Resource misallocation and total factor productivity: manufacturing firms in South Africa*

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Abstract
Misallocation of labor and capital can greatly reduce aggregate productivity. In this study we examine the extent of such resource misallocation in the context of South Africa. While we find that productivity increased on average in the manufacturing sector between 2009 and 2014 we also find evidence the labor and capital are misallocated across firms within sectors. We estimate that if resources were allocated optimally across firms, productivity would have been around 50 per cent higher. We examine the firm specific factors related to misallocation focusing in particular on access to credit and the impact of government incentives that aim to facilitate a more efficient allocation of resources. We find that credit constraints, allowances for labor training and a depreciation allowance which favors the use of capital all potentially have distortionary effects that lead to a widening in the productivity distribution. We also find evidence that allowances for R&D expenditure are potentially productivity enhancing by leading to a more efficient allocation of capital. We find that the extent of misallocation is greatest among the smallest firms.

Keywords: Resource misallocation, marginal revenue product, total factor productivity, South Africa
JEL Codes: D24, O4

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1. Introduction

Resource misallocation occurs in distorted economies when the flow of capital and labor from less productive to more productive firms is prevented. Such misallocation of resources can greatly reduce aggregate productivity in an economy. Hsieh and Klenow (2009) calculate potential TFP gains of 30 to 50 per cent in China and 40 to 60 per cent in India if resources were reallocated to equalize marginal products to US levels. In this study, we examine the extent of resource misallocation in the South African context. In particular, we examine the impact of government incentives for the use of different inputs on the allocation (or mis-allocation) of capital and labor across firms and the resulting impact on TFP. We consider the distribution of the marginal revenue product of capital (MRPK) and the marginal revenue product of labor (MRPL) across firms and examine the extent to which any dispersion in MRPK and MRPL can be explained by distortions or rigidities in the economy. We also analyze the misallocation of capital and labor along the firm size distribution and identify firm size categories where most misallocation is occurring.

Our paper is motivated by recent literature highlighting the impact that idiosyncratic distortions can have on aggregate productivity. In addition to the seminal work of Hsieh and Klenow (2009) a number of recent studies have examined misallocation and its impacts for productivity. Bartelsman et al. (2013) use firm-level data for a number of countries and show significant variation across countries in the extent of within-industry misallocation measured by the covariance between size and productivity. Using a model of heterogeneous firms they explain the variation in misallocation across countries by adjustment frictions and distortions, which in turn lead to differences in aggregate productivity performance. Similarly, Asker et al. (2014) investigate the extent to which the adjustment costs associated with dynamic production inputs lead to a misallocation of capital within industries and countries. They find that a very large proportion of the cross-industry and cross-country variation in the dispersion of the marginal revenue product of capital can be explained by volatility in productivity.

A number of recent empirical studies have examined the extent of misallocation in different developed country contexts but there is a dearth of evidence on emerging markets where, arguably, the extent of distortions and frictions are potentially significantly larger.[1] A literature also exists identifying the channels through which misallocation can occur. A number of papers highlight the role of credit constraints in creating distortions that lead to a misallocation of capital across firms (Caballero et al., 2008; Midrigan and Xu, 2014; Gopinath et al, 2015; Caggese and Cunat, 2013; Brandt et al, 2013). Channels through which labor is misallocated have also been identified. Hsieh et al (2013) attribute part of the reduction in misallocation in the US since 1960 to better allocation of talent due to a reduction in gender and race discrimination. Labor may also be misallocated due to policies that affect the size distribution of firms (Guner et al., 2008).

In this paper, we examine the extent to which capital and labor are allocated efficiently across firms within manufacturing sub-sectors. We find that in the South African context both capital and labor are misallocated and that this misallocation is increasing over time (2009-2014). At the same time, however, TFP in the sector has also increased. A core contribution of this research is that it explicitly examines the extent to which the observed misallocation is related to access to credit and a range of recent incentives introduced by the South African government that could potentially distort the natural allocation of labor and capital across firms. As such it has direct policy relevance for the South African context but also for other emerging markets following a similar approach to promoting private sector development.

[1] See Calligaris et al. (2016) for evidence from Italy, and citations to studies from Spain, Portugal, France and Germany.

The rest of the paper is organized as follows. In section 2 describes the South African context focusing in particular on recent incentives. We present the methodological approach in Section 3. The data are described in Section 4. Section 5 presents the results and Section 6 concludes.

2. South African Context

In this section we provide a background to the various larger scale government incentives that could potentially lead to a reallocation of labor and capital resources in South African manufacturing. We also describe the credit market incentives relevant to manufacturing firms.

Government Incentives

According to the National Treasury (2016: 139), tax expenditures refers to the amount of revenue foregone by government due to certain legislative provisions, which in the case of South Africa aims to encourage investment, job creation, and entrepreneurship. Provisions include the use of income exclusions and exemptions for tax purposes, as well as special tax rates (or the option to defer tax liability) and the use of credits to reduce the overall tax burden. Tax expenditure as a portion of GDP has been around 3 per cent over the past few years, albeit on a gradual increasing path.

Table 1 shows the largest tax expenditure components in terms of corporate income tax. We focus on two relatively large corporate tax expenditure items; the Learnership Allowances and the Research and Development (R&D) incentive. While foregone revenue associated with the reduction in the headline rate of the small business corporation regime accounts for most of the total corporate revenue foregone, it is not the focus of our analysis. We do consider one component, however, namely the Section 12E depreciation allowance.

Table 1: Tax expenditure estimates for corporate incentives, 2010/11 – 2013/14

Corporate Income Tax				
Section 12E depreciation allowance	20	20	25	26
Research and development	1,216	1,131	360	745
Learnership allowances	1,368	1,219	758	966

Source: National Treasury (2016)

The Section 11D Research and Development (R&D) incentive was introduced in 2006 and its main objective is to encourage investment in scientific or technological research and development. The R&D incentive firstly allows for a tax deduction equal to 150 per cent of expenditure incurred directly for research and development. An accelerated depreciation deduction for capital expenditure incurred on machinery or plants used for research and development are also offered. It should be noted that large firms tend to benefit more from this type of incentive, given that smaller firms typically do not have the cash resources available to make large capital expenditures upfront. The Section 11D incentive replaced the R&D rule that was in place in terms of Section 11B.

Given the favorable depreciation schedule and tax deduction for R&D expenditure, it is expected that, all other factors being equal, labor would be substituted for capital in the presence of this incentive. This argument is also supported to some extent by the sector composition of companies claiming for this incentive. Roughly 10 per cent of firms were engaged in other manufacturing and fund management activities respectively, followed by data processing and the manufacture of special purpose materials. It should be noted that the fund management sector classification may be misleading as some firms transfer assets to a separate legal entity (sometimes called ‘special purpose vehicle’) in order to protect assets from bankruptcy proceedings. These entities get classified under the fund management sector classification and may therefore distort the distribution.

The learnership allowance falls under Section 12H of the Income Tax Act and provides additional deductions to employers for qualifying learnership agreements. Two types of deductions are available: (1) an annual allowance and (2) a completion allowance. This serves as an incentive to employers to encourage training, skills development and ultimately job creation. The number of firms that claimed under the annual allowance reached almost 1,800 in 2013, with a total amount claimed equal to R1.8 billion. It is interesting that firms engaged in accounting, bookkeeping and auditing dominates in terms of this incentive (more than 14 per cent of companies). Since firms rely on Sector Education and Training Authorities (SETAs) to register all learnerships, this likely reflects the fact that the Finance and Accounting Services Sector Education and Training Authority (FASSET) has consistently been recognized as one of the better functioning SETAs. This Section 12H incentive will likely motivate firms to hire more workers (keeping all other factors constant), or at the very least encourage training opportunities to existing employees.

Credit markets

Following Turner et al (2008), the lending and financial services infrastructure of South Africa compares favorably to other upper middle income countries, even when compared to the infrastructure of certain developed economies. However, a dichotomy exists between the larger and smaller firms in terms of gaining access to credit, where larger firms enjoy easy access to credit financing which is not the case for businesses operating at a smaller scale. Focus on access to finance of small businesses has therefore been central in the capital misallocation discussion in South Africa.

Based on various surveys of MSME lending in South Africa, it can be stated that small businesses in South Africa tend to struggle to obtain access to financing. Finmark (2010), for example, finds that approximately 8.7 per cent of small business owners who participated in the Small Business Survey indicated that access to finance served as a growth constraint. The study by GEM (2015) paints a more negative view of access to finance by small businesses, where over the period 2006-2013 more than 25 per cent of businesses cited lack of finance as a reason for discontinuing their operations.

