Urbanization, Structural Transformation and Rural-Urban Linkages in South Africa

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Summary

South Africa faces many challenges, including modest economic growth and negative structural change, as well as high unemployment and inequality, and persistent poverty. Urbanization over the last two decades is an additional concern. Migration and population growth are highest in metropolitan areas, and even though poverty is more pronounced in rural areas, there are concerns about an "urbanization of poverty". In response, this paper considers three broad strategies for national development and urban planning. First, investment more in major cities to accommodate migrants and prevent urban poverty from worsening. Second, maintain (or expand) investments in rural areas to provide job and income opportunities for poor rural households who would otherwise migrate to cities. Third, invest in towns and secondary cities given their supposedly stronger linkages to the rural poor.

We examine these three options using an economywide model of South Africa's rural and urban economies. Simulations indicate that faster urbanization can act as a catalyst for faster economic growth and structural transformation. However, without supporting investments in urban infrastructure and services, urbanization may lead to higher urban poverty, especially in major cities. Importantly, we find that investing in cities and towns should not be at the expense of rural areas. Financing urbanization by reducing rural investment is found to be counterproductive. Adverse effects on farming, food prices, and rural migration worsen, rather than improve, the urban poverty.

Concerns about urbanization and urban poverty reflect more fundamental weaknesses in South Africa's economy, particularly slow growth and a shift away from agriculture, mining and manufacturing, which have, in the past, been some of the country's more productive and labor-intensive sectors. Thus, while urbanization poses many challenges, it is slow economic growth and deindustrialization there are severely limiting the capacity of South Africa's urban areas to accommodate and employ rural migrants. Investing in the growing number of people living in larger cities, without neglecting the already-large and poor rural population, remains one of South Africa's most difficult development challenges.

1. Introduction

South Africa has experienced steady urbanization over the last two decades. Although urbanization is usually associated with economic development, South Africa enjoyed only modest economic growth, negative structural change, and inadequate job creation and poverty reduction. This suggests three broad pathways for South Africa's national development strategy:

First, poverty and unemployment are most pronounced in rural areas. Many of the poorest households live in rural areas, especially the former "homelands", where public services and infrastructure are least developed. Most migrants arriving in cities come from rural areas in search of better jobs, but high levels of urban unemployment could lead to an "urbanization of poverty". Investing in rural areas and promoting agriculture may provide an opportunity to reduce internal migration and provide better income and job opportunities in rural areas. It may also reduce national poverty and narrow the urban-rural divide.

Second, faster growth outside of agriculture and mining over the last two decades suggests that the growth potential of major metropolitan areas may be far greater than that of rural areas and small towns. An alternative strategy would direct investments towards major metropolitan areas to accelerate the pace of nonagricultural growth, create more productive jobs, and prevent poverty for worsening amongst a fast-growing urban population. Urban growth can also generate positive agglomeration effects that arise when workers and economic activities are concentrated within more densely-populated locations. An urban-oriented strategy might encourage more people to migrate to major cities where poverty and the cost of providing public services are lower.

A third intermediate strategy is to invest in smaller urban centers. Small town development could, for example, strengthen the linkages between rural agriculture and other sectors (via product markets) and provide opportunities for smallholders and their family members to diversify incomes (perhaps via seasonal and circular migration). Developing small towns might therefore lead to incremental improvements along agricultural value-chains, while also providing a more gradual employment

transition for people looking to leave agriculture and rural areas. Small towns might provide a "middle path" towards more inclusive urbanization and the development of nearby rural economies.

South Africa's national strategy will inevitably involve a combination of investments in both rural and urban areas. Nevertheless, it is important to understand the relative benefits and trade-offs between alternative pathways. This paper addresses three broad policy questions: (i) what role do urban centers play in the national growth and development process? (ii) what would be the economic implications of accelerated urbanization? And (iii) what are the synergies and trade-offs from investing in major cities, smaller towns, or rural areas?

We first review national growth and employment trends over the last two decades (Section 2). We find that while workers are leaving agriculture, they are not necessarily finding more productive work in other sectors. In fact, many of South Africa's more productive sectors, such as manufacturing and mining, have experienced a fall in employment. This process of decline is known as "negative structural change" and is not typically associated with long-term economic development (see McMillan et al. 2014).

To provide an empirical basis for forward-looking analysis, we draw on a range of data sources, including household and labor force surveys, to spatially disaggregate national economic statistics across major metropolitan cities; smaller cities and towns; and rural areas (Section 3). Past trends suggest that most of South Africa's population and economic growth and job creation is driven from within the Gauteng and Cape Town metropolitan areas, although faster in-migration and population growth in these areas is not translating into equally fast job creation, such that per capita incomes are rising more slowly than elsewhere in the country, including in rural areas. This underscores the potential trade-off between alternative future pathways.

Drawing on a new spatial database (Section 4), we develop an economywide model that distinguishes between major cities, small towns, and rural areas (Section 5). The model captures many of the arguments for and against urban-oriented investment strategies, including internal labor migration, urban "congestion" effects, and potential growth-enhancing urban agglomeration effects. The model is used to experiment with alternative future scenarios, including faster urbanization and a reallocation of public investments across urban and rural areas (Section 6). We conclude by summarizing our findings and discussing their implications for South African policy.

2. National Growth and Structural Change

To contextualize our study of spatial dynamics, it is important to first understand the national drivers of economic change. National GDP growth in South Africa averaged 2.7 percent per year between 1993 and 2016. This exceeded population growth of 1.6 percent per year, such that GDP per capita increased by almost a third – from R37,800 in 1993 to R49,100 in 2016 (measured in constant 2010 prices).

Even though economic growth was modest, South Africa still experienced a shift in employment patterns out of agriculture, mining and manufacturing. As shown in Table 1, services were the main driver of economic growth over the last two decades. Despite declining employment in agriculture and manufacturing, both sectors increased GDP, leading to sizable gains in average GDP per worker (labor productivity). This is consistent with South Africa's dual agricultural system, in which a relatively small number of large-scale commercial farms produce almost all agricultural output, whereas a larger number of smallholder farmers produce mainly for subsistence. Under this configuration of the agricultural sector, an exodus of workers from smallholder farms would not necessarily affect formal agricultural production. Similarly, a decline in manufacturing employment may be associated with firms outsourcing demand for professional and technical services, as well as a shift towards short-term contract work via labor brokers, whose businesses form part of the service sector. Overall, trade and business services together accounted for two-fifths of total economic growth and three-fifths of net job creation since 1993.

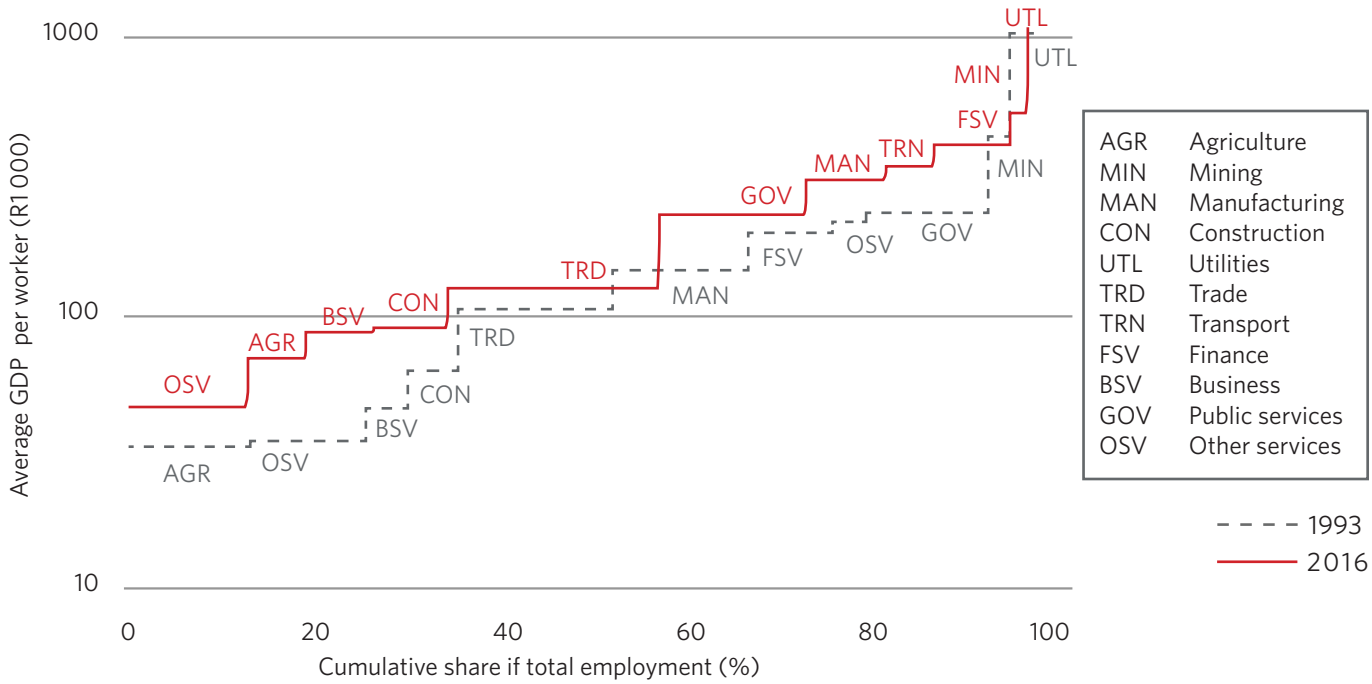
Table 1: Summary Statistics

	1993	2016	Annual growth, 1993-2016
GDP (R mil.)	1,476	2,733	2.7
Agriculture	50	66	1.2
Mining	240	223	-0.3
Manufacturing	231	380	2.2
Other industry	86	172	3.1
Services	869	1,892	3.4
Employment (1000s)	11,660	15,913	1.4
Agriculture	1,590	1,020	-1.9
Mining	616	463	-1.2
Manufacturing	1,743	1,380	-1.0
Other industry	711	1,378	2.9
Services	7,001	11,673	2.2
GDP per worker (R)	126,583	171,740	1.3
Agriculture	31,309	64,230	3.2
Mining	390,279	481,703	0.9
Manufacturing	132,551	275,362	3.2
Other industry	120,313	125,063	0.2

Source: Own calculations using SASID data from Quantec (2017).

Long-term economic development is usually associated with "positive structural change", which is a process in which workers move from less to more productive sectors, thereby raising national average labor productivity. Figure 1 shows average GDP per worker across sectors, as well as the cumulative share of each sector in total employment, both for 1993 (checked line) and 2016 (solid line). Note that GDP includes compensation of employees and gross operating surplus, and so GDP per worker is higher than wages and salaries. Labor productivity is low in agriculture (AGR) at R64,200 per worker per year in 2016. This means that the falling share of workers in agriculture raised national average GDP per worker. Conversely, labor productivity is high in mining (MIN) and so the decline in mining's employment share lowered the national average. Labor productivity is lowest in "other services" (OSV), which includes domestic workers and other elementary occupations, and is highest in utilities (UTL), which includes electricity, gas and water distribution.

Figure 1: Employment Shares and GDP per Worker, 1993 and 2016



Source: Own calculations using SASID data from Quantec (2017).

The solid line lies almost entirely above the checked line in Figure 1, indicating that average labor productivity increased in almost every sector. We follow McMillan et al. (2014) by decomposing economywide labor productivity into two components: (i) within-sector gains in worker productivity; and (ii) gains arising from workers moving between sectors. The first component is the sum of sectoral productivity changes weighted by initial employment shares, assuming that changes in national employment are distributed proportionally across sectors. The second component is the additional effect of reallocating labor across sectors after accounting for changes in sectoral productivity. When workers move, in aggregate, from low to high productivity sectors or when job creation is faster in higher productivity sectors, then structural change is said to have contributed positively to national labor productivity. Table 2 reports the results from the growth decomposition analysis.

Table 2: Sectoral Decomposition of Labor Productivity Gains, 1993-2016

	Change in value-added per worker (US$)		
	Within-sectors	Between-sectors	Total change
Total for all sectors	56,000	-10,843	45,158
Agriculture	4,417	-4,570	-152
Mining	2,678	-9,273	-6,595
Manufacturing	21,604	-17,535	4,069
Other industry	1,658	1,830	3,488
Services	25,643	18,706	44,348

Source: Own calculations using SASID data from Quantec (2017).

