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Cities, Productivity and Jobs in South Africa: Problems and Potential

Discussion Document 12

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A background image of a smiling woman wearing a white hoodie, partially obscured by a large blue circular graphic. The image is faded and serves as a backdrop for the text.



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Matthew Simmonds
Director



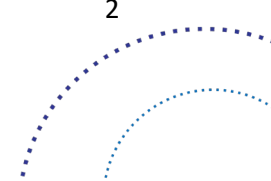
Cities, productivity and jobs in South Africa: Problems and Potential

1. Introduction

The underlying question addressed in this paper is whether cities in South Africa could contribute more to economic growth and job creation? Throughout global history, urbanisation has spurred the growth of national economies because it has been bound up with the evolving division of labour and the transition from agriculture to more productive manufacturing industry (Jacobs, 1984; Spence et al, 2009; Collier and Venables, 2017). Across much of the contemporary world, cities have become even more important contributors to national prosperity because of their role in sharing information, generating ideas and fostering innovation in tradable service industries and the knowledge economy (Storper, 2013; Glaeser and Joshi-Ghani, 2015; Pike et al, 2017). Many governments and multilateral organisations such as the UN, OECD and World Bank have come to realise that it isn't in the rarefied atmosphere of the macroeconomy that you find much dynamism, but on the ground in the dense ecosystem of cities where people and firms are drawn together to compete and collaborate and form a hive of creative energy (World Bank, 2009; United Nations, 2016; OECD/European Commission, 2020).

By any measure, South African cities have not been performing well and could do better (National Treasury, 2018; CDE, 2020; Duminy et al, 2020; Turok et al, 2021a; von Fintel, 2023). Unemployment, poverty and inequality are very high by historic and international standards. The formal education and skills of most urban adults are poor, and rates of entrepreneurship and business growth are low. Many city roads, commuter rail networks, electricity grids, and water and sanitation systems are under pressure and in a state of disrepair. Social despair, violent crime, vandalism and environmental decay are serious concerns within many communities. Most metropolitan municipalities are in financial distress, politically unstable, suffer high turnover of senior officials, and struggle to deliver reliable public goods and services. Underlying these issues are various structural and spatial peculiarities of SA cities that inhibit growth and development.

Of course, some of these problems are not confined to cities and are relevant to many towns and rural areas as well. Yet it cannot be emphasised enough how vital cities are strategically because of their disproportionate role in the national economy





and the prominent position they occupy within society at large and in the eyes of the international community (Turok, 2021). Any of the long catalogue of challenges identified above could undermine confidence, discourage productive investment and hold back economic growth, at least in the short-term. The main question that arises is what's the key to unlock lasting economic progress in cities. What are the priorities to turn the situation around and shift cities onto a higher growth path? The paper draws on international research in urban economics and combines it with new empirical evidence to consider the recent performance of South African metropolitan areas in relation to each other and to compare them with towns and rural areas. By focusing on the recent contribution of the metros to productivity and employment it seeks to distil some important lessons for realising the economic potential of cities. It is a partial and selective assessment rather than a comprehensive treatment of these complicated and multi-faceted issues.

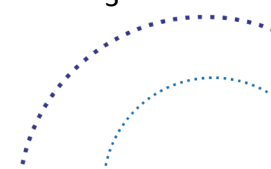
2. Framing the issues

2.1 The productivity of firms

If it's possible to pinpoint a single fundamental driver of sustained economic prosperity, productivity is arguably that crucial variable. Nobel prize-winner Paul Krugman famously argued that: "Productivity isn't everything, but in the long run it is almost everything" (1997, p.11). Productivity is the ability of a firm, city or country to produce more and better output for its inputs of labour and other resources. This determines its ability to improve the living standards of its workforce, residents and population over time.

There are many linked drivers and dimensions of productivity improvements because this is a broad concept. They include business technologies, management practices, workforce skills, entrepreneurial talent, higher quality products, infrastructure efficiency, competitiveness in international trade and responsive public institutions. Productivity gets close to the heart of economic success, especially if increases are accompanied by higher levels of labour absorption, so that productivity gains are not achieved simply by cutting the workforce. Labour absorption stems from the expansion of economic activity and the creation of more job opportunities. Access to such opportunities is vital to lift households out of poverty and to reduce social and spatial inequalities.

Another introductory point is that large firms typically have much higher





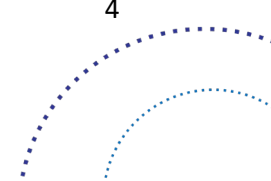
productivity than small firms because of internal economies of scale or scope.

These are cost savings that come from producing at a larger scale or across multiple products or processes through managerial efficiencies, shared inputs or better coordination of activity. Yet small enterprises should not just be dismissed for this reason. Many small firms also perform a valuable role in introducing new products and processes because of their flexibility, responsiveness to emerging opportunities and adaptability to a changing environment. Some of today's small firms also become tomorrow's large firms. So a higher concentration of small firms may be related to economic dynamism and long-term success (Glaeser, 2009). Low barriers to entry also mean that many micro-enterprises provide vital livelihoods for people who can't access formal employment. Large companies can potentially dampen economic progress by inhibiting the start-up and entry of new, more productive firms through their market power and control.

2.2 Productivity and agglomeration

Productivity is not just about firms, because location or 'place' also has an important influence on business performance. In recent years, considerable effort has been devoted to understanding the relationship between cities and productivity (Ahlfeldt and Pietrostefani, 2019). One important insight is that the spatial concentration of activity increases the productivity of firms through external economies of scale and scope. These positive external effects are often called 'agglomeration economies' or urban 'externalities'. They arise in cities from the superior access to shared infrastructure (such as transport networks, energy systems and other public utilities); deep pools of labour, talent and related resources; strategic institutions such as universities, research centres and major cultural amenities, and efficient flows of information and knowledge among firms and workers. These urban advantages are neatly summed up as sharing, matching and learning (Duranton and Puga, 2020). The process of urbanisation can amplify these processes, especially by deepening and continually refreshing the supply of labour and entrepreneurs (Turok and McGranahan, 2013).

There is an ongoing debate in urban economics about the importance of the sheer size of the city compared with its other attributes. Some researchers argue that scale is pre-eminent and 'the bigger the better' in terms of boosting productivity, innovation and growth (Melo et al, 2009). Only the largest cities can accommodate well-connected airports, reputable universities, significant museums and corporate headquarters. This implies that the largest cities in a country deserve special





government support because of their unique contribution to national growth. This means managing the negative externalities that accompany urban growth, including congestion, infrastructure bottlenecks and environmental degradation.

Other researchers put at least as much emphasis on other characteristics of the city, such as its industrial composition, the average size of its firms or the agility of its institutions (Storper et al, 2015; Sunley et al, 2020). They suggest that smaller cities that specialise in advanced sectors or that have high levels of new business formation may be more dynamic and prosperous than large cities without any distinctive industrial or enterprise strengths.

This bears upon an important distinction within the agglomeration economies literature between cities with relatively specialised economies and more diverse structures. This is reflected in the distinction between ‘localisation economies’ (also known as Marshall–Arrow–Romer (MAR) externalities) and ‘urbanisation economies’ (or Jacobs externalities) (Glaeser, 2008). The former refers to the positive externalities available to firms within the same industry, hence it favours specialisation and the growth of distinctive industrial clusters. These include specialised services (such as marketing, design or R&D), knowledge spillovers between cognate firms, and pools of highly skilled labour with particular know-how and expertise.

Urbanisation economies are a function of the scope (or diversity) of local industries in a city. They include shared public utilities, transport infrastructure, logistics facilities and generic business services (such as accountants, consultants and lawyers). These common resources available in cities are particularly important for new and small firms because they are much more dependent on external facilities and services than large firms that tend to be more self-sufficient. Cities have traditionally served a unique function as incubators of new enterprise because of these externalities and the sizeable market opportunities available (Jacobs, 1984).

Almost nothing is known about the productivity of South African cities compared with cities in other countries. Until recently, an absence of suitable data has also inhibited efforts to assess cities against each other, and to compare them with towns and rural areas. Inadequate prior research also means that little is known about the relative importance of industrial specialisation and diversity in South African cities. This is symptomatic of a wider neglect of the distinct economic problems and potential of metropolitan areas (von Fintel, 2023).



2.3 An efficient spatial form

It was noted above that many factors influence cities' economic performance, most of which are not specifically urban. In contrast, the spatial form or organisation of cities is distinctly urban. It is the physical arrangement of land-uses and buildings that ensures density and proximity between economic actors. This is one of the main distinguishing features of cities compared with towns and rural areas (Ahlfeldt and Pietrostefani, 2019; Duranton and Puga, 2020). An efficient urban form turns out to be crucial for the realisation of agglomeration economies, for reasons explained below. Furthermore, the spatial form is more amenable to policy influence than many of the other determinants of firm productivity, such as technology, management capabilities or workforce skills. Indeed, South African cities are held back by a uniquely inefficient spatial form, partly reflecting the historic government efforts to impose racial separation and urban fragmentation, thereby negating the magnetic urban forces of density and proximity (Turok, 2021). It is argued here that much could be achieved by undoing this legacy and using the policy levers of spatial planning, land-use regulation and infrastructure provision to create a more productive and vibrant urban environment.

