Firm dynamics and productivity growth

Scoping future research

Research note for the New Zealand Productivity Commission, August 2020

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1. Introduction

This note assesses the state of knowledge about firm dynamics in New Zealand. It recommends that research shifts from mostly descriptive analysis to models of how firms operate in practice, to provide greater insight into:

(i) why firms grow

(ii) how firm performance affects aggregate productivity growth

(iii) what role policy can play in improving productivity growth.

The note comprises two distinct parts. The first is a high-level review of existing analysis and research methods. The focus is on empirical analysis that makes use of firm-level data and the use of Statistics New Zealand's Longitudinal Business Database (LBD). The objective is to identify any significant gaps in research to date, in terms of answering the three questions listed above.

We find that descriptive analysis predominates in the research and there is comparatively little research, at least in recent years, that can be a basis for diagnosing problems and informing policy decisions.

We also find that existing descriptive analyses provide mixed evidence on important questions such as whether new firms contribute positively to productivity growth.

In the second part of this note we provide an updated decomposition of the contribution of firm dynamics to productivity growth. This update makes use of improved firm-level productivity data and improved decomposition methods, proposed by Diewert and Fox (2010).

The note concludes with a comment on directions for future research that would provide greater insight into firm dynamics, issues affecting productivity growth and potential policies to improve productivity growth.

2. Assessment of existing research

2.1. Focus on methods

Existing research into firm dynamics in New Zealand spans a range of issues, such as export performance, competition, and productivity growth. Our assessment of this research focusses on methods and the extent to which these methods provide causal insights into firm dynamics and firm performance.

Our focus on methods and causality has been motivated by inferences about problems in firm dynamics in New Zealand and negative effects on productivity growth, such as:

> *"A large share of employment and capital is concentrated in firms with low productivity. There are too many small, old and relatively unproductive firms that neither grow rapidly nor exit the market." Nolan et al (2018).*

This observation is summarised in Meehan (2020) as "a lack of 'up-or-out' dynamics among New Zealand firms" (p. 41).

This is an important inference that has the potential to attract the attention of policy makers. It raises questions such as: How many small, old and relatively unproductive firms is too many? Why might there be too many? What might be done about it?

Thus, a key question of this review is whether research has employed methods that can answer these kinds of policy-focused questions.

In addition, we consider that the evidence is at times quite mixed, raising a question about whether this could be resolved by alternative methods of analysis.

2.2. Methods are predominantly descriptive

We find that existing research into firm dynamics in New Zealand provides only limited foundations for forming diagnoses of problems and formulating responses; based on the relative scarcity of papers that adopt a diagnostic framework that can uncover ultimate causes of firm dynamics and their links to productivity growth.

Our review of existing research is summarised in Table 1. It shows the number of published papers[1] about New Zealand firms that provide analyses or findings of relevance to firm dynamics. Papers have been categorised according to the subject matter that they touch upon and the diagnostic framework used to guide the analysis.

The list of subjects reflects broad categories that have been considered in LBD research in New Zealand. The term 'diagnostic framework' is used here to capture both conceptual models and methods of inference.

[1] Published papers are defined as working papers, monographs, research notes, and journal articles, whether formally published or simply made publicly available online.

The sample of papers included in Table 1 is a subset of a database of New Zealand research papers that have made use of firm-level data.[2] The sample includes papers that analyse the full life-cycle of firms – birth, growth and death – and papers that provide insights into particular aspects of firm dynamics such as determinants of exit rates. Figure 1 provides context around the timing of these papers and wider context in terms of number of papers being published using firm-level data.

TABLE 1: SCOPE OF NEW ZEALAND RESEARCH ON FIRM DYNAMICS

Count of subjects considered and number of papers[3]

	Diagnostic framework:			
Subject matter:	Descriptive	Proximate	Ultimate	Number of papers
Exploratory	5			5
Decomposition[4]	2	2		4
Competition	1	2		3
Innovation				0
Management		1		1
Infrastructure				0
Skills		1		1
Geography			1	1
Trade	1	2	2	5
Policy	1		2	3
Number of papers	10	9	4	23

Firm dynamics research has been primarily descriptive in nature without much in the way of a diagnostic framework for interpreting the analysis. Such studies typically report firm sizes and birth, growth, and death rates over time (e.g. Mills and Timmins, 2004; Law et al, 2006), some with cohort analyses (Meehan and Zheng, 2015; Stephenson, 2019), and some that decompose the influence of firm dynamics on output growth or productivity growth (Law and McLellan, 2005; Devine et al 2012).