Several reasons have been given for the firm size heterogeneity in credit access. Small businesses are not always aware of all the avenues that exist to obtain finance, which could partly be attributed to a lack of information and high searching costs. For example, only 1.2 per cent of small business owners surveyed were aware of the SA MicroFinance Apex Fund, implying poor uptake of available funding initiatives. Moreover, almost 42 per cent of small businesses indicated that they used no financial products or services to operate their business, and businesses with the lowest level of business sophistication were most likely to be financially excluded. Young people in businesses are especially vulnerable as they often have a limited credit history and typically have insufficient savings to finance their business (Wellalage and Locke, 2016). In addition the relatively poor levels of schooling may also disadvantage especially young entrepreneurs, and although government initiatives have been set in motion to make access to entrepreneurial finance easier, there seems to be an increasing divergence between entrepreneurs and financial service institutions, most likely due to: (1) Insufficient collateral provided by the entrepreneur; (2) business plans that are considered to be of sufficient quality; (3) inability of entrepreneurs to present a viable business idea; and (4) lack of market access.

However, it is not given that solving the above mention constraints and allocating a larger share of loanable funds towards MSMEs will reduce misallocation of capital in South Africa. Here a rigorous analysis of differences in marginal revenue product of capital (MRPK) across the firm size distribution is needed.

3. Methodological approach

We follow Hsieh and Klenow's (2009) approach to measuring the extent of misallocation within manufacturing sub-sectors in South Africa. Hsieh and Klenow (2009) measure misallocation as the deviation of TFP from the level that could be obtained if all resources are allocated efficiently across firms within a sector. This optimal allocation of resources would occur in a situation where there are no frictions in factor markets or distortions that prevent labor and capital from being employed by the firms paying the highest price and would result in the marginal product of labor and capital being equalized across firms within a sector. Distortions and frictions in labor and capital markets can affect heterogeneous firms differently and so can lead to deviations in this efficient allocative equilibrium. Hsieh and Klenow (2009) distinguish between two different types of distortions:

i) those that affect the marginal products of labor and capital equally.
(such as, for example, subsidies for particular firms in a sector or firms that face high transport costs).

ii) those that affect the marginal product of one factor relative to another.
(such as, for example, credit constraints faced by certain firms or government incentives that favor the use of one factor over another).

The production function for each differentiated product (Y) is given by a Cobb-Douglas function of firm TFP (A), capital (K) and labor (L). Capital and labor shares are allowed to differ across industries, but not across firms within an industry. Distortions that affect both capital and labor can be identified separately to distortions that change the marginal product of one of the factors relative to the other factor of production. Distortions that increase the marginal products of capital and labor by the same proportion are output distortions τ_Y. τ_Y would be high for firms that face government restrictions on size or high transport costs and low in firms that benefit from subsidies. Distortions that raise the marginal product of capital relative to labor are denoted capital distortions, τ_K. This parameter would be high for firms that do not have access to credit but low for firms that have access to cheap credit.

In this model, Hsieh and Klenow (2009) show that the MRPL is given by:

$$MRPL_{si} \overset{\Delta}{=} (1-\alpha_S)\frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{L_{si}} = w\frac{1}{1-\tau_{Y_{si}}} \tag{1}$$

while the MRPK is given by:

$$MRPK_{si} \overset{\Delta}{=} \alpha_S \frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{K_{si}} = R\frac{1+\tau_{K_{si}}}{1-\tau_{Y_{si}}} \tag{2}$$

where R is the interest rate and w are wages. The after-tax marginal revenue products of capital and labor will be equalized across firms. The before-tax marginal revenue products will be higher in firms that face disincentives and will be lower in firms that benefit from subsidies and other incentives.

Firm-specific distortions can be measured by the firm's revenue productivity (Foster et al., 2008). We distinguish between revenue and physical productivity as follows:

$$TFPQ_{si} \overset{\Delta}{=} A_{si} = \frac{Y_{si}}{K_{si}^{\alpha_s}\left(wL_{si}\right)^{1-\alpha_s}}$$

$$TFPR_{si} \overset{\Delta}{=} P_{si} A_{si} = \frac{P_{si} Y_{si}}{K_{si}^{\alpha_s} \left(wL_{si}\right)^{1-\alpha_s}} \tag{3}$$

This implies that any variation in TFPR across plants within an industry is due to distortions. With no distortions, more capital and labor should be allocated to plants with higher TFPQ up to the point where their higher output results in a lower price and the exact same TFPR as at smaller plants.

Using (1) and (2), plant TFPR is proportional to a geometric average of the plant's marginal revenue product of K and L:

$$TFPR_{si} \propto \left(MRPK_{si}\right)^{\alpha_s} \left(MRPL_{si}\right)^{1-\alpha_s} \propto \frac{\left(1+\tau_{K_{si}}\right)^{\alpha_s}}{1-\tau_{Y_{si}}}$$

High plant TFPR is a sign that the plant confronts barriers that raise the plant's marginal products of capital and labor, rendering the plant smaller than optimal. Industry TFP is given as:

$$TFP_s = \left[\sum_{i=1}^{M}\left(A_{si} \cdot \frac{\overline{TFPR}_s}{TFPR_{si}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}} \tag{4}$$

Where $\overline{TFPR}_s \propto \left(\overline{MRPK}_s\right)^{\alpha_s} \left(\overline{MRPL}_s\right)^{1-\alpha_s}$ is a geometric average of the average marginal revenue product of capital and labor in the sector. If marginal products are equalized across plants TFP would be $\overline{A}_s = \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$

When TFPQ (A) and TFPR are jointly log-normally distributed there is a simple closed-form expression for aggregate TFP.

$$\log TFP_s = \frac{1}{\sigma-1}\log\left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right) - \frac{\sigma}{2}\operatorname{var}\left(\log TFPR_{si}\right)$$

Under this assumption, the negative effect of distortions on aggregate TFP can be summarized by the variance of log TFPR. The extent of misallocation is worse when there is greater dispersion of marginal products.

The distortions and productivity for each plant in each year can then be computed as:

$$1+\tau_{K_{si}} = \frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{RK_{si}} \tag{5}$$

$$1+\tau_{Y_{si}} = \frac{\sigma}{\sigma-1}\frac{wL_{si}}{(1-\alpha_S)P_{si}Y_{si}} \tag{6}$$

$$A_{si} = \kappa_S \frac{(P_{si}Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}} \tag{7}$$

3. Data

We use tax administrative data collected by the South African Revenue Services (SARS) for the 2009–14 period.[2] The primary data source is the South African Corporate Income Tax (CIT) data which are collected annually and are based on self-reported corporate income tax returns.[3] These data include information on sales, capital and other financial indicators, as well as information on access to government incentives. The database does not include information on the number of persons employed in the firm. We gather this information from the PAYE tax data records that are also collected by SARS and can be matched to the firms in the CIT database. Employers must issue tax certificates to all employees that are paid by the firm.

Output is measured using value added which is computed as total sales minus the cost of sales. Value added is deflated by the value added at basic prices deflator (SARB KBP6634; see SARB 2014). Labor is measured as the total number of employees of the firm where each employee is weighted by the total number of periods they work at the firm. Capital is measured as the fixed assets of the firm deflated using the manufacturing industry fixed capital investment deflators rebased to March 2012.[4] To address lumpiness in fixed assets we use the two-year average of total assets in line with Hsieh and Klenow's (2009) approach. Summary statistics by sector for each of these variables in each year are available in a Web Appendix.

The core markers of misallocation of interest in this paper are access to credit and the capital and learnership incentives described in Section 2. The average take-up rate of each of these incentives for each sector is provided in Table 2. There is a good deal of heterogeneity across sectors in the take up rate of the different incentive schemes. On average 1.5 per cent of firms avail of learnership incentives. This ranges from as few as 0.32 per cent in the furniture sector to 5 per cent in pharmaceuticals. For the R&D incentive and the depreciation allowance the take up rate is slightly higher at 1.72 per cent and 2.07 per cent, respectively. The lowest take-up rates for the R&D incentive are in the furniture, apparel and wood sectors. High take-up rates are observed in the pharmaceutical sector and in chemicals. For the depreciation allowance there is somewhat less heterogeneity across sectors. Firms in the pharmaceuticals sector are more likely to avail of the depreciation allowance as are firms in beverages and transport equipment.

[2] For a full description of the dataset and how it is compiled see Kreuser and Newman (2016).
[3] Firms are aware that they may be audited by SARS but do not know in any given year whether they will be selected for audit.
[4] Gross fixed capital formation in manufacturing (SARB KBP6082; see SARB 2014).

