SOUTH AFRICA'S GLOBAL GATEWAY

PROFILING THE GAUTENG CITY-REGION'S INTERNATIONAL COMPETITIVENESS AND CONNECTIONS

GLOBAL CITIES INITIATIVE
A Joint Project of Brookings and JPMorgan Chase

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SUMMARY

The Gauteng City-Region, centered on Johannesburg, reflects the challenges and opportunities of South Africa's extraordinary economic, demographic, social, and political transformation. Just 20 years removed from the transition to a multiracial democracy, the city-region's economic assets rival other major international cities—a stable of global companies, leading universities, a young and increasingly educated workforce, well-connected infrastructure, and democratic governance. Yet as in many other emerging market cities, too many residents still lack the skills, networks, and access to benefit from, and contribute to, the Gauteng City-Region's economy. Significant levels of unemployment, income inequality, and social exclusion are hindering progress toward full equality of opportunity and the city-region's long-term economic competitiveness. This report, developed as part of the Global Cities Initiative, a joint project of Brookings and JPMorgan Chase, provides a framework for the Gauteng City-Region to examine its competitive position in the global economy, offering information and insights to inform regional leaders working to sustain the region's prosperity. Its key findings are:

Much economic progress has been made in the Gauteng City-Region since 2000, but signs of a competitiveness challenge linger. The Gauteng City-Region—with 12.9 million people and including the metropolitan municipalities of Johannesburg, Tshwane (East Rand), and Ekurhuleni (Pretoria)—accounts for just under one-quarter of South Africa's population and generates 35 percent of national economic output. Production of goods and services in the Gauteng City-Region has expanded consistently over the past 15 years. Average standards of living and labor productivity are much higher today than they were in 2000. Compared to seven other major global cities on these measures, the Gauteng City-Region places behind some major metro economies but ahead of others. But signs of a competitiveness challenge linger: comparatively low job creation during this period, slowing productivity growth since 2010, and continued high levels of income inequality. In a composite economic performance index, the Gauteng City-Region placed fifth among peers.[1]

The Gauteng City-Region can take advantage of changing market, technology, and demographic trends, but it must focus on the core drivers and enablers of competitiveness. A competitive region is one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households. Globally competitive traded sectors, innovation ecosystems, and skilled labor are the key drivers of overall productivity, employment creation, and income growth. These drivers are supported by enablers: well-connected, spatially efficient infrastructure and a reliable

governance structure and business environment. The Gauteng City-Region contains notable strengths and significant opportunities to better deploy these five factors to increase its global competitiveness.

TRADE: The Gauteng City-Region is a major hub for global trade and investment, but its tradable economy is undergoing an industrial transformation. Trade and investment is becoming a more important component of economic growth for the Gauteng City-Region. Goods trade and national trade in services have grown much more quickly than the economy as a whole. Mining products continue to be the city-region's fastest-growing export, riding a decade of Chinese demand. The city-region also maintains export specializations in manufacturing, especially machinery and transportation equipment products destined for the rest of Africa. Yet, these traded sectors have not generated employment growth over the past 15 years, which has been concentrated in services, especially business and financial services and communications, reflecting the city-region's position as Africa's de facto business and technology capital. Further confirming its hub status, the Gauteng City-Region ranks highly among its peers in foreign direct investment flows, especially in technology-intensive sectors. Leveraging its position as a major business center by boosting services exports can be a significant growth driver going forward. In a composite trade index, the city-region placed seventh among peers.

INNOVATION: Anchored by leading universities, the Gauteng City-Region has many of the elements of a thriving innovation ecosystem, which can be bolstered by greater commercialization and entrepreneurship. The city-region's two most highly-ranked research universities are significant hubs of knowledge creation and do a good job of collaborating with industry on joint research. Rates of new commercial inventions in the Gauteng City-Region fall in the middle of global peers, but patenting activity has declined recently. Entrepreneurship—an important innovation driver since new firms must offer the market some new product or process to thrive—is much higher in the region than in South Africa as a whole, but falls in the middle of global peer countries. Venture capital investment, one measure of the presence of high-growth entrepreneurs, is still quite low comparatively. In a composite innovation index, the city-region placed third among peers.

TALENT: The skill levels of the region's workforce have been increasing over time, but high and lasting unemployment remains a major challenge. The Gauteng City-Region's demographic dividend and steady flows of in-migrants ensure a growing supply of workers for the regional economy. Yet, currently workers are not being absorbed into the labor market at a sufficient scale and pace. Unemployment currently stands at 26.8 percent, highest among its global peer cities by a significant margin, and reflecting both demand-side and supply-side issues. Raising the long-term growth potential of the economy by improving industrial competitiveness would help address demand-side challenges. On the supply side, after decades of progress, the Gauteng City-Region's workforce is more educated than the rest of South Africa and falls in the middle of its peer cities in terms of higher education completion. While closing over time, substantial education disparities between racial groups remain, underlying the skills mismatches between the workforce and the competencies demanded by new jobs. In a composite talent index, the city-region placed fourth among peers.

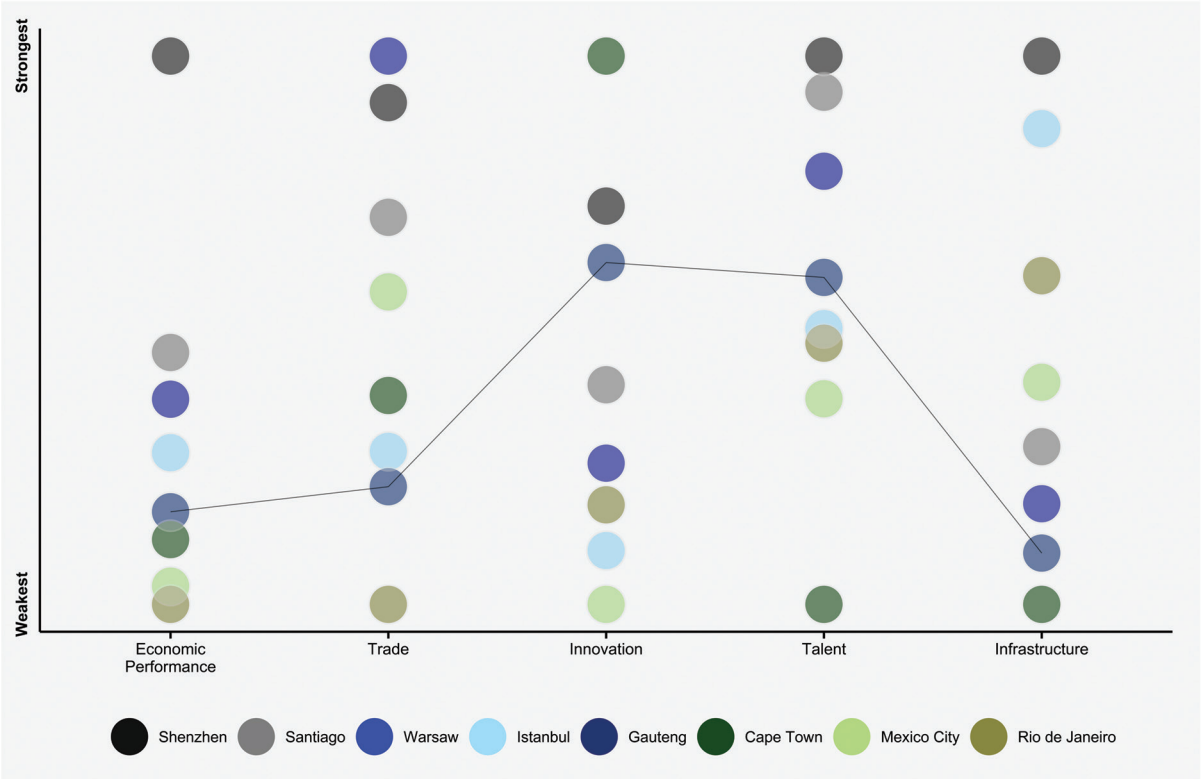
INFRASTRUCTURE: Firms and workers benefit from the Gauteng City-Region's status as Africa's most well-connected aviation hub, but the city-region's digital connectivity lags global peer cities. South Africa's freight and logistics systems rank in the middle of their peer group, but exporting costs remain relatively high for firms. The O.R. Tambo International Airport has positioned the city-region as an important international aviation node, offering a comparative advantage for businesses that demand global access. Local infrastructure can continually be upgraded. Broadband speeds have improved over time, but are not yet on-par with most global peer cities and remain varied across communities. Continuing local and provincial-led efforts to align transportation, new housing development, and land use policy to increase density along key corridors

and nodes can help improve spatial efficiency. In a composite infrastructure index, the city-region placed seventh among peers.

GOVERNANCE: The public sector has embraced government coordination at the city-region scale, a process that could be strengthened by further collaboration with the private and civil sectors. Two decades after adopting multiracial democracy, governance in South Africa continues to be a work in progress, and the Gauteng City-Region reflects this reality. The public sector's commitment to improved service delivery and a more streamlined business environment have placed the city-region on-par with global peers on various governance metrics. Public perceptions about corruption remain a challenge, however. Building on relatively high fiscal autonomy, local governments have embraced coordination at a regional scale that reflects the true economic geography of Gauteng. This vision is an important step to further positioning the city-region's economy globally, a process that could be strengthened by more input from private, civic, and educational groups.

The Gauteng City-Region has considerable competitive strengths. Building on strategies already underway at the municipal and provincial levels, the city-region can bolster this position by leveraging its distinct niche in services to cement its status as the trade and investment gateway to Africa, expanding technology commercialization, boosting employability through enhanced connections between the worlds of school and work, and organizing public, private, and civic leaders around a shared vision for growth and competitiveness. By taking purposeful action now, the Gauteng City-Region's public, private, and civic institutions can build a globally competitive economy that works for all.

Summary of the Gauteng City Region's performance and competitiveness factors



I. INTRODUCTION

Cities around the world must adapt to a set of global forces that are redefining what it takes to excel in today's global economy.

First, globalization is intensifying. Revolutions in information technology and transportation, the rapid rise of emerging markets, the globalization of finance, and the advent of global value chains has intensified international exchange. Global flows of goods, services, and capital have expanded rapidly over the last two decades, increasing from $5 trillion in 1990 to $26 trillion in 2012.[2]

Second, technology is altering how we communicate, how firms create products and services and deliver them across the globe, and the very nature of work itself.[3] The McKinsey Global Institute predicts that 12 emerging technologies will generate an annual economic impact of $33 trillion by 2025.[4] Risks accompany these breakthroughs; for instance, new technologies are placing 47 percent of U.S. occupations at risk of being automated by 2033.[5]

Third, urbanization and the world's continued shift from rural areas to cities is changing the geography of growth and economic activity in emerging markets, especially in Asia and Africa. The share of global population in metropolitan areas has grown from 29 percent in 1950 to half in 2009, and is predicted to reach 60 percent by 2030.[6]

Cities are on the frontlines of all of these shifts, creating both challenges and opportunities. As more emerging markets have come online—connected by technology and trade—the places where firms and workers can locate their activities have expanded, generating new pressures on individual cities to provide a distinct value proposition to the market. This basic premise is not necessarily new; for thousands of years firms have sought out supportive environments that provide them the inputs required to sell their

products and services outside of their own borders, using external demand as a route to expanded local wealth and prosperity.[7] But the competition for firms and workers has increased considerably due to the sheer number and size of cities in the network. Of course, these same dynamics have created abundant market opportunities for cities as well. For those places that can offer competitive environments that allow firms and people to successfully plug-in to the global economy, the returns are high.[8]

Political, business, and civic leaders across the world have thus become increasingly focused on understanding and enhancing their city-regions' economic competitiveness and connections. To help inform their efforts, the Global Cities Initiative—a joint project of Brookings and JPMorgan Chase—will explore the competitiveness of six global city-regions through a two-year series of *Global City Profiles*, starting with Stockholm, the Gauteng City-Region of South Africa, and Santiago. This research draws on the Harvard Business School definition of a competitive region as one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households.[9]

It acknowledges that firms ultimately compete in the global marketplace, but that the public sector can support a healthy and vibrant private sector through investments in skills, innovation, and infrastructure. It also acknowledges that corporate success alone is unsustainable if it is not accompanied by flourishing workers and families, and that connecting residents to education, training, basic infrastructure, finance, and human services is also critical.[10] Competitive regions are, by this definition, supportive environments for both companies and people.

This profile draws upon a unique dataset of globally comparable performance indicators to offer new insights about the economic competitiveness of the Gauteng City-Region (see sidebars). It uses international benchmarking to explore the overall economic performance of the region; its comparative strengths and weaknesses on five key competitiveness factors; and concludes with implications from this assessment, and key topics for the city-region's network of government, business, civic, and community leaders to consider as it positions the Gauteng City-Region on the global stage in the coming years.

Table 1. Key indicators for the Gauteng City-Region and global peer metro areas

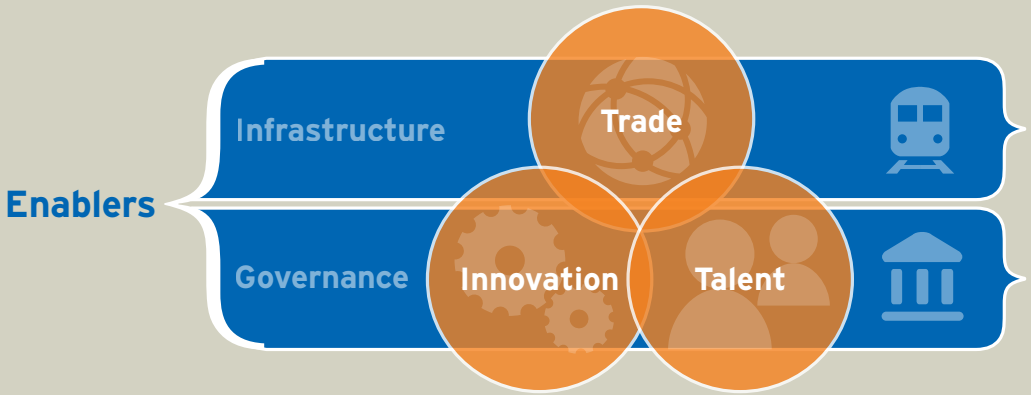
Rank	Population	Nominal GDP	Employment	GDP per capita	GDP per worker
1	Mexico City	Mexico City	Mexico City	Warsaw	Warsaw
2	Istanbul	Istanbul	Shenzhen	Shenzhen	Istanbul
3	**Gauteng City-Region**	Shenzhen	Rio de Janeiro	Istanbul	Santiago
4	Rio de Janeiro	Rio de Janeiro	Istanbul	Santiago	Shenzhen
5	Shenzhen	**Gauteng City-Region**	**Gauteng City-Region**	Mexico City	Mexico City
6	Santiago	Santiago	Santiago	Rio de Janeiro	Rio de Janeiro
7	Cape Town	Warsaw	Warsaw	**Gauteng City-Region**	**Gauteng City-Region**
8	Warsaw	Cape Town	Cape Town	Cape Town	Cape Town

Source: Brookings analysis of Oxford Economics data.

Defining and measuring competitiveness through international benchmarking

Countless definitions of competitiveness exist. This research draws on the Harvard Business School definition of a competitive market as one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households.[11] Competitive regions are, by this definition, supportive environments for both companies and people. Building on an extensive literature review on regional economic development by researchers at George Washington University, this research analyzes competitiveness through a five-factor framework—trade, innovation, talent, infrastructure, and governance.[12] Globally competitive traded sectors, innovation ecosystems, and skilled labor are the key drivers of overall productivity, employment creation, and income growth, outcomes that all metro areas care about. These drivers are supported by enablers: well-connected, spatially efficient infrastructure and reliable governance, public services, and business environment.[13] Focusing on these fundamentals positions metropolitan economies to compete based on the distinct long-term value their industries and people can provide, and avoids economic strategies that attract firms through "race-to-the-bottom" techniques that compete via one-time tax breaks or low wages.

