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# **Production and technology changes, restructuring, and employment in the plastics sector**

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### ***Abstract***

The paper utilises data from a survey of plastics firms and six firm case studies to examine the relationships between production and technology changes, and employment. The analysis examines associations between different factors influencing firms in making such changes and firm performance. These factors include trade liberalisation and the export performance of firms. The paper further explores the institutional relationships involved in technology changes, the sources of technologies which are introduced, and the nature of competition in which firms are engaged. In particular, the analysis distinguishes between defensive changes associated with cost minimisation and constructive changes associated with growth in employment and turnover. We find that it is important to consider the development of firm capabilities, and that these are based largely on the domestic market.

## **Introduction**

With liberalisation of current and capital accounts, increasing trade flows and greater integration into the international economy, South African industry has been undergoing a process of restructuring. An important aspect of the gains from processes which have been commonly placed under the banner of 'globalisation' is held to be greater awareness of, and access to, new technologies (Archibugi and Michie, 1997).<sup>1</sup> Effects associated with technology upgrading were also one aspect of the case made by the South African government for the process of trade liberalisation to encourage export-led growth (IDC, 1996; Rustomjee, 1997; Habib and Padayachee, 2000). At the same time as restructuring, however, there have been significant reductions in employment in South African industry and low rates of growth. This paper examines the relationships between production and technology changes, liberalisation and trade performance, and employment changes by drawing on a firm level survey of the plastics industry complemented by in-depth case study interviews with firms.

The plastics industry in South Africa has been subject to the pressures to restructure affecting manufacturing. It is also central in South Africa's ongoing industrialisation as it provides inputs into a broad range of products. The survey collected data on whether firms had made major production changes, and whether these changes had involved a change in production technique. It also examined the motivations for making such changes and the sources of new technologies introduced by firms. A separate section of the questionnaire collected information on the impacts of trade liberalisation and the trade performance of the firms. This enables the testing of associations of restructuring factors with liberalisation and employment performance.

After a brief review of different theoretical approaches and a background on restructuring and the plastics sector in South Africa, we explore associations in the survey data. We then draw on the case studies to deepen our understanding and suggest an explanatory framework for evaluating restructuring and employment change.

### **Production changes, international trade and restructuring: different perspectives**

The link between international trade, growth and employment is a subject of debate. In this brief survey, we highlight three theoretical perspectives on the relationships involved. These perspectives are: a) the orthodox neo-classical approach; b) the structuralist-institutional approach; and c) the Keynesian approach. By categorising perspectives into these three approaches we do not assume homogeneity in each of them nor the absence of overlap, we are only concerned with the central features that distinguish each from the other.

Based on a set of assumptions neo-classical theory asserts that free trade leads to efficient allocation of resources. Free trade enables specialisation based on comparative advantage allowing countries to consume outside their production

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<sup>1</sup> Literature on globalisation abounds. See, for example, Singh (1997) for a critical review and Harris and Michie (1999) for a discussion in the context of economic policy formulation in South Africa.

possibilities set, and implies a rise in global welfare. Protection is viewed as distortionary, with its effects on social welfare analysed in terms of deadweight losses. However, as Krugman (1984) has shown, under increasing returns to scale a tariff which increases the share of sales of the domestic firm in the domestic market at the expense of a foreign firm lowers the domestic firm's marginal costs. This in turn leads to a rise in exports due to improved competitiveness of this firm. Lastly, the assumptions underlying the neo-classical model rule out the market power relations and inter-dependence that characterise inter-firm relations.

Structuralist and institutional perspectives such as those of Bairoch and Kozul-Wright (1996) and Lall (1997) have noted that the success of a firm in coping with international competition depends on its ability to access new technology. Within this approach, the resource-based theory of the firm interprets firms' growth in terms of their productive resources, organisational routines, capabilities and competencies, which together describe differences in firms' competitiveness and the evolution of 'business-enterprise systems' (Penrose, 1959; Fujimoto, 1998; Dosi, 1997). Teece and Pisano (1998) further draw on the definition of the firm in terms of capabilities and competencies in order to identify a firm's 'strategic dimensions', which include its present position and the paths available to it. This raises the question of the structure of inter-firm relationships which govern much of access to technology, especially for firms operating in developing countries.

The Keynesian approach emphasizes the role of effective demand in promoting capacity, innovation and productivity. Based on cross-country studies, Eatwell (1995 and 1997) concludes that increasing effective demand raises productivity which in turn improves competitiveness, and provides the basis for employment creation. The link between effective demand and improved competitiveness is through learning-by-doing, capacity utilisation and scale effects.<sup>2</sup> This implies that unemployment may not be due to rigidities in the labour market, but is attributable to those factors which reduce the growth rate of effective demand.