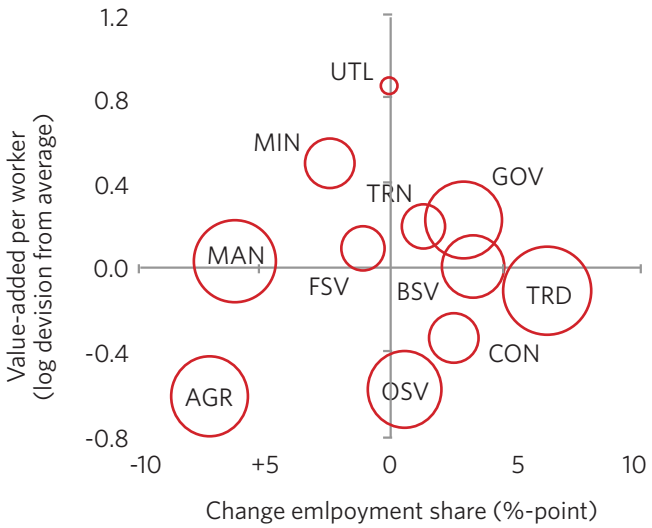
National GDP per worker increased by 45,200 between

1993 and 2016 (i.e., roughly R171,700 minus R126,600 – see Table 1). During this period, South Africa experienced negative structural change caused by workers moving out of agriculture, mining and manufacturing into services and other industries. In other words, initial GDP per worker for agriculture, mining and manufacturing combined was higher than the average GDP per worker in services and other industries, where employment share rose. The driver of economic growth was therefore rising labor productivity within sectors, rather than a movement of workers from less to more productive sectors. As mentioned, it is likely that it was less-productive workers within agriculture and manufacturing who exited these sectors, causing average productivity of those workers who remained behind to increase. In addition, production patterns within agriculture and manufacturing shifted towards more capital-intensive subsectors (e.g., a relative decline in labor-intensive textiles and clothing). Most important, however, is that the large increase in the number of workers in services did not drive down this sector's labor productivity. In fact, the within-sector productivity gains within services accounted for more than half of the overall increase in national GDP per worker. As a result, services have accounted for almost all economic growth in South Africa over the last two decades.

Figure 2 helps visualize the process of structural change. The vertical axis shows sectoral productivity relative to economy-wide productivity. A positive value means that a sector generated above-average value-added per worker in 1993. The horizontal axis shows the percentage point change in employment shares from 1993 to 2016. A negative value means that a sector's share of total employment fell, even though employment in the sector may have grown in absolute terms. Finally, the size of the circles represents a sector's initial contribution to total employment. Trade (TRD) has the largest circle because it accounted for 16.9 percent of total employment in 1993.

Figure 2: Structural Change in South Africa, 1993-2016

Source: Own calculations using SASID data from Quantec (2017).



Notes: Size of circle equals initial employment share. AGR is agriculture; MIN is mining; MAN is manufacturing; UTL is utilities (electricity and water); CON is construction; TRD is trade services; TRN is transport and communication; FSV is financial and business services; and OSV is public and community services.

Agriculture's share of total employment fell by 7.2 percentage points over a 23-year period. Agriculture also had the lowest average GDP per worker. Taken together, this places agriculture on the lower left-hand side of the figure. Mining and manufacturing's employment shares also declined, but labor productivity in these sectors was above the national average in 1993, and so they lie in the upper left-hand side of the figure. Employment shares increased for trade, business (BSV) and government services (GOV). However, it is clear from the figure that, except for government and transport services, the sectors with rising employment shares tended to have below-average productivity levels, at least initially. Overall, the figure shows how the shift from manufacturing to retail trade was largely offsetting and productivity-neutral.

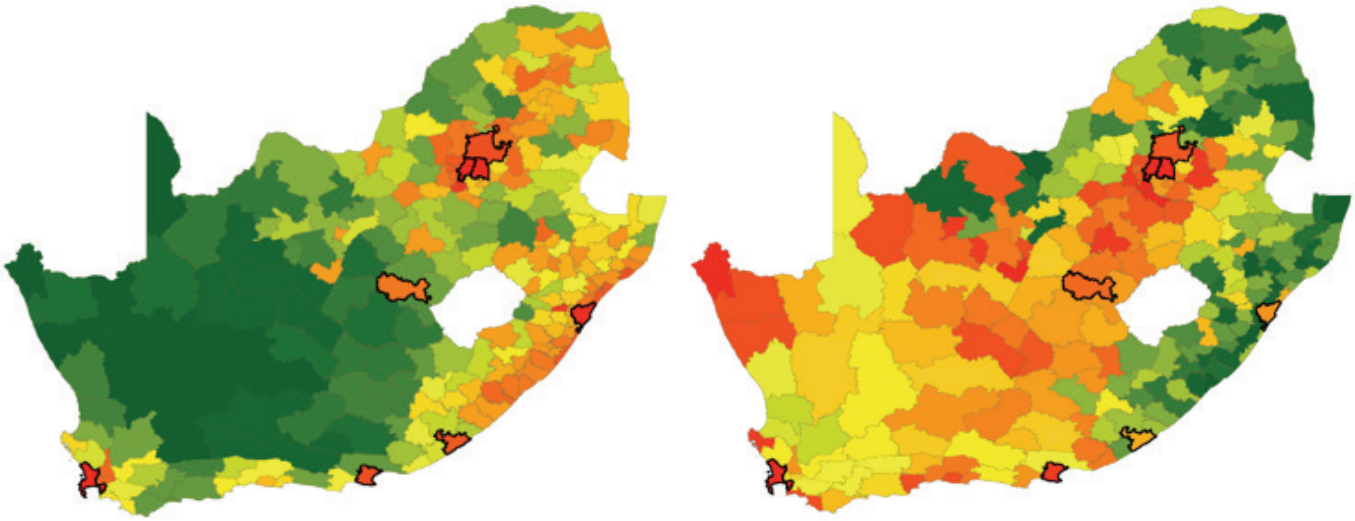
In summary, South Africa experienced modest economic growth by the standards of other emerging economies. Moreover, the growth that has occurred was not associated with positive structural change, which is typically viewed as an essential driver of long-term economic development. While growth in most successful developing countries, particularly in East Asia, was led by export-oriented manufacturing, South Africa's decline in agriculture and mining coincided with falling employment in manufacturing. Sectors that have performed better include construction and services, but labor productivity in these sectors is relatively low. The reliance on trade services as a source of employment for new job seekers raises concerns about the sustainability of South Africa's current development trajectory and the ability of urban areas to absorb rural migrants. The next section decomposes national growth and employment trends across rural and urban areas.

3. Unpacking Urban and Rural Economies

South Africa's metropolitan and municipal areas

The 2011 demarcation of subnational areas separated South Africa into eight metropolitan municipalities and 226 local municipalities. Although the latter were reduced to 205 local municipalities in 2016, our analysis is based on the Quantec database which continues to use the 2011 demarcation. Metropolitan municipalities are governed as single entities and their definition aims to identify areas with strong interdependent social and economic linkages. Figure 3 shows all 234 municipal areas, with the eight metro areas outlined in bold. The left-hand panel shows relative population densities of each municipality, and the right-hand panel shows the share of municipal populations living in urban settlements.

Figure 3: Municipal Population Densities and Urbanization Rates, 2011



Population density (people per square kilometer)

Urban share of municipal population (%)

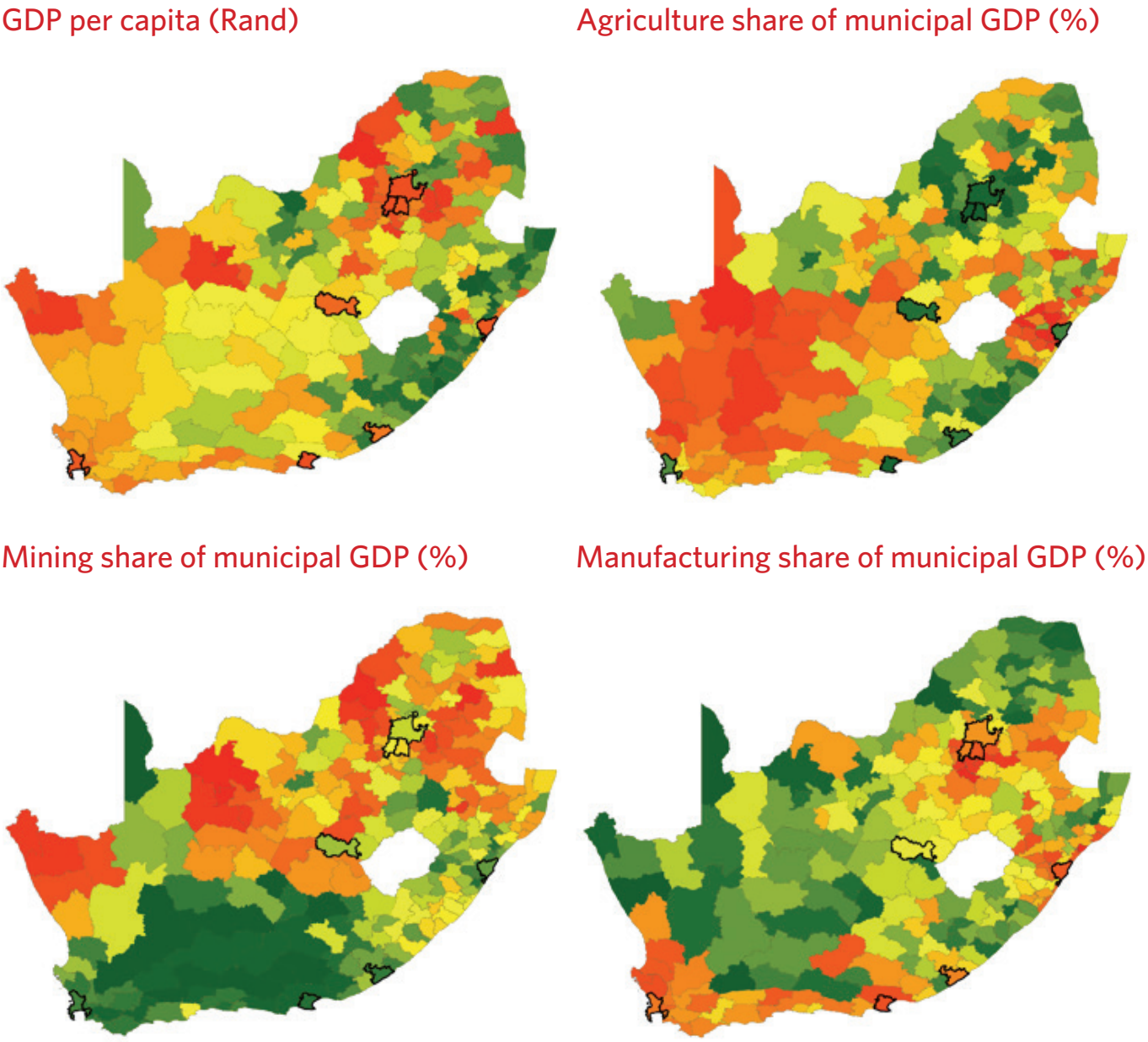
Source: Own calculations using Quantec (2017).
Note: Red (green) indicates higher (lower) density or urban shares.

Five characteristics of South Africa's municipal demographic structure are apparent from the figure. First, as expected, population densities and urban population shares tend to be highest in the metro areas. Second, there are local municipalities that are densely populated and highly urbanized, even though they are not classified as metropolitan areas. Most of these municipalities lie to the south and west of the three contiguous Gauteng metros (i.e., City of Johannesburg, City of Tshwane, and Ekurhuleni). There are also "dense urban" areas immediately adjacent to the two major coastal metros (i.e., City of Cape Town and eThekwini). Third, the figure shows that there are highly urbanized municipalities that have low population densities. Most of these are in the inland parts of the Western and Northern Cape. They include semi-arid regions where most of municipal populations live in small towns. An example of a "sparse urban" area might be mining towns bordering the Karoo desert.

Fourth, there are sparsely populated municipalities with high rural population shares. These "sparse rural" areas tend to be the former Apartheid homelands governed by traditional or tribal authorities (e.g., the region slightly inland from the coast running from the Eastern Cape into KwaZulu-Natal and then inland into Mpumalanga and Limpopo). Finally, there are densely-populated municipalities with large rural populations. These "dense rural" areas are mainly along the KwaZulu-Natal coastline or are north of the three Gauteng metros.

Figure 4 reports average GDP per capita in each municipality, along with the share of GDP generated by agriculture, mining or manufacturing. GDP per capita is highest in more urbanized municipalities, especially in the eight metropolitan centers and their surrounding urban areas. These areas tend to be where manufacturing and/or mining are most important. In contrast, agriculture is most important in rural KwaZulu-Natal and in the "sparse urban" areas of the Western and Northern Cape. Finally, services – the main residual sector after accounting for the three shown in the figure – are most important in the former Apartheid homelands in the Eastern Cape, KwaZulu-Natal and Limpopo.

Figure 4: Relative Levels and Sources of Municipal GDP, 2016



Source: Own calculations using Quantec (2017).
Note: Red (green) indicates higher (lower) GDP levels or sectoral shares. Scale varies across panels.

Classifying urban and rural municipalities

The Government of South African officially separates municipalities into the five categories. The first category (denoted "A") includes the country's eight metropolitan areas. As shown in Figure 5, we further separate metro areas into two groups. Group A1 includes the four Gauteng and Cape Town metros, and A2 includes the remaining four metros. Local municipalities are divided into four groups: secondary cities (B1); large towns (B2); small towns (B3); and rural areas (B4).