A framework for regional competitiveness

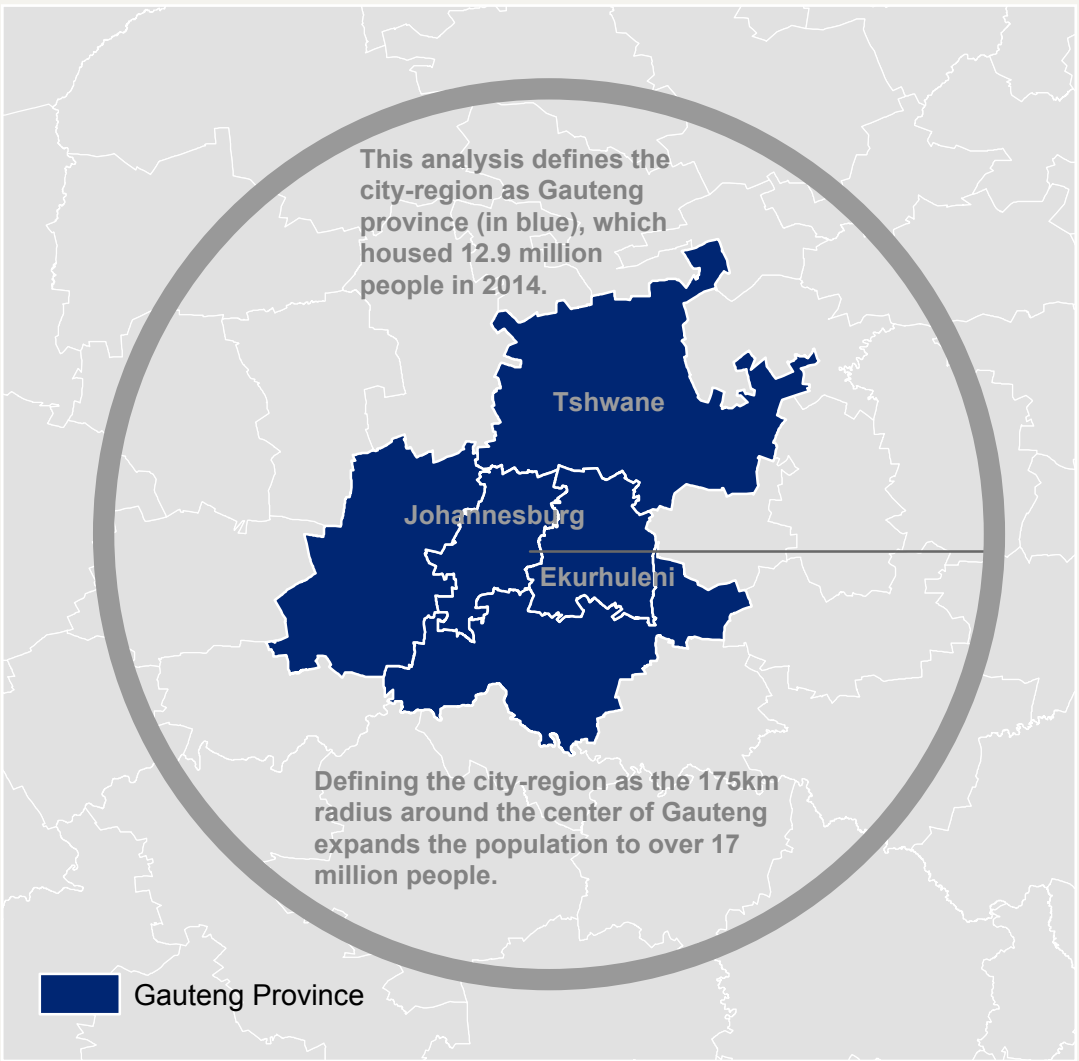


Source: Brookings Institution, RW Ventures, and McKinsey and Company.

This report utilizes a group of carefully selected metropolitan peers to understand competitiveness beyond a national context. The Gauteng City-Region's peer cities were selected through a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering using 22 variables that measure economic size, wealth, productivity, industrial structure, and competitiveness.[14] Seven emerging market cities were selected because they most closely resemble the economic profile of the Gauteng City-Region based on this analysis. Table 1 compares the city-region to its peer metro areas on five of these variables. Similar to the city-region, these metro areas are large in terms of output and population, remain in the middle-income development stage, and tend to be important hubs of business and exchange in their respective countries and regions. Whenever possible, the analysis employs comparable metrics of economic performance and the five competitiveness factors to unveil areas of comparative strength and weakness.[15]

Defining the Gauteng City-Region

The Gauteng City-Region Observatory (GCRO) defines the Gauteng City-Region as the "integrated cluster of cities, towns and urban nodes that together make up the economic heartland of South Africa."[16] The core of the city-region is Gauteng province, but the city-region's footprint extends beyond the formal provincial boundaries. GCRO estimates that the population in the full interconnected conurbation to be 17 million. This area is defined as the geography within a 175 km radius of the center of Gauteng province, including places such as Rustenburg, Emalahleni, Potchefstroom, Sasolburg, and Secunda.[17] Due to data limitations, however, we use provincial-level data to examine trends in the Gauteng City-Region throughout this report. Additionally, Gauteng province contains three metropolitan municipalities—Johannesburg, Tshwane, and Ekurhuleni—and two district municipalities Sedibeng and West Rand. When data availability allows for it, we also provide data for the three metropolitan municipalities.

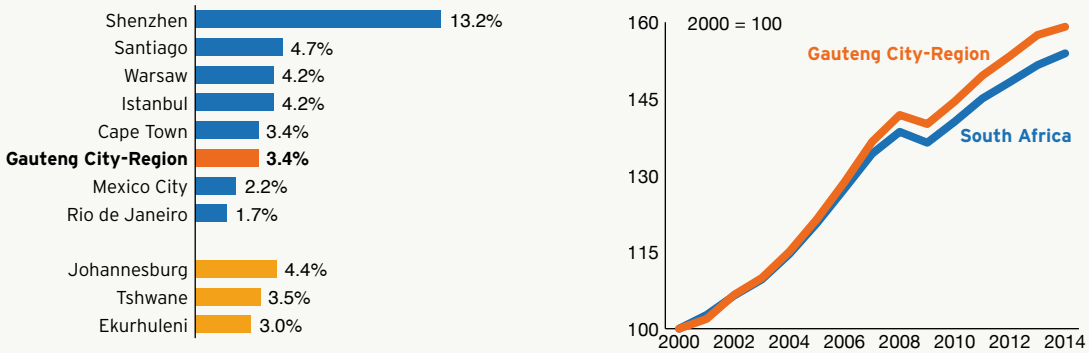


II. THE STATE OF THE GAUTENG CITY-REGION'S ECONOMY

The Gauteng City-Region is the economic engine of South Africa. Anchored by the three metropolitan municipalities of Johannesburg, Ekurhuleni (East Rand), and Tshwane (Pretoria), the city-region housed 12.9 million people and accounted for approximately 24 percent of national population and 35 percent of the South African economy in 2014.[18]

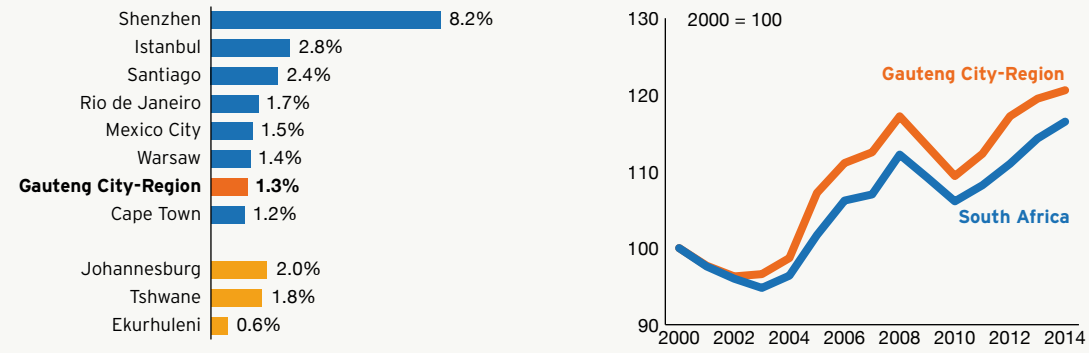
The Gauteng City-Region's economy has grown significantly since 2000 in terms of output, but employment growth has lagged global peer regions. The rate of change in the size of the regional economy can indicate the pace of its progress toward expanding economic opportunity. By these metrics, the Gauteng City-Region is clearly growing. GDP growth averaged a solid 3.4 percent between 2000

Figures 1a and 1b. Real output growth, CAGR and index, 2000-2014



Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

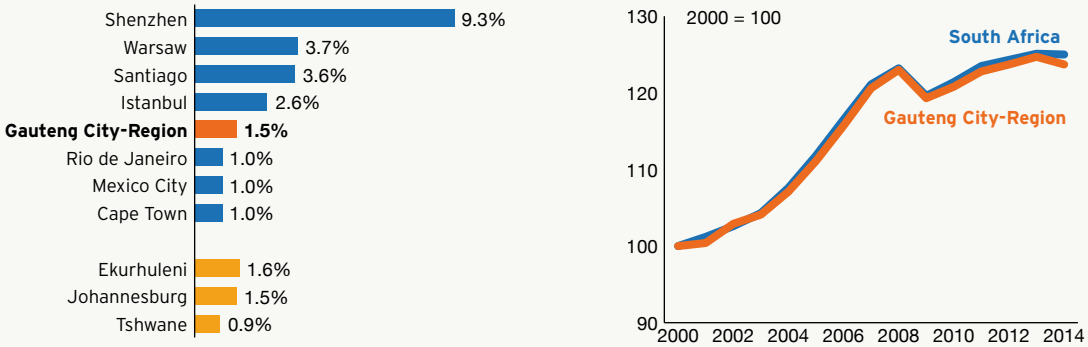
Figures 2a and 2b. Employment growth, CAGR and index, 2000-2014



Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

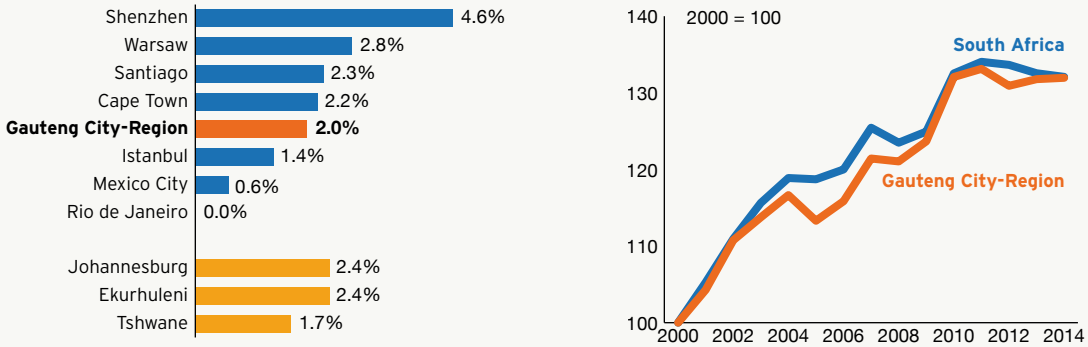
and 2014, on par with Cape Town and slower than four other global peer regions. The Johannesburg Metropolitan Municipality's economy grew faster than every regional peer except Shenzhen and Santiago. Employment growth has been more sluggish, averaging 1.3 percent per year since 2000, partly due to major job losses in the aftermath of the global recession.[19] Job growth has picked back up in recent years and the city-region has returned to pre-recession employment levels. Both employment and output growth have outpaced national averages since the mid-2000s.

Figures 3a and 3b. Real GDP per capita growth, CAGR and index, 2000-2014



Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

Figure 4a and 4b. Growth of output per worker, CAGR and index, 2000-2014



Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

GDP per capita and productivity are higher today than in 2000, but growth in both metrics has slowed during the first half of this decade. To create lasting prosperity, economic growth must keep pace with population and labor force growth so that individuals can continue to see their standard of living rise. Annual GDP per capita growth, a common metric of standard of living, in the Gauteng City-Region has averaged 1.5 percent since 2000, similar to national trends and fifth among its peer regions.[20] After steady gains leading up to the global recession, however, GDP per capita growth has slowed since 2009, as GDP growth has not kept pace with rapid population growth. GDP per capita growth is in turn related to productivity, or the ability of firms and workers to transform the factors of production into more

valuable products and services. Productivity—measured by GDP per worker—grew rapidly until 2010 (2.9 percent compound annual growth rate), but its growth has since slowed. Enhancing productivity provides a key long-term route to improving competitiveness and living standards. Both GDP per capita and productivity growth resemble national trends.

Income inequality continues to inhibit broadly shared growth. High inequality can reduce the durability of economic growth if it undermines health and education access, limits productivity-enhancing investments, and diminishes social cohesion.[22] While many of the global economic trends that contribute to income inequality are beyond the control of any individual city, understanding how income gains are distributed within a regional economy can reveal who among the population is benefitting from local growth. One common way to measure income inequality is the Gini coefficient, which defines inequality on a scale from zero (perfect equality) to one (perfect inequality). The city-region registered a Gini of 0.74 in 2011, down from 0.76 in 2001.[23] While lessening over time, income inequality in the Gauteng City-Region exceeds that of South Africa (Gini of 0.65) and almost every major metropolitan region in the world.[24]

➤ **BOTTOM LINE:** Much economic progress has been made since 2000. Production of goods and services in the Gauteng City-Region has expanded consistently over the past 15 years. Average standards of living and labor productivity are higher today than they were in 2000. When compared to other major global cities, changes in these metrics place the Gauteng City-Region behind some major metro economies but ahead of several others. But signs of a competitiveness challenge linger: comparatively low job creation during this period, slowing productivity growth since 2010, and continued high levels of income inequality. The Gauteng City-Region remains South Africa's largest and most globally significant metropolitan economy—and many of these trends reflect that status. To solidify this international position in the coming decades, however, the city-region's leadership must focus on the core drivers and enablers of competitiveness and prosperity.

"Job growth has picked back up in recent years and the city-region has returned to pre-recession employment levels. Both employment and output growth have outpaced national averages since the mid-2000s."

III. COMPETITIVENESS DRIVERS AND ENABLERS

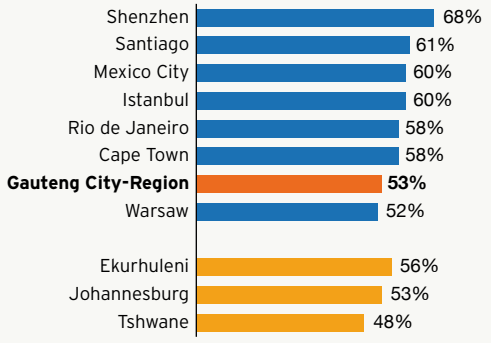
A. TRADE

WHY IT MATTERS: Trade is a critical driver of prosperity and competitiveness. Firms selling internationally inject new wealth from abroad that, when spent locally, creates a "multiplier effect" in the regional economy, spurring new jobs, growth, and further tax revenue to be reinvested locally. Participating in global trade also makes metro areas more competitive and productive. Firms that generate revenue from outside their home market must provide goods and services faster, better, and cheaper than global competitors. Local companies that embed themselves in global value chains gain access to high-quality inputs, lower overall costs, and as a result become more globally competitive. This process tends to boost productivity, wages, and export prowess.[26] Therefore, the traded economy—as measured by the health of traded sectors, trade in goods, services, and foreign direct investment—is both an important signpost and a critical driver of competitiveness.

A1. TRADED SECTOR STRUCTURE AND GROWTH

The Gauteng City-Region's traded sector accounted for 43 percent of employment and 53 percent of economic output in 2014.[27] For all the reasons mentioned above, the health of the traded sector—those

Figure 5. Share of traded sector in total output, 2014



Source: Brookings analysis of Oxford Economics data.

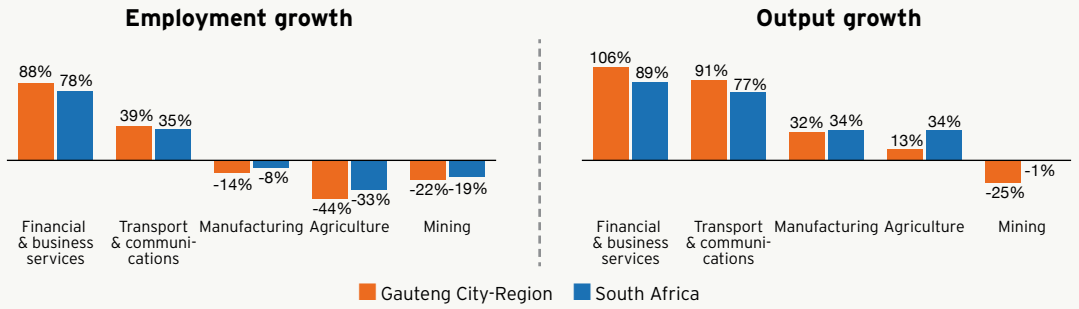
Table 2. Gauteng City-Region's industrial structure, 2014

Sector	Share of jobs	Share of output
Tradable	43%	53%
Financial & business services	20%	24%
Manufacturing	13%	17%
Transport & communications	8%	9%
Agriculture, forestry & fishing	1%	0%
Mining	1%	3%
Non-Tradable	57%	47%
Public services	21%	23%
Wholesale & retail trade and hotels & catering	21%	13%
Other services	7%	4%
Construction	7%	5%
Utilities	1%	2%

Source: Brookings analysis of Oxford Economics data.

industries that sell their goods and services beyond the local economy—is an important indicator of overall competitiveness.[28] The share of regional output generated by tradable industries in the Gauteng City-Region is lower than all regional peers except for Warsaw. Within the city-region's traded sector, financial and business services generated the largest shares of both employment and output, followed by manufacturing, transport and communications, and then agriculture and mining. Public services—including education and health—accounted for the largest portion of the city-region's non-tradable employment and output, followed by wholesale, retail, and accommodation services.

