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Exploring Unbalanced Growth in South Africa: Understanding the Sectoral Structure of the South African Economy

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# Exploring Unbalanced Growth in South Africa: Understanding the Sectoral Structure of the South African Economy

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#### Abstract

This paper explores the reasons for the unbalanced growth structure of South Africa. While a number of emerging markets show a high proportion of value added and employment being generated by the service sector, South Africa is one of very few such economies that also show a strong decline in manufacturing. In this paper we begin by an extensive presentation of the evidence that details the structural changes in the economy that have led to this unusual economic structure. In what follows we provide an explanation of the observed changes that rests op four distinct structural forces in the economy. First, on the supply-side of the economy, we confirm the well-known fact of differential total factor productivity (TFP) growth across sectors. Combined with a price elasticity of demand that is below unity, this leads to a prediction of labour shedding in sectors that have high TFP growth, and labour absorption in sectors with low TFP growth. Second, on the demand-side of the economy, economic sectors also face a differential income elasticity of demand, with "old" sectors such as agriculture and mining falling below unity, "new" sectors particularly in services reporting elasticities above unity. With income growth, this leads to a restructuring of demand from primary and secondary sectors to the tertiary sectors of the economy. Finally, we also consider the structural implications of inefficiencies in the labour and output markets of the economy. Pricing of labour, the rate of return on employment, and the pricing power of producers in output markets are all considered. The combination of the supplyside, the demand-side, and the factor market forces allow for a successful four category typology of sectors. Type 1 sectors are high TFP growth, labour shedding, with output growth moderated by low income elasticity of demand. Examples are Manufacturing and Construction. Type 2 sectors are low TFP and output growth, but with labour absorption moderated by low rates of return on the cost of employing labour. Examples are Agriculture and Mining. Type 3 sectors are high TFP growth, labour shedding, and output growth accelerated by high income elasticity of demand. Examples are the Utilities, Trade and Communications sectors. Type 4 sectors are low TFP growth, labour absorbing, with output growth accelerated by high income elasticity of demand. Examples are provided by the Finance sectors.

## Contents

1	Introduction	4
2	Illustrating the Question in More Detail         2.1       Changes in Value Added Contribution         2.2       Employment	<b>5</b> 9 11
3	Two Possible Explanations of these Patterns of Structural Change         3.1       The Technology Based Explanation	<b>14</b> 16 18 19 21
4	Empirical Evidence on the Two Explanations of Structural Change4.1Productivity	<b>22</b> 22 26 27 31 33
5	Further Evidence on Structural Change in the Labour Market5.1Real Remuneration Per Worker5.2Comparing the Real Productivity and the Real Cost of Labour5.3Capital Intensity5.4Inferences	<b>38</b> 40 41 44 45
6	Further Evidence of Structural Change in Output Markets	47
7	Conclusions and Evaluation	52
8	Appendix 1: Data Sources	59

# **List of Tables**

1	Proportion of Value Added by Economic Sector	7
2	Proportion of Employment by Economic Sector	8
3	Economic Sectors and Associated Variable Names	11
4	Proportion of Formal Sector Employment by Economic Sector	12
5	Proportion of Formal and Informal Sector Employment by Economic Sector	12
6	Proportion of Formal Sector Employment by Economic Sector	12
7	Empirical Predictions under the Impact of Technological Change	23
8	Average TFP Growth for Period by Sector in Percentage Points	24
9	Annualized Percentage Changes in Sectoral Relative Prices	26
10	Proportion of Formal Sector Employment by Economic Sector	30
11	Labour Force Growth Rate and TFP Growth	32
12	Estimating the Elasticity of Substitution from GDP Shares	33

13	Univariate Time Series Characteristics Augmetned Dickey Fuller Test Stastitics	35
14	Probability Values of the Trace Test Diagnostic for the Rank of the Cointegrating	
	Matrix under the Specified Null	36
15	Estimated Income Elasticities	37
16	Comparing the Factor Intensity of Production with the Differential Between Labour	
	Productivity and the Real Cost of Labour	46
17	Augmented Dickey-Fuller Test Statistics	50
18	Estimated Mark-ups	51
19	The Final Sectoral Classification	53
20	SARB Data Sources	59

# **List of Figures**

1	Real Per Capita Income - Indexed on 1960.	5
2	Share of Total Value Added by Economic Sector vs. Real Per Capita GDP PPP	8
3	Shares in Value Added: Private Sector	9
4	Shares in Value Added: Public Sector	10
5	Growth in TFP - Pattern 1	25
6	Growth in TFP - Pattern 2	25
7	Sector Prices Relative to Economy Average - Pattern 1	28
8	Sector Prices Relative to Economy Average - Pattern 2	28
9	Sector Prices Relative to Economy Average - Pattern 3	29
10	TFP Growth and Relative Price Changes	29
11	Employment Growth versus TFP Growth	31
12	Estimated Sectoral Income Elasticities	38
13	Nominal Output Growth vs Income Elasticity of Demand	39
14	Real Output Growth vs Income Elasticity of Demand	39
15	Labour Force Growth vs Income Elasticity of Demand	40
16	Real Remuneration Per Worker - Deflated by PPI	41
17	Proportion of Labour Force Skilled - Formal Labour Market. Reported is the propor-	
	tion of Highly Skilled and Skilled workers to the total labour force	42
18	Difference Between Real Value Added per Worker and Real Remuneration per Worker	43
19	Percentage Return on Cost of Employment	43
20	Real Value Added Per Unit of Capital	45
21	Capital Labour Ratio	46
22	Labour Force Growth Rate vs. Mark-up	51

## **1** Introduction

This paper explores the reasons for South Africa's unusual economic structure. Not only do the service sectors in South Africa contribute disproportionately to value added and employment given its level of development, but its industrial sectors have been in long-term relative decline since the 1980s.

Such a structure has close affinities with the characteristics of developed economies, rather than emerging markets. This is further confirmed by the very anemic evolution of real per capita income of the South African economy over time, when compared with other emerging markets - see Figure 1. The flat-lining of real per capita income is in sharp contrast to the improvements in economic welfare generated by the comparator middle income countries. Despite the fact that South Africa continues to lag developed countries substantially in terms of per capita GDP, its annual growth remains low, shows little signs of catch-up, and thus appears to behave much more like a country in growth steady state than a country subject to strong developmental impetus.

The paper explores the interaction of four distinct mechanisms, that serve to account for the emergence of this economic structure. On the supply side of the economy, differential total factor productivity (TFP) growth across sectors, combined with a price elasticity of demand that is below unity, leads to labour shedding in sectors that have high TFP growth, and labour absorption in sectors with low TFP growth. On the demand side of the economy, economic sectors face differential income elasticities of demand, with "old" sectors such as agriculture and mining falling below unity, "new" sectors particularly in services reporting elasticities above unity. Combined with income growth, this leads to a restructuring of demand from primary and secondary sectors to the tertiary sectors of the economy.

Inefficiencies in both labour and output markets also contribute to structural change over time. In the case of labour markets, there are strong sectoral differences in the evolution of the real cost of labour, and hence the return on job creation over time. In the case of output markets, strong differences in mark-ups of price over the marginal cost of production are associated with strongly differentiated productivity growth across sectors.

The combination of the supply-side, the demand-side, and the factor market forces allow for



Figure 1: Real Per Capita Income - Indexed on 1960.

a four category typology of sectors. Type 1 sectors are high TFP growth, labour shedding, with output growth moderated by low income elasticity of demand. Examples are Manufacturing and Construction. Type 2 sectors are low TFP and output growth, but with labour absorption moderated by low rates of return on the cost of employing labour. Examples are Agriculture and Mining. Type 3 sectors are high TFP growth, labour shedding, and output growth accelerated by high income elasticity of demand. Examples are the Utilities, Trade and Communications sectors. Type 4 sectors are low TFP growth, labour absorbing, with output growth accelerated by high income elasticity of demand. Examples are provided by the Finance sectors.

## 2 Illustrating the Question in More Detail

The South African economy has an unusual sectoral structure, given its level of development. More than 60% of GDP is contributed by the service sectors, while typically for emerging markets this proportion is distributed around the 50% mark.

The unusual structure of the South African economy is emphasized by means of an international comparison against other emerging market economies. In Table 1 we report the share of total value added contributed by the Agricultural, Industrial and Service sectors of 17 emerging markets, report-

ing decade averages from the 1960s through the 2000s. Table 2 repeats for the share of employment contributed by the sectors for a smaller sample of countries. What emerges is that South Africa has an unusually high proportion of both GDP and employment that is attributable to the service sectors, rather than industry or agriculture. Of our sample of 17 countries for the 2000s average contribution, five countries had less than 50% of GDP arising from Services (China, Egypt, Indonesia, Malaysia, Thailand), eight had a contribution in the 50-60% range (Argentina, Brazil, Chile, Colombia, Ecuador, India, Korea, the Philippines), and only four had service sector contributions to GDP in excess of 60% (Mexico, Singapore, Turkey, South Africa).

South Africa's distribution of output and employment is much closer to that of High Income countries than its peer group of Middle Income countries.

A second unusual feature of the South African economy attaches to the dynamics surrounding the Industrial sectors - from Table 1 it emerges that for South Africa the contribution of Industry has been in decline over time. While it is true that for our sample of emerging economies rising per capital GDP is associated with a falling contribution to total GDP by Agriculture and a rising contribution to GDP by the Service sector, it does *not* follow that the industrial sectors come to contribute a declining proportion of GDP - see the evidence of Figure 2. In fact, in our sample of 17 countries over the past five decades eight countries report a rising proportion of GDP coming from the industrial sectors (China, Colombia, Ecuador, Egypt, Indonesia, Korea, Malaysia, Thailand.), and seven a constant proportion (Brazil, Chile, India, the Philippines, Mexico, Singapore, Turkey). Only two, Argentina and South Africa have a falling proportion of GDP arising from the industrial sectors. Thus while South Africa is one of four countries in our sample of emerging markets to show a very high contribution of the service sector to output and employment, it is the only one of these four to also combine this with a declining industrial sector.

The task of this paper is to attempt an explanation of the unusual sectoral economic structure of South Africa. More specifically we ask whether the distribution of activity across sectors should be interpreted as a sign of efficiency, inefficiency, or whether it is neutral from an efficiency perspective. While a few prior papers have reflected on the unusual industrial sector of South Africa (see Fedderke 2010, 2013), the analytical engagement of possible underlying causes of the structure has been

		1960s	1970s	1980s	1990s	2000s				1960s	1970s	1980s	1990s	2000s
Argentina	Agriculture	10	9	8	6	9		Korea, Rep.	Agriculture	38	26	13	7	4
	Industry	48	46	40	30	32	1		Industry	20	30	39	41	40
	Services	42	45	52	64	59			Services	49	44	47	52	56
Brazil	Agriculture	17	13	10	8	9		Malaysia	Agriculture	31	27	20	13	9
	Industry	36	39	45	35	37			Industry	25	33	39	43	50
	Services	47	48	45	57	54			Services	44	40	41	44	41
Chile	Agriculture	9	8	8	8	6		Mexico	Agriculture	12	12	9	6	4
	Industry	39	40	39	38	42			Industry	28	32	34	28	27
	Services	52	52	54	54	53			Services	60	56	57	66	69
China	Agriculture	37	32	29	20	13		Philippines	Agriculture	26	29	24	20	15
	Industry	35	45	45	45	46			Industry	28	35	37	32	32
	Services	28	23	26	34	41			Services	46	36	39	47	53
Colombia	Agriculture	28	24	18	15	13		Singapore	Agriculture	-	2	1	0	0
	Industry	27	30	35	33	32			Industry	-	34	37	35	33
	Services	45	46	47	52	55			Services	-	64	62	65	66
Ecuador	Agriculture	28	19	14	15	8		South Africa	Agriculture	10	7	5	4	3
	Industry	22	33	39	30	38			Industry	38	40	44	35	32
	Services	51	48	47	55	54			Services	52	52	51	61	65
Egypt	Agriculture	29	28	20	17	16		Thailand	Agriculture	32	26	18	10	10
	Industry	27	28	31	32	35			Industry	22	28	32	40	43
	Services	44	44	50	51	49			Services	46	47	50	50	47
India	Agriculture	46	42	35	29	21		Turkey	Agriculture	42	34	21	17	13
	Industry	20	22	26	27	26			Industry	20	21	28	29	24
	Services	34	35	39	44	53			Services	38	45	51	55	63
Indonesia	Agriculture	52	34	23	18	15								
	Industry	14	30	38	42	45								
	Services	34	36	39	40	39								
				Sou	rce: W	orld D	eve	lopment Ir	ndicators					

Table 1: Proportion of Value Added by Economic Sector

		1990-1999	2000-2005				
Brazil	Agriculture	25	21				
	Industry	20	21				
	Services	55	58				
China	Agriculture	50	45				
	Industry	20	17				
	Services	12	14				
Russia	Agriculture	15	12				
	Industry	35	30				
	Services	51	59				
South Africa	Agriculture	11	12				
	Industry	25	25				
	Services	61	63				
Source: World Development Indicators							

Table 2: Proportion of Employment by Economic Sector



Figure 2: Share of Total Value Added by Economic Sector vs. Real Per Capita GDP PPP

cursory. The present paper aims to redress this omission.