Table 2: Take-up rate of government incentives across sectors

Sector	Obs.	Learnership	R&D	Depreciation
Food	16,269	1.01	2.04	2.28
Beverages	2,002	2.53	3.07	4.28
Textiles	5,242	1.47	1.62	1.84
Apparel	4,225	1.54	0.42	1.31
Leather	2,021	1.70	1.85	2.24
Wood	3,978	0.45	0.40	1.73
Paper	2,924	1.81	1.21	3.63
Printing	9,548	1.07	0.71	2.10
Coke & refined petrol	4,168	0.90	0.81	1.52
Chemical	7,869	1.86	4.22	2.97
Pharmaceuticals	644	5.01	8.85	7.08
Plastics	4,654	1.21	2.55	2.59
Other minerals	6,193	0.75	1.54	2.64
Basic metals	7,558	2.21	1.77	2.30
Other metals	17,816	1.48	1.35	1.62
Computer, electronic	2,746	0.44	2.25	1.60
Electrical machinery	3,830	1.77	2.26	1.74
Machinery nec.	18,819	0.95	1.68	1.66
Motor vehicles	23,966	2.74	0.74	1.63
Transport equipment	3,286	2.06	1.13	3.16
Furniture	5,620	0.32	0.41	1.53
Other manufacturing	19,049	1.39	3.13	2.32
Total	172,427	1.50	1.72	2.07

4. Results

We begin by documenting the extent of misallocation in the South African manufacturing sector. Figure 1 displays the dispersion in MRPK and MRPL, as measured by equations (2) and (1), respectively, for 2009 and 2014. The rightward shift in the marginal revenue products between 2009 and 2014 is clearly evident, as is the widening of the distribution of each component. The conclusion to be drawn from this is that while, TFP has increased it has not increased by as much as it could have if capital and labor were more efficiently allocated across firms. It is also clear that both capital and labor are misallocated but that the extent of misallocation of capital is larger than that of labor, as indicated by a wider dispersion in the distribution of MRPK.

Figure 2 displays the trend in the standard deviation of TFPR over time. Here the within-sector-year standard deviation is aggregated for the whole of the manufacturing sector in each year. Consistent with the widening dispersion in the distribution of the MRPK and MRPL observed in Figure 1, the standard deviation displays a clear upward trend. Large increases in the dispersion of TFPR are observed between 2009 and 2013. Between 2013 and 2014 the extent of misallocation declined. Taken together, Figures 1 and 2 point to significant increases in resource misallocation of capital and labor across firms within sectors over time.

Figure 1: Dispersion in MRPK and MRPL 2009 vs 2014

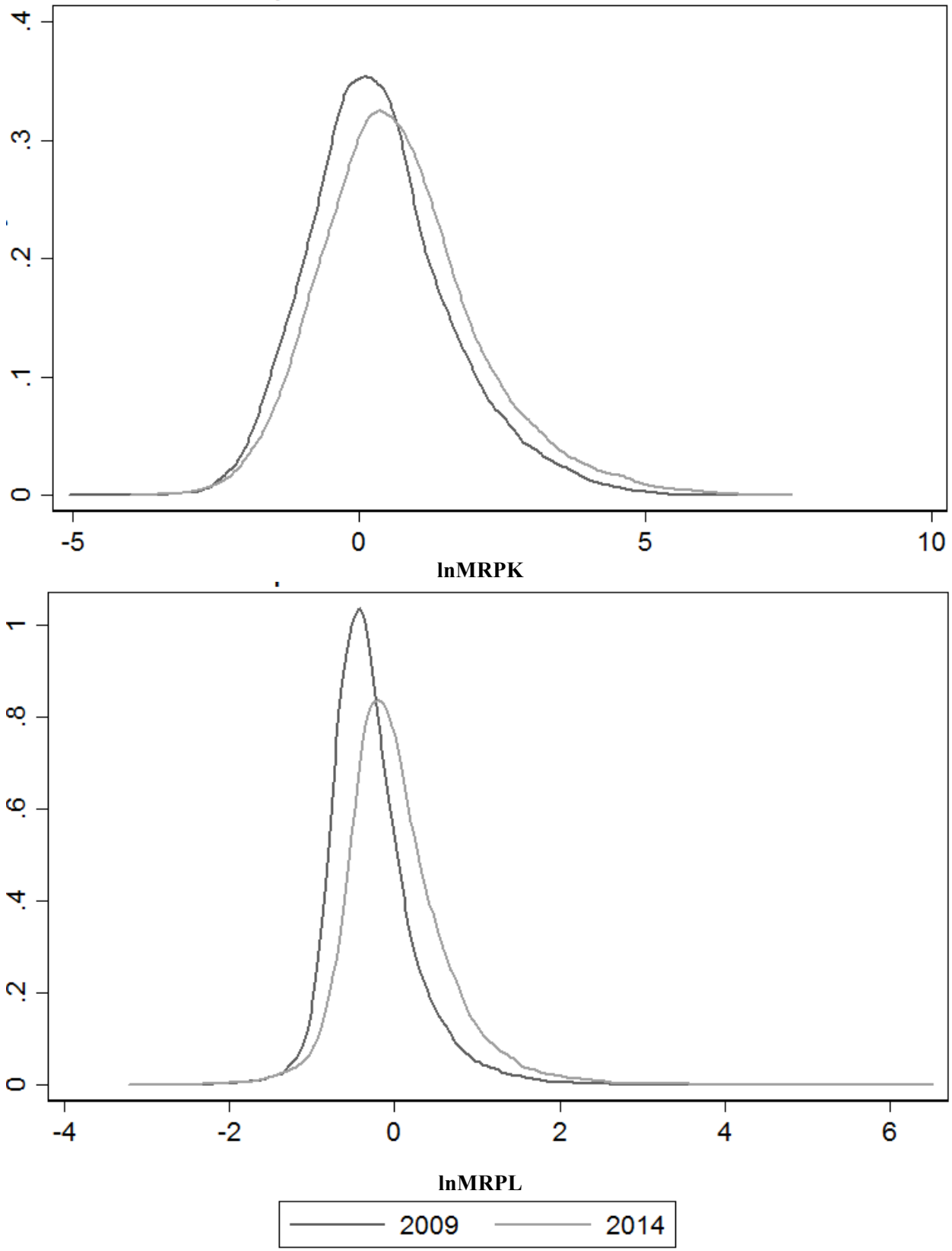
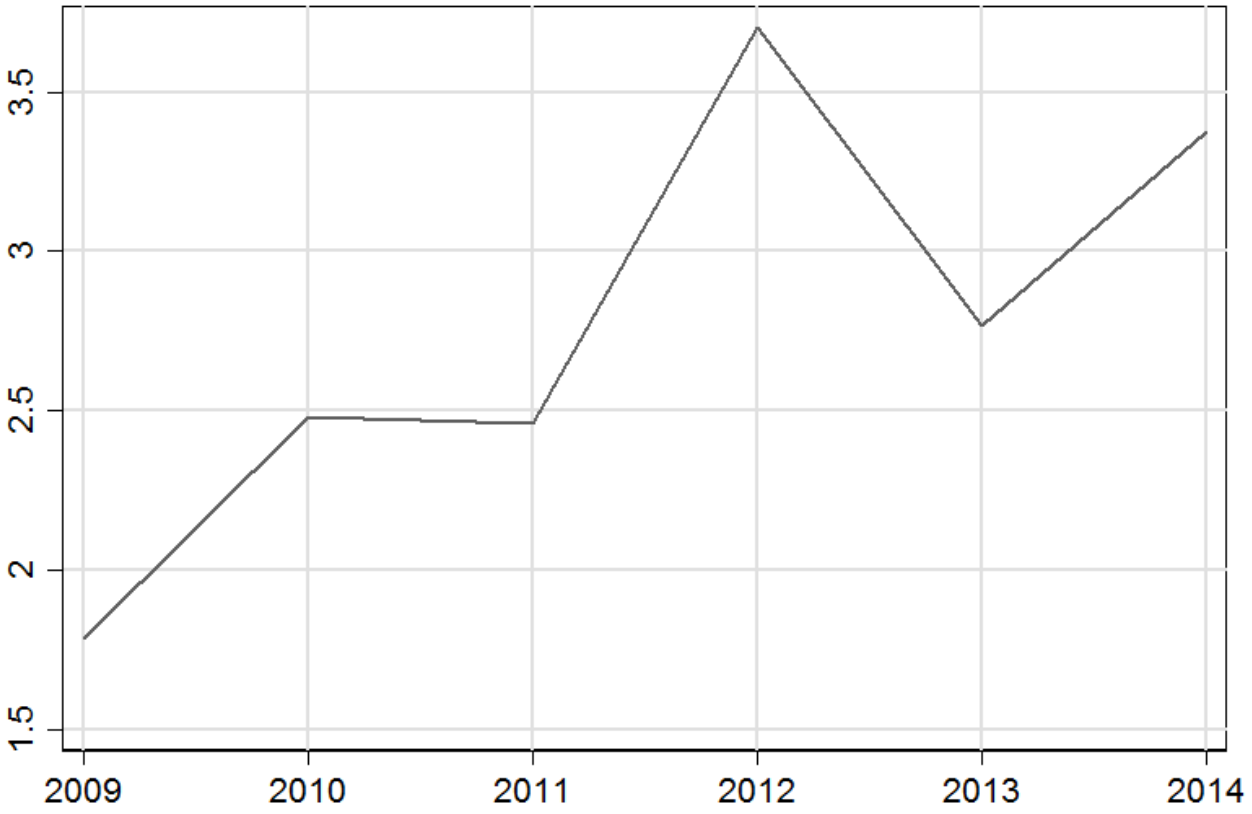
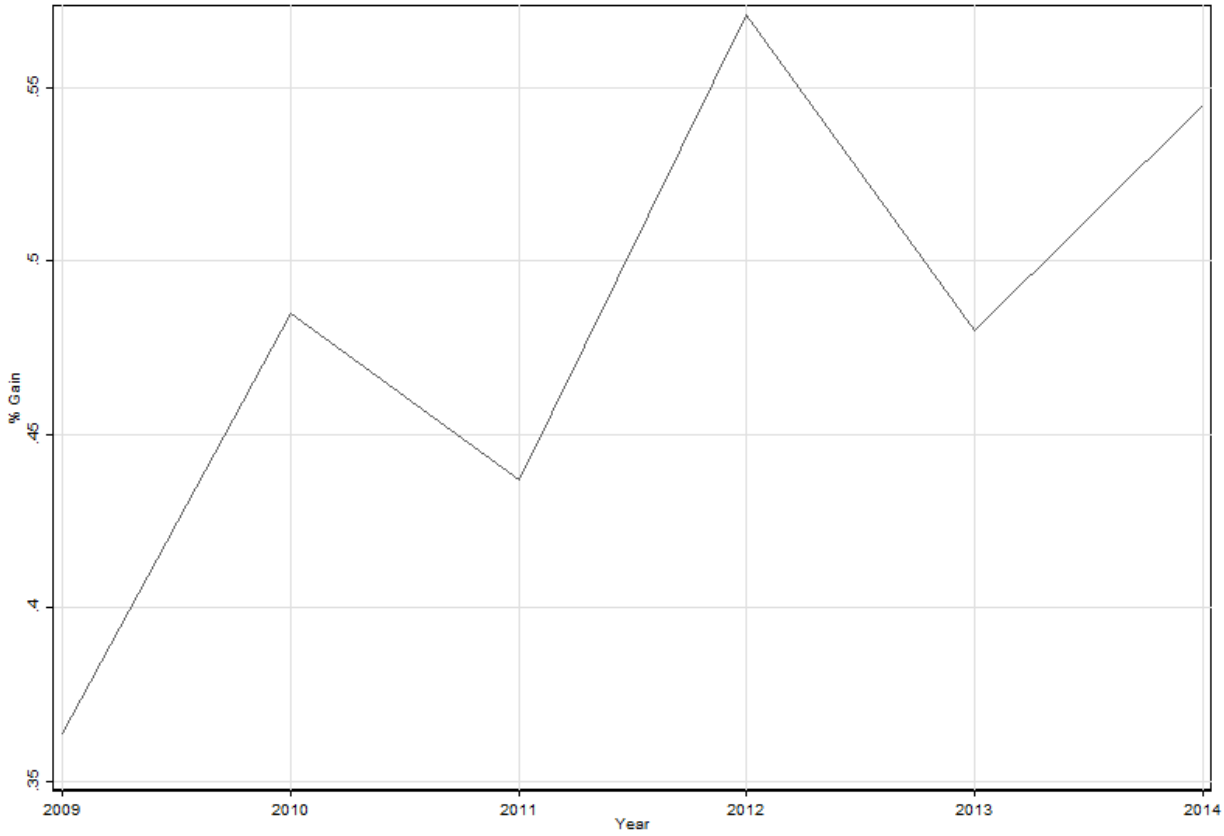


