The Contributions from Firm Entry, Exit and Continuation to Labour Productivity Growth in New Zealand

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Abstract

This paper evaluates the contributions from firm entry, exit and continuation to labour productivity growth in New Zealand over the period 1995 to 2003. Decomposition techniques developed by Griliches and Regev (1995) and by Foster, Haltiwanger and Krizan (1998) are employed. Results suggest significant heterogeneity across both industries and firms. Most entering firms' initial level of labour productivity is below the industry average but grows rapidly thereafter. Continuing firms generally add to industry labour productivity growth. On average exiting firms experience stagnant or declining labour productivity in the years leading up to their death, and when they eventually die most have below average labour productivity compared to their industry. This pattern persists even at a highly disaggregated industry level and indicates that firm turnover has positively contributed to labour productivity growth in New Zealand.

JEL CLASSIFICATION D21 – Firm behaviour
L00 – Industrial Organisation – General
O12 – Microeconomic analyses of economic development

KEYWORDS Firm Performance; Entry; Exit; Turnover; Mobility; Labour Productivity; New Zealand

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The Contributions from Firm Entry, Exit and Continuation to Labour Productivity Growth in New Zealand

1 Introduction

Sustaining and increasing per capita GDP growth over the long run requires sustaining and increasing labour productivity growth. Arithmetically, labour productivity growth is made up of contributions from the labour productivity of continuing and entering firms, less the contribution from the labour productivity of exiting firms. More fundamentally, analysing the evolution of industry labour productivity growth is about understanding an economic process in which firm entry, exit and continuation play an integral part. This process is about firms making product, process and organisational innovations, investing, and learning to create and exploit profit opportunities in an environment where outcomes are to some extent uncertain. Firm entry occurs because entrepreneurs believe they have a product or process that will enable them to make a profit. Firm exit occurs as competitive pressures result in the closure of less productive firms.

An extensive literature exists that seeks to understand the relationship between firm dynamics and economic performance. Theoretical models have been developed where entrants discover information about their relative profitability that influences their decisions to expand, contract, or even to exit. This may occur in a passive fashion as firms receive information on realised profits (Jovanovic 1982) or as firms actively explore their economic environment (Ericson and Pakes 1995; 1998). Empirical work has focused on measuring the contributions from firm entry, exit and continuation to productivity growth, the dispersion of productivity within industries, the mobility of firms within the productivity distribution, and how these are correlated with various firm characteristics such as size and ownership. More recent empirical work has examined the influence of the business environment on firm dynamics (Klapper, Laeven and Rajan 2004).

This paper should be viewed as a microeconomic counterpart to the productivity work presented in Black, Guy and McLellan (2003). The aim of this paper is to evaluate the contributions from firm entry, exit and continuation to labour productivity growth in New Zealand over the period 1995 to 2003. Decomposition techniques developed by Griliches and Regev (1995) and by Foster, Haltiwanger and Krizan (1998) are employed. These techniques have been commonly used in the international literature (see for example, Balk and Hoogenboom-Spijker 2003 and Disney, Haskel and Heden 2003) however, this is the first such study to be undertaken for New Zealand. Interest in New Zealand results is reinforced because of the economic restructuring that commenced in the middle of the

1980s that "… focussed on developing a competitive environment in which no sector was singled out for encouragement by policy intervention: rather, the market place was to be the sole determinant of commercial outcomes." (Evans, Grimes, Wilkinson and Teece 1996).

The remainder of this paper is organised as follows. Section 2 provides some definitions, describes the data, and reports summary measures of firm dynamics and labour productivity. Section 3 describes the techniques used to measure the respective contributions from firm entry, exit and continuation to industry labour productivity growth and Section 4 the results. Resource reallocation and firm productivity life cycle dynamics are examined in Sections 5 and 6, respectively. The final section concludes.

2 Firm dynamics and productivity

This section outlines the classification of firms as either entering, exiting or continuing in any given period. Concepts such as entry, exit and turnover rates and labour productivity are defined. The data used are discussed and descriptive statistics presented.

2.1 Definitions

Consider two years, $t-1$ and t. Between these two years firms may enter or exit an industry, while others will continue to operate. Entering firms are present in t but not in $t-1$; exiting firms are present in $t-1$ but absent in t; and continuing or surviving firms are present in both $t-1$ and t. The number of firms present in any given industry in year t, as well as the numbers of firms that enter, exit or continue in that industry between $t-1$ and t are defined as follows:

$E_t =$ the number of firms that enter an industry between $t-1$ and t;

$C_t =$ the number of firms present in an industry in both $t-1$ and t;

$X_t =$ the number of firms that exit an industry between $t-1$ and t;

$T_t = C_t + E_t =$ the total number of firms present in an industry in year t.

The literature provides a number of possible alternatives for calculating entry and exit rates. The procedure adopted in this paper is to calculate entry and exit rates using the total number of firms present in an industry in year $t-1$.[1] This has the attractive property that the entry and exit rates share the same denominator. The denominator of the exit rate represents the pool of all possible exiting firms in t. The pool of possible entering firms however, cannot be observed.

[1] See for example Dunne, Roberts and Samuelson (1988). Another common method of calculating entry rates is to use the stock of firms present in *t* rather than *t-1*. In general this would lead to lower entry (and hence turnover) rates. This is because the number of firms in a given industry tends to increase over time.

Entry (e_t) and exit (x_t) rates for any given industry between $t-1$ and t are defined as follows:

$$e_t = \frac{E_t}{C_{t-1} + E_{t-1}} = \frac{E_t}{T_{t-1}} \tag{1}$$

and

$$x_t = \frac{X_t}{C_{t-1} + E_{t-1}} = \frac{X_t}{T_{t-1}}. \tag{2}$$

The turnover rate (to_t) for the same period is then the sum of the entry and exit rates,

$$to_t = e_t + x_t. \tag{3}$$

The level of productivity for firm i in year t $\left(a_{i,t}\right)$ is defined as the ratio of real outputs $\left(y_{i,t}\right)$ to real inputs $\left(z_{i,t}\right)$,

$$a_{i,t} = \frac{y_{i,t}}{z_{i,t}}. \tag{4}$$

When constructing productivity at the firm level, choices need to be made as to whether to use real gross output or real value added as the output measure, and whether to use a single input or multiple inputs in forming the real input measure. When the real input is formed using a single input the corresponding productivity measure is a partial productivity measure.

Throughout the remainder of this paper the focus will be on labour productivity. Real value added will be used as a measure of output and hours worked by employees as an input measure. This partial productivity measure has a number of limitations, the most obvious being that its value can be influenced by omitted inputs such as capital. Available data does not however permit the calculation of multifactor productivity.

2.2 Data

Data have been assembled on employment and output for a large proportion of New Zealand firms that were in existence between 1994 and 2003. Analysis is conducted at the enterprise as apposed to the plant level.[2] The sample covers an average of over 200,000 firms in any given year.

Output data comes from GST data collected by the Inland Revenue Department. GST sales and purchases data are combined with industry producer price input and output indices to produce estimates of the real value added by a firm over a given year.

Employment data comes from the Business Demography Statistics (BDS) database. There are four labour input variables in this database which give the numbers of full time and part time employees and the numbers of full time and part time working proprietors for

[2] Measures for plant level output are unavailable.

each firm. These simple head counts are combined with Household Labour Force Survey (HLFS) 4 digit industry average hours worked by type of worker to arrive at an estimate of the number of hours of labour used by a firm over a given year.[3]

The BDS industry coverage is not the same from year to year. To maintain constant industry coverage over the period, enterprises in industries that were not included in the BDS in every year between 1994 and 2003 were dropped. This means that agriculture and livestock production, residential property leasing and rental, commercial property and leasing, child care services, residential and non-residential services, business professional and labour organisations, religious organisations, social and community groups, and sporting and recreational services industries were excluded from the firm-level productivity database. Results reported for the aggregate throughout this paper include all industries except those listed above.

Entry, exit and turnover rates are based on the first and last years that either employment or GST data are observed for a firm. There are likely to be a number of false births and deaths for various reasons such as ownership changes. There are other data limitations. Small enterprises that have annual GST sales below $30,000 are excluded from the BDS. Employment data are for a point in time, while sales and purchases data are on an annual basis. For entering and exiting firms in particular, sales and purchases data were not always available for the entire year of entry or exit and had to be annualised. In addition, employment, sales and purchases data in a number of cases were not always observed over the entire lifetime of a firm and had to be imputed. These limitations mean results should be interpreted with a degree of caution. For more information on data sources, limitations and construction see Appendix 1.

2.3 Descriptive statistics

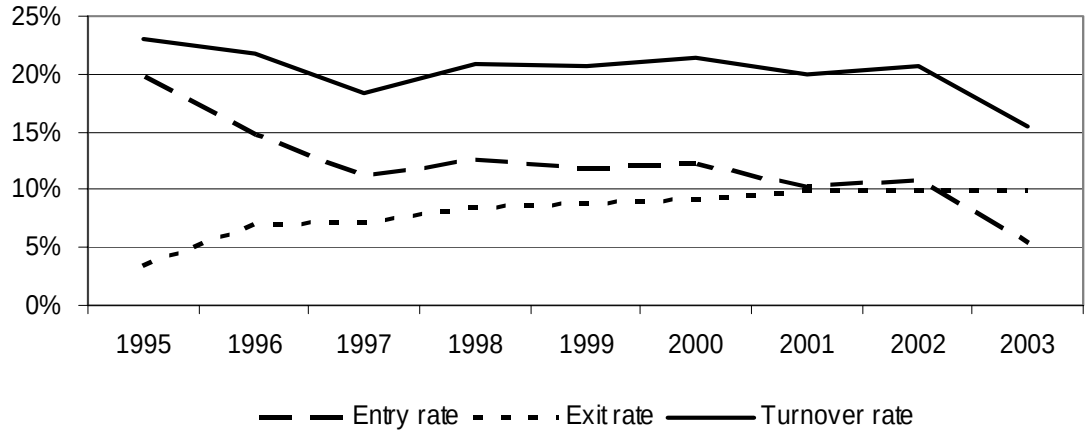
In Figure 1 entry, exit and turnover rates for the aggregate are shown over the period 1995 to 2003.[4] The turnover rate remains reasonably constant over the period, apart from the decline in 2003, and averages around 20%. The entry rate declines steadily over the period while the exit rate rises. This pattern may be owing to a number of factors but is likely to be partly related to institutional changes in New Zealand before and during this period, as well as the business cycle.[5]

[3] Estimates of hours worked by industry from the HLFS may not be representative of annual averages.