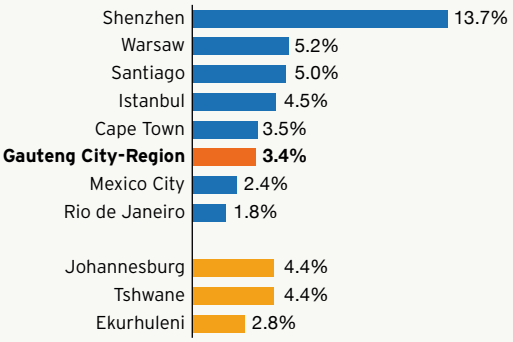
Figure 6. Employment and output growth in traded sectors, 2000-2014



Source: Brookings analysis of Oxford Economics data.

The Gauteng City-Region's traded sector has undergone a shift toward advanced services since 2000. Overall, the Gauteng City-Region's traded sector has grown 3.4 percent per year since 2000, a healthy expansion but lower than most of its global peer regions. One simple way to gauge the health of individual traded sectors is to examine the change in jobs and output within each of them. Doing so reveals a significant industrial transition in the Gauteng City-Region over the past fifteen years. Financial and business services and transport and communications grew quite quickly; both sectors outperformed national growth trends between 2000 and 2014 indicating an expanded market share for the city-region. Within manufacturing—where labor-saving automation has expanded productivity—employment declined by 14 percent during this period yet output expanded by 32 percent. Changes in the city-region's manufacturing sector mirror national shifts. Particularly striking is the significant decline in both employment and output within mining, which have shrunk more quickly within the city-region than in South Africa as a whole.

Figure 7. Output growth in traded sectors, CAGR, 2000-2014

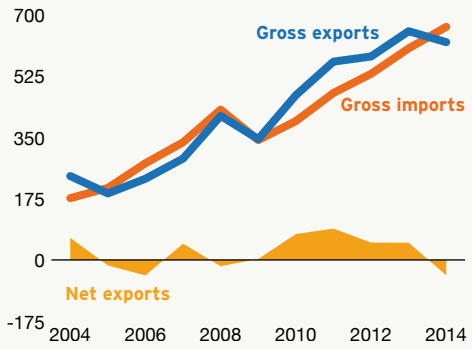


Source: Brookings analysis of Oxford Economics data.

A2. EXPORTS AND IMPORTS

The Gauteng City-Region accounted for 63 percent of total South African goods trade in 2014, up from 20 percent in 2004. This high share of national trade partly reflects the importance of the prominence of the city-region's economy, but also reflects how import and export statistics from the South African Revenue Service (SARS) are assigned to the postal code of the trading firm's reporting office, not necessarily the site of production. As South Africa has become more globally integrated over the past decade, the city-region's goods trade with the rest of the world has grown much faster than its economy as a whole. Between 2004 and 2014, nominal growth in two-way goods trade averaged 12 percent annually, compared to nominal GDP growth of 5.5 percent. In 2004, the Gauteng City-Region enjoyed a goods trade surplus of R63.2 billion ($4.6 billion), but since then imports have grown 40 percent faster than exports (14 percent vs. 10 percent, annually). By 2014, the province's trade surplus had shifted to a R44.5 billion deficit.[29] Notwithstanding the robust global demand for exports, the rapid expansion of domestic investment and consumption activity contributed to trade deficits between 2005 and 2008.[30] Subsequently, slowing domestic investment coupled with global economic recovery and elevated commodity prices produced a trade surplus in Gauteng after 2009.[31] Yet by 2014, a trade deficit reappeared as commodity prices weighed down exports, while imports continued to expand. Such goods trade deficits are common in major metropolitan areas, which import consumables and raw goods to fuel their large populations and tend to focus on exporting higher value-added services.[32]

Figure 8. Merchandise trade of Gauteng City-Region, Rand billion

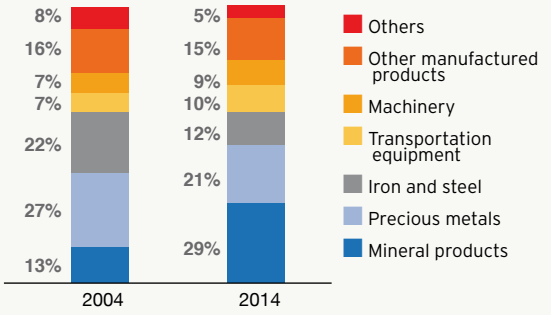


Source: Brookings analysis of Quantec data.

"Firms selling internationally inject new wealth from abroad that, when spent locally, creates a 'multiplier effect' in the regional economy, spurring new jobs, growth, and further tax revenue to be reinvested locally."

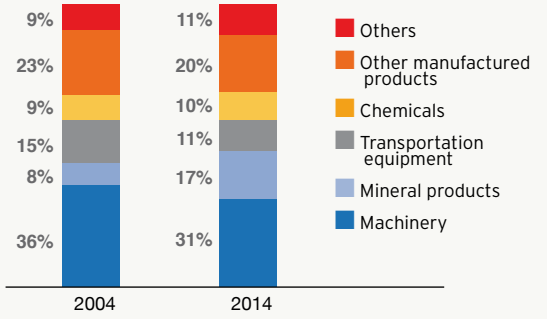
The Gauteng City-Region's merchandise export advantages lie in a core set of industries while imports to the province are dominated by manufactured goods. The city-region exported R622 billion (roughly $54 billion) in goods in 2014. Five local industries—mining products, precious metals, iron and steel products, transportation equipment, and machinery—accounted for 81 percent of exports in 2014 and 90 percent of export growth since 2004.[33] Exports of mineral products alone accounted for 62 percent of total export growth during the past 10 years, even as total output and employment in mining declined, a contradiction that may be partly explained by how trade data is tabulated at the sub-national level in South Africa.[34] Manufactured products dominate the city-region's import basket, reflecting the rising demand for goods among local firms and consumers. In 2014, the top import industries are machinery (31 percent), mineral products (17 percent), transportation equipment (11 percent), and chemicals (10 percent).

Figure 9. Share of gross exports by products in Gauteng City-Region



Source: Brookings analysis of Quantec data.

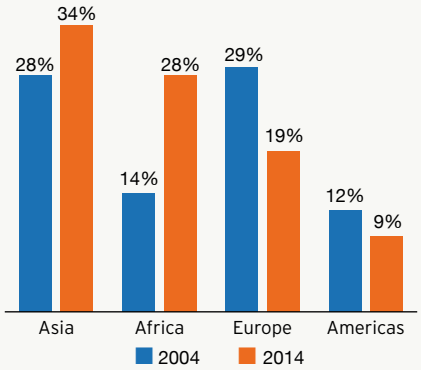
Figure 10. Share of gross imports by products in Gauteng City-Region



Source: Brookings analysis of Quantec data.

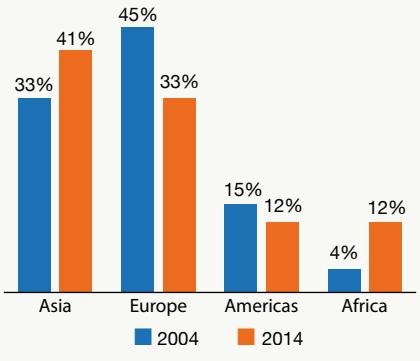
Key trading partners have changed over the past decade. Due mainly to greater economic ties with China, Asia surpassed Europe in 2007 as the largest destination for the Gauteng City-Region's exports. In 2014, 34 percent of total Gauteng exports went to Asia, followed by Africa (28 percent), Europe (19 percent), and the Americas (9 percent). Raw commodities dominate the export basket to Asia and Europe, while the rest of Africa represents Gauteng's most significant export market for more sophisticated manufactured products such as machinery, chemicals, and motor vehicles and parts. Imports are dominated by Asia (41 percent of total), which specializes in machinery and electronics for the local market. Similarly Europe (33 percent), led by Germany, supplies machinery, transportation equipment, and chemicals while the Americas (12 percent) and Africa (12 percent) specialize in machinery and mineral products, respectively.

Figure 11. Share of Gauteng City-Region exports by world regions, 2004 and 2014



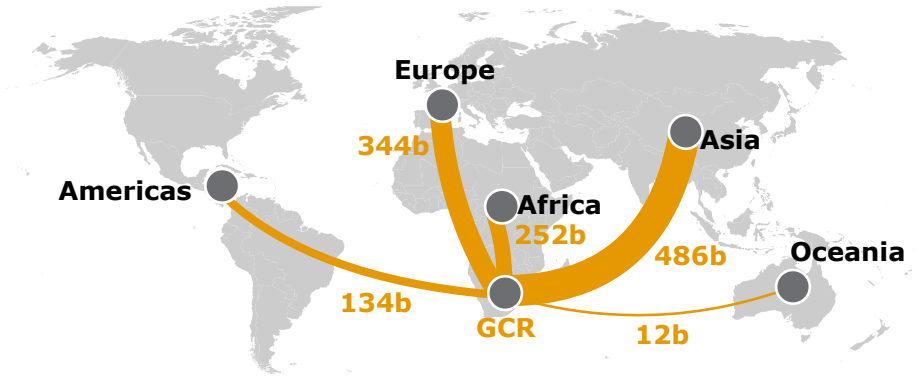
Source: Brookings analysis of Quantec data.

Figure 12. Share of Gauteng City-Region imports by world regions, 2004 and 2014



Source: Brookings analysis of Quantec data.

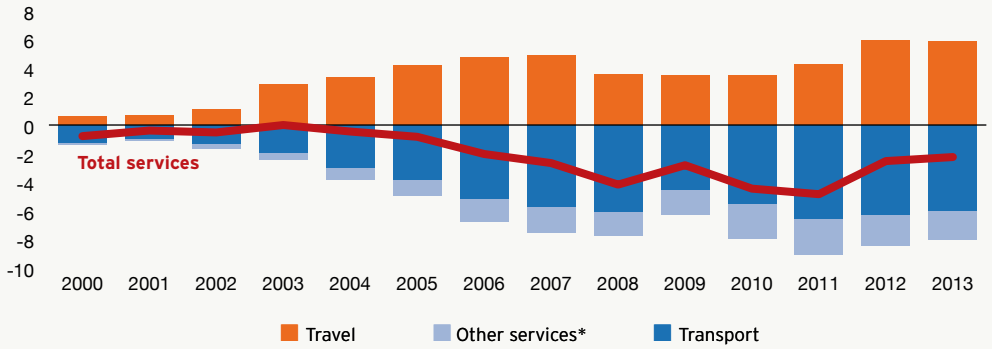
Map 1. Total goods trade by world region, Rand, 2014



Source: Brookings analysis of Quantec data.

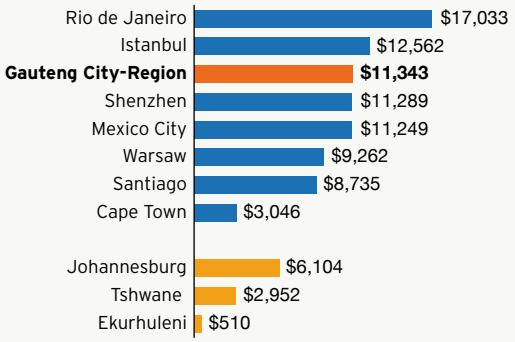
Expanding services exports, which are still relatively limited nationally, can be an important growth driver for the Gauteng City-Region. In the absence of provincial-level data, country-level trade statistics can be useful to understand the city-region's role in the global exchange of services, especially given its position as South Africa's most prominent services hub (the city-region accounts for 39 percent of national value added in tradable services). In 2013, South Africa exported $14.2 billion and imported $16.4 billion in services, a deficit of $2.2 billion overall. Since 2001, services exports and imports have grown 9.4 and 10.0 percent per year, respectively, slower than the growth in provincial-level goods trade. National service exports are dominated by tourism (65 percent), followed by other business services (7 percent) and financial services (6 percent). Transportation is the largest imported service (47 percent), followed by tourism (21 percent) and royalties (12 percent), the latter indicating that South Africa imports much more intellectual property than it exports. As shown earlier, services such as finance, business services, and telecommunications are significant sources of employment and output growth, yet those gains do not appear to be translating to the export statistics. Yet this could change. The McKinsey Global Institute recently estimated that expanding South Africa's service exports could generate up to 460,000 jobs by 2030, a significant share of which would be created in the Gauteng City-Region.[35]

Figure 13. Net services exports in South Africa, USD billion at current prices



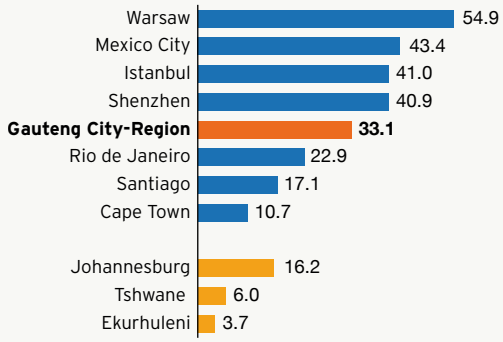
**Includes exports and imports for professional services, computer and information services, and royalties and fees.*
Source: Brookings analysis of Statistics SA data.

Figure 14. Total greenfield FDI, 2009-2015, USD million



Source: Brookings analysis of fDi Intelligence data.

Figure 15. New employment supported by greenfield FDI, thousand of persons, 2009-2015



Source: Brookings analysis of fDi Intelligence data.

A3. FOREIGN DIRECT INVESTMENT

The Gauteng City-Region remains the top destination for new, or "greenfield," foreign direct investment (FDI) in Sub-Saharan Africa, and one of the top recipients among peer cities. Greenfield investments—the process by which companies open a new establishment in a foreign market—help reveal the extent to which multinational firms find the Gauteng City-Region an attractive operational environment vis-à-vis other global regions. Greenfield FDI flows into the Gauteng City-Region have totaled $11.3 billion since 2009, trailing only Rio de Janeiro and Istanbul in terms of FDI attraction. According to fDi Intelligence, these investments brought over 33,000 new jobs to the city-region during this period, which represented one-quarter of net new employment created since 2009.

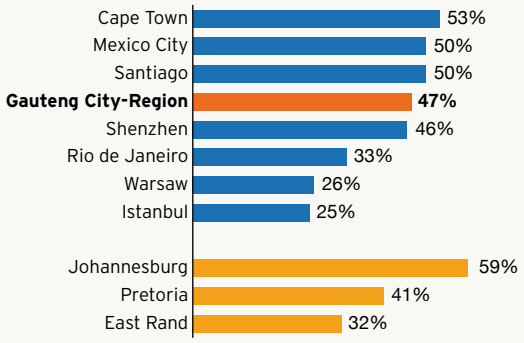
"Companies investing in the Gauteng City-Region since 2009 tend to be headquartered in large advanced economies, led by the United States ($2.3 billion), Germany ($2.2 billion), the United Kingdom ($1.7 billion), Australia ($1.1 billion), and Japan ($712 million). Emerging markets such as India ($517 million) and China ($177 million) are significant, but not yet dominant sources of new foreign direct investment in the city-region."

Table 3. Greenfield FDI by industry, 2009-2015

Industry	Total FDI (USD million)
Coal, Oil and Natural Gas	1,751
Communications*	1,701
Metals	1,285
Software & IT services*	1,124
Automotive OEM*	775
Business services*	555
Alternative/renewable energy*	530
Financial services	492
Warehousing & storage	432
Pharmaceuticals*	406

Source: Brookings analysis of fDi Intelligence data.
**Advanced industries*

Figure 16. Share of total FDI in tech-intensive sectors, 2009-2015

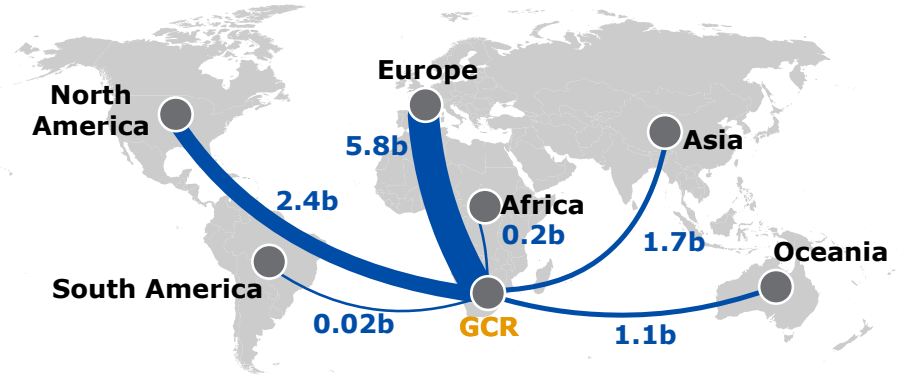


Source: Brookings analysis of fDi Intelligence data.