We begin by unpacking the distribution of output and employment across sectors, and over time in greater detail. The fundamental point remains the surprisingly high contribution by the service sectors in the economy. Additional nuance does emerge, however, specifically with the preponderance of the financial sectors in both output and employment terms within the service sectors.

### 2.1 Changes in Value Added Contribution

The structure of sectoral contributions to value added in South Africa has changed markedly over the last five decades.

Figure 3 illustrates for the private sectors of South Africa, Figure 4 for the public sectors, using SARB quarterly real value added at basic prices before seasonal adjustment data series. Sectoral descriptions are detailed in Table 3. Detailed descriptions of the data series employed are reported in Appendix 1 of the paper.



Figure 3: Shares in Value Added: Private Sector

A number of patterns emerge from the data.

First, sectors that have substantially increased their relative contribution to aggregate value added of the South African economy, are all located in the private sector service industries. They include



Figure 4: Shares in Value Added: Public Sector

most dramatically Finance, insurance, real estate and business services (FIREBS), but also, though less starkly Wholesale and retail trade, catering and accommodation (TCA), and Transport, storage and communications (TSC). What is more, these gains have occurred primarily since 1990. In the case of the FIREBS sector, the increase has been particularly dramatic, with the relative contribution rising from approximately 13% to 20% of aggregate output of the economy, making it the largest single sector of the economy.<sup>1</sup>

Second, a number of sectors have shown a declining relative contribution to value added. Mining and quarrying (M&Q) has manifested a long-term structural decline since the mid-1960s, from approximately 20% to less than 5% of total output. Public sector service provision has also declined in terms of its relative contribution to aggregate production. Since 1990, Community, social and personal services (CSPS) has fallen below 20% of aggregate output, while General government services (GGS) has fallen below the 15% mark. Notably, Manufacturing (Man) while rising from 10% to approximately 18% of aggregate output over the two decades from 1960 through 1980, has since

<sup>&</sup>lt;sup>1</sup>One of the reasons for the rise of the financial sectors is one of data classification. During the 2000s business services were added to the sector, thereby increasing its relative size in the economy. While relevant, the reclassification serves to exacerbate a trend that is already present in the data, and does not change the fundamental insight of the growth of the sector in the economy. This is also true of the employment series in the following subsection.

Sector	Name
Agriculture, Forestry and Fishing	AFF
Mining and Quarrying	M&Q
Manufacturing	Man
Electricity, Gas and Water	EGW
Construction	Constr
Wholesale and retail trade, catering & accommodation	TCA
Transport, storage and communications	TSC
Finance, insurance real estate and business services	FIREBS
Community, social and personal services	CSPS
General government services	GGS
Other community, social and personal services	OCSPS

Table 3: Economic Sectors and Associated Variable Names

systematically declined in importance, now contributing only 13-14% of aggregate production.

Finally, a number of sectors have consistently contributed a small (less than 5%) proportion of aggregate value added, but without any indication of a systematic further decline in their contribution. These sectors include Agriculture, forestry and fishing (AFF), Construction (Constr), Electricity, Gas and Water (EGW), and Other community, social and personal services (OCSPS).

### 2.2 Employment

A consideration of employment patterns across the economic sectors of the economy provides much the same evidence as the value added data.

Given that the SARB does not report employment in the Agriculture, forestry and fishing sector, for employment we report evidence from both the SARB employment series, as well as those published by Quantec. In the Quantec data, there is additional disaggregation of the employment series into formal and informal sector employment.

Table 4 records the evidence for the distribution of formal sector employment across economic sectors, while Table 5 repeats for the distribution of total employment (formal and informal sector employment). In both instances the data source is Quantec. Table 6 reports the SARB data source.

The patterns observed for the distribution of value added repeat for employment in the economy for the most part, though there are some nuances that emerge. The inferences are invariant to the use of only formal sector employment or total employment across both formal and informal sectors of the labour market. Moreover, patterns are essentially invariant across the SARB and Quantec data

Source: Quantec								
	1970s	1980s	1990s	2000s	2000-7	2008-12		
AFF	22	17	16	10	12	7		
M&Q	8	8	6	5	4	5		
Man	15	15	14	13	13	12		
EGW	0	1	0	1	0	1		
Constr	6	6	7	4	4	4		
TCA	12	13	14	16	16	17		
TSC	6	6	5	4	4	4		
FIREBS	3	4	9	17	16	18		
CSPS	30	29	29	31	30	34		

Table 4: Proportion of Formal Sector Employment by Economic Sector

Source: Quantec								
	1970s	1980s	1990s	2000s	2000-7	2008-12		
AFF	22	17	16	10	12	6		
M&Q	8	7	5	4	4	4		
Man	14	14	14	12	13	11		
EGW	0	1	0	0	0	0		
Constr	7	8	8	6	6	6		
TCA	14	16	19	22	21	23		
TSC	5	6	5	4	4	5		
FIREBS	2	4	8	14	14	15		
CSPS	28	27	26	27	26	29		

Table 5: Proportion of Formal and Informal Sector Employment by Economic Sector

Source: SARB									
	1960s	1970s	1980s	1990s	2000s	2000-7	2008-13		
AFF	-	-	-	-	-	-	-		
M&Q	15	13	11	8	2	6	6		
Man	25	24	22	20	17	17	14		
EGW	1	1	1	1	1	1	1		
Constr	11	12	10	7	5	5	5		
TCA	16	16	15	16	21	20	20		
TSC	6	6	6	5	5	4	4		
FIREBS	7	8	12	19	23	22	22		
CSPS	5	4	4	5	5	5	5		
GGS	15	16	18	19	21	19	22		

Table 6: Proportion of Formal Sector Employment by Economic Sector

sources, though the growth of the service sectors appears stronger under the SARB data than the Quantec source.

Just as Financial, insurance, real estate and business services and Wholesale and retail trade, catering and accommodation show an increasing relative contribution to value added in the South African economy, both sectors are showing an increase in the proportion of total employment in the economy. In the case of the financial sector, the proportion increases from 3% to 18% (2% to 15% considering both formal and informal employment), in the case of the Wholesale and retail trade, catering and accommodation sector the increase is more moderate (12% to 17% in the formal sector). The data suggests that the trade and hospitality sector has grown more substantially in terms of informal employment (the increase is from 14% to 23% of total employment), while for the finance sectors there is relatively little evidence of informal sector employment.

Sectors with declining relative contributions to employment are Manufacturing and Agriculture, forestry and fishing. The losses in Manufacturing are more moderate (from 15% to 12%), while losses in agricultural sectors of the economy are relatively severe, with a dramatic acceleration of employment losses in agriculture in the 2000s, and post 2007 in particular.<sup>2</sup>

A number of sectors have consistently contributed a small but relatively stable proportion of employment in the economy. This applies to Construction, Electricity, gas and water, Transport, storage and communications, and Mining & quarrying. This is much the same set of sectors that have consistently contributed a small but constant proportion of aggregate value added in the economy. The exceptions are twofold. First, the mining sector, which shows a dramatic decline in the proportion of total value added it provides (from the largest, to one of the smallest economic sectors), has never been a significant contributor to relative total employment. On the other hand, the declining trend that is evident for output for mining, is also evident in employment. Second, Transport, storage and communications is one of the sectors showing a growing relative contribution to value added - yet it has done so with a declining proportion of total employment located in the sector.

Finally, note that the Community, social and personal services sector shows a relatively constant relative contribution to employment (approximately 30%, or higher in the formal labour market),

<sup>&</sup>lt;sup>2</sup>It is worth noting that 2003 saw the introduction of a minimum wage into the agricultural sectors for the first time - which may explain the significant employment losses in the sector.

though subject to some cyclical variation over time. This is in contrast to the declining relative contribution of the sector to value added in the economy.

## **3** Two Possible Explanations of these Patterns of Structural Change

The rising significance of the service sector over time, and with rising per capita GDP, is not unique to South Africa.

Observations of this pattern for the USA are associated with Clark (1941), Stigler (1956), Kuznets (1957, 1966), Baumol (1967), Fuchs (1968), Kravis et al (1984) and Maddison (1987).

Explanations of the rising significance of the service sector have fallen into two, non-exclusive alternatives. One explanation rests on the demand side of the economy, the other on features of the supply side. The implication is that both mechanisms may be operative, and contributing to the changing structure of production.

What both approaches have in common is that they represent attempts to move beyond the balancedgrowth framework that is fundamental to core growth theory. Growth theory as represented by for instance Solow (1956, 1957), has the fundamental prediction that the economy will have a unique steady state, in which output, capital and labour grow at the same fundamental rate, rendering the capital-labour ratio and per capita income level of the economy constant. As a result, the empirical prediction of the neoclassical growth model is consistent with the stylized facts of economic growth formalized by Kaldor (1961), and which continue to be a baseline expectation of much of empirical work on growth for developed nations.

In the two approaches we present below, the objective is to maintain the Kaldor stylized facts of growth at the aggregate economy-wide level, but to allow structural change at the industry level, thereby generating the possibility of considerable sectoral "churn" beneath the veneer of balanced growth at the aggregate level. In short, while sectoral growth is unbalanced in the sense that the relative importance of sectors changes, at the aggregate level output per worker and capital-labour ratios will appear unchanged, thereby effectively creating sectors of increasing, and sectors of decreasing importance.

The first of the two explanation types rests on the structure of demand. The case we examine here,

following Foellmi and Zweimüller (2008),<sup>3</sup> is of a non-linear formalization of Engel's consumption cycles. Households are held to have a hierarchy of preferences, that are satisfied sequentially with rising income. Thus consumption moves from a preponderance of consumption focussed on basic needs (eg. food), to consumption focussed on less immediate, and finally luxury items. The associated pattern is one in which the weight of consumption moves from agricultural, to other primary commodities (associated with mining, say) to manufactures, and finally to services. Changes in the sectoral composition of aggregate GDP is therefore fundamentally attributable to sectoral differences in income elasticities of demand - a feature this model shares with Kongsamut et al (2001).

The second type of explanation rests on sector-biased technological change. In the Ngai and Pissarides (2007) model we use in this paper, sectors experience different total factor productivity growth rates but have identical capital intensities. Aggregate growth will then be consistent with the Kaldor stylized facts if the intertemporal utility function is logarithmic in the consumption aggregate, but the consumption composite is non-logarithmic but homothetic across goods.<sup>4</sup> Then, in a two-sector model with constant elasticity of substitution preferences and Cobb-Douglas production technology, provided that the elasticity of substitution is less than unity, convergence to the steady state is slow, while along the transition path capital share and the interest rate change only gradually, reconciling structural change with the Kuznets facts.