[4] As the calculation of entry, exit and turnover rates requires two time periods we are unable to give these rates for 1994.

[5] It is also possible this pattern is in part due to the nature of the data. Censored data is used and survey non response is observed as explained in Appendix 1. In the current context this may result in artificially high entry and exit rates in the early and latter parts of the sample period, respectively.

Figure 1 – Aggregate entry, exit and turnover rates, 1995-2003



Entry, exit and turnover rates are compared across industries in Table 1. Figures given in this table are arithmetic averages of annual rates for each industry over the period 1995 to 2003. There is considerable variation across industries, especially in the entry rate which varies from just under 7% in mining and quarrying to over 14% in the business services sector. Entry and exit rates are positively correlated across industries. It is interesting to see that those industries which tend to have high costs of entry and/or exit, such as mining and quarrying, tend to have turnover rates below the average for the aggregate. Similarly, industries with low entry and/or exit costs, such as business services, tend to have above average turnover rates.

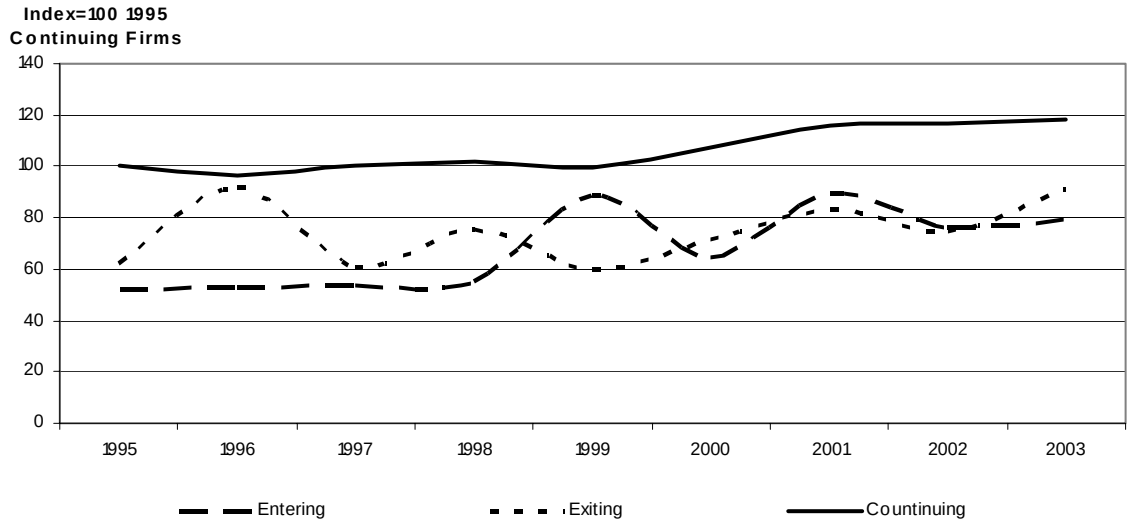
Table 1 – Average industry entry, exit and turnover rates, 1995-2003

Industry	Entry rate	Exit rate	Turnover rate
Mining & quarrying	6.9	6.7	13.6
Manufacturing	9.6	7.3	16.9
Electricity, gas & water	8.6	5.9	14.5
Construction	11.8	8.0	19.9
Wholesale & retail trade	11.8	9.4	21.2
Transport, storage & communications	12.6	9.9	22.5
Business services	14.4	7.9	22.3
Personal & community services	10.9	6.4	17.3
Aggregate	12.1	8.2	20.3

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003.

Figure 2 shows the average weighted labour productivity of entering, exiting and continuing firms respectively over the period 1995 to 2003 where the average labour productivity of entering and exiting firms is expressed relative to the average labour productivity of continuing firms (and has been indexed to 100 in 1995). On average continuing firms have considerably higher labour productivity than both exiting and entering firms, however, these differences decline over the period. Entering and exiting firms' labour productivity appears to be more variable compared to continuing firms, although this variability in labour productivity also declines over the period.

Figure 2 – Average weighted labour productivity of entering, exiting and continuing firms, 1995-2003



The average weighted labour productivity of entering, exiting and continuing firms are compared across industries in Table 2. Figures given in this table are relative to the average labour productivity for continuing firms (and have been indexed to 100). In all industries except one, entering and exiting firms have lower average labour productivity than continuing firms in their industries. There is considerable variation in labour productivity across industries for all three groups of firms. This is likely to be largely owing to differences in capital intensity between industries. For example, the electricity, gas and water industry has higher labour productivity than all other industries.

Table 2 – Average weighted labour productivity of entering, exiting and continuing firms by industry, 1995-2003

Industry	Continuing	Entering	Exiting
Mining & quarrying	207	-28	201
Manufacturing	91	62	79
Electricity, gas & water	439	320	142
Construction	61	62	61
Wholesale & retail trade	81	35	40
Transport, storage & communications	200	126	113
Business services	99	93	98
Personal & community services	75	52	68
Aggregate	100	64	68

Notes – All numbers are relative to the aggregate average continuing firm (whose labour productivity has been indexed to 100) and are the arithmetic averages of yearly observations between 1995 and 2003.

A comparison of Tables 1 and 2 suggests that turnover and labour productivity across industries are negatively correlated. Differences in capital intensity between industries are a possible explanation for this. As the amount of capital used in production increases labour productivity will rise as will the costs associated with entry and exit which should, all else equal, lower turnover. An exception to this pattern is the transport, storage and communications industry which has both high levels of labour productivity and turnover.

This may be owing to the mobility of capital in this industry, particularly in the transport sector.

3 Labour productivity accounting

This section outlines two widely used methods for decomposing aggregate and industry labour productivity growth into contributions from firm entry, exit and continuation.

Consider the level of aggregate or industry labour productivity which is defined as the sum of the share weighted levels of firm labour productivity:[6]

$$A_t = \sum_i \theta_{i,t} a_{i,t} \,, \tag{5}$$

where $\theta_{i,t}$ denotes the labour input share[7] of firm i in year t and $a_{i,t}$ the labour productivity of firm i in year t. Note that $\sum_i \theta_{i,t} = 1$.

To compute the change in aggregate or industry labour productivity consider two years, $t-1$ and t. The level of aggregate labour productivity in $t-1$ is the sum of share weighted labour productivity of continuing and exiting firms (ie, $A_{t-1} = \sum_{i \in C \cup X} \theta_{i,t-1} a_{i,t-1}$) and the level of aggregate labour productivity in t is the sum of share weighted labour productivity of continuing and entering firms (ie, $A_t = \sum_{i \in C \cup E} \theta_{i,t} a_{i,t}$).

The change in aggregate or industry labour productivity is found by taking the difference in the level of labour productivity between $t-1$ and t:

$$\begin{aligned} \Delta A_t &= A_t - A_{t-1} \\ &= \sum_{i \in C} \theta_{i,t} a_{i,t} + \sum_{i \in E} \theta_{i,t} a_{i,t} - \sum_{i \in C} \theta_{i,t-1} a_{i,t-1} - \sum_{i \in X} \theta_{i,t-1} a_{i,t-1} \,. \end{aligned} \tag{6}$$

To compute aggregate or industry labour productivity growth it is necessary to divide equation (6) by the level of aggregate or industry labour productivity in $t-1$.

After some manipulation, it is possible to rewrite equation (6) in the following two ways:

$$\begin{aligned} \Delta A_t^{FHK} = &\sum_{i \in C} \theta_{i,t-1} \Delta a_{i,t} + \sum_{i \in C} \Delta \theta_{i,t} (a_{i,t-1} - A_{t-1}) + \sum_{i \in C} \Delta \theta_{i,t} \Delta a_{i,t} \\ &+ \sum_{i \in E} \theta_{i,t} (a_{i,t} - A_{t-1}) - \sum_{i \in X} \theta_{i,t-1} (a_{i,t-1} - A_{t-1}) \end{aligned} \tag{7}$$

and

[6] This paper defines aggregate or industry labour productivity as the sum of share weighted firm labour productivity. An alternative is to define the logarithm of aggregate or industry labour productivity as the sum of the share weighted logarithm of firm labour productivity. The former definition is preferred because of its ability to handle non-positive firm labour productivity levels. Non-positive firm labour productivity can result when firm labour productivity is constructed using value added as the output measure.

[7] Shares are calculated using hours worked rather than value added for two reasons. First, value added tends to be more volatile than hours worked. Second, section 5 investigates the role of resource reallocation in contributing to industry labour productivity growth.

$$\Delta A_t^{GR} = \sum_{i \in C} \bar{\theta}_i \Delta a_{i,t} + \sum_{i \in C} \Delta \theta_i (\bar{a}_{i,t} - \bar{A}) + \sum_{i \in E} \theta_{i,t} (a_{i,t} - \bar{A}) - \sum_{i \in X} \theta_{i,t-1} (a_{i,t-1} - \bar{A}) . \quad (8)$$

A bar indicates a time average over $t-1$ and t. There is no unique decomposition of labour productivity as defined by equation (6). In particular, the choice of weights and the benchmark parameter A in equations (7) and (8) is arbitrary. Equation (7) is the decomposition proposed by Foster, Haltiwanger and Krizan (1998) (hereafter FHK), while equation (8) is the decomposition outlined by Griliches and Regev (1995) (hereafter GR).