By design, the official classification closely correlates with average municipal population densities and the share of municipal population living within urban settlements. This is shown in Figure 6, which also shows the national average population density in 2011 (42.4 people per square kilometer) and urban population share (62.9 percent). Not surprisingly, the metro areas (A1 and A2) lie in the top right-hand side of the figure, indicating both high population density and high urban population share. Secondary cities (B1) and large towns (B2) also tend to lie within this quadrant.

Figure 5: Classification of Municipalities into Urban and Rural Areas

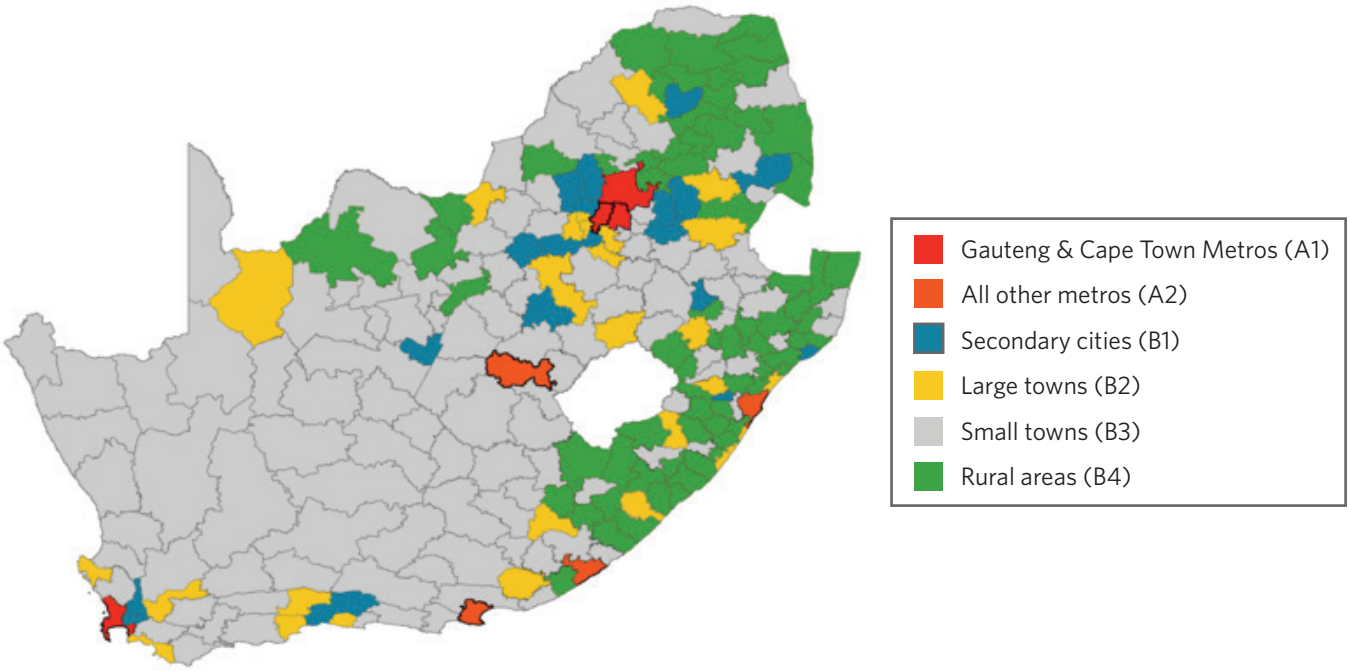
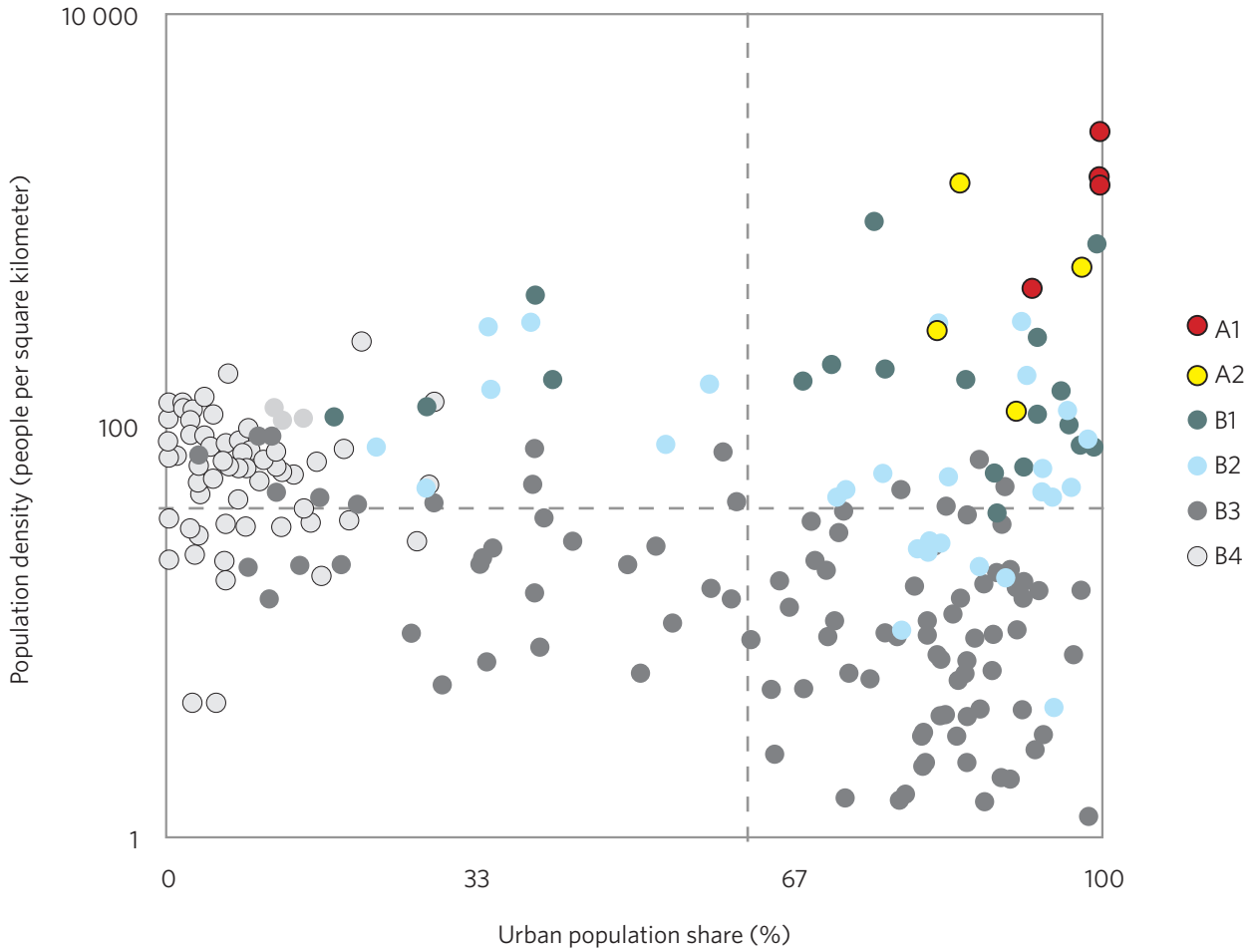


Figure 6: Urban Population Shares and Population Densities, 2011



Source: Own calculations using 2011 Population Census data and municipal demarcation from Quantec (2017).

In contrast, most municipal areas that are classified as small towns (B3) lie in the bottom right-hand quadrant of the figure, indicating that, despite having a low population density, a large share of their municipal populations live in urban centers. As discussed earlier, these municipalities tend to include the sparsely-populated areas of the Western and North Cape and Free State provinces, where mining and manufacturing tend to be relatively more important. Conversely, most municipal areas classified as "rural areas" (B4) tend to have low urban population shares, but also above-average population density. These typically include the more densely-populated former homeland areas, where agriculture is relatively more important.

Table 3 provides summary statistics for the six groups. About two-fifths of South Africa's population live in metro areas, which together generate 55.9 percent of national GDP. GDP per capita is therefore highest in these areas, particularly in the Gauteng and Cape Town metros (A1). Secondary cities (B1) areas also enjoy above-average GDP per capita and labor productivity. Mining is particularly important in both secondary cities and small towns, where the sector accounts for over a fifth of average municipal GDP. Mining is capital-intensive and so while GDP per worker is high, miners themselves tend to earn lower wages and are generally less-skilled. This explains why relatively few workers in small towns (B3) are classified as "skilled".[1]

Table 3. Summary Statistics for Urban-Rural Regions, 2016

	South Africa	Gauteng & Cape Town (A1)	Other metros (A2)	Secondary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)
Population (mil.)	55.6	16.0	6.3	7.9	4.5	7.5	13.4
Share (%)	100	28.7	11.4	14.2	8.0	13.5	24.2
Urban pop. share, 2011 (%)	0.91	98.1	87.6	71.9	65.7	58.5	7.9
Pop. density (people/sq. km)	4.71	1,155	466	137	43	9	52
Total GDP (R bil.)	2,733	1,118	408	485	201	292	229
Share (%)	100	40.9	14.9	17.7	7.4	10.7	8.4
Employment (mil.)	15.9	6.2	2.0	2.6	1.3	2.0	1.7
Share (%)	100	39.0	12.8	16.3	8.2	12.8	10.8
Unemployment rate (%)	26.6	22.8	27.2	25.7	25.0	23.5	40.9
GDP per capita (R1000)	49.1	70.0	64.5	61.2	45.1	38.9	17.0
GDP per worker (R1000)	171.7	180.0	200.6	186.3	153.7	143.2	133.2
Share of population (%)	100	100	100	100	100	100	100
Black African	79.2	66.8	73.8	79.6	77.1	74.6	98.7
White	8.9	15.5	8.8	11.2	9.4	7.4	0.7
Other	11.9	17.6	17.5	9.3	13.6	17.9	0.6
Share of GDP (%)	100	100	100	100	100	100	100
Agriculture share	2.5	0.6	0.9	1.7	4.6	9.2	5.5
Mining share	8.2	1.0	0.3	21.0	8.6	21.0	13.1
Manufacturing share	13.9	15.2	18.3	13.6	14.8	8.7	6.4
Other sectors	75.5	83.2	80.5	63.7	72.0	61.0	75.0
Employment share (%)	100	100	100	100	100	100	100
Formal share	74.3	75.8	76.1	75.1	73.8	72.4	68.3
Skilled	19.1	23.1	21.5	16.7	16.1	12.0	16.0
Semi-skilled	34.8	36.1	36.5	37.4	34.2	31.3	29.1
Low-skilled	20.4	16.7	18.1	20.9	23.6	29.1	23.2
Informal	25.7	24.2	23.9	24.9	26.2	27.6	31.7

Source: Own calculations using 2016 SASID and 2011 Population Census data and 2011 municipal demarcation from Quantec (2017).
Note: CPT is Cape Town. Population density and urban population are for 2011.

[1] *The classification of skills is based on occupation. Skilled workers include managers, professionals and technicians; semi-skilled include clerks, skilled farmers (includes smallholder farmers); crafts people and related*

The rural group of municipal areas contains a quarter of the country's population. Rural areas have much lower GDP per capita, although the gap in GDP per worker is less pronounced. This reflects high unemployment rates in rural areas, which reduces GDP per capita even if GDP per worker remains closer to those of the urban groups. As mentioned, one of the defining features of rural economies in South Africa is not so much their dependence on agriculture, whose share of GDP is still quite low, but rather their high dependence on services, particularly government services and education. Manufacturing in rural areas is more focused on food processing and other "light industries".

Table 4 summarizes information on household assets and services drawn from the 2011 Population Census. Most households in metro areas and secondary cities (A1, A2 and B1) live in houses or apartments made of brick or cinder blocks and have access to electricity, piped water, and a flush toilet within the house or yard. In contrast, only a third of households in rural areas (B4) have access to piped water and less than one in six have a flush toilet in the house. Electricity access in rural areas is quite high, although, unlike urban households, very few have refuse collected and disposed of by local authorities. Rural households also tend to have fewer assets, although a majority own mobile phones, televisions and radios. Finally, relatively few South African households have access to the internet and computers (either at home, work or school), but access is particularly low in rural areas.