Figure 2: Trend in standard deviation of TFPR within sectors over time



While we observe a shift to the right in the productivity distribution over time, a key question is the extent to which productivity could have increased had resources been efficiently allocated. In Figure 3, we compare the actual observed TFP with potential TFP (the TFP that could be achieved if all distortions were eliminated). The annual potential gain in TFP is in the region of 35 to 60 per cent. This is consistent with Hsieh and Klenow's (2009) findings for China and India.

Figure 3: Potential gain in TFP if resources were efficiently allocated



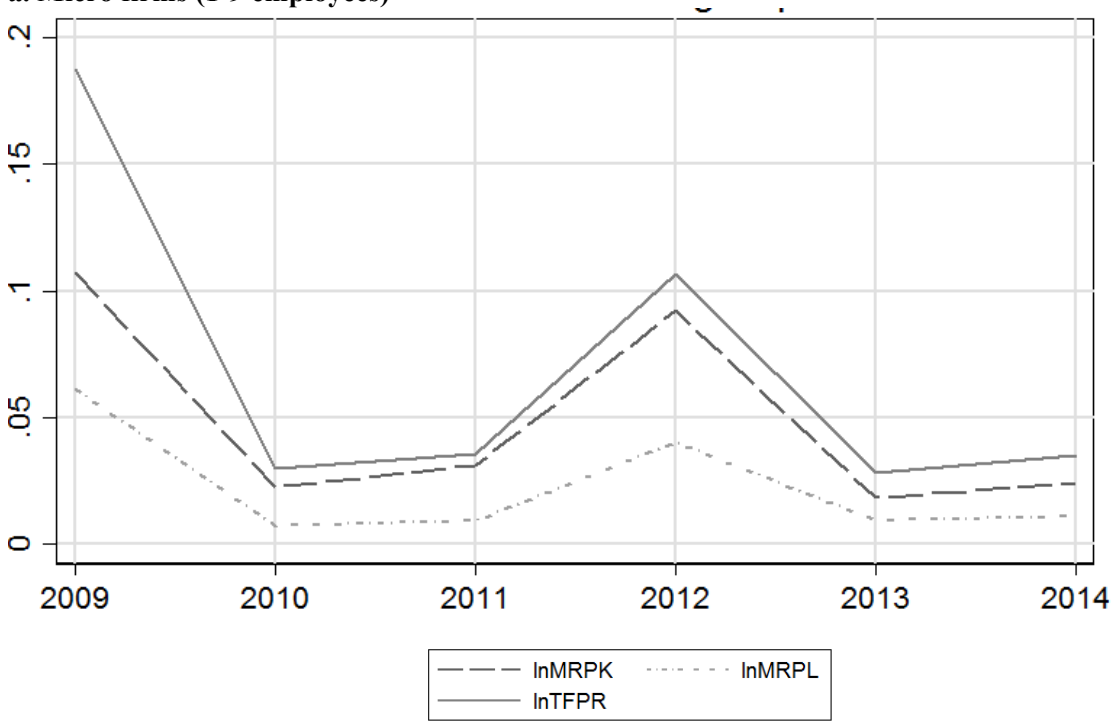
It is clear that the extent of misallocation of capital and labor in South African manufacturing has increased over time and this has led to lower productivity gains than would otherwise be attained. A key question is understanding the determinants of this underlying misallocation. As highlighted in the introduction, a number of possible drivers have been identified in the literature. We focus on specific policy measures put in place by the South African government (see Section 2 for details and Table 2 in the data section).

First we consider whether the extent of misallocation is similar across different size groups and sectors, as take-up rates are fructuous especially along these dimensions. Figure 4 presents the trend in the standard deviation of MRPK, MRPL and TFPR for four different size groups defined in accordance with the World Bank definition.[5] We see considerable heterogeneity across size groups. In all size groups the misallocation of capital is greater than the misallocation of labor. Of particular note is that the extent of misallocation has been falling for micro firms and for small firms, with the exception of 2013-2014 when it grew the standard deviation in TFP increased quite substantially to the 2010 level. For the largest firms misallocation has been steadily growing over the time frame of the analysis. Misallocation patterns across sectors are presented in the Appendix.

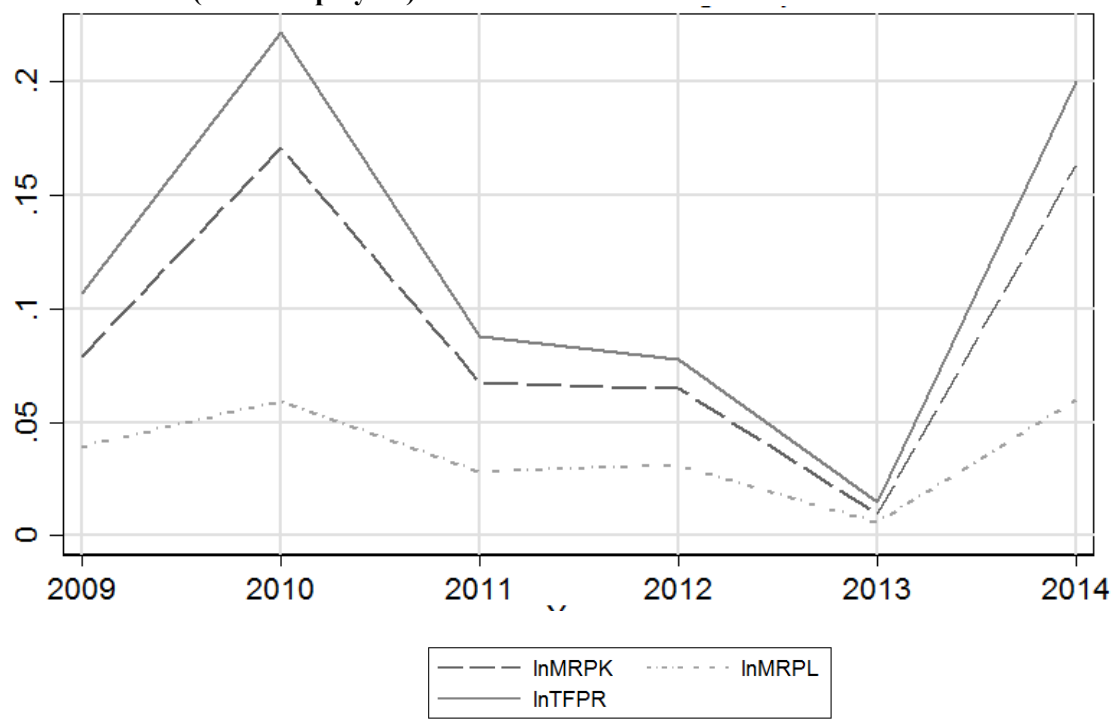
[5] Four size groups are considered in accordance with the World Bank definition: micro firms (with 1-9 employees), small firms (10-49 employees), medium firms (50-299 employees) and large firms (300+ employees).