The first component of the FHK decomposition measures the contribution to labour productivity growth arising from the labour productivity growth of continuing firms. This component is often termed the 'within' component as it measures the change in labour productivity that occurs within a firm. The second component measures the contribution to labour productivity growth from changes in continuing firms' size, as measured by their labour input shares, after accounting for continuing firms' labour productivity relative to aggregate labour productivity. This component is called the 'between' component as it captures changes in labour input shares between firms. The between component makes a positive contribution to aggregate labour productivity growth when continuing firms that have above average labour productivity experience an increase in their labour input share. The third component, which is like a covariance or cross-product term, measures the interaction between changes in continuing firms' labour productivity and changes in their shares. The fourth and fifth components measure the contribution to labour productivity growth from entering and exiting firms, once accounting for firms' labour productivity relative to aggregate labour productivity.

A disadvantage of the FHK decomposition is it is prone to measurement error and can generate spurious results in the cross term. It can also suffer from spurious effects associated with transitory changes in labour use and output. The GR decomposition is less sensitive to measurement error and is more appealing because of its symmetry in using time averages (Balk and Hoogenboom-Spijker 2003). However, components of the GR decomposition can be interpreted in a similar manner to the components of the FHK decomposition.

The first component of the GR decomposition measures the contribution to aggregate labour productivity growth from changes in the labour productivity of continuing firms. This is the 'within' component of the GR decomposition. The second component measures the contribution from changes in continuing firms' shares once accounting for a firm's labour productivity relative to average labour productivity. The third and fourth terms measure the contribution to aggregate labour productivity growth from entering and exiting firms once controlling for firm labour productivity relative to aggregate labour productivity.

Baldwin and Gu (2003) have suggested the FHK and GR decompositions should be modified so that continuing and entering firms' labour productivity is compared relative to the average labour productivity of exiting firms. The rationale for comparing entering firms' labour productivity relative to the average labour productivity of exiting firms is that entering firms replace exiting firms in the turnover process. When the labour productivity of continuing and entering firms is compared relative to the average labour productivity of exiting firms, the FHK decomposition becomes:

$$\Delta A_t^{FHK(X)} = \sum_{i \in C} \theta_{i,t-1} \Delta a_{i,t} + \sum_{i \in C} \Delta \theta_{i,t} (a_{i,t-1} - A_{t-1}^X) + \sum_{i \in C} \Delta \theta_{i,t} \Delta a_{i,t} + \sum_{i \in E} \theta_{i,t} (a_{i,t} - A_{t-1}^X) . \quad (9)$$

The first and third components of the of the FHK decomposition relative to the average labour productivity of exiting firms (hereafter FHK(X)) are identical to the first and third components of the FHK decomposition. The second component of the FHK(X) decomposition measures changes in continuing firms' market shares once accounting for a firm's labour productivity relative to the average labour productivity of exiting firms. The fourth component of the FHK(X) decomposition measures the contribution to aggregate labour productivity growth of entering firms relative to the productivity of exiting firms.

The GR decomposition relative to the average labour productivity of exiting firms becomes:

$$\Delta A_t^{GR(X)} = \sum_{i \in C} \bar{\theta}_i \Delta a_{i,t} + \sum_{i \in C} \Delta \theta_i (\bar{a}_i - A_{t-1}^X) + \sum_{i \in E} \theta_{i,t} (a_{i,t} - A_{t-1}^X). \quad (10)$$

The first component of the GR decomposition relative to the average labour productivity of exiting firms (hereafter GR(X)) is identical to the first component of the GR decomposition. The second and third components measure the contribution from changes in continuing firms' labour input shares and the labour productivity of entering firms after adjusting for the average labour productivity of exiting firms.

4 Contribution of firm dynamics to labour productivity growth

This section presents results for the labour productivity growth decomposition methods outlined in the previous section. Results for the aggregate economy and eight industries are presented in subsection 4.1. Subsection 4.2 examines more disaggregated 3-digit industry level results. A comparison between measures of labour productivity growth derived in this paper and in Black, Guy and McLellan (2003) and a sensitivity analysis of the aggregate GR labour productivity growth decomposition to an alternative data set is conducted in subsection 4.3.

4.1 Benchmark results

The FHK decomposition for the aggregate is presented in Figure 3. As with all decompositions throughout this paper the values given for each of the components are the arithmetic averages of those components for the years 1995 to 2003.

Average annual labour productivity growth for the aggregate was 1.8% over the period. The within, between and cross components of this decomposition all relate to continuing firms. The within component is positive suggesting that in general continuing firms labour productivity has been increasing over the period. The between component is also positive which is consistent with more productive continuing firms gaining market share and less productive continuing firms losing market share. The cross component, which is like a covariance between the other two, is negative and indicates that continuing firms tend either to become less productive when expanding their market share or more productive when contracting their market share. When these three components are added together continuing firms generally have added to labour productivity growth over the period.

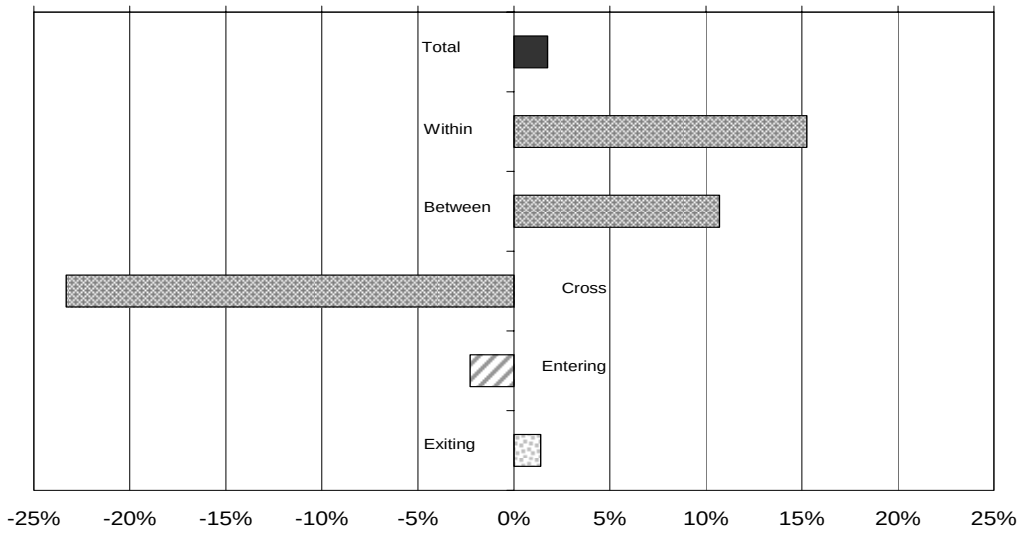
The component relating to entering firms is negative which indicates that on average, in their first year of operation entering firms have subtracted from labour productivity growth

over this period (as these firms tended to enter below the mean level of labour productivity). This component relates to entering firms in their first year of life only. It is entirely possible that entering firms will make positive contributions to labour productivity growth over their lifetime.[8] Because real value added is used as the output measure, labour productivity is likely to be initially lower for these firms than it otherwise might have been as they build up inventories of both inputs and final goods. In contrast to entering firms, exiting firms add to labour productivity growth. This is because those firms that exit tend to have below average labour productivity and therefore by exiting, raise the average labour productivity of the stock of firms that continue to operate.

These results are similar to those found in a number of other OECD countries. Scarpetta, Hemmings, Tressel and Woo (2002) decomposed labour productivity growth over five year periods in the manufacturing sectors of Finland, France, Western Germany, Italy, the Netherlands, Portugal, the United Kingdom and the United States using both the FHK and GR methods. They found the within component for all of these countries was positive and tended to make up a large portion of overall labour productivity growth. The between component tended to be less important and the cross component for these countries tended to be negative. The exit of firms generally added to labour productivity growth.

The main difference between results for the OECD countries examined by Scarpetta *et al* (2002) and the results for New Zealand presented in this paper is that while the entry component is negative in New Zealand it tends to be positive for the other countries.[9] In this regard New Zealand is most like the United States. This result may be related to lower entry and exit costs for firms in New Zealand and the United States and an environment that is in general more conducive to experimentation by firms (Bartelsman, Haltiwanger and Scarpetta 2004). This result may also be related to the time period of analysis in relation to the business cycle.

Figure 3 – FHK aggregate decomposition, 1995-2003



[8] See section 6 for preliminary work on this. Later work will examine the life cycle of firms in more detail.

[9] The results from this study are not directly comparable with those from Scarpetta et al (2002) for a number of reasons, one of which being that decompositions in this study are for one year as apposed to five year periods. As the decomposition period becomes larger the entry component will make a larger contribution to labour productivity growth. It is therefore possible that the entry component for New Zealand could also be positive if the decomposition period was extended to five years.

Table 3 shows FHK decompositions for eight industries as well as the aggregate. It is apparent that labour productivity growth has varied considerably across industries for the period 1995 to 2003. Continuing firms in all industries make positive contributions to labour productivity growth. In contrast to all other industries the between component for electricity, gas and water is negative. This suggests increases in labour input shares tend to go to less productive continuing firms, however, it could also be a symptom of the partial nature of the labour productivity measure.

The exit of firms in most industries adds to labour productivity growth. There are three exceptions, however, the exit of firms in two of these industries subtracts only slightly from labour productivity growth. In the third, mining and quarrying, the exit of firms subtracts considerably from labour productivity growth, although in this industry there are relatively few exits in any given year so this result may be driven by a small number of exiting firms.

Firm entry in most industries subtracts from labour productivity growth. Exceptions are the electricity, gas and water industry and the construction industry. The size of the average contribution to labour productivity growth from entering firms in these industries is small.

Table 3 – FHK industry decompositions, 1995-2003

Industry	Total	Within	Between	Cross	Entering	Exiting
Mining & quarrying	-3.0	15.4	6.1	-15.9	-5.5	-3.1
Manufacturing	2.9	19.4	4.8	-20.7	-1.3	0.7
Electricity, gas & water	5.8	22.4	-1.2	-18.5	0.3	2.7
Construction	3.1	7.9	22.3	-27.3	0.2	-0.1
Wholesale & retail trade	3.9	18.9	6.0	-19.9	-4.2	3.0
Transport, storage & communications	3.4	10.2	5.6	-12.4	-1.9	2.0
Business services	1.7	11.6	23.5	-32.6	-0.6	-0.2
Personal & community services	1.1	16.9	5.8	-20.4	-1.3	0.2
Aggregate	1.8	15.3	10.7	-23.3	-2.3	1.4

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The entering, exiting, within, between and cross components sum to the totals for each of the industries and the aggregate respectively.