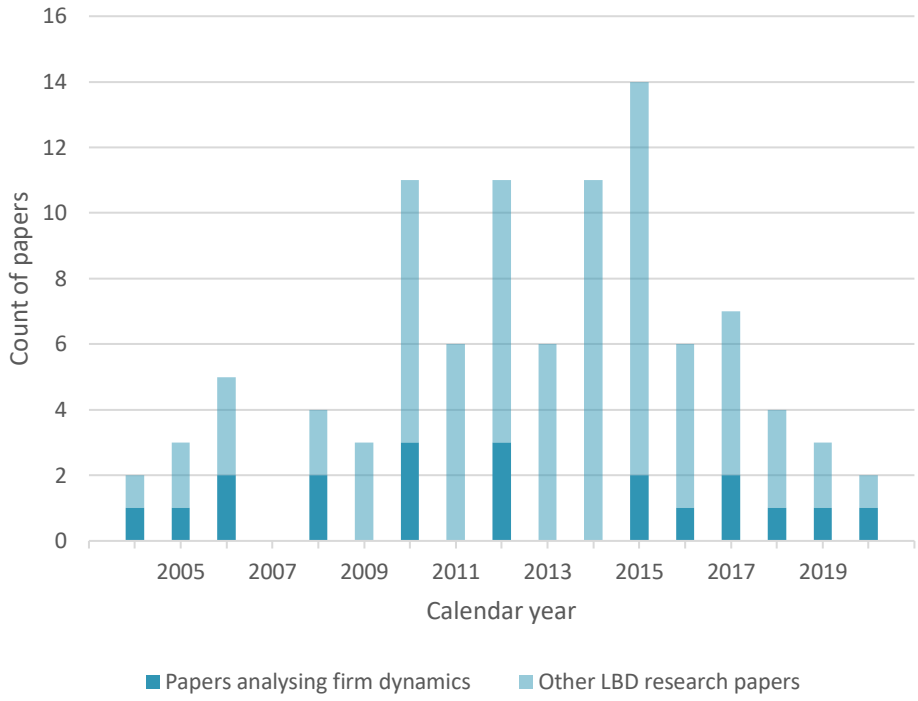
A handful of these descriptive studies consider contextual factors associated with firm dynamics, such as competition (Doan et al, 2012), policy changes (Malcolm, 1993), export performance (Fabling et al, 2008a), and qualitative factors associated with firm performance (Fabling et al, 2008b).

[2] The database covers all published studies that use the longitudinal business database (LBD) and precursors, since 2004, to the LBD analysis using firm level data from Statistics New Zealand's Linked Employer Employee Database (LEED), business demography data, and the Inland Revenue Department's GST database. The starting point for this sample was a bibliography constructed by Motu Economic and Public Policy Research in 2015 (https://motu.nz/our-work/productivity-and-innovation/firm-productivity-and-performance/bibliography-of-research-using-the-new-zealand-longitudinal-business-database/). Two studies published prior to 2004 are included in the database because they directly relate to firm dynamics (Gibson and Harris, 1996; Malcolm, 2003).

[3] Research papers that consider multiple subject matter areas are counted more than once in the cell counts inside the table. The bottom row counts the number of unique papers. Thus the values in the right hand column sum to 24, while the count of unique papers in the bottom row sums to 23 – the number of unique papers included in the table.

[4] This category captures the papers listed in Table 3.

FIGURE 1: NEW ZEALAND FIRM-LEVEL ANALYSES OVER TIME
Count of published working papers, research notes and journal articles[5]



Four papers shed light upon causal relationships that can explain what drives firm dynamics, the extent to which firm dynamics affect productivity growth or the effects that government policies have on firm dynamics. [6] In Table 1 these studies are counted under the category 'Ultimate' to reflect that these studies consider underlying or primitive drivers of firm dynamics and firm performance, as opposed to activities that are only correlated with firm dynamics and firm performance, which we label 'Proximate'.