Figure 4: Misallocation of capital and labor across firms within sectors in specific size groups

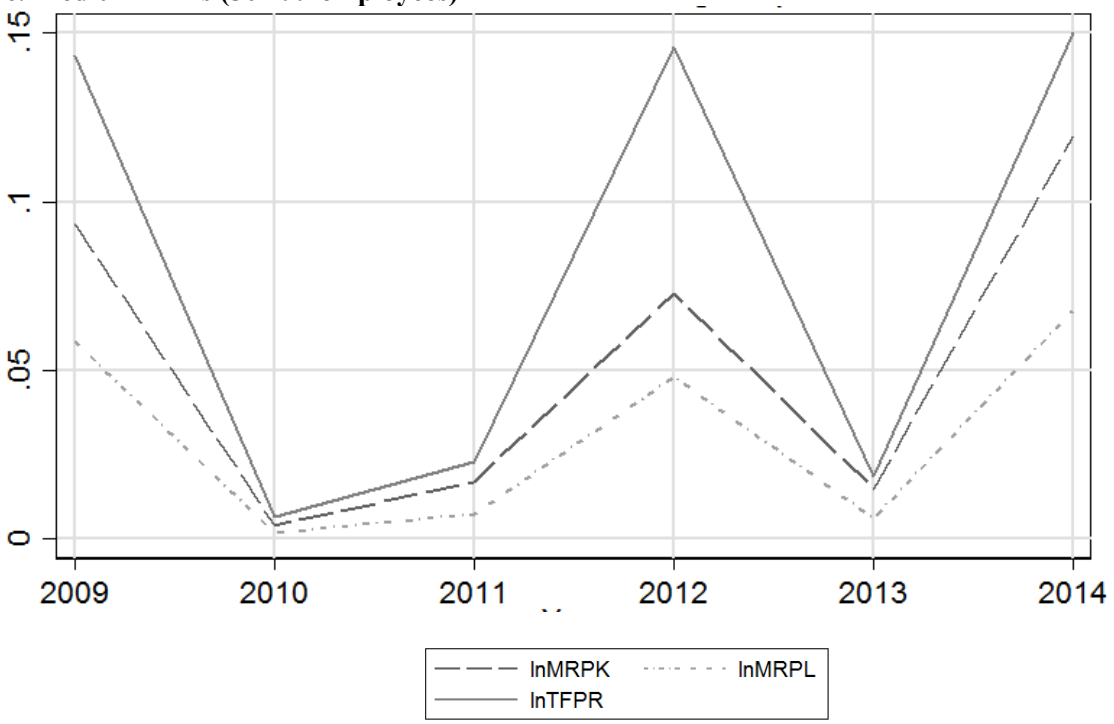
a. Micro firms (1-9 employees)



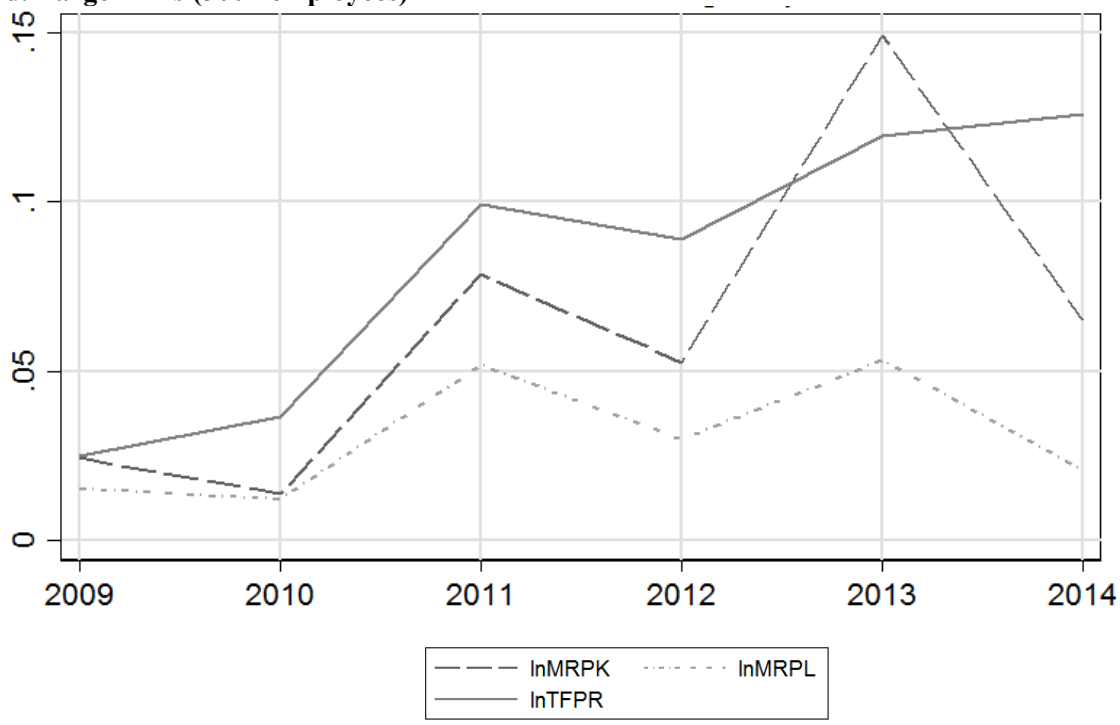
b. Small firms (10-49 employees)



c. Medium firms (50-299 employees)



d. Large firms (300+ employees)



The above analysis points to misallocations of capital and labor across firms in South Africa. Understanding the markers of misallocation is important in establishing the underlying distortions that lead to such inefficiencies. To achieve this we consider how various firm-specific characteristics, including access to credit and capital favoring government incentives, relate to the MRPK and MRPL of firms relative to the sector average.[6]

We estimate the following reduced form equation separately for capital and labor.

$$\ln \frac{MRP_{ist}}{MRP_{st}} = \beta_0 + \beta_1 X_{ist} + \tau_t + \theta_s + \varepsilon_{ist} \quad (8)$$

The dependent variable is the MRP (of capital or labor) of firm *i* relative to the average in the sector in time *t* and X_{ist} are potential markers of misallocation. The coefficients in β_1 will tell us the extent to which a particular marker is associated with firms that have a high or a low MRP relative to the average. A positive coefficient would indicate that the particular marker is associated with firms with a higher MRP relative to the average and depending on whether the marker is associated with more or less usage of that particular input could be associated with a reduction or a widening in the dispersion in the productivity distribution.

We consider a number of markers of misallocation. In particular, we focus on access to credit, which has been found to contribute significantly to capital misallocation in other contexts. We also consider policy measures that are specific to the South African context, namely the uptake of the Learnership incentives, R&D incentives and depreciation allowance described in Section 2.

The results of a baseline model including the size category of the firm, year and sector dummies, are presented in Table 3. The coefficients on the time dummies show that on average firms have a higher level of MRPK relative to the sector average in 2010, 2011 and 2012 compared with 2009 but a lower relative level in 2013 and 2014. The average level of MRPL relative to the sector average is higher in all years compared with 2009 but the magnitude of the difference in 2013 and 2014 is smaller than in the earlier years. Taken together, both contribute to a widening in the productivity distribution between 2009 and 2012 and a leveling off there after confirming our earlier finding.

The results for the coefficients on size are interpreted relative to the smallest size group, i.e. the micro firms. On average, the MRPK and MRPL relative to the sector average, is highest for micro firms suggesting that it is among these firms that most of the misallocation occurs. The extent of misallocation is decreasing in the size of the firm for capital. While labor is also most misallocated among micro firms the difference in the extent of misallocation of labor among medium and large firms compared with micro firms is quite small.

[6] Calligaris et al. (2016) use a similar approach to explore the markers of deviations in TFPR from the sector average.