The percentages of firms making positive contributions to their respective FHK decomposition components, and therefore labour productivity growth, are given in Table 4. The number of firms that contribute positively to each of the within, between and cross components in any given year are divided by the total number of continuing firms in that year. The numbers of positively contributing entering and exiting firms are divided by the total number of entering and exiting firms in any given year.

Although there is some industry variation, in all industries over eighty percent of exiting firms make positive contributions to labour productivity growth (as when they exit their labour productivity is below the mean level for the industry). In comparison only a small proportion of entering firms are able to make positive contributions to labour productivity growth in their first year of life (approximately 12 % in the aggregate). On average around half of all continuing firms experience increases in their labour productivity between consecutive years. This means that around half of all continuing firms experience either a fall or no change in labour productivity. However, because the within component for all industries and the aggregate is positive it must be the case that the increases in labour

productivity experienced by continuing firms dominate decreases in labour productivity from continuing firms. This can be seen clearly in Appendix Table 1 where the total contributions to the various FHK decomposition components from both positively and negatively contributing firms are shown separately.

Table 4 – FHK industry decompositions - % firms making positive contribution, 1995-2003

Industry	Within	Between	Cross	Entering	Exiting
Mining & quarrying	47.9	42.1	40.9	10.2	83.0
Manufacturing	50.3	50.2	39.8	10.0	89.2
Electricity, gas & water	48.3	43.3	37.1	11.3	89.9
Construction	50.2	67.1	41.8	20.2	81.1
Wholesale & retail trade	51.4	64.9	40.4	10.3	89.6
Transport, storage & communications	50.2	55.9	41.7	5.2	94.6
Business services	45.8	69.3	40.2	19.3	83.1
Personal & community services	45.9	67.2	36.0	20.7	83.0
Aggregate	48.8	67.8	39.5	12.2	88.9

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003.

As outlined in Section 3 the GR decomposition is often preferred to the FHK decomposition. Figure 4 shows the GR decomposition for the aggregate. The within, entering and exiting components for this decomposition are very similar to those of the FHK decomposition. The between component, however, is essentially a combination of the cross and between components from the FHK decomposition.

The pattern here is similar to that presented earlier in this section. On average continuing firms make positive contributions to labour productivity growth as do exiting firms. On average entering firms subtract from labour productivity growth in their first year of life.

Figure 4 – GR aggregate decomposition, 1995-2003

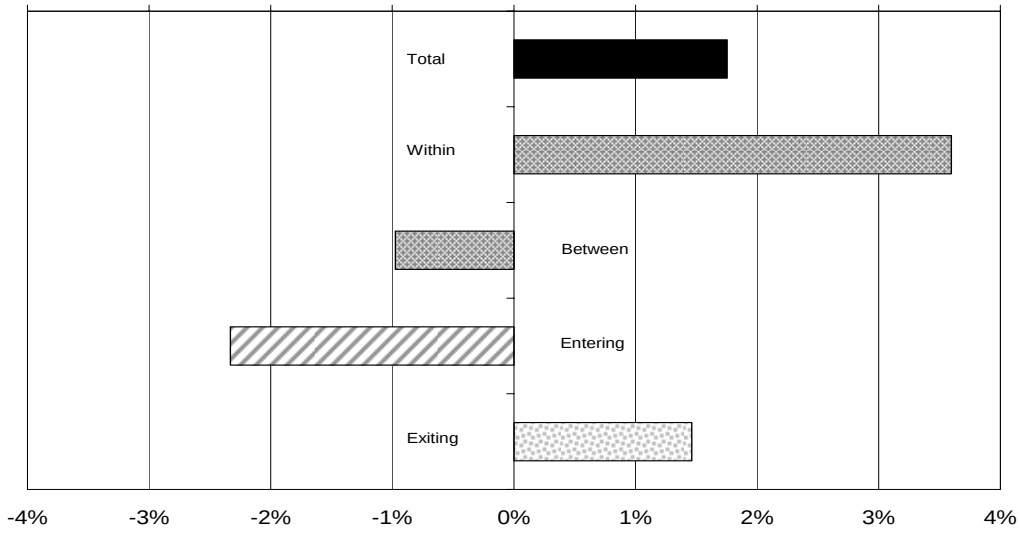


Table 5 shows GR decompositions for eight industries and the aggregate. The pattern here is similar to that shown in Table 3 with continuing firms in all industries making

positive contributions to labour productivity growth. The main difference relates to the way continuing firms' contributions to labour productivity growth are apportioned across different components. The GR decomposition tends to put more weight on the within component than the FHK decomposition and the between component here is a combination of the cross and between components of the FHK decomposition. The between component is negative for most industries, however, this is not surprising as entering firms become continuing firms in their second year of life. These firms are likely to experience increases in both labour productivity and their labour input shares while maintaining below average labour productivity for some time. For further analysis of the between component and the labour productivity of entering firms refer to sections 5 and 6.

Table 5 – GR industry decompositions, 1995-2003

Industry	Total	Within	Between	Entering	Exiting
Mining & quarrying	-3.0	7.5	-1.5	-5.4	-3.5
Manufacturing	2.9	9.0	-5.6	-1.4	0.8
Electricity, gas & water	5.8	13.2	-10.6	0.3	2.9
Construction	3.1	-5.7	8.7	0.1	0.0
Wholesale & retail trade	3.9	9.0	-3.9	-4.3	3.2
Transport, storage & communications	3.4	4.0	-0.7	-2.0	2.1
Business services	1.7	-4.7	7.2	-0.7	-0.1
Personal & community services	1.1	6.6	-4.4	-1.4	0.3
Aggregate	1.8	3.6	-1.0	-2.3	1.5

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The entering, exiting, within and between components sum to the totals for each of the industries and the aggregate respectively.

The percentages of firms making positive contributions to their respective GR components are given in Table 6 for eight industries and the aggregate. The pattern here is similar to that shown in Table 4, with most exiting firms adding to labour productivity growth, most entering firms subtracting from labour productivity growth and around half of all continuing firms experiencing increases in labour productivity between consecutive years. See Appendix Table 2 for the total contributions to the various GR decomposition components from both positively and negatively contributing firms.

Table 6 – GR industry decompositions - % firms making positive contribution, 1995-2003

Industry	Within	Between	Entering	Exiting
Mining & quarrying	47.9	40.7	9.4	82.5
Manufacturing	50.3	48.1	9.7	89.5
Electricity, gas & water	48.3	40.5	10.8	89.7
Construction	50.2	65.3	19.7	81.6
Wholesale & retail trade	51.4	63.3	10.0	89.8
Transport, storage & communications	50.2	55.3	5.2	94.7
Business services	45.8	68.0	19.1	83.3
Personal & community services	45.9	65.3	20.5	83.1
Aggregate	48.8	66.3	12.0	89.0

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003.

As discussed in section 3, both the FHK and the GR decompositions can be modified so that continuing and entering firms' labour productivity is compared relative to the average labour productivity of exiting firms. The FHK and GR decompositions relative to exiting firms for eight industries and the aggregate are shown in Appendix Tables 3 and 5. It is interesting that for most industries as well as the aggregate the entering component is still negative. This means that entering firms on average have lower labour productivity than the average for exiting firms.

The percentages of firms making positive contributions to their respective FHK(X) and GR(X) decomposition components are given in Appendix Tables 4 and 6 respectively. As expected the percentages of firms making positive contributions to the between and entering components are now higher since the mean of exiting firms' labour productivity is lower than the mean for all firms.

4.2 Disaggregated industry results

There is likely to exist a great deal of heterogeneity across firms in terms of both production processes and outputs produced within the eight industries examined in the previous section. It is possible that this heterogeneity is driving results rather than genuine labour productivity differences between entering, exiting and continuing firms. To guard against this possibility analysis is now conducted at a much lower level of aggregation where differences across firms' production processes and outputs within industries should be less marked. For confidentiality reasons it is not possible to show individual industry decompositions at a lower level of aggregation than in the previous section. However, it is possible to summarise these results.

Table 7 gives the percent of 3-digit industries that made positive and negative contributions to the various GR decomposition components on average over the period 1995 to 2003. Industries where a decomposition component was zero in any given year (due to no entries or exits occurring in that year) were excluded. Thus, out of 152 possible industries, results are summarised for 117 of these.

These results are similar to the aggregate and industry results of the previous section. For most industries the exit component is generally adding to labour productivity growth

while the entry component is generally subtracting from labour productivity growth. The within component for around two thirds of industries is positive. The between component for most industries is also positive, in contrast to the aggregate results of the previous section.

Table 7 – GR decompositions for 117 industries - % industries making positive and negative contributions, 1995-2003

	Total	Within	Between	Entering	Exiting
Positive contributions	79.5	65.8	61.5	19.7	75.2
Negative contributions	20.5	34.2	38.5	80.3	24.8
Total	100	100	100	100	100

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. These percentages are based on 117 industry observations.

Table 8 gives the percent of 3-digit industries observations that made positive and negative contributions respectively to the various GR decomposition components for each of the years 1995 to 2003. In other words Table 8 differs from Table 7 in that there are now 9 yearly observations for each of 117 industries instead of only one average observation for each of 117 industries. These results are similar to those above except there are now a smaller proportion of positive contributions to the within and between components. This suggests that the magnitude of observations with positive contributions to the within and between components tend to be greater than those with negative contributions.

The OECD produces a similar table for the manufacturing and business services sectors of a number of countries in OECD (2004: 77). The New Zealand results presented in this paper are similar to most other countries with regard to the exit and between components. Where New Zealand differs is in the entry component with most other countries having large proportions of positive entry components, the United States being the only exception.