An efficient urban form is vital for the circulation of people, goods, materials and information (Collier and Venables, 2017; Turok, 2017). This means frequent human and business interactions and seamless input-output linkages between firms. It is also essential for the city to function well as an integrated labour market, with abundant choices available to firms and workers, and efficient matching of labour demand and supply. A functional spatial form typically consists of a dense business district on the valuable land at the metropolitan centre of gravity surrounded by, and interspersed with, dense residential neighbourhoods that decline in density with distance from the centre. There may be secondary commercial and industrial districts dispersed across outlying areas, each supported by residential zones to ensure access to employment for workers. The whole urban fabric is underpinned by a skeleton transport network to ensure connectivity and interdependence between the different activities and areas of the city. Cities with fragmented physical layouts and deficient transport systems suffer from worse congestion, higher travel costs, weaker knowledge spillovers and less vibrancy than dense, well-connected cities.

The efficiency of the urban landscape partly reflects the capabilities of city authorities to plan ahead and steer private investment in business and residential



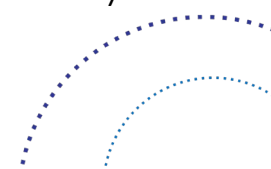
development towards the most suitable locations, without provoking endless disputes and lengthy delays (Turok, 2017). They have to balance the value of proximity between different activities and groups with the contradictory desire of some firms and residents for separation (e.g. the rich from the poor). Guiding urban development requires alignment and coordination across the different government entities responsible for public utilities, schools, healthcare, social housing, public transport and other facilities. City governments need the power and legitimacy to prevent scarce urban land being withheld from the market due to speculation or inertia, and to protect vacant land from unauthorised occupation. Regulatory procedures also need to be sufficiently flexible and responsive to allow for well-located land to be redeveloped at higher densities or converted to alternative uses when existing land-uses become inappropriate or redundant.

2.4 South African's urban form

The fractured form of South African cities is a source of economic underperformance as well as social inequality and unfairness (Duminy et al, 2020; Turok, 2021). Within each city, the population density gradient is unusual in tending to increase with distance from the centre, which means longer travel times, extended infrastructure networks and higher costs as a result. The problem has been getting worse in most cities as new arrivals settle on the outskirts where they can get away with paying little or no rent. Ongoing spatial segregation inhibits enterprise and upward mobility by separating formal firms and households with high disposable incomes from poor communities. Yet every city has large tracts of vacant and under-used land in high value areas that have remained in public ownership for decades - a huge opportunity cost. They could have been used for infill development to densify the established urban structure and reap the benefits of more intensive use of the existing infrastructure capacity.

Meanwhile, township residents incur exceptionally high transport costs and lengthy journeys in seeking and holding onto jobs in central business districts and industrial areas (National Treasury, 2018; Charman et al, 2020). This reduces their disposable incomes, inflates their wage demands and hampers their ability to study and improve their qualifications and skills after work. High transport and labour costs also reduce the returns on investment for businesses and makes it more difficult for firms in tradable sectors to compete internationally.

Since the 1990s, most central cities have been abandoned by formal companies





because of safety and environmental concerns, causing dereliction, further decay and occupation by informal businesses and low-income groups, including foreign nationals engaged in all kinds of enterprising activities (Turok et al, 2021b; Zack and Lewis, 2022). New commercial centres, business districts and retail complexes have been constructed in outlying areas accessible by private car. However, they lack the rich mixture of land-uses, vibrant public spaces and social vitality of the original districts. The new centres also tend to be less accessible to township residents by public transport and usually block informal trading and other street level consumer services. The separation of affluent groups and economic centres from low income households and poor neighbourhoods tends to reproduce the disjointed structure of South African cities and limit the positive external effects and income spillovers from well-off districts. One of the outcomes is a stunted informal economy and curtailed pathways out of poverty and unemployment.

South Africa now has more shopping malls in relation to its population than most other countries, where high streets remain important. Malls are where the vast majority of consumers do their weekly and monthly shopping. They favour tenants that are part of large retail chains or franchises, and to disadvantage independent and emerging businesses. The Competition Commission's recent inquiry (2019) into the grocery retail market confirmed that national retail chains dominate shopping centres. It concluded that this is partly because these corporates negotiate long-term exclusive lease agreements with property developers and landlords which exclude competitors. Indeed, over 70% of shopping centres are subject to exclusive lease agreements, some of which last for up to 30 years. This means that small and medium retail outlets, especially those run by historically disadvantaged entrepreneurs, are denied the opportunity to rent space in malls and thereby participate in the economy. The inquiry also found that the manufacturers and suppliers of foodstuffs and related goods also tend to favour national retail chains in the trading terms and rebates they pay. This creates further barriers to entry and inhibits the growth of small, informal and township businesses.

2.5 Urban Policy

The democratic government has been ambivalent about cities and generally sceptical of urbanisation, preferring a neutral, even-handed approach to urban and rural areas (CDE, 2020). This is partly because the negative effects and pressures of urbanisation have dominated public attention, while the less visible benefits for jobs, incomes and tax revenues have been neglected (Turok et al, 2021a). As a result, there is no shared



vision or plan of action across government to reinforce existing cities and to prepare for urban population growth by making serviced land and additional infrastructure capacity available in advance of human occupation. Instead, municipalities in the cities have battled to react to the rising demands for public services and shelter, resulting in bulk infrastructure shortfalls, overcrowded townships, stressed public services, swelling informal settlements and escalating social protests. These problems are compounded in Gauteng by the population growing much faster than elsewhere. Being landlocked is bound to be a disadvantage for local economic activities that are internationally traded. The limited local water supply on the Highveld also means higher costs and technical complications in diverting water from further afield, including pumping which relies on a stable electricity supply.

Things got off to a promising start with local government reorganisation during the late-1990s and the creation of more robust metropolitan administrations in the six largest cities (Turok, 2021). Unitary authorities were given wide territorial boundaries to reflect their functional urban areas and to prevent leapfrog development into neighbouring districts. The incorporation of outlying townships permitted resource redistribution from suburban property taxes. A strategic decision was made to assign housing and public transport functions to the provinces, which in retrospect has denied metros two important policy levers to densify well-located areas and to integrate their urban forms. The separation of responsibilities has created ongoing difficulties in aligning municipal priorities for investment in basic household infrastructure (water, sanitation, energy etc.) with provincial housing projects, transport services, schools and hospitals. The challenges for cities may even have increased over time as the provinces have gradually gained more political influence at the expense of municipalities.

The government's mass housing programme epitomizes a classic silo intervention driven from the centre and standing separate from the existing urban housing system and property market. The sheer scale of delivery of residential units has been an administrative achievement. However, the narrow focus on constructing physical shelter has come at the expense of other factors that determine people's well-being and that create viable human settlements and vibrant cities, such as access to jobs, other livelihood opportunities and social infrastructure.

Public transport plays a crucial role in connecting fractured cities. However, different transport functions are dispersed across various government spheres and entities, which has obstructed efforts to integrate the multiple road, rail, bus and taxi

networks into a seamless urban mobility system. Urban transport planning is also poorly articulated with land-use and built environment decision-making because the transport sector operates in a functional silo with its own regulations, procedures and professional skillsets. City governments lack the know-how and policy levers to coordinate transport investments with housing decisions, spatial plans, land-use controls and infrastructure projects.

The Constitution recognised municipalities as a distinct and relatively autonomous sphere of government, rather than an agent or tier of national or provincial government. Municipalities were given a mandate to promote economic as well as social development. The 1998 Local Government White Paper gave three distinct reasons for creating metros, one of which was to enhance city-wide economic competitiveness (Turok, 2014). In practice, the metros have never really developed significant economic strategies to pursue this bold objective by capitalising on their unique economic assets and focusing on the distinctive opportunities they face.

The full explanation for this is complicated, but the reasons include the scarcity of suitable knowledge and expertise, and a tendency to focus on small-scale, local enterprise rather than larger firms and tradable sectors that face the biggest competitive challenges from elsewhere. Metro politicians have also harboured suspicions of the private sector (especially major companies) and kept business owners and executives at arms-length, rather than putting in the time and effort to build relationships of trust and mutual accountability. Meanwhile, national and provincial authorities have done little to encourage place-based municipal economic strategies to complement their plans for specific industry sectors and types of infrastructure (Visagie and Turok, 2022). Instead, the whole gamut of prescriptive national regulatory frameworks and hierarchical reporting requirements inhibit metros from creative problem-solving and economic policy innovation.

3. Original evidence

South Africa collects a wealth of survey data about individuals and households but surprisingly little about firms (Tregenna et al, 2022). The national statistics agency, Statistics South Africa, produces a variety of headline economic indicators and related statistical reports about the economy, but these are not curated and released as microeconomic databases (at the firm level) for research. The dearth of reliable economic data is particularly serious when analysing the performance of cities. No



official statistics are routinely collected and reported about the size of the local economy (i.e. GDP), the structure of industry, or levels of investment in any of South Africa's urban centres. When economic information on cities is presented this is invariably sourced from commercial companies which specialise in compiling and packaging statistics. However, their estimates are at best forecasts or projections of local economic activity and deserve careful scrutiny because neither their methods nor their original sources are disclosed. For many years there has been insufficient recognition of the paucity of credible sub-national economic data in South Africa.

