OFFSHORING WITHIN SOUTH AFRICAN MANUFACTURING FIRMS: AN ANALYSIS OF THE LABOUR MARKET EFFECTS[1]

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Abstract

South Africa's manufacturing sector experiences declining growth and labour demand, and increased imports of intermediate goods. The paper investigates the influence of offshoring on employment and wages for capital- and labour-intensive industries and skilled and unskilled workers, using firm- and employer-employee-level data. Unlike findings in developed countries, offshoring generally lowers employment in manufacturing firms, and increases and decreases the percentage of unskilled workers and lower skilled workers respectively. Increased narrow offshoring seemingly grows the cohort of unskilled workers, particularly in ultra-labour-intensive industries. As offshoring gains momentum, worker-level earnings increase in capital- and labour-intensive industries but decrease in ultra-labour-intensive industries.

JEL classification: F14, F16

***Keywords**: offshoring, firm-level data, employer-employee data, employment, skills, wages*

1. INTRODUCTION

In South Africa, the manufacturing sector's contribution to GDP has been steadily declining. Declining growth in the sector has resulted in approximately 250 000 job losses between 2005 and 2014. Of this, the largest decline in jobs was in the textiles industry (91 000). An exception was in the petroleum and chemicals industry, which created 20 000 jobs (StatsSA, 2016). The differences in productivity and performance between different industries in the sector calls for a nuanced approach in detailing the relationship between manufacturing and employment growth by considering industries as per their intensity level – being capital- or labour-intensive (Kreuser and Newman, 2018; Zalk, 2014). Indeed, South Africa's economy is highly capital intensive, with costly labour being increasingly substituted by capital. Moreover, labour-intensive sectors also faced severe competition from low-wage countries after 1995, with many companies being shut down as a result (World Bank, 2018).

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Another trend in the manufacturing sector has been an increase in imports of intermediate inputs. In the South African metals and engineering sector, for example, the increase was from approximately 22 per cent twenty years ago to approximately 35 per cent in recent years (Creamer, 2015). Creamer (2015) explains this trend by detailing rising domestic production costs, including significant increases in electricity and labour costs, and production volatility such as strikes and power disruptions. This signifies South African manufacturers' increasing involvement in fragmented production networks as a result of engaging in offshoring activities.

As relevant international literature has shown, these offshoring activities have consequences for the labour demand in manufacturing firms for both skilled and unskilled workers, as well as for wages paid to workers within a firm. For South Africa, this has pertinent importance, as finding the solutions for employment creation within the manufacturing sector is challenging, given the current context of the large unskilled workforce. Bhorat and Rooney (2017:9), in their analysis of the manufacturing sector, surmise that the manufacturing sector has had a greater demand for skilled workers relative to semi-skilled and unskilled workers. Indeed, they explain that in absolute terms, "59 000 highly-skilled jobs in manufacturing were created in the South African economy between 2001 and 2014, while 149 000 semi-skilled jobs were lost, and unskilled jobs grew by 9 000". The question that arises is to what extent offshoring plays a role in these dynamics. Labour demand and firm dynamics, including entry and exit, are complex within the formal-plus-informal and multi-segment context of the South African labour market. The issue of offshoring is thus one of the knowledge gaps that need to be narrowed for efficient and focused policy formulation.

This paper aims to address this gap by answering the following question: What are the labour market impacts of offshoring regarding wages and employment levels within South African manufacturing firms? Due to the heterogeneous nature of manufacturing, the general analysis is extended to determine if the observed relationships differ across different categories of firms. Estimations are done on sub-groups of manufacturing firms, for instance firms regarded as narrow-offshorers, as well as groups with differing capital-labour ratios. Apart from estimates on sub-groups, the marginal impact of different categories of firms is tested by the inclusion of interactive terms. The paper focuses on both firm and employer-employee level. Firm-level analysis reveals the extent to which South African manufacturing firms are engaged in offshoring, while worker-level data provides an indication of the individual wages and number of employees with different skills levels per firm that are subject to offshoring shocks. Understanding the labour market effects of importing activities within fragmented production networks provides first-time firm- and worker-level insights for South Africa that can assist policymakers in laying the path for South Africa's inclusive growth targets, specifically in employment creation within the manufacturing sector.

Andersson et al. (2016) conclude that only a limited number of studies employ firm-level data. An even more limited number of studies make use of matched employer-employee data. Hummels et al. (2016) explain that this type of data have only recently been utilised to study the offshoring effects on labour market outcomes. Such data has information on firm and worker characteristics and allows researchers to track workers over time. In particular, Hummels et al. (2016:44) state that "[m]atched employer-employee data allow researchers to accurately measure offshoring, and cleanly identify the causal effects of offshoring on wages". A further contribution of this paper is therefore to the international literature in the application of offshoring using employer-employee data within a developing-country context.

We utilised the newly made available tax administrative data, more specifically the CIT-IRP5 panel data for the firm-level analysis. This panel consists of matched firm-level data from three tax forms, namely the company income tax (CIT) form, customs transaction form and worker-level tax form (IRP5 certificates).

The remainder of the paper is organised as follows: Section 2 provides a brief contextualisation of the South African manufacturing sector; Section 3 provides the international and South African literature context; Section 4 contains the data discussion, descriptive statistics and empirical results, and Section 5 concludes the paper.

2. BRIEF CONTEXTUALISATION OF THE SOUTH AFRICAN MANUFACTURING SECTOR

Approximately one hundred years ago, South Africa (SA) was an economy dominated by mining and agriculture. The expansion of the mining sector brought with it an increased demand for complementary products, such as processed foods and textiles (Rodrik, 2008). The government responded in the 1920s by commencing to provide relatively cheap electricity and steel for use by industry in a bid to assist manufacturing. During this time, a number of state-owned businesses became the dominant forces in local manufacturing. This process continued after the Second World War, and the government played an important role in establishing industries in the areas of chemicals, oil from coal, and armaments (Rodrik, 2008). As a result, manufacturing and its contribution grew until the 1980s[2].

The 1980s saw a number of factors impacting negatively on local manufacturing (Zalk, 2014). There were droughts, coupled with an economic downswing. To add, gold prices displayed increasing levels of volatility, while sanctions and disinvestment also caused a decline in manufacturing (Zalk, 2014). This process continued into the 1990s, when South Africa's integration into the world economy was accompanied by new challenges.

The globalised world into which South Africa emerged after the democratic elections in 1994 brought with it brutal competition from other developing countries, especially in South-East Asia (Bhorat and Rooney, 2017; Kaplinsky et al., 2002; Odén, 1999). Suddenly, the South African government, having to adhere to its obligations to the World Trade Organization (WTO), had less room to implement protectionist policies (Bhorat and Rooney, 2017, Edwards and Alves, 2006; Odén, 1999). However, inferring that the decline in the share of manufacturing in GDP is driven by South Africa's obligations to the WTO will be a dangerous and erroneous simplification.

Liberalisation during the 1990s entailed significant unilateral liberalisation as the tariff liberalisation program went further than required by the General Agreement on Tariffs and Trade (GATT) agreement (Bell 1997; Edwards et al., 2009). This was justified in the South African Government's macroeconomic strategy as being essential for the generation of export-led growth (Roberts, 2000). For example, on the eve of the Uruguay Round implementation period, the average existing rates of duty in 1994 for capital goods, intermediate goods and manufactured goods in the aggregate, were already lower than the

[2] The anonymous reviewer importantly pointed out that it is important to note that that the share in nominal GDP plateaued during 1970s and then fell from 1981/2 (when the real GDP share of manufacturing also fell). Manufacturing employment as a share of total employment has also been declining from around the early 1980s. This is important as it signals that the decline in manufacturing commenced prior to the liberalisation in the 1990s.

average GATT bound rates (Bell, 1997). It can be argued that, except for consumption goods, further tariff reductions have largely been within the discretion of the South African authorities (Bell, 1997), implying there was room for the implementation of additional protection. Bell (1997:76) also stated that tariff reductions exceeded those required by the commitments entered into by South Africa in the Uruguay round. This even applied to employment "sensitive" industries such as textiles and clothing, and motor vehicles. Furthermore, although protection has fallen, the decline has been no faster than in other lower-middle-income economies (Edwards, 2005). As pointed out by the anonymous reviewer on an earlier draft, while liberalisation and outsourcing may have contributed or even accelerated deindustrialisation in SA, the fact that these trends took place prior to SA opening up to trade indicates that other factors are potentially alternative drivers of this trend.

