

van Seventer, Dirk; Davies, Robert H.

Working Paper

A 2016 social accounting matrix for South Africa with an occupationally disaggregated labour market representation

WIDER Working Paper, No. 2019/56

Provided in Cooperation with:

United Nations University (UNU), World Institute for Development Economics Research (WIDER)

Suggested Citation: van Seventer, Dirk; Davies, Robert H. (2019) : A 2016 social accounting matrix for South Africa with an occupationally disaggregated labour market representation, WIDER Working Paper, No. 2019/56, ISBN 978-92-9256-690-6, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki, <https://doi.org/10.35188/UNU-WIDER/2019/690-6>

This Version is available at:

<https://hdl.handle.net/10419/211286>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



WIDER Working Paper 2019/56

**A 2016 social accounting matrix for South Africa
with an occupationally disaggregated labour
market representation**

Dirk van Seventer* and Rob Davies†

August 2019

Abstract: Examining the economy-wide consequences of South Africa following a similar trajectory of labour market polarization to the rest of the world requires an appropriate database for an economy-wide policy analysis framework. This paper describes how a 2015 South Africa social accounting matrix (SAM) was updated for 2016 and expanded to include labour market disaggregation by occupation and some capital market disaggregation. This extended SAM will provide a basis for the construction of an economy-wide modelling framework to examine the implications of likely future growth and structural and technological changes for skills demand in South Africa.

Key words: Social accounting matrix, national accounts, supply table, use table, labour market

JEL classification: E16, C63, J4, O55

Link to: [2016 SASAM with Occ&Cap Disaggregation for Distribution v9](#)

*UNU-WIDER Consultant, corresponding author: denvanseventer@gmail.com; †UNU-WIDER Consultant.

This study has been prepared within the UNU-WIDER project ‘[Southern Africa—Towards Inclusive Economic Development \(SA-TIED\)](#)’.

Copyright © UNU-WIDER 2019

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9256-690-6

<https://doi.org/10.35188/UNU-WIDER/2019/690-6>

Typescript prepared by Merl Storr.

The United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland, Sweden, and the United Kingdom as well as earmarked contributions for specific projects from a variety of donors.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

The views expressed in this paper are those of the author(s), and do not necessarily reflect the views of the Institute or the United Nations University, nor the programme/project donors.

1 Introduction

Traditionally, occupations have been thought of—by the general public, by expert classifiers, and by economists—as fitting into a hierarchy. Those at the top typically require the most skill and receive the highest pay. Occupations further down the hierarchy receive less pay and are regarded as requiring fewer skills. The highest occupations involve work that is more flexible, include managerial work, and are often regarded as preferable to those lower down. This structure is widely recognized and regarded as normal; even collective bargaining agreements recognize an occupational hierarchy for pay grades. Higher-productivity work is often associated with occupations higher up the hierarchy.

Consistent with this view, technologies that replace labour with machines are viewed as displacing people at the bottom of the ladder. Tractors replace people who use hoes; forklift trucks replace the muscle power of unskilled labour. Development is often seen as requiring raising the skills of the less skilled, allowing them to move up the hierarchy to occupations that both pay more and are more productive. Technological advancement, in this view, is seen as moving people up the ladder.

Evidence from around the world suggests that technological change—especially change related to automation, machine learning, artificial intelligence, and robotics (AMLAIR)—is increasingly disrupting this simple scheme. Rather than uniform upskilling throughout the hierarchy, new technologies are leading to polarization, displacing occupations in the middle relative to those at both the bottom and the top. Many of these relatively skilled middle occupations involve work that can be routinized, in the sense of being codified in a way that allows machines to follow instructions and perform the work. As new technologies develop, it seems the scope for routinization is much greater than was originally thought. From robotic arms that perform tasks such as bolting wheels onto cars, we now see driverless cars becoming a reality. The range of fields in which this is happening seems to be expanding at an accelerating pace. Medical diagnostics and operations through to warehouse management have all become areas where machines can replace human workers.

These routinizable occupations traditionally fall in the middle of the occupational hierarchy in terms of both the skills required and the pay. Disruptive new technologies thus displace workers in the middle. Those higher up the hierarchy tend to undertake work that requires conceptualization, planning, and management, which as yet have not been significantly displaced by AMLAIR. And there are jobs further down the hierarchy that do require human intervention. Although some aspects of nursing or care work, say, can be handed over to machines, there are aspects that require a human touch.