Table 3: Baseline model

	(1) MRPK	(2) MRPL
size2	-0.126***	-0.114***
	(0.007)	(0.003)
size3	-0.433***	-0.072***
	(0.010)	(0.005)
size4	-0.990***	-0.027**
	(0.021)	(0.011)
year10	0.152***	0.089***
	(0.011)	(0.005)
year11	0.221***	0.249***
	(0.011)	(0.005)
year12	0.117***	0.174***
	(0.011)	(0.005)
year13	-0.051***	0.072***
	(0.011)	(0.005)
year14	-0.090***	0.054***
	(0.012)	(0.006)
Constant	1.371***	1.868***
	(0.012)	(0.006)
Sector dummies	YES	YES
Observations	168,449	168,449
R-squared	0.370	0.716

In Table 4 we extend the model to include indicators for access to credit and the various government policy measures which potentially favor labor over capital or vice versa. From the Table we see that the different incentive schemes have very different resource (mis)allocation effects. Firms with access to credit have a lower marginal revenue products relative to the sector average. This suggests that credit is not allocated to the firms that could yield the highest return if that credit is used to invest in either capital or labor resources. This suggests that a lack of access to financial markets may be a contributing factor in the misallocation of resources across firms.

The Learnership program is also accessed by firms with lower marginal returns relative to the sector average. This suggests that the scheme, which offers firms subsidies for training workers, is not being accessed by the firms that could potentially yield the highest return from these investments. For example, the negative correlation with relative MRPK implies that if the Learnership allowances lead to more capital investments, due to say labor becoming more skilled and the firm investing in capital that is complementary to those skills, then this could further widen the dispersion in MRPK and consequently productivity. Similarly, if one interprets capital more broadly as also including human capital, then the Learnership allowances are not being accessed by the firms that yield the highest return.

The R&D scheme on the other hand is associated with higher relative levels of MRPK. This suggests that the firms availing of these incentives are those that yield a higher marginal return from capital. Resources provided to these firms through the incentive scheme could potentially be productivity enhancing.

The depreciation allowances in contrast are accessed by firms with lower MRPK and so are a potential contributing factor to the misallocation of capital across firms. They are also accessed by the firms with higher MRPL relative to the sector average. As a capital favoring incentive this could potentially reduce to use of labor thus potentially exacerbating the extent of misallocation.

In sum, it appears that both credit and the capital favoring incentives offered by the South African government are not accessed by the firms that could potentially yield the highest return from those incentives and are potentially contributors to resources misallocation.

Table 4: Correlation between credit and policy variables and returns and dispersion in returns

	(1) MRPK	(2) MRPL
Learnership	-0.295***	-0.030**
	(0.028)	(0.015)
RD	0.108**	0.044
	(0.051)	(0.027)
Depreciation	-0.364***	0.052***
	(0.024)	(0.014)
Credit	-0.229***	-0.016***
	(0.002)	(0.001)
size2	-0.189***	-0.124***
	(0.007)	(0.004)
size3	-0.541***	-0.092***
	(0.010)	(0.005)
size4	-0.989***	-0.054***
	(0.025)	(0.014)
year10	0.168***	0.089***
	(0.011)	(0.005)
year11	0.217***	0.247***
	(0.011)	(0.005)
year12	0.113***	0.175***
	(0.011)	(0.005)
year13	-0.071***	0.073***
	(0.012)	(0.006)
year14	-0.134***	0.050***
	(0.012)	(0.006)
Constant	0.774***	1.836***
	(0.013)	(0.007)
Sector dummies	YES	YES
Observations	139,796	139,796
R-squared	0.434	0.724

We disaggregate the impact of access to credit and government incentives on misallocation by firm size in Tables 5 and 6 for MRPK and MRPL, respectively. We find that accessing credit is associated with the firms that have lower MRPK and MRPL in all size categories. This confirms our finding from above, that lack of access to credit may in fact be a contributing factor to resource misallocation in South Africa, and also suggests that this is the case across the entire size distribution of firms. It should be noted that the magnitude of the correlation is decreasing in the size of the firm for both MRPK and MPRL suggesting that the credit constraints are more distortionary at the lower end of the size distribution.

The Learnership allowance is also associated with lower relative levels of MRPK across the size distribution supporting our earlier finding. The negative correlation between the Learnership allowances and the MRPL is only evident for micro-firms and is, in fact, positive for small firms. The former suggests that among micro firms, those availing of the Learnership Allowances are those with low relative MRPL. If the Learnerships lead to more labor resources being employed then this is potentially distortionary and would result in a widening in the productivity distribution among micro firms. If the Learnerships are labor saving then it would have the opposite effect. For small size firms the positive correlation between the Learnership Allowance and the MRPL suggests that the firms accessing the

Learnerships are those with a lower MRPL so the converse is the case. That is, if the Learnerships lead to more labor being employed they could potentially reduce the dispersion in MRPL given that they are used by the firms with a higher MRPL. However, if they lead to less labor being employed the opposite would be the case. The Learnerships have no relationship with MRPL for medium and large firms.

As with credit constraints and the Learnership allowance, the depreciation allowance is accessed by firms with lower relative MRPK across the size distribution but as with credit constraints the magnitude of the correlation is decreasing in the size of the firm. This suggests, that as a capital favoring incentive it potentially widens the productivity distribution by diverting capital away from the firms where it could yield a higher return, particularly for smaller sized firms. The depreciation allowance is positively correlated with the MRPL for micro, small and medium sized firms. As indicated above, this may also contribute to the widening of the productivity distribution if it diverts resources away from labor toward capital.

The R&D incentives are associated with higher levels of MRPK for all but the large firms. This suggests that these incentives may serve to reduce the dispersion in the productivity distribution since they are accessed by the firms with the highest return on capital. Moreover, this effect is likely to be greater for smaller firms. There is no strong evidence to suggest that the R&D allowance is related to the MRPL in a differential way across the size distribution.

Table 5: Impact of access to credit and incentives on dispersion in MRPK by size category

	(1)	(2)	(3)	(4)
VARIABLES	MRPK 1	MRPK 2	MRPK 3	MRPK 4
Learnership	-0.674***	-0.315***	-0.209***	-0.131**
	(0.109)	(0.057)	(0.042)	(0.066)
RD	0.285*	0.336***	-0.019	-0.242
	(0.155)	(0.087)	(0.081)	(0.148)
Depreciation	-0.329***	-0.430***	-0.268***	-0.165**
	(0.059)	(0.040)	(0.042)	(0.064)
Credit	-0.251***	-0.239***	-0.185 ***	-0.122***
	(0.003)	(0.003)	(0.006)	(0.015)
Observations	61,920	58,652	16,712	1,707
R-squared	0.394	0.424	0.413	0.509

Table 6: Impact of access to credit and incentives on dispersion in MRPL by size category

	(1)	(2)	(3)	(4)
VARIABLES	MRPL 1	MRPL 2	MRPL 3	MRPL 4
Learnership	-0.129**	0.064**	0.006	0.000
	(0.059)	(0.030)	(0.022)	(0.040)
RD	0.058	0.096**	0.086	-0.126
	(0.077)	(0.040)	(0.055)	(0.079)
Depreciation	0.068**	0.070***	0.061**	-0.033
	(0.034)	(0.024)	(0.026)	(0.038)
Credit	-0.026***	-0.013***	-0.014***	-0.015*
	(0.002)	(0.001)	(0.003)	(0.008)
Observations	61,920	58,652	16,712	1,707
R-squared	0.671	0.709	0.686	0.729

6. Conclusion

Misallocation of labor and capital has been shown to reduce aggregate productivity. In a South African context we set out to take a first glance at the extent of such resource misallocation utilizing tax administrative data for the 2009–14 period. We find that productivity increased on average in the manufacturing sector between 2009 and 2014, but the extent of resource misallocation has increased also. More specifically, we estimate that productivity in 2014 would have been 50 percent higher if capital and labor resources had been allocated optimally across firms such that the marginal products of labor and capital inputs were equalized.

As a second step in our analysis we explore potential markers of misallocation by examining which firms have access to credit and a range of different firm-level incentives offered by the South African government which favor the use of capital over labor. In particular, we examine whether it is the firms with higher or lower marginal revenue products within sectors that have access.

We find that credit, the Learnership and Depreciation Allowances are all accessed by firms with lower relative MRPK. If credit and these allowances are associated with greater capital investments, they are potentially distortionary diverting capital away from firms with higher relative MRPK. Similarly, credit and Learnership Allowances are accessed by firms with lower relative levels of MRPL. If access to credit and Learnerships lead to more labor resources being employed they could in fact divert labor away from firms with a higher MRPL. We also find that the depreciation allowance is accessed by firms with higher relative MRPL. If accessing the allowance leads to firms employing less labor and more capital it could have an additional distortionary effect through this mechanism. The R&D allowance potentially has the opposite effect given that it is associated with firms that have a higher relative MRPK. If the R&D allowance leads to investments in capital by firms with a higher MRPK this would contribute towards equalizing MRPK across firms within sectors.

Overall, our findings suggest suggests that credit constraints, the Learnership allowance and the depreciation allowance have distortionary effects on the productivity distribution but that the R&D allowance potentially leads to more efficient allocations of capital. The extent of misallocation is greatest among the smallest firms and these markers of misallocation are also most prominent among these firms. Future work will explore further the underlying mechanisms at work and will map more clearly the link between the markers of misallocation and the dispersion in the productivity distribution. In addition, a range of robustness checks will be carried out to consider other ways of thinking about misallocation such as those proposed by Bartelsman et al. (2013) and Asker et al. (2014).