Data from the South African Reserve Bank (SARB, 2019) and the World Bank (2019) shows the decline in the share of manufacturing in South Africa's GDP has been an almost constant feature since 1990. The beneficiaries in this period were evidently skilled workers, in both absolute and relative terms. The price of unemployment was thus paid by semi-skilled workers (Bhorat and Rooney, 2017), although the South African manufacturing sector was still the fourth-largest contributor to economic activity at 13.5 per cent in 2014 (South African Market Insights, 2019) and remains an important part of the economy (Bhorat and Rooney, 2017). However, the past decade has seen additional pressures such as significant increases in the price of electricity coupled with unreliable supply. This decreases already-flagging levels of profitability for the manufacturing sector even further. These challenges occur against the backdrop of worldwide changes in the structure of production, including offshoring. This backdrop forms the point of departure for an overview of relevant literature in the next section.

3. LITERATURE REVIEW AND OFFSHORING IN THE SOUTH AFRICAN CONTEXT

Worldwide, production has become more fragmented due to firms' increasing offshoring activities (Bandyopadhyay et al., 2017). Different prices for production factors allow firms to be efficiency seekers, thereby acquiring better or cheaper resources to enlarge their gains from trade that arise from specialisation (Bottini et al., 2007; Hummels et al., 2016). External factors such as lower trade barriers and decreased transport and international telecommunication costs have also contributed to the rise in global production networks (Andersson et al., 2016; Bottini et al., 2007). Offshoring within the manufacturing sector can therefore be defined as the geographical disaggregation of specified production tasks, where component production occurs in a foreign country (Hummels et al., 2016).

How does offshoring affect employment levels and wages? A vast body of theoretical and empirical literature on the labour consequences of offshoring has emerged over the last two decades (as detailed by Hummels et al., 2016). Andersson et al. (2016) surmise that most of the empirical literature uses industry-level data, whereas employment data within industries are garnered at plant level. Traditionally, offshoring has been critically viewed within the public domain of developed countries, claiming that low-skilled jobs are exported to developing countries which, in turn, results in large-scale job losses and rising wage inequality within the home country (Bottini et al., 2007; Hsieh and Woo, 2005; Hummels et al., 2016). However, the perceived link between offshoring and labour outcomes is not straightforward. Hummels et al. (2014), using Danish data, explain that offshoring can lead to the displacement of workers, for instance through the importation of an input/intermediate good that was previously produced within the firm. Moreover, acquiring more cost-effective foreign inputs could have a positive effect through enhanced productivity which, in turn, leads to higher output, employment levels and wages. However, this benefit is linked to the skills level of the worker, as offshoring tends to increase the wages of high-skilled workers and decrease wages for low-skilled workers. Feenstra and Hanson (2003) concur with this finding in their study on US data, namely that offshoring results in a lower demand for low-skilled workers and a higher demand, coupled with higher wages, for high-skilled workers.

Several South African studies have considered the labour market effect of increased exports. For instance, Edwards (2001) provides a summary of some of the earlier literature which includes one of the first studies in this field by Bell and Cattaneo (1997). This literature shows that exports increased employment in manufacturing between 1985 and 1993 but decreased the labour coefficients of exports compared with manufacturing and imports. The growth rate of employment thus decreased as a result of an increase in exports (Edwards, 2001). Edwards (1999) extended the time period to 1997 in order to take into account the impact of the tariff liberalisation programme initiated in South Africa in 1994. The results were generally consistent with the Bell and Cattaneo (1997) study. In his 2001 paper, Edwards' results did not support the notion that trade liberalisation was the reason for the decline in employment since the late 1980s, although export-led employment growth was unable to reduce unemployment (Edwards, 2001).

It appears that no specific reference to the impact of offshoring is available. Pretorius and Blaauw (2005), for example, analysed industry data for the period 1993 to 2001 and found that the higher the ratio of exports to domestic sales, the more workers are employed. This however applied to highly skilled workers and not to semi- and unskilled workers. A follow-up study by Pretorius and Blaauw (2018) considers the impact of imported inputs on industry employment levels. Highly skilled and skilled employment respond positively to increases in the ratio between imported and local inputs for manufacturing; the same observation is not true for the semi- and unskilled categories of employment.

The present paper builds on previous trade- and labour-related studies conducted on the SARS (South African Revenue Service) administrative data (see Edwards et al., 2018; Matthee et al., 2017; 2018). Matthee et al. (2018) examined the characteristics of manufacturing exporters, while Matthee et al. (2017) added an understanding of the labour dynamics of this manufacturing sector. The Edwards et al. (2018) study, however, has a wider scope, including importers of intermediate inputs. These authors found that importing intermediates increases exports, especially for imports that are sourced from developed countries. They also found that two-way traders (importing inputs and exporting output) are more productive, employ more workers, and pay higher wages than exporters only or importers only (Edwards et al., 2018).

The present paper contributes to and expands the body of existing work on administrative data by investigating offshoring within the South African manufacturing context. As indicated above, the literature on offshoring considers the importation of intermediate inputs with labour implications for workers in the manufacturing industry. The empirical analysis that follows is built on this premise.

4. EMPIRICAL ANALYSIS

The empirical analysis commences with a discussion of the variables deployed in the study.

4.1 Variables employed

Hummels et al. (2014: 1604) describe broad offshoring as the 'total value of imports by manufacturing firm per year' and narrow offshoring as 'purchases of inputs belonging to the same industry as that of the producing firm'. They go on to state that narrow offshoring takes place when a firm imports goods classified in the same HS4 category as the products that the firm sells – both domestic and internationally. Therefore, the closer the imported products are to the final product, the more likely it is that labour within the firm could have produced it and that job losses may occur if imports increase.[3]

The broad offshoring measure in our analysis is provided in the company income tax (CIT) panel as the total rand value of imports. The data set does not provide an indication of the HS4 codes of products sold domestically and we thus disregard the domestic sales classification criterion and define narrow-offshoring firms (narrow offshorers) as those firms for which the HS4 code of their most recurrent/most traded imported product and the HS4 code of their most recurrent exporting product coincide[4]. This measure is based on the value of imports and exports, but could exclude indirect imports. This definition may be more limiting and narrower than the one proposed by Hummels et al. (2014) but suits the available data. It is important to note that narrow offshoring only applies to two-way traders (those that export and import). As seen from Edwards et al. (2018), two-way traders differ significantly from firms that only imports and firms that do not import, therefore the results on narrow offshoring are not representative of manufacturing firms in general. Although narrow in definition and sample, narrow offshoring provides particular insight into how outsourcing affects the labour market outcomes of firms that export and import as part of global value chains.

We investigated the labour market effects of offshoring within South African manufacturing firms at firm level as well as at employer-employee level. Firstly, the CIT-IRP5 panel data available as on 19 May 2019 were utilised for the firm-level analysis. This panel consists of matched firm-level data from three tax forms, namely the CIT form, customs transaction form, and worker-level tax form (IRP5 certificates). In addition to the value of total imports, the following information was utilised; sales, capital, number of employees, employee expenses, ISIC4 code to classify the type of manufacturing firm, and HS4 product code of most traded good per firm to create the narrow-offshoring dummy, as was discussed above.

While the IRP5 data include no measure of education level or skilling, we were able to create a variable indicating the percentage of employees in a firm earning 'skilled' and 'unskilled' salaries by using the raw IRP5 data. This is a novel contribution, since similar

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[3] Narrow offshoring within the context of manufacturing firms therefore excludes firms that merely resell imported goods—in which case the importing firm would be classified as belonging to 'wholesale and retail'. Narrow offshoring manufacturing firms are still engaged in value-added activities. It is however possible that manufacturing firms could engage in retail as well as production – something that would not be reflected in the trade data. The authors would like to thank the anonymous reviewer for this comment.

[4] For future research an alternative more comprehensive measure of narrow outsourcing could possibly be constructed using the 3-digit industry classification of firms.

studies merely considered monthly salaries of R20 000 and above to represent 'skilled' workers (see Edwards et al. 2018). Our skills threshold was determined from Quantec's average salaries for low-skilled and high-skilled workers in the manufacturing industry for 2010 to 2017 (Quantec, 2018). Their mean salary for all skilled workers in manufacturing (in a specific year) was thus used as yardstick. We then calculated the percentage of workers in each firm who earned more than this mean salary to determine the percentage of skilled workers per firm. The same was done for unskilled workers: the mean salary for all unskilled workers in the manufacturing sector is calculated and all workers earning this amount or less are considered to be unskilled.[5]

According to our approach the benchmark annual salary for skilled workers was R332 166 in 2010 and the nominal value increased to R500 509 in 2017. On the other side of the spectrum the benchmark annual salary for unskilled workers was R109 377 in 2010 increasing to R193 892 in 2017. In 2010 the unskilled salary was 32.9% of the skilled salary. This increased to 38.7% in 2017. This relative increase in lower wages/ wages of unskilled workers in general was also mentioned in a recent paper by Bhorat et al. (2020) when they observed "growth of wages at the bottom end of the distribution" and "positive growth in real wages at the bottom and top end" of the wage distribution. See Table A4 in Appendix for the salaries from 2010 – 2017.