Polarization is thus the notion that occupations in the middle of the traditional hierarchy shrink relative to those at both the top and bottom ends. This might be in terms of numbers of jobs in occupations, or in terms of wages. In either case, there may not be an absolute fall in the middle. Rather, there may be a relative shift: employment or wages in the middle occupations may rise, but more slowly than those at the ends. Other factors—especially overall growth—may counterbalance the absolute effects of polarization.

There is a large and growing academic literature exploring polarization. Although there were earlier studies, Autor, Levy, and Murnane (2003) is a seminal paper. Acemoglu and Autor (2011) provide a survey. Further, more recent contributions have been made by Acemoglu, Autor, and their

various co-authors (Acemoglu and Restrepo 2018a, 2018b; Autor 2013; Autor and Salomons 2018). Important contributions have been made by Goos et al. (2014) and Das and Hilgenstock (2018). Polarization in South Africa has been studied in a master's dissertation by van der Linde (2015), focussing on wage polarization. The issue is also increasingly covered in the media.

These effects are already being felt in South Africa and are likely to strengthen, especially as much of its technological development is the adaptation of global knowledge. Polarization will happen on top of South Africa's already high structural unemployment. This may create a dynamic that is different from that found in developed countries. While some displaced workers from the middle may be able to transition to abstract labour, others will find themselves competing in the already oversupplied market for manual labour.

For this reason, it is probably less useful to 'predict' future skills demands based on past trends than to examine the economy-wide consequences of South Africa following the same trajectory as the rest of the world. Such trends also have potentially profound implications for skills development programmes that policymakers wish to develop. By investigating this, we hope to help develop a basis for modelling to analyse prospective economy-wide changes.

This paper is one of three that look at the issues described above. Each is a distinct paper, but together they enable the development of a suitably adapted economy-wide policy modelling framework to inform labour market policy by analysing the future skills needs of the South African economy. The first paper in the series considers historical trends in order to set the scene for the third paper (Davies and van Seventer 2019a).

In this paper we describe how we extend a 2015 South Africa social accounting matrix (SAM) developed by van Seventer et al. (2019) to the year 2016. At the same time as using updated data we include a labour market disaggregated by occupation. This extended SAM will provide a basis for the construction of an economy-wide modelling framework to examine the implications of likely future growth and structural and technological changes for skills demand in South Africa in a forthcoming paper (Davies and van Seventer 2019b).

Although we have constructed the SAM as an integrated part of our investigation of polarization in South Africa, we hope it will be useful for other purposes, and we are therefore publishing it as a stand-alone piece with supporting data.

We start this paper by outlining the construction of a 2016 SAM for South Africa. A SAM is a consistent data framework that captures the information contained in the national income and product accounts (South African Reserve Bank 2018), a supply table (ST), and a use table (UT) (Statistics South Africa 2018b), as well as the monetary flows between institutions for the year 2016. A SAM is an *ex post* accounting framework in that within its square format, total receipts must equal total payments for each of its accounts. Since the required data is not drawn from a single source, information is manipulated in order to make it internally consistent. This process is valuable since it helps identify inconsistencies among statistical sources. For example, there are invariably differences between the incomes and expenditures reported in national household surveys and the national accounts. SAMs are economy-wide databases that are used in conjunction with analytical techniques to strengthen the evidence underlying policy decisions.

Section 2 reviews the general structure of SAMs. This is followed by a discussion of how a South African SAM is compiled, using national accounts and Statistics South Africa's ST and UT data sources, into a consistent SAM framework. This results in what we label a SUTSAM, since the data sources only identify a single type of labour and a single household. A subsequent step then draws on survey information to disaggregate the labour account of the SUTSAM. Section 3

describes the data sources used to construct the SAM. Given the diversity and inaccuracy of the various data sources, the SAM is initially invariably inconsistent. The balancing procedure of the SAM accounts is discussed in section 4.

This SAM was constructed in collaboration with the National Treasury of South Africa, based mostly on publicly available information from and the South African Reserve Bank.

2 What is a SAM?

Table 1 shows an aggregate or macro SAM for South Africa that is consistent with the SAM we will construct, giving verbal explanations instead of numbers.