These studies address specific issues affecting firm dynamics and firm performance:, the effect of trade policy liberalisation on firm exit (Gibson and Harris, 1996); agglomeration effects by firm age (Maré and Timmins, 2006); the effect of minimum wage policies on employment and firm entry and exit rates (Hyslop et al, 2012); and learning effects, positive selection, and resource reallocation through exporting (Fabling and Sanderson, 2013). Only one of these papers makes use of the LBD and the most recent of these papers was submitted for publication more than ten years ago.[7]

[5] Counts are limited to papers that report primary research using the longitudinal business database, since 2004. Year of publication is defined as the year of the most recent version of a paper. These are raw counts, so research notes and journal articles are given equal weight. The counts include methods papers and papers documenting the LBD.
[6] In this summary, causality is defined as an analysis that is capable, in its intent and methodological motivation, of finding truly causal relationships. It is not a comment on the accuracy of findings or whether the findings still hold.
[7] Fabling and Sanderson (2013) was, at least in its working paper version (2010), based on data from a prototype version of the LBD.

The nine studies in Table 1 categorised as having a 'Proximate' diagnostic framework provide a richer description of firm dynamics than the simple descriptive analyses, through greater use of covariates or more considered use of formal models, though they are not causal. This is not an oversight in the sense that these studies are typically designed to examine proximate correlates, rather than ultimate drivers, of observed phenomena such as firm dynamics, firm performance, or aggregate productivity growth.

For example, Meehan (2020) analyses the efficiency of resource allocation in the New Zealand economy and finds evidence of substantial inefficiencies and that these inefficiencies are most pronounced in the case of capital allocation. Useful as they are, these findings do not shed light on the causes of these allocative inefficiencies, whether coordination problems, geography, government policy or some other causal relationship.

Other issues examined in these studies include: correlations between competition and firm entry and exit rates (Devine et al, 2010); entrepreneurship and exporting (Fabling and Sanderson, 2010); slow rates of convergence to the technological frontier (Conway et al, 2015); changes in worker skill levels (Maré et al, 2017); cyclical labour market adjustment (Fabling and Maré, 2017); selection into self-employment (Fabling, 2018); and ostensibly weak links between competition and productivity (Maré and Fabling, 2019).

2.3. Mixed evidence on key aspects of firm dynamics

We find conflicting evidence on key aspects of firm dynamics and their effects on productivity growth such as:

- whether poor performing firms are too slow to exit (a lack of up-or-out dynamics) and
- whether productivity growth has come primarily from creative destruction (entry and exit) or from improvements in productivity of existing (continuing) firms.

Up-or-out dynamics

The empirical evidence of a lack of up-or-out dynamics is mixed. Supporting evidence includes the finding in Meehan (2020) of limited covariance in total factor productivity levels and output growth. Other analyses of firm-level data have found most firms do not grow much and yet they use a substantial share of resources (Meehan and Zheng, 2015; Stephenson, 2019). And Table 2 below shows considerable persistence in firms at the top end of the distribution of gross output, relative to firms' positions in the distribution of multi-factor productivity.

Yet decompositions of firm growth dynamics suggest that firms with higher productivity growth have typically increased their shares of overall economic activity (see Table 3) – even if this is not always the case in all time periods.

Furthermore, a substantial share of firms in the bottom half of the productivity distribution do, subsequently, move up the productivity distribution (see Table 2) while also exhibiting higher than average rates of exit (Conway et al, 2015).

TABLE 2: FIRM PROGRESS, RELATIVE TO STARTING POSITION

Share of firms changing decile. Average for 2002-2017[8].

Deciles are calculated separately for multi-factor productivity and gross output.

Decile	1	2	3	4	5	6	7	8	9	10	Pattern
Multi-factor productivity											
Improve	0.46	0.51	0.50	0.47	0.43	0.37	0.31	0.25	0.16	0.00	
Same	0.54	0.31	0.23	0.21	0.20	0.20	0.21	0.24	0.30	0.48	
Decline	0.00	0.19	0.26	0.32	0.37	0.43	0.48	0.51	0.54	0.52	
Gross Output											
Improve	0.44	0.40	0.36	0.33	0.31	0.29	0.27	0.22	0.15	0.00	
Same	0.56	0.37	0.33	0.32	0.32	0.34	0.38	0.44	0.57	0.83	
Decline	0.00	0.22	0.31	0.35	0.36	0.37	0.36	0.34	0.28	0.17	

Of course, the claim that there is a lack of up-or-out dynamics among New Zealand firms is a claim about the relative rate of up-or-out dynamics – that there could be more up-or-out dynamics – not a claim that there are no up-or-out dynamics.