About one-third of the Gauteng City-Region's foreign direct investment is concentrated in high value-added industries such as communications, software and IT, and automotive. Since 2009 almost half of new investments into the city-region have been concentrated in advanced industries, a segment of the economy that demands significant levels of research and development and science, technology, engineering, and math (STEM) workers.[36] Anchored by the Johannesburg Metropolitan Municipality, which received two-thirds of the city-region's advanced industrial investment, the city-region has established itself as the preferred destination for firms in advanced industries within Africa. However, the global competition for these investments is significant. Despite its impressive stock, the Gauteng City-Region trails peers like Mexico City, Shenzhen, Santiago, and Cape Town in the share of total FDI in advanced industries.

Advanced economies are the largest greenfield investors in the Gauteng City-Region. Companies investing in the Gauteng City-Region since 2009 tend to be headquartered in large advanced economies, led by the United States ($2.3 billion), Germany ($2.2 billion), the United Kingdom ($1.7 billion), Australia ($1.1 billion), and Japan ($712 million). Emerging markets such as India ($517 million) and China ($177 million) are significant, but not yet dominant sources of new foreign direct investment in the city-region. While still relatively low in comparison to the United States and Europe, investments from these countries are expected to grow over the next two decades as multinational companies expand globally.[37]

Map 2. Greenfield FDI into Gauteng City-Region, USD, 2009-2015



Source: Brookings analysis of fDi Intelligence data.

Firms seeking to establish regional headquarters in Africa benefit from a dense set of advanced services that cater to the Gauteng City-Region's significant concentration of major multinational firms. The Johannesburg Metropolitan Municipality houses the headquarters of 14 Global 2000 firms—most among its peer city-regions—with assets totaling more than $400 billion.[38] When Tshwane is added, the city-region boasts 15 headquarters. The density of major multinational firms reflects the city-region's status as Africa's premier business capital. Multinational headquarters demand clusters of firms that provide a diversity of advanced services such as finance, management consulting, legal services, advertising, and marketing.[39] Among 525 urban areas worldwide, Johannesburg ranks 25th in terms of its centrality in global networks of advanced services firms, second highest among its peer city-regions (after Mexico City) and by far the most connected African city.[40]

Table 4. Global 2000 corporate headquarters, 2012

City	Country	Number of headquarters	Revenue (USD billion)	Profits (USD billion)	Assets (USD billion)
Johannesburg	**South Africa**	**14**	**116**	**18**	**410**
Shenzhen	China	12	129	14	1,051
Mexico City	Mexico	12	106	15	168
Santiago	Chile	9	66	5	153
Istanbul	Turkey	7	89	8	411
Rio de Janeiro	Brazil	7	246	43	598
Cape Town	South Africa	6	32	4	114
Warsaw	Poland	4	27	4	99
Tshwane	South Africa	1	2	1	5

Source: Brookings analysis of GaWC data.

➤ **BOTTOM LINE:** Trade and investment is becoming a more important component of economic growth for the Gauteng City-Region. Provincial goods trade and national trade in services have grown much more quickly than the economy as a whole. Mining products continue to be the city-region's fastest-growing export, riding the wave of Chinese demand over the past decade. The city-region also maintains export specializations in manufacturing, especially machinery and transportation equipment products destined for the rest of Africa. Yet these traded sectors have not generated employment growth over the past 15 years, which has been concentrated in services, especially business and financial services and communications, reflecting the city-region's position as Africa's de facto business and technology capital. Further confirming its hub status, the city-region ranks highly among its peers in foreign direct investment flows, especially in technology-intensive sectors. Leveraging its position as a major business center by boosting services exports can be a significant growth driver. These tradable services, along with certain segments of advanced manufacturing, can help bolster the Gauteng City-Region's traded economy going forward, but it will require additional investments in innovation, human capital, and infrastructure to fully capture the opportunity.

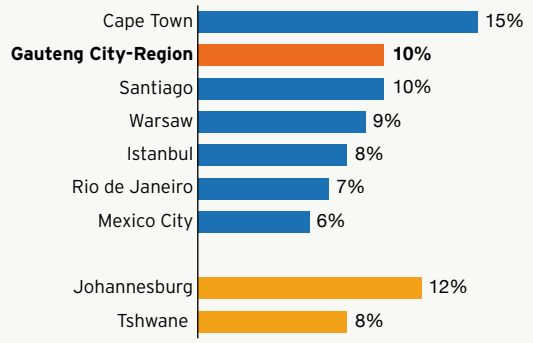
B. INNOVATION

WHY IT MATTERS: A region's innovative capacity and its levels of entrepreneurship both have implications for its ability to develop and deploy commercial applications, start new businesses, and maintain industrial competitiveness in the face of disruptive technological change.[41] Innovation takes many forms and can be hard to measure, especially innovations that improve processes, management techniques, or occur in the informal economy. Yet, the most productive and technologically-advanced metropolitan economies in the world tend to combine a common set of institutions and assets into a rich, collaborative innovation ecosystem that can commercialize research and development into new products and services for the market.[42]

The city-region is home to 44 percent of South Africa's research and development, but is comparatively less R&D-intensive than other parts of the world. Research and development (R&D) is an important measure of the resources invested in the discovery and commercialization of new products, processes, and technologies.[43] R&D in South Africa has been growing in absolute terms since 2009 but has remained relatively steady as a share of the economy, accounting for 0.76 percent of GDP in 2012/2013.[44] The Gauteng City-Region accounts for 44 percent of national R&D, and as a result is more R&D intensive (just over 1 percent of provincial GDP) than South Africa as a whole. But even at these levels, the region is less R&D-intensive than emerging market competitors like Brazil, China, and Russia.[45] Critically, businesses in the region are driving research and development activity. The private sector accounted for the majority of the Gauteng City-Region's R&D (65 percent), followed by science councils (18 percent), higher education (13 percent), and government (2 percent).[46]

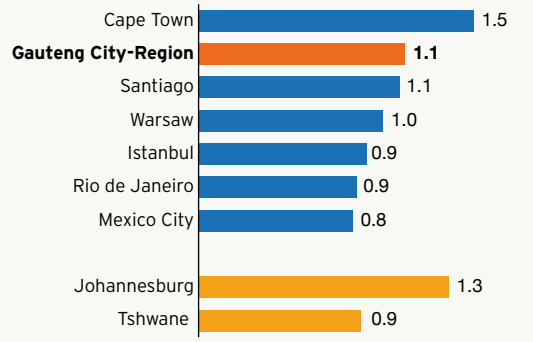
The Gauteng City-Region houses internationally-relevant research universities and performs near the top in terms of research impact when compared to peer cities. Research universities play a major role in driving innovation by providing the basic research that underlies scientific discovery and understanding, facilitating the translation of research results into consumable goods and services, and attracting and supporting the growth of other research-intensive industries.[47] To measure the scientific performance of universities, the Centre for Science and Technology Studies (CWTS) and Leiden University has compiled metrics for 750 major universities worldwide. Two universities in the Gauteng City-Region, the University of Pretoria and the University of the Witwatersrand, are ranked within the top 750 research universities. The Gauteng City-Region ranks second among its peers, only behind Cape Town, in overall scientific impact as measured by two metrics—1) share of published papers among the top 10 percent most cited publications, and

Figure 17. Share of total publications in top 10 percent most cited papers in all fields, 2010-2013



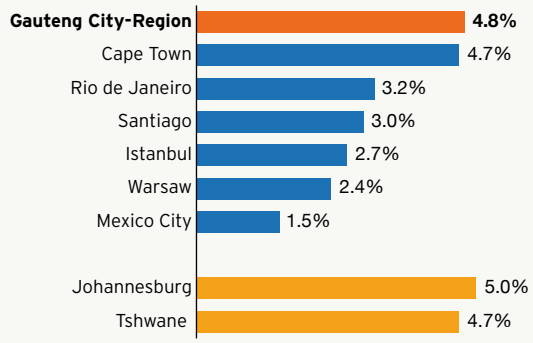
Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

Figure 18. Normalized mean citation score for all fields, 2010-2013



Source: Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

Figure 19. Share of total publications done with industry, 2010-2013

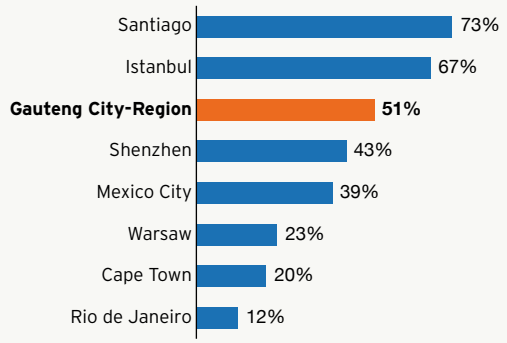


Source: Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

2) a normalized citation score that measures overall research quality.[48] Further, the city-region's research universities lead in publications developed in conjunction with industry, an indicator that illustrates the degree of collaboration between the private sector and universities to spur innovation.[49] Between 2010 and 2013, the two universities in the city-region produced 4.8 percent of all scientific papers in collaboration with industry partners, highest among peers. The challenge for the city-region's major universities will be to maintain the quality of its research base amid new funding constraints.[50]

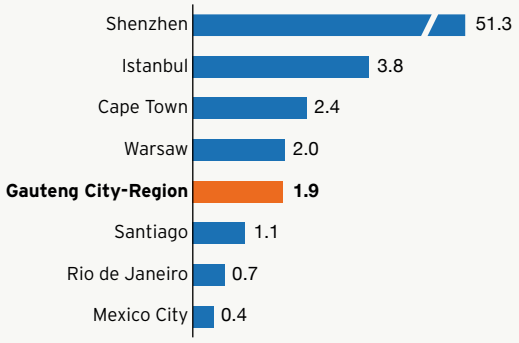
The Gauteng City-Region generates more than half of South Africa's patent activity, but the rate of new commercial inventions has declined in the last five years. Patents provide a reliable and comparable, if imperfect, measure of new inventions that spur economic development.[51] As with research and development, the Gauteng City-Region demonstrates an outsized contribution to patenting activity within South Africa. Only Santiago and Istanbul accounted for a higher share of national patents than the city-region, which generated 51 percent of South Africa's patents between 2008 and 2012, led by the Ekurhuleni metropolitan municipality.[52] However, after rising quickly in the 1990s, the number of patents per worker in both South Africa and the region was actually lower in the period between 2008 and 2012 than it was in both the 1998–2002 and 2003–2007 periods.[53] As compared to global peers, the Gauteng City-Region falls in the middle, higher than the three Latin American metro regions, but trailing Cape Town and its Asian and European counterparts.

Figure 20. Share of national patents, 2008-2012



Source: Brookings analysis of OECD REGPAT data.

Figure 21. Patents per 10,000 workers, 2008-2012

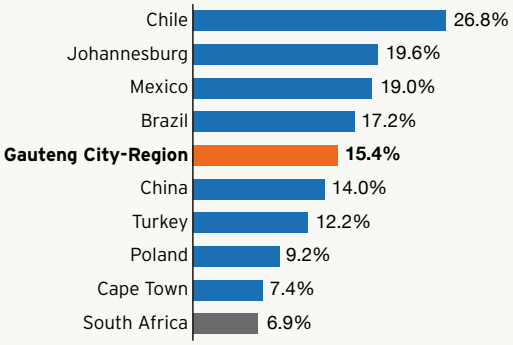


Source: Brookings analysis of OECD REGPAT data.

Two-thirds of the patents awarded to inventors between 2008 and 2012 belong to three major technologies: advanced manufacturing (29 percent), energy and infrastructure (21 percent), and information technology (17 percent). Within those sectors, four sub-groups of technologies—IT methods and management, metallurgy and materials, oil and gas, and civil engineering—are particularly important, accounting for 27 percent of Gauteng's total patents. Gauteng's most globally connected and sophisticated industries—finance and telecommunications, mining, and manufacturing—tend to demand these technologies, highlighting the imperative to innovate to maintain the city-region's key industrial specializations.

Entrepreneurial activity is much higher in Gauteng than in the rest of South Africa, and roughly on-par with levels of entrepreneurial activity in the countries of its peer city-regions. The development and growth of new businesses spurs job formation, raises incomes, and creates productivity-enhancing innovations.[54] The Global Entrepreneurship Monitor compares entrepreneurship in countries and regions based on their total entrepreneurial activity, or TEA, which measures the prevalence of individuals engaged in nascent entrepreneurship and new firm ownership in the 18-64 population.[55] At 6.9 percent in 2014, South Africa's TEA rate is quite low by international standards.[56] In 2013, the most recent data available for cities and provinces, TEA rates were 15.4 percent and 19.6 percent in Gauteng and Johannesburg, respectively, indicating the relative entrepreneurial vibrancy of the city-region. By comparison, Cape Town's rate was 7.4 percent.[57]

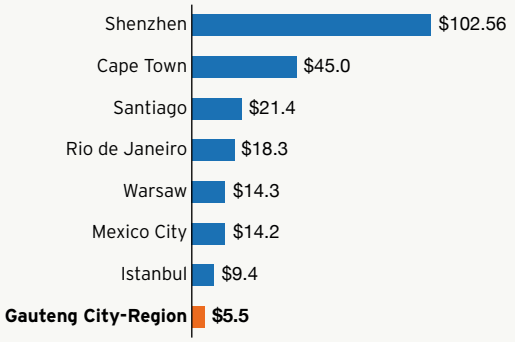
Figure 22. Share of population aged 18-64 years old engaged in entrepreneurship activities, 2013



Source: Brookings analysis of data from the Global Entrepreneurship Monitor

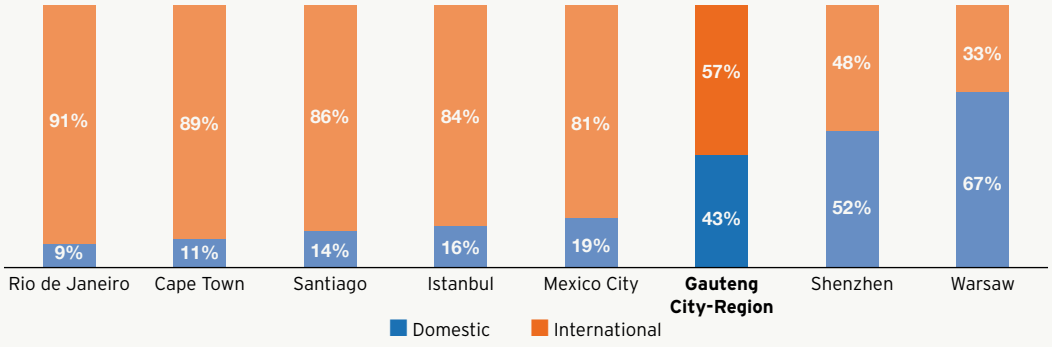
Yet, the Gauteng City-Region lags global peers in venture capital investment per capita.[58] Venture capital (VC) provides funds for innovative enterprises positioned for high growth and the potential to create and capture entire new markets.[59] Firms that receive venture capital can be particularly important stimulants to regional economies; VC recipients are three to four times more patent-intensive than other firms, and are much more likely to translate their R&D activities into high-growth ventures.[60] Despite having top ranked universities and other important innovation assets, Gauteng has not fully captured the benefits of venture capital, ranking last among its peers in VC investments per 1,000 residents. Three sectors accounted for 83 percent of all the venture capital invested in the region between 2005 and 2014: communications and networking (40 percent), software (30 percent), and commercial services (13 percent). Finally, venture capital investments tend be domestically sourced, with 43 percent of total VC invested by domestic funds, a higher proportion than every peer except Warsaw and Shenzhen.

Figure 23. Total venture capital investments, USD millions per 1,000 inhabitants, 2005-2015



Source: Brookings analysis of Pitchbook data and SAVCA data.

Figure 24. Share of venture capital investment by source, 2005-2015



Source: Brookings analysis of Pitchbook data.

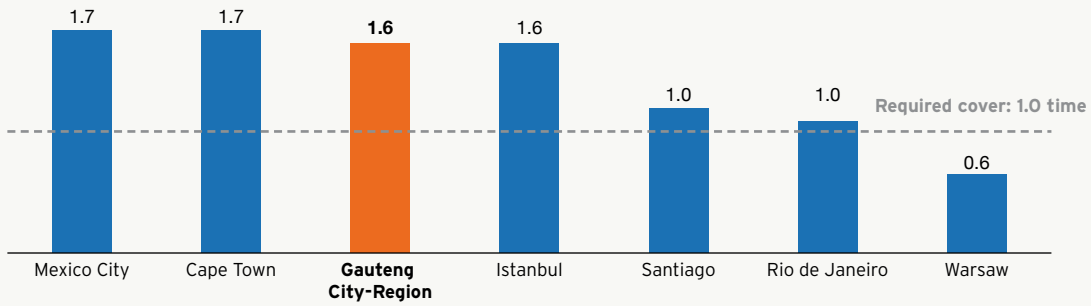
➤ **BOTTOM LINE:** Whether measured by R&D or new commercial inventions, a significant share of innovative activity in South Africa occurs among firms, universities, and research institutes in the Gauteng City-Region. The city-region's two major global research universities are significant hubs of knowledge creation and do a good job of collaborating with industry on joint research. Rates of new commercial inventions in the Gauteng City-Region fall in the middle of global peers, but patenting activity has declined recently. Entrepreneurship—an important innovation driver since new firms must offer the market some new product or process to thrive—is much higher in the region than in South Africa, but falls in the middle of global peer countries. Venture capital investment, one measure of the presence of high-growth entrepreneurs, is still quite low comparatively. This assessment reveals that the Gauteng City-Region has many of the ingredients of a global innovation hub, but must continue to invest in R&D, increase new commercial inventions, expand entrepreneurship, and facilitate collaboration between government, firms, and universities to develop new products and processes that help its businesses expand into new markets.