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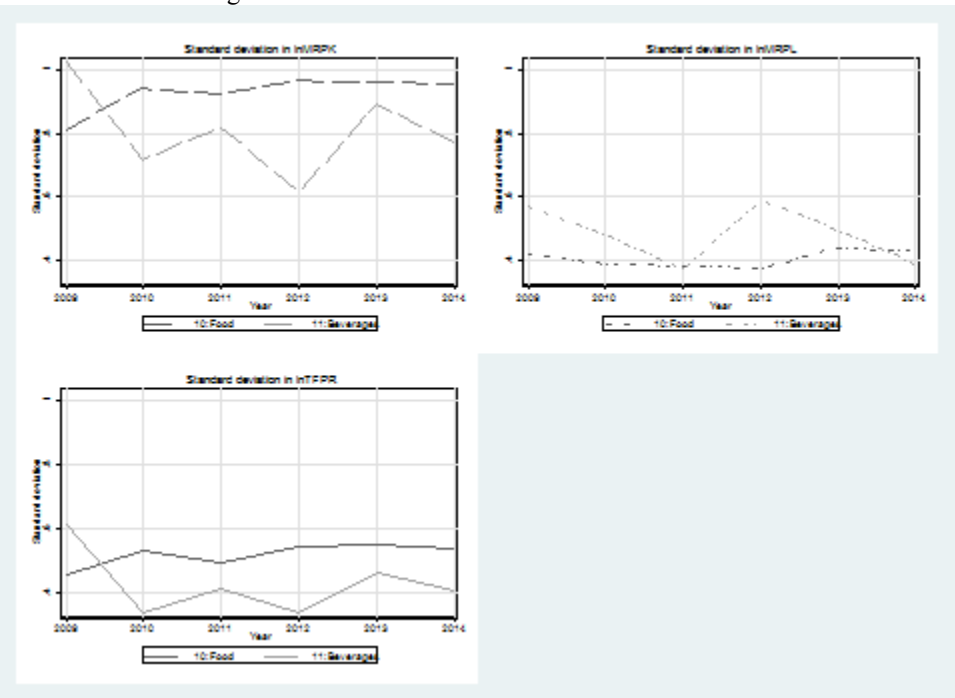
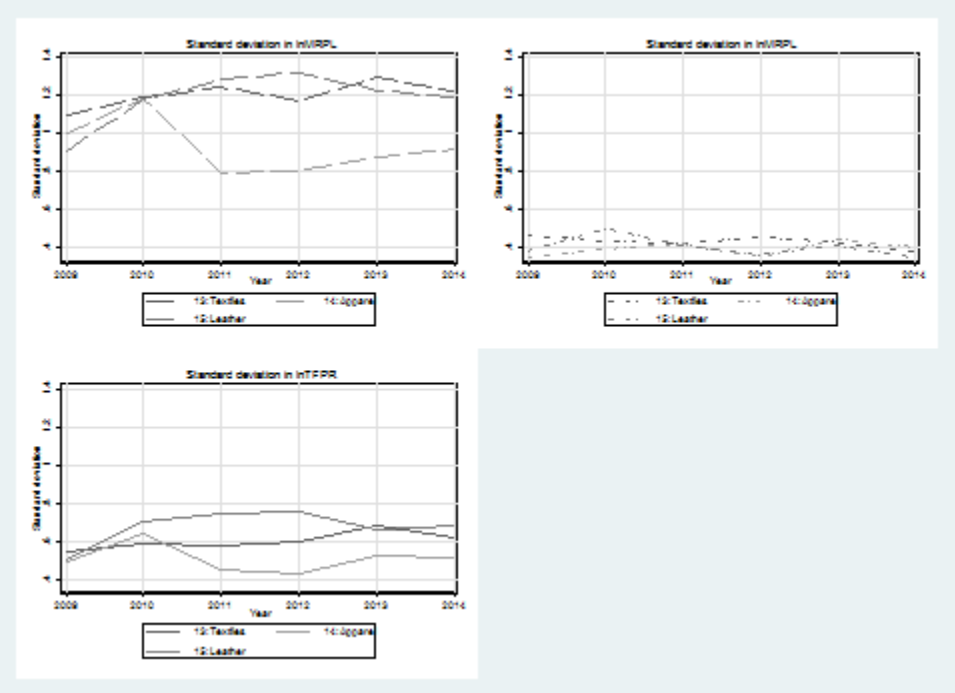
Appendix