In their analysis of industrial development in South Africa, Fine and Rustomjee (1996) propose that the state should engage in infrastructure development to promote industry, in line with the broad thrust of Eatwell's position. By comparison, Joffe *et al.* (1995) attribute lack of competitiveness in South African manufacturing to a range of factors such as the costs of imported inputs, the existence of excess capacity and the poor services provided by South African firms. They fail to explore the links of these factors with demand. In addition, while Joffe *et al.* note the levels of concentration and dominance of conglomerates in upstream industries, they do not incorporate the relations of power between downstream and upstream firms into their analysis of productivity. In this regard, Malikane *et al.* (2000) have shown that there exists a complex of relationships characterising the chemicals and plastics sector in South Africa. In these relationships, access to technology and material inputs are often intertwined.

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<sup>2</sup> Wittenburg (1997) found evidence of Verdoorn effects for South African manufacturing, where increased output stimulates productivity gains, thereby stimulating further growth.

High profit margins may also inhibit investment in the upstream firms as the margins enable old capital stock to be retained (Harcourt and Kenyon, 1976). The exertion of market power on the part of upstream firms may retard growth in downstream production through the simple effect of higher priced inputs, and it may also inhibit the dynamism of the supply-chain overall.

In conceptualizing the link between international trade, growth and employment three crucial issues need to be observed. First, it is important that firms' capabilities and different dimensions of competition be appreciated. A universalizing conception of competition which emphasises price as the dominant dimension of competition has been shown to be misleading (Best, 1990). Competition is increasingly based on non-price factors such as product design, quality and service. The performance of the firm is therefore linked with its ability to compete in terms of these areas, including its technological capabilities.

Second, a concrete analysis of the capacity of firms to cope with international competition and their response to pressures associated with such competition crucially depends on the relationships within the supply-chain in which these firms find themselves. A co-operative arrangement in the supply chain facilitates production changes and product development by downstream firms. Studies have indicated that, in contrast, defensive responses to restructuring which are based on cost minimisation and price based competitive strategies do not enable the development of new product areas and adaptations of existing products (Sengenberger and Wilkinson, 1995; Best, 1990). In these interpretations, dynamic production capabilities go alongside the valuation of labour, rather than viewing it as a cost to be minimized.

Third, effective demand has been shown to be a crucial variable. It has been demonstrated that the growth of effective demand is associated with rising productivity through learning-by-doing and scale effects, as well as the effect on inducing more rapid upgrading of capital stock in a virtuous cycle. This in turn raises the firms' competitiveness and capacity to respond constructively to global pressures, creating employment.

### **Background: restructuring in South Africa and the plastics sector**

Under trade liberalisation, higher levels of trade have been accompanied by higher levels of production and lower levels of formal employment in South African manufacturing. Total manufacturing production in 1997 was 5.7 per cent higher than in 1990, while employment was 12.7 per cent lower. The trade liberalisation programme involved moves toward neutrality through a mix of rationalisation and lowering of tariff rates and non-tariff barriers to trade. The average tariff rate was reduced by approximately one third from 1994 to 1999, more than 10 000 tariff lines were rationalised to less than 6 000 and quantitative measures were progressively abolished.<sup>3</sup>

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<sup>3</sup> In addition, import surcharges ranging from 10 per cent on intermediate goods to 60 per cent on luxury goods were also progressively reduced until they were abolished in 1995 (Bell, 1997).

The plastics sector has been one of the better performing manufacturing sectors, with average annual real output growth of 1.2 per cent from 1990 to 1997 and employment growth of 0.5 per cent. Over the same period, imports increased by more than threefold and exports increased (from a much lower base) by a factor of six and half in nominal Rand terms.

Plastic products are part of a supply chain that runs from polymer chemicals (processed from fossil fuels) through intermediate stages to production of a variety of goods, many of which are not for final demand but are inputs into other sectors such as automobile manufacture. This means that in identifying the markets for plastics it is essential to differentiate by function, as well as by the product characteristics and production processes used. In South Africa, as elsewhere, the upstream manufacture of polymers is highly concentrated due to large economies of scale, significant barriers to entry and relatively capital intensive production.<sup>4</sup> Polymer production capabilities were encouraged by the apartheid government's support for processes to extract oil from coal in response to sanctions, through the state-owned firm Sasol. Now privatised, Sasol and its subsidiary Polifin (originally a joint venture with AECl) is the dominant South African polymer manufacturer, producing polypropylene, linear low density polyethylene and low density polyethylene.<sup>5</sup>

In contrast, the manufacture of plastic products is characterised by relatively low scale economies, and a large number of firms. Ongoing technological developments and differentiation by the specific characteristics and uses of products heighten the importance of vertical relationships. While the main polymer producers do have ownership relationships with some downstream manufacturers, most plastics manufacturers are independent or belong to corporate groupings associated with downstream sectors utilising plastics, such as packaging. Packaging is also by far the largest product grouping in terms of consumption by weight (accounting for almost 50 per cent in 1997), followed by building & construction, automotive, and electrical & electronics. Although plastics manufacturing is relatively developed, there is a trade surplus in only two main product groupings, baths & basins and packaging products.