The 2016 SAM distinguishes 62 ‘activities’ (the entities that carry out production) and 104 ‘commodities’ (representing markets for goods and non-factor services). The activities and commodities are listed in Appendix A of van Seventer et al. (2019). SAM flows are valued at producers’ prices in the activity accounts, and at market prices (including indirect commodity taxes and trade and transport margins) in the commodity accounts. The commodities consist of activity outputs, either exported or sold domestically, and imports. In the activity columns, payments are made to commodities (intermediate demand) and factors of production (value-added, comprising operating surplus and compensation of employees, the latter broken down by occupation as discussed later), as well as activity (production-based) tax. In the commodity columns, payments are made to domestic activities, various tax accounts (for domestic and import taxes), trade and transport margins, and the rest of the world. This treatment provides the data needed to model imports as perfect or imperfect substitutes vis-à-vis domestic production.

The government is disaggregated into a core government account and various tax collection accounts, one for each tax type. In the SAM, direct payments between the enterprises, households, and government are reserved for transfers as reported in the national accounts. Payments from the government to factors (for the labour services provided by public-sector employees) are captured in a government services activity. Government consumption demand is a purchase of the output from this government services activity, which in turn pays labour.

The SAM contains a number of factors of production, which earn incomes from their use in the production process, and then pay their incomes to enterprises, households, government, and the rest of the world. Indirect capital earnings or enterprise profits are taxed according to average corporate tax rates, while some profits are repatriated abroad. The remaining capital earnings, together with labour earnings, are transferred to households. Unlike in the 2015 SAM (van Seventer et al. 2019), households are not disaggregated. Households use their incomes to pay taxes, make transfers, save, and consume domestically produced and imported commodities.

Table 1: Basic structure of a 2016 SAM for South Africa

	Activities	Commodities	Labour	Capital	Enterprises	Households	Government	Net activity taxes	Net product taxes	Import duties	Income taxes	Changes in inventories	Accumulation	Rest of world	Total
Activities		Output of total domestic economy													Gross output
Commodities	Intermediate consumption	Transactions margins				Final consumption expenditure by households	Final consumption expenditure government					Change in inventories + residual item	Gross fixed capital formation	Exports of goods and services	Total demand
Labour	Compensation of employees													Compensation SA residents in RoW	Labour income
Capital	Net operating surplus + depreciation													Property income paid: RoW	Capital income
Enterprises				Gross operating surplus of corporations, adjusted for property income paid to/received from RoW	Net property income + other current transfers received: corporations - non-life insurance claims paid: corporations	Property income paid: households + net non-life insurance premiums: households	Social contributions received: financial corporations + property income paid: general government								Enterprise earnings
Households			Compensation of residents	Gross operating surplus/mixed income of households	Misc. transfers paid: corporations + property income received: households + non-life insurance claims: households + adj. for change in net equity in pension fund reserves: households		Misc. current transfers paid: general government + social benefits received: households							Misc. current transfers paid: RoW	Household earnings
Government				Gross operating surplus of general government	Social benefits paid by corporations, property income received by general government	Misc. transfers received: general government + social contributions paid: households	Net social contributions received: general government	Net other taxes on production in all industries	Net taxes on products - import duties	Import duties	Current taxes on income and wealth			Current international cooperation paid: RoW	Government receipts

Net activity taxes	Net other taxes on production in all industries												Net other taxes on production in all industries	
Net product taxes	Net taxes on products - import duties												Net taxes on products - import duties	
Import duties	Import duties												Import duties	
Income taxes			Current taxes on income and wealth paid by corporations		Current taxes on income and wealth of households								Current taxes on income and wealth	
Changes in inventories													Change in inventories + residual item	
Accumulation			Residual: corporations + gross saving of corporations		Residual: households and NPISHs + gross savings of households and NPISHs		Gross saving of general government						Change in inventories + residual item	
Rest of world	Imports of goods and services		Compensation of SA employees	Property income received: RoW			Misc. current transfers received: RoW	Current international cooperation received: RoW						Current external balance: RoW
Total	Gross output	Total supply	Distribution of labour income	Distribution of capital income	Enterprise outlays	Household outlays	Government outlays	Net other taxes on production in all industries	Net taxes on products - import duties	Taxes on international trade and transactions: import duties	Current taxes on income and wealth paid by corporations + current taxes on income and wealth of households	Change in inventories + residual item	Gross fixed capital formation (investment) + change in inventories + residual item	Foreign exchange inflow

Notes: NPISH: non-profit institutions serving households. RoW: rest of the world.