Table 8 – GR decompositions for 117 industries, yearly observations - % industry observations making positive and negative contributions, 1995-2003

	Total	Within	Between	Entering	Exiting
Positive contributions	56.4	55.7	53.8	18.0	76.7
Negative contributions	43.6	44.3	46.2	82.0	23.3
Total	100	100	100	100	100

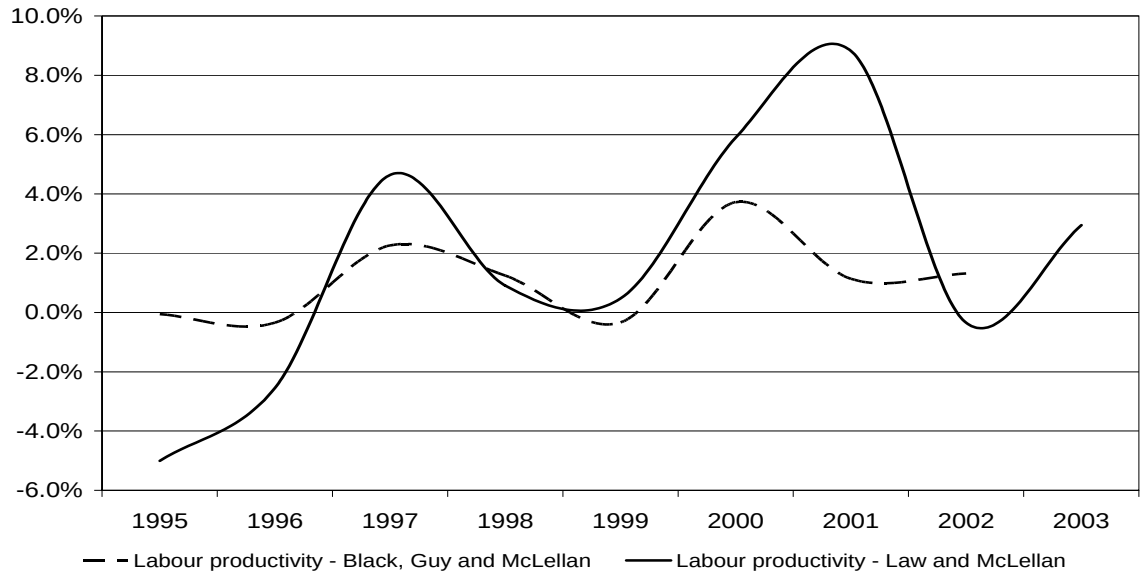
Notes – All numbers are percentages and are based on 1053 observations.

4.3 Robustness testing

As already mentioned this paper should be viewed as a microeconomic counterpart to the productivity work presented in Black, Guy and McLellan (2003) (hereafter BGM). Figure 5 compares aggregate labour productivity growth rates derived in both papers. There are some differences in industry coverage between the two series. Most notably BGM include agriculture while the current analysis does not. Another difference is that BGM are able to take account of changes in inventories of final goods.

Despite these differences the two series appear to be quite similar. For the period 1995 to 2002 average labour productivity growth as estimated by BGM was 1.1% as compared to 1.6%. Both series exhibit the same pattern. Current analysis gives a more volatile labour productivity growth series than does BGM. This is not surprising as inventories of final goods tend to be counter cyclical in New Zealand and act as a buffer to changes in demand (Buckle and Meads 1991).

Figure 5 – Labour productivity growth comparison



As explained in Appendix 1, when constructing the data set used for analysis thus far a number of firms were observed to have missing employment or GST sales information over part of their lifetime. There are a number of possible reasons for this but the most likely explanation is the 10% to 15% non-response rate to the Annual Business Frame Update (the survey used to update the Business Demography Statistics database). To avoid losing observations the approach taken was to impute missing information based on the most recent data available for those firms.

An alternative approach would be to simply discard any firm that has missing information at any point during its lifetime. This approach means that observations on labour productivity fall from approximately 2.4 million to less than 1 million.

Table 9 shows how the choice of data set affects aggregate entry, exit and turnover rates. Switching to the alternative data set does not alter the turnover rate by much, but does increase the entry rate and reduce the exit rate slightly.

Table 9 – Average aggregate entry, exit and turnover rate comparison, 1995-2003

Dataset	Entry rate	Exit rate	Turnover rate
Benchmark	12.1	8.2	20.3
Alternative	13.0	7.4	20.4

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The benchmark data set is the data set used throughout this paper where missing employment and GST sales information have been imputed. The alternative data set is the data set used only in this section where firms with missing employment or GST sales data have been discarded.

Table 10 shows how the choice of data set affects the GR aggregate decomposition. Switching to the alternative data set lowers average labour productivity growth for the period 1995-2003 from 1.8% to around 0.9% per annum. The signs of all decomposition components however remain unchanged.

Table 10 – GR aggregate decomposition comparison, 1995-2003

Dataset	Total	Within	Between	Entering	Exiting
Benchmark	1.8	3.6	-1.0	-2.3	1.5
Alternative	0.9	3.1	-1.1	-2.2	1.2

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The entering, exiting, within and between components sum to their respective totals for each data set. The benchmark data set is the data set used throughout this paper where missing employment and GST sales information have been imputed. The alternative data set is the data set used only in this section where firms with missing employment or GST sales data have been discarded.

Table 11 shows how the choice of data set affects the proportion of firms making positive contributions to their respective GR aggregate decomposition components. The overall pattern remains unchanged. However, a slightly higher proportion of continuing firms are able to make positive contributions to both the within and between components. A slightly lower proportion of entering firms are able to make positive contributions to labour productivity growth. A slightly higher proportion of exiting firms exit with below average labour productivity and hence make positive contributions to labour productivity growth.

Table 11 – GR aggregate decomposition comparison - % firms making positive contribution, 1995-2003

Industry	Within	Between	Entering	Exiting
Benchmark	48.8	66.3	12.0	89.0
Alternative	52.6	68.1	9.9	90.7

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The benchmark data set is the data set used throughout this paper where missing employment and GST sales information have been imputed. The alternative data set is the data set used only in this section where firms with missing employment or GST sales data have been discarded.

5 Reallocation

This section provides further analyses of resource reallocation occurring within the eight industries investigated in the previous sections. First, the size of the labour input shares of entering and exiting firms is examined. Second, further accounting of the components of the FHK and GR decompositions that attempt to measure the magnitude of resource

reallocation between continuing firms is performed. Although, labour is only one input used by firms (albeit the larger one as measured by compensation to labour for the economy as a whole), the degree of resource reallocation of the labour input provides an indication of the flexibility of the New Zealand economy.

Table 12 reports the average and total labour input shares for entering and exiting firms for the period 1995 to 2003. The average shares of entering and exiting firms are quite small. In addition, the average share of entering firms is generally less than the average share of exiting firms. However, the total share of entering firms for most industries is greater than the total share of exiting firms (the exceptions being mining and quarrying, manufacturing and electricity, gas and water) because the number of entering firms is sufficiently larger than the number of exiting firms (as shown by the entry and exit rates reported in Table 1). For the aggregate, these figures suggest that 5.3% of labour inputs were made available by the exit of firms for use by continuing or entering firms on average in any one year. Given most exiting firms have below average labour productivity, these labour inputs become available for firms with higher than average labour productivity or firms with lower than average labour productivity but are exhibiting relatively high labour productivity growth. Entering firms started using 6.7% of the total labour input on average in any one year.

Table 12 – Labour input shares of entering and exiting firms

Industry	Entering firms		Exiting firms	
	Average share	Total share	Average share	Total share
Mining & quarrying	0.174	4.4	0.200	5.0
Manufacturing	0.002	4.6	0.003	5.3
Electricity, gas & water	0.270	3.7	0.429	4.3
Construction	0.002	9.2	0.003	6.9
Wholesale & retail trade	0.473	7.6	0.554	6.6
Transport, storage & communications	0.003	5.6	0.003	5.0
Business services	0.001	8.9	0.001	5.6
Personal & community services	0.001	5.0	0.001	3.1
Aggregate	0.000	6.7	0.000	5.3

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003.

A further means of exploring resource reallocation is to examine the between and cross components of the FHK decomposition and the between component of the GR decomposition in greater detail.

Continuing firms can make positive contributions to the between component of the FHK decomposition in one of two ways: i) firms with higher than average labour productivity experience increases in their labour input shares; or ii) firms with lower than average labour productivity experience decreases in their labour input shares. In contrast, continuing firms can make negative contributions to the between component of the FHK decomposition in one of two ways: i) firms with lower than average labour productivity experience increases in their labour input share; or ii) firms with higher than average labour productivity experience decreases in the their labour input share. The percentage of firms and the percentage point contribution for each of these four cases are reported

from left to right in Table 13. The sum of the percentage contributions in each row of Table 13 should equal the percentage shown for the between component in Table 3.

Recall from Section 4 that the between component of the FHK decomposition for the aggregate and all industries, except electricity, gas and water, was positive. Table 13 suggests the positive contribution to labour productivity growth from the between component of the FHK decomposition is owing to a small number of firms with above average labour productivity exhibiting increases in their labour shares. In addition there are also a large number of firms with below average labour productivity with shrinking labour input shares, but the magnitude of the positive contribution from this component is less than from firms with above average productivity that are expanding. The third case suggests there are a number of firms that have below average productivity experiencing increases in their labour input shares, making a negative contribution to the between component of the FHK decomposition. As discussed in the next section, this is possibly owing to firms that enter with below average productivity that subsequently expand, but where it takes a period of time for entering firms to converge on the average labour productivity level for the industry.

Table 13 – FHK decomposition of between component

Industry	$\Delta\theta > 0$ $(a - A) > 0$		$\Delta\theta < 0$ $(a - A) < 0$		$\Delta\theta > 0$ $(a - A) < 0$		$\Delta\theta < 0$ $(a - A) > 0$	
	% of firms	% contribution	% of firms	% contribution	% of firms	% contribution	% of firms	% contribution
Mining & quarrying	8.8	18.5	33.3	8.7	53.8	-13.8	4.1	-7.5
Manufacturing	9.4	11.2	40.8	3.4	43.7	-6.9	6.2	-2.9
Electricity, gas & water	9.9	8.6	33.4	5.2	51.4	-7.2	5.4	-7.7
Construction	8.6	23.3	58.5	3.7	19.9	-1.9	13.0	-2.8
Wholesale & retail trade	7.0	12.7	57.9	4.9	27.0	-7.0	8.1	-4.5
Transport, storage & communications	3.8	9.6	52.1	4.3	40.8	-4.3	3.3	-4.0
Business services	6.2	26.9	63.1	5.6	14.4	-4.3	16.3	-4.7
Personal & community services	9.0	7.1	58.2	3.0	16.0	-2.2	16.8	-2.1
Aggregate	5.8	14.8	62.0	4.4	23.4	-4.7	8.8	-3.8

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The sum of the % contributions in each row of this table should equal the % shown for the between component in Table 3. There will be minor difference however due to rounding.

