937)	(1.241)	(1.032)	(0.656)	(0.844)	(1.112)	(1.134)
BCap	-2.792	-2.982*	-2.089***	-0.781*	0.389	0.560	-0.663	-0.811	0.697***	0.663***	-0.521	-0.661
	(1.789)	(1.589)	(0.382)	(0.457)	(0.889)	(0.905)	(0.746)	(0.793)	(0.182)	(0.135)	(0.580)	(0.589)
Comp*BCap		3.981*		1.971***		-2.266		3.108		-0.666*		1.932
		(2.113)		(0.665)		(1.548)		(1.486)		(0.392)		(1.517)
Inf	1.467***	0.591	-0.751***	-0.391*	-0.536	-0.020	-0.194	-0.878*	0.016	0.158*	0.027	-0.418
	(0.472)	(0.627)	(0.185)	(0.228)	(0.388)	(0.564)	(0.246)	(0.424)	(0.147)	(0.092)	(0.252)	(0.430)
BSDev	3.254***	2.407**	2.032***	0.660*	0.585	0.920	-3.734***	-4.396***	-4.121***	-3.800***	-4.180***	-4.470***
	(0.980)	(0.997)	(0.359)	(0.369)	(0.793)	(0.887)	(0.832)	(0.697)	(0.190)	(0.407)	(0.498)	(0.546)
GovExp	7.868*	6.853*	0.000	0.000	-2.522	-1.444	1.026	0.234	0.000	0.000	2.474*	1.530
	(4.151)	(3.332)	(0.000)	(0.000)	(2.299)	(2.504)	(2.975)	(2.549)	(0.000)	(0.000)	(1.395)	(1.576)
LForcce	-29.626***	-14.520*	-3.026***	-2.868***	-10.308*	-21.650**	10.852*	22.644***	1.667***	1.412***	2.216	11.953
	(6.472)	(7.709)	(0.311)	(0.274)	(5.727)	(8.973)	(5.606)	(6.505)	(0.316)	(0.166)	(3.968)	(8.603)
EG	2.308***	1.908***	1.269***	1.910***	2.305***	2.562***	-0.947***	-1.259***	-0.397***	-0.366***	-0.834***	-1.054***
	(0.534)	(0.561)	(0.236)	(0.224)	(0.412)	(0.425)	(0.190)	(0.314)	(0.145)	(0.061)	(0.234)	(0.290)
Electricity	0.001**	0.001**	0.001***	0.000***	0.000**	0.001***	-0.000	-0.000*	-0.000***	-0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GovDebt	-0.139	-0.398*	0.153*	-0.132	0.028	0.139	0.023	-0.179	-0.118***	0.015	-0.045	-0.139
	(0.091)	(0.192)	(0.078)	(0.085)	(0.104)	(0.108)	(0.066)	(0.134)	(0.032)	(0.050)	(0.062)	(0.096)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	336	336	315	315	315	315	336	336	315	315	315	315
R-squared	0.2452	0.2466					0.6126	0.6200				
AR(1)			-3.39***	-3.42***					-2.37**	-3.08***		
AR(2)			-0.55	-0.21					-2.03**	-2.74***		
Hansen test			36.08	17.39					20.62	18.05		
Instruments			93	79					113	58		
Industries												

Note: The dependent variables are Growth and Std of Growth. Growth is a twelve-month average of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry. Std of Growth is a twelve-month standard deviation of the monthly growth of real gross output. Comp is the number of commercial bank branches per 1,000 km^2. BCap is the bank regulatory capital to risk-weighted assets. BSDev is an index of banking system development computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP and the ratio of bank credit to bank deposits). GovExp is the real general government final consumption expenditure (% of GDP). Inf is the rate of change in GDP deflator (annual %). LForce is the proportion of the population ages 15-64 that is economically active. EG is economic globalization index. Electricity is total electricity production (GWh). GovDebt is government debt (% of GDP). Standard errors are reported in parentheses. We estimate all the static regressions using FE with Driscoll-Kraay standard errors. ∗∗∗, ∗∗ and ∗ denote statistical significance at the 1%, 5% and 10% respectively.