Over the estimation period the percentage of skilled workers generally declined with a maximum value of 6.45% in the beginning to 5.22% at the end. The percentage of unskilled workers generally increased with a lowest value of 69.01% in the beginning and 76.06% towards the end. Comparing skills-levels among different categories of manufacturing reveals that the highest percentages of skilled workers were employed in the production of machinery, transport equipment, electronics, chemicals and pharmaceuticals. The highest percentages of unskilled workers were manufacturing furniture, leather products, textiles, wearing apparel and food products. An earlier study by Bhorat and Lundall (2004) painted a similar picture regarding skill-levels in manufacturing firms by calculating skill coefficients.

Secondly, to create an employer-employee matched data set (of the manufacturing sector), the CIT-IRP5 panel data at firm level were matched onto the employee-level data (IRP5 certificates). The raw IRP5 data were adjusted to remove duplicate certificates, multiple job spells, and invalid periods worked (see Table A1, Appendix A). The IRP5 certificates include information on the number of days an individual worked in a specific job (start and end date), their income earned (in South African rand value), and their birth date, from which their age can be determined. As the numbers of days worked differs between jobs, the monthly wage variable was calculated by taking the income and dividing it by the number of days worked to determine the daily wage equivalent. This was then multiplied by 30, to calculate the monthly equivalent wages. Even though the final panel data set spans the period 2010 to 2017, the tenure of each job was calculated by using the IRP5 data from 2010 to 2016. The reason for not including 2017 is that there were many missing values in the 2017 data at the time when we accessed the IRP5 panel and the income variable was inconsistent with that of previous years. To create a measure of firm size, the number of employees per firm was calculated using a full-time equivalent over each year, i.e. the number of days worked across all workers in a firm/365.

[5] We therefore exclude the middle grouping or skills level.

4.2 Offshoring and narrow offshoring in South African manufacturing

What do manufacturing firms import? While Danish firms mainly import raw materials (see Hummels et al., 2014), the same is not true for South African manufacturing firms. Information supplied in the firm-level panel identifies the HS4 codes of the most recurrent import product per firm (see Figure 1). The vertical axis shows the percentage of firms for which the specific HS4 product code on the horizontal axis is the main import in terms of value – for all firms across all years in the panel. The percentages indicated by the bars therefore add up to 100 and represent all manufacturing firms that engage in imports.

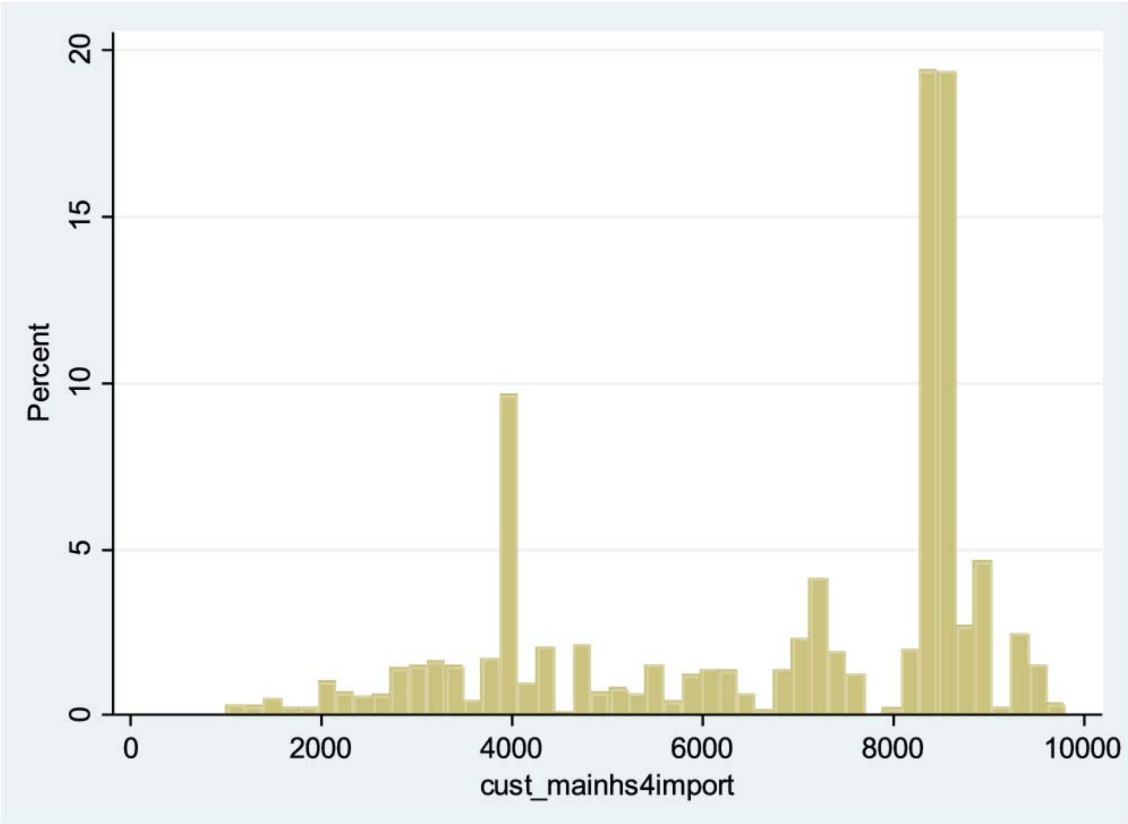

Figure 1. Most imported products per HS4 classification. *Source*: Authors' construction based on SARS data

The spikes in Figure 1 appear around the following HS2 categories: 84, 90 and 39[6]. Raw materials, according to Hummels et al. (2014: 1604), fall into the HS2 categories 01–15, 25–27, 31 and 41. From Figure 1 it is evident that raw materials are not that important in the import basket of South African firms. As a further classification of the imports reflected in Figure 1, the HS4 categories were converted into their respective broad economic categories. According to this classification, 18.53 per cent of South African firms' imports are capital goods, 65.21 per cent intermediate goods, and 13.57 per cent consumer goods. The remaining 2.69 per cent could not be classified.

[6] Descriptions of mentioned HS codes – 84: "Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof"; 90: "Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories"; 39: "Plastics and articles thereof".

Focusing only on the narrow offshorers, Figure 2 displays the HS4 code on the horizontal axis and the percentage of firms involved in narrow offshoring according to our restricted narrow definition.

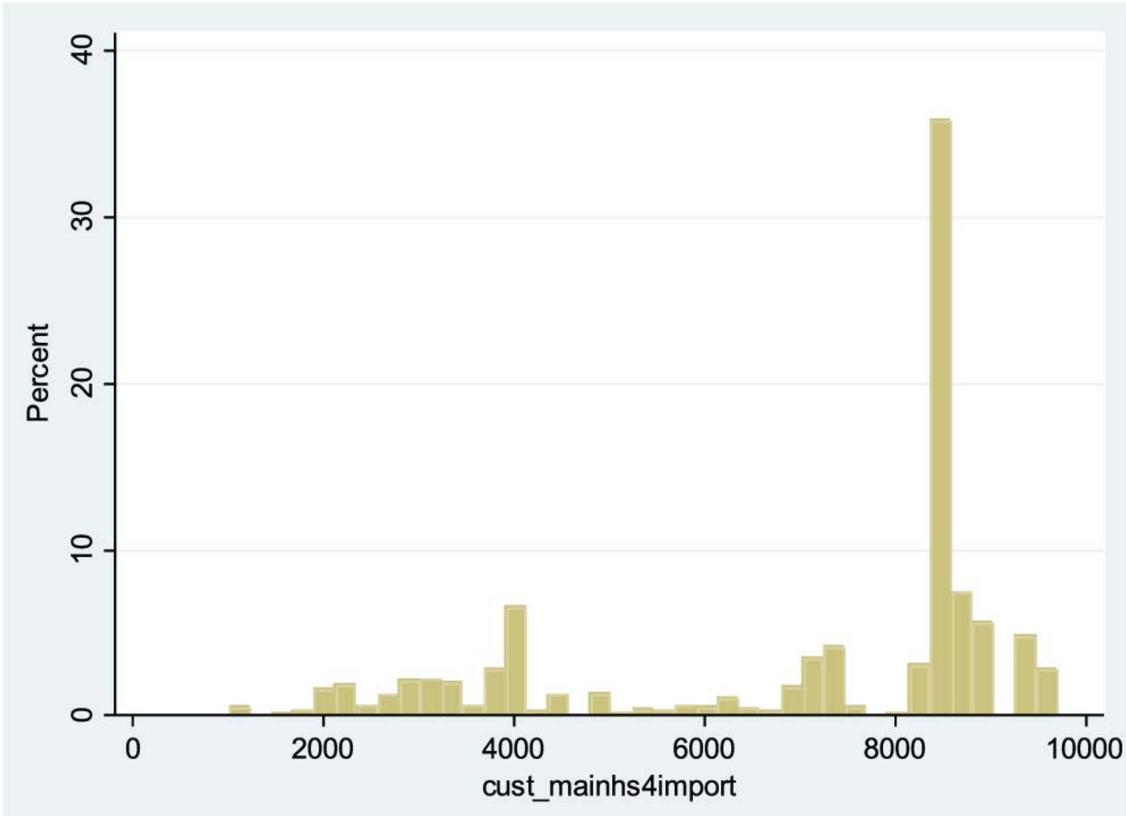

Figure 2. HS4 codes of products involved in narrow offshoring. *Source*: Authors' construction based on SARS data

The major spikes in Figure 2 correspond with the spikes in Figure 1. However, as expected, not all the imported products feature simultaneously as exports. The following products, on HS2 level, are those most often observed in narrow offshoring: 84, 87, 90, 88, 85, 94, 73 and 39[7].