The other component of the FHK decomposition that gauges the degree of resource reallocation is the cross component. The cross component can make a positive contribution in one of two ways: i) firms with increasing labour productivity also have increases in their labour input shares; or ii) firms with declining labour productivity also have reductions in their labour input shares. In contrast, firms can make a negative contribution to the cross component in one of two ways: i) firms with increasing labour input shares experience declines in their labour productivity; or ii) firms with declining labour input shares experience increases in their labour productivity. The percentage of

firms and the percentage point contribution for each of these four cases are reported from left to right in Table 14. The sum of the percentage contributions in each row of Table 14 should equal the percentage shown for the cross component in Table 3.

The cross component of the FHK decomposition makes a negative contribution to labour productivity growth in the aggregate and each of the eight industries examined. Hence, this component is dominated by the contribution from firms that experience increases in their labour shares but declines in their labour productivity and firms that have declining labour shares and increasing labour productivity. Table 14 shows the largest negative percentage point contribution (-16.1%) arises from approximately 40% of firms with increasing labour productivity but declining labour shares. It is possible these firms are increasing their labour productivity by reducing their labour input. A large negative contribution also arises from firms that experience declines in their labour productivity but which experience increases in their labour input shares. It is possible that as these firms seek to expand, taking on additional labour input in the process, their average labour productivity falls.

Table 14 – FHK decomposition of cross component

Industry	$\Delta\theta > 0$ $\Delta a > 0$		$\Delta\theta < 0$ $\Delta a < 0$		$\Delta\theta > 0$ $\Delta a < 0$		$\Delta\theta < 0$ $\Delta a > 0$	
	% of firms	% contribution	% of firms	% contribution	% of firms	% contribution	% of firms	% contribution
Mining & quarrying	26.7	5.4	15.5	3.0	35.2	-9.4	22.6	-15.0
Manufacturing	22.6	5.3	18.3	9.2	30.1	-10.1	29.0	-25.1
Electricity, gas & water	23.8	3.7	13.8	5.4	37.2	-7.2	25.2	-20.4
Construction	11.8	1.8	31.2	2.1	17.1	-22.7	39.9	-8.5
Wholesale & retail trade	14.5	5.8	27.1	3.6	20.0	-11.6	38.4	-17.6
Transport, storage & communications	20.0	1.8	23.2	1.2	24.9	-7.5	32.0	-7.9
Business services	8.4	2.9	36.0	3.0	13.6	-26.2	42.1	-12.3
Personal & community services	8.7	1.1	30.8	1.0	18.8	-6.6	41.8	-15.9
Aggregate	12.0	3.1	29.7	3.3	18.7	-13.6	39.6	-16.1

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The sum of the % contributions in each row of this table should equal the % shown for the cross component in Table 3. There will be minor difference however due to rounding.

The between component of the GR decomposition is a combination of the between and cross components of the FHK decomposition and similarly provides a measure of the degree of labour productivity growth arising due to resource reallocation amongst continuing firms. Firms can make either positive or negative contributions to this component in essentially the same ways as for the between component of the FHK decomposition. The percentage of firms and the percentage point contribution for each of these four possibilities are reported from left to right in Table 15. The sum of the percentage contributions in each row of Table 15 should equal the percentage shown for the between component in Table 5.

Table 15 – Decomposition of GR between component

Industry	$\Delta\theta > 0$ $(\bar{a} - \bar{A}) > 0$		$\Delta\theta < 0$ $(\bar{a} - \bar{A}) < 0$		$\Delta\theta > 0$ $(\bar{a} - \bar{A}) < 0$		$\Delta\theta < 0$ $(\bar{a} - \bar{A}) > 0$	
	% of firms	% contribution	% of firms	% contribution	% of firms	% contribution	% of firms	% contribution
Mining & quarrying	8.3	15.2	32.4	8.1	54.4	-11.9	5.0	-12.9
Manufacturing	8.2	6.8	39.9	6.7	44.8	-5.0	7.0	-14.0
Electricity, gas & water	8.5	6.2	32.0	5.5	52.7	-7.0	6.8	-15.2
Construction	7.7	12.4	57.6	3.1	20.8	-1.6	13.9	-5.3
Wholesale & retail trade	6.1	7.7	57.2	5.1	27.9	-5.1	8.9	-11.6
Transport, storage & communications	3.5	6.5	51.9	4.0	41.1	-4.2	3.6	-7.0
Business services	5.6	14.4	62.4	5.2	15.0	-3.6	16.9	-8.9
Personal & community services	8.0	4.1	57.3	2.7	17.0	-2.1	17.7	-9.1
Aggregate	5.1	8.6	61.3	4.7	24.2	-3.8	9.5	-10.5

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The sum of the % contributions in each row of this table should equal the % shown for the between component in Table 5. There will be minor difference however due to rounding.

6 Preliminary life cycle dynamics

Section 4 discussed the contribution from firm entry and exit to industry labour productivity growth. As noted in that section, the entry and exit components of the FHK and GR decompositions measure the contribution from entering and exiting firms for the first and last years of their lives respectively. For entering firms, this means that firms that survive beyond one year are classified as continuing firms in subsequent years. Therefore, although most entering firms make a negative contribution to industry labour productivity growth in the first year of their lives, because their entry level of labour productivity is lower than the average level of labour productivity for the industry, at a later point in their life cycle they may begin to make positive contributions to industry labour productivity growth.

To provide some insight into labour productivity dynamics of entering firms, Figure 6 shows the evolution for cohorts of entering firms between 1995 and 1999 conditional on survival in 2003.[10] The average labour productivity of each cohort is indexed at 100 for the year of entry for ease of comparison.

[10] A similar picture results if one does not condition on survival.

Figure 6 – Growth of entering firms

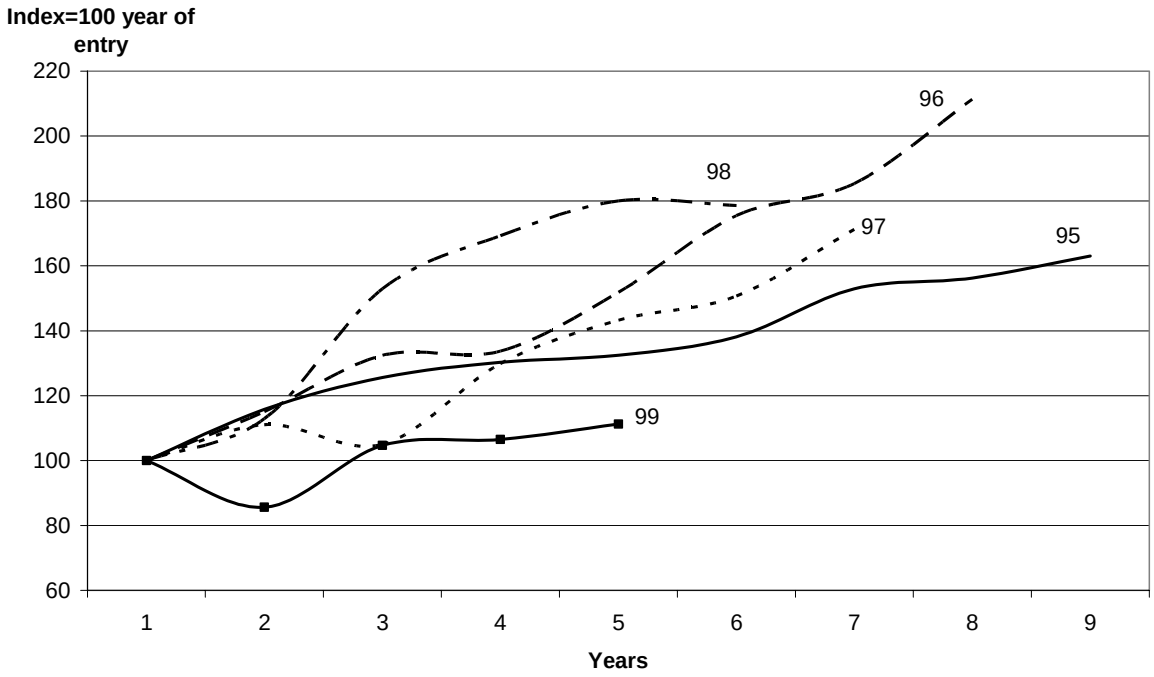
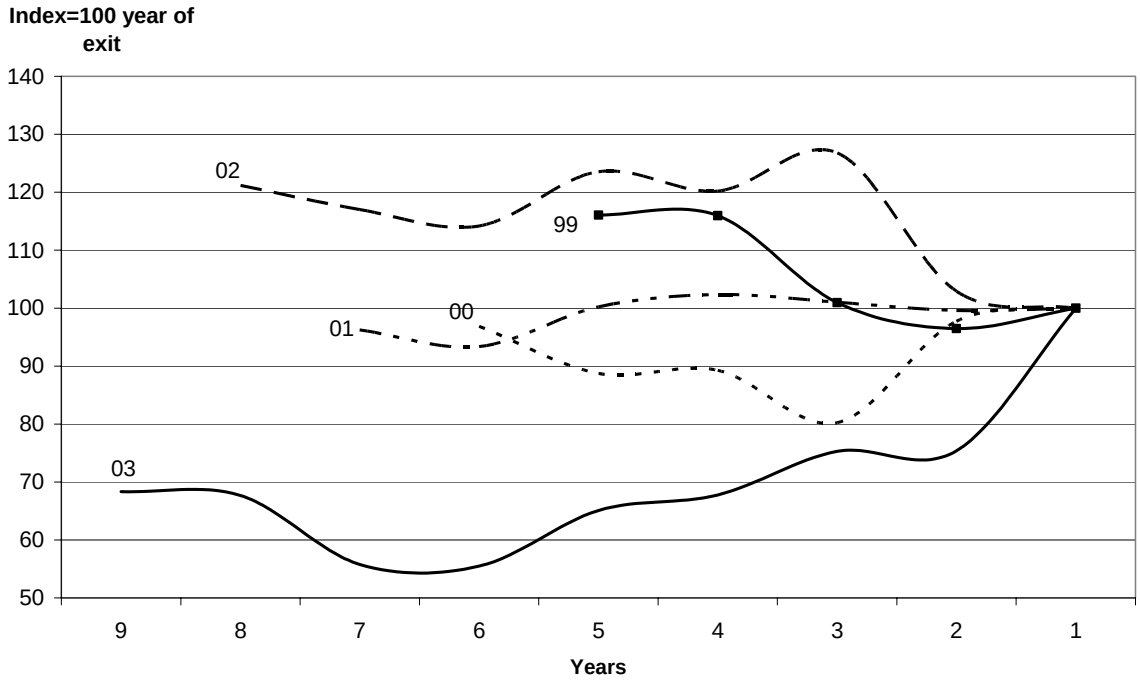