### **Conduct of the survey and case studies**

The survey was conducted by post in September 1998 using a random sample of plastics firms provided by the Plastics Federation of South Africa.<sup>6</sup> 88 responses were received representing a 45 per cent response rate. Of these, 32 did not fully complete data on turnover and 18 did not complete data on employment. The survey asked questions of three main types: (i) those identifying a particular characteristic of firms or activity undertaken by them, yielding nominal or categorical data; (ii) those of a quantitative nature which provide interval or ratio data; and (iii) those assessing the

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<sup>4</sup> The minimum efficient scale exceeds the size of the domestic market in most polymers. See Malikané *et al.* (2000) for a more detailed analysis of issues of industrial structure and market power in the plastics sector.

<sup>5</sup> It has also taken-over the polymer production of AECl, part of the Anglo-American grouping, meaning it produces PVC.

<sup>6</sup> The Plastics Federation of South Africa (PFSA) is the main independent industry association. Its coverage of firms in the sector is considered good, as it is an important point from which firms receive information and services including training.

importance or impact of various factors (such as the importance of price for export performance) which provide ordinal measures. This enables associations to be explored between characteristics of firms, including different impacts of liberalisation, and production changes and firm performance.<sup>7</sup>

Performance varied considerably across the firms surveyed, with a mean annual growth in turnover of 12 per cent (in nominal terms) and in employment of two per cent.<sup>8</sup> The simple mean, however, conceals the greater tendency of larger firms to shed employment, with total employment of the respondent firms falling by seven per cent between 1992 and 1997.<sup>9</sup>

From the firms responding to the survey, in-depth interviews were held with six which were selected to represent the diversity within the sector, and to highlight the issues of internationalisation and technical change. The firms selected covered a range of subsectors including the packaging, auto components, building materials, intermediate materials for baths & basins and stationery and utilised the main different production techniques. They ranged in size from 52 employees to 604 employees and included two independently owned, while the others were part of diversified or industry conglomerate groupings. They included firms that had achieved high annual rates of growth in turnover and firms which had retrenched large numbers of employees. The interviews were semi-structured, based on a topic guide. The case studies reveal insights into the decision-making of firms around restructuring and changes in production techniques. Interviews were also held with representatives of the industry association, the main polymer manufacturer, and representatives of the Department of Trade and Industry.

### **Production changes and performance**

In the survey, respondents were asked in the questionnaire to identify whether they had made major investments or production changes and whether these changes involved a change in production technique. Respondents were also asked to identify the significance of different factors motivating the changes, and the sources of new technologies which may have been introduced. Drawing on these responses the data were tested for associations of production changes and firm performance with different dimensions of internationalisation, competition and institutional relationships.

71 firms made a major investment or production change since 1990, of which 54 involved a change in production technique. Of the firms making major investments or production changes, domestic demand and pressure from competitors were by far the most important of the motivations identified, followed by export requirements which were an important stimulus for 37 per cent of firms. Only 10 per cent of firms

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<sup>7</sup> Due to the nature of the data, associations were explored through cross-tabulations, using SPSS.

<sup>8</sup> Clearly, growth of firms in the sample over the period cannot take into account the impact of entry and exit on the growth of the sector as a whole. For the same reason, firms' development is not equivalent to development of the sector.

<sup>9</sup> This compares with a 15 per cent reduction in employment recorded by *Statistics South Africa* for the sector as a whole over the same period.

recorded government measures as being an important stimulus, although a significant proportion of firms had drawn on government support programmes.

Perhaps surprisingly, there is no direct association between having made production changes and firm growth, while a significant association was, however, found between changes in production technique and *contraction* in employment (Table 1). This may suggest the introduction of labour saving technologies in which case there should be a strong association with a higher rate of increase in labour productivity. But, there is no significant difference in the level of labour productivity or its rate of change for firms making changes in production techniques.<sup>10</sup> Indeed, for the whole sample there is a strong and highly significant positive correlation between changes in employment and turnover.<sup>11</sup>

**Table 1. Production changes and firm performance**

	Change in turnover <sup>1</sup>		Change in employment	
	High growth	Low growth	Growth	Contraction
	%	%	%	%
Investments/production change	76	89	76	88
Change in production technique	66	70	**51	**79
Factors motivating production changes: <sup>1</sup>				
• domestic demand	*68	*46	61	51
• export requirements	32	46	39	35
• pressure from competitors	59	54	***39	***76
• government policies	5	13	14	10
Sources of new technologies: <sup>1</sup>				
• in-house development	68	67	57	69
• suppliers	*50	*25	36	38
• owner	23	29	21	35
• licensing	23	21	18	31
• strategic alliance	18	13	14	24
• joint venture	18	13	14	24
Firms drawn on foreign techno sources	*50	*25	39	35
	N=29	N=27	N=37	N=33

Notes: <sup>1</sup> High growth in turnover is defined as an annual average nominal growth rate of 10% or greater.