Until recently, the scope to do rigorous research on cities has been hampered by the almost complete vacuum in official statistics. However, this is starting to change in line with a global trend towards making better use of administrative data for research (Chetty, 2012; Cole et al, 2020). This report draws on a new source of economic activity data based upon tax data supplied by the South African Revenue Services (Arndt et al, 2018; Pieterse; 2018). Anonymised tax records are made available to researchers under restricted conditions in a Secure Data Centre. So far, studies based on South African tax data have been used for understanding national dynamics. However, a new initiative by the Human Sciences Research Council (HSRC) in partnership with the National Treasury's (NT) Cities Support Programme is curating tax data as spatial panels.

We make use of the HSRC/NT Spatial Tax Panel to interrogate the performance of South African cities for the period 2013/14 to 2020/21.¹ The backbone of the Spatial Tax Panel is the IRP5 tax form which is mandatory for each Pay-as-you-Earn (PAYE) registered employer for all employees earning more than R2,000 per annum. Therefore, the panel offers the full 'universe' of employment in formal firms. The anonymised IRP5 data includes details relating to each individual (income, gender, age and industry), and importantly information relating to the work address postal code. The work address is provided at the establishment or branch level which means that employment is allocated appropriately by place for multi-location firms. This should limit concerns about the potential for bias from a 'head office effect' in assessing trends in employment – which is where branch information is incorrectly attributed to a single head office location.² That said, balance sheet information – such as firm revenue, cost

¹ The data is grouped by tax year rather than calendar year, which runs from March to February

² The head office effect is a well-known problem in South African customs and balance of payments data which are only captured at the head office level. That said, we have identified several cases in the spatial panel where firms have not filed their tax appropriately (i.e. they do not report required IRP5 branch level information) which means all employees are listed at a single head office. These are isolated cases related to the way some firms file tax, but can influence the results particularly if such firms have a large market share. Further research is needed to assess the full extent of any potential head office bias.

of sales and cost of capital – is derived from the ITR-14 tax form, which is NOT reported at branch level. This is a limitation when estimating firm-level productivity for South African cities, which we are careful to outline when interpreting the results.

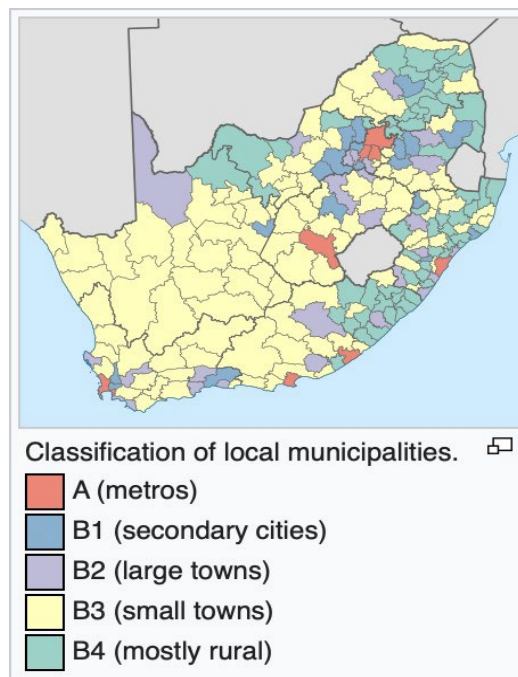
Finally, we also draw on metro-level estimates of formal employment from the Quarterly Labour Force Survey as a means of cross-checking the tax data. The measurement error is large due to the limited sample size, particularly for the smaller metros, but still arguably offers a useful point of comparison (Visagie, 2018).

4. Methods

4.1 Descriptive

The results are primarily descriptive and focus on the distribution of employment by geography as well as trends over time. The Spatial Tax Panel contains information on all 213 municipalities in South Africa (including the metros). We report on trends for municipalities according to their degree of urbanisation, using the well-established hierarchy of the Municipal Investment Infrastructure Framework (MIIF) (DBSA and COGTA, 2011; see map 1).

Map 1: MIIF classification



We also make some slight amendments to the MIIF typology in order to separate out the Gauteng metros (which arguably function as an integrated city region) from the Coastal metros, and to reassign Buffalo City and Mangaung as secondary cities rather than metros due to their much smaller populations (both were classified as secondary cities in earlier rounds of the MIIF).

Hence, we classify South African municipalities into: Gauteng metros (Johannesburg, Ekurhuleni and Tshwane), coastal metros (Cape Town, eThekweni and Nelson Mandela Bay), secondary cities (B1 municipalities³ including Buffalo City and Mangaung), large towns (B2 municipalities⁴), small towns (B3 municipalities⁵) and mostly rural (B4 municipalities⁶).

It is important to note that levels of employment refer to employees in formal employment only (i.e. with IRP5 tax certificates). In addition, the tax data represent the total number of employer-employee relationships rather than total employment in the labour market because some individuals are employed by multiple firms at the same time and hence generate more than one IRP5 certificate. Whilst individuals may also transition between firms (or become unemployed) within a tax year, IRP5 certificates have been converted to full time equivalents for that year to avoid double counting.

4.2 Total factor productivity

The final part of our empirical analysis is an attempt to directly estimate firm-level productivity. Economists refer to this as modelling ‘total factor productivity’ (TFP) (also ‘factor productivity’ or ‘multi factor productivity’). The basic idea is to understand the “efficiency with which firms turn inputs into outputs” (Saliola and Seker, 2011). The usual emphasis in any TFP analysis is to understand the contribution of ‘technology’ or ‘technical efficiency’, which is modelled as a residual once the shares from labour and physical capital are accounted for. These estimates are then compared across settlement type in order to better understand how geography is related to productivity. A technical discussion of our approach to modelling TFP is outlined in Annexure A.

Whilst firm-level productivity has been explored in recent research using the SARS data, most studies to date have been limited to manufacturing firms (manufacturing made up less than 12% of GDP in 2019) with little analysis of geography (Kreuser and Newman, 2018; Matthee et al, 2018; Kreuser and Brink, 2021). The only exception is Amusa et al (2019), who provide a spatial estimation of TFP in an analysis of agglomeration economies. However, the emphasis of their work is on modelling the returns to agglomeration rather than spatial estimates of TFP. Their findings are counterintuitive because “productivity is relatively higher in firms located in

3 The MIIF defines B1 as “municipalities with the largest budgets referred to as secondary cities”

4 The MIIF defines B2 as “municipalities with a large town as core”

5 The MIIF defines B3 as “municipalities with relatively small populations and a significant proportion of urban population but with no large town as core”

6 The MIIF defines B4 as “municipalities which are mainly rural with, at most, one or two small towns in their area”

regions/municipalities outside key economic clusters” and there is little discussion of the possible reasons for this (Amusa et al, 2019: 24). There is clearly scope for much more research on the spatial economy.

5. The evidence about cities, productivity and jobs

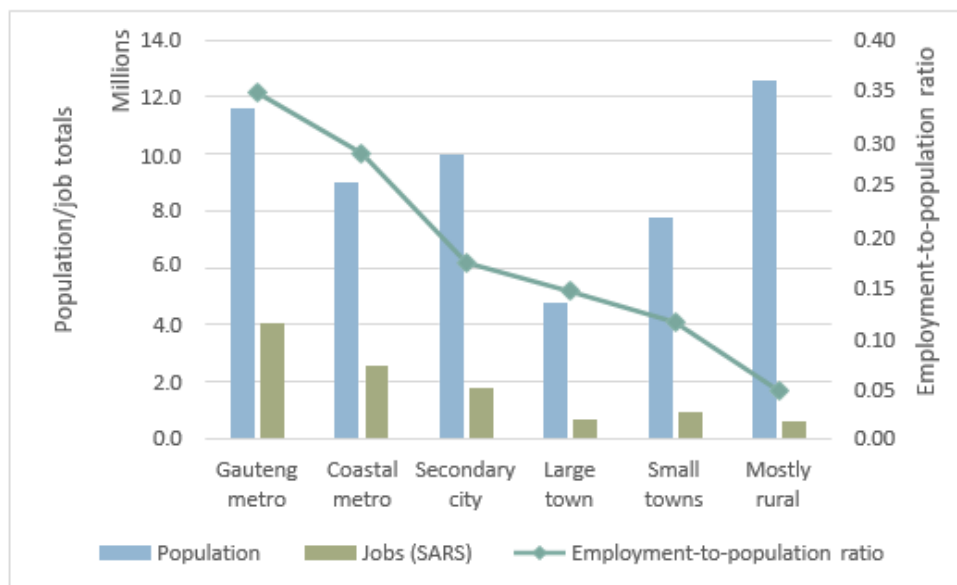
We discuss the evidence from the tax data in this section. It identifies eight important ‘stylised facts’ which emerge from the empirical evidence.

Eight stylised facts about the recent performance of cities

(I) *Employment rates in metros are much higher than everywhere else*

A striking feature of the geography of jobs is the concentration within major cities, especially when compared with the populations they support (figure 1). The large contrast between the cities and the countryside in terms of their basic viability in this respect must be exceptional by international standards.

Figure 1: Population and employment size, 2019/20



Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: Population size is for all ages

The Gauteng metros account for nearly 4 out of every 10 current jobs in the country and more than 6 out of 10 when combined with the Coastal metros. Primary and secondary cities collectively make up almost 8 out of 10 jobs. This highlights the centrality of cities to the national economy. A preliminary conclusion is that it’s a great deal easier to create jobs in cities than elsewhere. Informal work is missing in the tax data. Its inclusion would not change this picture greatly because of the limited size of

the informal economy and its interdependence with the formal economy. Hence, many informal jobs are also created in cities.