C. TALENT

WHY IT MATTERS: Human capital—the stock of knowledge, skills, expertise, and capacities embedded in the labor force—is of critical importance to enhancing productivity, raising incomes, and driving economic growth.[61] Producing, attracting, and retaining educated workers; creating jobs for those workers; and connecting those workers to employment through efficient labor markets all matter for regional competitiveness and ensuring broad-based economic opportunity for a metropolitan area's population.[62]

The Gauteng City-Region's demographic dividend and steady flows of in-migrants ensure a growing supply of workers for the regional economy. In an aging world, the Gauteng City-Region has the advantage of being relatively young. The demographic profile of the city-region suggests that it will have a significant supply of workers over the next two decades. Growth in the working-age population will also result from migration to the city-region from the rest of South Africa and the world. As of 2011 approximately 44 percent of the population was born outside of the city-region; 10 percent of residents were born outside of South Africa. Of these international in-migrants, nearly half are between the prime working ages of 20 and 35.[63]

Figure 25. Workforce replacement rate coverage in 2034

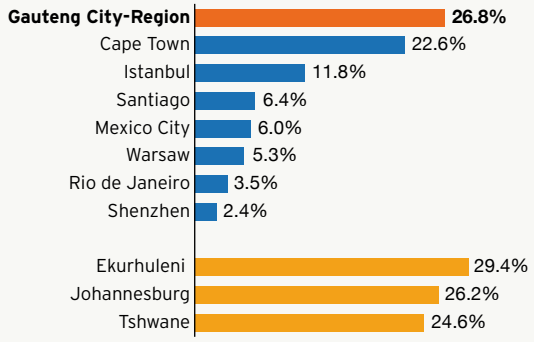


Source: Brookings analysis of Oxford Economics data.

Yet currently workers are not being absorbed into the labor market at a sufficient scale and pace, resulting in high levels of unemployment, particularly among youth. High structural unemployment remains the most pressing issue for the Gauteng City-Region and the country as a whole. As of the second of quarter of 2015, unemployment in the city-region stood at 26.8 percent, lower than national unemployment but highest among its global peer cities by a significant margin. As of 2014, youth unemployment stands at 39.8 percent, slightly higher than the national average of 36.9 percent.[64] Educational disparities by race are playing out in the labor market, as evidenced by unemployment disparities between black African (29.5 percent), Coloured (people of mixed ethnic origin, 36.9 percent), Indian/Asian (14.5 percent), and white (7.2 percent) population groups.[65]

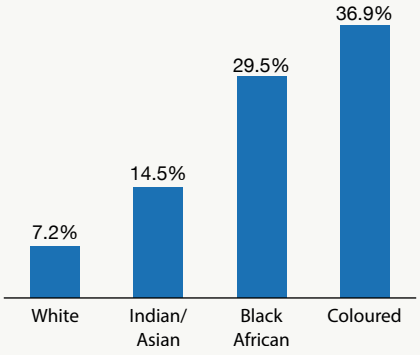
High and lasting unemployment reveals problems with both labor demand and labor supply. Demand for labor has been low as growth has slowed in recent years, exacerbating unemployment. Raising the long-term growth potential of the city-region's economy by improving industrial competitiveness would help address this challenge.[66] But growth alone is likely insufficient to curb labor market challenges. Supply-side issues matter as well. Skills mismatches are a global problem, but they are particularly pronounced in South Africa, and the Gauteng City-Region's labor market has not been immune to these challenges.[67] Between 2000 and 2014, the city-region added new jobs at a clip of 1.3 percent annually. The two sectors that created the most new jobs—financial and business services (4.6 percent annually) and public services (3.3 percent)—generally demand high levels of skills.

Figure 26. Unemployment rate, 2014 or most recent data available



Source: Brookings analysis of Statistics SA and Oxford Economics data.
Note: Unemployment rate as at end-June 2015 for all South African geographies.

Figure 27. Unemployment rate by race in Gauteng City-Region, 2014

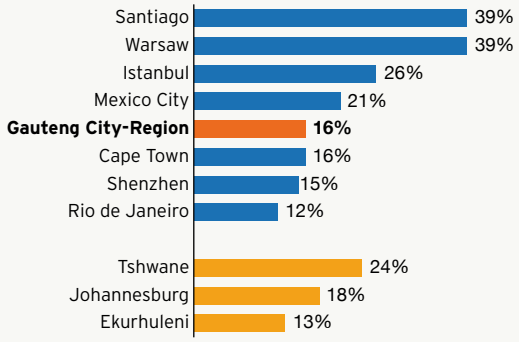


Source: Brookings analysis of Statistics SA and Oxford Economics data.

Meanwhile, sectors that offer employment opportunities to lower and middle-skill workers such as agriculture, mining, manufacturing, and wholesale and retail trade actually shed jobs amid increasing global competition and technological change. These growing disparities in skills demand and supply further disadvantage a significant segment of the Gauteng City-Region's labor market.[68]

The Gauteng City-Region's population is becoming more educated, and ranks in the middle of its peer group on post-secondary educational attainment. Understanding this growing skills mismatch, provincial and national governments have made the expansion of education and training a major priority. Education gains have been substantial in the post-apartheid era. Compared to the nation, a higher share of Gauteng City-Region residents possess secondary and tertiary degrees. Indeed, in 2012 the city-region's universities produced over half the graduates in South Africa.[69] The region can build on this progress to further upgrade the education, skills, and competencies of its population to reach par with the most educated emerging market cities.[70]

Figure 28. Share of population above 15 years old with tertiary education, 2014 or most recent data available

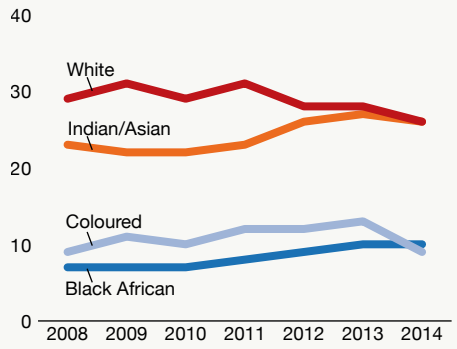


Source: Brookings analysis of data from Statistics SA and Oxford Economics. Note: Shenzhen data is from 2009 and measures share of population aged 6 years old and over; Istanbul and Warsaw data are from 2013 measures share of population 15+ years old that is economically active; Rio de Janeiro data is from 2010 and measures the 10+ years old population; and Mexico City data are from 2010. All other data measure the population aged above 15 years old and are from 2014.

"Between 2000 and 2014, the city-region added new jobs at a clip of 1.3 percent annually. The two sectors that created the most new jobs—financial and business services (4.6 percent annually) and public services (3.3 percent)—generally demand high levels of skills."

Educational achievement gaps between racial groups, while still significant, have been closing in recent years. Stark disparities remain between the coloured and black African segments of the Gauteng City-Region population, for whom the proportion of the population with a tertiary degree is 9.6 percent, and whites and Indians, among whom 26.1 percent had attained tertiary education levels in 2014.[71] Yet, this gap has been closing since 2008.

Figure 29. Share of Gauteng City-Region population with tertiary education by race



Source: Brookings analysis of Statistics SA data.

➤ **BOTTOM LINE:** The Gauteng City-Region's demographic dividend and steady flows of in-migrants ensure a growing supply of workers for the regional economy. Yet, currently workers are not being absorbed into the labor market at a sufficient scale and pace. Unemployment currently stands at 26.8 percent, higher than national unemployment and largest among its global peer cities by a significant margin. High and lasting unemployment reveals problems with both labor demand and labor supply. Raising the long-term growth potential of the economy by improving industrial competitiveness would help address the demand-side challenges. But growth alone will not likely solve the problem. Supply-side issues matter as well. After decades of progress, the Gauteng City-Region's workforce is more educated than the rest of South Africa and falls in the middle of its peer cities in terms of higher education completion. While closing over time, substantial educational disparities between racial groups remain, and underlie skills mismatches between the workforce and the competencies demanded by new jobs.

D. INFRASTRUCTURE

WHY IT MATTERS: Infrastructure and the spatial layout of a metropolitan area matter for competitiveness in two ways. First, firms rely upon global access points like airports and port and digital infrastructure to bring their products and services to domestic and global markets outside the region in the most cost-effective manner possible.[72] Second, the competitiveness of a regional economy also hinges on its ability to effectively connect its people and physical assets to their best use within the region—what planners and economic developers call "spatial efficiency."[73]

The Gauteng City-Region benefits from well-developed logistics infrastructure to send goods to market. Metropolitan areas rely on the exchange of goods to allow for economic specialization and, ultimately, long-term growth and prosperity. Freight transportation networks are critical to forge these economic connections.[74] Given its landlocked position, the Gauteng City-Region's ability to deliver goods to the global marketplace depends on infrastructure countrywide, especially freight corridors to send raw commodities and manufactured products via road and rail to seaports in Durban, Cape Town, and Port Elizabeth. According to the World Bank, South Africa's transportation and logistics systems are relatively well-developed, ranking 34th out of 160 countries and

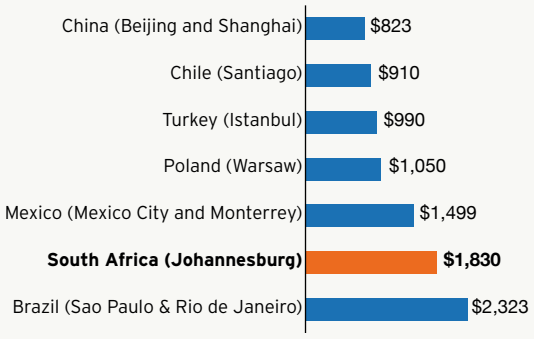
fourth among global peer countries in 2014.[75] Yet, as global trade has increased, so too has congestion in the system. Despite having declined 6 percent since 2005, the average cost of $1,830 to ship a container from Johannesburg exceeds the cost in many global peer cities.[76]

Table 5. Logistics performance index rank, 2014

Rank	Country (City)
28	China (Shenzhen)
30	Turkey (Istanbul)
31	Poland (Warsaw)
34	**South Africa (Johannesburg)**
42	Chile (Santiago)
50	Mexico (Mexico City)
65	Brazil (Rio de Janeiro)

Source: World Bank Logistics Performance Index and World Bank Doing Business data.

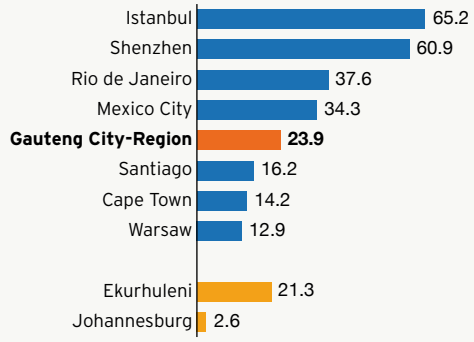
Figure 30. Cost to export, real USD per container, 2014



Source: World Bank Logistics Performance Index and World Bank Doing Business data.

Firms and workers benefit from the Gauteng City-Region's status as Africa's most well-connected aviation hub. In addition to goods, metropolitan economies must efficiently move people. Airports serve as key exchange points in the domestic and international flow of people and ideas, and in doing so help stimulate regional employment and GDP per capita growth. Connectivity via the O.R. Tambo International Airport amounts to a major comparative advantage for the city-region. In 2014, 23.9 million passengers moved through the airports in the Gauteng City-Region's three main metropolitan areas (Johannesburg, Ekurhuleni, and Tshwane), the 67th highest total of any metropolitan area in the world and by far the highest total in Africa and fifth among global peer regions.[78] Nearly two in three passengers are destined for other parts of South Africa, typically Cape Town (6.7 million) or Durban (2.2 million).[79] Total aviation passenger flows increased by 5.3 percent annually in the city-region between 2004 and 2014.

Figure 31. Total aviation passengers, millions of persons, 2014

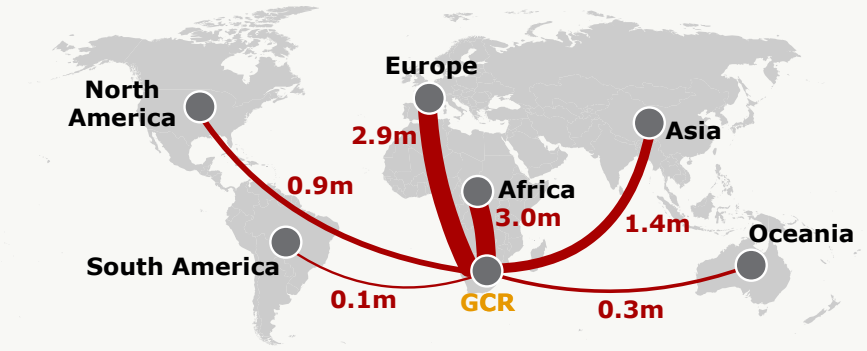


Source: Brookings analysis of Sabre data.

Gauteng City-Region's Global Aviation Connections

International aviation flows reveal key linkages to major African and European metropolitan areas. In 2014, approximately 36 percent (8.7 million) of the city-region's aviation passengers traveled to and from international destinations.[80] The most common final origins and destinations outside of Africa are London, Amsterdam, Frankfurt, Paris, and New York.

Map 3: Gauteng City-Region's global aviation linkages, persons, 2014



Source: Brookings analysis of Sabre data.

Table 6. Largest metropolitan corridors (final origin/destination), 2014

Rank	City	Country	Total passengers	Share of Gauteng City-Region's total passengers
1	Cape Town	South Africa	6,718,700	31.5%
2	Durban	South Africa	2,150,494	10.1%
3	London	United Kingdom	889,041	4.2%
4	East London	South Africa	846,458	4.0%
5	Port Elizabeth	South Africa	740,332	3.5%
6	George	South Africa	469,111	2.2%
7	Harare	Zimbabwe	261,223	1.2%
8	Lagos	Nigeria	242,532	1.1%
9	Bloemfontein	South Africa	226,657	1.1%
10	Amsterdam	Netherlands	223,817	1.0%
11	Frankfurt	Germany	219,500	1.0%
12	Paris	France	211,283	1.0%
13	Windhoek	Namibia	198,541	0.9%
14	New York	United States	189,896	0.9%
15	Mauritius	Mauritius	180,866	0.8%

Source: Brookings analysis of Sabre data.

Economic growth in other African countries has spurred connectivity to growing cities such as Harare, Lagos, Windhoek, and Mauritius. Between 2004 and 2014, total inbound and outbound passenger traffic increased by 6.7 percent annually to these four markets.[81] Passenger flows are also growing quickly to major Asian cities (typically from a small base) such as Fuzhou (25.9 percent annually), Beijing (18.4 percent), Istanbul (14.1 percent), Phuket (12.1 percent), and Seoul (11.9 percent).

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Table 7. Fastest growing metropolitan corridors (final origin/destination), 2004-2014

Rank	City	Country	Total passengers, 2014	Annual growth in passengers
1	Tete	Mozambique	29,890	60.5%
2	Fuzhou	China	24,076	25.9%
3	Beijing	China	79,712	18.4%
4	Beira	Mozambique	24,659	15.3%
5	Lagos	Nigeria	242,532	14.2%
6	Bulawayo	Zimbabwe	59,709	14.2%
7	Istanbul	Turkey	71,578	14.1%
8	Phuket	Thailand	37,079	12.1%
9	Seoul	South Korea	33,636	11.9%
10	Shanghai	China	56,254	11.6%
11	Delhi	India	55,716	10.3%
12	Upington	South Africa	33,993	10.2%
13	Washington	United States	84,190	10.1%
14	Pietermaritzburg	South Africa	121,156	9.5%
15	Libreville	Gabon	24,400	8.8%

Source: Brookings analysis of Sabre data.

The Gauteng City-Region relies on yet another set of metropolitan economies as "connection points" to global destinations. These 15 metropolitan areas—led by Dubai, London, Frankfurt, and Paris—are where passengers "pass through" on their way to and from the Gauteng City-Region. In this sense, these metropolitan hubs act as critical gateways that connect the city-region to the rest of the world.