<sup>2</sup> Of firms making production changes.

\*\*\* Difference significant at 1 per cent level.

\*\* Difference significant at 5 per cent level.

\* Difference significant at 20 per cent level.

There is also no association of changes in production technique and the capital:labour ratio, and firms which have made changes in production techniques have a

<sup>10</sup> Indeed, firms making a change in production technique have a slightly lower mean increase in labour productivity, although the difference is not significant.

<sup>11</sup> Pearson correlation coefficient of 0.462, significant at the 0.05% level. The change in turnover was measured in real terms.

significantly *lower* mean rate of increase in the capital:labour ratio.<sup>12</sup> This is surprising as changes in technique would be expected to be associated with greater capital intensity, as well as taking into account that the contraction in employment reported by these firms would in itself result in increasing capital intensity. This implies that there is a much lower growth in capital for these firms. The mean annual real growth in total assets of firms making changes in production techniques is 5.3%, compared with 20.2% for firms which had not made changes in techniques.<sup>13</sup>

The data reveal the importance of understanding the different factors underlying production changes. Of the two main motivations recorded for changes, domestic demand is associated with having achieved a high level of growth in turnover. In contrast, pressure from competitors as the motivation is strongly and significantly associated with employment contraction (Table 1). The data also indicate that export requirements as a motivation for production changes are not associated with growth.

These findings imply that new techniques may be introduced for defensive reasons as well as being part of a growth strategy. It is important to note also that growth may be linked with ongoing processes of product development rather than with making discrete changes in production systems. In any event, a deeper understanding of the context within which production and technology changes take place is required. We first examine the relationships governing changes in production techniques before exploring the different dimensions of the internationalisation of production (including trade liberalisation) more closely.

### ***Institutional relationships***

The majority of new technologies introduced by respondents came from in-house development, followed by suppliers and owners, although licensing, strategic alliances and joint ventures were each listed as sources by more than a quarter of the firms making new investments or production changes.<sup>14</sup> The importance of in-house sources of technologies is consistent with a framework centred on firms' capabilities, while the importance of various other institutional arrangements also illustrates the need to examine the wider environment within which the firm develops and exercises these capabilities.

The findings indicate that inter-firm relationships are important elements of firms' abilities to respond to restructuring pressures with constructive rather than defensive production changes. While the most reported source of technologies was in-house (Table 1), sourcing technologies from suppliers is significantly associated with having achieved a high turnover growth. Firms making changes in production techniques are also significantly more likely to have longer relationships with suppliers.<sup>15</sup> In

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<sup>12</sup> Capital is measured by total assets, while labour is measured as total employees. Capital therefore includes more than fixed assets in production, however, it should be remembered that we are discussing changes in capital.

<sup>13</sup> This difference is significant at the 5% level.

<sup>14</sup> For those firms making the distinction, it is also notable that foreign sources of new technologies outweighed the domestic sources in the cases of technology sourced from suppliers, sourced through licenses and through strategic alliances.

<sup>15</sup> Significant at the 5% level.

addition, a significantly greater proportion of firms making changes in production techniques are members of a group of companies, suggesting that ownership links are also a factor facilitating technical change. But, membership of a group is not associated with constructive rather than defensive restructuring.

The nature and intensity of competition in the product market was also found to be associated with production changes and firm performance. There is a strong and significant association between the intensity of price competition reported by firms and pressure from competitors as the motivation for production changes, and these factors together are linked with employment contraction.<sup>16</sup> Conversely, there is an association between higher levels of quality-based competition and domestic demand as the motivation for production changes.<sup>17</sup>

### *Internationalisation, liberalisation and production changes*

The export-led growth position which underpinned trade liberalisation in South Africa is based on a positive association between export performance and firm growth. This is due to the static effect of firms with competitive advantages being better able to exploit them through selling in international markets, as well as benefits from returns to scale and dynamic effects associated with greater exposure to technical change and increased competitive pressures. Our data provide no support for this. No significant association was found between whether a firm has experienced growth and its involvement in trade, the level of exports, or it having increased its export orientation (Table 2). There is, however, a positive association between growth in employment and turnover and perceiving the international economy to be more important in terms of technology than in terms of trade.

**Table 2. Trade and firm performance**

	Change in turnover		Change in employment	
	High growth %	Low growth %	Growth %	Contraction %
Participate in international trade	86	74	81	82
Exports $\geq$ 25%	68	65	67	67
Exports increasing	76	70	70	70
International economy perceived to be more important in terms of technology than trade	***83	***44	*76	*58
	N=29	N=27	N=37	N=33

Notes: \*\*\* Difference significant at 1% level  
 \*\* Difference significant at 5% level  
 \* Difference significant at 20% level

<sup>16</sup> Two thirds of firms for which pressure from competitors was a motivation for production changes also recorded the level of price competition as very high, compared with just over one third of firms for which pressure from competitors was not important (significant at 5% level). Only 16% of firms which have increased employment both rate price competition as very high and pressure from competitors as an important motivation for production changes, compared with 42% of firms which have contracted employment.