A third approach worth mentioning is provided by Buera and Kaboski (2012). In this approach, structural change is not driven by skill-biased technical change. Instead, consumption moves into more skill-intensive output, which triggers the growth of the skills-intensive service sector, which is (empirically) the part of the service sector that has reported strong growth rates in the USA. The underlying model posits that skills are specialized, allowing productivity gains in the use of skills in market versus home production, lowering costs of market versus home production, and increasing the price and hence the supply of skills. The trade-off of moving home into market production is that while market production is more productive (due to specialization) and hence cost effective, home production is more customized and hence yields higher utility (at higher cost). With development, the

<sup>&</sup>lt;sup>3</sup>See also the broader related literature on non-homethetic preferences - Echevarria (1997), Laitner (2000), Caselli and Coleman (2001), and Gollin et al (2002). A further approach is to abandon the independence of preferences and technology, as in Kongsamut et al (2001).

<sup>&</sup>lt;sup>4</sup>In Acemoglu and Guerrieri (2008) both technical progress and capital intensity differ across sectors.

opportunity cost of home production rises, switching production to the market. Since this mechanism is more likely for a highly developed, high technology context, we do not extent consideration to this mechanism at this stage.

#### 3.1 The Technology Based Explanation

The results of the model rests on the existence of differential TFP growth rates across sectors, under alternative assumptions regarding the price elasticity of demand.

Consider an economy consisting of m sectors, of which sectors i = 1, ..., m - 1, produce only consumption goods, and sector m produces both a consumption good and the economy's capital good.<sup>5</sup> Equilibrium in the economy is the solution to a social planning problem, of which the objective function is given by:

$$U = \int_0^\infty e^{-\rho t} \nu\left(c_1, ..., c_m\right) dt \tag{1}$$

where the rate of time preference  $\rho > 0$ , the  $c_i \ge 0$  are per capita consumption levels, the instantaneous utility function  $\nu(\bullet)$  is concave and satisfies the Inada conditions. Constraints on the optimization problem are an exogenous labour force growing at rate  $\eta$ , and the endogenous aggregate capital stock which defines the state of the economy. The utility function is assumed to have constant elasticities across goods and time:

$$\nu(c_1, ..., c_m) = \frac{\phi(\bullet)^{1-\theta} - 1}{1-\theta}$$
(2)

$$\phi(\bullet) = \left(\sum_{i=1}^{m} \omega_i c_i^{(\varepsilon-1)/\varepsilon}\right)^{\varepsilon/(\varepsilon-1)}$$
(3)

where  $\theta$ ,  $\varepsilon$ ,  $\omega_i > 0$ , and  $\sum \omega = 1$ .

In the decentralized economy, demand functions have constant price elasticity  $-\varepsilon$  and unit income elasticity.<sup>6</sup>

<sup>&</sup>lt;sup>5</sup>Our exposition follows Ngai and Pissarides (2007). In their model the sector producing the capital good is termed the "manufacturing" sector. Here we refer to the capital good sector instead, since in any empirical application the manufacturing sector produces a wide array of consumption goods. When testing the theory, however, we test for the sensitivity of our results to excluding the manufacturing sector, thereby treating it as the capital goods sector, entirely. Results do not prove sensitive to the exclusion.

<sup>&</sup>lt;sup>6</sup>Note that this is consistent with the unitary income elasticity that applies to the demand-side model below in the aggregate. The demand-side model differentiates the income elasticity of demand by sector (to lie above and bellow unity), while maintaining a unit value of the income elasticity in aggregate.

Production in sectors i = 1, ..., m - 1, is consumed, while production in sector m, may be either consumed or invested, so that:

$$c_i = F^i(n_i k_i, n_i), \ \forall i \neq m$$
(4)

$$\mathbf{k} = F^m \left( n_m k_m, n_m \right) - c_m - \left( \delta + \eta \right) k$$
(5)

where  $n_i \ge 0$  is the employment share and  $k_i \ge 0$  is the capital-labour ratio in sector *i*, with  $k \ge 0$ the aggregate capital-labour ratio, and  $\delta$  denotes the depreciation rate. The production function has constant returns to scale, positive and declining returns to factors, and satisfies the Inada conditions.

To focus on the impact of different TFP growth across sectors, all production functions are assumed identical across sectors, except for their TFP growth rates:

$$F^{i} = A_{i}F\left(n_{i}k_{i}, n_{i}\right), \ \frac{\dot{A}_{i}}{A_{i}} = \gamma_{i}, \ \forall i$$
(6)

Under this utility function, static efficiency and the resource constraints, it can be shown that:

$$\frac{p_i c_i}{p_m c_m} = \left(\frac{\omega_i}{\omega_m}\right)^{\varepsilon} \left(\frac{A_m}{A_i}\right)^{1-\varepsilon} = \left(\frac{\omega_i}{\omega_m}\right)^{\varepsilon} \left(\frac{p_i}{p_m}\right)^{1-\varepsilon} = x_i, \ \forall i$$
(7)

where  $x_i$  denotes the ratio of consumption expenditure on good *i* to consumption expenditure on the capital good.

Note that, given the assumption of a unit income elasticity, the  $x_i$  ratio is determined by the price ratio of the i'th good to that of the capital good, and the common price elasticity  $\varepsilon$ . Specifically, an increase in the price ratio  $p_i/p_m$  will raise the ratio of consumption expenditures by  $(1 - \varepsilon)$ .

Defining structural change as a change in the share of labour employed in a sector, such that  $\hat{n}_i \neq 0$ for at least some *i*, the relative growth rates of two sectors' employment shares comes to depend only on the difference between the sectors' TFP growth rates, and the constant elasticity of substitution between the goods that arises from changing relative prices:

$$\frac{\mathbf{n}_i}{n_i} - \frac{\mathbf{n}_j}{n_j} = (1 - \varepsilon) \left( \gamma_j - \gamma_i \right), \ \forall i, j \neq m$$
(8)

the growth rate of relative prices is given by:

$$\frac{\mathbf{p}_i}{p_i} - \frac{\mathbf{p}_j}{p_j} = \gamma_j - \gamma_i, \ \forall i$$
(9)

so that:

$$\frac{\dot{n}_i}{n_i} - \frac{\dot{n}_j}{n_j} = (1 - \varepsilon) \left( \frac{\dot{p}_i}{p_i} - \frac{\dot{p}_j}{p_j} \right), \ \forall i, j \neq m$$
(10)

Thus for the consumption sectors, the growth rate in the employment share of each consumption sector is a linear function of its own TFP growth,  $\gamma_i$ , subject to a constant slope,  $(1 - \varepsilon)$ .

#### 3.1.1 Empirical Expectations

We are now in a position to specify the empirical predictions of this model.

The properties of structural change follow from (8) to (10), and differentiate four distinct possible cases.

Case 1: All sectors have the same TFP growth rate:

$$\gamma_i = \gamma_m, \ \forall i$$

In this instance the economy manifests: (a.) **Balanced** TFP growth (all sectors reporting the same TFP growth rate); (b.) Constant relative prices; (c.) The relative employment shares of the consumption sectors remains constant over time.

Case 2: Sectors have differing TFP growth rates:

$$\gamma_i \neq \gamma_j, \ \forall i, j$$

Then the economy is subject to **unbalanced** TFP growth. This case can be further nuanced.

Case 2A: where:

$$\varepsilon = 1$$

such that, from (8,9): (a.) Employment shares are constant; (b.) Relative prices change; (c.) Faster growing sectors produce more output over time, lowering prices, but price changes trigger changes in consumption demand that match the changing output due to differential TFP growth rates.

Case 2B: where:

$$\varepsilon < 1$$

such that from (8) to (10): (a.) Consumption demand is too inelastic to match output changes; (b.) Therefore employment moves to the slow productivity growth sectors, despite the rise in their price.

Case 2C: where:

 $\varepsilon > 1$ 

such that: (a.) Consumption demand is too elastic for the output changes; (b.) Therefore employment moves disproportionately to the fast-growing sectors, whose relative prices are falling.

Note that for both Case 2B and Case 2C, by (7) *nominal* consumption shares are given by  $x_i/X$ , so the results obtained for employment shares also hold for nominal consumption and output shares:

$$\frac{(p_i c_i)}{(p_i c_i)} - \frac{(p_j c_j)}{(p_j c_j)} = (1 - \varepsilon) \left(\gamma_j - \gamma_i\right), \ \forall i, j \neq m$$
(11)

$$\frac{(p_i F_i)}{(p_i F_i)} - \frac{(p_j F_j)}{(p_j F_j)} = (1 - \varepsilon) \left(\gamma_j - \gamma_i\right), \ \forall i, j \neq m$$
(12)

However, *real* consumption and output growth satisfies:

$$\frac{\mathbf{c}_i}{c_i} - \frac{\mathbf{c}_j}{c_j} = \varepsilon \left( \gamma_i - \gamma_j \right), \ \forall i, j$$
(13)

$$\frac{F_i}{F_i} - \frac{F_j}{F_j} = \varepsilon \left( \gamma_i - \gamma_j \right), \ \forall i, j \neq m$$
(14)

Hence, where  $1 > \varepsilon \rightarrow 0$ , we will observe small changes in real consumption (or output) shares, and large changes in relative nominal consumption (or output) shares. This would be consistent with the evidence reported in Baumol et al (1985), Kravis et al (1983), Sichel (1997), Falvey and Gemmell (1996). Where real relative output is rising, nominal relative output should be declining due to falling relative prices. Conversely, where  $\varepsilon > 1$ , we will observe large changes in real consumption (or output) shares, and small changes in relative nominal consumption (or output) shares. Real and nominal relative output would move in the same direction, despite falling relative prices.

We examine the empirical evidence on which of these cases holds in detail in section 4.

#### **3.2** The Income Elasticity Explanation

Explanations of structural change based on the nature of technological change, are supply-side based.

There is an alternative, which relies on the demand side of the economy instead. The fundamental proposition of the demand-side model of structural change is of non-linear Engel-curves, with hierarchical preferences generating high income elasticities for newly introduced goods that are treated as

luxury goods. Over time goods face declining income elasticities as demand matures, and the goods become necessities in the consumption bundle of individuals.<sup>7</sup>

Consider a representative agent economy with an infinite number of potentially producible goods and services, ranked by the index *i*. Let the utility derived from consuming good *i* in quantity *c*, be denoted by  $\nu(c(i)) = (\frac{1}{2}) [s^2 - (s - c(i))^2]$ , where *s* denotes the saturation level of consumption. Under hierarchic preferences, some goods may not be consumed because the consumer cannot afford them. Hierarchical preferences are generated by a weighting function for utility, given by the power function:  $\xi(i) = i^{-\gamma}, \gamma \in (0, 1)$ .

Provided all goods *i* are on the market, this then gives the objective function:

$$u(c(i)) = \int_0^\infty (i^{-\gamma}) \left(\frac{1}{2}\right) \left[s^2 - (s - c(i))^2\right] di$$
  
s.t. 
$$\int_0^\infty p(i) c(i) di = E$$
  
$$c(i) \ge 0 \forall i$$

The optimal consumption of good *i*, when supplied at the marginal cost price, is:

$$c(i) = s - i^{\gamma} \lambda$$

which gives the equilibrium composition of demand as:

$$c(i) = s\left[1 - \left(\frac{i}{N}\right)^{\gamma}\right], \ i \in [0, N]$$

It is now clear that the quantity demanded of any good *i* will depend on its relative position in the "hierarchy of needs," (i/N), with goods at a lower position in the hierarchy receiving higher priority, since c(i) decreases in *i*. Moreover, the steeper the hierarchy (the greater is  $\gamma$ ) the stronger the effect of the relative position on equilibrium quantities.

With economic development, the number of goods produced in the economy increases. With increasing N, demand for already existent goods increases at a diminishing rate, approaching stagnation level, s. Specifically, while the composition of demand across sectors can change, the income elasticity of any particular product (under a constant savings rate) is given by:

$$\varepsilon_{i,Y} = \frac{\gamma \left(\frac{i}{N(\tau)}\right)^{\gamma}}{1 - \left(\frac{i}{N(\tau)}\right)^{\gamma}}$$

<sup>&</sup>lt;sup>7</sup>The exposition here follows the framework provided by Foellmi and Zweimüller (2008).