Table 7: Regression results (Competition = CompIndex)

	Dependent variable = Growth						Dependent variable = Std of Growth					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FE	FE	GMM	GMM	QML	QML	FE	FE	GMM	GMM	QML	QML
L. Dep. variable			0.860***	0.859***	0.956***	0.957***			0.206**	-0.092	0.340***	0.338***
			(0.014)	(0.014)	(0.046)	(0.047)			(0.092)	(0.104)	(0.097)	(0.102)
Comp	2.542*	2.623*	1.876***	2.647***	3.660***	3.608***	-4.962***	-4.863***	-3.384***	-3.681***	-4.429***	-4.380***
	(1.301)	(1.241)	(0.431)	(0.544)	(1.011)	(1.015)	(0.805)	(0.765)	(0.322)	(0.681)	(0.714)	(0.543)
BCap	-3.358*	-3.669**	-1.505***	-1.392***	0.011	0.309	0.135	-0.247	0.539***	0.397*	0.220	-0.061
	(1.724)	(1.640)	(0.408)	(0.395)	(1.092)	(1.202)	(0.951)	(0.804)	(0.131)	(0.232)	(0.363)	(0.634)
Comp*BCap		0.864		0.936**		-0.798		1.059		-0.487*		0.761
		(0.990)		(0.426)		(1.340)		(0.636)		(0.294)		(0.714)
Inf	1.472**	1.151*	-0.737***	-0.779***	-0.236	0.064	-0.429	-0.822*	0.030	-0.087	-0.154	-0.443
	(0.554)	(0.613)	(0.188)	(0.186)	(0.527)	(0.728)	(0.406)	(0.418)	(0.103)	(0.131)	(0.181)	(0.391)
BSDev	3.852***	3.639***	1.789***	1.325***	1.179	1.352	-4.714***	-4.974***	-5.037***	-4.139***	-5.124***	-5.291***
	(1.020)	(1.036)	(0.461)	(0.493)	(0.927)	(0.971)	(0.740)	(0.878)	(0.417)	(0.361)	(0.601)	(0.515)
GovExp	9.295*	9.304*	0.000	0.000	-1.792	-1.716	-0.860	-0.849	0.000	0.000	1.001	0.913
	(4.592)	(4.611)	(0.000)	(0.000)	(2.701)	(2.704)	(2.547)	(3.413)	(0.000)	(0.000)	(1.109)	(1.405)
LForcce	-30.186***	-24.912**	-2.601***	-2.370***	-12.146	-17.477	12.890*	19.353**	1.513***	1.378***	2.731	7.859
	(8.327)	(9.924)	(0.311)	(0.309)	(7.857)	(11.903)	(6.173)	(8.084)	(0.127)	(0.111)	(3.390)	(6.355)
EG	2.173***	1.839***	1.638***	1.561***	2.288***	2.600***	-0.814**	-1.223***	-0.527***	-0.312	-0.697***	-0.996***
	(0.565)	(0.425)	(0.226)	(0.232)	(0.446)	(0.689)	(0.339)	(0.313)	(0.058)	(0.200)	(0.098)	(0.367)
Electricity	0.001***	0.001**	0.000***	0.000***	0.001***	0.001***	-0.000*	-0.000*	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GovDebt	-0.016	-0.076	0.095	0.051	0.214*	0.263*	-0.220**	-0.293**	-0.235***	-0.189***	-0.275***	-0.322***
	(0.135)	(0.154)	(0.090)	(0.088)	(0.123)	(0.149)	(0.095)	(0.125)	(0.028)	(0.038)	(0.047)	(0.080)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	336	336	315	315	315	315	336	336	315	315	315	315
R-squared	0.2429	0.2432					0.5883	0.5913				
AR(1)			-3.36***	-3.41***					-3.58***	-3.47***		
AR(2)			-0.48	-0.45					-2.27**	-2.53**		

Hansen test			32.30	25.13					27.29	22.39		
Instruments			82	83					84	73		
Industries	21	21	21	21	21	21	21	21	21	21	21	21

Note: The dependent variables are Growth and Std of Growth. Growth is a twelve-month average of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry. Std of Growth is a twelve-month standard deviation of the monthly growth of real gross output. Comp is an index of bank competition computed through principal component analysis of Inverse3Con, Branches, and BranchOutreach. BCap is the bank regulatory capital to risk-weighted assets. BSDev is an index of banking system development computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP and the ratio of bank credit to bank deposits). GovExp is the real general government final consumption expenditure (% of GDP). Inf is the rate of change in GDP deflator (annual %). LForce is the proportion of the population ages 15-64 that is economically active. EG is economic globalization index. Electricity is total electricity production (GWh). GovDebt is government debt (% of GDP). Standard errors are reported in parentheses. We estimate all the static regressions using FE with Driscoll-Kraay standard errors. $***$, $**$ and $*$ denote statistical significance at the 1%, 5% and 10% respectively.