<sup>17</sup> Firms were almost twice as likely to rate domestic demand as the main motivation for production changes if they also rated competition as intense in terms of quality.

In addition, changes in production techniques are significantly associated with participation in international trade and with having increased exports (Table 3), although there is no difference between the proportion of output which is exported by firms which have made production changes and those which have not. Given the association of production technique changes with employment contraction, this suggests an important distinction between firm capabilities in drawing on the international economy for technology changes in support of growth, and production changes associated with trade performance which are *not* related to firm growth. This is reinforced by the association of having drawn on foreign sources of technology and turnover growth (Table 1).<sup>18</sup> However, drawing on foreign sources of technology is *not* significantly associated with export performance, or the impact of trade liberalisation. Together, these findings further emphasise the importance of relationships governing firms' technological capabilities and imply that technological gains do not necessarily accompany greater 'openness' in international trade. It is also notable that firms making production technique changes are also significantly more likely to have a price-based orientation in the competitiveness of their exports.

**Table 3. Internationalisation and production change**

	Change in production technique?	
	Yes %	No %
Participate in international trade	**89	**62
Mean proportion of output exported	19	19
Exports increasing	***70	***38
Price of greater or equal importance as quality for export performance	**77	**50
	N=54	N=34

Notes: \*\*\* Difference significant at 1 per cent level.

\*\* Difference significant at 10 per cent level.

### *Impact of trade liberalisation*

Firms were asked to rate the impact of trade liberalisation in terms of a number of factors ranging from competition from imports through to product development, changing work practices and technologies. As might be expected there is a negative correlation between the overall impact of liberalisation and employment performance.<sup>19</sup> Having made a change to production technique is also significantly associated with high ratings of the impact of tariff liberalisation (Table 4).

Furthermore, of firms experiencing a high impact in terms of competition from imports, there is a clear distinction between firms which have been able to respond in terms of product development and those which have not. Firms which recorded the impact of liberalisation as also being high in terms of product development were four times as likely to have achieved high turnover growth as firms recording a high impact in terms of import competition but not in terms of product development.<sup>20</sup> It is also production capabilities in terms of product development rather than the

<sup>18</sup> Having drawn on international sources of technology is also significantly associated with higher mean profits (a pre-tax return on assets of 22.4% in 1997 compared with 0.4% for other firms).

<sup>19</sup> Significant at the 10% level.

<sup>20</sup> Difference significant at 5% level.

introduction of new technology *per se* which appears significant (the relationship does not hold for firms recording liberalisation as having stimulated changes in technology). The capability to respond through product development is also not linked with export performance; these firms do not have a higher mean level of exports nor are they significantly more likely to have increased exports. They do, however, have a significantly higher mean proportion of imported inputs.<sup>21</sup>

**Table 4. Changes in production technique and the impact of trade liberalisation**

Impact of liberalisation rated as high/very high in terms of:	Change in production technique:	
	Yes %	No %
Competition from imports	59**	28**
Decision to export	41*	19*
Profitability	61***	19***
Investment	28*	10*
Changing technology	42***	7***
Changing work practices	40**	13**
Product development	54**	27**
Feedstock supplies	25*	10*
	N=54	N=31

Note: \*\*\* Difference significant at 1 per cent level.  
 \*\* Difference significant at 5 per cent level.  
 \* Difference significant at 20 per cent level.

### **Institutional relationships, restructuring and employment: firm case studies**

It is evident from the above analysis that the associations identified do not support the orthodox model of restructuring and change resulting from liberalisation and increasing interaction with the global economy. Instead they suggest that an alternative range of relationships impact on the outcomes in terms of employment and production. The data analysis, however, does not constitute an explanatory framework. Indeed, the factors which are indicated suggest that the restructuring is influenced by institutional relationships and the capabilities of firms, the nature of which are not necessarily amenable to statistical description.

In order to develop a better understanding of the processes and relationships involved, we draw on six firm case-studies. These serve to build on the information collected in the survey and to explore what underlies the survey responses. The different types and sources of information enable the core question to be approached from different angles, in a process which has been described as ‘triangulation’ (Jick, 1979).

The case study firms are briefly outlined, before we draw on them to extend our analysis.<sup>22</sup>

<sup>21</sup> Significant at the 10% level.

<sup>22</sup> The case studies are drawn from Roberts (2000), where a more detailed description of the firms is provided.

***Manufacturer A of auto components:*** The firm is in an established position as an original equipment manufacturer supplying all the major motor-vehicle assemblers in South Africa. It has stable employment levels and has recorded strong growth in production based on its capabilities in a relatively specialised production technique (moulding using thermoforming). Competition is largely non-price, due to meeting demanding standards and the ability to supply on a just-in-time basis.