How many firms are involved? The CIT firm-level data span the period 2010 to 2017, with the number of firms increasing until 2014 and then declining to 2017. Table 1 compares the number of firms in three different samples between 2010 and 2017.

[7] Descriptions of mentioned HS codes – 87: "Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof"; 88: "Aircraft, spacecraft and parts thereof"; 85: "Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such"; 94:"Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.s.; illuminated signs, illuminated name-plates"; 73: "Iron or steel articles"; 22:"Beverages, spirits and vinegar".

Table 1. *Comparing number of firms in manufacturing categories over time*

	2010					2014					2017				
	All	Offshorers		Narrow		All	Offshorers		Narrow		All	Offshorers		Narrow	
	Firms #	Firms #	%	Firms #	%	Firms #	Firms #	%	Firms #	%	Firms #	Firms #	%	Firms #	%
All firms	23966	6185	25.81	985	4.11	27925	7282	26.08	1231	4.41	23315	6493	27.85	1013	4.34
1010	1357	281	20.71	24	1.77	1639	348	21.23	46	2.81	1354	335	24.74	32	2.36
1011	364	109	29.95	12	3.30	513	134	26.12	13	2.53	547	145	26.51	17	3.11
1012	36	13	36.11	2	5.56	40	17	42.50	2	5.00	53	23	43.40	3	5.66
1013	1066	346	32.46	27	2.53	1180	364	30.85	37	3.14	974	307	31.52	22	2.26
1014	832	240	28.85	19	2.28	1051	245	23.31	22	2.09	892	220	24.66	22	2.47
1015	270	104	38.52	13	4.81	331	125	37.76	11	3.32	277	107	38.63	7	2.53
1016	1256	133	10.59	10	0.80	1489	188	12.63	23	1.54	1202	170	14.14	21	1.75
1017	520	177	34.04	12	2.31	599	202	33.72	15	2.50	485	166	34.23	17	3.51
1018	829	127	15.32	12	1.45	884	122	13.80	15	1.70	739	120	16.24	8	1.08
1019	147	28	19.05	6	4.08	157	43	27.39	9	5.73	127	30	23.62	9	7.09
1020	1041	361	34.68	57	5.48	1258	426	33.86	84	6.68	1091	385	35.29	67	6.14
1021	407	165	40.54	45	11.06	457	166	36.32	45	9.85	350	156	44.57	32	9.14
1022	1534	469	30.57	56	3.65	1786	570	31.91	64	3.58	1493	526	35.23	57	3.82
1023	568	109	19.19	9	1.58	576	122	21.18	13	2.26	497	117	23.54	18	3.62
1024	1119	248	22.16	38	3.40	1275	282	22.12	39	3.06	1059	219	20.68	30	2.83
1025	2810	548	19.50	102	3.63	3186	646	20.28	123	3.86	2697	564	20.91	86	3.19
1026	357	158	44.26	24	6.72	379	169	44.59	28	7.39	293	141	48.12	17	5.80
1027	829	358	43.18	58	7.00	946	413	43.66	75	7.93	770	349	45.32	62	8.05
1028	1565	565	36.10	146	9.33	1674	642	38.35	160	9.56	1466	590	40.25	151	10.30
1029	391	124	31.71	36	9.21	457	150	32.82	46	10.07	421	147	34.92	40	9.50
1030	259	104	40.15	26	10.04	293	124	42.32	34	11.60	232	99	42.67	23	9.91
1031	865	143	16.53	23	2.66	993	162	16.31	35	3.52	848	155	18.28	28	3.30
1032	4255	1068	25.10	193	4.54	5366	1402	26.13	251	4.68	4416	1236	27.99	217	4.91
1033	1289	207	16.06	35	2.72	1396	220	15.76	41	2.94	1032	186	18.02	27	2.62

Source: Authors' construction based on SARS data.

The current sample includes a total of 23 966 manufacturing firms in 2010, of which 25.81 per cent imported one or more product and 4.11 per cent engaged in narrow offshoring – with main imports and main exports classified in the same HS4 product code. The number of manufacturing firms declined to 23 315 in 2017. In the same period, the percentage of offshorers and narrow offshorers increased to 25.81 per cent and 4.34 per cent for offshorers and narrow offshorers respectively. This may indicate increased importing activity by manufacturing firms in general or that the firms present throughout the time period 2010 to 2017 tended to be the ones engaging in imports.

In order to refine the analysis, the number of firms is also reported per ISIC4 industry (see Appendix A, Table A2, for a description of each ISIC4 code). Interestingly, there are offshorers as well as narrow offshorers in each of the industries. The percentage of firms engaging in offshoring increased between 2010 and 2017 in 17 out of the 24 industries, while the percentage of narrow offshorers increased in 14 out of the 24 industries.

In order to compare key indicators across the three categories of manufacturing firms, Table 2 provides a profile by summarising the mean values across all firms included in the panel across all the years.

Table 2. *Mean values for key indicators in the firm-level panel*

	All manufacturing firms	All offshorers	Narrow offshorers
Sales	78,700,000	249,000,000	448,000,000
Number of workers	47	95	110
Imports	-	22,500,000	68,700,000
Sales per worker	2,231,640	4,110,221	4,803,972
Import per worker	-	773,236	1,226,280
Capital per worker	279,171	565,952	1,192,112
Salary per worker	221,272	338,628	345,934
% skilled workers	5.59	9.30	13.75
% unskilled workers	73.97	65.34	57.01
Net profit	8,410,779	24,100,000	35,400,000
Profit as % of sales	10.69	9.68	7.90

Note: all amounts in ZAR.
Source: Authors' construction based on SARS data.

Except for the percentage of unskilled workers, all indicators show the same trend. The mean values for the total sample of manufacturing firms are the lowest; they increase for the group of firms that import and are the highest for the group engaging in narrow offshoring. The mean net profit as a percentage of sales, however, shows a declining trend across the three columns. The amount of capital per worker increases relatively more between importer and narrow offshorer. From Table 2 it is evident that narrow offshorers in this sample employ highly skilled workers. This may be due to selection bias in the absence of firms that only sell domestically and do not export.

The above finding corresponds with Amiti and Davis's (2011) study on Indonesian manufacturing firms, in which they found that exporters pay 8 to 28 per cent higher wages, importers pay 15 to 47 per cent higher wages, and two-way traders 25 to 66 per cent higher wages than non-traders do, depending on the controls implemented. The picture regarding the number of workers in Table 2 also corresponds with a finding by Edwards et al. (2018) that two-way traders employ more workers than firms only engaging in imports or exports. They also found that two-way traders pay higher wages than one-way traders. This is also reflected in Table 2, indicating that narrow offshorers, in general, pay slightly higher wages than all offshorers.

4.3 Theoretical foundation of the regression analysis

Our regression analysis focuses on labour demand and wages in manufacturing firms. Andersson et al. (2017) estimate labour demand as a function of the level of capital in the firm as well as the level of output (or production). They further add the relative wage between skilled and unskilled workers when estimating demand specifically for skilled or unskilled workers. Previous studies on this data set also included output as a proxy for firm size (see, for example, Edwards et al., 2018; Matthee et al., 2018).

The theoretical basis of the empirical analysis is found in Hsieh and Woo (2005) and based on previous work from Berman et al. (1994) and Feenstra and Hanson (1996). This is explained in Equation 1:

$$\Delta D_{tj} = \beta_1 \Delta Out_{tj} + \beta_2 \Delta \ln\left(\frac{K_{tj}}{Y_{tj}}\right) + \beta_3 \Delta lnY_{tj} \qquad (1)$$

The dependent variable in their equation is skilled worker wages as a ratio of the total wage bill. It is explained on the right-hand side by a proxy for offshoring (outsourcing), the capital output ratio, and total output. The two important variables are the dependent variable and the outsourcing variable. The capital output ratio controls for technological change and output controls for cyclical changes. The underlying assumptions include variable labour cost, a cost function with constant returns to scale, and an objective of cost minimisation. The relationship is estimated in differences. Changes in relative wages are then left out of the equation due to differences in worker quality across different industries – see Hsieh and Woo (2005) for further justification.