It may be tempting to conclude that any improvement in resource allocation is worthwhile, based on the observation that more productive economies tend to exhibit a better match between resource allocation and productivity growth. But such a conclusion does not provide a diagnosis for interventions that can be used to improve resource allocation and it ignores potential costs from pursuing improvements in resource allocation.

Models are needed to begin answering these questions and these models need to account for the fact that firm-level productivity growth advances and recedes, it does not increase unendingly. As a result, 'out' is not necessarily the only efficient alternative to 'up'.

The waxing and waning of firm performance, in terms of output growth or productivity growth, is both an observed phenomenon and a tautological prediction of models that accommodate the possibility of uncertain market developments (productivity shocks), risky investment, or competitive dynamics – any model that starts from a position that success is never guaranteed.

Intuition and empirical evidence show that firm birth and growth involves search, search for the ideal production technology, location, or for customers (Foster et al, 2016; Eslava and Haltiwanger, 2020). This, combined with costs that constrain adjustment in response to changing market conditions, such as large fixed capital costs, means that statically inefficient allocations might be dynamically efficient (Asker et al, 2014).

[8] Average transitions between deciles over 5 sub-periods: 2002-2005, 2005-2008, 2008-2011, 2011-2014, 2014-2017. The data set is discussed in section 3.

An example of these sorts of dynamics was observed by Fabling and Sanderson (2013), finding that new exporters tend to be cautious and delay investment until they have learned more about exporting while experienced exporters invest ahead of forays into a new market. This dynamic is, broadly speaking, consistent with optimal investment under uncertainty.

Entry, exit and within firm productivity growth

Decompositions of productivity growth show mixed results as to the effects of firm entry and exit on productivity growth versus the productivity growth in existing firms. Some studies show aggregate productivity growth being driven by improvements within existing firms and by the exit of poor performing firms. Others show that the productivity of existing firms has been a drag on productivity growth while the performance of new entrants has had positive effects.

These differing results are summarised in Table 3. This includes results from analysis discussed in the next section of this note. Contributions to productivity growth from firms are divided into positive (+) or negative (-) effects from:

- growth within continuing firms (**Within**)
- reallocation of resources between continuing firms (**Between**)
- productivity within continuing firms for which productivity is observed at the end of the period but not the start (**Join**)
- productivity within continuing firms for which productivity is observed at the start of the period but not the end (**Leave**)
- productivity of new firms (**Entry**)
- productivity of firms that shut down (**Exit**)

There are methodological differences that may explain these disagreements. For example, labour productivity measures are associated with negative effects of firm entry on aggregate productivity growth, while decompositions of multi-factor productivity growth show positive or weakly positive effects of firm entry.[9]

Time periods are also likely to have an effect. This could be due to underlying structural changes to the economy or because contributions to productivity growth vary with the economic cycle.

Differences in data quality and definitions are also likely to cause differences in results. For example, early decompositions of the effects of firm entry and exit on labour productivity used rolling mean employee counts as the measure of labour input. Later research efforts have benefitted from more nuanced measures of labour input that account for intensity of labour input (Fabling and Maré, 2015).

[9] For the sake of summarising results, studies have been distilled to a single qualitative finding. Where the average contribution is positive (negative) and more than two-thirds of results are positive (negative) the findings are labelled as being positive (negative). Where the average contribution is positive (negative) but fewer than two-thirds of results are positive (negative) the findings are labelled as being weakly positive (weakly negative). This procedure nevertheless hides considerable variation of findings within these studies, including decompositions over multiple years during which contributions to productivity growth sometimes vary between positive or negative.

Finally, there has been some inconsistency in methods used to conduct these decompositions themselves.

These decompositions are only descriptive in nature but, in principle, they should be able to provide a useful high-level monitoring framework for tracking changes in the link between firm dynamics and productivity. As such it would be useful if consistent methods and data could be used to monitor changes over time. This is a matter we consider in the next section of this note.

At the same time, some proportion of the differences we observe is likely to be due to actual changes in firm dynamics and productivity growth, over time. This suggests that future research needs to:

- be careful to place this sort of descriptive analysis within its wider context
- not to infer structural implications from phenomena that may be temporary
- consider alternative empirical methods for understanding the structural implications of firm dynamics for productivity growth.