***Manufacturer B of auto components:*** The firm supplies three of the major assemblers and utilises the more standardised injection moulding technology. It has engaged in significant restructuring, and reduced employment. The technologies are supplied by the auto assemblers on licence. It competes with other subcontractors to auto assemblers on price subject to meeting supply conditions. Liberalisation has increased the competitive pressure from foreign suppliers in the auto assemblers' sourcing networks.

***Intermediate manufacturer of plastic sheet for baths & basins:*** The firm manufactures imported polymer into sheet for moulding into baths & basins by domestic firms. These firms supply both the domestic and international markets, and this is the most successful subsector within plastics in terms of exports. The firm has increased employment and recorded high rates of turnover growth. The ability to adapt and use international technology together with local innovation is viewed as the most important contributor to the firm's development. While there has been increased import competition downstream, the cluster of manufacturers are internationally competitive based on the quality, ability to deliver and price of the product. The knowledge and technology of this firm have been developed in-house, using understanding gained from international practices and from technology licensed from the supplier. The firm has recently used its own skills to construct a major new plant with a view to a five-fold expansion of capacity.

***Manufacturer of tubes and pipes for building/construction:*** The firm uses relatively standard technology embodied in the machinery purchased, although there is scope for some in-house adaptation. There are also significant economies of scale associated with production. The firm has reduced employment and recorded positive, but low, growth in turnover. Weak domestic demand has been the main reason for poor performance, and has stimulated the firm to increase exports to maintain the scale of production. Competition is largely price-based.

***Manufacturer of plastic folders/files (stationery):*** This is a small firm using readily available technology embodied in machinery purchased 'off the shelf'. It has reduced employment and turnover growth has been negative. Competition in the domestic market is intense and is largely price-based.

***Manufacturer of plastic bags (packaging):*** The firm is a major domestic manufacturer and part of a large packaging group. While the main technologies are relatively standardised, there is considerable scope for product development and differentiation in quality and design. The firm successfully shifted production into higher value areas based on its own capabilities in response to greater import competition, and is embarked on a strong growth path, including exports. Competition occurs through a mixture of price, quality and design. It has utilised duty

free import permits available to exporting firms to purchase imported inputs and, as a large purchaser, views itself as having relatively strong bargaining power with respect to the domestic polymer manufacturer.

### *Analysis*

The case studies indicate that it is important to view employment decisions as part of the evolution of the firms. The experience of the firms also conforms to the observation from the survey data that employment and output move together and that labour and capital tend to be complements rather than substitutes. Where firms have experienced significant pressures, whether from domestic competition, weak domestic demand or liberalisation, some (such as the manufacturer of pipes, the second auto component manufacturer and manufacturer of stationery products) have reduced employment as part of wider cost-minimisation strategies.

Comparison of case study firms supports the observation from the survey findings as to the importance of understanding the interaction between liberalisation and firms' capabilities in terms of their being able to respond with product development. For example, the progressive shift by the packaging firm engaged in the manufacture of plastic bags to differentiated and higher value products was partly in response to increased import competition. In addition, of the two firms producing auto components, the firm which employs the more specialised production technique has been better able to further advance product development and is also in a stronger position with respect to the major auto assemblers in competing with alternative international suppliers in the ongoing processes of introducing new auto models.

Questions of interactions with the international economy revealed the importance of technology-based international interactions rather than trade-based ones for firms' capabilities. Moreover, while illustrating that technological relationships are widespread, they also indicate that, contrary to the globalisation position, they do not appear to have undergone sudden change, in nature or scope. For example, the firm engaged in supplying the baths & basins subsector initially gained its production capability directly from an overseas company, via its South African owner, although now its own capabilities appear to rival the original source in its particular niche.<sup>23</sup> The international technology arrangements were also acknowledged to impact on trade, although this was not embodied in formal agreements.

The studies further indicate that capabilities determine trade performance, rather than vice versa. For example, the export success of the baths & basins sub-sector was based on prior development of production capabilities for the domestic market. The same is true for the packaging company. Rather than internationalisation and trade liberalisation stimulating growth and development, the causality therefore appears to run substantially in the opposite direction – capabilities developed in the domestic market are the foundation for international competitiveness. There are also indications that exports occur in response to weak domestic demand, which may explain the survey finding that firms which had increased exports had not recorded

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<sup>23</sup> In the interview, it was also reported that regular meetings are held with the original source to share knowledge in making incremental improvements to the main product.

better turnover performance. It is also evident that economies of scale mean that investment decisions may result in sizeable production capacities relative to the domestic market, and exports are a way of maintaining volumes when domestic demand is poor. For example, the firm manufacturing water pipes expanded capacity based on expected demand from the government water extension programme, and turned to export markets when the demand was not as great or as of long duration as expected.