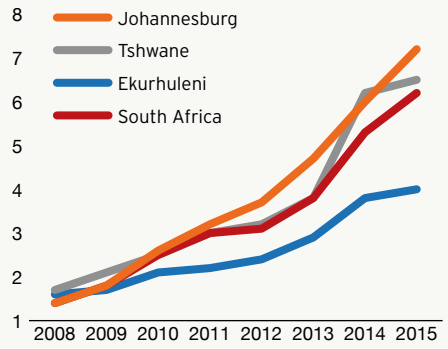
Table 8. Top metropolitan gateways, 2014

Rank	City	Country	Total passengers
1	Dubai	United Arab Emirates	682,138
2	London	United Kingdom	407,936
3	Frankfurt	Germany	361,589
4	Paris	France	281,553
5	Hong Kong	Hong Kong	217,940
6	Atlanta	United States	203,029
7	Amsterdam	Netherlands	180,859
8	Abu Dhabi	United Arab Emirates	145,437
9	Doha	Qatar	144,395
10	Dakar	Senegal	123,640
11	Addis Ababa	Ethiopia	116,645
12	Zurich	Switzerland	104,589
13	Cairo	Egypt	83,565
14	Sydney	Australia	83,058
15	Istanbul	Turkey	80,071

Source: Brookings analysis of Sabre data.

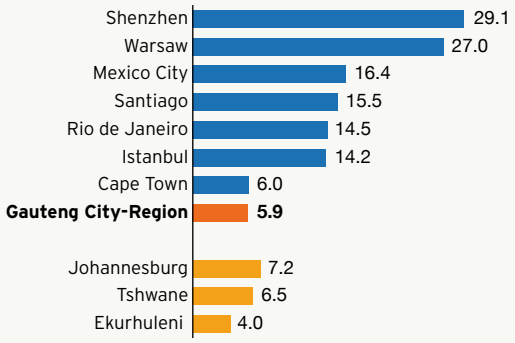
Broadband speed in the Gauteng City-Region is improving, but lags speeds in global peers. Mobile technologies and the internet have revolutionized communication across the globe. Today, consistent and quality broadband access is increasingly a prerequisite for students, workers, and firms to benefit from the knowledge available online in ways that spur regional economic development.[82] One common way to measure broadband quality is the speed at which data can be transferred through the network. By this metric, the average download speeds reported by internet users in Johannesburg quintupled in just seven years, from 1.4 megabits per second in 2008 to 7.2 megabits per second in 2015. Similar gains were seen in Tshwane and Ekurhuleni as well.[83] Yet, global comparisons suggest that more progress needs to be made around broadband speed, as all three metro municipalities trail comparison cities.

Figure 32. Internet download speed, mbps



Source: Brookings analysis of Oakla data.

Figure 33. Internet download speed, mbps, 2015



Source: Brookings analysis of Oakla data.

While broadband quality has improved, access remains unequal within the city-region. Broadband delivery tends to be influenced by market mechanisms in which firms deploy new infrastructure in the areas of the city where internet use is highest. These are typically the higher income portions of a metropolitan area. The Gauteng City-Region tends to follow this pattern; access is greatest in the urban core and more limited in township communities, where residents rely much more on mobile phones to access the internet than connections via the home.[84] In 2011, 54 percent of the city-region's residents did not have access to the internet, although this number has improved in recent years.[85] Download speeds also vary significantly within the Johannesburg metropolitan municipality, ranging from Sandton (25.2 mbps) to Roodepoort (3.1 mbps). Understanding these spatial disparities, broadband expansions are a stated objective of the province's infrastructure planning.[86]

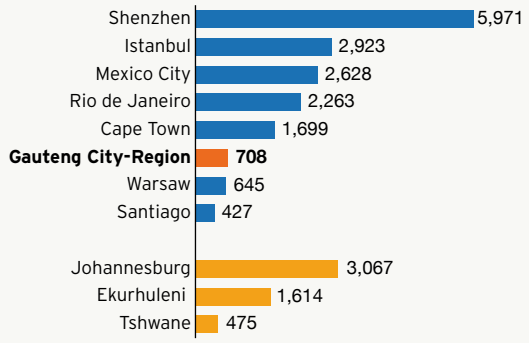
Table 9. Average internet download speed in Johannesburg sub-metropolitan districts, 2015

Rank	City	Download speed (mbps)
1	Sandton	25.2
2	Midrand	10.5
3	Randburg	8.3
4	Rivonia	7.9
5	Fietas	7.5
6	**Johannesburg**	**7.3**
7	Bryanston	7.2
8	Soweto	6.8
9	Krugersdorp	4.7
10	Randfontein	4.5
11	Roodepoort	3.1

Source: Brookings analysis of data from Ookla.net.

The city-region's legacy of spatial segregation, sprawling housing development, and insufficient public transportation coverage creates inefficiencies that slow economic growth. As the Gauteng City-Region Observatory has clearly documented, the city-region's physical growth patterns have followed the apartheid spatial framework.[87] While exceptions exist, much of the growth in the recent decades has been on the fringes of the city-region, where land is cheaper.[88] The province's share of urbanized land grew by 45 percent between 1991 and 2009.[89] Population density varies significantly, from 3,067 inhabitants per square kilometer in Johannesburg to 475 in Tshwane. Overall, the Gauteng City-Region is less dense than most of its comparison regions, although Johannesburg's density level exceeds that in all peers except Shenzhen. Coordinating transportation investments with higher density residential and commercial development—as is being done with the City of Johannesburg's Corridors of Freedom initiative and the province's expansions of bus rapid transit and the Gautrain—are important efforts to further improve spatial efficiency.[90] Currently, the city-region's residents cite lack of transportation as a significant barrier to employment.[91]

Figure 34. Population density (persons per square kilometre), 2014



Source: Brookings analysis of Oxford Economics data.

➤ **BOTTOM LINE:** International infrastructure connections in the Gauteng City-Region are relatively well-developed. South Africa's freight and logistics systems rank in the middle of their peer group, but exporting costs remain relatively high for firms. The O.R. Tambo International Airport has positioned the city-region as an important international aviation node, offering a comparative advantage for businesses that demand global access. Local infrastructure can continually be upgraded. Broadband speeds have improved over time, but are not yet on-par with most global peer cities and remain varied across communities. Continuing to align transportation, new housing development, and land use policy to increase density along key corridors and nodes can help improve spatial efficiency in the city-region.

E. GOVERNANCE

WHY IT MATTERS: Broadway and Shah define governance as "the formulation and execution of collective action at the local level."[92] Therefore, we consider governance to include formal government structure as well as the quality and capacity of public, private, and civic institutions to positively influence competitiveness.[93] Governance matters for competitiveness because proactive government, public, and civic groups can marshal investment from a wide variety of domestic and international sources to enable new growth strategies. Central, provincial, and municipal governments also have unique and complementary roles to play in enabling firms and their wider regions to succeed in global markets.[94]

A majority of the city-region's residents are satisfied with public service delivery, but are wary of corruption's influence. The quality of service delivery influences the competitiveness of the Gauteng City-Region because it shapes the support systems for local students, workers, and firms to unleash their full economic potential.[95] Respondents to the Gauteng City-Region Observatory's Quality of Life Survey are most satisfied with the provision of basic services such as water, waste removal, sanitation and energy, and less satisfied with the provision of street lights, education, road infrastructure, and public safety. These figures occur against the backdrop of growing protests about the quality of service delivery. According to the GCRO survey, approximately 4 percent of the city-region's residents participate in protests, reflecting citizen concerns around service delivery and the quality of government.[96] Perceptions that government is corrupt fuel these concerns.[97] GCRO's Quality of Life Survey found that 89 percent of the city-region's residents either strongly agree or agree that corruption is the main threat to South Africa's democracy, a public perception confirmed by broader trends in the World Bank's Worldwide Governance Indicators.[98]

The Gauteng City-Region's municipal governments enjoy relatively high fiscal autonomy. The OECD provides several useful metrics of sub-national autonomy, including the share of sub-national government expenditures and the share of sub-national tax collections. According to a 2011 report, approximately half of total government spending in South Africa is undertaken by sub-national governments, higher than OECD averages overall. Municipal governments have greater authority to raise revenues locally than their provincial counterparts. However, much of local spending relies on central government grants, as sub-national governments only generate about 20 percent of their own revenue.[99]

Government strategies are considered within the "city-region concept," ensuring that policies reflect the economic, as well as political, geography of Gauteng. The Gauteng City-Region is not a formal government, but rather a concept that has been advanced at the highest levels of leadership within the metropolitan municipalities and the province. Transportation, land use, environmental, infrastructure, and economic planners have embraced coordination between different levels of government. Given the recentness and complexity of this task, it is not surprising that these institutional arrangements have not been perfected, but it is an important first step to market and position the network of cities in Gauteng locally, nationally, and globally as a unified regional economy. Going forward, consolidating a set of cross-government strategies, institutional arrangements, and an ethos of collaboration can help cement the city-region ideal. This process can be reinforced by drawing in a wide set of private, civic, educational, and community actors to help steward the city-region's economy.

Johannesburg's business environment compares favorably to other cities. Firms often cite the "business environment" as a determining factor in where they locate operations.[100] This environment is based partly on factors outside the remit of local or provincial officials (e.g. property rights, national taxes, quality of financial markets, distance to other markets, etc.) as well as those squarely within their control (e.g. local tax rates, permitting processes, other regulatory structures, corruption, etc.). The World Bank's Doing Business project, which collects measures of the business environment, assembles its analysis from the

perspective of a firm located in the largest city in the country. In this way, it actually provides a window into the business environment of Johannesburg, as well as several other global peer cities. South Africa performs well overall (43 of 189 countries) in terms of the overall ease of doing business, behind Poland, Mexico, and Chile but ahead of Turkey, China, and Brazil. Firms in Johannesburg find it relatively easy to pay taxes and obtain construction permits. The level of protection afforded minority investors is quite high. Electricity access and trading across borders remain the main challenges for firms operating in Johannesburg.[101]

Figure 35. Rank in World Bank Doing Business 2015 Report (out of 189 countries)

Source: World Bank Doing Business 2015.
BR =Brazil (Sao Paulo & Rio de Janeiro);
CL = Chile (Santiago); CN = China (Beijing & Shanghai); MX=Mexico (Mexico City & Monterrey);
PL = Poland (Warsaw);
TR= Turkey (Istanbul);
ZA =South Africa (Johannesburg).

➤ **BOTTOM LINE:** Two decades after adopting multiracial democracy, governance in South Africa continues to be a work in progress, and the Gauteng City-Region reflects this reality. According to survey research, residents are satisfied with the quality of basic government responsibilities—service delivery, enforcing regulations, and supporting the business environment—although corruption remains a concern for the city-region's residents. Building on a relatively high municipal fiscal autonomy, governments are intent on collaborating at a regional scale that reflects the true economic geography of Gauteng. This vision is an important step to further positioning the city-region's economy globally, a process that could be strengthened by more input from private, civic, and educational groups.

IV. IMPLICATIONS AND OPPORTUNITIES

The Gauteng City-Region has significant strengths to build upon to enhance its global competitiveness: an acknowledged status as Africa's most globalized city; specializations in financial and business services, some advanced manufacturing products, telecommunications; and construction and engineering services; a notable innovation presence; good international infrastructure connectivity; and a well-established democratic public sector.

Building on these assets is the focus of current economic strategies at the municipal and provincial levels. The city-region's metropolitan municipalities—Johannesburg, Ekurhuleni, and Tshwane—each have integrated development plans for social, physical, and economic development. The Gauteng provincial government has launched strategies focused on industrial competitiveness, trade and investment, innovation, skills and education, transportation, and broadband. These strategies are intended to add up in a coordinated way with the goals of the National Development Plan. As a result, essentially all of the topics discussed in this profile are covered in some way by a local plan or initiative.

The purpose of this section is, therefore, not to offer a comprehensive competitiveness strategy for the city-region. Rather, it aims to discuss implications that arise specifically from this assessment's comparisons of the Gauteng City-Region to other similar global cities, and the opportunities it reveals to further advance the region's global competitiveness.

A. TRADE: Reinvigorate economic growth through expanded exports and foreign investment, cementing the Gauteng City-Region's status as the "Gateway to Africa."

The Gauteng City-Region has always been a trading region. From its roots as a mining hub to its current position as an international financial and business center, the city-region houses an enviable stable of successful international companies. Mining remains a critical source of goods exports, generating over 60 percent of recent export growth, but the city-region also has specializations in advanced production, particularly in machinery and transportation equipment. Services, however, have generated all the net new jobs in the Gauteng City-Region's tradable sector since 2000, anchored by growing sectors like financial and business services, transportation, and communications. The top greenfield foreign direct investment inflows correspond to these major industry clusters in mining, metals and manufacturing, and financial, business, and IT services. Yet, services trade still remains relatively low in South Africa, and has actually been growing more slowly than goods trade.

An important tactic to boost trade and investment is solidifying the city-region's position as the gateway to a rapidly expanding market in Sub-Saharan Africa. The density of multinational headquarters—and the financial, accounting, marketing, and IT services that they demand—makes the city-region an attractive destination for global companies that want to establish African operations. Its international airport and relatively well-developed freight infrastructure allows for good continental access. Immigrants from surrounding countries flock to the city-region for education and economic opportunities, establishing lasting linkages between the city-region and their home markets. And as the rest of Africa grows, firms and consumers will demand the products and services the city-region can offer, whether a Tshwane-made

car, Ekurhuleni-developed mining equipment, or Johannesburg's construction and engineering services expertise.

These exports can translate into higher growth and, most importantly, more jobs, especially considering that the rest of Africa is the city-region's largest destination for manufactured goods, which tend to support more labor market opportunities.[102] Many of the Gauteng City-Region's global peers have achieved growth by serving this same gateway function, whether Shenzhen in China, Istanbul in the Middle East, Warsaw in Eastern Europe, and Mexico City in North America. As their surrounding economic blocs have grown, so too have these gateways.

As Africa urbanizes and industrializes, the Gauteng City-Region can take several steps to increase the local benefits of that growth wave. First, it can make competitiveness-enhancing investments in important traded sectors through technology and skills upgrading. The Automotive Industry Development Centre's Automotive Supplier Park in Tshwane could offer a useful model for other sectors to upgrade skills development, supplier development, and technology sharing.[103] Second, the city-region can further embrace services exports. Lack of services trade data at the municipal or provincial level currently limits tracking. Advocating to the relevant central ministries (e.g. SARS, DTI, etc.) to track services data could provide the platform for a more robust services exports strategy. The Greater London Authority and the Centre for London have undertaken such an analysis, and subsequently made service exports a key pillar of Greater London's export strategy.[104] Third, Gauteng's leaders can expand FDI by consistently marketing the city-region as the continent's gateway. Rio de Janeiro, which attracted more FDI than any of the city-region's peers, has established a public-private business development agency, Rio Negócios, that partners with state-level promotion agencies to market the city internationally, incentivize foreign direct investment, and streamline red tape for incoming firms.[105] Finally, networking with strategic trading partners at the subnational level can help yield mutual economic benefit. The Gauteng Trade and Investment Strategy will pursue "twinning agreements" with key cities of interest. Mexico City has pursued similar agreements with a range of international cities, including a comprehensive economic partnership with the city of Chicago that has facilitated exchange between entrepreneurs and start-ups in each market.[106]

B. INNOVATION: Focus on expanding technology commercialization in key industries.

This assessment revealed that the Gauteng City-Region's innovation ecosystem has several notable strengths—a significant share of national research and development, universities that generate scientific knowledge in collaboration with industry, and greater entrepreneurial activity than the rest of the country. Yet, even with this base, after rising quickly in the 1990s, the number of patents per worker in the city-region region was actually lower in the period between 2008 and 2012 than it was in both the 1998–2002 and 2003–2007 periods. As compared to global peers, the Gauteng City-Region falls in the middle in terms of its patenting prowess.

"An important tactic to boost trade and investment is solidifying the city-region's position as the gateway to a rapidly expanding market in Sub-Saharan Africa."

These trends indicate an opportunity to further maximize the commercial impact of innovative activities to improve the competitiveness of the city-region's industries. While the private sector ultimately determines innovation outcomes, government policies can help increase commercialization. Maintaining investments in the city-region's major research universities is an important first step. In addition to their important role in skill development, universities are hubs of knowledge creation and transfer that can stimulate industrial development and generate new societally-enhancing innovations. Similarly, institutions like the Council for Science and Industrial Research centers and the Innovation Hub remain important anchors for not only stimulating new sectors, but also upgrading the productivity and competitiveness of legacy industries such as mining and manufacturing. One best practice with similar aims is the state of Pennsylvania's Ben Franklin Technology Partners (BFTP). While the city-region's industrial structure and development stage differ from Pennsylvania, the lesson that provincial government can provide, at the least, a coordinating role between firms, research institutes, universities, and investors to stimulate innovation applies.

Sparking innovation in Pennsylvania: Ben Franklin Technology Partners

Three decades ago Pennsylvania's political leadership founded the Ben Franklin Technology Partners (BFTP) to provide companies with capital, technical assistance, and connections to a broad network of firms, universities, and experts.