On introduction of a new good,  $i = N(\tau)$ ,  $\varepsilon_{i,Y} = \infty$ , rendering it a luxury good, while as  $\frac{i}{N(\tau)}$  declines,  $\varepsilon_{i,Y} \to 0$ , such that the good becomes a necessity. Note that the income elasticity of aggregate consumption stays constant at unity.

Structural change is thus a function of the introduction of new products, with different income elasticities of demand across sectors.

At a sectoral level, the implication of this is that "old" sectors should have a low income elasticity of demand, eg. Agriculture, while "new" sectors should manifest a high income elasticity, eg. services.

This also carries implications for employment in a dynamic sense. Workers would have started in the "old" sectors, such that the "old" sectors would have contributed the bulk (all) employment. With the emergence of "new" sectors, workers would be drawn from "old" to the "new" sectors.

#### **3.2.1 Empirical Expectations**

There are three core empirical predictions that emerge from the demand-side model of structural change in the economy.

First, there should be differential income-elasticities across the sectors of the economy. Specifically, income elasticities should increase from below, to above unity as one moves from "old" to "new" sectors. A plausible sequencing of sectors one advance *a priori* in the South African context might be as follows. Old sectors might be expected to be: Agriculture, forestry and fishing (AFF); Mining & quarrying (M&Q); Construction (Constr). Secondary tier sectors might be expected to be given by Manufacturing (Man). New sectors might be: Wholesale and retail trade, catering and accommodation (TCA); Transport, storage and communications (TSC); Finance, insurance, real estate and business services (FIREBS). A number of sectors are difficult to classify, and we specify these as indeterminate: Electricity, gas and water (EGW) as the power and utilities services providers to all sectors.

An alternative empirical operationalization for the insights of this model, would be to predict high income elasticities for sectors that show strong growth in output, rather than to formulate a stylized schematic of agriculture, mining, manufacturing, services as a sequence of sectoral developments.

Second, labour force growth should also show dynamic evolution with time. Employment growth

should mirror the distribution of output growth across old, secondary and new sectors. Old sectors should show employment decline. Secondary sectors should first show an increase, and then a decrease in employment. New sectors should show employment growth.

Alternatively, the income elasticity of sectors should map into distinct employment growth patterns. Low income elasticity should be associated with declining employment. Intermediate income elasticity should show an inverted-U shaped employment pattern. High income elasticity should be associated with employment growth.

Finally, prices should also show dynamic evolution over time, with the income elasticity of sectors mapping into distinct relative price patterns. Low income elasticity should have low relative prices; intermediate income elasticity, intermediate relative prices; and high income elasticity sectors, high relative prices.

## 4 Empirical Evidence on the Two Explanations of Structural Change

At this stage we turn our attention to the question of whether the empirical predictions of the two theoretical frameworks we have presented are borne out by the South African evidence.

We proceed sequentially, and both descriptively and econometrically.

A summary of the empirical expectations under the alternative possible types of structural change under the impact of technological change is provided by Table 7.

We consider the range of empirical predictions in turn.

#### 4.1 Productivity

The supply side account of unbalanced growth, ultimately rests on whether or not sectors report differences in total factor productivity growth. Recall that under the supply side explanation of unbalanced growth, we distinguish between a Case 1 and Case 2 in terms of the nature of the productivity growth. Case 1 would require the same structure of productivity growth across all economic sectors. Case 2 predicts that the nature of productivity growth will be different across economic sectors.

The comparison is in terms of total factor productivity (TFP) growth.<sup>8</sup> We compute TFP growth

<sup>&</sup>lt;sup>8</sup>Output per worker gives the same principal inference as TFP: that sectors differ strongly in terms of productivity growth. However, the patterns are distinct from those of TFP growth.

Explanation	Cases	Core Prediction
Technology	Case 1	Sectors the same TFP growth rate
		Stable Relative Prices
	Case 2A	Sectors different TFP growth rates
	$\varepsilon = 1$	Constant Employment Shares
		Changing Relative Prices
	Case 2B	Sectors different TFP growth rates
	$1 > \varepsilon \to 0$	Changing Employment Shares
		Employment Growth in Slow TFP Sectors
		Changing Relative Prices
	Case 2C	Sectors different TFP growth rates
	$\varepsilon > 1$	Changing Employment Shares
		Employment Growth in Fast TFP Sectors
		Changing Relative Prices
Preferences	Income Elasticity	Decrease in the "age" of the sector
		Increase in the growth rate of output
	Employment growth	low in low income elasticity sectors
		middling in mid-level income elasticity sectors
		high in high income elasticity sectors
	Output growth	low in low income elasticity sectors
		middling in mid-level income elasticity sectors
		high in high income elasticity sectors
	Relative Prices	low in low income elasticity sectors
		middling in mid-level income elasticity sectors
		high in high income elasticity sectors

 Table 7: Empirical Predictions under the Impact of Technological Change

	1960s	1970s	1980s	1990s	2000s	2000-7	2008-12
AFF	-	-	-	-	-	-	-
M&Q	0.65	-1.22	-1.05	0.75	-0.80	-0.34	-1.53
Man	1.01	0.14	-0.09	0.12	0.80	1.05	0.41
EGW	-0.06	-0.08	0.46	1.09	-0.49	0.66	-2.32
Constr	1.03	0.05	-0.63	0.75	0.62	0.99	0.04
TCA	1.65	-0.30	0.28	0.20	0.46	0.53	0.35
TSC	1.75	0.09	0.38	1.30	0.52	1.02	-0.27
FIREBS	0.53	-0.42	-0.38	0.20	0.95	1.21	0.53

Table 8: Average TFP Growth for Period by Sector in Percentage Points

by means of the primal decomposition.<sup>9</sup>

Period averages by economic sector are reported in Table 8, and Figures 5 and 6 report a 10-year moving average value for TFP growth.

Two broad patterns emerge from the evidence.

First, for three sectors, Mining & quarrying, Electricity, gas and water, Transport, storage and communications, there is a sustained upward trend in TFP growth from the mid 1980s through the early 2000s, after which the trend in TFP growth turns sharply negative. See Table 8.

Second, for four sectors, Manufacturing, Construction, Wholesale and retail trade, catering and accommodation, Finance, insurance, real estate and business services, TFP growth starts from a lower level than for the first grouping of sectors, but shows a sustained recovery into positive territory, and maintains strong positive growth through the 2000s, including the post 2007 recessionary period.

By the close of the period, the strongest TFP growth issues from the financial sectors (0.95% per annum on average over the 2000s), Manufacturing (0.80% per annum on average over the 2000s), and Construction (0.62% per annum on average over the 2000s).

Despite the emergence of sectoral growth "clubs" in terms of TFP growth, very strong differences in TFP productivity growth rates across sectors remain. This precludes Case 1 under the technological change based explanation of structural change in the economy. Instead, the evidence is consistent with Case 2 in all its variants, A through C.

<sup>9</sup>Thus:

$$TFP_{i,t} = \left(\frac{\bullet}{Y/Y}\right)_{i,t} - \kappa_{i,t} \left(\frac{\bullet}{K/K}\right)_{i,t} - \eta_{i,t} \left(\frac{\bullet}{L/L}\right)_{i,t}$$
(15)

where Y denotes real value added, K real capital stock, L employment, and  $\kappa$ ,  $\eta$ , the share of capital and labour in value added respectively, for sector i in period t. We compute  $\kappa$  from the gross operating surplus,  $\eta$  from the share of remuneration in gross value added. Note therefore that  $\kappa + \eta \approx 1$ , due to the impact of the tax treatment of the GOS.



Figure 5: Growth in TFP - Pattern 1



Figure 6: Growth in TFP - Pattern 2

	AFF	M&Q	Man	EGW	Constr	TCA	TSC	FIREBS
1960s	-0.61	-1.42	-1.05	-0.45	-0.39	-1.27	-0.04	2.52
1970s	-1.55	11.97	-1.50	1.75	0.24	-1.39	-2.76	-0.40
1980s	-3.27	-3.11	1.84	-1.68	2.92	2.50	0.30	1.07
1990s	0.22	-0.78	-1.08	-4.25	0.24	-0.20	-0.58	2.25
2000s	-2.94	5.61	-3.30	1.42	-1.39	0.34	-1.95	-1.34
2000-7	0.62	6.31	-1.36	-1.95	-2.61	-1.48	-2.41	0.00
2008-12	-8.63	4.49	-6.42	6.82	0.56	3.26	-1.21	-3.50

Table 9: Annualized Percentage Changes in Sectoral Relative Prices

#### 4.2 Price Changes

For both the supply-side and the demand-side explanation of unbalanced growth, relative price changes play a critical role.

Under the supply-side explanation of unbalanced growth, Case 1 and Case 2 are distinguished in terms of the nature of relative price changes across sectors. Case 1 requires that relative prices remain unchanged across all economic sectors. Case 2 predicts that relative prices do change across economic sectors.

For the demand-side explanation, the magnitude of relative price changes would be distinguished across sectors with different income elasticities, and we return to this in section 4.5.

To consider changes in relative prices over time, we proceed by means of considering sectoral prices relative to economy-wide average of prices:

$$\widetilde{P}_{i,t} = \left(\frac{P_{i,t}}{\frac{1}{n}\sum_{j=1}^{n}P_{j,t}}\right) \times 100$$

where  $P_{i,t}$  denotes sector *i*'s producer price index in period *t*, and where n = 11 is given by the 11 sectors for which we have relevant data able to define the PPI.

Relative prices in the economy have shown substantial change over the 1960-2010 period. To summarize, in Table 9 we report the average quarterly percentage change in sectoral prices relative to economy-wide average prices for the sample period.

In the aggregate, three sectors consistently report prices above the economy average (Agriculture, forestry and fishing, Transport, storage and communications, Electricity, gas and water), four sector prices are consistently below the economy average (Finance, insurance, real estate and business

services, Community, social and personal services, General government services, Other community social and personal services), three sectors are consistently approximately at the economy average (Manufacturing, Construction, Wholesale and retail trade, catering and accommodation), and one sector reports prices that rise from below to above the economy wide average (Mining & quarrying).

In terms of the time path of prices for the individual sectors, three broad patterns emerge in our sample period. For three sectors there is a consistent decline in prices relative to the economy average (Agriculture, forestry and fishing, Transport, storage and communications, Electricity, gas and water - see Figure 7). The contrasting pattern of consistently rising relative prices emerges for four sectors (Mining & quarrying, Finance, insurance, real estate and business services, General government services, Community, social and personal services - see Figure 8 for the private sectors). The remaining four sectors report relatively constant prices relative to the economy average, and approximately at the average (Manufacturing, Wholesale and retail trade, catering and accommodation, Construction, and Other community social and personal services - see Figure 9 for the private sectors).<sup>10</sup>

It is follows that over the sample period relative prices have changed substantially. This precludes Case 1 under the technological change based explanation of structural change in the economy. Instead, the evidence is consistent with Case 2 in all its variants, A through C.

Finally, the supply side explanation requires that TFP growth and relative price changes be negatively associated. In Figure 10, we illustrate for the private sector decade averages, confirming the prior of the supply side approach.

### 4.3 Employment Shares and TFP Growth

The evidence based on productivity changes and relative price changes points toward Case 2 rather than Case 1. We have not yet determined which of the Case 2 instances is the most likely to apply.

To consider this question we turn to employment shares in the economy. Case 2 ( $\varepsilon = 1$ ) anticipates constant employment shares over time. Both Cases 2B and 2C both anticipate changing employment

<sup>&</sup>lt;sup>10</sup>One of the debates in the South African literature has centered on the impact of pricing power in output markets over the marginal cost of production. One position that has been that pricing power in the South African economy has been significant for an extended period of time, and that this has had negative growth consequences. See Fedderke et al (2007), Aghion et al (2008) and Aghion et al (2013). A dissenting view has been that the substantial trade liberalization of the the South African economy renders a substantial degree of pricing power implausible, and that the manufacturing sector in particular has shown significant losses in competitiveness over time as manifested in falling relative prices for the sector. See Rodrik (2008). Note that the evidence of the present section does not support this view.