The metros are also home to large and growing populations. Despite this, the ratio of jobs to population (one measure of the employment rate) is at least double that of smaller towns, farming and rural communities (figure 1). The employment rate falls in line (monotonically) with settlement size, moving from the Gauteng metros to mostly rural municipalities. Formal jobs are very sparse in rural areas with a gulf between population and jobs numbers (an employment ratio of only 0.05). In other words, there are only 5 formal jobs supporting every 100 persons in mostly rural municipalities, compared to 35 in the Gauteng metros and 29 in the Coastal metros. It is well documented that rural areas, particularly the former homelands, have the highest and most persistent levels of poverty and reliance on social grants and household remittances in the country.

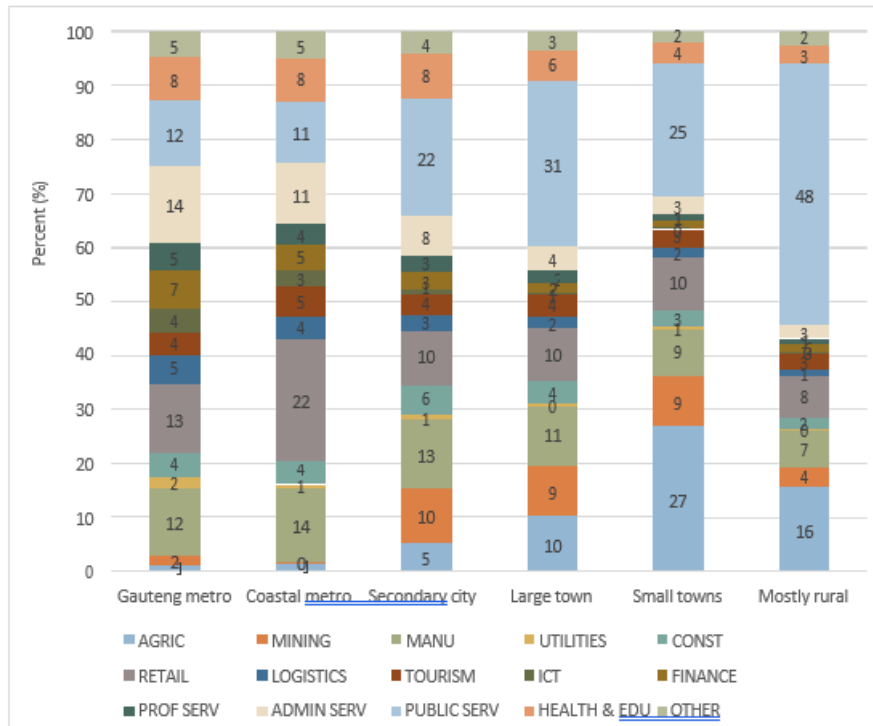
(II) *The metro economies are diversified in tradable sectors, whereas smaller towns and rural areas depend heavily on public services and agriculture*

Measuring total employment by settlement type overlooks important differences in the composition of jobs between places. The kinds of jobs on offer and the variety of labour demand from firms depends on the configuration and specialisation of the local economy. There are marked differences in the industrial make-up between city, town and countryside (figure 3).

The broad picture is that the metros have a fairly diversified base, including manufacturing and a range of business services. In contrast, small towns, rural areas and even large towns are heavily dependent on public services and agriculture. South Africa's traditional minerals and mining base remains important in many large towns and secondary cities, but barely features in the metros. Manufacturing is slightly more important in the metros than elsewhere, but is outweighed by a group of business services. Mostly rural municipalities don't have much of a formal economy, and a staggering half of their jobs are in the public sector.



Figure 2: Composition of industry, 2019/20



Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: Industry classifications derived from StatsSA SIC7-1 digit level. See

https://www.statssa.gov.za/classifications/codelists/Web_SIC7a/SIC_7_Final_Manual_Errata.pdf

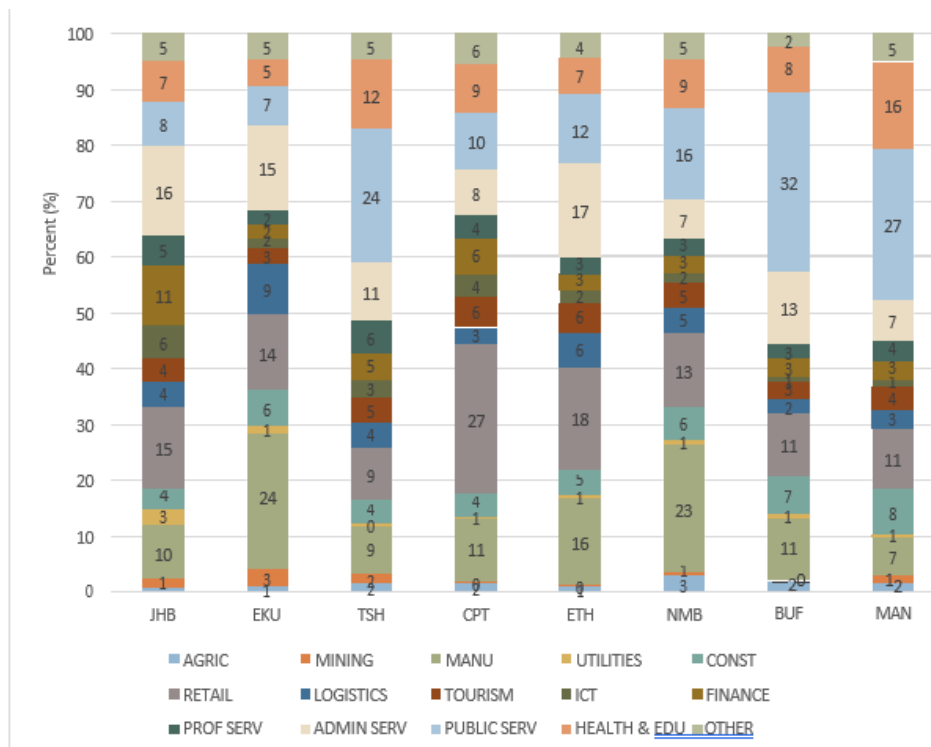
(III) *Specialisation is an important feature of metro economies*

A deeper dive into the jobs composition of each metro highlights important differences between them. The metros share certain similarities as the largest urban hubs servicing wider hinterlands, but their industrial structure is clearly variegated (figure 3). This highlights the importance of specialisation within the urban system. Cities compete but also complement and share outputs with each other based on their unique assets, infrastructure, natural resources, local institutions, workforce, politics and historical strengths. A dynamic urban system builds on the comparative advantages and synergies between different cities to reinforce their specialised functions and amplify their capabilities and productivity.

A full appreciation of the unique character of each metro economy warrants a careful historic and qualitative review. At the risk of oversimplification, we offer a brief description of the primary role of each metro from the industry employment tax data:



Figure 3: Composition of industry between metros, 2019/20

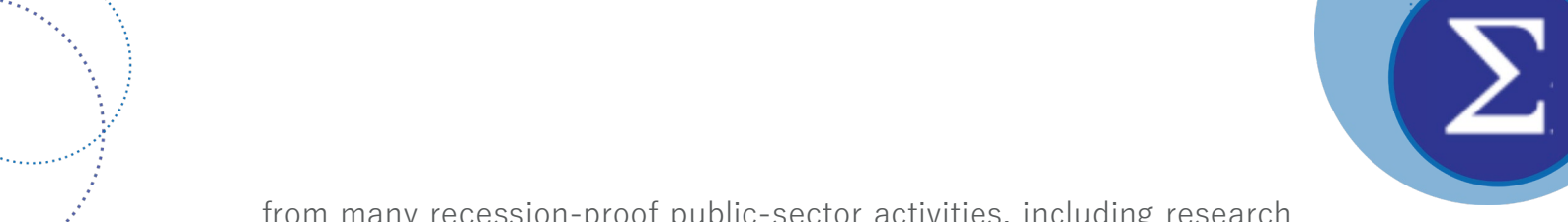


Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: Industry classifications derived from StatsSA SIC7-1digit level. See

https://www.statssa.gov.za/classifications/codelist/Web_SIC7a/SIC_7_Final_Manual_Errata.pdf

- Johannesburg: ‘Financial centre’. Finance makes a much bigger contribution to the local economy than it does in other cities. Johannesburg houses the headquarters of most of the banks, pension funds and insurance companies, the JSE, Industrial Development Corporation and Public Investment Corporation. Many related business services are also clustered in Johannesburg, including ICT, administrative and professional services such as accountants and lawyers.
- Ekurhuleni: ‘Manufacturing-logistics’. The East Rand used to be known as the workshop of the country. Manufacturing is still the largest employer in the metro, with prominent industrial districts such as Germiston, Boksburg, Nigel and Springs. The transport sector plays an important support function, including airport-logistics in Kempton Park near OR Tambo International Airport, one of Africa’s busiest.
- Tshwane: ‘National government and professional services’. Tshwane is the administrative capital of the country and the seat of the executive branch of government, with most national departments located there. Hence it benefits



from many recession-proof public-sector activities, including research councils and foreign embassies. Various other industries feed-off or are funded by the government, including teaching hospitals and universities.