It is, however, very important in the development of capabilities for the firm to be able to independently modify and adapt technologies and develop a degree of autonomy from the original sources. Such change occurs incrementally with processes such as adaptation, reverse engineering and copying taking place which are not necessarily identified by firms as constituting the introduction of new techniques of production. This has characterised the evolution of the successful firms, in comparison with the second auto component manufacturer which relies on technologies supplied by the car assemblers themselves, leaving it little autonomy.

The case studies also demonstrate that it is not long-term relationships with suppliers in themselves which contribute to growth. Firms may have relatively long relationships with suppliers where there are few alternatives due to the levels of concentration in the domestic market, as is the case with almost all of the case-study firms. The benefits from vertical relationships therefore depend on the interaction between firms, and the position of downstream firms in balancing the influence of the dominant polymer suppliers. Where firms have greater leverage (as in the cases of the firm producing for the baths & basins sub-sector and the packaging firm), vertical relationships are less unbalanced and are more likely to yield constructive gains. In contrast, where firms are relatively small (such as the stationery manufacturer) and/or rely on outside technology under license, such as in the case of one of the auto producers, then capabilities are weak. The imbalance in vertical relationships retards firms' development and exacerbates the capability weaknesses, in turn placing greater pressure on narrow cost-cutting approaches in response to restructuring pressures.

Work practices, such as the ability to change production and do small batch manufacturing were cited in several instances as also being the basis of production strengths, and as more important than technologies *per se*. For example, the strengths of the more specialised auto manufacturer and the manufacturer for baths & basins were based on work organisation and ongoing improvements in production techniques. In contrast, other case-studies suggested that firms introducing new techniques may do so because of a lack of capabilities in terms of work practices such that they attempt to cut costs and labour by adopting new technologies (such as the auto manufacturer which was contracting).

The case studies therefore point to the need to understand institutional conditions within the broader context of position and power in the supply-chain. While factors such as size and relative autonomy have already been mentioned, there is also a link with the use of imported inputs. Firms, such as the manufacturer for baths & basins, which utilise a major input not manufactured in South Africa can import duty free and are not subject to the market power of domestic polymer manufacturers. Import tariffs have historically been set on polymer products where there were domestic

suppliers. Given the concentration of polymer producers, firms utilising types or grades of polymer plastics produced in South Africa were subject to price-setting of domestic suppliers at import-parity levels (including the tariff and the effects of various non-tariff barriers), in other words pricing just up to the level at which the barriers to imports are still prohibitive.<sup>24</sup> This means that manufacturers which rely on a single domestic supplier (such as the firm making stationery) face higher than world prices, and are therefore at a competitive disadvantage relative to international competitors which operate in an economic region with competing polymer suppliers (such as the European Union or the USA). This is also confirmed by the association in the survey data of a higher proportion of imported inputs with high growth in turnover.

Taking the factors discussed above, it is evident that the impact of liberalisation varies depending on the position of firms, the nature of competition and product characteristics, and firm capabilities. It is not, however, these factors in themselves which determine performance, but their impact on the autonomy of the firms and their relative power in the supply-chain. Similarly, longer-term relationships with suppliers may facilitate technological change, but the length of the relationships themselves do not contribute to growth (as observed in the survey data). The mutual benefits of the vertical relationships depend on the interaction between firms, and the capabilities of downstream manufacturers in balancing the dominance of polymer suppliers. This is evident in differing ways: the size of the plastic bag manufacturer countering the dominance of the supplier; the independent production capabilities of the growing auto-component manufacturer; and the sourcing of imported inputs by the intermediate product manufacturer.<sup>25</sup> The relative power of firms in the supply chain also determines whether the supply chain (and institutional relationships within it) operates constructively or whether it governs downstream stagnation and the extraction of maximum returns by upstream producers.

### **Different forms of restructuring: integrating case study and survey findings**

The findings broadly support the resource-based theory of the firm. They also highlight the need to understand reasons for changes in production techniques and the way in which control over technologies is embodied in a variety of institutional arrangements, central to which is the relative strength of different agents. Only by distinguishing these factors can the linkages of technology changes with employment changes become clearer. We draw on the case studies to distinguish factors in what we characterise as constructive as opposed to defensive restructuring, and reflect back on the survey data to assess the consistency of such an approach.

#### ***Constructive restructuring***

Broadly this path is determined by firm capabilities which have been developed over time and largely to supply the domestic market, yielding employment and turnover growth as well as investment. The capabilities are reflected in the adaptability of the firm and their ability to draw on foreign sources of technology. The relationships in

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<sup>24</sup> PARAS (1998); Crompton (1995); interviews with firms and industry analysts.

<sup>25</sup> This is also consistent with the findings reported in Malikane *et al.* (2000) and the interviews with the main polymer manufacturer.

the supply chain are relatively strong and mutually reinforcing as part of the development of products along the chain, and the firms are relatively autonomous in being able to reinforce their position vis-à-vis larger suppliers.