Figure 7: Sector Prices Relative to Economy Average - Pattern 1



Figure 8: Sector Prices Relative to Economy Average - Pattern 2



Figure 9: Sector Prices Relative to Economy Average - Pattern 3



Figure 10: TFP Growth and Relative Price Changes

Source: SARB & Quantec									
	1960s	1970s	1980s	1990s	2000s	2000-7	2008-13		
AFF	-	25	19	17	12	14	8		
M&Q	15	9	9	6	2	5	6		
Man	25	18	18	17	15	15	13		
EGW	1	1	1	1	1	1	1		
Constr	11	9	8	6	5	4	5		
TCA	16	12	12	13	19	18	19		
TSC	6	5	5	4	4	4	4		
FIREBS	7	6	10	16	20	19	20		
CSPS	5	3	3	4	5	4	5		
GGS	15	12	15	16	19	17	20		

Table 10: Proportion of Formal Sector Employment by Economic Sector

shares. Case 2B ( $\varepsilon < 1$ ) predicts rising employment shares in low TFP growth sectors, Case 2C ( $\varepsilon > 1$ ) in high TFP growth sectors.

The discussion of Section 2.2 has already indicated that employment shares of individual sectors have changed substantially over our sample period. Recall the evidence as repeated in Table 10.

With the possible exception of the Electricity, gas and Water, Transport, storage and communications and Community, social and personal services sectors, all other sectors report substantial variation in employment shares in the economy.

This precludes Case 2A under the technological change based explanation of structural change in the economy.

The evidence remains consistent with both Case 2B and Case 2C.

The distinction between Case 2B and Case 2C is in the size of the price elasticity of substitution between the output of the individual economic sectors. For Case 2B,  $1 > \varepsilon \rightarrow 0$ , while for Case 2C,  $\varepsilon > 1$ .

The theory predicts that under the  $1 > \varepsilon \rightarrow 0$  scenario, employment growth occurs in sectors with low TFP growth; conversely that under the  $\varepsilon > 1$  scenario, employment growth occurs in sectors with high TFP growth.

Consider the evidence as reported in Figure 11, which plots employment growth against TFP growth rates in our sample (we employ sectoral decade averages). The association is clearly negative.

The negative association is confirmed by panel estimations as reported in Table 11, controlling for



Figure 11: Employment Growth versus TFP Growth

both industry and time effects.

This evidence thus favours Case 2B over Case 2C.

#### 4.4 Output Shares and TFP Growth

The two cases of  $\varepsilon \neq 1$ , Case 2B and Case 2C, are also distinguished by their predictions for changes in output shares of sectors in the economy. We can estimate the magnitude of the elasticity parameter directly from (12) and (14).

We estimate controlling both for industry and time effects, for the 1967Q1 - 2012Q4 sample period, employing all feasible pair-wise comparisons between sectors for which we have data. An important consideration is that relative TFP growth rates (the  $(\gamma_i - \gamma_j)$ ) are likely endogenous to changes in relative real and nominal GDP shares. For this reason we estimate under the GMM systems estimator, utilizing lagged values levels and first differences of variables as instruments. Throughout we control for industry and time effects.

Note that in terms of the theoretical framework, the "manufacturing" sector provides intermediate capital inputs into production, and should therefore be excluded from the estimation of the price

	$\frac{dL/dt}{L}$	$\frac{dL/dt}{L}$	$\frac{dL/dt}{L}$	$\frac{dL/dt}{L}$
Const	0.46**	1.34***	_	_
TFP	$(0.18) - 49.19^{***} (12.74)$	(0.39) $-47.94^{**}$ (17.97)	$-62.93^{***}$ $(9.74)$	$-70.15^{***}$ (11.61)
Ν	70	70	70	70
$\mathbb{R}^2$	0.18	0.45	0.30	0.62
Industry	No	No	Yes	Yes
Time	No	Yes	No	Yes
Wald (joint)	14.90***	7.12***	41.71***	36.49***
Wald (Dummy)	6.45**	58.44***	-	52.78***
Wald (Time)	-	68.00***	-	52.78***
AR(1)	1.96**	1.32	1.30	-1.17
AR(2)	1.43	1.34	-0.49	-1.34

Table 11: Labour Force Growth Rate and TFP Growth

elasticity of substitution,  $\varepsilon$ . however, as we noted at the outset, in practice, the manufacturing sectors also supply consumption goods in considerable measure. This is all the more so in emerging market contexts, where a substantial proportion of capital goods are imported, rather than produced domestically. Nevertheless, we therefore present results both under inclusion of the manufacturing sector, and excluding the manufacturing sectors, to assess the sensitivity of results to the treatment of the manufacturing sectors.

We report the panel estimation results in Table 12.

For the data including the manufacturing sector, we have a total of 3843 pair-wise comparisons. Both the nominal and real GDP shares return consistent results: the point estimates of the elasticity of substitution is less than unity. For the nominal GDP shares the estimated range is given by  $0.32 \le \hat{\epsilon} \le 0.45$ . For the real GDP shares the estimated range is given by  $\hat{\epsilon} \approx 0.63$ .

For the data excluding the manufacturing sector, we have a total of 2745 pair-wise comparisons. Again the nominal and real GDP shares return consistent results: the point estimates of the elasticity of substitution is less than unity. For the nominal GDP shares the estimated range is given by  $0.40 \le \hat{\varepsilon} \le 0.51$ . For the real GDP shares the estimated range is given by  $0.63 \le \hat{\varepsilon} \le 0.71$ .<sup>11</sup>

<sup>&</sup>lt;sup>11</sup>Note that for the highest estimate of the price elasticity under the real GDP shares, a null of a unit elasticity cannot be rejected. However, given that the prerequisite of a unit elasticity, of constant employment shares is clearly not satisfied, and since the point estimate of the price elasticity falls below unity, we ignore this possibility in the following discussion.

		With Man	ufacturing		Without Manufacturing			
	Non	ninal	Re	eal		Nominal	R	eal
	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
Const	_	_	-	_	_	_	_	—
TFP Differential	$0.68^{***}_{(0.12)}$	$0.55^{***}_{(0.18)}$	$0.63^{***}_{(0.08)}$	$0.63^{***}_{(0.07)}$	$0.49^{**}$ (0.21)	$0.60^{***}$ (3.52 $e$ -0081)	$0.71^{***}_{(0.10)}$	$0.63^{***}_{(0.07)}$
R <sup>2</sup>	0.27	0.27	0.28	0.28	0.23	0.23	0.40	0.28
Ν	3843	3843	3843	3843	2745	2745	2745	2745
Industry	No	Yes	No	Yes	No	Yes	No	Yes
Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald (joint)	32.31***	*** 9.91	*** 65.07	*** 65.07	5.61**	3.45e+014***	*** 50.80	*** 65.07
Wald (Dummy)	212.0*	136.6	*** 886.7	*** 886.7	90.67	*** 5.03e+014	*** 474.5	*** 886.7
Wald (Time)	212.0*	136.6	*** 886.7	*** 886.7	90.67	5.03e+014***	474.5***	*** 886.7
AR(1)	*** -3.24	0.30	-0.93	-0.93	1.53	-3.50 ***	-0.57	-0.93
AR(2)	-3.55 ***	-1.55	0.02	0.02	-	-3.18 ***	2.20**	0.02
Sargan	*** 3405.	-7.362e-015	-5.96e-014	-5.96e-014	3.82e-015	0.01	-7.54e-015	-5.96e-014
GMM:	Systems	Systems	Systems	Systems	Systems	Systems	Systems	Systems
	2 Step	2 Step	2 Step					
Transf. Eq IVs	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Level Eq IVs	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1
ε	0.32	0.45	0.63	0.63	0.51	0.40	0.71	0.63

Table 12: Estimating the Elasticity of Substitution from GDP Shares

This evidence thus also favours Case 2B over Case 2C. The inference that  $\varepsilon < 1$  does not depend on the inclusion or exclusion of the manufacturing sector in the pair-wise comparisons.

### 4.5 Income Elasticity of Demand

Thus far the focus of the evidence has been on the supply-side accounts of structural change. Implicit in the evidence is thus a presumption that the driver of structural change in the economy is given by sectoral differences in technological change as measured by total factor productivity.

At this point we turn our attention to the demand-side explanation that rests structural change on differences in the income elasticity of demand across sectors.

We begin by examining the evidence of whether income elasticities do manifest differences across sectors.

To do so we consider:

$$\ln Y_{i,t} = \alpha_0 + \alpha_1 \ln GDPpc_t + \sum \beta_j X_{j,i,t} + \varepsilon_{i,t}$$
(16)

where  $Y_{i,t}$  denotes value-added in sector *i* in period *t*,  $GDPpc_t$  denotes aggregate per capita GDP in period *t*, and  $X_{j,i,t}$  denotes a set of *j* additional controls. We employ the sectoral price, and the ratio of gross operating surplus to gross value added (GOS/GVA) and cost of total employment to gross value added (COE/GVA) as indicators of the rate of return and cost structure of production in the sector as possible additional controls.

Estimation is time-series, sector by sector, on quarterly data over the 1960Q1 through 2012Q4 period, giving a total of 212 observations.

Methodology is given by a VECM structure. The estimation technique is standard, so that our exposition is brief.<sup>12</sup> Consider the general VAR (Vector Autoregressive Estimation) specification given by:

$$z_t = A_1 z_{t-1} + \dots + A_m z_{t-m} + \mu + \delta_t \tag{17}$$

where  $z_t$  is a  $n \times 1$  matrix, m is the lag length,  $\mu$  deterministic terms and  $\delta$  a Gaussian error term. Reparametrization provides the VECM specification:

$$\Delta z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-k+1} + \mu + \delta_t$$
(18)

where

$$\Pi = \alpha \beta' \tag{19}$$

The loading matrix,  $\alpha$ , contains the short-run dynamics, while  $\beta$  is the matrix containing the long run equilibrium (cointegrating) relationships. The rank, r, of the matrix represents the number of cointegrating vectors and is tested for using the standard Trace and Maximal Eigenvalue test statistics. Where r > 1 issues of identification arise.<sup>13</sup> Just identification can proceed by means of restrictions on the  $\alpha$ ,  $\beta$ , or  $\Gamma$  space.<sup>14</sup>

<sup>&</sup>lt;sup>12</sup>See the more detailed discussion in Johansen (1991), Johansen and Juselius (1990, 1991, 1992).

<sup>&</sup>lt;sup>13</sup>See Wickens (1996), Johansen and Juselius (1990, 1992), Pesaran and Shin (1995a, 1995b), Pesaran, Shin and Smith (1996).

<sup>&</sup>lt;sup>14</sup>See Greenslade et al, 1999:3ff.