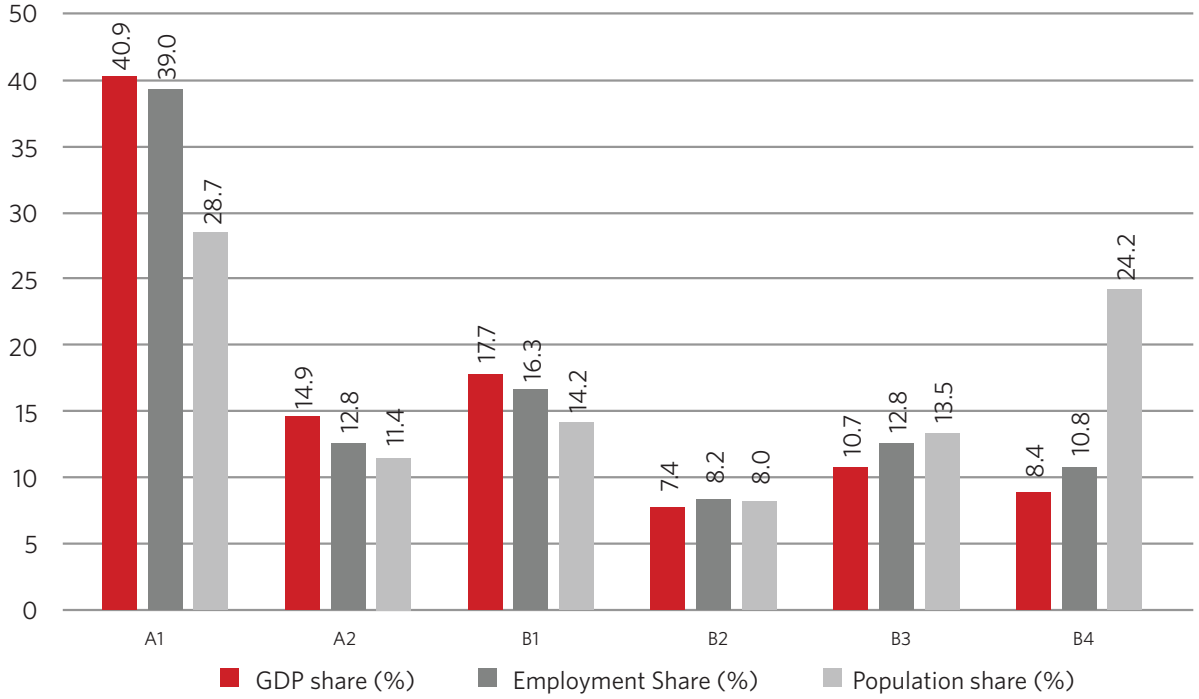
Table 4: Household Assets and Services, 2011

	Share of households with the following characteristics or owned assets (%)						
	South Africa	Gauteng & Cape Town (A1)	Other metros (A2)	Secondary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)
Brick house or apartment	73.9	73.7	77.9	75.8	75.8	76.5	68.3
Piped water	73.4	89.0	82.0	84.1	71.3	75.9	37.5
Flush or chemical toilet	62.6	87.8	76.2	68.7	63.6	61.0	14.8
Electricity or solar power	85.1	89.4	89.3	87.9	85.0	83.2	76.0
Authority-collected refuse	62.1	90.5	82.5	66.7	63.5	53.6	10.9
Washing machine/vacuum	67.5	69.9	71.7	69.7	67.2	65.8	61.1
Electric/gas stove	77.0	85.1	84.0	81.6	77.7	75.4	59.0
Refrigerator	68.5	75.4	74.5	72.1	67.3	63.5	56.0
Motor vehicle	29.6	40.7	32.3	31.3	28.6	24.0	14.7
Landline or mobile phone	90.0	94.7	90.7	91.8	88.7	84.5	85.3
Television	75.1	83.2	80.0	78.1	74.6	70.5	61.3
Radio	67.5	69.9	71.7	69.7	67.2	65.8	61.1
Internet access	35.4	48.5	38.8	35.9	31.7	25.8	21.7
Computer	21.4	33.7	24.3	22.3	18.5	13.9	7.1

Source: Own calculations using Population Census data and 2011 municipal demarcation from Quantec (2017).
Note: Refuse collection done by local authority at least once a week. Flush toilet connected to sewage system or with septic tank. Internet access may be outside the house or place or work.

In summary, South Africa has a clear urban-rural divide. GDP shares are larger than population and employment shares in more urbanized areas, and so these areas have higher GDP per capita and per worker. As shown in Figure 7, the largest difference in GDP per capita is between the Gauteng and Cape Town metros (A1) and rural municipalities (B4). A1 accounts for 41 percent of national GDP, but only 29 percent of the population, whereas B4 accounts for 8 percent of GDP and 24 percent of the population. This suggests that there is "excess" population (relative to GDP) residing within rural areas (B4) and excess GDP (relative to population) in the country's largest metro areas (A1). This explains rapid migration flows from the former to the latter, which largely define South Africa demographic change over the last two decades. These dynamics are described next.

Figure 7: South Africa's Rural-Urban Divide, 2016



Source: Own calculations using 2016 SASID data and 2011 municipal demarcation from Quantec (2017).

Spatial drivers of growth and structural change

The rural-urban divide in South Africa is the product of long-term economic and demographic trends. Table 5 reports average annual growth rates for GDP, employment and populations. In absolute terms, metropolitan areas (A1 and A2) have dominated the national GDP growth process. However, population growth in the A1 metro areas is much higher than in A2. In fact, dependency ratios are rising everywhere, except in A2 (where they are largely constant) and in B4 (where they are falling). As a result, per capita GDP growth in the A1 metros is only half the rate of growth in the A2 metros. The rural-urban divide may also be narrowing, as measured by growth in per capita GDP.

Table 5: Population and Economic Growth Dynamics, 1993-2016

	South Africa	Gauteng & Cape Town (A1)	Other metros (A2)	Secondary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)
Annual GDP growth (%)	2.7	3.5	2.8	1.9	1.8	2.3	2.5
Employment growth (%)	1.4	1.7	1.2	1.2	0.9	0.9	1.4
GDP per worker growth (%)	1.3	1.7	1.5	0.7	0.9	1.4	1.1
Population growth (%)	1.6	2.6	1.2	1.7	1.4	1.1	0.8
GDP per capita growth (%)	1.1	0.8	1.6	0.3	0.4	1.1	1.6

Source: Own calculations using 2016 SASID and 2011 Population Census data and 2011 municipal demarcation from Quantec (2017).
Note: CPT is Cape Town. Population density and urban population are for 2011.

One of the main advantages of adopting the official municipal-level definition of urban and rural areas is that we can decompose the drivers of growth and structural change across the six subnational regions. Table 6 recasts the sectoral decomposition analysis from Table 2 across spatial regions. As discussed earlier, average GDP per worker in South Africa increased by R45,200 between 1993 and 2016. Most of this increase occurred within metropolitan areas and was driven by large productivity gains within sectors. However, the table now separates productivity gains arising from not only the movement of workers between sectors, but also between low and high productivity municipalities. Overall, inter-group migration contributed very little to total labor productivity growth (i.e., about R1000 out of the R45,200 gain in GDP per worker). However, this hides substantial gains within the Gauteng and Cape Town metros, which enjoyed faster employment growth (i.e., an inflow of workers from other regions). Employment growth in large and small towns (B2 and B3) was particularly weak over the two decades, in part due to these regions' dependence on mining and manufacturing employment, both of which declined considerably over this period (see Figure 2).

Table 6: Regional Decomposition of Labor Productivity Gains, 1993-2016

	Change in value-added per worker (US$)			
	Within-sectors	Between-regions	Between-sectors	Total change
South Africa	56,000	1,032	-11,874	45,158
Gauteng & CPT (A1)	26,935	6,365	-6,927	26,373
Other metros (A2)	9,985	-849	-2,083	7,053
Secondary cities (B1)	8,249	-1,011	-3,446	3,792
Large towns (B2)	4,181	-1,581	-1,319	1,281
Small towns (B3)	4,277	-2,084	1,231	3,423
Rural areas (B4)	2,374	192	669	3,235

Source: Own calculations using SASID data from Quantec (2017).

Finally, we measure internal migration flows between the six regions using information drawn from the 2016 Community Survey. Survey respondents were asked if they had moved residence over the last five years (i.e., 2011-2016) and if so, which municipality did they previously reside in. Table 7 shows our estimation of inward migration rates for each region. The top section of the table reports population increases over the five years, only some of which is due to internal migration. Population growth in the Gauteng and Cape Town metros (A1) was particularly high at 2.4 percent per year, whereas it was less than one percent per year in rural areas (B4).[2] The middle of the table shows the number of migrants moving between regions. At the national level these flows offset each other such that there is no net migration. Note that we are only focusing on internal migration flows and so do not consider external migrants arriving from other countries, many of whom are likely to work in or around Gauteng.

Table 7 Population Growth and Internal Migration, 2011-2016

	Share of households with the following characteristics or owned assets (%)						
	South Africa	Gauteng & Cape Town (A1)	Other metros (A2)	Secondary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)
Population, 2011 (1000s)	51,574	14,182	6,002	7,311	4,141	7,006	12,933
Increase, 2011-2016	4,045	1,797	319	614	319	493	503
Annual growth rate (%)	1.5	2.4	1.0	1.6	1.5	1.4	0.8
Net in-migration (1000s)	0	127	2	37	13	15	-193
Inward flow, 2011-2016	3,496	1,389	348	569	316	474	400
Outward flow, 2011-2016	3,496	1,262	346	533	303	459	592
Migration for work (%)	0	55.5	47.1	55.3	19.1	77.6	53.7
In-migration rate (%)	0	0.89	0.03	0.50	0.31	0.21	-1.49

Source: Own calculations using 2011 SASID and 2016 Community Survey data from Quantec (2017).
Note: Migration for work reasons includes job search, retrenchment and starting a business, but excludes family members moving with migrant workers. Migration rate is the number of in-migrants relative to 2011 population.

There was substantial net in-migration into the larger metro areas (A1), but almost no inflow of migrants into the other metro areas (A2). In-migration for A1 metros largely matches the outflow of migrants from rural areas (B4). Most migrants reported moving for work-related reasons, including job search and retrenchment. Although not included in the calculation, there are other people who moved indirectly for work-related reasons, because they accompanied family members (e.g., children moving with parents). Overall, the ratio of in-migration to base year population indicates that about 1.5 percent of the inhabitants of rural areas migrate to urban areas each year. Most, but not all, of these rural migrants headed to the larger metro areas (A1). In the sections that follow, we use an economywide model to measure the economic implications of internal migration for the six rural and urban areas.

[2] *Detailed information on the model can be found in the appendix and in Diao and Thurlow (2012).*

4. Measuring Rural-Urban Linkages

We spatially disaggregate a national social accounting matrix (SAM) to identify and measure rural-urban linkages. A SAM is a consistent accounting framework that captures all income and expenditures flows in South Africa during a given year. A SAM is an economywide database because it includes all sectors and households as well as the government and the economy's interactions with the rest of the world. We constructed a new 2015 SAM for South Africa. The main data source is the official 2015 Supply-Use Table (SUT), built by Statistics South Africa using the 2012 Input-Output Table (StatsSA 2015). National accounts data provided information on other transfers or exchanges between government, enterprises, households and the rest of the world. We used government financial statistics and balance of payments data published by the IMF (2017a, 2017b) using information provided by the South African Reserve Bank, amongst others. Total compensation to employees was separated into four education-based groups using information from the 2015 Labor Force Survey (StatsSA 2016a). The labor groups (i) uneducated or with no schooling; (ii) completed primary school; (iii) completed secondary school to Grade 12; and (iv) completed secondary school and received a tertiary qualification, including certificates or diplomas. Households were disaggregated across per capita expenditure deciles, with the top decile further disaggregated into quartiles to capture South Africa's high level of inequality and concentration of wealth and skills at the top of the income distribution. The 2010 Income and Expenditure Survey (IES) provided this information.

We then disaggregated all sectors, factors and households across the six municipal groups described in the previous section. The spatial data used to disaggregate production in the SAM was drawn from SASID (2016), but other information on employment and household consumption comes from national household and labor force surveys and this may differ slightly from what was reported in Table 3.