Figure 6 indicates growth in the average labour productivity of a cohort of entering firms is usually quite strong in the second year. With the exception of the 1999 cohort where average labour productivity declines by around 14% (which may be owing to the recession of the late 1990's), the average labour productivity growth of the other cohorts range between 11% and 16%. This will add to the within component of both the GR and FHK decompositions. The contribution to the between component of both the GR and FHK decompositions from entering cohorts in the second year is likely to be negative, even if firms experience an increase in labour input shares, because most entering firms have lower labour productivity than the industry average. It is therefore not clear whether entering firms in general will make positive or negative contributions to labour productivity growth in their second year of life. Conditional on survival the average annual labour productivity growth for each cohort of firms to 2003 is: 6% for the 1995 cohort; 11% for the 1996 cohort; 9% for the 1997 cohort; 12% for the 1998 cohort; and 3% for the 1999 cohort. Furthermore, the average labour input share for each cohort also tends to increase over time.

The opposite pattern to that seen for entering firms can be seen in the evolution of labour productivity for firms as they approach the year that exit occurs. Figure 7 shows the evolution of labour productivity for the 1995 population of firms that exit between 1999 and 2003. The average labour productivity for the cohort of exiting firms is indexed at 100 in the year that exit occurs. Figure 7 shows that cohorts of exiting firms from the population of firms in 1995 generally experience static or declining labour productivity as they approach the year that they exit. The average labour input share of each cohort also declines through time by approximately 4% per annum.

One interesting observation is that most cohorts of exiting firms experience a slight improvement (or a reduction in the rate of decline) in labour productivity over the year immediately prior to their exit. This could be due to a number of factors such as shedding labour, running down inventories or acquiring new capital in an effort to remain in operation.

Figure 7 – Growth of exiting firms, 1995 population of firms



7 Discussion and conclusions

Results reported in Section 2 suggest significant heterogeneity across both industries and firms in terms of their labour productivity. The standard textbook model of the representative firm predicts no variation in labour productivity amongst firms within an industry as firms face the same factor and output prices and have the same access to inputs (including technology, broadly defined). Moreover, even though the standard textbook model can be modified to include learning, technological diffusion etc, the reliance on comparative statics, obscures dynamic effects that are likely to be important in understanding the evolution of an industry's economic performance.

An alternative paradigm to the representative agent model is to view the economic process that underpins the relationship between firm dynamics and productivity growth as one characterised by disequilibrium in which there is a "…constant competitive struggle of agents to beat each other, induced by the incentives of the economic system and enforced by competition…" (Eliasson 1992: 3). Firms make product, process and organisational innovations, invest, and learn to create, maintain and exploit profit opportunities in an environment where outcomes are to some extent uncertain. Entrepreneurial activity is at the heart of this process as firms experiment, engaging in resource reallocation to take advantage of these profit opportunities (Schultz 1975).

When experimentation takes place in an uncertain environment there will be a range of labour productivity outcomes because some firms succeed in their innovations while others fail, consistent with the findings of intra-industry variation in labour productivity presented in Section 2. Firm entry is likely to be an important source of innovation for an industry, as new firms bring new products, processes and organisational configurations. On the other hand, firms that fail to experiment or that experiment but fail, may find that competitive pressures force them to exit the industry. Firm learning also plays an important part in this process. As a firm's management experiments with different

innovations they will learn from both their successes and mistakes. Firms also learn by observing their competitors. A firm's management may be able to infer things about its competitors' activities by observing, for example, prices charged in the market or hiring decisions. This is likely to spur innovation if the observing firm perceives its market position is threatened.

Firm turnover in New Zealand is not unusual when compared with other economies. Around 60% of this turnover comes from the entry of new firms. Most of these firms' initial level of labour productivity is below the industry average but grows rapidly thereafter. Cohorts of entering firms have average annual labour productivity growth of between 3% and 12%. Continuing firms generally add to industry labour productivity growth. On average exiting firms experience stagnant or declining labour productivity in the years leading up to their death and when they eventually die most have below average labour productivity for their industry. The average labour input share of each cohort of exiting firms declines through time by approximately 4% per annum.

This pattern persists even at a highly disaggregated industry level and indicates that firm turnover has positively contributed to labour productivity growth in New Zealand. It also points to the importance of policies that do not impede the firm turnover process.

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Appendix 1 – Firm productivity database

To investigate the firm dynamics that underpin aggregate labour productivity it is necessary to form a measure of firm labour productivity. This requires the construction of a longitudinal firm productivity database that contains information on outputs and labour inputs for New Zealand firms. This appendix discusses the data sources used to form the firm productivity database, issues associated with merging and cleaning various datasets, and the construction of measures of firm labour productivity.

Data sources and construction

The firm productivity database was formed from three data sources:

1. Business Demography Statistics Database (BDS)
2. Producer Price Indexes (PPI)
3. Household Labour Force Survey (HLFS)

The New Zealand BDS contains demographic and employment (both employees and working proprietors) information on enterprises (firms) from the New Zealand Business Frame that are deemed to be 'economically significant'.[11] These data are collected for mid February of each year as part of the Annual Business Frame Update (ABFU). Monthly data on enterprise Goods and Service Tax (GST) sales and purchases are also available.[12] These GST data are sourced from the Inland Revenue Department (IRD). From 1994 onwards an enterprise was deemed to be economically significant if it satisfied any one of the following criteria:

- The enterprise had annual GST expenses or sales greater than $30,000;
- The enterprise had more than two full time equivalent paid persons employed;
- The enterprise was in a GST exempt industry (except residential property leasing and rental);
- The enterprise was part of a group of enterprises;
- The enterprise was a new GST registration that was compulsory, special or forced (which normally means the enterprise was expected to have GST sales or expenses that exceed $30,000); or
- The enterprise was registered for GST and was involved in agriculture or forestry

The BDS has some limitations. First, small enterprises that have GST sales below $30,000 are excluded from the BDS. Second, company restructures and changes of ownership that are accompanied by new GST registrations will result in enterprise births and deaths even though these pertain to existing enterprises. Therefore, enterprise births and deaths may reflect administration changes in addition to genuine business start ups and closures.[13]

The PPI provide information on producer output and input prices. The output price indexes measure changes in the prices received by producers. The input price indexes measure changes in the cost of inputs to production (excluding labour and capital costs). These data were used as deflators when constructing measures of firm level output.

[11] The New Zealand BDS also contains demographic information on geographical units (previously known as activity units) ie, units engaged in one or predominately one economic activity from a single physical location or base.
[12] These data have had capital sales and purchases removed.
[13] Although the BDS does not control for 'false' births and deaths owing to enterprise administrative changes, the development of the Linked Employer Employee Database (LEED) is attempting to do this.

The HLFS is used to provide information on the average hours worked by full time and part time working proprietors and full time and part time employees for four digit industries. The HLFS is a private household based survey and has greater industry coverage than the alternative Quarterly Employment Survey (QES), which is a firm based survey, that contains information on the average hours paid to full time and part time workers within an industry.[14] The HLFS classifies a person as a full time working proprietor or employee if they work 30 hours or more per week. A person is classified as a part time working proprietor or employee if they work less than 30 hours per week.

The BDS industry coverage is not the same from year to year. Additional industries were included in the ABFU in some years; in other years industries were dropped. To maintain constant industry coverage over the period 1994 to 2003 it was necessary to drop enterprises in industries that were not included in the BDS in every year between 1994 and 2003. This means that agriculture and livestock production, residential property leasing and rental, commercial property and leasing, child care services, residential and non-residential services, business professional and labour organisations, religious organisations, social and community groups, and sporting and recreational services industries were excluded from the firm productivity database.

Data on monthly GST sales and purchases were collapsed to an annual frequency and merged with the BDS demographic and employment data. Because BDS data on numbers of working proprietors and employees are recorded for mid February in each year, the annual GST sales and purchases data were formed for the year ending August. When forming annual GST sales and purchases for entering and exiting firms that had monthly sales and purchases data for less than a full year, which suggests these firms were operating for only part of the year, the aggregated monthly sales and purchases were annualised to ensure entering, exiting and continuing firms were analysed on a comparable basis.[15]

Merging demographic and employment data with GST sales and purchases data highlighted several issues. First, there were enterprises that had GST sales information but no employment data for the entire period they existed, or conversely had employment data but no GST sales information. Because it was not possible to form a measure of firm labour productivity when either employment or GST sales data were missing for the entire period the firm existed these firms were dropped. Second, some enterprises had partial information on employment or GST sales for part of the period the firm was recorded as existing. When this occurred during the middle of a firm's existence the missing data observations were filled using the last recorded observation. For example, a firm in existence between 1994 and 2004 with GST sales for the corresponding period but missing employment data in 1996 and 1997 would have the missing 1996 and 1997 employment data filled using employment in 1995. A partial explanation for situations similar to the example above is that some firms fail to respond to the Annual Business Frame Update (ABFU) questionnaire, despite the firm still operating (as indicated by the firm filing GST sales of $30,000 or greater). The non-response rate for the ABFU is estimated to be between 10% and 15%. The approach to imputing missing values is one that has been adopted by Statistic New Zealand in other contexts.