- Cape Town: ‘Diversified tourism-centric’. The economy of Cape Town is relatively diversified and therefore difficult to summarise. There are clear strengths in retail and tourism-related activities. Some of South Africa’s largest retailers have their headquarters in Cape Town including Shoprite, Pick n Pay, Woolworths, Foshini, Pep, Truworths and online vendor Takealot. The city is also the country’s second largest centre of financial services, after Johannesburg.
- eThekweni: ‘Manufacturing-logistics’. eThekweni has always been an important manufacturing centre. The Port of Durban has since become a major anchor of the busy logistics corridor to Gauteng. Less-skilled tourism and administrative services (including call centres, private security and outsourcing) are an emerging feature of the local economy.
- Nelson Mandela Bay: ‘Automotive centre’. Nelson Mandela Bay is known for its automotive cluster including various international vehicle manufacturers and related suppliers such as Volkswagen, Ford, Goodyear, Bridgestone, Isuzu, Continental Tyre, Shatterprufe, and more recently First Automotive Works (FAW). It has struggled to diversify its manufacturing sector despite substantial investment in infrastructure such as the Coega Industrial Development Zone (IDZ).
- Buffalo City: ‘Provincial government’. Buffalo city is the headquarters of the Eastern Cape government and has the largest share of workers in government of any metro. Besides the civil service, East London has some manufacturing capabilities including Mercedes-Benz, Daimler Chrysler and several upstream suppliers in the East London IDZ.
- Mangaung: ‘Health and education’. Mangaung is the smallest metro and benefits from the headquarters of the Free State provincial government. A distinctive feature is the high concentration of workers in healthcare and education. The metro has a long history of education facilities (including two universities) and significant private health facilities (three private hospitals, many private day clinics and an increasing number of medical research institutions), as well as several public health facilities.

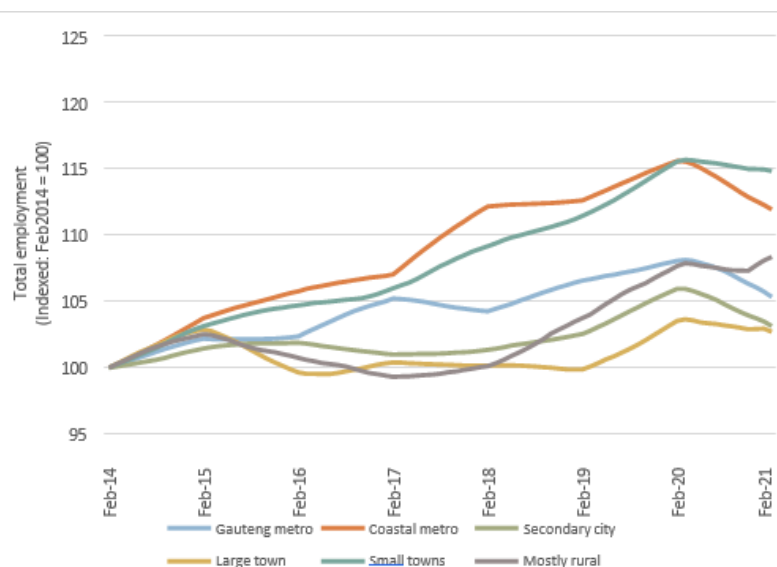
The metros should not be seen as equivalent or interchangeable economic units because this obscures their distinctive features. More research is needed to better understand the distinctive and specialised contribution of each metro to the national economy. This is vital to inform efforts to bolster their comparative advantages.

(IV) *Cities have not led employment growth across the country*

The national economy has experienced a prolonged period of stagnation dating back to the global financial crisis of 2008. Employment growth has also been suppressed by the tendency of recent activity to be capital intensive or skewed to high skills. Employment trends based on available tax data for the period 2013/14 to 2020/21 confirm a depressed economy (figure 4). They also reveal a mixed picture of relative strength and weakness which does not correspond in any simple way to settlement size or urbanisation hierarchy. With some exceptions, cities have not performed consistently better than towns and rural areas.

Despite their size and significance, the Gauteng metros have not performed well. Total employment increased by only 8 per cent between Feb-2014 and Feb-2020 (a meagre 1.3% average growth compounded over the period). Jobs grew more quickly in the coastal metros and small towns. Gauteng's growth was still better than secondary cities and large towns but no different from mostly rural areas. The relatively strong performance of the agriculture sector in recent years must have been a boon for farming and rural areas.

Figure 4: Trends in employment, 2013/14 – 2020/21



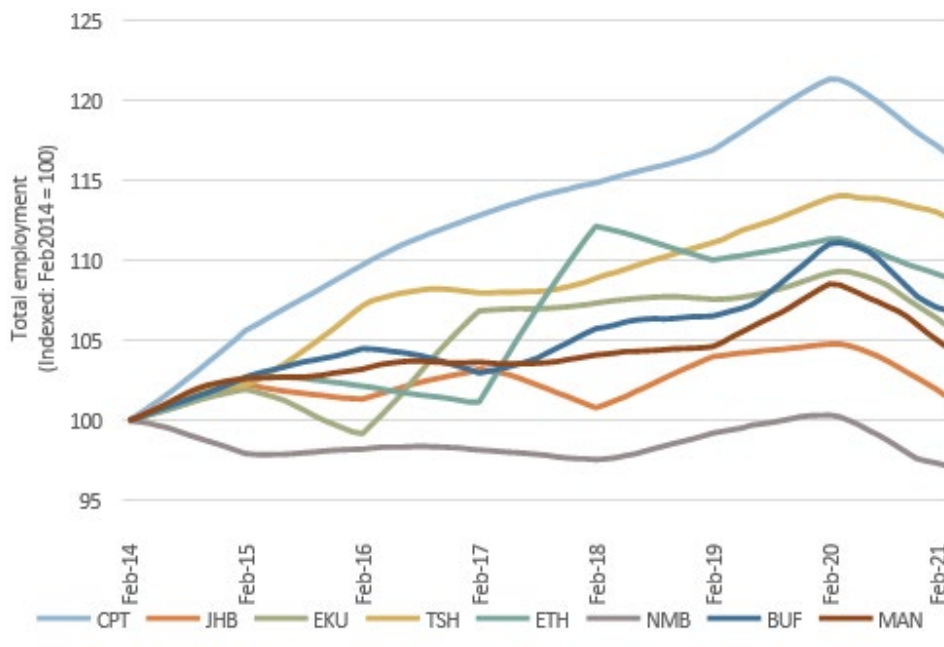
Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: 12-month rolling average



The negative shock of the Covid-19 pandemic is also clear in the employment data. Interesting, the impact appears to have been less severe in large towns, small towns and mostly rural municipalities, perhaps because of their greater reliance on government services. In addition, agriculture has been impacted less than other sectors, as an essential service. More recent data is required to assess the speed and extent of the recovery from the crisis. All settlement types were still below their pre-pandemic levels by February 2021, with the exception of mostly rural areas. Rural communities may have benefited disproportionately from means-tested social support measures, especially the Social Relief of Distress grant.

Figure 5: Trends in employment, 2013/14 – 2020/21



Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: 12-month rolling average

Uneven performance also characterises employment trends across the metros (figure 5). Cape Town’s employment level increased by 21 per cent followed by Tshwane at 14 per cent. Cape Town’s growth up to the pandemic works out at a compounded growth rate of 3.3% per year, which is noteworthy in a context of weak growth. Johannesburg’s employment growth has been particularly weak, increasing by only 5 per cent by Feb-2020 (less than 1% growth per annum). Tepid jobs growth in Johannesburg is ominous, given its significance as South Africa’s largest city and employment hub. Nelson Mandela Bay was the worst performing metro and the only one to actually lose jobs over the period. All the metros were badly affected by Covid-19, with Tshwane perhaps shielded more than the others.



(V) *Large firms feature everywhere, especially in small towns and rural areas*

South Africa’s product and capital markets are unusually concentrated by international standards. This is not just in industries such as mining and energy, where scale is a natural feature of competitiveness, but across the board in manufacturing, finance, retailing and so on. Large firms with dominant market shares have the potential to lead structural transformation through pioneering new techniques, access to external markets, and long- term commitments to R&D and learning. However, they can also hold back progress if they are complacent and abuse their market power to exclude new entrants, obstruct competition and push up prices.

Figure 6: Establishments grouped by firm size (total employment)



Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Figure 6 shows the proportion of establishments in each category of firm size. The proportion of jobs would look quite different because large firms are much bigger employers than small firms. The incidence of large firms varies greatly by settlement type (figure 6). They are much more important in rural areas and towns than in big cities. This is bound to reflect their internal resources to cope with the external costs and other limitations of peripheral locations, such as deficient public utilities, limited skills and fewer suppliers. The precise employment share for large firms is not available from the tax data, but it could amount to as many as half of all jobs in small towns and



rural areas.⁷ The implication is that large firms hold disproportionate sway in smaller economies and could be valuable partners in promoting local growth and development. The developmental contribution of large firms is likely to depend on the function performed by the local branch, for example whether it is involved in production or is simply a sales outlet.