4.3.1 Specification

Our specification builds on the above and includes various fixed effects (FE):
fixed time effects (to account for the use of nominal values as well as technological changes over time),

- industry effects (to distinguish between different industries within manufacturing),
- firm fixed effects (this is excluded from the difference equations, but included in the equations with instrumental variables due to the potential weaknesses in the constructed instrumental variables) and
- job-spell effects.

To further refine the analysis regarding offshoring, two dummy variables are added. The first tests for a change in the intercept for narrow offshorers ($dumnarrow_{tj}$ = 1 if firm is classified as a narrow offshorer) and the second for a different slope for narrow offshorers (by including

$Out_{tj} * dumnarrow_{tj}$).

Different dependent variables are included: number of manufacturing workers (workers), percentage of skilled workers (skilled_per), percentage of unskilled workers (unskilled_per), salary per worker (salaryperw), and individual income (lis). The empirical model tries to explain these dependent variables for all of the manufacturing firms in the panel as well as a few sub-samples. Since the focus of the study is on offshoring, the most important sub-sample is the one including all manufacturing firms engaging in imports. The group of importers is further narrowed down to focus on firms classified as narrow offshorers, firms in capital-intensive industries, firms in labour-intensive industries, and firms in ultra-labour-intensive industries.[8] Narrow offshoring is classified as firms importing and exporting products in the same HS4 code (see section 3.1). It is thus possible that the estimated effect captured by *dumnarrow* may be attributed to two-way traders in general and not exclusively the effect of the defined narrow offshorers.

Similar to equation (1) our basic specifications are in difference format. The dummy variable and interactive term are not included in all estimations. The results tables indicate which fixed effects form part of each regression. In order to determine the effect of offshoring on employment equations (2) – (4), we include three different dependent variables: $\Delta lnWorkers_{tj}$, $\Delta skilled\_per_{tj}$ and $\Delta unskilled\_per_{tj}$.

[8] Intermediate capital-intensive firms as a group are not included in the analysis.

$$\Delta lnWorkers_{tj} = \beta_1 \Delta lnOut_{tj} + \beta_2 \Delta lnOut_{tj} * dumnarrow_{tj} + \beta_3 dumnarrow_{tj} + \beta_4 \Delta \ln\left(\frac{K_{tj}}{Y_{tj}}\right) + \beta_5 \Delta lnY_{tj} \quad (2)$$

$$\Delta skilled\_per_{tj} = \beta_1 \Delta lnOut_{tj} + \beta_2 \Delta lnOut_{tj} * dumnarrow_{tj} + \beta_3 dumnarrow_{tj} + \beta_4 \Delta \ln\left(\frac{K_{tj}}{Y_{tj}}\right) + \beta_5 \Delta lnY_{tj} \quad (3)$$

$$\Delta unskilled\_per_{tj} = \beta_1 \Delta lnOut_{tj} + \beta_2 \Delta lnOut_{tj} * dumnarrow_{tj} + \beta_3 dumnarrow_{tj} + \beta_4 \Delta \ln\left(\frac{K_{tj}}{Y_{tj}}\right) + \beta_5 \Delta lnY_{tj} \quad (4)$$

The last specification has monthly earnings as dependent variable and do not include dummy variables, but rather estimate the relationship over different sub-samples – see equation (5).

$$\Delta lnlis_{tj} = \beta_1 \Delta lnOut_{tj} + \beta_2 \Delta \ln\left(\frac{K_{tj}}{Y_{tj}}\right) + \beta_3 \Delta lnY_{tj} \quad (5)$$

The following variables are represented in the above firm-level equations:

$lnOut_{tj}$: Total imports as proxy for outsourcing (log imports)
$\ln\left(\frac{K_{tj}}{Y_{tj}}\right)$: Capital–output ratio measured as total value of capital plant and equipment to total sales (log capout)
Y_{tj}: Total sales (log sales)

4.3.2 Instrumental variables

Additional to the above specification, the use of instrumental variables was essential in the analysis in order to address possible endogeneity. A firm can, due to endogenous reasons, import more inputs, which would influence its labour demand. For example, a more productive firm would import more inputs, pay higher wages, export more, and be more capital-intensive. Therefore, an endogeneity problem can occur when examining the effect of imported inputs on a firm's labour demand. Are the changes in labour demand due to a firm being more productive, or is it because the firm has started importing more inputs due to an exogenous reason? The solution would be to find an exogenous shock that would result in a firm importing more inputs, irrespective of its productivity and wage structure. This requires the use of an instrument. Usually, a major change in policy would act as such an instrument.

However, in the absence of such policy changes (i.e. where the trade environment is stable, without significant changes in trade policy), it is suggested in the literature that an import flow, namely world export supply (WES) be used (see, for example Andersson et al., 2017; Balsvik and Birkeland, 2012; Hummels et al., 2014).

Suppose firm j imports product p from country c. The WES instrument would be country c's export of product p to the rest of the world, minus South Africa, in year t. Now suppose there is a shock that changes the export supply of product p by country c. This shock could be the result of an increase in the supply by country c due to more product varieties and better-quality products being offered, higher productivity, and lower wages and costs. The import of product p by firm j from country c will therefore be affected by this shock – firm j will import more and this will subsequently impact its labour demand. The change in labour demand is then completely exogenous to/does not correlate with the firm's own wage-setting and productivity. This will differ across all importing firms, as they each import a different mix of product p.

Hummels et al. (2016) conclude that these instruments are particularly well suited to employer-employee data, where endogeneity is likely to be a serious concern. Similar to Kreuser and Newman (2018) and Matthee et al. (2018), tests were performed to confirm the validity of chosen instrumental variables. Various F-tests, as well as Hansen's J-test, were employed to test for under-identification, weak identification, excluded instruments, and over-identification.

We intended to follow suit with Andersson et al. (2017) and Hummels et al. (2014) by using world export supply as instrumental variable. Data were obtained from COMTRADE on an HS4 level for each country-year observation. Anderson et al. (2017: 245) explain that to obtain a firm-level instrument, "world export supply (demand) in year t will be multiplied with the offshoring intensity in year t-1 for each firm j matched at the country, c, and product level, p":

$$WES_{it} = \sum_{cp} \frac{M_{j,t-1,c,p}}{Q_{j,t-1}} \times WE_{t,c,p} \qquad WID_{jt} = \sum_{cp} \frac{E_{j,t-1,c,p}}{Q_{j,t-1}} \times WI_{t,c,p} \qquad (6)$$ [9]

In order to replicate the Andersson et al. and Hummels et al. instrument, we used import data at HS4 level for all firms in the panel. When we tried to match the indicated HS4 codes for firm-level imports, a significant number of the codes provided in the firm-level panel could not be matched with trade data from the COMTRADE database. In other words, HS4 codes listed in the firm-level panel, representing 10% of the import value in the sample period, do not exist or did not match codes in the COMTRADE database (these codes are not in the Harmonised System: Revisions, 1988, 1996, 2002, 2007, 2012, 2017, and combined). Therefore, two alternative instruments were constructed. From COMTRADE, we obtained the total value of world export supply and subtracted the value of all South African exports. The remaining world export supply therefore includes all of the potential world exports available to South African firms for imports, and the dollar values were converted to South African rand values. Our WES instrument was consequently calculated as:

$$WESIV_{jt} = \frac{Total\ firm\ level\ imports_{jt-1}}{WES_{t-1}} \times WES_t$$

As an alternative instrument, we obtained the rand value of total South African manufacturing imports from the Quantec database and constructed a 'South African manufacturing' instrument in almost the same way:

$$SAmanuIV_{it} = \left(\frac{Total\ firm\ level\ imports_{jt-1}}{Total\ South\ African\ manufacturing\ imports_{t-1}}\right) \times Total\ South\ African\ manufacturing\ imports_t$$

Two additional instruments were tested, along with the two described above. A WESIV, in dollar terms, was used together with the rand-dollar exchange rate, while the mere lag of firm-level imports was also tested. In the end, the best results were obtained from the

[9] M: imports, Q: quantity, WI: world imports, WID: world import demand, E: exports, WE: world exports, WES: world export supplies, WI: world imports

SAmanuIV and WESIV. In some of the regressions reported in Section 3.4.1, these two instruments rendered the same results. Therefore, the later regressions in Section 3.4.3 only included SAmanuIV[10].

Regressions where imports are instrumented were estimated in Stata using the xtivreg2 command. Various test statistics were generated to test for under-identification (Kleibergen Paap LM); weak identification (Kleibergen Paap Wald F, Cragg-Donald Wald F); first-stage F; F-test of excluded instruments first stage; over-identification (Hansen J); and endogeneity[11].