BFTP makes direct investments to both start-ups and established companies seeking to commercialize new technologies. Through a rigorous vetting process, BFTP has made over 3,500 investments in Pennsylvania companies since its founding in 1983. Often BFTP has been one of the first institutional investors in a company, helping solidify commercialization efforts and spurring additional capital injections from other investors.[107]

Anchored in four regional offices, BFTP's experts also deliver technical assistance. The organization's experts help young companies with product development, marketing, fundraising, accounting, operations, and human resources. This aspect of BFTP's work helps companies chart a growth path that takes them from their initial idea to full commercialization.[108]

Finally, and perhaps most importantly, BFTP serves as the hub of a deep institutional network that can be tapped to support companies. This network stretches across the investor community, universities and research labs, state and regional economic development organizations, business incubators and other entrepreneurs. Since 1987, East Penn Manufacturing, one of the world's largest battery manufacturers, has drawn on BFTP's networking capabilities to partner with Lehigh University, Enterprise Systems Partners, Penn College of Technology's Plastics Innovation and Resource Center, and Northampton Community College's Emerging Technology Applications Center.[109]

Together, these services have yielded real economic benefit. An evaluation of BFTP by Pennsylvania Economy League and KLIOS Consulting estimated that since 1989 BFTP has contributed over $23 billion to the state economy, helped create 51,000 jobs in its firms, and generated a 3.6-to-1 return on investment in terms of state tax revenue.[110] Strong economic outcomes from its relatively modest budget (around $14 million as of 2011) continue to position BFTP as a leading state-level best practice to emulate.[111]

C. TALENT: Boost employability through enhanced connections between the worlds of school and work.

The high rate of unemployment stands out as the most significant challenge in the Gauteng City-Region, and expanding employment undergirds both requirements of our definition of a competitive region. Firms will be able to compete globally in the city-region to the extent they can find a skilled workforce. And rising standards of living for residents relies upon widespread labor market opportunities.

The full slate of reforms and actions needed to expand employment opportunity is beyond the scope of this report. In a recent synopsis, Bhorat and colleagues suggest that addressing labor market rigidities, instituting public employment schemes, easing job creation in the informal sector, pursuing labor-intensive industry growth, improving basic education through increased educational expenditures per learner, streamlined management of basic education systems, and improved teacher quality all could make dents in the unemployment rate.[112] While many of these reforms require central government action, the Gauteng province's education budget echoes many of the recommendations aimed at sub-national governments, with an added emphasis on the role that technology can play a role in overcoming disparate teacher quality and school management.[113]

Nonetheless, the labor market skills mismatches and high rates of youth unemployment documented in this report suggest that improving basic education on its own may not be enough to smooth the pathway from the education system to gainful employment. Nationwide, approximately four in ten youth aged 15–24 that hold a matric qualification (U.S. high school degree equivalent) are not in education, training, or work.[114] In an effort to provide more work-relevant skills, South Africa has reformed the nation's network of technical and vocational education training (TVET) colleges. Following reforms to the system, enrollment in TVET colleges doubled between 2010 and 2013.[115] Yet, the quality of TVET colleges remains highly varied and often not well-aligned with the needs of local employers and industries, partly due to the fact that employers must do a better job of defining their skills needs. Empowering sector-focused workforce intermediaries such as Sector Education and Training Authorities and the Human Resources Development Council to help bridge the gap between employers and educators on skills demands, curriculum development, and job placement would help address this coordination failure.[116] Similar efforts are underway in states and provinces around the world.

"In metropolitan areas across the world, regional competitiveness is becoming an increasingly shared agenda. Formal and informal networks of public, private and civic leaders are coming together to design and implement economic strategies."

Job-Driven Training Efforts: Lessons from Mexican and U.S. States

In Mexico, the state of Querétaro is implementing innovative education and employment programs that prepare workers for its key industry clusters. Mexico's first aerospace university, Universidad Aeronáutica de Querétaro (UNAQ), has been instrumental in supplying the skilled production workers and engineers demanded major aerospace firms. Of the 1,800 workers at Bombardier's Querétaro facility, nearly two-thirds were trained at UNAQ, and the firm works closely with the university to tailor the curriculum for all rungs of the aerospace career ladder.[117] Querétaro has recently constructed a similar university for the automotive industry.

In the United States, similar public-private partnerships to boost skills and employability have been instituted. In the state of South Carolina, Apprenticeship Carolina provides companies with free apprenticeship consultants to guide them through the registered apprenticeship development process, from initial information to full recognition in the national Registered Apprenticeship System.[118] Consultants identify occupational training gaps, solicit proper supervisors for apprentices, link to providers for related technical instruction (often at one of the state's 16 technical colleges), and recruit a supervisor to maintain training standards.[119] The program costs about $1 million a year, which is covered through state funding and includes an annual employer tax credit of $1,000 per apprentice.[120] Begun in 2007 with just 777 trainees and 90 companies, it has since served over 10,000 students and more than 650 companies.[121]

D. GOVERNANCE: Organize public, private, and civic leaders around a shared vision for growth and competitiveness.

In metropolitan areas across the world, regional competitiveness is becoming an increasingly shared agenda. Formal and informal networks of public, private and civic leaders are coming together to design and implement economic strategies. These networked approaches, while certainly more complex, incorporate the market expertise, financial resources, and political will of a wider range of stakeholders, and thus make economic strategies more market-oriented, community-driven, and sustainable beyond political cycles.[122]

The principles of public-private-civic economic planning are already present in the Gauteng City-Region. Government growth strategies go through an extensive public review process that draws upon the feedback of all elements of the region, including targeted outreach to particularly relevant groups. The Gauteng Growth and Development Agency, the provincial economic development group, has a private sector board that influences its strategies and decision-making. Premier Makhura has launched the Business Consultative Forum as a vehicle for further discussion about the city-region's economy. Within the private sector, chambers of commerce, industry associations, and leadership groups advocate for the policy priorities of business. Universities and non-profits also weigh in on economic debates with their insights. Yet, the Business Consultative Forum, notwithstanding, none of these current arrangements offer a shared space where leaders from all sectors debate economic issues and craft solutions to pressing problems.

Cities and regions across the world are forming organizations that provide more coherence to economic development, including the Committee for Sydney and the Western Cape Economic Development Partnership (EDP). Comparable organizations exist in regions ranging from Barcelona to Chicago to Melbourne. These organizations, which differ somewhat in their structure, financing, and mandate, all share a focus on economic development and a commitment to public-private collaboration, could serve as models for a Gauteng-based group.

Collaborating to Compete in Cape Town and Western Cape and Greater Sydney

Launched in 2012, the Western Cape Economic Development Partnership is an independent non-profit organization that seeks to improve the local and regional economy by building and sustaining partnerships between different public, private, and civic stakeholders.[123] It is mandated to organize leaders around a shared economic vision for Cape Town and the Western Cape, develop the partnering processes and partnerships necessary to implement that vision, and then use a data-oriented approach to track and monitor performance over time. It exists outside of government, but works with government in an advisory capacity on economic planning and development partnering methodology. Its board consists of a mix of private sector and local, provincial, and national government officials, as well as the EDP chief executive, and is chaired by a former cabinet minister. While still in its experimental phase, early signs indicate that EDP is providing value locally, leading on initiatives to bolster the agriculture sector, improve the innovation ecosystem, align local spatial economies, strengthen business and community safety partnerships, convene diverse groups around open data, convene government-business engagements around pressing issues such as energy security and develop Cape Town and the Western Cape's global identity. The EDP is linked to other metro regions in South Africa in a knowledge-sharing partnership through the Economies of Regions Learning Network, an initiative of the National Treasury.

In 2003, leaders in Greater Sydney—Australia's largest metropolitan economy—founded the Committee for Sydney to enhance and retain the region's global position. With over 100 members that include large firms, universities, not-for-profits, local governments and state government departments, and key cultural, sporting, and marketing bodies, the committee does not represent one specific sector but rather uses research, advocacy, and network-building to advance a unified regional economic agenda beyond any one election cycle. The committee organizes taskforces that offer thought leadership and policy recommendations on high-priority issues such as planning and housing, transportation, financial and professional services, and livability. These taskforces have delivered results. Within the financial services issue area, the committee's work has helped inaugurate Stone and Chalk, a financial technology (fintech) hub that aims boost entrepreneurship within financial services and connect new companies with larger corporations, venture capital, and university research.[125]

"Progress towards full equality of opportunity and long-term competitiveness requires addressing the city-region's significant levels of unemployment, income inequality, and social exclusion."

V. CONCLUSION

This assessment reveals that the Gauteng City-Region reflects the challenges and opportunities of its nation's extraordinary economic, demographic, social, and political transformation. Just 20 years removed from the adoption of multiracial democracy, the city-region rivals other major international cities in key competitive assets: major global companies, leading universities, a young and increasingly educated workforce, well-connected infrastructure, and democratic government. Yet, as in many other emerging market cities, too many residents still lack the skills, networks, and access to benefit from, and contribute their abilities to, this competitive position. Significant levels of unemployment, income inequality, and social exclusion remain, hindering progress toward full equality of opportunity and the city-region's long-term economic competitiveness. The city-region can bolster its position by embracing its services sector as a route to cement its status as trade and investment gateway to Africa, enhancing technology commercialization, boosting employability through enhanced connections between the worlds of school and work, and organizing public, private, and civic leaders around a shared vision for growth and competitiveness. By taking purposeful action now, the Gauteng City-Region's public, private, and civic institutions can build a globally competitive economy that works for all.

METHODOLOGICAL APPENDIX

SELECTION OF PEERS

Global peer cities were selected based on economic characteristics and competitiveness factors. Classifying and identifying peers allows policymakers and stakeholders to better understand the position of their economies in a globalized context as well as to conduct constructive benchmarking.

To select peers we utilized a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering.[1] These commonly used data science techniques allowed us to group metro areas with their closest peers given a set of economic and competitiveness indicators. For this report we selected 14 economic variables: population, nominal GDP, real GDP per capita, productivity (defined as output per worker), total employment, share of the population in the labor force, and industry share of total GDP (8 sectors).[2] We included seven additional variables that measure one of the four quantitative dimensions of the competitiveness analysis framework used in this report. The variables included are: share of the population with tertiary education (talent), stock of Greenfield foreign direct investment (FDI) (trade), number of international passengers in 2014 (infrastructure), number of highly cited papers between 2010 and 2013 (innovation), mean citation score between 2010 and 2013 (innovation), and average internet download speed in 2014 (infrastructure).

Our analysis proceeded in three steps. First, we applied PCA to reduce the number of dimensions of our data by filtering variables that are highly interrelated while retaining as much variance as possible. PCA generates "components" by applying a linear transformation to all the variables.[3] To successfully perform our clustering algorithm we selected the number of components that explain 80 to 90 percent of the variance of a dataset. For this report we selected the first seven components, which accounted for 84 percent of the total variation of the data.

The second stage applied a k-means algorithm to the seven components, a process which calculates the distance of every observation in our dataset to each other, then generates a cluster centroid and assigns each data point to the closest cluster.[4] K-means repeats this procedure until a local solution is found. This algorithm provides a good segmentation of our data and under most circumstances it is a sufficient method for partitioning data.[5] However k-means sometimes generates clusters with multiple observations, thus obscuring some of the closest economic relationships between metro areas. To improve the results of k-means we implemented a third step, hierarchical clustering, which follows a similar approach to k-means. Hierarchical clustering calculates Euclidean distances to all other observations, but generates a more granular clustering that permits clearer peer-to-peer comparison.

Key variables

Table 1. Main indicators used in the report

Dimension	Indicator	Source
Economic Performance	Gross domestic product	Oxford Economics, Moody's Analytics
	Employment	Oxford Economics, Moody's Analytics
	Gross domestic product per capita	Oxford Economics, Moody's Analytics, U.S. Census Bureau
	Output per worker	Oxford Economics, Moody's Analytics
	GINI coefficient	OECD
Trade	Traded sector output	Oxford Economics, Moody's Analytics
	Traded sector employment	Oxford Economics, Moody's Analytics
	Exports and imports	Statistics Sweden data
	Greenfield foreign direct investment	fDi Intelligence data
Innovation	Share of total publications in top 10 percent cited papers	Centre for Science and Technology Studies (CWTS) and Leiden University data
	Mean citation score 2010-2013	
	Share of total publications done with industry	
	Patent output per 1,000 inhabitants	REGPAT
	Venture capital investments, millions of dollars per 1,000 inhabitants	Pitchbook
	Venture Capital Stock by Industry	
Talent	Share of population 15+ with tertiary education	Oxford Economics, U.S. Census Bureau
	Foreign-born share of total population	Unemployment rate
Infrastructure	Total aviation passengers	SABRE
	Average download speed	Net Index
	Population density	Oxford Economics

DATA SOURCES

Oxford Economics:
Economic indicators as well as selected indicators corresponding to talent for non-U.S. metropolitan areas were provided by Oxford Economics (OE). Economic variable such as GDP, Gross Value Added (GVA), employment, unemployment rates, educational attainment, and industry-level employment and output were collected by OE from national statistics bureaus in each country or from providers such as Haver, ISI Emerging Markets, and Eurostat. Population estimates and the share of the foreign-born population were based on official population projections produced by national statistical agencies and or organizations such as Eurostat, adjusting migration assumptions on a case-by case basis. The study uses gross value added (GVA) and Gross Domestic Product (GDP) in nominal terms at purchasing power parity rates, and in real terms at 2009 prices and expressed in U.S. dollars. All the indicators were provided at the metropolitan level.

Moody's Analytics:
Economic indicators for U.S. metro areas were provided by Moody's Analytics. Moody's uses data published by the Bureau of Labor Statistics (BLS) and by the Bureau of Economic Analysis (BEA) to generate their estimates of employment and GDP at the county level. We aggregated those estimates to metropolitan areas using the current Census Bureau definition. For real GDP, both total and at the industry level, Moody's provides 2009 chained dollars. For nominal analysis they report their estimates in current dollar.

Census Bureau:

The indicators for talent for U.S. metro areas come from a variety of surveys published by the U.S. Census Bureau. The population estimates were created using intercensal population estimates at the county level and then aggregating those estimates to the metro level using the current definitions of metropolitan areas. For the foreign-born share of the population and unemployment rates, we utilized American Community Surveys at the county levels and aggregated them at the metropolitan level. The educational attainment variables were obtained through the Integrated Public Use Microdata Series platform (IPUMS) from the Minnesota Population Center. Data was built up from PUMA level microdata on the educational attainment and age of residents. These age intervals were utilized to comport with the international education attainment levels.

For more information, see Steven Ruggles, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek. Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2015.

REGPAT:

The source of the patents data is the OECD's REGPAT database. The OECD manages this database as part of the Patent Cooperation Treaty, which offers patent protection to organizations and individuals planning to do business in multiple countries. A number of research decisions went into the construction of the patent estimates. Patent locations correspond to the inventor's place of residence or workplace. In cases when there are multiple inventors, the patent was fractionally-counted and apportioned in equal shares to each co-inventor. Patents that fall under multiple International Patent Classification (IPC) technology codes were also apportioned in equal shares to each technology class in order to account for the cross-cutting nature of technological development. To mitigate year-to-year fluctuations in invention activity, patents were summed in five-year intervals. The time dimensions represents the "priority year" when the patent was first filed. This year is closest to the actual date of invention and is the most relevant reference date when assessing an areas technological activity at a specific point in time. Since patent filing is a costly and administratively burdensome process the analysis excludes patents submitted in 2013 and 2014 since patents filed in these years only account for a portion of patents actually invented and may bias places and organizations with better systems for shortening lag time between the date of invention and the application year.

For more information see Maraut, Stephane. Helene Dernis, Colin Webb, Vincenzo Spiezia, and Dominique Guellec. 2008. "The OECD REGPAT Database: A Presentation." June 3, 2008.

http://www.oecd.org/sti/inno/40794372.pdf

Leiden:

The source of the university scientific impact data is the Centre for Science and Technology Studies (CWTS) at Leiden University. This publicly available database tracks bibliometric performance data for 750 universities with the largest publication output in internationally recognized journals. The database relies on the Thomson Reuters Web of Science citations indices which researchers cleansed, geocoded, and classified into fields of study. CWTS reports publications based on full-counting methods which gives equal weight to all publications from a university and fractionally-counting methods which apportion shares to each collaborator. Brookings' analysts focused on fully-counted publications and aggregated the raw university-level citations data into metro-level estimates (see geocoding section below). Mean citation scores were aggregated based on the metro average weighted according to university-level publication count. Brookings analysis primarily focused on two measures. First, the mean normalized citation score is the average number of citations of the publications of a university, normalized for field differences and publication year. A value of two for instance means that the publications of a university have been cited twice above world average. Second, the percent of publication in the top ten percent most cited is the proportion of the publications of a university that, compared with other publications in the same field

and in the same year, belong to the top ten percent most frequently cited.