			Linear		Log				Linear		Log
		Levels	First Difference	Levels	First Difference			Levels	First Difference	Levels	First Difference
AFF	Nominal Output	2.238	-6.165***	-1.303	-7.375***	Constr	Nominal Output	0.6526	-10.22***	-1.151	-3.495***
	Real Output	-1.538	-8.235***	-1.907	-8.267***		Real Output	0.1633	-3.109**	-0.7860	-3.425**
	Price	-1.161	-8.311***	-0.9583	-8.156***		Price	-1.695	-5.372***	-1.755	-5.419***
	TFP	-	-	-	-		TFP	-4.410***	-	-	-
	GOS/GVA	-1.229	-7.975***	-	-		GOS/GVA	-0.05280	-6.287***	-	-
	COE/GVA	-1.890	-8.099***	-	-		COE/GVA	-0.05093	-6.374***	-	-
MQ	Nominal Output	0.1301	-4.109***	-1.296	-5.355***	TCA	Nominal Output	5.818	-11.22***	-0.6986	-5.054***
	Real Output	-2.448	-5.677***	-2.443	-5.703***		Real Output	0.7982	-3.992***	-0.5532	-4.710***
	Price	-1.335	-5.488***	-1.918	-5.166***		Price	-1.350	-5.745***	-1.430	-5.861***
	TFP	-3.996***	-	-	-		TFP	-5.213***	-	-	-
	GOS/GVA	-1.954	-5.722***	-	-		GOS/GVA	-0.8091	-8.029***	-	-
	COE/GVA	-1.973	-5.700***	-	-		COE/GVA	-0.7123	-7.381***	-	-
Man	Nominal Output	1.283	-4.469***	-2.694	-3.724***	TSC	Nominal Output	4.088	-9.504***	-2.006	-7.433***
	Real Output	-0.6903	-5.909***	-2.031	-5.285***		Real Output	1.354	-3.918***	-0.7914	-5.653***
	Price	0.5089	-5.226***	1.185	-4.890***		Price	-1.237	-6.957***	-0.7900	-6.736***
	TFP	-5.515***	-	-	-		TFP	-5.873***	-	-	-
	GOS/GVA	-1.081	-5.062***	-	-		GOS/GVA	-0.6995	-7.846***	-	-
	COE/GVA	-0.9405	-4.908***	-	-		COE/GVA	-0.6853	-7.852***	-	-
EGW	Nominal Output	4.188	-2.879**	-1.839	-4.166***	FIREBS	Nominal Output	4.236	-3.053**	-1.761	-5.154***
	Real Output	-1.141	-5.086***	-2.855	-4.518***		Real Output	1.964	-3.433**	0.6752	-5.365***
	Price	-1.979	-4.852***	-1.805	-4.984***		Price	-1.271	-6.329***	-1.261	-6.420***
	TFP	-3.458**	-	-	-		TFP	-4.257***	-	-	-
	GOS/GVA	-2.808	-5.763***	-	-		GOS/GVA	-2.624	-8.088***	-	-
	COE/GVA	-2.452	-5.783***	-	-		COE/GVA	-2.173	-8.199***	-	-
Per Capita GDP	Nominal	6.159	0.1379	-2.012	-3.299**	Per Capita GDP	Real	-0.1446	-3.678***	-0.3663	-3.666***
			*1	** denotes si	onificacne at the 1%	** at the 5% and * a	at the 10% level				

Table 13: Univariate Time Series Characteristics Augmetned Dickey Fuller Test Stastitics

The univariate time series characteristics of the data are recorded in Table 13. The test statistics are Augmented Dickey-Fuller, with drift and seasonal terms (we employ seasonally unadjusted data), under a lag-order augmentation of 4 (since data is quarterly - note that inference is not sensitive to lag order). The inference is that all variables are  $\sim I(1)$ , with the exception of the TFP measures, which are  $\sim I(0)$ , as befits a residual. Note that the nominal per capita GDP variable in linear transform is not stationary under first differencing, but only under the natural log transform. We therefore estimate under the log transform for all variables, except the GOS/GVA and COE/GVA ratios.

In Table 14 we report the probablity values of the trace test statistic under the specified null hypotheses for estimation using real and nominal output values respectively. Given the failure of the nominal per capita GDP variable to integrate under the first order, we estimate (16) only under the log

	Nominal Sectoral Output Values and Nominal Per Capita GDP								
				7	Trace p-va	lue			
$H_0$ :	$r \leq 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$				
AFF	0.001	0.094	0.099	0.252	0.569	with rate of return and cost, with price			
MQ	0.000	0.010	0.871	0.836	0.553	with rate of return and cost, with price			
MAN	0.000	0.004	0.159	0.188		with rate of return and cost			
EGW	0.047	0.263				without rate of return			
С	0.007	0.098	0.844	0.748	0.650	with rate of return and cost, with price			
TCA	0.000	0.068	0.205	0.184	0.132	with rate of return and cost, with price			
TSC	0.000	0.024	0.383	0.808	0.136	with rate of return and cost, with price			
FIREBS	0.013	0.277	0.891	0.903	0.683	with rate of return and cost, with price			

Table 14: Probability Values of the Trace Test Diagnostic for the Rank of the Cointegrating Matrix under the Specified Null

transform.15

Throughout we estimate the associated VECM under the restriction that r = 1. We interpret only those  $\varepsilon$ -values for which r = 1, and hence are supported for the rank order identification criterion. We estimate (16) without any of the additional controls, including only either the sectoral price indicator, or the cost and rate of return proxies, or both sets of additional controls. Given r = 1, identification for the four cases is then straightforwardly given by:

<sup>&</sup>lt;sup>15</sup>In estimation we employed both real and nominal GDP values. However, estimates under the specification employing real magnitudes return estimates of the income elasticity that are both implausibly large (eg. the TSC sector), small (eg. the MQ and MAN sectors), or inconsistent (eg MAN and TSC). What is more, it does not prove possible to obtain a cointegrating relationship for the financial sectors (FIREBS). By contrast, for the nominal specifications the income elasticity values are both theoretically plausible, consistent, and we obtain a cointegrating relation for the financial sector (FIREBS). Hence, we report only the nominal GDP specifications.

	Elasticity ( $\varepsilon_Y$ )
AFF	0.29
MQ	0.96
MAN	0.90
EGW	1.23
C	0.48
TCA	1.19
TSC	1.18
FIREBS	1.17

Table 15: Estimated Income Elasticities

$$\Pi z_{t-k+1} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix} \begin{bmatrix} 1 & -\beta_{12} \end{bmatrix} \begin{bmatrix} \ln Y \\ \ln GDPpc \end{bmatrix}_{t-k+1}$$

$$\Pi z_{t-k+1} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{41} \end{bmatrix} \begin{bmatrix} 1 & -\beta_{12} & -\beta_{13} & -\beta_{14} \end{bmatrix} \begin{bmatrix} \ln Y \\ \ln GDPpc \\ GOS/GVA \\ COE/GVA \end{bmatrix}_{t-k+1}$$

$$\Pi z_{t-k+1} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \end{bmatrix} \begin{bmatrix} 1 & -\beta_{12} & -\beta_{13} \end{bmatrix} \begin{bmatrix} \ln Y \\ \ln GDPpc \\ \ln P \end{bmatrix}_{t-k+1}$$

$$\Pi z_{t-k+1} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \\ \alpha_{41} \\ \alpha_{51} \end{bmatrix} \begin{bmatrix} 1 & -\beta_{12} & -\beta_{13} & -\beta_{14} & -\beta_{15} \end{bmatrix} \begin{bmatrix} \ln Y \\ \ln GDPpc \\ GOS/GVA \\ COE/GVA \\ \ln P \end{bmatrix}_{t-k+1}$$

Our interest is in the  $-\beta_{12}$  coefficient, since this captures the income elasticity directly.

In Table 15 we report the estimation results specifically for the estimated values of  $\beta_{12}$ .

The consequence is that we obtain the ranking of sectors in terms of income elasticity that is represented in Figure 12.

Note that the magnitude of the elasticities conforms in broad measure with the prior predictions that emerged from the discussion of section 3.2. The "new" service sectors (TCA, TSC, FIREBS) prove to have income elasticities above unity, and with the exception of the utilities sector the largest elasticity of any sector. By contrast, the "old" sectors (MQ, MAN, C, AFF) report income elasticities below unity. Arguably the only aberration is the utilities sector. Given the central role of infrastructure and energy production to long run growth in South Africa,<sup>16</sup> the responsiveness of the sector to

<sup>&</sup>lt;sup>16</sup>See the evidence of Perkins et al (2005), Fedderke et al (2006), and Fedderke and Bogetic (2009).



Figure 12: Estimated Sectoral Income Elasticities

changes in per capita GDP, is not surprising.

Recall also that the prediction of the theory was that there should be a positive correlation between the income elasticity of demand of sectors, and output growth (we examine this in Figure 13 for nominal output, and Figure 14 for real output) and labour force growth (we examine this in Figure 15).<sup>17</sup>

We obtain confirmation of the theoretical priors in the case of both output and labour force growth.

## 5 Further Evidence on Structural Change in the Labour Market

The literature on South Africa has accumulated an extensive debate on the characteristics and efficiency of the labour market. In this section we consider a range of relevant evidence. Focus of the discussion will be to isolate the real cost of labour per unit of employment, and the return on the cost of employment to employers as measured by labour productivity.

<sup>&</sup>lt;sup>17</sup>There is also a predicted association with proportional relative prices changes. However, since we have already controlled for relative price changes in estimating the income elasticity of demand, price changes have been incorporated into the estimated elasticity.



Figure 13: Nominal Output Growth vs Income Elasticity of Demand



Figure 14: Real Output Growth vs Income Elasticity of Demand



Figure 15: Labour Force Growth vs Income Elasticity of Demand

#### 5.1 Real Remuneration Per Worker

We begin with the real cost of labour. In Figure 16 we report the private sector remuneration per worker by economic sector, over the 1967Q1 through 2013Q2 period.

At the aggregate level for real remuneration per worker there is an emergence of two broad groupings of sectors by the end of the sample period, replacing a relatively wide dispersion of sector values in the early 1970s. Three sectors, Manufacturing, Electricity, gas and water, and Transport, storage and communications converge on real remuneration per worker of approximately R40,000. All remaining sectors, (Mining & quarrying, Construction, Wholesale and retail trade, catering and accommodation, and Finance, insurance, real estate and business services) converge on a value of approximately R20,000.

Note that the emergence of strong upward trends in real remuneration per worker is generally a post-1990 phenomenon.

Two additional points are worth noting here. First, one possible explanation of the changes in the relative real remuneration per worker across sectors is that this is due to differences in the skills intensity of employment. However, this is not borne out by the evidence - see Figure 17. Instead, what emerges is that the sector with the highest level of skills intensity, and the strongest increase in



Figure 16: Real Remuneration Per Worker - Deflated by PPI

skills intensity is Finance, insurance, real estate and business services. We have just reported that at best the real cost of employment in the sector is no more than mid-range relative to other sectors.

Second, it is important to note that since the focus here is on the demand side of the labour market, computation of the real cost of labour is by means of deflation relative to the producer price index of the sector, not the consumer price index. Of course, from the perspective of the suppliers of labour services, this determination of the real wage does not map neatly into the real purchasing power of their wage earnings. The consumption bundle of consumers contains more than the specific output of a single sector, and typically contains the representative bundle contained in the computation of the consumer price index. It should be noted that using the CPI in order to deflate earnings per worker, issues in quite different patterns of real remuneration.

### 5.2 Comparing the Real Productivity and the Real Cost of Labour

Both real labour productivity, and real labour cost have shown strong changes over time.

What does this imply for the incentive to hire?

To explore this question we consider the data in two alternative formats: in terms of the differential between real value added per worker,  $(Y/L)_t$ , and the real remuneration per worker,  $(W/P)_t$  as



Figure 17: Proportion of Labour Force Skilled - Formal Labour Market. Reported is the proportion of Highly Skilled and Skilled workers to the total labour force.

reported in Figure 18:

$$D_{(Y/L-W/P),t} = \left(\frac{Y}{L}\right)_t - \left(\frac{W}{P}\right)_t$$

and in terms of the rate of return on job creation, as reported in Figure 19:

$$R_{L,t} = \frac{D_{(Y/L-W/P),t}}{\left(\frac{W}{P}\right)_t} \times 100$$

Consider the evidence of Figure 18.

At the aggregate level, there are again two groupings of sectors. Starting from relatively widely dispersed values of  $D_{(Y/L-W/P),t}$  in the early 1970s, two sectors (Electricity, gas and water, and Transport, storage and communications) converge on a high value of  $D_{(Y/L-W/P),t}$  of R80,000 - R100,000. The remaining sectors (Mining & quarrying, Manufacturing, Construction, Wholesale and retail trade, catering and accommodation, and Finance, insurance, real estate and business services) converge on a much lower  $D_{(Y/L-W/P),t}$  range of R20,000 - R30,000.