TABLE 3: PRIOR DECOMPOSITIONS OF THE IMPACT OF FIRM DYNAMICS SHOW MIXED RESULTS

	Law and McLellan (2005)		**Devine et al (2012)**	**Jaffe et al (2016)[10]**	**Mare et al (2017)[11]**	**This research note**	
Years	1995-2003		2001-2008	2001-2012	2001-2012	2002-2017	
Productivity	Labour		Labour	Multi-factor	Multi-factor	Multi-factor	
Method[12]	GR	FHK[13]	MP	GR	GR	DF	
Includes owner-only firms?	Yes	Yes	Yes	Yes	No	Yes	No
Contributions to productivity growth (++ = positive, + = weakly positive, — = negative, - = weakly negative):							
Within	++	++	++	—	—	+	+
Between	—	++	++	++	+	+	-
Entry	—	—	—	++	++	+	++
Join[14]				—	—	—	+
Exit	++	++	++	—	—	++	—
Leave[4]				++	++	++	++

[10] Jaffe et al (2016) focusses on productivity in the construction sector. The results reported here are for all industries in the measured sector (in Table 14 in their report). Jaffe et al (2016) use very similar methods and data to Mare et al (2017) with the exception that the Mare et al (2017) analysis exclude firms consisting solely of working proprietors.

[11] The results used for comparison here are for the results in Table 6 of Mare et al (2017) without skill-adjusted labour input. Other findings in that paper show estimated effects changing sign depending on the time period over which transitions are measured and whether or not productivity is measured include skill-adjusted labour input.

[12] Decomposition methods: GR = Griliches and Regev (1995); FHK = Foster et al (2001); MP = Melitz and Polanec (2015); DF = Diewert and Fox (2010).

[13] The interaction term produced using the FHK decomposition has been excluded from this table for ease of comparison. Law and McLellan (2005) found a relatively large negative interaction effect implying that within firm productivity growth is negatively correlated with changes in firms' market shares.

[14] Earlier studies by Law and McLellan (2005) and Devine at al (2012) did not include the leave and join categories. Law and McLellan (2005) impute missing observations for continuing firms and Devine at al (2012) assign firms with missing observations to either exit or entry categories.

3. Decomposition of the contribution of firm dynamics to productivity growth

Given the significant differences in past findings, we revisited the data and methods used to decompose the effects of firm dynamics and productivity growth.

For this analysis we have considered a range of possible decomposition methods but here we focus on results based on our preferred method, the Diewert and Fox (2010) decomposition.

3.1. Diewert and Fox decomposition

The decomposition proceeds from defining groups of continuing (C), exiting (X) and entering (N) firms (indexed by i) and tracking changes in firm level productivity (π_i) and shares of inputs (s_i) between periods (indexed by t and $t-k$).

The decomposition of the change in aggregate productivity (Π) is:

$$\Pi_t - \Pi_{t-k} = \sum_{i \in C} \frac{1}{2}(s_{it} + s_{it-k})(\pi_{it} - \pi_{it-k}) + \sum_{i \in C} \frac{1}{2}(s_{it} - s_{it-k})[(\pi_{it} + \pi_{it-k}) - (\Pi_t^c + \Pi_{t-k}^c)] + \sum_{i \in N} s_{it}(\pi_{it} - \Pi_t^c) - \sum_{i \in X} s_{it-k}(\pi_{it-k} - \Pi_{t-k}^c)$$

The first term is within firm productivity growth for continuing firms, the second term is the change in productivity due to higher productivity firms increasing their share of inputs and the third and fourth terms respectively are the effects from firm entry and exit.

Comparison with other methods

A variety of methods have been proposed for decomposing firm dynamics, some of which were used in the studies cited in Table 2.[15] In general terms, methods vary over decisions common to most indexes. For example, the period to use as the base period when constructing weighted averages or aggregating multiple changes.

The decomposition method most like the Diewert and Fox method is the method proposed by Griliches and Regev (1995). This method has the same general form but uses average productivity of all firms, over the two periods, as the benchmark for deviations in firm-level productivity. In contrast, the Diewert and Fox decomposition uses only the average of continuing firms. Griliches and Regev also compares the productivity of entering and exiting firms to average aggregate productivity levels of firms in the current and prior periods respectively.

Another frequently used decomposition method is developed by Foster et al (2001) and includes an additional fourth decomposition term. This term seeks to capture changes due to within sector heterogeneity and splits the change in productivity due to higher productivity firms increasing their share of activity into:

(i) a component due to changes in activity shares

[15] Alternative indices have been considered, for comparison purposes, but only the Diewert and Fox method is presented in the body of this note.