Source: authors' descriptions and labels.

Table 2: A 2016 macro SAM for South Africa (ZAR, billions)

	Activities	Commodities	Labour	Capital	Enterprises	Households	Government	Net activity taxes	Net product taxes	Import duties	Income taxes	Changes in inventories	Accumulation	Rest of world	Total
Activities		8,432													8,432
Commodities	4,551					2,586	905					-16	849	1,336	10,210
Labour	2,064													11	2,075
Capital	1,739													77	1,816
Enterprises				971	203	378	413								1,965
Households			2,062	548	653		422							22	3,707
Government				102	252	249	212	77	422	47	657			2	2,021
Net activity taxes	77														77
Net product taxes		422													422
Import duties		47													47
Income taxes					228	429									657
Changes in inventories													-16		-16
Accumulation					628	56	27							121	833
Rest of world		1,309	13	195		10	42								1,568
Total		8,432	10,210	2,075	1,816	1,965	3,707	2,021	77	422	47	657	-16	833	1,568

Source: authors' reporting of South Africa's national accounts, based on data from South African Reserve Bank (2018).

3 How is this SAM constructed?

The initial task in building a SAM involves compiling data from various sources into the SAM framework. For this SAM, the information was drawn from national accounts, STs, UTs, and a labour force survey. This information often uses (1) different disaggregations of activities, production factors, and socio-economic household groups, (2) different years and/or base-year prices, and (3) different data collection and compilation techniques. Consequently, the initial SAM typically faces some imbalances between row and column account totals.

The macro SAM shown in Table 2 is an aggregation of the more detailed micro SAM. The details of the micro SAM are described in van Seventer et al. (2019) for the year 2015. The same procedure applies to the benchmark 2016 year of the SAM described in this paper. The only difference is that there is no disaggregation of households, while the labour market disaggregation is more detailed.

The range of datasets used to construct the SAM described above suggests that there may be imbalances (i.e. row and column totals are unequal). However, Statistics South Africa's ST and UT for 2016 are almost consistent with each other and with the national accounts. The inconsistency is considered to be a rounding error, and therefore small enough to load into the existing UT's residual. The latter is itself already merged with the change in stocks, for reasons of modelling convenience.

4 Final touches

After we balanced the SUTSAM, the wage earnings were disaggregated across labour categories for each activity using 2016 labour market dynamics (LMD) data (Statistics South Africa 2018a). The following steps were taken:

- i. Benchmark employment for the year 2016 was obtained from the LMD report (Statistics South Africa 2018a). Workers 65+ were added since they also earn wages. The total number of workers (employment) amounting to 15,968,004 was our benchmark.
- ii. The Quarterly Employment Survey (QES, Statistics South Africa 2019) was used to distribute total employment of (i) across the SUTSAM activities, to create an activity level benchmark. QES data excludes agriculture and private household activities (domestic workers). Their respective LMD totals were used. Activity level control totals were subsequently scaled to match LMD one-digit activity estimates, as shown in the LMD report (Statistics South Africa 2018a), which for our purpose also includes the 65+ workers.
- iii. To disaggregate the employment benchmark for each SUTSAM activity of (ii) across two-digit occupations, employment by SUTSAM activity and two-digit occupation was extracted from the LMD. This included 65+ workers. Missing observations were shown in the extraction for each activity as unreported occupation. These missing observations were distributed for each SUTSAM activity across occupations on a pro-rata basis to arrive at employment by SUTSAM activity and two-digit occupation that meets the overall and SUTSAM activity specific benchmarks of (ii). As an additional benchmark, employment for one-digit occupation, as shown in the LMD report (Statistics South Africa 2018a)—and scaled up to include 65+ workers—was imposed.
- iv. Earnings per worker by SUTSAM activity and two-digit occupation were derived from the LMD by taking the ratio of earnings and workers for each SUTSAM activity and

occupation. Earnings per worker were multiplied with employment of (iii) to arrive at adjusted wage earnings.