Table 8: Characteristics of Municipal Areas in the SAM and CGE model, 2015

	South Africa	Gauteng & Cape Town (A1)	Other metros (A2)	Secondary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)
Population (millions)	54.8	11.2	10.2	7.8	4.4	7.5	13.6
Share (%)	100	20.5	18.7	14.3	8.0	13.7	24.8
Poor population (millions)	21.9	1.1	2.5	3.2	1.8	3.9	9.4
Share (%)	100	4.9	11.2	14.7	8.3	17.7	43.1
Consumption per capita (R)	45.0	62.5	55.7	52.6	41.1	39.0	22.4
Poverty headcount rate (%)	40.0	9.6	24.0	41.2	41.4	51.9	69.5
Regional GDP per capita (R)	48.2	62.5	58.4	52.7	46.8	44.4	28.7
Regional GDP per worker (R)	168.4	191.3	177.3	162.8	155.0	140.0	162.2
Sector GDP shares (%)	100	100	100	100	100	100	100
Agriculture	2.4	0.4	1.1	1.5	4.3	8.0	4.9
Industry	28.4	22.4	23.9	41.5	31.1	35.0	25.6
Services	69.2	77.3	75.0	57.0	64.6	57.0	69.5
Regional GDP shares (%)	100	30.1	23.9	17.2	7.3	11.4	10.1
Agriculture	100	4.7	11.2	11.2	13.2	38.7	21.0
Industry	100	23.7	20.1	25.2	8.0	14.0	9.1
Services	100	33.6	25.9	14.2	6.8	9.4	10.1
Total consumption shares (%)	100	100	100	100	100	100	100
Agriculture	4.4	2.9	3.9	4.1	4.5	5.7	7.7
Processed foods	21.4	17.7	20.5	21.7	20.6	24.2	29.3
Industrial goods	27.6	25.8	27.9	29.8	28.3	29.0	26.7
Services	46.6	53.5	47.7	44.5	46.7	41.1	36.3
Product consumption shares (%)	100	28.5	23.2	16.7	7.4	11.9	12.4
Agriculture	100	19.1	20.6	15.6	7.5	15.4	21.8
Processed foods	100	23.5	22.1	16.9	7.1	13.4	17.0
Industrial goods	100	26.6	23.4	18.0	7.5	12.4	12.0
Services	100	32.8	23.7	16.0	7.4	10.5	9.7

Source: Own calculations using 2011 SASID and 2016 Community Survey data from Quantec (2017).
Note: Migration for work reasons includes job search, retrenchment and starting a business, but excludes family members moving with migrant workers. Migration rate is the number of in-migrants relative to 2011 population.

The discussion in previous sections focused on rural-urban production and employment patterns. Table 9 provides some indication of the size of rural-urban consumption linkages drawn from the 2015 SAM. Households in the Gauteng and Cape Town metros (A1) are responsible for 19.1 percent of the value of agricultural products consumed in South Africa, but cities only produce 4.7 percent of agricultural output (see Table 8). Cities are therefore "net importers" of agricultural products from rural areas. This is shown in Table 9 by the large and negative 15.6 percentage point gap between production and consumer shares. In contrast, households in small towns and rural areas are net producers of agricultural products – they account for over have of agricultural production but less than a quarter of agricultural consumption. Rural producers and households, on the other hand, are net importers of industrial products and services.

Table 9: Rural, Town and City Demand Self-Sufficiency Measures, 2015

	Gap between national supply and demand shares (%-point)							
	Allocated						Un-allocated	Total gap
	Gauteng & Cape Town (A1)	Other metros (A2)	Second-ary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)		
Total	6.9	7.3	1.8	1.8	2.3	-0.4	-19.7	0.0
Agriculture	-15.6	-14.0	-2.1	4.5	25.4	8.1	-6.2	0.0
Industry	5.3	6.9	1.6	2.1	2.5	-1.7	-16.7	0.0
Mining products	-3.4	-4.5	20.6	2.6	14.7	8.1	-38.3	0.0
Manufacturing	4.0	5.9	-0.8	1.6	0.8	-3.7	-7.8	0.0
Processed foods	2.1	6.3	-2.0	2.2	1.8	-7.6	-2.8	0.0
Textiles	-3.6	8.3	-8.1	-2.4	-6.9	-9.8	22.5	0.0
Wood and paper	0.1	3.4	-2.3	-0.8	-2.3	-0.9	2.7	0.0
Chemicals	6.0	3.4	-3.6	-0.2	-8.1	-6.8	9.2	0.0
Non-metallic minerals	2.9	-3.7	0.4	0.0	1.0	-3.1	2.4	0.0
Metal products	4.4	0.4	7.4	1.2	-0.9	-1.1	-11.2	0.0
Machinery and vehicles	11.4	4.6	-0.9	-0.8	-3.9	-3.7	-6.6	0.0
Other manufactures	11.2	8.8	-2.8	0.5	-2.5	-5.2	-10.0	0.0
Construction	22.0	20.4	12.5	6.1	8.8	8.8	-78.6	0.0
Utilities	-0.4	-3.2	4.3	0.0	-1.2	0.6	0.0	0.0
Services	10.7	9.2	2.0	1.3	0.8	1.2	-25.3	0.0
Trade services	-3.1	-0.2	2.1	0.9	3.5	2.7	-5.8	0.0
Hotels and catering	-7.0	2.9	1.3	1.4	2.0	3.3	-4.0	0.0
Transport	7.7	13.2	-4.3	0.6	-3.3	-3.5	-10.4	0.0
Communications	14.4	2.8	-4.6	-2.1	-4.7	-6.1	0.1	0.0
Finance and business	7.7	3.6	-1.4	-0.5	-2.3	-1.8	-5.5	0.0
Real estate	4.7	6.7	-1.0	-0.7	-2.7	-2.5	-4.5	0.0
Community services	18.0	12.3	8.6	4.4	6.7	9.2	-59.3	0.0

Source: Own calculations using the South Africa SAM and CGE model.
Notes: Allocated supply-demand gaps include domestic production, intermediate demand, and household consumption. Unallocated includes gross capital formation, government consumption, imports and exports.

Unfortunately, data limitations mean that we can only separate production and household consumption spending across the six subnational regions. It is not possible to spatially allocate investment, government consumption, and exports on the demand-side, or imports on the supply-side. This makes it difficult to infer the direction of rural-urban trade for certain goods and services. For example, the table reports that all six regions are net importers of community services. Since the government is the major consumer of these services (i.e., education and health) and the SAM cannot tell us where government demand is located, it is not possible determine which regions are actually the net importers or exporters of these services. A similar problem exists for construction, because we cannot spatially allocate investment demand. For most other products, however, the unallocated gap mainly reflects net imports from abroad (e.g., petroleum chemicals and textiles).

Overall, Table 9 indicates that metropolitan areas (A1 and A2) import most of their agricultural products from rural areas, but are self-sufficient in manufactured goods, including processed foods, and in most services. Rural areas and small towns (B3 and B4) are net importers of most manufactured goods, and services. Finally, metro areas tend to export higher-value services to the rest of the country, such as transport, communication, finance and business services.

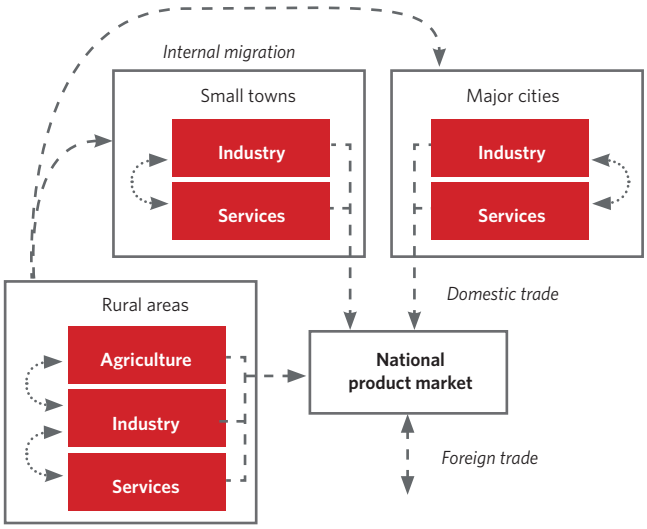
In summary, the SAM and its underlying survey and census data reveal strong and complex production and consumption linkages between urban and rural areas in South Africa. These detailed structural differences and economic linkages will largely determine the national benefits and trade-offs from urbanization and the implications of adopting either urban- or rural-oriented development strategies.

5. Modeling Urbanization and Urban Investments

The model used in this paper is called a "Computable General Equilibrium" (CGE) model. These are widely used to evaluate national policies and investment plans. These models have been used in South Africa to examine a wide range of issues, including social protection programs; climate change; trade and industrial policy; and energy infrastructure and other public investments. The South African model used here captures the complex workings of the economy, including all interactions between producers, households, government and the rest of the world. The model's parameters are assigned values from the 2015 SAM. The CGE model allows us to experiment with alternative future urbanization and investment scenarios and to assess their implications for economic growth, employment and poverty (at national, sectoral and spatial levels).

Figure 7 offers a stylized representation of the model.[3] The spatial SAM separates South Africa's economy into six spatial units – represented in the figure as major cities, smaller towns, and rural areas. Each region contains 48 different sectors. Representative producers in each sector and region produce output by combining labor, capital and intermediate inputs based on their production "technologies". Information on production technologies comes from the national supply-use table. These production technologies (or "input-output coefficients") capture rural-urban production linkages. They indicate to what extent city sectors use goods and services produced in other regions, and vice versa.

Figure 7: Spatial Modeling Framework



Rural and urban workers are separated into the four education categories described earlier. We assume that unemployment in South Africa is structural in nature, implying that labor in the model is fully employed. Separating workers into education groups is important because it captures sectors' differing skill requirements. Our discussion above indicated that rural workers tend to be less-skilled on average than workers in metropolitan areas. As such, new migrants from rural areas may find it difficult to compete with better-skilled urban workers. The model's detailed technology and labor market specification allows it to capture these issues.

As with most countries, data on internal trade is not available in South Africa. This means that we must assume that rural and urban producers supply output to national product markets, where a single national price equates demand and supply. In other words, while rural and urban areas do trade with each other in the model, we cannot track the exact flow of products moving between each spatial unit. This could cause the model to exaggerate rural-urban linkages because, for example,

[3] *Detailed information on the model can be found in the appendix and in Diao and Thurlow (2012).*

increases in rural consumer demand can be supplied by both rural and urban producers. This assumption is less problematic in South Africa, where transport and marketing systems are well-developed and transaction costs are low compared to most developing countries.

The model captures international or foreign trade. Increased domestic demand can be satisfied by either imports or domestic production. Likewise, increased domestic production may lead to more exports rather than increased supply to domestic markets. The decision to import or export is based on changes in the relative price of domestic and foreign goods. There are rigidities to this decision-making due to differences in product qualities and the difficulties in interacting with foreign markets. To capture this, the model treats domestic and foreign goods as imperfect substitutes. This means that even when prices in foreign markets rise, producers will continue supply domestic markets, but the level of supply may fall and cause domestic prices to rise. Conversely, when import prices fall, consumers continue to purchase domestic goods, but the price of these goods fall due to import competition. Finally, from a global perspective, South Africa is a small economy and so its foreign trade decisions are unlikely to influence global commodity prices. The model therefore fixes world prices.

The model allows for internal migration between rural areas, towns and metropolitan areas. During the year, workers can only migrate across sectors within their spatial unit. Between years, however, they can migrate between rural and urban areas in response to spatial wage differentials. Migration rates are initially calibrated to replicate observed migrant flows at prevailing wage gaps (see Table 7). Over time, population growth and widening wage gaps can lead to larger absolute migration flows. Ultimately, total labor supply in rural areas, towns and cities depends on previous period labor supply; exogenous population growth; and net internal migration. Importantly, we assume that workers migrate with their immediate families based on observed worker dependency ratios. We do not assume that rural-to-urban migration simply leads to higher rural dependency ratios. Nor do we assume that urban centers benefit from new working-age migrants without also having to accommodate their families. Finally, new urban migrants adopt the consumption patterns of existing urban households at similar levels of income. For example, urban households tend to have more import-intensive consumption baskets and so urbanization leads to greater demand for imported goods and services.

National accounting rules state that the level of investment should equal the level of private savings less the fiscal deficit. The latter is the difference between the government's tax revenues and recurrent spending. New capital stocks depend on previous period investment, and are allocated to rural and urban sectors based on profit rate differentials. Once invested, new capital cannot move between rural and urban sectors. It is worth noting that migration tends to increase returns to capital in the receiving region, and so urbanization can attract larger allocations of new capital and cause faster economic growth in urban centers.

Urbanization also affects the rate of technical change or productivity growth in each rural and urban areas. Following Henderson and Wang (2005), we assume that agglomeration spillovers are a positive function of population density. As workers move to a new city or town they raise the population density and hence productivity in all sectors.[4] However, urbanization reduces the amount of public capital available to each urban resident, and, without additional public investment, reduces productivity gains from urban agglomeration. In other words, the model captures what are called "congestion effects", which arise when urbanization outpaces urban public investment, leading to overstretched transport systems, inadequate housing, etc. Congestion effects reduce worker productivity by, for example, increasing the time taken to get to work on crowded roads, or increasing morbidity (sick days) because of inadequate water and sanitation infrastructure. The model therefore allows for an "urbanization of poverty" that can arise when the urban economy cannot absorb enough migrant workers, and when urban infrastructure (capital) cannot accommodate enough migrant residents. The allocation of public investments across rural areas, towns and cities is determined outside of the model and is the main policy instrument in our simulations. Finally, we only allow for modest agglomeration and congestion effects in rural areas, due to their low population densities.

In summary, the model captures the detailed economic characteristics of South Africa's metropolitan areas, cities, towns and rural areas. Rural-urban linkages in the model include trade flows in product markets, and labor migration and capital allocations in factor markets. Urbanization affects rural areas through production and consumption channels. Macroeconomic and resource constraints also generate spillovers between urban and rural economies. For example, increased migration to urban centers means that less labor is available in rural areas and can cause rural wages to rise. Finally, we include urban agglomeration and congestion effects. The model allows us to run alternative urbanization and public investment scenarios to determine the potential contribution of cities and towns to national development.