While employment growth is negatively associated with changes in production technique, within the subset of firms making production technique changes, growth is associated with domestic demand as the stimulus for such changes. This is reinforced by the survey finding that, while there are significant associations of production changes with exporting, export performance (including having achieved growth in exports) is not associated with growth in employment or turnover. However, the international economic links governing technology (rather than trade) are associated with growth, as is perceiving the international economy to be more important in terms of technology than in terms of trade.

The factors are also evident in the response to trade liberalisation. Rather than changing technology, it is the impact of liberalisation in terms of product development, alongside other influences such as increasing import competition, which is associated with employment growth.

The nature of competition reported in the survey also reflects firms' orientation and capabilities. High ratings of the intensity of competition in terms of quality and delivery speed, relative to price, are associated with turnover and employment growth.<sup>26</sup> Firms' capabilities are also expressed in terms of their abilities to source technologies from various institutional relationships. Where the supplier relationships have involved the sourcing of technology, indicating the depth of such relationships, firms are significantly more likely to have recorded growth.

We identified several indicators of whether firms had autonomy in the supply chain and argued that this yielded mutually beneficial outcomes in terms of the growth of the supply chain as a whole. The survey data confirm the significance of factors related to the concentration of suppliers, imported inputs rather than reliance on domestic polymer suppliers, and capabilities. Where there are higher levels of concentration of suppliers, longer supply relationships are associated with contraction in employment, however, for lower levels of concentration, longer supply relationships are associated with employment growth. Similarly, for firms which import a quarter or more of their inputs, concentration is associated with employment growth, for firms importing less than a quarter of their inputs, concentration is associated with employment contraction. Product development as an outcome of trade liberalisation is also associated with a higher proportion of imported inputs. Lastly, firms recording employment growth are three times more likely to have *both* drawn on international sources of technology and increased their share of imported inputs.

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<sup>26</sup> If the level of competition in terms of both quality and delivery speed is rated as equal or greater than that of price, then firms are significantly more likely to have increased employment (5% level) and turnover (10% level).

### *Defensive restructuring*

Conversely it is possible to identify conditions where restructuring has been associated with down-sizing and contraction. It is important to note also that, while it may be argued that defensive restructuring is a platform for future growth, in our study it is the factors underpinning the restructuring which are important in understanding it as defensive, and unless these factors change, then the firms are unlikely to embark on growth. Production techniques are therefore only one part of the wider picture governing firm performance, including employment.

Defensive strategies and contraction are associated with the weakness of firms' capabilities. This is reflected in production changes being driven by competitive pressures in conjunction with an inability to respond dynamically, and a relatively weak position in the supply chain both with respect to input suppliers and the ability to source technologies. It is also associated with price-based competition and trade-based rather than technology-based interactions with the international economy. The survey data outlined above further indicate that liberalisation, where it has been experienced as competition from imports without the ability to respond with product development, has resulted in downsizing.

Employment contraction is associated with having both a high level of price competition and pressure from competitors as the main motivation for production changes. Concentration of suppliers together with long supply relationships (consistent with being subject to the dominance of an upstream supplier) is associated with contraction, as is concentration of suppliers in conjunction with a reliance on domestic sources of inputs.

### **Conclusions**

Liberalisation was intended to promote export-led growth, including increasing access to international sources of technology. Our findings provide no evidence in support of a link between export performance and growth, and drawing on international sources of technology is not associated with export performance. Instead, it appears as if restructuring has been associated with down-sizing and employment loss. Changes in production technique are associated with contractions in employment and yet are not associated with higher rates of increase in labour productivity.

Our study indicates the importance of examining the motivations of production technique changes, the context of these changes and the development of firm capabilities. In this regard, domestic demand as the stimulus for changes is associated with firm growth and the development of firm capabilities. These capabilities are reflected in firms drawing on international sources of technologies, sourcing technologies from suppliers and the ability of firms to respond to liberalisation with product development. There is also evidence of links with the nature of competition in which firms are engaged.

The case studies provided further insights on the development of firms' capabilities and indicated the importance of the position and relative autonomy of firms in the supply-chain for their ability to engage in constructive restructuring, creating

employment. This was confirmed in the survey findings, where longer supply relationships were found to be associated with employment growth in cases where there were lower levels of concentration in the suppliers of inputs and where firms imported a greater proportion of their inputs.

The general picture which emerges is that an effective policy intervention needs to locate the domestic market as central in firms' capabilities and their ability to generate employment. The findings suggest that with stimulation of domestic demand, firms develop capabilities and become more competitive internationally. Such capability development is accompanied by growth in turnover which is positively associated with growth in employment. In addition, raising domestic demand will not only raise production and productivity levels, it will also go some way towards addressing institutional problems that block downstream firms from accessing technologies.

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