(VI) Firms productivity appears weakly related to metro location when all firms are included

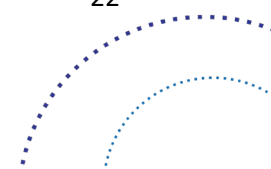
This shifts the focus from employment trends to estimates of firm-level productivity. (Annexure A contains a technical discussion of TFP modelling). A vital question is whether operating in a metro offers firms any measurable advantage compared with being located elsewhere in the country. At first sight there appears to be a fairly weak relationship between cities and productivity (figure 7). However, more care is needed to appreciate the nuanced relationship between agglomeration and productivity.

For the full sample of profit-making firms – including branches throughout the country and in all economic sectors – the differences in aggregate productivity by settlement type are only slight. Only firms located in rural areas lag behind the rest of the country to a noticeable extent. An important part of the reason for the lack of variation by location is the strong influence of multi-location firms in the sample. This is because productivity is assumed to be the same across all branches in multi-establishment firms.⁸ This is an obvious simplification but it is not completely unrealistic considering that large firms can deploy their various assets between branches and often adopt standard operational practices and procedures. Enterprises in different locations might also perform different functions within an integrated value chain.

When these large multi-location firms are omitted from the sample, there is an important change in the results (figure 7). A much clearer relationship emerges between agglomeration and productivity, with a premium for firms locating in either coastal or Gauteng metros, and to a lesser extent, secondary cities. Interestingly, the aggregate level of productivity also declines in all locations when multi-location firms are omitted. This indicates that these large firms are relatively productive. Reviewing the correlates

⁷ Large firms will account for a much larger employment share because because of the size of their payroll. For example, employment in a large firm of 200 employees is 100x greater than a micro enterprise with only 2 employees.

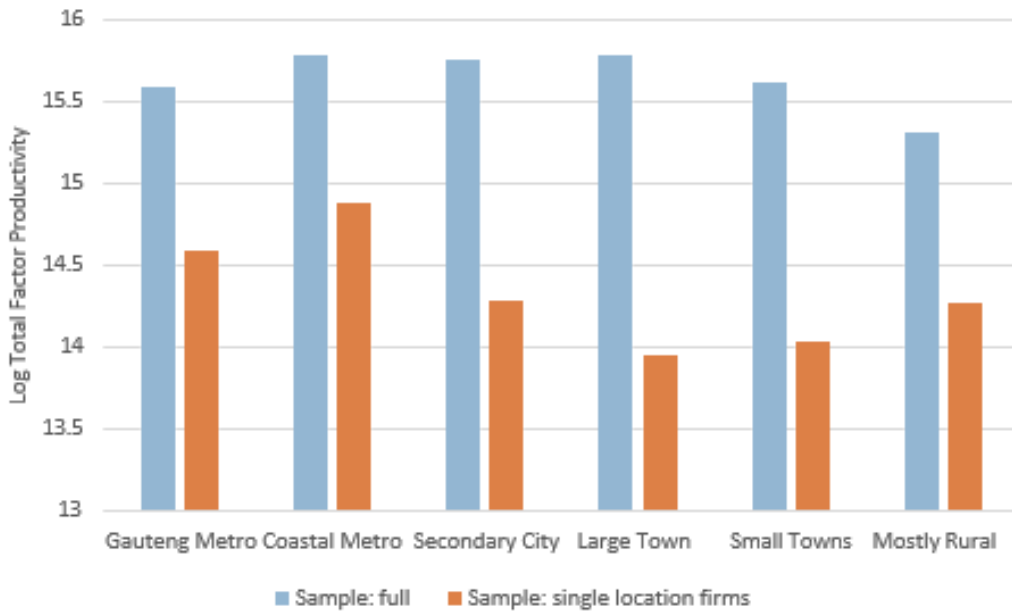
⁸ Estimates of TFP are based on balance sheet information which is only reported at the firm-level and hence branches are estimated with identical productivity.





of productivity as part of a regression model for different samples leads to the same conclusions (see Appendix A: Table A2).

Figure 7: Total factor productivity, average (2013/14 – 2019/20)



Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: Productivity estimates available for for-profit firms with tax returns. TFP is modelled separately at SIC-2-digit level and weighted by branch-level employment. See Appendix A: Table A3 for production function results.

(VII) Firm productivity is more strongly related to metro location at the industry level

Analysing productivity at a more granular, industry level shows even clearer patterns of productivity by location (see Appendix A: Table A1). The results support the proposition that productivity is generally higher in cities, especially in tradable sectors. It is very striking how productivity for all the service industries in the metros is almost always above average, but generally below average in the secondary cities, towns and rural areas. Another way of expressing this is that most towns and rural areas cannot compete with the metros in most sectors, but rather concentrate on activities such as mining or agriculture where they have a distinct advantage because of natural resource endowments.

It is also interesting how average productivity varies by sub-sector between the different metros, depending on their particular specialisation(s). For example, Cape Town stands out as a leader in retail and wholesale, as well as in arts and entertainment. Johannesburg stands out across most of its business services, suggesting strength in depth. Nelson Mandela Bay has the highest average productivity

in manufacturing, presumably reflecting its advanced automotive assembly plants.

The point is that there doesn't appear to be a linear relationship between city size and productivity because the sectoral strengths of each city differ. These differences in industry composition tend to obscure or iron out any simple correlation between city size and productivity because there is a lot more going on beneath the overall pattern. The results confirm the importance of agglomeration economies in increasing productivity, but suggest that the distinctive externalities available to firms within the same industry (localisation economies) are ultimately more important than the generic externalities available to all firms (urbanisation economies). Specialisation really does seem to matter.

(VIII) Internal economies of scale outweigh agglomeration economies

The final observation concerns the relative importance of internal and external determinants of firm-level productivity. As explained earlier, large firms benefit from internal economies of scale, such as managerial oversight, coordination of production or lower overheads. In contrast, cities benefit their firms through positive external economies, such as shared service providers, a pool of skilled labour or collaboration on product development or marketing.

A regression of the correlates of productivity suggests that both internal and external economies of scale are significant (see Appendix A: table A2). However, the size of internal economies appears to be far greater than external economies. Whilst examining raw correlations is not definitive, the analysis does point towards the advantages firms gain from internal scale and control being more significant than their external linkages associated with their location. This is important to put into perspective the benefits firms gain from being located in a major city. The agglomeration advantages of large South African cities compared with smaller cities and towns appear to be much weaker than the advantages that large firms enjoy over their smaller rivals. There are bound to be multiple reasons for this.

6. The evidence about cities, productivity and jobs

Meagre economic data has been a hindrance to systematic research on the economy of cities in South Africa. There are many gaps in knowledge and understanding that have, in turn, held back policies to build more productive and inclusive cities. The recent release of the SARS tax data after a decade of determined efforts behind the scenes is



a welcome step in the right direction. This paper provides some preliminary insights into the evidence it offers on productivity and jobs by industry and location. It enables some light to be shed on the recent contribution cities have made to the economy and employment, including a comparison with towns and rural areas.

The focus on productivity is justified because of its fundamental role in steering long-term economic success. Productivity does not account for every single dimension of economic performance, but it is so important as to be worth focusing on for strategic insights. The productivity of firms is determined by multiple factors, both internal and external to the firm. There are well-developed theoretical arguments, supported by a substantial body of empirical evidence from around the world, to support the idea that cities contribute to higher productivity in firms. The dense concentration of activity ensures proximity between firms and people, which fosters many different kinds of interaction, as well as sharing of resources and infrastructure.

There is much debate among economists about precisely how cities matter to productivity and growth – the particular mechanisms that contribute most to lower costs and higher returns. An important distinction is made between the general externalities that apply to firms in different sectors (urbanisation economies) and the particular externalities relevant to firms in the same sector (localisation economies). The former favour the largest and most diverse city economies, whereas the latter favour cities with certain specialisations. In some countries city size and industrial diversity seem to be decisive, while in others specialisation seems to be all important.

According to the evidence provided here, there isn't a simple relationship in South Africa between the size of cities and the productivity of firms – bigger is not necessarily better. It seems that there are multiple factors and forces at work that have the effect of obscuring or confounding any neat correlation between city size and productivity. In other words, it is difficult to compare the aggregate productivity of different cities because one is not comparing the same thing. Three specific factors appear to be particularly important in qualifying the relationship between city size and firm productivity.

First, large firms are much more productive than small firms. The difference is very marked and needs to be grasped more fully by decision-makers. When large, multi-locational firms are omitted from the econometric analysis, a much clearer and simpler relationship emerges between city size and productivity. This may be because large firms have the ability to internalise many of the positive externalities available in cities.



This appears to enable some of them to operate successfully in secondary cities, towns and rural areas, where there are fewer local suppliers and service providers, a smaller pool of skills and more restricted availability of shared infrastructure. Large firms can survive in these 'thin' markets because they can provide these facilities in-house. Yet metros remain better incubators for smaller firms and therefore for entrepreneurship and innovation which are critical for long-term economic success. Further research is needed to test the assumptions behind firm size, entrepreneurship and economic growth in South Africa.

Second, the diversity of metro economies muddies the relationship between city size and productivity. Each metro has a different sectoral make-up and distinct industry strengths and specialisations. Some are more efficient and competitive than their rivals in certain industries, but less efficient and competitive in other sectors. This complicates any comparison of their aggregate productivity. Nevertheless, when comparing the metros with other settlement types it becomes apparent that their productivity across all the service industries is almost always above average, but generally below average in the secondary cities, towns and rural areas. This supports previous research which indicates that agglomeration economies are stronger in the service industries than in manufacturing.