[4] *The elasticity linking population density to agglomeration effects is set at 0.08 based on estimates by Rosenthal and Strange (2004). It is assumed that sparsely populated rural areas do not experience agglomeration spillovers*

6. Urbanization and Investment Scenarios

The model is used to examine two sets of scenarios involving future deviations from historical urbanization rates and public investment patterns. In the "Urbanization" scenarios, we consider the economic implications of more rapid rural-to-urban migration. The pace of urbanization is accelerated in either metropolitan areas (A1 or A2) or secondary cities (B1). In the "Investment" scenarios, faster urbanization in each urban group is matched by increased public investment in that group. We compare these urban investment scenarios with a scenario that increases investment in rural areas and small towns.

Baseline

To measure the impacts of the urbanization and investment scenarios, we first develop a baseline or reference scenario that assumes a "business-as-usual" growth path for South Africa during 2015-2035 (the model's 20-year simulation period). The baseline scenario assumes that future economic growth in South Africa broadly replicates historical trends from 1993-2016. The national population grows at 1.2 percent per year with faster growth in metro areas, especially in A1 (see Table 10). Total labor supply expands at roughly the same rate as the population, implying little change in national dependency ratios over time. Private capital accumulation rates are determined inside the model based on past levels of investment. Based on historical capital stock accumulation rates, public investment is assumed to grow at 1.7 percent each year, which is faster than population growth. This means that public capital per capita is rising in the baseline and contributes positively to urban growth by reducing congestion effects.

Table 10: Baseline "Business-as-Usual" Scenario, 2015-2035

	South Africa	Gauteng & Cape Town (A1)	Other metros (A2)	Secondary Cities (B1)	Large Towns (B2)	Small Towns (B3)	Rural Areas (B4)
Annual GDP growth (%)	2.81	4.04	2.51	1.99	2.03	2.10	1.86
Labor	1.44	2.54	1.13	1.56	1.33	1.14	0.04
Private capital	2.29	2.52	2.11	2.16	2.19	2.33	2.30
Public capital	1.74	1.73	1.74	1.74	1.76	1.74	1.72
TFP	0.96	1.61	0.98	0.15	0.31	0.38	0.81
Annual migrant flow (1000s)	0.00	18.08	3.55	2.24	-0.37	-0.25	-23.25
Inflow	37.82	18.08	5.74	7.25	2.97	3.77	0.00
Outflow	37.82	0.00	2.19	5.01	3.34	4.02	23.25
Share of workforce (%)	0.00	0.36	0.09	0.07	-0.02	-0.01	-0.93
Population growth rate (%)	1.21	2.93	1.16	1.59	1.40	1.17	0.81

Source: South Africa CGE model results.

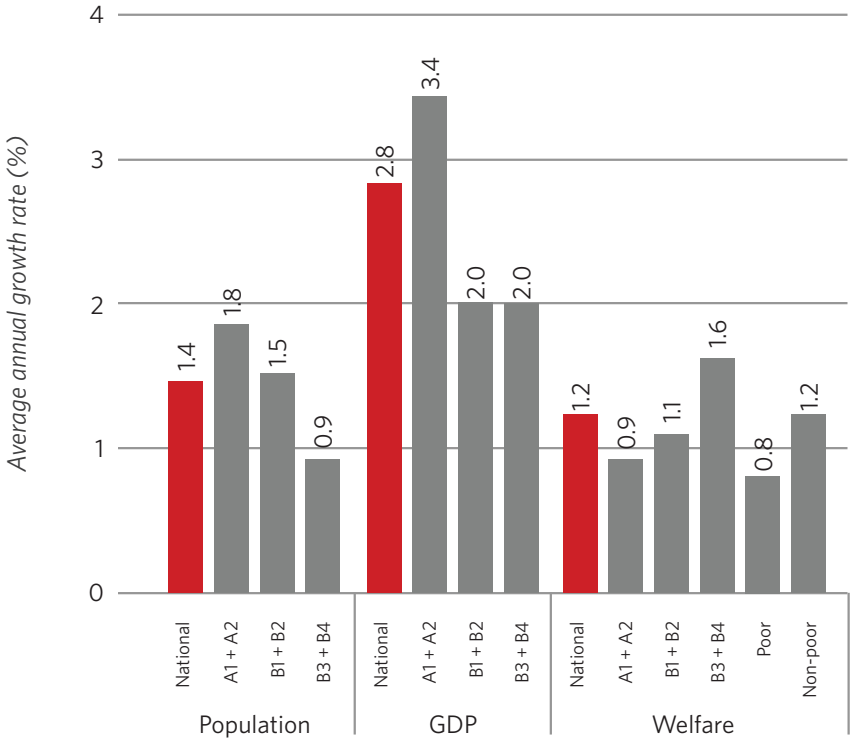
Labor supply growth rates in rural and urban areas diverge over time due to internal migration. The model endogenously reallocates labor and populations across urban and rural areas based on wage differentials. We assume that the wage differentials in the model's base year (2015) reproduce the implied migration flows from the 2011-2016 period, as captured in the 2016 Community Survey (see Section 3). This amounts to a net average annual inflow of 37,800 migrants during 2015-2035, with around 18,080 moving to the larger metro areas (A1) (see Table 10). Each year, 23,250 migrants leave rural areas for other municipalities. Migration causes urban population growth to exceed that of rural areas, which is consistent with historical trends.

Economic growth in the model is determined by changes in factor supply and total factor productivity (TFP). As described in the previous section, productivity growth is determined by endogenous migration and agglomeration effects and by exogenous trends. Migration generates positive agglomeration effects, which are only partially offset by congestion effects. In order to replicate historical GDP growth rates, exogenous productivity growth is negative for agriculture and mining, and is close to zero for manufacturing. Overall, total GDP in the baseline scenario grows at 2.8 percent per year (or 1.6 percent in per capita terms). This is consistent with average GDP growth rates during 1993-2016.

Poverty declines in the baseline scenario. Figure 8 summarizes baseline growth, population and welfare outcomes. The lowest section in the figure reports welfare changes for poor and non-poor household groups. Welfare is measured using "equivalent variation", which is a consumption-based measure that controls for changing prices. "Poor households" are those in the bottom four national per capita consumption deciles. Poor households' per capita welfare increases by only 0.8 percent per year

in the baseline, but since this is positive and measured in real terms, it means that poverty declines in the baseline. Non-poor households' welfare grows faster at 1.2 percent per year, causing the gap between poor and non-poor households to widen. Welfare gains are smaller in metro areas and larger in rural areas. This is partly because faster urban GDP growth is offset by inward migration, leading to smaller changes in per capita terms. This is consistent with observed growth and employment patterns.

Figure 8: Growth and Welfare Outcomes in the Baseline Scenario, 2015-2035



Source: South Africa CGE model results.
Note: Welfare is measured using equivalent variation, which is a consumption-based measure that controls for price changes.

The baseline scenario is only meant to provide a counterfactual against which we can compare the alternative urbanization and investment scenarios. As such, the baseline is not of direct interest for our analysis. Nevertheless, the baseline is consistent with South Africa's growth trajectory over the last two decades. Based on observed migration and population growth, the rural population share continues to fall from 24.8 percent in 2015 to 21.6 percent in 2035. This is consistent with the relatively gradual pace of urbanization in the country. Moreover, mining and agriculture's slower growth relative to industry and services reduces its share of national GDP and reflects ongoing structural changes. The baseline provides a suitable reference for analyzing future urban developments.

Faster Urbanization Scenarios

We explore alternative urbanization and urban investment scenarios. The first set of simulations explore the implications of increasing inward migration above historical rates for different regions in the model. The rural areas' population share fell from 24.8 percent in 2015 to 21.6 percent in 2035 in the baseline. In the Faster Urbanization scenarios, we further reduce this final share to 19.6 percent (i.e., reduced by two percentage points). Increased rural out-migration is driven by raising the inward migration rate in three separate regions: A1, A2 and B1. The model measures the impact of more rapid urbanization on economic growth and household welfare.

The first section of Table 11 reports wage differentials and migration flows in the three Faster Urbanization scenarios. We start with faster migration to Gauteng and Cape Town (A1). The larger flow of migrants increases job competition in these areas and reduces labor availability in other areas. This causes the ratio of average metro wages to average wages elsewhere to fall. For example, by the end of the baseline scenario, the average metro wage to rural wage was 0.68, implying that rural wages were on average around two-thirds of metro wages. However, the annual flow of migrants leaving rural areas in the A1 Urbanization Scenario rises from 23,250 in the baseline to 52,130 in the A1 Faster Urbanization scenario. This narrows the rural-metro wage gap to 0.84 times the metro wage in 2035.

Table 11: Wage Differentials and Migration Flows, 2015-2035

	Baseline scenario	Faster urbanization scenarios (annual growth rate %)			Increased investment scenarios (annual growth rate %)			
		A1	A2	B1	A1	A2	B1	B4
Average wage ratios, 2035								
Secondary cities/metros (B1/A)	0.84	0.96	0.95	0.73	0.95	0.94	0.77	0.88
Towns / metros (B2-3/A)	0.66	0.76	0.72	0.69	0.75	0.72	0.70	0.73
Rural areas / metros (B4/A)	0.68	0.84	0.85	0.79	0.83	0.85	0.80	0.86
Annual net migrant flows (1000s)	0	0	0	0	0	0	0	0
Rural areas (B4)	-23.25	-52.13	-54.74	-53.99	-52.89	-55.62	-55.04	-53.82
Towns (B2 and B3)	-0.62	-25.62	-12.94	-20.41	-26.68	-13.49	-21.48	-21.25
Secondary cities (B1)	2.24	-17.33	-17.66	53.33	-18.24	-18.68	56.24	4.11
Metropolitan areas (A1 and A2)	21.63	95.08	85.34	21.07	97.81	87.79	20.27	70.96
Population share, 2030 (%)	100	100	100	100	100	100	100	100
Metropolitan areas (A1 and A2)	42.67	47.80	46.70	42.55	47.96	46.85	42.50	45.90
Secondary cities & towns (B1-3)	35.69	32.58	33.66	37.82	32.46	33.57	37.93	34.48
Rural areas (B4)	21.63	19.63	19.64	19.62	19.58	19.58	19.56	19.62

Source: South Africa CGE model results.

Faster urbanization reduces the total supply of labor in rural areas and small towns, which reduces agricultural GDP growth. However, urban producers benefit from higher labor supply and lower wages. Faster urban growth generates backward linkages to agriculture and rural areas, mainly because rising urban incomes generate demand for agricultural products, almost all of which are produced in rural areas (see Table 8). Unfortunately, urban-to-rural linkages are not strong enough to outweigh the loss of rural labor, and rural and town GDP declines in response to faster urbanization rates in A1, A2 and B1.[5]This is shown in Table 12, which reports deviations in average annual GDP growth rates relative to the baseline. The rural GDP growth rate in the As Urbanization scenario is 0.9 percentage points lower than in the baseline (i.e., it is now 0.9 instead of 1.9 percent per year).

Table 12: Economic Growth Results, 2015-2035

	Total GDP share, 2012 (%)	Basline growth rate (%)	Faster urbanization scenarios (%-point deviation from baseline)			Increased investment scenarios (%-point deviation from baseline)			
			A1	A2	B1	A1	A2	B1	B4
Annual GDP growth	100	2.81	0.21	0.07	0.06	0.28	0.08	0.03	0.03
Agriculture	2.4	2.10	-0.02	-0.01	-0.05	-0.02	0.00	-0.07	-0.08
Industry	9.8	2.21	0.19	0.09	0.07	0.25	0.10	0.05	0.03
Manufacturing	7.3	1.95	0.17	0.06	0.06	0.22	0.06	0.07	0.01
Agro-processing	69.2	3.27	0.24	0.09	0.06	0.33	0.09	0.03	0.05
Other manufacturing	48.9	3.41	0.29	0.09	0.06	0.41	0.09	0.01	0.05
Other industry	20.3	2.93	0.09	0.07	0.06	0.12	0.09	0.07	0.04
Services	20.5	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gauteng & Cape Town (A1)	30.1	4.04	1.04	0.01	0.02	1.36	-0.15	-0.12	0.25
Other metros (A2)	23.9	2.51	-0.18	0.95	0.02	-0.33	1.30	-0.10	0.21
Secondary cities (B1)	17.2	1.99	-0.38	-0.40	1.02	-0.52	-0.54	1.42	0.00
Large towns (B2)	7.3	2.03	-0.45	-0.32	-0.22	-0.56	-0.42	-0.31	-0.42
Small towns (B3)	11.4	2.10	-0.29	-0.07	-0.33	-0.37	-0.14	-0.41	-0.30
Rural areas (B4)	10.1	1.86	-0.92	-1.04	-1.03	-1.00	-1.11	-1.11	-0.77

Source: South Africa CGE model results.