- v. The occupation shares of each activity's total earnings were derived from (iv) and multiplied with the SUTSAM earnings for all occupations of each SUTSAM activity. In this way internal consistency was ensured.

We use two-digit occupations as shown in the Appendix. A mapping to a broad task-based aggregation of occupations is based on Acemoglu and Autor (2011) and Acemoglu and Restrepo (2018b).

Summing earnings across activities results in total labour income for each two-digit occupation group. Each two-digit occupation group's total earnings are distributed to households and in addition to the rest of the world. The latter is based on the same shares as total labour earnings. These shares can be derived from the entries in the third column of Table 2. The rest of the SAM remains unaffected by the disaggregation.

In order to substitute any occupation (or task-based aggregation thereof) with capital, it makes sense to break capital stock down to some degree as well. Our working hypothesis is that the routine tasked aggregation of occupations listed in the Appendix may or may not easily substitute for capital stock of plant, machinery, and other office equipment. Substitution is not likely to be the case with capital stock of transport equipment (at least not in the foreseeable future), non-residential buildings, and other capital stock. For this purpose, we use the Annual Financial Statistics (AFS) Survey for the year 2016 (Statistics South Africa 2017). A range of capital stock types are identified for a large number of activities. We map the activities to the 62 identified in our SAM, and we create an activity-level breakdown for 'other property, plant, and equipment' plus 'plant, machinery, and other office equipment' on the one hand, and all other capital stock on the other. Note that we include 'computer software' and 'computers and other IT equipment' in the latter, as we consider this more likely to be complementary to the abstract aggregation of occupations in the Appendix, rather than substitutable with the routinized aggregation of occupations.

Based on the shares of equipment in capital stock for each industry, we then replace the single account for the earnings of the production factor capital (gross operating surplus) with two accounts, i.e. equipment capital stock and other capital stock. Thus, the working assumption is made here that for each activity, the shares of capital stock and the shares of earnings of the production factor capital are the same. Unfortunately, the AFS does not allow us to improve on this rather heroic assumption. Be that as it may, the total earnings for each disaggregated production factor capital (i.e. equipment and other capital) are distributed to the recipients in the SAM according to the shares of the entries shown in column 4 of Table 2. The rest of the SAM remains unaffected by the disaggregation.

In summary, we have disaggregated the SUTSAM, which was based on national accounts and Statistics South Africa's ST and UT data for 2016 with only a single account for labour and capital, into one in which both are disaggregated.

5 Supplementary data: physical capital stock and employment

Although SAMs are typically presented in monetary values, modellers and other users might wish to refer to the physical quantities that are associated with certain flows. In particular, employment

figures related to the wage flows recorded in the SAM can be useful. Employment estimates by SUTSAM activity and occupation are described in (iii) of section 4 above.

In our case we also want to use physical capital stock estimates for the two types of capital mentioned in the previous sections. A similar albeit somewhat simpler approach was followed with regard to the capital stock data. The activity-level shares of equipment and other capital stock were derived from the AFS (Statistics South Africa 2017) and made consistent with South African Reserve Bank one-digit capital stock data (South African Reserve Bank 2018) using AFS shares of their one-digit lower-level control totals. The data is available in the accompanying Excel workbook.

6 Earnings rates for labour

Now that we have estimates of earnings for the factors of production as well as physical stocks of them, we can present earnings rates. Here, we limit the exposition of earnings per worker to industry and occupation averages respectively, and we ignore the underlying detail of combinations thereof. Further detail is available in the accompanying Excel workbook. In Table 3 we consider average earnings rates for activities.

While it comes as no surprise that financial intermediation-related activities are in the top rankings, it is somewhat revealing that there are quite a few mining and manufacturing-related activities up there as well. As expected, at the bottom of the table we find activities such as agriculture, sewerage and refuse disposal, retail trade, and the hospitality industry. The ratio of these bottom activities relative to the top 10 or so is roughly 1:10. Results at the occupation level are reported in Table 4. We also add the physical employment numbers.