4.4 *Empirical results*

Numerous regressions were estimated– with and without fixed effects and with and without IVs – of which the ones with statistical significant results are reported here. That is the main reason why fewer regressions including IVs are reported. Although all regressions were estimated including firm FEs, it was found that the firm FEs were not significant in the regressions on certain sub-samples – specifically where the different capital intensities were grouped together (Tables 3 and 6). Thus, regressions run on the whole sample include firm FEs (Tables 4 and 5), while the ones in sub-samples do not.

4.4.1 *Offshoring and employment*

Three different measures were used to determine the impact of offshoring on employment. Firstly, the total number of manufacturing workers per firm was considered followed by the percentage of skilled workers and the percentage of unskilled workers.

To start the empirical analysis, we first considered firm-level employment by estimating equation (2) with change in log of number of workers as dependent variable. Table 3 reports regression results from the firm-level panel. Apart from the log of imports, the impact of offshoring was also tested by including an interactive variable, log imports multiplied by narrow offshoring. Column 1 indicates the impact of offshoring on employment for the complete sample of manufacturing firms. Because of expected heterogeneity and substantial differences between the various manufacturing industries, the regressions were also run for three sub-samples of the panel to test whether the impact of offshoring differs between firms with differing capital (labour) intensities.

Various measures are available to determine the factor intensity of production. Since the data were primarily provided within an accounting and tax environment, we did not base such classification on capital labour ratios calculated from this dataset. As an alternative measure, we used the classification of the South African manufacturing sector as described and employed in Edwards (2001)[12]. Regression results are reported for the total panel of manufacturing firms, as well as for three sub-groups – labour-intensive, capital-intensive and

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[10] The inclusion of time fixed effects combined with the persistence and cost of importing may result in the instrumental variable not be independent of the error term. (We thank an anonymous reviewer for this comment.) However, we are satisfied that the included IVs did pass certain statistical tests.

[11] Due to space limitations more info on the first stage results is not provided. If is available from the corresponding author on request.

[12] A list of the ISIC4 classification codes, descriptions, and factor intensity classification appears in Appendix A (Table A2).

ultra-labour-intensive industries. Results for intermediate capital-intensive industries are not reported, as they did not render statistically significant results.[13]

Table 3. *Regression results with change in log of number of workers as dependent variable*

	1 **All manufacturing**	2 **Labour-intensive**	3 **Capital-intensive**	4 **Ultra-labour-intensive**
Δlog imports	.0016229 (.0021436) [0.449]	.0015454 (.0034999) [0.659]	−.0050035# (.0032798) [0.127]	−.0018047 (.0062848) [0.774]
Δlog imports*narrow	.001353*** (.0004996) [0.007]	−.00056 (.0008038) [0.486]	.0018589 (.0015944) [0.244]	.0007736 (.0017916) [0.666]
dumnarrow	−.020391*** (.0064219) [0.001]	.0036512 (.0092826) [0.694]	−.0326246* (.0174881) [0.062]	.0363319# (.0236058) [0.124]
Δlog capout	.0070164*** (.0017575) [0.000]	.0089552*** (.0029361) [0.002]	.0070966 (.0039288) [0.071]	.0001203 (.006071) [0.984]
Δlog sales	.2106811*** (.0144596) [0.000]	.2240805*** (.0250555) [0.000]	.2002549*** (.0495634) [0.000]	.2404576*** (.0600261) [0.000]
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No
Instruments	No	No	No	No
Observations	31,417	10,626	5,238	2,155
R-squared	0.0881	0.0928	0.0833	0.0650

Notes: Robust standard errors in parentheses; probability in square brackets; ***p<0.01, **p<0.05, *p<0.1, #p<0.15.
Source: Authors' construction based on SARS data.

Table 3 shows different responses to offshoring for firms of different capital/labour intensities. With some of the dummy and interactive terms found to be significant, it seems as if there is a difference between the reactions of general and narrow offshorers. However, due to the potential impact of endogeneity, the analysis was extended to include instrumental variables – see Table 4.

None of the sub-groups rendered significant results with the instrumental variable specification. Table 4 therefore only shows the results for all manufacturing firms. All the test statistics confirm the validity of the instrument. The first results column includes the slope dummy variable and the second excludes the slope dummy variable. While the slope dummy variable is not significant in the equation, both specifications confirm the negative and statistically significant effect of offshoring on the level of employment. As firm-level growth in imports increase, the growth in the number of workers employed by manufacturing firms decreases.

[13] All values sourced from the tax sources are reported in nominal values. Similarly to Edwards et al. (2018), the nominal values are used in the regression analysis, combined with year fixed effects.

Table 4*. Regression results with change in log number of workers as dependent variable*

	1	2
	All manufacturing	**All manufacturing**
Δlog imports	−0.0194*** (0.0061) [0.001]	−0.0196*** (0.0061) [0.001]
Δlog imports*narrow	0.0007 (0.0005) [0.189]	
Δlog capout	0.0039* (0.0021) [0.064]	0.0039* (0.0021) [0.064]
Δlog sales	0.0995*** (0.0214) [0.000]	0.0997*** (0.0214) [0.000]
Year FE	Yes	Yes
Industry FE	Yes	Yes
Firm FE	Yes	Yes
Instruments	Yes	Yes
Observations	14,449	14,449
R-squared	0.0071	0.0069
Under-identified Kleibergen Paap rk LM stat	384.54 0.000%	384.12 0.000%
Weak ident Cragg-Donald KP rk LM	2796.63 772.49 (0.00%)	2790.63 770.45 (0.00%)
Hansen J	0.000 exact id	0.000 exact id
Endog test	12.672 (0.000%)	12.814 (0.000%)

Notes: Robust standard errors in parentheses; probability in square brackets; ***p<0.01, **p<0.05, *p<0.1, #p<0.15.
Source: Authors' construction based on SARS data.

4.4.2 Offshoring and skill levels

Secondly, we considered employment according to skills level. Similar international studies, particularly from Scandinavia, are based on detailed information about individuals, such as education level, union membership and marital status. The South African IRP5 data/worker-level data contain no such information and a major shortcoming is the lack of an education indicator or skills-level proxy. Section 3.1 describes the proxies created to represent skilled and unskilled employment. Given that the dependent variable in the skills analysis is a share bounded by 0 and 1, predictions from the current estimation approach can fall outside of the 0-1 bracket. The data also does not fall in the middle of the bracket which could impact on the estimates[14]. Even though the newly introduced measure of skills level may not be perfect, it does provide an indication of the change in the skills level of manufacturing workers over time – something that was otherwise impossible to do from this data set.

For manufacturing firms in this panel, on average, 5.59 per cent of their workers are considered to be skilled and 73.97 per cent to be unskilled, while the trend observed in Table 2 again repeats for the other two groupings. The skilled percentage for importing firms increases to 9.30 per cent and the unskilled decreases to 65.34 per cent, while narrow offshorers employ relatively greater numbers of skilled workers, at 13.75 per cent of their workforce, and the fewest unskilled workers, at 57.01 per cent of the workforce.

[14] The authors would like to thank the anonymous reviewer for this comment.

According to observations from the descriptive statistics in Table 2, narrow offshorers employ a higher percentage of skilled workers compared to broad offshorers. In order to confirm that this observation is not due to endogeneity, a regression was run using instrumental variables. Table 5 contains results for the instrumental variable specification (equation 3) for all manufacturing firms engaging in offshoring (Column 1) and the sub-group of narrow offshorers (Column 2). The test statistics confirm the validity of the instrument for the narrow equation, but for all manufacturing firms the endogeneity test is not conclusive. As growth in imports increase across all offshorers (all manufacturing firms that do import), the growth in the percentage of skilled workers decreases. This is statistically significant at 10 per cent. Column 2 repeats the estimation for the subgroup of all narrow offshorers. When growth in imports for narrow offshorers increases, growth in their percentage of skilled workers also declines, but now at a rate of four times more than reported in Column 1. This is statistically significant at 5 per cent.

Table 5. *Regression results with change in % of skilled workers as dependent variable*

	1	**2**
	All manufacturing	**Narrow offshorers**
Δlog imports	−0.2200* (0.1289) [0.090]	−0.9662** (0.4444) [0.030]
Δlog capout	0.1337* (0.0862)	0.2748 (0.3581)
Δlog sales	0.4670 (0.4110)	−0.9975 (1.0971)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Firm FE	Yes	Yes
Instruments	Yes	Yes
Observations	14,460	2,358
R-squared	0.0032	0.0101
Under-identified Kleibergen Paap rk LM stat	384.57 0.000%	29.40 0.000%
Weak ident Cragg-Donald KP rk LM	2793.79 771.36 (0.00%)	500.63 46.22 (0.00%)
Hansen J	0.000 exact id	0.000 exact id
Endog test	1.60 (0.206%)	2.52 (0.113%)

Notes: Robust standard errors in parentheses; probability in square brackets; ***p<0.01, **p<0.05, *p<0.1, #p<0.15.
Source: Authors' construction based on SARS data

Since our analysis only includes skilled and unskilled employment, the middle group of semi-skilled employment is not represented. For certain firms this middle group represents a large portion of the workforce. Therefore the analysis focuses on both groups – skilled and unskilled – and does not assume that skilled workers will merely be affected in a way opposite to unskilled workers. Table 6 shows the results with the change in percentage of unskilled workers as the dependent variable. The model was run in a differenced format and included the narrow-offshorer slope dummy from the equation (4) specification.