[5] *Note that urban municipalities produce much of South Africa's agriculture, and so migration to urban municipalities leads to growth in urban agriculture and a decline in rural agriculture (not shown in the table).*

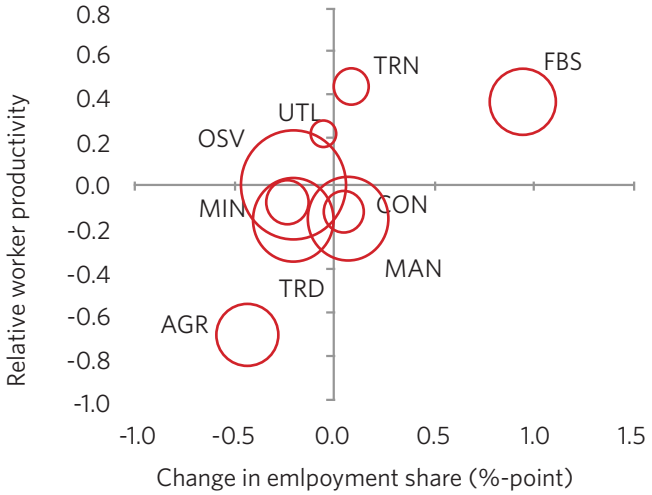
Despite the slowdown in agricultural growth, faster urbanization leads to faster national economic growth. Reducing the rural population share by two percentage points over 20 years raises the total GDP growth rate by 0.2 percentage points per year in the case of the A1 scenario or roughly 0.06-0.07 percentage point when growth is led by either the A2 or B1 regions. Cumulatively, this means that by 2035, the economy is 4.2 percent larger than it is the baseline without any accelerated urbanization. It should be emphasized that this positive growth-effect is almost entirely due to more people leaving rural areas for urban centers, i.e., the total population and workforce force remains unchanged from the baseline.

Most additional growth resulting in the faster urbanization occurs within cities or towns that are targeted with higher urbanization rates. The rural economy contracts (relative to the baseline) due to a slowdown in both rural agricultural and non-farm growth. Slower agricultural growth in rural areas and rising incomes and demand in urban areas places upward pressure on real food prices, which are only partially compensated for though food imports. Rising food prices encourage farmers in urban municipalities to increase production. Urbanization therefore has modest implications for agricultural and rural transformation overall, since it encourages greater production in areas closer to major cities and towns, but reduces production in more remote rural areas where alternative employment opportunities are less plentiful.

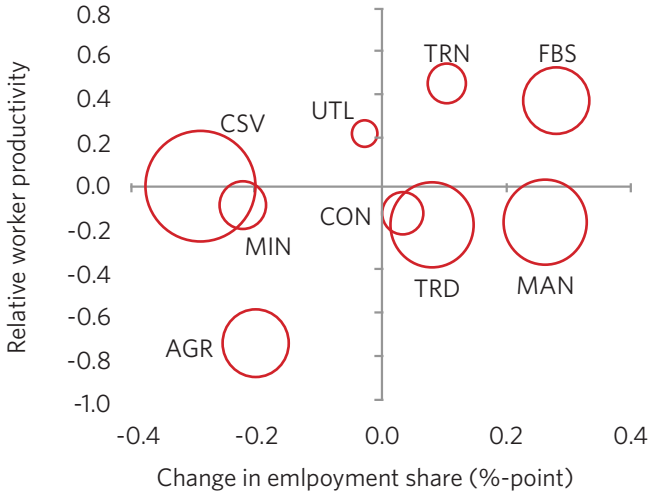
Faster urbanization accelerates the pace of structural change, as shown in Figure 11. Faster national economic growth is partly due to rural farm labor migrating to urban centers to work in non-agricultural sectors. However, unlike historical trends, more new jobs are created in manufacturing, in part because new urban residents increase demand for manufactured goods. The source of more rapid urbanization influences the nature of the structural change outcomes. Faster growth in A1 leads to large expansions in financial services (FBS) since these services dominate the Johannesburg area. In contract, faster growth in smaller towns leads to larger national structural change, because households in these regions are relatively poor and demand a wide range of goods and services many of which are produced locally.

Figure 11: Structural Change in the Faster Urbanization Scenarios, 2015-2035

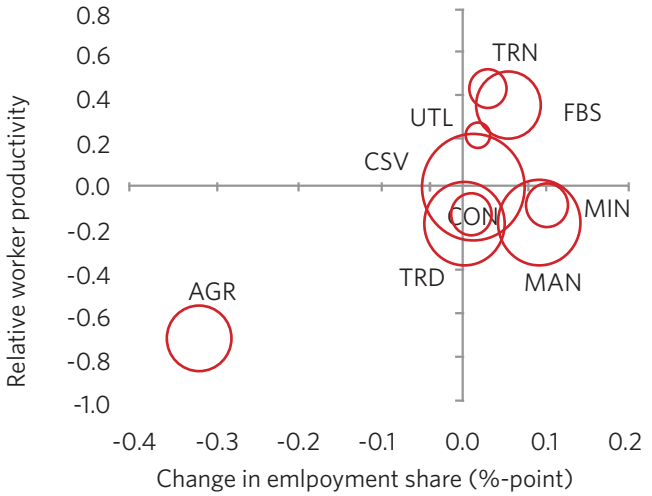
Gauteng and Cape Town (A1)



Other metropolitan areas (A2)



Secondary cities (B1)



Source: South Africa CGE model results.
Notes: Structural change is relative to the baseline scenario. Size of circle equals initial employment share. AGR is agriculture; MIN is mining; MAN is manufacturing; EGY is energy and water; CON is construction; TFB is trade, financial and business services and real estate; TRC is transport and communication; GOV is public administration; and CSV is education, health and community services.

Employment-to-population ratios are very low in rural South Africa, with one worker for every six people. We assume that when a worker migrates to an urban center and finds employment, there are an additional two people who move with the worker to the urban area. These people may be non-working family members or they may be previously-unemployed migrants who are unsuccessful in finding employment in urban areas. As a result, the increase in urban population exceeds the gain in urban GDP, leading to lower metro per capita GDP for poorer households relative to the baseline (see Table 13). Faster urbanization leads to slightly higher national welfare and falling poverty, but the benefits primarily accrue to non-poor households.

Table 13. Household Welfare Results, 2015-2035

	Per capita consump-tion (R)	Baseline growth rate (%)	Faster urbanization scenarios (annual growth rate, %)			Increased investment scenarios (annual growth rate, %)			
			A1	A2	B1	A1	A2	B1	B4
National welfare	44,951	1.22	0.08	0.05	0.02	0.11	0.04	0.01	-0.01
Poor	13,574	0.78	-0.27	-0.17	-0.11	-0.30	-0.18	-0.10	-0.20
Non-poor	65,873	1.18	0.12	0.08	0.04	0.16	0.07	0.02	0.01
Rural welfare	59,276	0.89	-0.15	-0.12	0.03	-0.09	-0.12	-0.03	-0.18
Poor	15,201	0.30	-0.94	-0.36	0.07	-0.98	-0.30	0.04	-0.48
Non-poor	67,947	0.90	-0.04	-0.05	0.02	0.03	-0.04	-0.04	-0.12
Urban welfare	52,642	1.22	0.29	0.23	-0.34	0.29	0.20	-0.19	-0.04
Poor	17,953	0.60	0.03	0.00	-0.34	-0.01	-0.05	-0.19	-0.21
Non-poor	61,226	1.23	0.37	0.32	-0.37	0.37	0.29	-0.21	0.02
Town welfare	39,781	1.21	0.20	0.10	0.12	0.19	0.07	0.06	0.08
Poor	14,265	0.69	0.02	0.03	0.00	-0.01	-0.01	-0.03	-0.03
Non-poor	63,392	1.34	0.39	0.19	0.25	0.39	0.15	0.20	0.22
City welfare	22,447	1.53	-0.19	-0.24	-0.26	-0.20	-0.27	-0.31	-0.13
Poor	11,055	1.05	-0.29	-0.33	-0.34	-0.32	-0.36	-0.38	-0.24
Non-poor	48,346	2.00	0.27	0.25	0.21	0.27	0.23	0.18	0.35

Source: South Africa CGE model results.
Note: Welfare is measured using equivalent variation, which is a consumption-based measure that controls for price changes.

In summary, faster urbanization accelerates the pace of economic growth and structural change and raises national welfare. However, results from the Faster Urbanization scenarios suggest that, without increased public investment in urban infrastructure, urbanization does not generate sufficient economic growth to absorb new migrants, leading to slower welfare improvements, particularly for the urban poor. Major cities and towns face the largest migrant inflows and the greatest challenges to absorbing new migrant workers. The next set of scenarios examines how allocating more public resources to urban areas can prevent the relative losses in urban welfare.

Increased Investment Scenarios

The Urban Investment scenarios replicate each of the Faster Urbanization scenarios, but now allocates more public investment to the three urban areas (A1, A2 and B1) and to rural areas (B4). Urban investment levels are increased until urban public capital per capita remains largely unchanged from baseline levels (it had declined in the previous scenarios as migrants crowded into cities). This means that there are no negative congestion effects to offset positive urban agglomeration effects. This leads to faster urban economic growth, which will increase the absorptive capacity of the urban labor market. Urban infrastructure per capita is higher than in rural areas, and so maintaining per capita levels with an inflow of new migrants requires a sizable reallocation of public resources.

We do not raise the overall level of government spending in the three urban investment scenarios, and so increasing urban investment reduces investment in rural areas. National poverty worsens as a result. We initially focus on the effects that reduced rural investment have on the rural components of South Africa's agriculture-food system. Maintaining urban capital per capita at baseline levels, despite rapid urbanization, leads to a decline in sectoral TFP and GDP growth. This is the trade-off from increasing urban investment. Investing in rural areas, on the other hand (B4) also leads to lower agricultural production, although welfare losses are somewhat smaller in this scenario.

Table 12 reports the growth outcomes from raising urban investment. Industrial and service sector GDP growth increases after the reallocation of resources away from rural areas. This is because urban areas are the largest

producers of processed foods, and so the loss in TFP does not affect the processing component of the food system. However, agricultural GDP growth does decline somewhat because much of this sector is based in rural areas. This also causes some slowdown of downstream sectors, such as agro-processing. Table 11 shows that urban investment growth could widen the gap between average urban and rural wages and encourages slightly more migration to urban centers. However, the effects of urban investments on wages are modest.

Table 13 shows that urban welfare is slightly lower when investments are reallocated towards urban centers (i.e., compare the outcomes from the Urban Investment scenario to those from the Faster Urbanization scenario). Reallocating investment away from rural areas does not achieve the goal of reversing the slowdown in urban welfare growth that occurred in the Faster Urbanization scenario. Instead, the model shows that reducing rural investment leads to worse outcomes, particularly for poor urban households. This is because slower growth in the agriculture-food system leads to higher real food prices. Food purchases are an important part of poor urban households' consumption baskets. Higher food prices reduce real incomes, despite the increase in urban wages and job creation caused by faster urban economic growth. Moreover, reducing rural growth leads to even faster urbanization. Increasing urban investment by reducing rural investment may therefore be counterproductive. This finding is consistent with traditional development models that argue that raising agricultural productivity benefits the urban poor by reducing food prices. While these scenarios are stylized, they do suggest that, while increasing urban investment is necessary to improve urban welfare and accommodate new migrants, it should not ideally come at the expense of rural investments.

7. Conclusions

South Africa faces many challenges, including slow economic growth, weak structural change, high unemployment, and persistent poverty. Urbanization is a further challenge. Migration and population growth are highest in the major metropolitan areas, particularly within Gauteng and Cape Town. While poverty is concentrating in rural areas, there are concerns about a possible "urbanization of poverty", and the pressures that rising population density places on municipal governments and their ability to finance and deliver services.

This paper has considered three broad directions for national and urban planning. First, increase investments in major metropolitan areas to accommodate urbanization and prevent urban poverty from worsening. Second, maintain or expand investments in rural areas, such as in the agriculture-food system, to provide rural job and income opportunities for South Africa's poorest populations who are already a disproportionate share of migrants to cities. Third, invest in secondary cities as an intermediate option.

We examined these three strategic options using a dynamic economywide model. Our analysis suggests that faster urbanization can be a catalyst for faster economic growth and positive structural change. However, urbanization may well come at the cost of higher urban poverty, particularly within major cities, where most poor rural inhabitants chose to migrate. Our simulated acceleration in urbanization led to better outcomes only for poor households. Concerns over rising urban poverty reflect the more fundamental challenge posed by South Africa's weak economic performance and more specifically, the decline in its manufacturing sectors, which are traditionally seen as providing decent livelihoods and spurring broader urban development. Weak economic growth constrains the capacity of urban areas to accommodate and employ migrants from rural areas.