5. Conclusion

Using data for 21 South African manufacturing industries from 2005 to 2020, this paper examines the effects of bank competition and regulatory capital on output growth and stability in the manufacturing industry. We also examine the interactive effects of bank competition and regulatory capital. Our results show that bank regulatory capital reduces manufacturing output growth and its stability. With this relationship in mind, one might naively suggest that policymakers should refrain from implementing the Basel III capital requirements. This act might have adverse effects on the banking sector because a vast body of empirical literature has demonstrated a positive relationship between bank performance and regulatory capital. The various Basel Accords (I, II, and III) highlight the significant benefits of regulatory capital in the banking sector.

Interestingly, we find that increased bank competition enhances both manufacturing output growth and its stability. This conclusion is supported by four distinct indicators of bank competition: the inverse of 3-bank concentration ratio, the number of commercial bank branches per 100,000 adults, the number of commercial bank branches per 1000 km^2, and the banking sector competition index. The results also show that the interaction effects of bank competition and regulatory capital have positive impacts on output growth and stability. In essence, in addition to the growth-enhancingand volatility-reducing effects of bank competition, a more competitive banking market can offset the potential increase in volatility and reduction in growth resulting from higher bank regulatory capital.

From a policy perspective, our findings suggest that South Africa's current high bank capital requirement policy should be complemented with measures to increase bank competition. Policymakers could consider strategies such as expanding the number of bank branches, extending geographical outreach, and reducing bank concentration. Encouraging the market presence of efficient banks and promoting market entry, including foreign banks, can also boost competition. It is important for regulators to recognize that implementing high regulatory capital requirements without fostering bank competition may result in unintended consequences. This study underscores the importance of coupling high bank capital requirement policies with a competitive banking sector to effectively transmit benefits to the manufacturing industry. By combining competition-enhancing reforms with capital regulations, policymakers can foster a banking environment that supports sustainable industrial growth and economic resilience.

Although our examination is based on aggregated data from the banking sector, future investigations could leverage bank-specific data to capture heterogeneity among banks. Future studies might also explore whether the impacts of bank competition and capital regulation vary across different manufacturing sectors or company sizes. Furthermore, utilizing alternative competition indicators, such as the Lerner index or Boone indicator, could help validate and refine these observations. Analyzing the relationship between bank competition and capital regulation during various business cycles—particularly during economic downturns like the 2008 financial crisis or the COVID-19 pandemic—could yield additional insights. Lastly, conducting a cross-country comparative analysis could help assess the wider relevance of these findings within different economic and regulatory contexts.

Appendix A: Definitions of variables

Categories	Variables	Acronyms	Measurements
1. Dependent variables			
	Output growth	Growth	A twelve-month average of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry.[a]
	Output stability	Std of Growth	A twelve-month standard deviation of monthly growth of real gross output (seasonally adjusted, 2015=100) for a particular manufacturing industry.[a]
2. Main regressors			
a. Competition measures	Inverse of 3-bank concentration ratio	Inverse3Con	Inverse of the market share of the three largest commercial banks (in terms of total assets).[b]
	Number of bank branches	Branches	Number of commercial bank branches per 100,000 adults.[c]
	Branches' geographical outreach	BranchOutreach	Number of commercial bank branches per 1,000 km^2.[c]
	Competition index	CompIndex	Index of bank competition computed through principal component analysis of Inverse3Con, Branches, and BranchOutreach.
b. Capitalization	Banking sector capitalization	BCap	Bank regulatory capital to risk-weighted assets.[d]
3. Control variables			
	Banking system development index	BSDev	Index of banking system development computed through principal component analysis of two banking sector development indicators (the ratio of deposit money banks' assets to GDP and the ratio of bank credit to bank deposits).[b]
	Government size	GovExp	Real general government final consumption expenditure (% of GDP).[h]
	Inflation	Inf	Rate of change in GDP deflator (annual %).[e]
	Labour force growth	LForce	The proportion of the population ages 15-64 that is economically active.[e]
	Economic globalization index	EG	The index measures the economic dimension of globalization, focusing on the extent to which countries are integrated into the global economy through trade, investment, and other economic activities.[f]
	Electricity	Electricity	The total electricity production (GWh).[g]
	Debt-to-GDP	GovDebt	Government Debt (% of GDP)[h]