In terms of the rate of return on job creation the evidence is more nuanced.

At the start of our sample period, we have two broad groupings of sectors, one with a high rate of return on employment, and one with a low rate of return. Three sectors (Mining & quarrying, Elec-



Figure 18: Difference Between Real Value Added per Worker and Real Remuneration per Worker



Figure 19: Percentage Return on Cost of Employment

tricity, gas and water, Finance, insurance, real estate and business services) report a rate of return of at least 150%, on the real wage, with occasional substantial cyclical increases in that margin especially for Mining & quarrying. For the remaining sectors the rate of return on the cost of employment is considerably lower at 50% (Manufacturing, Wholesale and retail trade, catering and accommodation, Transport, storage and communications) or 25% (Construction).

By contrast, the end of the sample period sees convergence on three separate groupings. Three sectors (Mining & quarrying, Electricity, gas and water, Transport, storage and communications) converge on a rate of return of 200% on the cost of employment. A further three sectors (Construction, Wholesale and retail trade, catering and accommodation, Finance, insurance, real estate and business services) converge on a rate of return of 150% on the cost of employment. Finally, Manufacturing after achieving a rate of return on 100% during the 1990s, shows a sharp reversal on the rate of return on the cost of employment to 50% by the end of the sample period.

#### 5.3 Capital Intensity

Given the strong changes that are evident in the cost of and return on labour, what complementing evidence is there from the capital intensity of production? To consider this question we present data both on output per unit of capital, and on the capital labour ratio.

Figure 20 presents the evidence on real value added per unit of capital stock for the principal South African economic sectors.

The evidence suggests a strong contrast to the evidence to have emerged from the labour market, in at least two senses. First, there is considerably less variability in the output capital ratio than for labour productivity, and secondly there are only two basic patterns in the time paths that sectors report for the output capital ratio - a constant time path and a falling time path. For five sectors there is little evidence of any substantial change in the ratio over the 1960 - 2013 sample period (Agriculture, forestry and fishing, Electricity, gas and water, Wholesale and retail trade, catering and accommodation, Transport, storage and communications, and Finance, insurance, real estate and business services sectors). By contrast, for four sectors value added per unit of capital has declined over the 1960 - 2013 period (Mining & quarrying, Manufacturing, Construction and Community, social and personal services).



Figure 20: Real Value Added Per Unit of Capital

Finally, over the sample period of this study, the capital intensity of production across sectors has come to converge on two contrasting values - see Figure 21.<sup>18</sup> For two sectors, production has low capital intensity, so that the ratio of real value added to capital is high (Construction, Wholesale and retail trade, catering and accommodation). For all other sectors capital intensity of production is at least twice as great.

Note that in the period for which we reported rising real remuneration per worker, for virtually all sectors (other than Construction, Wholesale and retail trade, catering and accommodation), capital intensity of production has been increasing. Since the real return on capital over the corresponding period has been constant, the likely driver in factor intensity of production likely lies in the labour, not capital markets.

#### 5.4 Inferences

At this point we draw only some preliminary inferences on the evidence from the real cost of employment, the rate of return evidence on employment, and the factor intensity of production. Complete

<sup>&</sup>lt;sup>18</sup>Note that given scale differences, for two sectors (Electricity, gas and water, Transport, storage and communications) the capital labour ratio is sufficiently higher than that of the other sectors for which we report data, to require the use of a secondary vertical axis.



Figure 21: Capital Labour Ratio

		Capital-L	abour Ratio
		High	Low
Real Labour Productivity	High	EGW	TSC
-	Low	FIREBS	TCA
Real Cost of Labour:		Man	Constr
		M&Q	

Table 16: Comparing the Factor Intensity of Production with the Differential Between Labour Productivity and the Real Cost of Labour

inferences will be presented in section 7.

In the context of our discussion, the point is that the cost of labour, and the return on job creation for employers, may exert additional influence on the pattern of resource distribution across sectors, over and above those that emerge from the demand-side and supply side forces that we have explored in section 4.

For simplicity, we divide sectors into those with high and low capital intensity of production (by the end of the sample period), and compare the factor intensity of production with whether the differential between labour productivity and the real cost of labour is high or low. Table 16 reports.

For four sectors the factor intensity of production reflects directly the implied return on job creation, controlling for the cost of employment. Specifically, for the Transport, storage and communications sector, the rate of return on job creation is high, and correspondingly the capital-labour ratio of production is low (implying a high labour intensity of production). Symmetrically, for Finance, insurance, real estate and business services, Manufacturing and Mining & quarrying, the rate of return on job creation for employers is low, and correspondingly the capital-labour ratio of production is high.

There are also three sectors for which the rate of return on job creation does not map immediately into the factor intensity of production. For Wholesale and retail trade, catering and accommodation and Construction, the rate of return on employment given the real cost of labour is low, but the capital-labour ratio nevertheless remains low, implying labour intensity of production. Conversely, for Electricity, gas and water, the capital intensity of production is high despite a high rate of productivity return on employment. However, in all three of these sectors, the factor intensity of production may be dictated by technology constraints rather than cost of employment and rate of return on employment considerations alone.

While we return to this evidence for final inferences in section 7, at this stage we reiterate that sectoral differences in the rate of return on the cost of employment, and its potential impact on the factor intensity of production, may serve to modulate the impact of the mechanisms identified under the supply-side and demand-sides of the economy in section 4.

### 6 Further Evidence of Structural Change in Output Markets

One of the persistent recent findings about South African output markets, is that they manifest high levels of concentration,<sup>19</sup> and high levels of pricing power,<sup>20</sup> with negative growth consequences.<sup>21</sup> The theoretical framework that this paper uses also carries implications for expected market conduct in this context.

Consider again the implications of the supply-side model of section 3.1. Under the assumptions of the model, it follows that:

$$\frac{p_i c_i}{p_m c_m} = \left(\frac{\omega_i}{\omega_m}\right)^{\varepsilon} \left(\frac{p_i}{p_m}\right)^{1-\varepsilon} = x_i, \ \forall i$$

<sup>&</sup>lt;sup>19</sup>See Fedderke and Szalontai (2009) and Fedderke and Naumann (2010).

<sup>&</sup>lt;sup>20</sup>See Fedderke et al (2007), Aghion et al (2008, 2013), OECD (2008), Klein (2011).

<sup>&</sup>lt;sup>21</sup>See Aghion et al (2008, 2013).

where  $x_i$  denotes the ratio of consumption expenditure on good *i* to consumption expenditure on the capital good. Since the capital good represents the capital input into production, the  $p_i/p_m$  represents an approximation of the marginal price-cost margin of sector *i*, which in turn translates into the relative composition of demand in the economy.

Since employment shares are given by:

$$n_{i} = \frac{x_{i}}{X} \left(\frac{c}{y}\right), \forall i \neq m$$
$$n_{m} = \frac{x_{m}}{X} \left(\frac{c}{y}\right) + \left(1 - \frac{c}{y}\right)$$

where  $(x_i/X)(c/y)$  denotes the consumption demand for all goods, including the manufacturing good, this then translates directly into the distribution of employment in the economy. Then, given:

$$\frac{\dot{n}_i}{n_i} - \frac{\dot{n}_j}{n_j} = (1 - \varepsilon) \left( \gamma_j - \gamma_i \right), \ \forall i, j \neq m$$
$$\implies \left( \gamma_j - \gamma_i \right) = \left( \frac{1}{1 - \varepsilon} \right) \left( \frac{\dot{n}_i}{n_i} - \frac{\dot{n}_j}{n_j} \right)$$

differential employment growth should reflect differential TFP growth rates, with low TFP growth in the high labour absorption sectors.

Finally, from:

$$\frac{\stackrel{\bullet}{F_i}}{F_i} - \frac{\stackrel{\bullet}{F_j}}{F_j} = \varepsilon \left( \gamma_i - \gamma_j \right), \; \forall i, j \neq m$$

for real output, and:

$$\frac{P_{i}F_{i}}{P_{i}F_{i}} - \frac{P_{j}F_{j}}{P_{j}F_{j}} = (1 - \varepsilon)\left(\gamma_{i} - \gamma_{j}\right), \ \forall i, j \neq m$$

for nominal output, TFP growth is of course also linked to output growth.

Now given our finding that  $\varepsilon < 1$ , our expectation should be that labour absorption occurs in the low TFP growth sectors, and in the low real and nominal output growth sectors. Since high mark-ups are associated with lower TFP growth, labour absorption should occur in sectors with high mark-ups. This gives us an additional set of expected empirical regularities.

To estimate sectoral mark-ups we employ the Roeger (1995) methodology for estimating mark-

ups.<sup>22</sup> The approach entails estimating, using the nominal Solow residual (NSR):<sup>23</sup>

$$NSR = \Delta (p+q) - \alpha \cdot \Delta (w+l) - (1-\alpha) \cdot \Delta (r+k)$$
$$= (\mu - 1) \cdot \alpha \cdot [\Delta (w+l) - \Delta (r+k)]$$
(20)

where  $\mu = P/MC$ , with P denoting price, and MC denoting marginal cost,  $\Delta$  denotes the first difference, lower case denotes the natural log transform, q, l, and k denote real value added, labour, and capital inputs,  $\alpha$  is the labour share in value added, and w, r denote the natural logs of the wage rate and rental price of capital respectively. Under perfect competition  $\mu = 1$ , while imperfectly competitive markets allow  $\mu > 1.^{24}$ 

The two crucial variables in estimating the mark-up are therefore the composite  $[\Delta (w + l) - \Delta (r + k)]$ and NSR.

We employ primarily SARB data in the estimation of the mark-ups across sectors. Note that the results thus represent a yet further robustness check on earlier mark-up estimates that employed other data sources (primarily related to manufacturing sub-sectors).

In deriving the two variables, we do so under the assumption of both a 5% (denoted 5) and a 10% (denoted 10) depreciation rate, and using both sectoral (denoted SP) and average economy-wide (denoted AvgP) price series in the derivation of the capital stock series.

Before proceeding to estimation, our starting point is to establish the univariate time series characteristics of the two variables by means of Augmented Dickey-Fuller test statistics. Table 17 reports results. All variables prove to be  $\sim I(0)$ , rendering standard estimation procedures appropriate.

In Table 18 we report the results of recursive estimation of (20), for the eight principal private sectors of South Africa, under the alternative pricing and depreciation assumptions. The reported

$$NSR = \left(\frac{\mu}{\lambda} - 1\right) \cdot \alpha \cdot \left[\Delta\left(w + l\right) - \Delta\left(r + k\right)\right]$$
(21)

where  $\lambda > 1$  denotes increasing returns to scale. Thus any estimate of mark-up that follows from Solow residuals should be interpreted as *lower-bound* values if increasing returns to scale are present.

<sup>&</sup>lt;sup>22</sup>See the extended discussion in Oliveira Martins and Scarpetta (1999), and the repeated applications of the method to South Africa in Fedderke et al (2007) and Aghion et al (2008, 2013). We note that it is not entirely clear that the methodology employed is equally appropriate across primary, secondary and tertiary sectors. We do so for the sake of completeness, and to allow comparison across sectors.

<sup>&</sup>lt;sup>23</sup>The important advantage of the approach is that endogenous productivity shocks that would bias estimation under either the primal or dual Solow residual decomposition, are eliminated from estimation.