(ii) a component due to firm level productivity relative to average productivity

(iii) an interaction or 'cross' term that accounts for changes in both activity shares and changes in firm-level productivity.

The most pronounced difference between the method preferred in Foster et al and the Diewert and Fox method is that the Foster et al method uses prior periods as base periods. That is, changes in within-firm productivity are weighted by prior period activity shares and contributions of entering firms are measured by their productivity relative to aggregate productivity in the prior period.

Rather than selecting either the current period or the prior period as base weights, Diewert and Fox (2010) chose to use averages over two periods when comparing contributions of continuing firms. They argue this ensures that their indices are symmetric in the sense that they yield the same results whether the change is measured as a movement from the prior to the current period or vice versa. They note that this is a desirable general property of indices and indeed Balk (2016) suggests this is a reason to prefer the Diewert and Fox method for evaluating the contribution of firm dynamics to productivity. Riley et al (2015) notes that both the Griliches and Regev decomposition and the Foster et al decomposition both over-state contributions of net entry when aggregate productivity is increasing and under-state contributions when aggregate productivity is decreasing.

Another decomposition method – referred to as the Dynamic Olley-Pakes method (Melitz and Polanec, 2015) – focusses on measuring changes in average firm productivity and average activity shares (or other points in the distribution of firm productivity). Usefully, this avoids measurement of individual firm changes in productivity.

However, this method uses unweighted changes in productivity which tends to create highly volatile measures of contributions to productivity growth where there are large numbers of small firms (Riley et al, 2015), as there is in New Zealand, and question marks have been raised over whether its measure of resource reallocation (based on covariances of firm productivity and activity shares) has a meaningful interpretation (Balk, 2016).

In the analysis that follows the focus is on an augmented version of the Diewert and Fox decomposition to distinguish the effects on productivity growth of firms that temporarily leave and re-join the market, either because their performance is not observed in the data or because they temporarily discontinue operation.

Previous studies by Jaffe et al (2016) and Maré et al (2017) included these 'join' and 'leave' categories for firms that are only intermittently observed. Law and McLellan (2005) imputed missing observations and Devine et al (2012) categorised these observations as exits and entries.[16]

[16] Join and leave categories, or similar, are not used in any of the non-New Zealand articles cited in this report. In most cases, missing data problems are not mentioned, although Griliches and Regev (1995) do report using imputation to deal with missing data.

3.2. Data

The data used for our analysis was constructed for productivity analysis by Fabling and Maré (2015, 2019) using data in Statistics New Zealand's Longitudinal Business Database.[17]

The data covers the period 2001 to 2018, though the last year is not used due to lags in rates of reporting of financial performance (in tax records) and consequently low coverage and unreliability of recent observations.

Notably, data quality improves over time. Table 4 shows that larger numbers of observations are dropped, typically due to poor quality, in the early years of the data set.

Table 3 documents the coverage of the dataset. The population of interest is active for-profit firms in the so-called measured sector of the economy. The count of firms in this population is shown in the second column of Table 3. Out of this population a sample of firms, on average 65% of the population, have data of sufficient quality to enable productivity estimates.

The data has substantial numbers of missing values, tending to over-sample higher performing and larger firms (based on a comparison of the sample data set with (GST) sales data and employee counts in the population of firms from which the sample is drawn). In this respect the sample appears to include some degree of selection bias. Adjustments have been made to the decomposition method to try and account for this – by weighting observations by population weights based on firm size (total labour input).

The data set includes firms that with no employees (firms that comprise only working proprietors). Including these firms in the analysis has the downside that the activity of these firms is more likely than other firms to be mis-measured (Fabling and Sanderson, 2014) or for data to be missing in some years even though the firm has not shut-down. This adds noise to our estimates and increases the number of firms that are classified as joining or leaving.

The main benefit of including firms without employees in our analysis is that these firms are an important part of firm dynamics. Around half of all firms have no employees. A small number of these firms become significant contributors to job growth, although the vast majority do not grow at all (Stephenson, 2019).

In a few industries, firms without employees are a substantial part of economic activity. In construction services, for example, these firms comprised an estimated 20% of the industry's labour input, on average, between 2001 and 2017.[18] However, across the entire economy firms without employees make up 11% of labour input and 4% of sales.