For more information see Waltman, L., Calero-Medina, C., Kosten, J., Noyons, E.C.M., Tijssen, R.J.W., Van Eck, N.J., Van Leeuwen, T.N., Van Raan, A.F.J., Visser, M.S., & Wouters, P. (2012). The Leiden Ranking 2011/2012: Data collection, indicators, and interpretation. *Journal of the American Society for Information Science and Technology*, 63(12), 2419–2432. **http://www.leiden-ranking.com/methodology**

PitchBook:

The source of the venture capital data is PitchBook, a private financial research firm that collects and tracks global private equity activity. Pitchbook analysts deploy web crawlers to perform a daily systematic scan of media reports and public filing information on deals which they then record and validate through a manual review process. In assembling their database they include address level data for both investors and recipient companies, industry, investor details along with the deal value. Brookings' analysts took the data and then assigned the investors and recipients to metropolitan geographies (see geocoding section below). The primary statistic in the analysis is the cumulative stock of venture capital which is the sum total of year-to-year investment flows. Secondary statistics examine the number of investors and companies along with data between different geographies, deal categories, and industries. The advanced industries classification is an approximate grouping based of detailed industry categories matched to Brookings' NAICS-based definition. All value measures were inflation-adjusted to 2014 dollars.

For more information see PitchBook.com **http://blog.pitchbook.com/wp-content/uploads/2014/06/3Q-2014-PE-Breakdown-Methodology.pdf**

Net Index:

The source of the internet download speed data is Ookla's "Net Index" (now rebranded as "Speedtest Intelligence"). Ookla is a web service that offers free internet speed tests to users as part of an internet intelligence business. The coverage is global in scope because the service relies upon user-submitted tests logged through the speedtest.net website that gauges internet speeds. Ookla reports the raw data at the city-level at the daily frequency which Brookings' aggregated into annual metro-level averages weighted according to the number of tests in each city-day record (see geocoding section below). Since the data is crowd-sourced from users it may be susceptible to bias if users disproportionately share characteristics that diverge from the average internet user in their metro area. One reason to trust the data is that it is unlikely that this bias would systematically vary between metro areas so if there is a "slow" or "fast" bias it would likely affect all places equally. In addition, the vast majority of metros display normal distributions and the sample size is quite large with the average largest 100 metro areas by population recording over 30 million tests in 2014.

For more information see Ookla.com **https://www.ookla.com/speedtest-intelligence**

Sabre:

The source of the aviation data is Sabre Aviation Solutions' global demand dataset (GDD). The dataset includes a record for every international itinerary entering and leaving the United States or any large global metro area with economies larger than $100 billion in 2014. Each record includes the origin and destination airports, plus up to three connecting airports with the number of passengers and total revenue generated from that specific itinerary for that year. The GDD is based on a variety of sources including information developed from direct business relations between Sabre and over 400 global airlines. For international itineraries not reflected in their database, Sabre imputes missing flights and passenger levels based on additional market data. The result is a complete dataset of travel into and out of major global aviation centers. Brookings' performs a number of additional value-adds. These include: assigning all airports to global metropolitan areas (see geocoding section below), obtaining latitude and longitude coordinates to derive distance measures, cleansing

anomalous records, and aggregating the passenger and revenue flows to better facilitate regional analysis. All value measures were inflation-adjusted to 2014 dollars.

For more information see Tomer, Adie, Robert Puentes, and Zachary Neal. 2012. "Global Gateways: International Aviation in Metropolitan America." Brookings Institution. October 25, 2012.

http://www.brookings.edu/~/media/research/files/reports/2012/10/25-global-aviation/25-global-aviation.pdf

FDI Intelligence:

The source of the Greenfield FDI data is the Financial Time's fDi Markets database. This database tracks all cross-border investment into new physical projects or expansions of an existing investment, otherwise known as "Greenfield" investment. Company announcements form the basis for the database and each submission is manually verified before being published. In cases when the capital investment and job counts are not publicly released, analysts impute the value invested and jobs created using an econometric model. The primary sources of the data are newswires, internal sources, top business journals, industry organizations, investment agencies, and data purchased from private vendors. Brookings' analysts assigned metro areas to the city-level information available in the database and processed the flows between different investor and recipient geographies and industry levels. The preferred metric is the cumulative stock of FDI invested and jobs created over the reference period from 2009 to 2015. All value measures were inflation-adjusted to 2014 dollars.

For more information see fDi Markets.com http://www.fdimarkets.com/faqs/

Geocoding Process

An addition layer of data assignment was required for data that was not available at the metropolitan scale. Geographic identifiers were used to process individual data points through the Google Maps Geocoding API to obtain latitude, longitude and other geographic information.[6] Using the latitude and longitude information, we assigned an observation to a metropolitan area using defined geographic boundaries through a geo-intersection.[7] Finally we aggregated observations and created a metropolitan level indicator. We iterated this process several times to ensure data consistency and the adequate allocation of observations to its corresponding geographic boundaries.

APPENDIX ENDNOTES

1. For an overview of the three methods utilized see Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, Springer: New York, 2011.
2. For industry analysis we collected industry-level data and estimates for Real Gross Value Added (GVA). Given the heterogeneity of the industrial classification used among the different metro areas we reclassified all the GVA information into eight major industrial sectors: transportation; utilities; business, financial and professional services; local non market services; construction; trade and tourism; manufacturing; and commodities. To see a complete list of the industries included in these 8 categories see: Parilla and others, *Global Metro Monitor 2014: An uncertain recovery*, Brookings Institution: Washington DC, 2015.
3. See I.T. Jolliffe, Principal component Analysis: Second Edition, Springer: New York, 2002.
4. Similar approaches to quantify complexity of data have been implemented at the national level, see: Ricardo Hausmann, César A. Hidalgo, Sebastián Bustos, Michele Coscia, Alexander Simoes, and Muhammed A. Yildirim, The atlas of economic complexity : mapping paths to prosperity, MIT press: Boston, 2014.
5. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer: New York, 2011
6. For more information on the Google Maps Geocoding API see: **https://developers.google.com/maps/documentation/geocoding/intro**
7. Wilpen L. Gorr and Kristen S. Kurland, GIS Tutorial 1: Basic Workbook, Esri Press: California, 2013.

ENDNOTES

1. We ranked the Gauteng City-Region and its peers along the five quantitative dimensions that this report examines. The categories and indicators we used to create indexed scores are as follows: **economic performance** (indicators: 2000–2014 annual growth in output, employment, productivity, and GDP per capita); **trade** (2000–2014 traded sector output growth; total greenfield FDI investment per 1000 workers, 2009–2014; share of greenfield FDI in tech-intensive industries, 2009–2014; and advanced services connectivity as defined by GaWC, 2012); **innovation** (local universities share of total publications in the top 10 percent of cited papers, 2010–2013; local universities mean citation score, 2010–2013; local universities share of total publications done with industry, 2010-2013; patents per 1,000 inhabitants, 2008–2012; venture capital investment per 1,000 inhabitants); **talent** (unemployment rate (latest year available); share of population above 15 with tertiary education, 2013; share of foreign-born population 2011 or most recent year available; workforce supply, 2014); **infrastructure** (total aviation passengers, 2014; total aviation passengers growth, 2004–2014; broadband download speed, 2014; and population density, 2014). We rank the performance of metropolitan area in a given dimension following the methodology developed in our *Global MetroMonitor* series. For every indicator in a given dimension we take the value of every observation minus the median value of that variable, and then we divide that difference by the distance between the values of that variable at the 90th percentile of the distribution minus the value at 10th percentile. We repeat the process for all the indicators in a dimension and then sum the results to obtain a global score. We rank the metropolitan areas based on these scores for all the dimensions. For the graph that we present we scaled the highest value to 100 and adjusted the remaining scores proportionally. For more information on the variables used see the methodological appendix. For information on the methodology see: Joseph Parilla and others, "Global Metro Monitor 2014: An uncertain recovery" (Washington: Brookings Institution, 2015).
2. James Manyika and others, "Global flows in a digital age," (San Francisco: McKinsey Global Institute, 2014).
3. James Manyika and others, "Disruptive technologies: Advances that will transform life, business, and the global economy," (San Francisco: McKinsey Global Institute, 2013). Carl Benedikt Frey and Michael A. Osborne, "The Future of Employment: How Susceptible are Jobs to Computerization?" (2013).
4. Ibid.
5. Ibid.
6. Rapid urbanization offers rural households access to higher-paid jobs, better education, and more social services. But urbanization also comes with potential downsides if it overwhelms existing infrastructure, degrades the environment, and heightens social and ethnic tensions. Edward Glaeser, *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier* (New York: Penguin Press, 2011). United Nations, "World Urbanization Prospects: 2014 Revision," (2014).
7. Alan Berube and Joseph Parilla, "MetroTrade: Cities Return to their Roots in the Global Economy" (Washington: Brookings Institution, 2012).
8. Brad McDearman, Greg Clark and Joseph Parilla, "The 10 Traits of Globally Fluent Metro Areas" (Washington: Brookings Institution, 2013). Greg Clark and Tim Moonen, "The 10 Traits of Globally Fluent Metro Areas: International Edition" (Washington: Brookings Institution, 2014).
9. Michael E. Porter and Jan W. Rivkin, "The Looming Challenge to U.S. Competitiveness," Harvard Business Review, March 2012. Jan W. Rivkin, Karen G. Mills and Michael E. Porter, "The Challenge of Shared Prosperity: Findings of Harvard Business School's Survey on U.S. Competitiveness" (Cambridge: Harvard Business School, 2015).
10. Ricardo Haussman, "The Economics of Inclusion," *Project Syndicate*, November 7, 2014.
11. Porter and Rivkin, "The Looming Challenge to U.S. Competitiveness." Rivkin and others, "The Challenge of Shared Prosperity."
12. George Washington Institute of Public Policy and RW Ventures, LLC, "Implementing Regionalism: Connecting Emerging Theory and Practice to Inform Economic Development" (Washington: George Washington University, 2011).
13. Ibid.
14. For an overview of the three methods utilized see Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction* (Springer: New York, 2011).
15. Since not all metrics were available across all of the metropolitan peers, non-comparable data and findings from other seminal reports on the Gauteng City-Region by the Gauteng City-Region Observatory, South African Cities Network, OECD, and local and provincial governments are also included to illuminate important trends.
16. Gauteng City-Region Observatory, "The Gauteng City-Region," available at: **www.gcro.ac.za/about/the-gauteng-city-region/** (October 8, 2015).
17. Ibid.
18. Brookings analysis of Oxford Economics data.
19. Employment figures for the years 2009 to 2015 come from the Quarterly Labor Force Survey (QLFS) of Statistics South Africa. This survey was adopted in March 2009 to better measure employment. As a result the employment figures for the years 2000–2008, which were based on the Labor Force Survey (LFS), and the new series were not comparable. To bridge this gap in the times series Oxford Economics estimated employment between 2007 and 2008 using GVA series and sectoral productivity trends. The data prior to 2007 was estimated using a combination of sectoral GVA, productivity trends and total employment from the original LFS. By using total employment data from the original LFS, the estimated profile follows the pattern of the original series. At each stage of the process, all provinces were constrained to be consistent with the national total.
20. Real output per person is a standard metric to measure standards of living and used in the United Nations Development Programme's work to gauge human progress. United Nations Development Programme, "Human Development Report 2013, The Rise of the South: Human Progress in a Diverse World" (2013).
21. Robert D. Atkinson, "Competitiveness, Innovation and Productivity: Clearing up the Confusion" (Washington: The Information Technology and Innovation Foundation, 2013).
22. Jonathan D. Ostry, Andrew Berg, Charalambos G. Tsangarides "Redistribution, Inequality, and Growth" (Washington: International Monetary Fund, 2014).
23. Louis Boshoff and others, "2013 State of City Finances: Towards sustainable municipal finances" (Johannesburg: South African Cities Network, 2013). Graeme Gotz and others, "Changing spatial inequality across the GCR," (Johannesburg: Gauteng City-Region Observatory, 2014).
24. United Nations Human Settlements Programme, "State of the World's Cities 2012/2013: Prosperity of Cities" (2013). World Bank Development Indicators, "GINI Index," available at: **data.worldbank.org/indicator/SI.POV.GINI**.

25. Masahisa Fujita, Paul R. Krugman, and Anthony Venables. *The Spatial Economy* (Cambridge: MIT Press, 1999). The simple model of base-multiplier analysis has not been immune from criticism—most importantly, that by focusing only on the demand side of the regional growth equation, it overlooks important supply-side factors like capital and labor flows, including the self-reinforcing process of agglomeration. See, e.g., Andrew Krikelas, "Review of Economic Base Literature." *Economic Review* (Federal Reserve Bank of Atlanta, 1992).

26. Marc J. Melitz and Daniel Trefler, "Gains from Trade When Firms Matter." *Journal of Economic Perspectives* 26(2) (2012): 91–118. OECD, "Interconnected Economies"; World Trade Organization, "World Trade Report 2013."

27. Defining a "tradable" industry has become more complicated as technology and transportation have redefined the types of economic activity that can be traded. In order to compare metropolitan areas in different countries, this analysis defines the tradable industries as: Agriculture, forestry & fishing; Mining; Manufacturing; Transport and communications; and Financial & business services. This definition is based on previous analysis by Spence and Hlatshwayo (2011) and Jensen and Kletzer (2005), but we were unable to recreate exactly the industrial definitions from these analysis. For instance, financial and business services include real estate activities, which are not tradable. A. Michael Spence and Sandile Hlatshwayo, "The Evolving Structure of the American Economy and the Employment Challenge" (New York: Council on Foreign Relations, 2011). J. Bradford Jensen and Lori G. Kletzer, "Tradable Services: Understanding the Scope and Impact of Services Outsourcing" (Washington: Peter G. Peterson Institute for International Economics, 2005).

28. For example one dollar's worth of a manufactured good generates a demand of 1.5 dollars in other sectors of the economy. Stephen Gold, "The Competitive Edge: Manufacturing's Multiplier Effect—It's Bigger Than You Think," *Industry Week*, 2014, available at: **www.industryweek.com/global-economy/competitive-edge-manufacturings-multiplier-effect-its-bigger-you-think**. Enrico Moretti, *The New Geography of Jobs* (New York: Houghton Mifflin Harcourt, 2012). Stephen J. Ezell and Robert D. Atkinson, "Fifty Ways to Leave Your Competitiveness Woes Behind: A National Traded Sector Competitiveness Strategy" (Washington: Information Technology and Innovation Foundation, 2012). Jonathan Cummings and others, "Growth and competitiveness in the United States: The role of its multinational companies" (San Francisco: McKinsey Global Institute, 2010).

29. The Gauteng City-Region Observatory (GCRO), who partnered with the Brookings Institution on the research for this report, is acknowledged for extracting, and furnishing to Brookings specific Quantec data used at various points in this City Profile. Under the auspices of a license for Quantec data held by the University of the Witwatersrand (Wits) where GCRO is based, which license was jointly paid for by GCRO, GCRO accessed selected Quantec datasets and provided data to Brookings as excel tables for the purposes of analysis. Quantec is referenced as the original source of the data wherever applicable.

30. N Ehlers, L Mboji and M M Smal, "The pace of potential output growth in the South African economy" Working Paper (Johannesburg: South African Reserve Bank, 2013).

31. Nir Klein, "Measuring the Potential Output of South Africa" (Washington: International Monetary Fund, 2011).

32. Adie Tomer, Robert Puentes and Joseph Kane, "Metro-to-Metro: Global and Domestic Goods Trade in Metropolitan America" (Washington: Brookings Institution, 2013).

33. Brookings analyzed trade data from Quantec, a data provider that receives provincial trade statistics from SARS, which provides the following disclaimer. "The import and export statistics from SARS are tied to postal codes. These are the postal codes of the head office or agent that report importing and exporting activity. Quantec publishes the import and export statistics for each province and municipality by aggregating the figures for all the postal codes in each province or municipality. The data Quantec receives from SARS incorporates two issues over which Quantec has no control. First, the postal code may not reflect the actual importer/exporter address but that of an agent that handles the actual international trade (smaller agricultural exporters are sometimes a good example of this). The agent may therefore not be in the same province/municipality as the exporter or importer. Second, the importer or exporter may have several branches but all international trade transactions are handled by head office (the petroleum and mining industries are sometimes a good example of this). The head office may therefore not be in the same province/municipality as the branches."

34. Brookings analysis of Quantec data.

35. Acha Leke and others, "South Africa's bold priorities for inclusive growth" (Johannesburg: McKinsey Global Institute, 2015).

36. Mark Muro and others, "America's Advanced Industries" (Washington: Brookings Institution, 2015).

37. Brookings analysis of fDi Intelligence data. Richard Dobbs and others, "Urban world: The shifting global business landscape" (San Francisco: McKinsey Global Institute, 2013).

38. Brookings analysis of data from the Globalization and World Cities Network (GaWC).

39. Saskia Sassen, *Cities in a World Economy: Fourth Edition* (Los Angeles: Pine Forge Press, 2012).

40. Ibid.

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