<sup>&</sup>lt;sup>24</sup>Note that while (20) assumes constant returns to scale, Oliveira Martins and Scarpetta (1999) demonstrate that where the assumption of constant returns to scale is dropped, equation (20) is actually:

VAR=4		NSR_5_SP	NSR_10_SP	NSR_5_AvgP	NSR_10_AvgP	Roeger_5_SP	Roeger_10_SP	Roeger_5_AvgP	Roeger_10_AvgP
AFF	levels	-8.585***	-8.464***	-8.756***	-8.688***	-5.753***	-5.531***	-6.506***	-5.942***
	difference	-	-	-	-	-	-	-	-
MQ	levels	-6.161***	-5.653***	-5.464***	-5.278***	-7.464***	-7.078***	-6.646***	-6.105***
	difference	-	-	-	-	-	-	-	-
MAN	levels	-7.112***	-6.643***	-6.633***	-6.123***	-6.940***	-6.282***	-7.594***	-7.137***
	difference	-	-	-	-		-	-	-
EGW	levels	-7.112***	-6.643***	-6.633***	-6.123***	-6.940***	-6.282***	-7.594***	-7.137***
	difference	-	-	-	-	-	-	-	-
С	levels	-7.170***	-6.647***	-7.204***	-6.729***	-7.669***	-7.147***	-7.517***	-6.863***
	difference	-	-	-	-	-	-	-	-
TCA	levels	-7.052***	-6.779***	-6.544***	-6.317***	-8.815***	-8.612***	-7.635***	-7.095
	difference	-	-	-	-	-	-	-	-
TSC	levels	-7.350***	-7.182***	-7.290***	-7.226***	-8.682***	-8.211***	-8.636	-8.148
	difference	-	-	-	-	-	-	-	-
FIREBS	levels	-8.100***	-7.945***	-8.040***	-7.887***	-7.910***	-7.652***	-7.857***	-7.535***
	difference	-	-	-	-	-	-	-	-
***	denotes	rejection	of the null	of non-stati	onarity at th	e 1% level,	** at the $5\%$	and * at the	1% level

Table 17: Augmented Dickey-Fuller Test Statistics

mark-ups range across a wide divergence of levels. The lowest (9%) is reported for the Construction sector. The manufacturing mark-up of 47% is comparable to that reported in earlier studies.<sup>25</sup> The three service sectors have heterogeneous mark-ups, of approximately 60% for Wholesale and retail trade, catering and accommodation and Transport, storage and communications, and 151% for the financial sectors. While the Agriculture, forestry and fishing sector also reports a high mark-up (148%), data quality for this sector may render the result unreliable.<sup>26</sup>

We began this section by noting a series of empirical expectations to emerge from the theory.

Since we have found that  $\varepsilon < 1$ , labour absorption should occur in the low TFP growth sectors (confirmed), and in sectors with high mark-ups.

Figure 22 plots the association between estimated sectoral mark-ups and sample average labour force growth rates.

The empirical expectation is confirmed.

<sup>&</sup>lt;sup>25</sup>See the discussion in Aghion et al (2008).

<sup>&</sup>lt;sup>26</sup>Evidence on the evolution of the mark-ups over time is also readily available by means of recursive estimation. This evidence is not directly germane to our argument here. We nervertheless note the absence of substantial decreases in mark-ups over time.

				-	
VAR=4		NSR_5_SP	NSR_10_SP	NSR_5_AvgP	NSR_10_AvgP
AFF	$\mu - 1$	$1.48^{***}$ (0.37)	$1.36^{***}_{(0.39)}$	$2.81^{***}_{(0.58)}$	$2.99^{***}$ (0.68)
	adj-R <sup>2</sup>	0.07	0.05	0.10	0.08
MQ	$\mu - 1$	$0.80^{***}$	$0.59^{***}$	$1.08^{***}$	$0.98^{***}$
	adj-R <sup>2</sup>	0.39	0.22	0.40	0.27
MAN	$\mu - 1$	$0.47^{***}$	$0.37^{***}$	$0.47^{***}$	$0.38^{***}$ (0.04)
	adj-R <sup>2</sup>	0.42	0.25	0.43	0.26
EGW	$\mu - 1$	$0.67^{***}$	$0.32^{***}$	$0.93^{***}$ (0.15)	$0.51^{***}_{(0.16)}$
	<sub>adj-R</sub> 2	0.16	0.08	0.16	0.04
С	$\mu - 1$	$0.09^{***}$ (0.03)	$\underset{(0.03)}{0.002}$	$0.13^{***}$	$\underset{(0.04)}{0.06}$
	adj-R <sup>2</sup>	0.04	0.00	0.05	0.003
TCA	$\mu - 1$	$0.61^{***}$ (0.04)	$0.58^{***}$ $(0.05)$	$0.74^{***}$ (0.04)	$0.76^{***}$ (0.05)
	adj-R <sup>2</sup>	0.49	0.39	0.58	0.51
TSC	$\mu - 1$	$0.58^{***}$	$0.52^{***}$ (0.04)	$0.57^{***}$	$0.51^{***}$
	adj-R <sup>2</sup>	0.53	0.39	0.54	0.41
FIREBS	$\mu - 1$	$1.51^{***}$ (0.06)	$1.35^{***}$ (0.07)	$1.64^{***}$	$1.57^{***}_{(0.08)}$
	adj-R <sup>2</sup>	0.76	0.64	0.78	0.68

Table 18: Estimated Mark-ups



Figure 22: Labour Force Growth Rate vs. Mark-up

## 7 Conclusions and Evaluation

At this point we can draw our final inferences on the determinants of the sectoral composition of the South African economy that are implied by the evidence we have presented.

The preceding discussion has established that growth in South Africa is unbalanced, in the sense that the relative sectoral composition of output and employment has been subject to strong change over time.

this paper has explained unbalanced growth as the intersection of four structural forces in the economy.

On the supply-side of the economy, South African economic sectors report strong differences in TFP growth. The evidence unambiguously implies that the price elasticity of demand is below unity ( $\varepsilon_P < 1$ ). This leads to the empirical expectation that labour absorption will occur in sectors with low TFP growth, an expectation that is confirmed by the South African evidence.

On the demand-side of the economy, South African economic sectors report differential income elasticities of demand. Sectors with income elasticities of demand above unity ( $\varepsilon_Y > 1$ ) include: Electricity, gas and water, Transport, storage and communications, Wholesale and retail trade, catering and accommodation, and Finance, insurance, real estate and business services. Sectors with income elasticities of demand below unity ( $\varepsilon_Y < 1$ ) include: Manufacturing, Mining & quarrying, Construction, Agriculture, forestry and fishing.

The labour market evidence indicates that there are also strong sectoral differences in the real cost of labour, and hence the real rate of return on job creation for employers. There are strong associated sectoral differences in the factor intensity of production. For four sectors the factor intensity of production reflects directly the implied return on job creation, controlling for the cost of employment. Specifically, for the Transport, storage and communications sector, the rate of return on job creation is high, and correspondingly the capital-labour ratio of production is low (implying a high labour intensity of production). Symmetrically, for Finance, insurance, real estate and business services, Manufacturing and Mining & quarrying, the rate of return on job creation for employers is low, and correspondingly the capital-labour ratio of production is high. For three sectors the rate of return on job creation does not map immediately into the factor intensity of production, for technological or

Low Price Elasticity: $\varepsilon_P < 1$								
			Mark-Ups					
			$\mu < \overline{\mu}$	$\mu > \overline{\mu}$				
Income	$\varepsilon_Y < 1$	Labour Market Return on Cost of Employment: high	-	-				
		Labour Market Return on Cost of Employment: low	Type 1	Type 2				
Elasticity	$\varepsilon_Y > 1$	Labour Market Return on Cost of Employment: high	Type 3	-				
		Labour Market Return on Cost of Employment: low	-	Type 4				

Table 19: The Final Sectoral Classification

other reasons. For Wholesale and retail trade, catering and accommodation and Construction, the rate of return on employment given the real cost of labour is low, but the capital-labour ratio nevertheless remains low, implying labour intensity of production. Conversely, for Electricity, gas and water, the capital intensity of production is high despite a high rate of productivity return on employment.

Finally, from the output market evidence, there are strong sectoral differences in the level of the mark-up of price over the marginal cost of production. In the comparison that follows, "high" and "low" are by reference to the economy-wide average. All mark-ups in South Africa (with the exception of Construction) are high by international standards. Sectors with high reported mark-ups include: Agriculture, forestry and fishing, Mining & quarrying, Finance, insurance, real estate and business services. Sectors with low reported mark-ups include: Manufacturing, Construction, Electricity, gas and water, Wholesale and retail trade, catering and accommodation and Transport, storage and communications. The expectation is that sectors with high mark-ups would report low productivity (TFP) growth, those with low mark-ups would report high productivity (TFP) growth.

This now allows for the sectoral classification reported in Table 19.

Specifically, Type 1 Sectors, typified by Manufacturing and Construction, are expected to have relatively low mark-ups, hence relatively high TFP growth. This is confirmed by the evidence. Relatively high TFP growth in turn would predict labour shedding (relative to other sectors), which is again confirmed by the evidence. TFP growth would also predict relatively high output growth. Here the evidence is at best mixed. However, the moderate output growth can be accounted for by a low income elasticity of demand,  $\varepsilon_Y$ , which serves to moderate output growth.

Type 2 Sectors are typified by Agriculture, forestry and fishing, and Mining & quarrying. These sectors have relatively high mark-ups, which serves to predict low TFP growth. This is confirmed

by the South African evidence. Low TFP growth in turn would predicts labour absorption (relative to other sectors). This is expectation is not confirmed by the empirical evidence. However, note that labour absorption in these sectors is moderated by a very low return on the cost of employment, lowering the incentive to hire in these sectors.<sup>27</sup> By contrast, the expectation of low output growth predicted by both low TFP growth and a low income elasticity of demand,  $\varepsilon_Y$ , is confirmed by the empirical evidence.

Type 3 Sectors are typified by Electricity, gas and water, Wholesale and retail trade, catering and accommodation, Transport, storage and communications. Here low mark-ups would predict relatively high TFP growth, which is confirmed by the empirical findings. High TFP growth in turn predicts labour shedding (relative to other sectors) - which is only partially confirmed by the evidence. The mixed labour result is due to relatively high rates of return on employment in the utilities and communications sectors, and potentially by technology constraints in the trade sectors. The low TFP growth would imply a relatively low output growth, and expectation that is also not confirmed by the evidence. High output growth in these sectors is accounted for by a high income elasticity of demand,  $\varepsilon_Y$ .

Finally, Type 4 Sectors are typified by Finance, insurance, real estate and business services. Here relatively high mark-ups predict low TFP growth, which is confirmed by the evidence. Low TFP growth then predicts labour absorption (relative to other sectors), also confirmed by the evidence. High output growth in these sectors is generated by a high income elasticity of demand,  $\varepsilon_Y$ , rather than productivity gains. A relatively low rate of return on job creation is a likely constraint on employment growth in these sectors.

The unusual industrial structure of the South African economy, is thus the outcome of the complex interplay between supply-side, demand-side, labour market and output market forces.

## **References and Notes**

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<sup>&</sup>lt;sup>27</sup>In addition, both are effectively sunset industries, and in the case of mining constrained by relatively extreme technological conditions.

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# 8 Appendix 1: Data Sources

	Value Added	Pri	ces	Capital Stock	Gross Operating Surplus	Employee Compensation
Sector						
AFF	NRI6631C	NRI6631K	NRI6631C	NRI6140C	NRIB031K	NRIV031K
Mining	NRI6632C	NRI6632K	NRI6632C	NRI6141C	NRIB032K	NRIV032K
Manuf	NRI6634C	NRI6634K	NRI6634C	NRI6142C	NRIB034K	NRIV034K
EGW	NRI6635C	NRI6635K	NRI6635C	NRI6143C	NRIB035K	NRIV035K
Constr	NRI6636C	NRI6636K	NRI6636C	NRI6144C	NRIB036K	NRIV036K
TCA	NRI6638C	NRI6638K	NRI6638C	NRI6145C	NRIB038K	NRIV038K
TSC	NRI6639C	NRI6639K	NRI6639C	NRI6146C	NRIB039K	NRIV039K
FIREBS	NRI6640C	NRI6640K	NRI6640C	NRI6147C	NRIB040K	NRIV040K
CSPS	NRI6642C	NRI6642K	NRI6642C			
GGS	NRI6643C	NRI6643K	NRI6643C			
OCSPS	NRI6647C	NRI6647K	NRI6647C			

Table 20: SARB Data Sources