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Table 6. *Regression results with change in percentage of unskilled workers as dependent variable*

	All manufacturing	**Labour-intensive**	**Capital-intensive**	**Ultra-labour-intensive**
Δlog imports	-.0021222 (.0898889) [0.981]	.1790255 (.1472198) [0.224]	-.0374962 (.1699959) [0.825]	-.1444835 (.2516515) [0.566]
Δlog imports*narrow	.024623 (.0243326) [0.312]	-.0049025 (.0434932) [0.910]	.0724827 (.0608216) [0.233]	.1884496** (.088093) [0.032]
dumnarrow	-.0327931 (.2599145) [0.900]	-.2758574 (.4864813) [0.571]	-.7274605 (.6665546) [0.257]	-.6180592 (1.191353) [0.604]
Δlog capout	.0826346 (.0873155) [0.344]	0381401 (.1560661) [0.807]	-.1774845 (.1419381) [0.211]	.1401903 (.1798906) [0.436]
Δlog sales	-.0474934 (.4793118) [0.921]	.0322242 (.8847866) [0.971]	-1.49653 (1.071975) [0.163]	1.864519# (1.239114) [0.132]
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No
Instruments	No	No	No	No
Observations	22,969	7,811	3,828	2,157
R-squared	0.0041	0.0057	0.0079	0.0129

Notes: Robust standard errors in parentheses; probability in square brackets; ***p<0.01, **p<0.05, *p<0.1, #p<0.15.
Source: Authors' construction based on SARS data.

Table 7. Table 7. *Regression results with change in percentage of unskilled workers as dependent variable*

	Ultra-labour-intensive
Δlog imports	0.1857 (0.5971)
Δlog imports*narrow	0.2258** (0.1141) [0.048]
Δlog capout	0.3235 (0.3028)
Δlog sales	2.3164 (2.6744)
Year FE	Yes
Industry FE	Yes
Firm FE	No
Observations	1278
R-squared	0.0189
Under-identified Kleibergen Paap rk LM stat	31.723 0.000%
Weak ident Cragg-Donald KP rk LM	 228.44 54.28 (0.00%)
Hansen J	0.00% exact id
Endog test	0.5681

Notes: Robust standard errors in parentheses; probability in square brackets; ***p<0.01, **p<0.05, *p<0.1, #p<0.15.
Source: Authors' construction based on SARS data.

Although Table 6 does not reflect many statistically significant relationships, there is some indication that there is a difference in response to offshoring depending on the factor intensity of manufacturing firms. Attention is especially drawn to the statistically significant coefficient of the interactive term for the group of firms classified as ultra-labour-intensive. Replicating the analysis in Table 6, while using instrumental variables, indicates a statistically significant impact of narrow offshoring only for the sub-group of ultra-labour-intensive firms (see Table 7).

The test statistics generally confirm the validity of the instrument for the narrow equation, but the weak instrument criteria are not convincing. Table 7 suggests that increased growth in imports from narrow offshorers increases the growth in the percentage of unskilled workers in manufacturing firms belonging to ultra-labour-intensive industries. While there are also indications of this trend in other industries, the instrumental variable specification does not render statistically significant results for the other sub-samples.

The empirical analysis on employment (Sections 3.4.1 and 3.4.2) indicates an overall decrease in manufacturing employment with increased imports/offshoring and an accompanying relative increase in the unskilled labour force or decrease in the skilled labour force. This is supportive of the idea that skilled jobs are being outsourced and that imports are complementing unskilled workers, particularly in ultra-labour intensive sectors. This is similar to the findings of Stone and Bottini (2012: 21). They analysed firm-level data for various OECD countries and their conclusions included: 'high technology offshoring leads to a reduction in labour demand' and 'there is a positive relationship between labour demand for medium and low skilled workers and the manufacturing content of exports'. Our definition of narrow offshoring relates directly to the manufacturing content of exported manufacturing products. Their explanation that the imports of cheaper inputs (cheaper than locally produced inputs) can increase exports and then lead to a higher demand for lower-skilled workers may also be the driver behind similar trends observed in our regression analysis. Feenstra and Hanson (2003) report the opposite for US firms. In their sample, offshoring resulted in lower demand for low-skilled workers and higher demand for high-skilled workers. If one considers South Africa to be a developing country, it is expected that the South African labour market would respond differently from the US market.

4.4.3 Offshoring and wages

The firm-level panel provides a very crude indicator for salary per worker in the form of total labour cost per firm divided by the number of workers per firm. We used this indicator as a first proxy for firm-level salaries[15]. Across most of the specifications, there are indications that firms in ultra-labour-intensive industries increase their salary per worker if narrow offshorers increase their imports, but these narrow offshorers do start the salary per worker at a lower level than the general offshorers. Estimations including instrumental variables do not confirm any statistically significant impact of offshoring on the firm-level proxy of wage level (or salary per worker). There are some indications that increased imports increase salary per worker for labour-intensive firms, but this is only significant at 13 per cent.

Finally, we analyse worker-level salaries by estimating equation (5) and adding more control variables in the form of age, age squared, tenure and tenure squared. While the above

[15] The regression results with log of salary per worker as dependent variable are not repeated here in the interest of space, but are available from the authors upon request.

analysis of salary per worker is based on a crude indicator of salary per worker, data from the IRP5 panel provides a potentially more reliable estimate of individuals' monthly earnings (income). Due to the large number of observations in the combined IRP5 panel, the following results were obtained from a random sample of 20% per cent of the total observations and limited only to workers in the manufacturing industry – rendering a sample of 323 390 observations.

The specification included job-spell fixed effects and not firm fixed effects, accounting for fixed effects of the specific period of employment and are more closely related to the individual earning the income than to the firm paying the salary. We did experiment with individual fixed effects (which was not statistically significant), while the specification including job-fixed effects was statistically significant. The choice of job-fixed effects/ job-spell effects is also supported by literature – see for instance Munch and Skaksen (2008). Table 8 reports on the regressions.

Table 8. *Regression results with change in log monthly earnings per worker as dependent variable*

	1	**2**	**3**	**4**	**5**
	All manufacturing	**Labour-intensive industries**	**Capital-intensive industries**	**Ultra-labour-intensive industries**	**Narrow offshorers**
Δlog imports	.0048222*** .0007626 [0.000]	.0089341*** .0015528 [0.000]	.0048801*** .001278 [0.000]	−.0061351** .0031156 [0.049]	−.0070469*** .0024522 [0.004]
Δlog capout	−.0059388*** .0010221 [0.000]	.0009924 .0018937 [0.600]	.0031522# .0021388 [0.141]	−.0207287*** .0028872 [0.000]	.0047293** .002203 [0.032]
Δlog sales	.0390392*** .0050108 [0.000]	.0797753*** .0093136 [0.000]	.0579953*** .0112081 [0.000]	−.0285388** .0138808 [0.040]	.0375813*** .0103883 [0.000]
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No
Job FE	Yes	Yes	Yes	Yes	Yes
Observations	323,690	80,493	64,333	29,328	66,653
R-squared	0.0003	0.0015	0.0008	0.0034	0.0009

Notes: Robust standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1; all regressions include additional control variables for age, age^2, tenure, and tenure^2.
Source: *Authors' construction based on SARS data.*

Increased growth in imports (offshoring) increase growth in individual monthly earnings for manufacturing employees overall (Column 1). However, a further breakdown into factor intensity classification reveals that increased growth in imports increase growth in monthly income in capital-intensive (Column 3) and labour-intensive (Column 2) industries but decrease growth in individual monthly income for workers in ultra-labour-intensive industries (Column 4). Firms engaging in narrow offshoring generally pay lower individual wages as offshoring increases (Column 5). In general, changes in total firm imports do not affect employment in ultra-labour-intensive firms, with the exception of the positive effect within narrow offshorers – as is evident from Tables 6 and 7. The influence appears to be primarily through reductions in wages. Regressions, similar to Table 8 and also including the interactive term of narrow offshoring with imports, confirm this observation from Column 5[16]. The coefficient of this interactive term is negative and statistically significant for all manufacturing firms, firms in labour-intensive industries and firms in ultra-labour intensive

[16] These results are not included in the paper, but are available from the corresponding author upon request.

industries. The only insignificant result is for capital-intensive firms. Hummels et al. (2014) conclude that offshoring increases the wages of highly skilled workers and lowers wages of unskilled workers. If one expects workers in capital-intensive industries to be more highly skilled than workers in ultra-labour-intensive industries, even though this is a crude assumption to make, the wage impact of offshoring in Table 8 corresponds generally with the international experience.