Third, the larger metros are bound to suffer more from negative externalities, which detract from their positive externalities and are likely to undermine the productivity of their firms. This is because larger cities tend to attract more inward migration and therefore experience more intense growth pressures, greater congestion, more environmental degradation and greater social discontent. Their municipalities struggle to keep pace with urbanisation in terms of building new infrastructure, maintaining existing infrastructure and providing additional public services and shelter. The unplanned occupation of land and creation of informal settlements on the periphery add to the inefficiency of the urban form and create additional demands for costly new infrastructure on margins of the city.

Three policy implications emerge from this analysis. First, the contribution of large firms to the economy of secondary cities and towns should not be underestimated. Big companies generally attract a bad press and public resentment – for the profits they generate, their powerful position in the marketplace, and sometimes their lack of transformation at senior levels and their questionable business practices. Negative perceptions mean that many municipalities fail to appreciate their impact on



the local economy and do not do all they can to harness their capabilities to enhance their impact further. Instead large firms should be seen as important ‘anchors’ of the local economy and efforts made to cultivate partnerships with them to enhance workforce skills, develop local suppliers and attract talent to the area. By guaranteeing certain standards of service delivery with these ‘key accounts’, municipalities may also be able to negotiate other contributions to the local economy and enhanced support for local enterprise. Oversight and monitoring of these partnerships will be important to learn from experience and ensure that agreements are adhered to.

Second, more effort is needed to understand and respond to the industry specialisations that exist in every city. This requires more research and interaction with key players to grasp the drivers and dynamics of different sectors. Carefully tailored responses are then required, depending on the problems and potential of each industry. In some case it may be necessary to create dedicated industry associations or to strengthen existing organisations that represent the interests of the sector and work closely with local firms. Specific actions and initiatives may follow from this, including interventions to bolster specialised skills, to gather up-to-date intelligence on technology or market trends, or to promote joint projects on product development.

Third, the metros need a more focused and accountable approach to deal with the bottlenecks and barriers to economic growth. Fixing the foundations is fundamental to attracting and retaining productive investment and supporting enterprise. Economic development needs to be seen as a higher priority in metro decision-making. This requires stronger backing from national and provincial authorities. Useful lessons in prioritisation can be learnt from Operation Vulindlela and applied to each metro. This needs to begin with a strategic assessment of where the main obstacles to growth lie. In some cases, this may mean simplifying or streamlining cumbersome regulatory procedures. In other cases, it may be necessary to align certain systems to ensure more coordinated decision-making and a stronger place-based perspective. Elsewhere, policy or operational responsibilities should be devolved to the metros to facilitate more responsiveness and integration with other functions.

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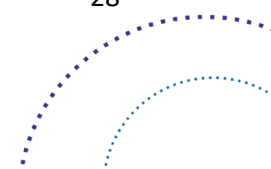
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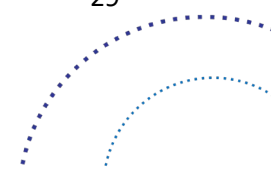
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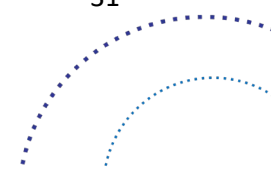
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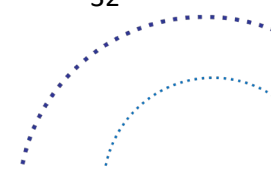
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Appendix A: Total Factor Productivity

Total Factor Productivity is commonly represented by a Cobb-Douglas production function which takes the form:

$$Y = A \times K^\alpha \times L^\beta \dots (1)$$

where Y is total output or revenue; A is TFP, K is capital inputs, L is labour inputs.

In this log-based estimation, α and β are output elasticities of capital and labour, respectively. This means that the elasticities capture the extent to which a '1%' change in an input results in a 'x%' change in output. Therefore, increasing returns to scale would mean that a doubling of inputs (K and L) would lead to a more than doubling of output ($\alpha + \beta > 1$).

In practice, a challenge of the econometric modelling is to ensure that bias is not introduced in the estimates of TFP because of the interdependent relationship between outputs and inputs. There is bound to be simultaneity (i.e. causality can run both ways) in a standard OLS regression because the level of output might influence decisions about inputs (such as where a firm delays capital investments during a recession or where a firm responds to a positive productivity shock by expanding inputs and total production).

A popular approach to dealing with this is the two step-procedure suggested by Olley and Pakes (1996) and Levinsohn and Petrin (2003) which uses investment or intermediate inputs as a control for productivity shocks. We implement the approach by Wooldridge (2009) which is found to be a more efficient than the OP and LP methodologies because the two stages are jointly estimated using a general methods of moments approach. Lags of capital and labour are shown to be potentially valid instruments in the estimation (see Rovigatti and Mollisi (2018) for a technical description of the model).

We are also careful to model the production function for each industry separately because of fundamentally different operating and technological constraints facing firms across different product markets. The large samples available in the SARS data mean that we can take advantage of running our estimations at a granular 2-digit⁹ industry classification level (which includes 73 sub-sectors in total).

In most instances we aggregate firm-level estimates of TFP up to a 1-digit level (or for all sectors combined), to make reporting our results more manageable.

⁹ Based on Statistics South Africa's Standard Industrial Classification of all Economic Activities (SIC) Seventh Edition

We also aggregate firm-level TFP when reporting by a particular geography. Simply adding together establishments ignores the vastly different market share held by firms. Therefore, we weight all of the results by local branch-level employment:

$$Weight = \frac{Empl_{it}}{\sum_{i=1}^n Empl_{it}}$$

where *Empl* is total employment (i.e. branch level), *t* is the tax year and *i* is the establishment.

A final issue of importance is dealing with the limitation that balance sheet information for firms is only available at an enterprise level (i.e. reported nationally rather than in each branch). This means making some assumptions about how productivity is distributed across establishments within each enterprise. We make the assumption that each branch of an enterprise faces an identical productivity function and hence generates an identical TFP. This is an obvious simplification but is not so unrealistic considering that large firms are able to deploy their technology, capital and labour between branches and often adopt a standardised set of operational practices and procedures. Enterprises in different locations might also perform different roles as distinct pieces within an integrated value chain. Recall, that each enterprise is still weighted by their local employment share.

As a robustness check, we run a separate model which only includes single-establishment firms. Whilst this has a large impact on the sample size, and generally excludes larger firms, it allows for a tighter controlled measurement of the potential returns to location.

Table A1: Detailed breakdown of Total Factor Productivity, average score (2013/14 – 2019/20)*

	JHB	EKU	TSH	CPT	ETH	NMA	Secondary Cities	Large Towns	Small Towns	Mostly Rural
All Sectors	15.81	15.41	15.21	16.02	15.52	15.40	15.76	15.78	15.61	15.32
Agriculture	14.93	14.46	14.68	15.09	14.06	15.94	14.48	14.69	14.68	14.82
Mining	18.00	17.76	15.33	16.51	17.30	15.20	20.29	20.08	20.90	19.61
Manufacturing	16.12	16.14	16.17	15.23	15.81	17.03	16.37	15.69	15.69	15.81
Construction	15.65	16.06	14.53	14.47	14.67	14.53	14.60	14.01	14.26	14.28
Retail & wholesale	16.61	15.39	15.39	18.35	16.83	15.32	14.82	14.78	14.95	15.43
Transport & storage	18.29	14.65	17.14	15.00	16.12	14.92	15.21	14.98	14.42	14.99
Accommodation and food	14.67	14.34	14.03	13.87	15.22	13.57	13.54	13.27	13.18	13.64
IC&T	15.83	14.88	15.87	14.59	14.89	15.05	14.70	14.26	15.10	15.67
Finance & Insurance	15.34	13.25	14.82	15.26	14.64	14.26	14.51	13.64	13.36	14.40
Real Estate	13.53	12.45	12.98	12.80	12.82	12.37	12.34	12.08	11.87	11.86
Professional Services	13.85	12.84	13.28	13.43	12.95	12.67	12.67	12.17	12.07	12.00
Admin. Services	15.46	15.00	14.88	14.41	15.06	14.36	14.67	14.47	13.78	14.17
For Profit Educ	12.63	11.91	12.71	12.29	12.98	11.99	12.05	12.13	11.46	11.76
For Profit Health	17.06	16.58	16.49	16.18	16.46	16.50	16.63	16.07	14.12	14.93
For Profit Arts & Entertainment	10.77	9.24	11.10	13.53	9.74	8.50	9.41	8.76	9.19	8.15

Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: *Yellow fill represents above average TFP score; Green border is the top ranked TFP score; BCM and MAN are classified as secondary cities

Table A2: OLS regression: predictors of firm-level productivity

Dependent variable: Log TFP	Sample: All	Sample: Single location firms
Spatial Class (Base: Mostly Rural)		
Gauteng Metro	0.395	0.368
Coastal Metro	0.491	0.422
Secondary City	0.353	0.257
Large Town	0.191	0.039
Small Towns	0.339	0.094
Firm Size (Base: 1-5)		
5-20	0.736	0.804
20-100	1.799	1.891
100-500	2.967	2.993
500+	5.426	5.080
Multi-establishment (Base: No)		
Yes	0.282	n/a
Industry dummies	Yes	Yes
Time dummies	Yes	Yes
Constant	10.905	11.057
Obs	1,762,215	897,495
R-Squared	0.6292	0.6559

Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021

Notes: All coefficients are significant at 99% level of confidence. The exception is 'Large Town' amongst single-location firms with a p-value of 0.15.