There are five occupations that stand out at the top of the two-digit ranking, including health and science professionals, legislators, and managers. At the bottom of the two-digit occupation ranking are subsistence agricultural workers, other agriculture-related workers, elementary workers, and salespersons, among others. Again, a large gap can be seen from the top of the table at around 1:10. This gap is confirmed in the top half of the second tableau of the tables, where average earnings of the one-digit occupations are presented. With the task-based aggregation of occupations, the gap is somewhat smaller, in the region of 1:6, i.e. the abstract tasked aggregation of occupations earns on average about six times the manual tasked aggregation of occupations, and just over three times the routine tasked aggregation. It can also be seen that routine tasked employment constitutes about 40 per cent of total employment, with abstract and manual tasked labour making up 10 per cent and 50 per cent respectively.

Table 3: Average earnings by activity, 2016

		Earnings per worker			Earnings per worker
1	Nuclear fuel, basic chemicals	1,462,344	32	Coke oven, petroleum refineries	152,534
2	Activities to financial intermediation	932,428	33	Air transport	144,320
3	Mining of metal ores	733,392	34	Footwear	119,232
4	Insurance and pension funding	449,887	35	Electrical machinery and apparatus	119,151
5	Mining of coal and lignite	373,681	36	Spinning, weaving and finishing of textiles	109,343
6	Electricity, gas, steam and hot water supply	355,980	37	Wholesale trade, commission trade	106,261
7	Radio, television, communication equipment and apparatus	345,904	38	Furniture	104,231
8	Financial intermediation	345,333	39	Health and social work	101,859
9	Mining of gold and uranium ore	343,429	40	Other mining and quarrying	99,439
10	Other chemical products, man-made fibres	339,898	41	Non-metallic minerals	94,283
11	Collection, purification and distribution of water	334,664	42	Tanning and dressing of leather	93,759
12	Basic iron and steel, casting of metals	300,552	43	Manufacturing n.e.c, recycling	90,815
13	Beverages and tobacco	299,539	44	Non-observed, informal, non-profit, households,	87,376
14	Basic precious and non-ferrous metals	284,889	45	Real estate activities	87,352
15	Glass	264,793	46	Medical, precision, optical instruments, watches and clocks	87,237
16	Education	235,387	47	Auxiliary transport	86,314
17	Rubber	229,790	48	Knitted, crouched fabrics, wearing apparel, fur articles	85,997
18	Fishing	224,848	49	Sale, maintenance, repair of motor vehicles	80,030
19	Government	222,845	50	Renting of machinery and equipment	73,888
20	Other transport equipment	220,699	51	Computer and related activities	62,738
21	Paper	216,711	52	Retail trade	58,900
22	Research and experimental development	211,549	53	Other business activities	57,086
23	Plastic	204,756	54	Recreational, cultural and sporting activities	54,844
24	Motor vehicles, trailers, parts	195,548	55	Forestry	50,997
25	Publishing, printing, recorded media	185,968	56	Water transport	44,811
26	Fabricated metal products	184,798	57	Construction	43,138
27	Sawmilling, planing of wood, cork, straw	180,865	58	Hotels and restaurants	37,023
28	Food	175,519	59	Activities of membership organisations	35,255
29	Post and telecommunication	156,759	60	Agriculture	28,437
30	Machinery and equipment	156,224	61	Other activities	17,282
31	Land transport, transport via pipe lines	153,833	62	Sewerage and refuse disposal	13,246

Source: authors' calculations.