[17] Fabling and Maré (2019) documents improvements to the methods used to construct the data set, resulting in increased numbers of observations and lower volatility in productivity estimates. The improvements were also implemented to address a discontinuity in tax data that occurred in 2013 when tax reporting requirements changed.

[18] In their 2016 study of productivity in the New Zealand construction industry Jaffe et al (2016) found that 95% of property development firms had no employees and that firms without employees had lower productivity, on average, than firms with employees.

TABLE 4: PRODUCTIVITY DATA SET COVERAGE

March year	Firms (N)			Gross output ($b)	
	Population	Sample	Coverage	Sample	Population weighted
2001	296,568	181,008	61%	163	200
2002	295,050	181,656	62%	172	211
2003	298,959	187,005	63%	181	217
2004	303,552	191,490	63%	189	226
2005	306,405	194,523	63%	207	248
2006	310,803	198,798	64%	217	256
2007	313,020	200,955	64%	224	267
2008	314,397	205,236	65%	243	290
2009	310,158	202,674	65%	246	289
2010	303,249	200,127	66%	235	277
2011	303,291	202,464	67%	252	298
2012	301,449	201,873	67%	261	305
2013	300,792	203,949	68%	264	310
2014	301,548	208,392	69%	285	333
2015	300,939	206,991	69%	293	344
2016	302,967	202,635	67%	296	351
2017	302,187	202,680	67%	311	371
Total	5,165,334	3,372,456	65%	4,037	4,793

The sample data has incomplete coverage of individual firms over their life-cycles. This is summarised in Table 5. It shows that completeness of firm-level observations declines over time, with, for example, only 21% of firms that are active over 17 years (from 2001 to 2017) having sufficient data in each of the 17 years to enable productivity analyses. In principle, population weighting will control for these missing observations and the results of our analysis should not be unduly biased as a result. However, other more causal analyses based on a longitudinal observations would need to carefully consider potential biases created from these missing values.

Following Maré et al (2017) [19], two different types of production function are estimated. One is an industry-specific Cobb-Douglas production function with firm and year fixed effects, used for estimating, analysing and decomposing firm-level productivity growth. The other is a pooled (all-industry) Cobb Douglas production function, with industry and year fixed effects, that is used to calculate input weights for consistent aggregation of industry productivity growth estimates.

[19] The functional form and methods for estimating the production function are also the same as Conway et al. (2015) Appendix C, although that study used different input data that had not benefited from the improvements to data discussed in Fabling and Maré (2019).

TABLE 5: INCOMPLETE COVERAGE OF FIRM OBSERVATIONS OVER THEIR LIFE CYCLES

Percent of observations in sample

	Years observed in productivity data																		
Years active	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total[20]
1	56	**44**																	2
2	35	28	**36**																4
3	25	17	26	**32**															5
4	20	11	15	24	**30**														5
5	17	8	10	15	22	**28**													5
6	15	7	8	10	14	21	**25**												5
7	13	6	6	7	10	13	20	**24**											5
8	12	5	5	6	7	10	13	20	**23**										5
9	11	4	4	5	6	7	9	13	19	**22**									5
10	10	4	4	4	5	6	7	9	12	18	**22**								5
11	9	3	3	3	4	5	5	7	9	12	18	**21**							5
12	9	3	3	3	3	4	4	5	7	9	12	17	**20**						5
13	8	3	3	3	3	4	4	4	5	7	9	12	17	**19**					5
14	8	2	3	3	3	3	3	4	4	5	7	9	12	16	**18**				5
15	7	2	2	2	3	3	3	3	4	4	6	7	9	12	16	**17**			5
16	7	2	2	2	2	3	3	3	3	4	4	6	7	9	12	15	**15**		6
17	5	1	1	2	2	2	2	2	3	3	3	4	5	7	8	12	17	**21**	24

3.3. Results

Results of the productivity growth decomposition, based on the Diewert and Fox method and accounting for sample weights, is summarised in Table 6. The Table presents contributions to productivity growth between pairs of years – each three years apart. Results are presented for decompositions weighted by sample weights and for unweighted decompositions. We also present results with and without owner-only firms.

Results show contributions to productivity growth by continuing firms have varied over time. In the ten years from 2002 to 2011 continuing firms exhibiting positive contributions to productivity growth but this turned negative in the period 2011 to 2017.