[14] The QES excludes the following industries: Agriculture and agricultural contracting, hunting and trapping, fishing, seagoing work, owning and leasing of real estate, armed forces (civilian staff are included), and domestic service in households.

[15] Some enterprises file GST returns on a quarterly or annual basis, rather than monthly (the required frequency of filing being related to the turnover of the firm. For firms that file quarterly or annually, the data file records GST sales or purchases in the last month of the quarter or year; and in the other months zero sales or purchases are recorded.

Cases occurred where a firm was in existence in the BDS but there was no recorded information on total employment and GST sales or purchases at the beginning or end of the firm's life. In these situations the firm was deemed to be an entrant in the first period where employment or GST was available and was 'ceased' in the period following the last observation for employment or GST sales.[16]

Firm output

Measures of firm output were constructed using data on GST sales and purchases, and producer output and input prices. GST sales were used as a proxy for nominal gross output. A proxy for real gross output was constructed by deflating GST sales by the corresponding producer price output index at approximately the two digit industry level. If the price for a firm's output is actually higher than the average industry price, then measured real gross output will be overstated and, hence, the firm's labour productivity, *ceteris paribus.*

A proxy for firm value added was constructed by subtracting material purchases from firm gross output. GST purchases were used to proxy for nominal material purchases. Real material purchases were calculated by deflating GST purchases by the corresponding producer price index at approximately the two digit industry level. Owing to the unavailability of firm data on final goods inventories, firm value added is likely to be miss measured. More precisely, firm sales differ from firm output by the change in inventories of final goods. Because of this it is likely that a measure of value added based on firm sales would be more volatile than one based on firm output as inventories tend to be counter cyclical and act as a buffer to changes in demand.

Firm labour input

The BDS contains enterprise data on the number of full time working proprietors, part time working proprietors, full time employees, and part time employees for mid February of each year. These data were used to construct a 'head count' measure of firm labour input by adding the number of full time working proprietors, part time working proprietors, full time employees, and part time employees. A limitation of the 'head count' measure of labour input is that it does not take into account differences in the number of hours worked by different types of workers. Data on the number of total hours worked within an enterprise is the preferred measure of that enterprises labour input (or less preferred, but still better than the number of working proprietors and employees or the number of hours paid by the enterprise). However, the number of hours worked or hours paid is not available from the BDS. To overcome the limitation of the 'head count' measure in not taking account of differences in the hours worked by different types of workers, an alternative labour input measure was constructed where each worker type was assigned the average hours worked by the corresponding type of worker at the four digit industry level. This alternative measure of enterprise labour input assumes there is no variation in the average hours worked by different types of workers within an industry at the four digit level (although there will still be variation in labour inputs within a four digit industry because enterprises have different numbers and types of workers).

[16] This situation may occur because i) SNZ are unable to determine whether non-response to the ABFU is genuine non-response or because the enterprise has ceased operating; or ii) the enterprise continues to file GST returns as it sells off assets even through it has ceased trading.

Firm labour productivity

Construction of two proxies for firm output – real gross output and real value added – and two measures of firm labour input – total number of workers and a proxy for the number of hours worked – means it is possible to construct four different measures of labour productivity: gross output per worker; gross output per hour; value added per worker; and value added per hour. However, analysis in this paper is conducted using value added per hour only.

Appendix 2 – Additional decompositions

Appendix Table 1 – FHK industry decompositions – positive and negative contributions, 1995-2003

Industry	Total	Within	Between	Cross	Entering	Exiting
Mining & quarrying	99.0	57.2	27.3	8.4	0.6	5.4
	(102.0)	(41.8)	(21.2)	(24.3)	(6.1)	(8.5)
Manufacturing	85.5	51.4	14.7	14.4	1.6	3.4
	(82.6)	(32.1)	(9.8)	(35.1)	(2.9)	(2.6)
Electricity, gas & water	77.7	49.2	13.8	9.1	2.4	3.2
	(71.8)	(26.7)	(15.0)	(27.6)	(2.1)	(0.5)
Construction	74.5	34.9	27.0	3.9	4.9	3.8
	(71.4)	(27.0)	(4.7)	(31.2)	(4.6)	(3.9)
Wholesale & retail trade	84.7	50.8	17.6	9.3	1.8	5.2
	(80.8)	(31.8)	(11.5)	(29.3)	(6.0)	(2.2)
Transport, storage & communications	50.5	26.9	13.8	3.0	2.8	3.9
	(47.1)	(16.8)	(8.3)	(15.4)	(4.7)	(2.0)
Business services	88.8	40.6	32.5	5.9	5.9	4.0
	(87.1)	(28.9)	(9.0)	(38.5)	(6.5)	(4.2)
Personal & community services	46.3	30.8	10.1	2.1	1.5	1.8
	(45.2)	(13.9)	(4.3)	(22.5)	(2.9)	(1.5)
Aggregate	72.7	40.7	19.2	6.4	2.5	3.8
	(71.0)	(25.4)	(8.5)	(29.8)	(4.8)	(2.4)

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. Numbers in parentheses are the sum of all negative firm contributions. The entering, exiting, within, between and cross components sum to the totals for each of the industries and the aggregate respectively.

Appendix Table 2 – GR industry decompositions – positive and negative contributinos, 1995-2003

Industry	Total	Within	Between	Entering	Exiting
Mining & quarrying	81.5	52.4	23.3	0.6	5.2
	(84.5)	(45.0)	(24.9)	(6.1)	(8.7)
Manufacturing	59.9	41.5	13.4	1.5	3.4
	(57.0)	(32.5)	(19.0)	(2.9)	(2.6)
Electricity, gas & water	58.2	40.8	11.6	2.4	3.4
	(52.3)	(27.6)	(22.2)	(2.1)	(0.4)
Construction	55.8	31.5	15.5	4.8	3.9
	(52.8)	(37.3)	(6.9)	(4.7)	(3.9)
Wholesale & retail trade	64.8	44.8	12.8	1.8	5.3
	(60.9)	(35.8)	(16.7)	(6.1)	(2.2)
Transport, storage & communications	41.1	23.9	10.5	2.8	4.0
	(37.8)	(19.9)	(11.1)	(4.7)	(2.0)
Business services	65.3	35.8	19.6	5.9	4.0
	(63.6)	(40.5)	(12.4)	(6.5)	(4.2)
Personal & community services	33.5	23.4	6.8	1.5	1.8
	(32.4)	(16.7)	(11.3)	(2.9)	(1.5)
Aggregate	53.9	34.2	13.3	2.5	3.9
	(52.2)	(30.6)	(14.3)	(4.9)	(2.4)

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. Numbers in parentheses are the sum of all negative firm contributions. The entering, exiting, within and between components sum to the totals for each of the industries and the aggregate respectively.

Appendix Table 3 – FHK(X) industry decomposition, 1995-2003

Industry	Total	Within	Between	Cross	Entering
Mining & quarrying	-3.0	15.4	1.5	-15.9	-4.0
Manufacturing	2.9	19.4	5.1	-20.7	-0.9
Electricity, gas & water	5.8	22.4	-0.6	-18.5	2.5
Construction	3.1	7.9	22.4	-27.3	0.0
Wholesale & retail trade	3.9	18.9	5.3	-19.9	-0.4
Transport, storage & communications	3.4	10.2	5.4	-12.4	0.2
Business services	1.7	11.6	23.3	-32.6	-0.6
Personal & community services	1.1	16.9	5.6	-20.4	-0.9
Aggregate	1.8	15.3	10.3	-23.3	-0.5

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The entering, exiting, within, between and cross components sum to the totals for each of the industries and the aggregate respectively.

Appendix Table 4 – FHK(X) industry decomposition - % firms making positive contribution, 1995-2003

Industry	Within	Between	Cross	Entering
Mining & quarrying	47.9	52.8	40.9	33.6
Manufacturing	50.3	52.4	39.8	17.1
Electricity, gas & water	48.3	40.2	37.1	40.0
Construction	50.2	67.1	41.8	19.8
Wholesale & retail trade	51.4	59.1	40.4	24.6
Transport, storage & communications	50.2	56.2	41.7	11.4
Business services	45.8	68.4	40.2	19.6
Personal & community services	45.9	64.9	36.0	26.6
Aggregate	48.8	65.5	39.5	18.9

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003.

Appendix Table 5 – GR(X) industry decomposition, 1995-2003

Industry	Total	Within	Between	Entering
Mining & quarrying	-3.0	7.5	-6.4	-4.0
Manufacturing	2.9	9.0	-5.2	-0.9
Electricity, gas & water	5.8	13.2	-9.9	2.5
Construction	3.1	-5.7	8.8	0.0
Wholesale & retail trade	3.9	9.0	-4.6	-0.4
Transport, storage & communications	3.4	4.0	-0.8	0.2
Business services	1.7	-4.7	7.0	-0.6
Personal & community services	1.1	6.6	-4.7	-0.9
Aggregate	1.8	3.6	-1.4	-0.5

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003. The entering, exiting, within and between components sum to the totals for each of the industries and the aggregate respectively.

Appendix Table 6 – GR(X) industry decomposition - % firms making positive contribution, 1995-2003

Industry	Within	Between	Entering
Mining & quarrying	47.9	52.1	33.6
Manufacturing	50.3	50.5	17.1
Electricity, gas & water	48.3	38.5	40.0
Construction	50.2	65.4	19.8
Wholesale & retail trade	51.4	57.1	24.6
Transport, storage & communications	50.2	55.0	11.4
Business services	45.8	67.2	19.6
Personal & community services	45.9	62.8	26.6
Aggregate	48.8	63.7	18.9

Notes – All numbers are percentages and are the arithmetic averages of yearly observations between 1995 and 2003.