For robustness, the analysis reported in Table 8 was replicated, including the instrumental variable for imports. However, the various test statistics do not confirm the validity of the instrument. Previous studies on similar South African IRP5 data did not utilise instrumental variables. One reason for this may be the nature of the worker-level data being linked to a specific individual rather than a firm. In the absence of a valid instrumental variable, and the decision not to use instruments in similar analyses, we consider the analysis reported in Table 8 to be sufficient.

5. CONCLUSION

Statistics show that over the last decade, manufacturing employment has decreased. The backdrop to this decrease is a continuous process of capital-deepening, since labour as a production factor is substituted by capital. Furthermore, the trend of increasing imports of intermediate inputs resulting from increasing domestic production costs (e.g. for electricity and labour) and production volatility (e.g. strikes and power disruptions) continues. Such production uncertainties have led to South African manufacturing firms' increasing involvement in offshoring activities. Offshoring occurs when manufacturing firms form part of fragmented production networks.

We have considered offshoring in the manufacturing sector from two perspectives, namely 'broad' and 'narrow'. Broad offshoring is considered as all imports from manufacturing firms. This percentage increased from around 26 per cent to around 28 per cent between 2010 and 2017. Moreover, the percentage of skilled workers decreases as imports increase across all offshorers. This may suggest that the type of goods imported are imported for reasons of cost-effectiveness, as confirmed by the findings of Stone and Bottini (2012) for OECD countries, or that these skills may not be as readily available as in the past.

We defined narrow offshoring in a way which is suited to the administrative data used and classified narrow offshorers as any manufacturing firm that imports goods (or intermediaries) in the same HS4 category in which they export. Here we have assumed that re-exporters are classified in retail or wholesale ISIC sectors, not in the manufacturing sector. Previous studies utilising SARS administrative data have considered two-way traders (see, for instance, Edwards et al., 2018). We provided a narrower classification of two-way traders that we argue brings us closer to considering these firms as being part of a fragmented production network as we controlled for endogeneity using instrumental variables.

Within the South African context, this analysis is of particular interest. The importance of inclusive growth in South Africa is reinforced by the country's persistent inequality, poverty and unemployment. However, achieving inclusive growth in an era of fragmented production networks through global value chains (GVCs) or multi-national organisations (MNOs) poses a number of labour market challenges to policymakers. As explained in the literature review, involvement in fragmented production networks has consequences for firms' labour demand and for the wages paid to workers within a firm. This is of pertinent importance for South

Africa, as finding the solutions to employment creation within the manufacturing sector in the country is a delicate operation.

The empirical part of the paper is based on a unique set of data not available in the public domain. The analysis thus confronts the issue of offshoring utilizing a new source of data. Even though the accounting data may not be suitable for sophisticated economic analysis, it does open up the opportunity to investigate topics and utilize angles not previously reported. Therefore despite the acknowledged weaknesses in certain measures, for instance the measure used for narrow offshoring, the paper does add to the South African literature and does raise questions and opens up a debate on topics like narrow offshoring not previously covered in the literature.

Our results have shown that the percentage of skilled workers declines as narrow offshorers increase their imports. This contrasts with the experiences of developed countries, where the percentage of skilled workers increases relative to that of unskilled workers (see, for example, Andersson et al. 2016). However, from a South African policy perspective, our results are encouraging, given South Africa's large semi- and unskilled workforce. In particular, our results show that the percentage of unskilled workers increases as narrow offshorers increase imports in ultra-labour-intensive industries such as wearing apparel, leather and related products, wood and food products, and furniture. We have also shown that on an employer-employee level, the wages of labour- and capital-intensive firms increase as offshorers increase their imports, while the wages for ultra-labour-intensive workers decrease.

Therefore, a comment by Black et al. (2018: 7), highlighting the policy context from an industrial policy perspective, is useful:

> The nature of industrial policy must depend on context and the South African context is one of massive structural unemployment. Thus, industrial policy should focus on improving economy-wide efficiency and should support more employment-intensive growth. Incentives should subsidise labour and training rather than capital investment, electricity and infrastructure for capital-intensive firms.

We are thus not arguing for the abandonment of a supportive environment for higher-skilled advanced manufacturing firms, but rather that both trade and industrial policy should take a balanced approach to seriously consider the context of South Africa's labour force and continue the emphasis on finding niche markets.

We also suggest further research to explore offshoring and firm-level policy interventions from an international business literature perspective by considering the manufacturing firms that are part of MNOs. This pertains in particular to the automotive industry, which would be insightful, given the Manufacturing Competitiveness Enhancement Programme (MCEP) and the Automotive Production and Development Programme (APDP). This type of further research may also add value from a literature perspective on GVCs in countries from where manufacturing imports originate and, in the case of narrow offshorers, the countries they export to.

In conclusion, we echo the caution of Edwards et al. (2018) in view of our current study which also involved firms that import and export directly. Imports may influence exports through other channels such as third-party transactions and domestic substitutes, but our results point directly to the need for continuous policy-relevant research in order to understand the effects of fragmented production networks and offshoring, especially on the lives and livelihoods of participants with different skill levels within the South African labour market.

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APPENDIX A

Table A1. *IRP5 data-cleaning*

Keep individual	From the IRP5 data, only workers/employees were used in this article, therefore from the variable 'nature of person' only 'Individuals' were kept.
Periods worked	Some of the data on the 'period employed from' and 'period employed to' have 'invalid periods' reported; this was corrected: 1. For instance 1910 instead of 2010 2. End date 27 February instead of 28 February 3. End date before start date 4. End date in the month before year end and then start again a few days after the start of the year.
Multiple job spells	There are individuals with 'multiple job spells', therefore one individual working multiple jobs at the same firm. When adding the number of days of each job spell 3% add up to more than 365 days (which is impossible). For this 3% of jobs the average of the worker's multiple job spells at the firm was taken.
Duplicate certificates	Each job is assigned a certificate number; duplicate certificates were dropped to avoid double counting.
Age 15–64	There were individuals found to be 90 years of age. This study kept to the South African labour force definition and kept workers of the age 15–64.
Income	There are various ways to calculate income; we used the gross remuneration (by adding three variables named: grossntaxableincomeamnt, grossretfundincomeamnt, and grossnretfundincomeamnt').

Table A2. *ISIC4 description*

ISIC4	Description
1010	'Manufacture of food products'
1011	'Manufacture of beverages'
1012	'Manufacture of tobacco products'
1013	'Manufacture of textiles'
1014	'Manufacture of wearing apparel'
1015	'Manufacture of leather and related products'
1016	'Manufacture of wood and of products of wood and cork, except furniture'
1017	'Manufacture of paper and paper products'
1018	'Printing and reproduction of recorded media'
1019	'Manufacture of coke and refined petroleum products'
1020	'Manufacture of chemicals and chemical products'
1021	'Manufacture of pharmaceuticals, medicinal chemical and botanical products'
1022	'Manufacture of rubber and plastics products'
1023	'Manufacture of other non-metallic mineral products'
1024	'Manufacture of basic metals'
1025	'Manufacture of fabricated metal products, except machinery and equipment'
1026	'Manufacture of computer, electronic and optical products'
1027	'Manufacture of electrical equipment'
1028	'Manufacture of machinery and equipment n.e.c.'
1029	'Manufacture of motor vehicles, trailers and semi-trailers'
1030	'Manufacture of other transport equipment'
1031	'Manufacture of furniture'
1032	'Other manufacturing'
1033	'Repair and installation of machinery and equipment'

Table A3. *Classification according to factor intensity*

ISIC4	Description
	Capital-intensive
1011	‘Manufacture of beverages’
1017	‘Manufacture of paper and paper products’
1018	‘Printing and reproduction of recorded media’
1019	‘Manufacture of coke and refined petroleum products’
1020	‘Manufacture of chemicals and chemical products’
1024	‘Manufacture of basic metals’
	Labour-intensive
1013	‘Manufacture of textiles’
1022	‘Manufacture of rubber and plastics products’
1023	‘Manufacture of other non-metallic mineral products’
1025	‘Manufacture of fabricated metal products, except machinery and equipment’
1028	‘Manufacture of machinery and equipment n.e.c.’
	Ultra-labour-intensive
1014	‘Manufacture of wearing apparel’
1015	‘Manufacture of leather and related products’
1016	‘Manufacture of wood and of products of wood and cork, except furniture’
1031	‘Manufacture of furniture’

Table A4*: Mean salaries for skilled and unskilled manufacturing workers*

Year	Skilled	Unskilled	Unskilled as % of skilled
2010	332166	109377	32.9
2011	347792	118391	34.0
2012	371299	129674	34.9
2013	402168	144031	35.8
2014	434554	158278	36.4
2015	456312	168023	36.8
2016	479103	179943	37.6
2017	500509	193892	38.7

Source: Calculated from Quantec data