Sources of data:

[a] Author's computations based on data obtained from United Nations Industrial Development Organization (UNIDO) database (2022).

[b] Author's computations based on data obtained from the Word Bank's Global Financial Development database (2022).

[c] IMF Financial Access Survey (2022).

[d] Word Bank's Global Financial Development database (2022).

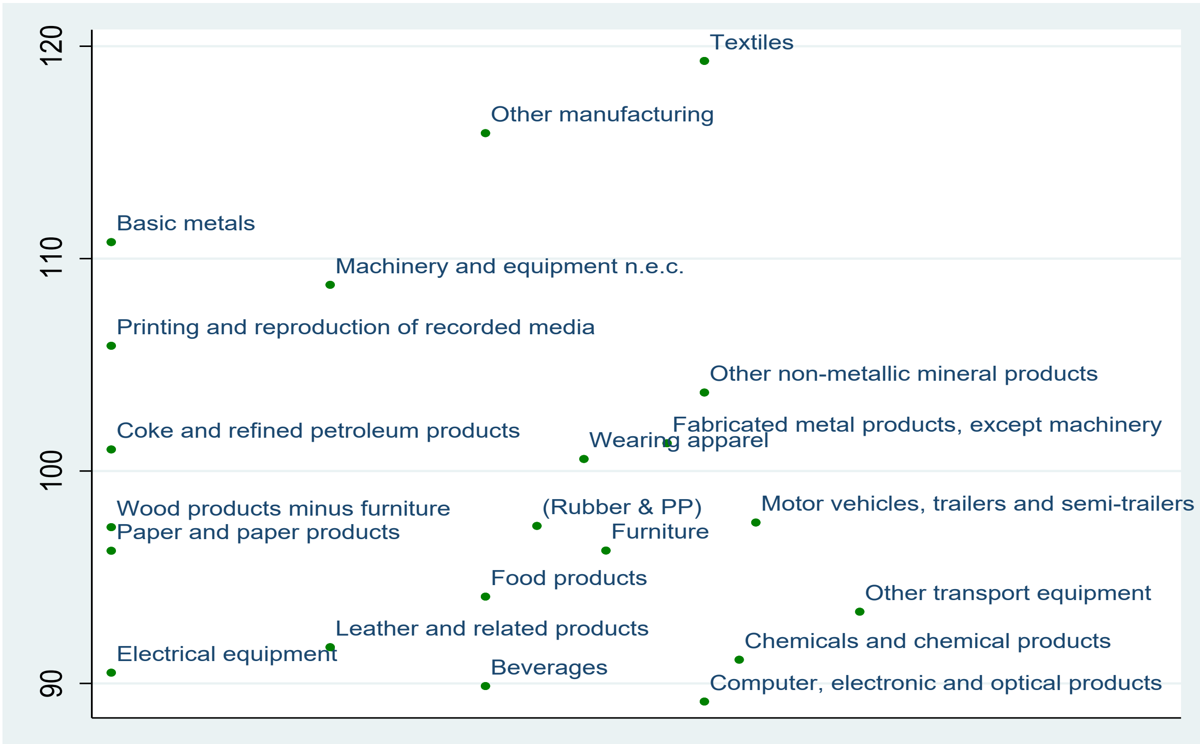
[e] Word Bank's World Development Indicators database (2022).

[f] KOF Swiss Economic Institute

[g] International Energy Agency

[h] IMF

Appendix B: Growth average for each industry over the sample period Jan. 2005-Dec. 2020



Note: This figure plots average Growth for each manufacturing industry over the period January 2005-December 2020.

Source: Prepared by the author using the Monthly Index of Industrial Production (IIP) data from UNIDO.

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