Resource Misallocations at the sector level

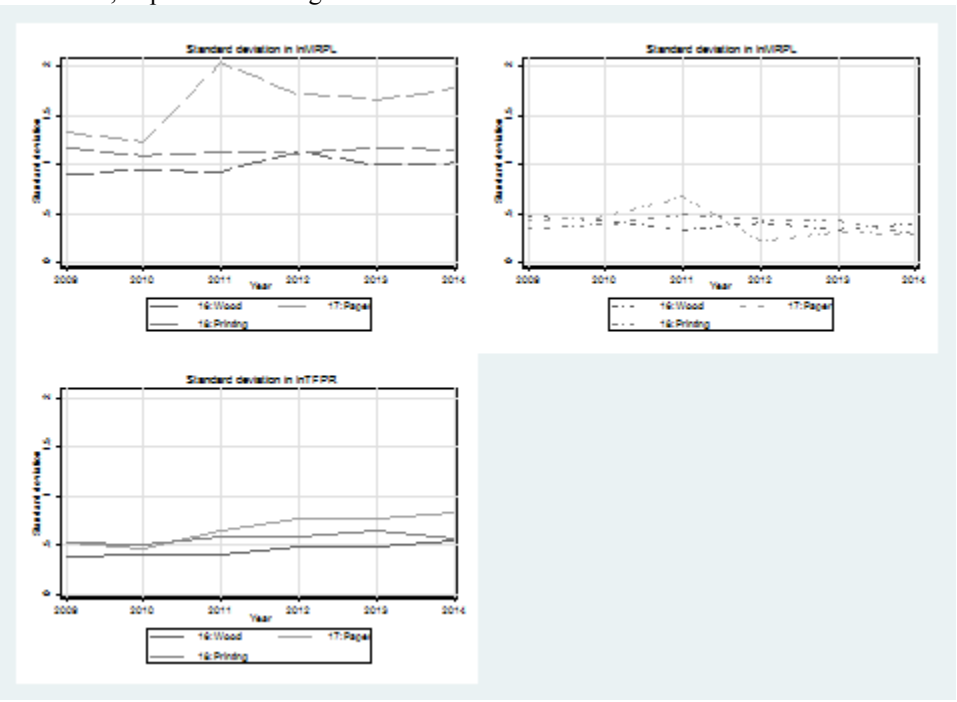
B1: Food and Beverages



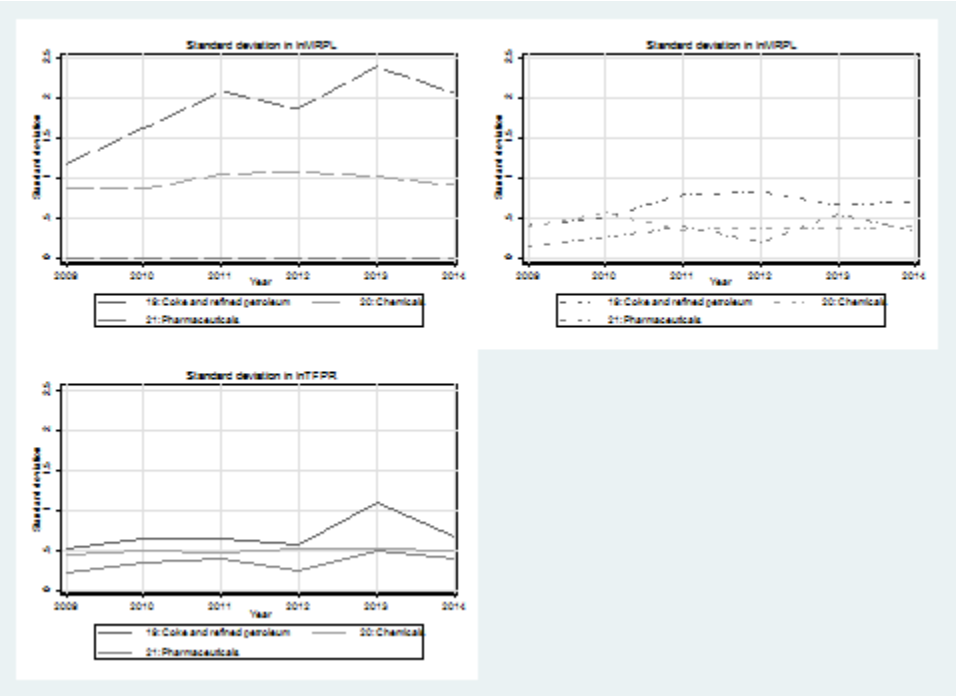
B2: Textiles, Apparel and Leather



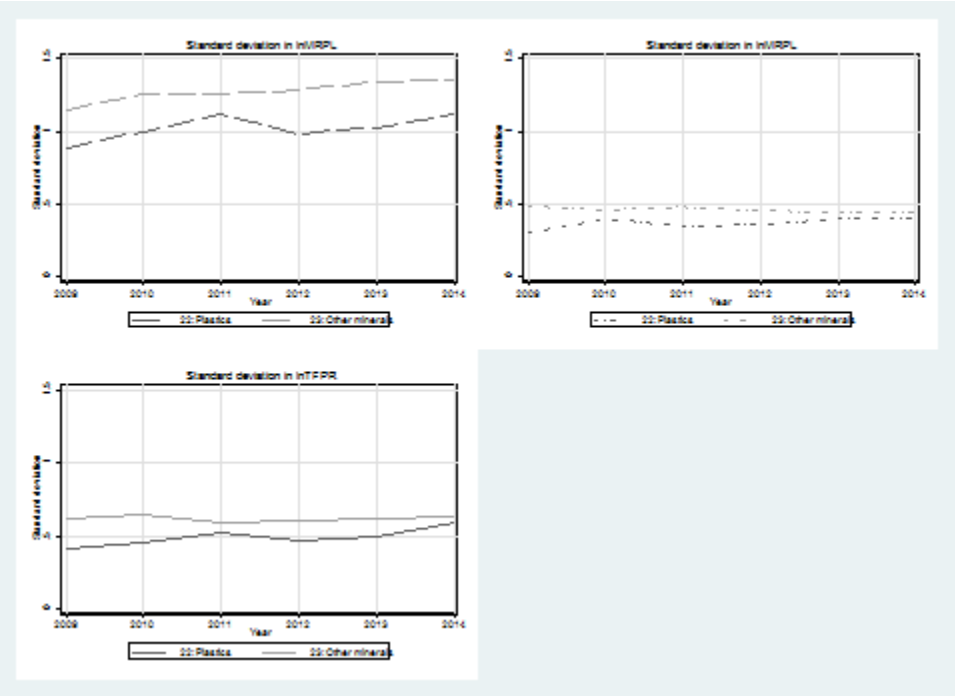
B3: Wood, Paper and Printing



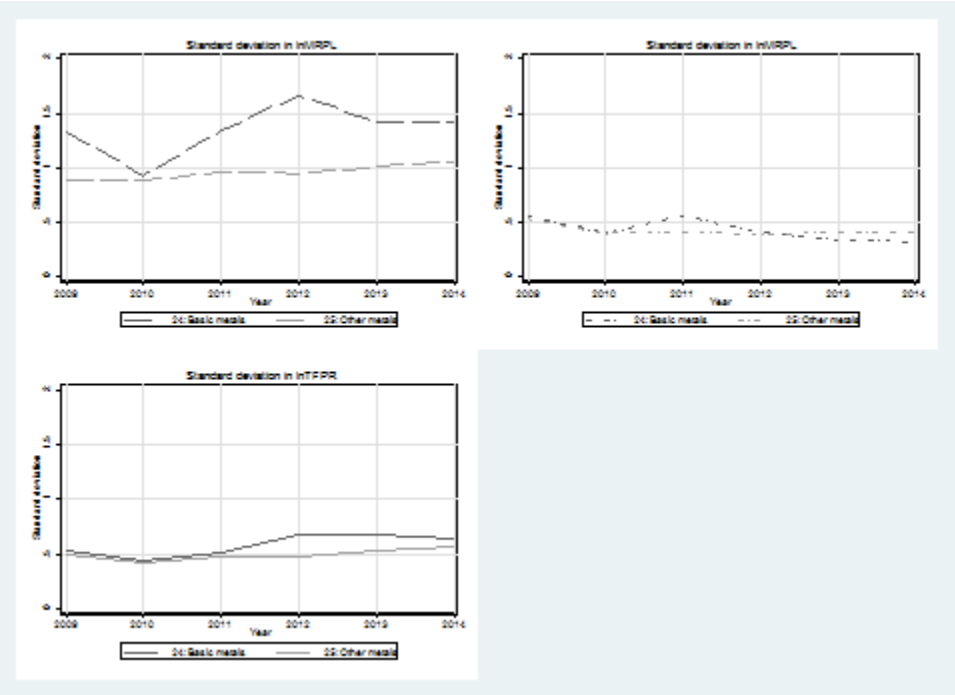
B4: Petroleum, Chemicals and Pharmaceuticals



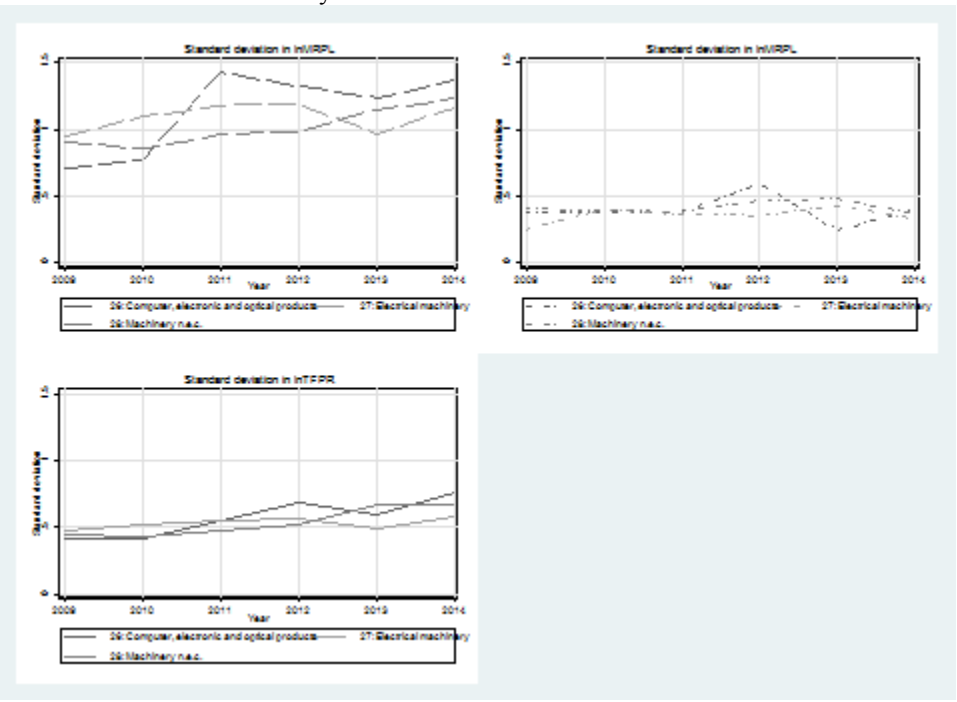
B5: Plastics and Minerals



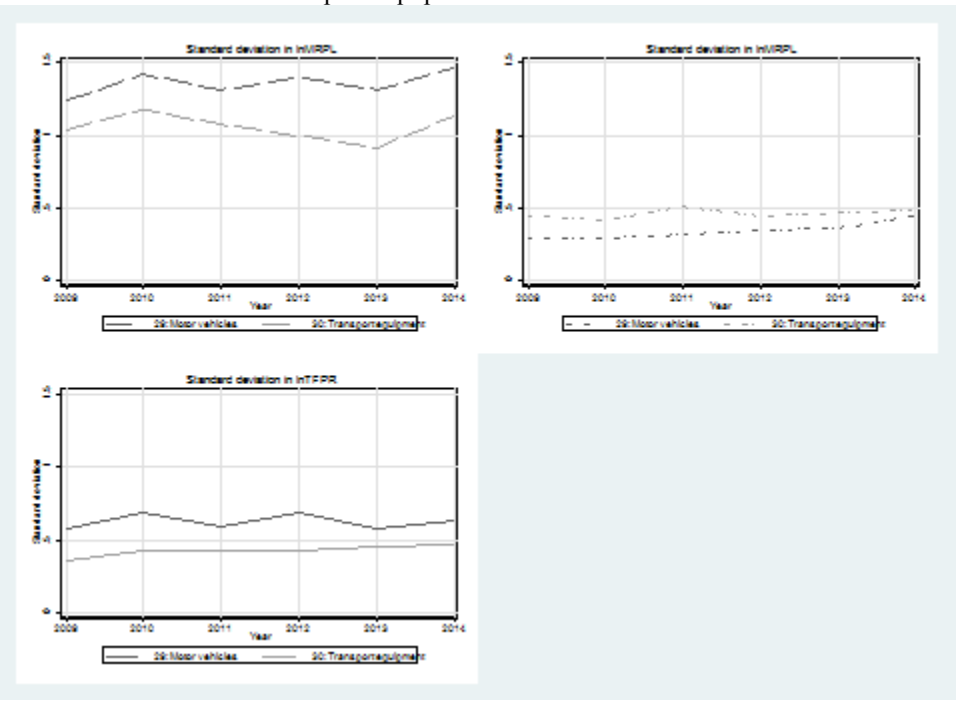
B6: Basic Metals and Other Metals



B7: Electronics and Machinery



B8: Motor Vehicles and Transport Equipment



B9: Furniture and Other Manufacturing