Table A3: Productivity function (Wooldridge method)

	SIC7 Division	Cost of Labour		Cost of Capital		Cost of Sales		Obs
		Est.	P-value	Est.	P-value	Est.	P-value	
Agriculture	1. Crop and animal production, hunting and related service activities	0.177	0.000	0.024	0.000	0.013	0.000	55 428
	2. Forestry and logging	0.190	0.000	0.049	0.000	0.012	0.025	2 760
	3. Fishing and aquaculture	0.072	0.000	0.043	0.000	0.020	0.001	3 259
Mining and quarrying	5. Mining of coal and lignite	0.096	0.000	0.067	0.000	0.029	0.000	1 460
	6. Extraction of crude petroleum and natural gas	0.129	0.000	-0.003	0.934	0.012	0.761	218
	7. Mining of metal ores	0.114	0.000	-0.030	0.000	0.006	0.447	3 490
	8. Other mining and quarrying	0.093	0.000	0.053	0.000	0.041	0.000	7 013
	9. Mining support service activities	0.181	0.000	0.005	0.223	0.076	0.000	5 948
Manufacturing	10. Manufacturing of food products	0.088	0.000	0.030	0.000	0.076	0.000	16 898
	11. Manufacturing of beverages	0.122	0.000	0.033	0.000	0.076	0.000	2 971
	12. Manufacturing of tobacco products	0.043	0.000	0.165	0.000	-0.017	0.596	257
	13. Manufacturing of textiles	0.067	0.000	0.022	0.000	0.075	0.000	6 344
	14. Manufacturing of wearing apparel	0.091	0.000	0.032	0.000	0.145	0.000	3 217
	15. Manufacturing of leather and related products	0.099	0.000	0.013	0.023	0.098	0.000	1 784
	16. Manufacturing of wood and of product of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.057	0.000	0.027	0.000	0.118	0.000	9 201
	17. Manufacturing of paper and paper products	0.053	0.000	0.037	0.000	0.070	0.000	3 181
	18. Printing and reproduction of recorded media	0.107	0.000	0.020	0.000	0.054	0.000	12 256
	19. Manufacture of coke and refined petroleum products	0.184	0.000	-0.005	0.444	0.090	0.000	1 962
	20. Manufacture of chemicals and chemical products	-0.010	0.000	0.027	0.000	0.086	0.000	11 151
	21. Manufacture of pharmaceuticals, medicinal chemical and botanical products	0.110	0.000	-0.002	0.633	0.025	0.030	2 883
	22. Manufacture of rubber and plastic products	0.068	0.000	0.023	0.000	0.088	0.000	10 004
	23. Manufacture of other non-metallic mineral products	0.002	0.000	0.003	0.000	0.004	0.000	8 199
	24. Manufacture of basic metals	0.056	0.000	0.013	0.000	0.102	0.000	8 791
	25. Manufacture of fabricated metal products, except machinery and equipment	0.080	0.000	0.018	0.000	0.117	0.000	28 829
	26. Manufacture of computer, electronic and optical products	0.096	0.000	0.023	0.000	0.146	0.000	3 665
	27. Manufacture of electrical equipment	0.070	0.000	0.019	0.000	0.091	0.000	5 041
	28. Manufacture of machinery and equipment n.e.c.	0.100	0.000	0.031	0.000	0.090	0.000	10 863
	29. Manufacture of motor vehicles, trailers and semi-trailers	0.133	0.000	0.021	0.000	-0.010	0.015	6 082
30. Manufacture of other transport equipment	0.117	0.000	0.051	0.000	0.160	0.000	1 709	
31. Manufacture of furniture (for manufacture of furniture of ceramics, concrete and stone, see 2393, 2395, 2396)	0.054	0.000	0.015	0.000	0.125	0.000	3 852	
32. Other manufacturing	0.099	0.000	0.018	0.000	0.122	0.000	7 081	



	33. Repair and installation of machinery and equipment	0.114	0.000	-0.001	0.451	0.064	0.000	16 640
Construction	41. Construction of buildings (for erection of complete prefabricated constructions from self- manufactured parts not of concrete, see divisions 16 and 25)	0.072	0.000	0.027	0.000	0.125	0.000	21 994
	42. Civil engineering	0.002	0.000	0.002	0.000	0.002	0.000	19 191
	43. Specialised construction activities	0.090	0.000	0.025	0.000	0.077	0.000	51 286
Wholesale and retail trade	45. Wholesale and retail trade and repair of motor vehicles and motorcycles	0.074	0.000	0.014	0.000	0.130	0.000	67 362
	46. Wholesale trade, except of motor vehicles and motorcycles (for activities of commission agents for motor vehicles, see 4510)	0.114	0.000	0.009	0.000	0.122	0.000	74 806
	47. Retail trade, except of motor vehicles and motorcycles	0.061	0.000	0.009	0.000	0.119	0.000	127 004
Transportation and storage	49. Land transport and transport via pipelines	0.139	0.000	0.024	0.000	0.023	0.000	27 419
	50. Water transport	0.451	0.000	0.019	0.029	0.088	0.000	1 079
	51. Air transport	0.474	0.000	0.097	0.000	0.018	0.055	2 518
	52. Warehousing and support activities for transportation	0.241	0.000	-0.001	0.712	0.036	0.000	17 411
	53. Postal and courier activities	0.258	0.000	0.030	0.000	0.030	0.000	3 110
Accommodation and food	55. Accommodation	0.178	0.000	0.006	0.038	0.020	0.000	22 664
	56. Food and beverage service activities	0.107	0.000	0.022	0.000	0.105	0.000	34 140
Information and communication	58. Publishing activities	0.205	0.000	0.018	0.000	0.022	0.000	4 416
	59. Motion picture, video and television programme production, sound recording and music publishing activities	0.118	0.000	0.006	0.077	0.074	0.000	6 139
	60. Programming and broadcasting activities	0.204	0.000	0.006	0.550	0.034	0.001	1 440
	61. Telecommunications (for telecommunications resellers, see 6190)	0.217	0.000	0.001	0.659	0.033	0.000	10 840
	62. Computer programming, consultancy and related activities	0.210	0.000	0.005	0.003	0.013	0.000	25 377
Financial and insurance activities	63. Information service activities	0.240	0.000	0.013	0.002	0.014	0.003	4 961
	64. Financial service activities, except insurance and pension funding	0.412	0.000	-0.026	0.000	-0.008	0.020	37 935
	65. Insurance, reinsurance and pension funding, except compulsory social security	-0.088	0.000	-0.042	0.000	0.008	0.251	11 290
	66. Activities auxiliary to financial service and insurance activities	0.500	0.000	-0.028	0.000	0.006	0.148	24 016
Real estate	68. Real estate activities	0.213	0.000	0.019	0.000	0.035	0.000	35 809
Professional, scientific and technical activities	69. Legal and accounting activities	0.279	0.000	-0.001	0.716	0.019	0.000	31 785
	70. Activities of head offices; management consultancy activities	0.253	0.000	0.006	0.070	0.018	0.000	12 987
	71. Architectural and engineering activities; technical testing and analysis	0.229	0.000	0.022	0.000	0.035	0.000	27 863
	72. Scientific research and development	0.286	0.000	0.009	0.542	0.012	0.348	922
	73. Advertising and market research	0.209	0.000	-0.003	0.157	0.033	0.000	10 275



Administrative	74. Other professional, scientific and technical activities	0.158	0.000	0.028	0.000	0.046	0.000	12 074
	75. Veterinary activities	0.162	0.000	0.029	0.000	0.057	0.000	2 568
	77. Rental and leasing activities	0.239	0.000	0.039	0.000	0.056	0.000	9 154
	78. Employment activities	0.183	0.000	0.014	0.000	0.104	0.000	15 134
	79. Travel agency, tour operator, reservation service and related activities	0.255	0.000	0.030	0.000	0.038	0.000	7 677
	80. Security and investigation activities	0.139	0.000	0.027	0.000	0.032	0.000	13 609
	81. Services to buildings and landscape activities	0.115	0.000	0.019	0.000	0.060	0.000	9 971
	82. Office administrative, office support and other business support activities	0.236	0.000	0.018	0.000	0.028	0.000	21 299
Education and health	85. Education	0.261	0.000	0.027	0.000	0.030	0.000	20 438
	86. Human health activities	0.185	0.000	-0.005	0.020	0.000	0.953	35 439
Arts, entertainment and recreation	90. Creative, arts and entertainment activities	0.127	0.000	0.037	0.000	0.040	0.000	3 847
	91. Libraries, archives, museums and other cultural activities	0.194	0.000	0.030	0.178	0.087	0.000	496
	92. Gambling and betting activities	0.672	0.000	0.019	0.000	0.035	0.000	2 784
	93. Sports activities and amusement and recreation activities	0.227	0.000	0.015	0.002	-0.002	0.777	5 853

Source: Nell, A. and Visagie, J. 2022. Spatial Tax Panel 2014-2021



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