Simulations in this paper confirm that urbanization requires additional public investments in urban infrastructure and services. Without these it may not be possible to fully exploit the agglomeration effects that arise from concentrating economic activity within urban locations. However, increasing investment in urban centers should not come at the cost of reducing investment in rural areas. Lower agricultural production leads to higher food prices, falling real incomes, and faster outmigration from rural areas. This can worsen, rather than improve, the welfare of the urban poor. Reaching the growing number of people living in larger cities, without neglecting the already-large and poor rural population, remains one of South Africa's most difficult development challenges.

References

Dervis K., J. De Melo, and S. Robinson. 1982. *General Equilibrium Models for Development Policy*. New York, USA: Cambridge University Press.

Diao, X. and J. Thurlow. 2012. A Recursive Dynamic Computable General Equilibrium Model, in X. Diao, J. Thurlow, S. Benin and S. Fan (eds.) *Strategies and Priorities for African Agriculture: Economywide Perspectives from Country Studies.* Washington DC, USA: International Food Policy Research Institute.

Dimaranan, B.V. 2006. *Global Trade, Assistance, and Production: The GTAP 6 Database.* West Lafayette IN, USA: Centre for Global Trade Analysis, Purdue University.

McMillan, M., D. Rodrik, and I. Verduzco-Gallo. 2014. *Globalization, Structural Change, and Productivity Growth with an Update on Africa.* World Development 63(11): 11-32.

Henderson, J.V. and H.G. Wang. 2005. Aspects of the Rural-Urban Transformation of Countries. *Journal of Economic Geography 5:* 23-42.

IMF. 2017a. Balance of Payment Statistics Online Database. Washington DC, USA: International Monetary Fund.

IMF. 2017a. Government Financial Statistics Online Database. Washington DC, USA: International Monetary Fund.

Robinson, S., A. Cattaneo and M. El-Said. 2001. Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods. *Economic Systems Research 13(1)*: 47-64.

SASID. 2017. South Africa Standardized Industrial Database: Regional Series. Pretoria, South Africa: Quantec.

StatsSA. 2011. Income and Expenditure Survey 2010/2011. Pretoria, South Africa: Statistics South Africa, Government of South Africa.

StatsSA. 2012. Census 2011. Pretoria, South Africa: Statistics South Africa, Government of South Africa.

StatsSA. 2015. National Accounts: Input-Output Table for South Africa, 2012. Pretoria, South Africa: Statistics South Africa, Government of South Africa.

StatsSA. 2016a. Quarterly Labor Force Survey: 4th Quarter 2015. Pretoria, South Africa: Statistics South Africa, Government of South Africa.

StatsSA. 2016b. Community Survey 2016. Pretoria, South Africa: Statistics South Africa, Government of South Africa.

Appendix A: Economywide Model

Consumer and producer behavior

Representative consumers and producers in the model are treated as individual economic agents. We assume that households (consumers) make decisions so as to maximize welfare (utility) subject to a budget constraint. For this we employ a linear expenditure system (LES) of demand:

$$P_i \cdot C_{ia} = P_i \cdot \gamma_{ia} + \beta_{iha} \cdot \left(\frac{(1 - s_a - td_a) \cdot Y_a}{LS_a} - \sum_{i'} P_{i'} \cdot \gamma_{i'a} \right)$$

where C is per capita consumption of good i in area a (i.e., cities, towns or rural areas), γ is a minimum subsistence level, β is the marginal budget share, P is the market price of each good, Y is total household income, LS is total labor supply (a proxy for population), and s and td are savings and direct tax rates, respectively. Our demand functions allow consumption patterns and income elasticities to vary across households in cities, towns and rural areas.

We assume producers maximize profits subject to input and output prices. A constant elasticity of substitution (CES) function determines output quantity X from sector i in area a:

$$X_{ia} = \alpha_{ia} \cdot \left(\delta_{ia} \cdot L_{ia}^{-\rho_{ia}} + (1 - \delta_{ia}) \cdot K_{ia}^{-\rho_{ia}}\right)^{-1/\rho_{ia}}$$

where α reflects total factor productivity (TFP), L and K are labor and capital demands, and δ and ρ are share and substitution parameters. Our production functions permit technologies to vary across producers and areas.

Maximizing profits subject to Equation 2 gives the factor demand equations:

$$\frac{L_{ia}}{K_{ia}} = \left(\frac{r \cdot D_{ia}}{W_a} \cdot \frac{1 - \delta_{ia}}{\delta_{ia}} \right)^{1/(1+\rho_{ia})}$$

where W is the labor wage in area a, and r is a fixed economywide capital rental rate adjusted by a sector/area-specific distortion term D. The factor substitution elasticity is a transformation of ρ. Higher elasticities means producers can more readily substitute between labor and capital when relative prices change. We do not show intermediate demand in the equations, although this is included in our model. The producer price PX is the sum of factor payments per unit of output:

$$PX_{ia} \cdot X_{ia} = W_a \cdot L_{ia} + r \cdot D_{ia} \cdot K_{ia}$$

National product markets and international trade

Products are traded in national markets at a single market-clearing price P. The national market assumption is needed because internal trade data is unavailable. Output from each area is combined into a composite national good Q using a CES function:

$$Q_i = \phi_i \cdot \left(\sum_a \lambda_{ia} \cdot X_{ia}^{-\tau_i} \right)^{-1/\tau_i}$$

Equation 5 permits imperfect substitution between goods from different areas. Relative producer prices are determined by the following first order condition, derived from minimizing the composite supply price of each good:

$$PX_{ia} = P_i \cdot (1 - ti_i) \cdot Q_i \cdot \left(\sum_{a'} \lambda_{ia'} \cdot X_{ia'}^{-\tau_i} \right)^{-1} \cdot \lambda_{ia} \cdot X_{ia}^{-\tau_i - 1}$$

where ti is the indirect tax rate applied to domestic sales. This function implies that demand for an area's output rises when its supply price falls relative to those in other areas.

We do not show the equations governing international trade. However, our model permits two-way trade assuming imperfect substitution between domestic and foreign goods. A constant elasticity of transformation (CET) function determines exports and a CES function determines imports. World commodity prices are fixed under a small country assumption. The current account balance is fixed in foreign currency units and the real exchange rate is flexible (i.e., a price index of tradable to non-tradable goods).

Government and investment demand

Assuming all factors in an area are owned by households in that area, then total income Y is

$$Y_a = \sum_i (W_a \cdot L_{ia} + r \cdot D_{ia} \cdot K_{ia}) + h_a \cdot LS_a$$

where h is per capita transfer payments from the government. The government is treated as a separate agent. Total domestic revenue is the sum of direct and indirect taxes, as shown on the left-hand side of the following equation:

$$\sum_a td_a \cdot Y_a + \sum_i ti_i \cdot P_i \cdot Q_i = \sum_i P_i \cdot A \cdot g_i + \sum_a h_a \cdot LS_a + B$$

The government uses revenues to purchase goods and make transfers (i.e., recurrent spending) and to save (i.e., finance public capital investment). This is shown on the right-hand side of Equation 8. Our macroeconomic closure for the government account assumes that public consumption spending is equal to base-year quantities g multiplied by an exogenous adjustment factor A. The fiscal balance B adjusts to equalize total revenues and expenditures.

We assume a savings-driven investment closure, i.e., total investment adjusts to the level of savings in the economy. As shown below, a national savings pool finances investment:

$$\sum_a s_a \cdot Y_a + B = \sum_i (P_i \cdot I \cdot ip_i + P_i \cdot G \cdot ig_i)$$

where ip and ig are fixed base-year quantities of private and public investment, respectively, multiplied by adjustment factors I (endogenous) and G (exogenous). For a given level of savings, an increase in public investment G must be matched by a decline in private investment I, i.e., the government "crowds-out" private investors.

Factor and product market equilibrium

We assume labor is fully employed. As such, total labor supply LS in each area is fixed and, in equilibrium, must equal the sum of all sector labor demands:

$$LS_a = \sum_i L_{ia}$$

Unlike labor, which is mobile across sectors, capital is sector/area-specific. Both factor demand K and the economywide rental rate r are therefore fixed (see Equation 3) and the rental rate distortion term D adjusts so that sectoral profit rate equate capital demand and supply.

Finally, product market equilibrium requires that the composite supply of each good Q equals total private and public consumption and investment demand:

$$Q_i = \sum_a C_{ia} \cdot LS_a + A \cdot g_i + I \cdot ip_i + G \cdot ig_i$$

Market prices P adjust to ensure equilibrium is achieved. Together, the above 11 equations simultaneously solve for the values of 11 endogenous variables (i.e., C, X, L, D, Q, PX, Y, B, I, W and P). The national consumer price index (CPI) is our numéraire.

Capital accumulation

The model is recursive dynamic; i.e., it consists of distinct within- and between-period components. The above equations specify the within-period component. Between-periods, exogenous variables and parameters are updated based on externally-determined trends and previous period results. We describe the processes of capital accumulation, labor migration, and agglomeration and technical change.

While not shown in Equations 1-11, each variable has a time subscript associated with it. Sector-level capital accumulation is determined endogenously based on previous period investment. As shown in Equations 12-14, the quantity of new capital N is based on the value of private investment and the capital price PK (i.e., a composite price derived from investment demand shares ip). New capital is allocated to sectors/areas after applying a national depreciation rate υ and according to a capital allocation factor SK ($0<SK<1$; $\sum SK=1$) (Dervis et al., 1982)

$$N_t = \sum_i (P_{it} \cdot I_t \cdot ip_i) \cdot PK^{-1}$$

$$K_{iat+1} = K_{iat} \cdot (1 - \upsilon) + SK_{iat} \cdot N_t$$

$$SK_{iat} = SP_{iat} + SP_{iat} \cdot \left(\frac{SR_{iat} - AR_t}{AR_t}\right)$$

SP is a sector/area's current share in aggregate profits, SR is a sector/area's profit rate (i.e., $r \cdot D_{ia}$), and AR is the national average profit rate. New capital is allocated in proportion to each sector/area's share in aggregate capital income, adjusted by its profit rate relative to the average profit rate. Sectors/areas with above-average profit rates receive a greater share of investible funds than their share in aggregate profits. This "putty-clay" specification implies that new capital is mobile, but once invested it becomes sector-specific.

Internal labor migration

Within each period, workers can only migrate across sectors within cities, towns and rural areas. Between periods they can also migrate between areas in response to real wage differentials. The flow of migrants M from area a to a' is defined by

$$M_{aa't} = LS_{at} \cdot m_{aa'} \cdot \frac{W_{a't}}{W_{at}} \cdot c_{aa'}$$

where m is the base-year migration rate and c is a "compensating wage" (i.e., the inverse of base-year wage differentials). Initially the compensating wage offsets the wage differential leaving the observed migration rate m unchanged, and when applied to total labor supply LS, reproduces observed migration flows M. If wages in a' increase relative to a then the migrant flow increases from base-year levels. Total labor supply is equal to previous period supply multiplied by an exogenous population growth rate ε and augmented by net migration inflows:

$$LS_{at+1} = LS_{at} \cdot (1 + \varepsilon_a) + \sum_{a'} (M_{a'at} - M_{aa't})$$

While not shown in the equations, our model separates poor and non-poor households within each area. This requires us to track both household populations and factor endowments. Migrant workers are drawn from within-area household groups in proportion to their labor endowments. Workers are assumed to migrate with their families (based on fixed observed dependency ratios), which limits the need to track remittance flows between areas.

Agglomeration, congestion and technical change

Rates of technical change in each sector/area are determined by three factors (see Equation 17). The first component is the agglomeration effects caused by changes in the density of economic activity. Following Henderson and Wang (2005), agglomeration spillovers are assumed to be a function of population density. Population growth and migrant inflow cause an area's total labor supply LS to expand relative to base-year levels ls, and raises TFP in all sectors (i.e., α in Equation 2). Given sparse rural populations and the concentration of industry in urban centers, we only allow agglomeration effects in towns and cities (i.e., θ is zero for rural areas).

$$LS_{at+1} = LS_{at} \cdot (1 + \varepsilon_a) + \sum_{a'} (M_{a'at} - M_{aa't})$$

The second component depends on the concentration of public capital amongst urban residents. TFP expands more rapidly in areas where per capita public capital stocks V are increasing relative to base-year levels v. Equation 18 shows how public capital depreciates at the same rate υ as private capital and is replenished by exogenously-determined public investment. Congestion occurs when, for a given level of investment, an inflow of migrants causes per capita capital stocks V to decline, thereby slowing the rate of technical change.

The third determinant of technical change is an exogenous growth rate σ, which allows the model to track long-term growth trends after accounting for growth in factor supply and endogenous sources of technical change.

This is one of nine background papers prepared as part of the South African Urbanisation Review (UR), which was commissioned by the Cities Support Programme (CSP) of the National Treasury to inform national policy and the Integrated Urban Development Framework (IUDF) on options for enhancing spatial integration. The other background papers and the overall report (`Managing Urbanisation to Achieve Inclusive Growth') is available from the CSP website.

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