Table 4: Employment and average earnings per worker by occupation, 2016

	Code	Label	Employment	Earnings per worker
	Tableau 1			
1	occ_22	Health professionals	89,950	422,627
2	occ_12	Corporate managers	1,236,674	383,430
3	occ_21	Science professionals	119,303	368,711
4	occ_23	Teaching professionals	344,613	354,771
5	occ_24	Other professionals	322,474	353,305
6	occ_11	Legislators & senior officers	77,053	299,958
7	occ_31	Science assoc. professionals	370,929	192,271
8	occ_33	Teaching assoc. professionals	355,596	180,658
9	occ_13	General managers	58,462	172,383
10	occ_81	Stationary-plant operators	134,030	167,031
11	occ_34	Other assoc. professionals	486,875	158,938
12	occ_72	Metal trades workers	629,697	131,912
13	occ_32	Health assoc. professionals	274,151	126,107
14	occ_41	Office clerks	1,019,792	117,807
15	occ_82	Machine operators	323,406	113,178
16	occ_51	Personal services workers	1,816,547	94,071
17	occ_83	Drivers and mobile-plant operators	841,894	92,285
18	occ_73	Precision trades workers	74,283	87,103
19	occ_74	Other trades workers	273,275	86,624
20	occ_71	Building trades workers	972,752	79,799
21	occ_42	Customer services clerks	641,812	74,645
22	occ_52	Salespersons	694,075	70,615
23	occ_93	Mining, constr., manuf. and trans. labourers	1,337,390	63,883
24	occ_91	Elementary service occupations	2,258,508	61,508
25	occ_61	Market agric. skilled workers	61,382	48,725
26	occ_92	Agric., fish & related labourers	1,146,051	41,923
27	occ_62	Subsistence agric. workers	7,430	6,377
	Tableau 2			
1	occ_1	Legislators, senior officials and managers	1,372,190	369,751
2	occ_2	Professionals	876,340	363,094
3	occ_3	Technical and associate professionals	1,487,551	166,391
4	occ_8	Plant and machine operators and assemblers	1,299,330	105,195
5	occ_4	Clerks	1,661,605	101,135
6	occ_7	Craft and related trades workers	1,950,007	97,862
7	occ_5	Service workers and shop and market sales workers	2,510,622	87,586
8	occ_9	Elementary occupation	4,741,948	57,444
9	occ_6	Skilled agricultural and fishery workers	68,812	44,153
	Tableau 3			
1		Abstract	2,248,530	367,157
2		Routine	6,467,305	115,367
3		Manual	7,252,570	67,879

Source: authors' calculations.

7 Conclusions

If we want to examine the economy-wide consequences of South Africa following a similar trajectory of labour market polarization to the rest of the world, we need to develop an appropriate database for an economy-wide policy analysis framework. Such a trajectory can have potentially profound implications for skills development programmes that policymakers wish to develop. More specifically, our challenge was to expand the SAM for South Africa and physical stocks of the factors of production with more labour and capital market detail.

In summary, we have disaggregated the SUTSAM, which was just based on national accounts and Statistics South Africa's ST and UT data with only a single account for labour and capital, into one in which both are disaggregated. In doing so, we hope to help develop a basis for modelling to analyse prospective economy-wide changes.

References

- Acemoglu, D., and D.H. Autor (2011). 'Skills, Tasks and Technologies: Implications for Employment and Earnings'. In D. Card and O. Ashenfelter (eds), *Handbook of Labor Economics, Volume 4B*. San Diego: Elsevier. doi:10.1016/S0169-7218(11)02410-5.
- Acemoglu, D., and P. Restrepo (2018a). 'Demographics and Automation'. NBER Working Paper 24421. Cambridge, MA: NBER. Available at: www.nber.org/papers/w24421 (accessed 8 August 2019).
- Acemoglu, D., and P. Restrepo (2018b). 'Modeling Automation'. *American Economic Association Papers and Proceedings*, 108: 48–53. doi:10.3386/w24321.
- Autor, D. (2013). 'The "Task Approach" to Labor Markets: An Overview'. NBER Working Paper 18711. Cambridge, MA: NBER.
- Autor, D., and A. Salomons (2018). 'Is Automation Labor-Displacing? Productivity Growth, Employment, and the Labor Share'. NBER Working Paper 24871. Cambridge, MA: NBER. doi:10.3386/w24871.
- Autor, D.H., F. Levy, and R.J. Murnane (2003). 'The Skill Content of Recent Technological Change: An Empirical Exploration'. *Quarterly Journal of Economics*, 118(4): 1279–333.
- Das, M., and B. Hilgenstock (2018). 'The Exposure to Routinization: Labor Market Implications for Developed and Developing Economies'. Working Paper 18/135. Washington, DC: IMF. Available at: www.imf.org/en/Publications/WP/Issues/2018/06/13/The-Exposure-to-Routinization-Labor-Market-Implications-for-Developed-and-Developing-45989 (accessed 14 March 2019).
- Davies, R., and D. van Seventer (forthcoming 2019a). 'Labour Market Polarization in South Africa: A Decomposition Analysis'. Working Paper. Helsinki: UNU-WIDER.
- Davies, R., and D. van Seventer (forthcoming 2019b). 'Modelling South Africa's Future Demand for Labour Skills'. Working Paper. Helsinki: UNU-WIDER.
- Goos, M., A. Manning, and A. Salomons (2014). 'Explaining Job Polarization: Routine-Biased Technological Change and Offshoring'. *American Economic Review*, 104(8): 2509–26.
- South African Reserve Bank (2018). 'Quarterly Bulletin of Statistics: March 2018'. Pretoria: South African Reserve Bank. Available at:

- www.resbank.co.za/Lists/News%20and%20Publications/Attachments/8334/01Full%20Quarterly%20Bulletin%20%E2%80%93%20March%202018.pdf (accessed 14 March 2019).
- Statistics South Africa (2017). 'Annual Financial Statistics Survey 2016 (AFS)'. Pretoria: Statistics South Africa. Available at: www.statssa.gov.za/?page_id=1854&PPN=P0021&SCH=7093 (accessed 30 March 2019).
- Statistics South Africa (2018a). 'Labour Market Dynamics in South Africa 2015'. Pretoria: Statistics South Africa. Available at: www.datafirst.uct.ac.za/dataportal/index.php/catalog/598 (accessed 14 March 2019).
- Statistics South Africa (2018b). 'P0441: Gross Domestic Product (GDP), 4th Quarter 2017'. Pretoria: Statistics South Africa. Available at: www.statssa.gov.za/?page_id=1854&PPN=P0441&SCH=6985 (accessed 13 March 2019).
- Statistics South Africa (2019). 'P0 0277: Quarterly Employment Statistics (QES), December 2018'. Pretoria: Statistics South Africa. Available at: www.statssa.gov.za/?page_id=1854&PPN=P0277 (accessed 30 March 2019).
- van der Linde, M. (2015). 'An Analysis of the Polarisation of the South African Labour Market'. Master's dissertation. Potchefstroom: North-West University.
- van Seventer, D., S. Bold, S. Gabriel, and R. Davies (2019). 'A 2015 Social Accounting Matrix (SAM) for South Africa'. SA-TIED Working Paper 35. Helsinki: UNU-WIDER. Available at: www.wider.unu.edu/database/2015-social-accounting-matrix-south-africa (accessed 30 March 2019).

Appendix: Occupations and mapping to broad tasks

Occupation codes	One-digit label	Task	Task code
1	Legislators, senior officials, and managers	Abstract	flab_abs
2	Professionals	Abstract	flab_abs
3	Technical and associate professionals	Routine	flab_rou
4	Clerks	Routine	flab_rou
5	Service workers and shop and market sales workers	Manual	flab_man
6	Skilled agricultural and fishery workers	Routine	flab_rou
7	Craft and related trades workers	Routine	flab_rou
8	Plant and machine operators and assemblers	Routine	flab_rou
9	Elementary occupation	Manual	flab_man
Occupation codes	Two-digit label	Task	Task Code
11	Legislators and senior officers	Abstract	flab_abs
12	Corporate managers	Abstract	flab_abs
13	General managers	Routine	flab_rou
21	Science professionals	Abstract	flab_abs
22	Health professionals	Abstract	flab_abs
23	Teaching professionals	Routine	flab_rou
24	Other professionals	Routine	flab_rou
31	Science associate professionals	Abstract	flab_abs
32	Health associate professionals	Abstract	flab_abs
33	Teaching associate professionals	Routine	flab_rou
34	Other associate professionals	Routine	flab_rou
41	Office clerks	Abstract	flab_abs
42	Customer services clerks	Abstract	flab_abs
51	Personal services workers	Abstract	flab_abs
52	Salespersons	Abstract	flab_abs
61	Market agricultural skilled workers	Abstract	flab_abs
62	Subsistence agricultural workers	Abstract	flab_abs
71	Building trades workers	Abstract	flab_abs
72	Metal trades workers	Abstract	flab_abs
73	Precision trades workers	Routine	flab_rou
74	Other trades workers	Routine	flab_rou
81	Stationary-plant operators	Abstract	flab_abs
82	Machine operators	Abstract	flab_abs
83	Drivers and mobile-plant operators	Routine	flab_rou
91	Elementary service occupations	Abstract	flab_abs
92	Agricultural, fishery and related labourers	Abstract	flab_abs
93	Mining, construction, manufacture, and transport labourers	Routine	flab_rou

Source: Statistics South Africa (2017) and authors' mapping based on Acemoglu and Autor (2011) and Acemoglu and Restrepo (2018b).