Amongst the firms we observe in the data, higher productivity firms typically gain market share, measured here by input shares, raising aggregate productivity growth. However, when we weight the data to account for under-representation of some types of firms', results are more equivocal with reallocation contributing positively to productivity growth in only 3 of the 5 periods analysed.

Firms that are observed only intermittently (joiners and leavers) tend to have significantly lower productivity than other continuing firms. This means joining firms tend to lower observed productivity growth while leaving firms tend to raise productivity growth.

[20] Percentage of year-firm observations in the data.

The effects of firm entry[21] are negative when continuing firms exhibit positive productivity growth, on average, and positive when continuing firms exhibit negative productivity growth. Firm exit, on the other hand, is consistently positive as firms that exit are consistently lower productivity than continuing firms.[22] On balance, net entry contributes positively to productivity growth.

TABLE 6: PRODUCTIVITY GROWTH DECOMPOSITION, ALL INDUSTRIES[23]

Diewert and Fox (2010) method, point-to-point percentage changes (over 3 years)

Input shares weighted by population weights (firm size based on labour input):

Years	Within	Between	Join	Leave	Entry	Exit	Total
2002-2005	0.77	-0.13	-1.52	2.56	-0.31	0.88	2.25
2005-2008	0.76	0.06	-1.70	2.00	-0.33	0.83	1.62
2008-2011	0.23	0.04	-1.66	1.95	0.04	0.90	1.50
2011-2014	-0.41	0.16	-1.39	1.76	0.49	1.46	2.06
2014-2017	-0.67	-0.36	-0.51	1.46	1.13	1.58	2.64

Unweighted results:

Years	Within	Between	Join	Leave	Entry	Exit	Total
2002-2005	0.81	0.20	-1.50	2.50	-0.47	0.71	2.24
2005-2008	0.92	0.20	-1.76	1.97	-0.51	0.70	1.52
2008-2011	0.45	0.27	-1.62	1.94	-0.10	0.73	1.67
2011-2014	-0.35	0.25	-1.34	1.71	0.32	1.13	1.72
2014-2017	-0.66	0.27	-0.45	1.45	0.86	1.23	2.70

These results are qualitatively similar to the results in Maré et al (2017) for contributions to productivity growth between 2001 and 2012.

Maré et al (2017) used a similar but different productivity decomposition in their analysis (Griliches and Regev, 1995) but their results are similar to the decomposition presented here, with a minor exception of slightly smaller contributions from entry and exit (in absolute terms).

One important difference, is that reallocation is shown here to have positive effects on productivity growth in some periods. Maré et al (2017) report negative effects from resource reallocation.[24] That is, firms with lower than average productivity gain an increasing share of inputs. Notably, the data set for this analysis is similar to the one used in Maré et al (2017) but has 5 additional years of data, includes firms with working-proprietors and without employees, and has been subject to refined cleaning protocols to remove unreliable observations (Fabling and Maré 2019).

Annual decompositions weighted by population weights do accord with the Maré et al observation of negative effects from resource reallocation (see Figure 2). This may reflect increased volatility in

[21] These firms enter in either the second or third of the three years considered.
[22] These firms exit the market in either the second or third year of the three years considered.
[23] All productivity industries. See list in Appendix.
[24] On average across their annual decompositions with productivity estimation including labour input without skill adjustment. After adjusting labour input for worker skill level, this effect reverses sign and becomes positive while the impact of within-firm growth productivity reverses sign and becomes negative.

market share changes when observed on a yearly basis and could also reflect measurement error rather than a result of substance.

Negative effects on productivity growth from resource reallocation could also reflect competitive dynamics such as firms temporarily facing declining returns when reaching to increase market share or due to the sort of search dynamics and price competition that is hypothesised as affecting the productivity of new entrants (Foster et al 2008) which may also be present in existing firms entering new geographic markets or introducing new products.

Findings for continuing firms persist when we exclude from the analysis firms that do not have employees. But, as shown in Figure 3, when we remove firms that do not have employees[25]:

- firm entry plays a persistently and significantly positive role in productivity growth, while results are more mixed when we include firms without employees
- previously positive effects of firm exit become more mixed, with positive effects only observed in the period 2011 to 2017
- there is a reduction in the effects on productivity growth of firms that are observed intermittently (the leave and join categories).

Importantly, this analysis does not shed light on *why* these firm dynamics are observed. More generally, decompositions of productivity growth do not provide insights on the causes of productivity differences. Furthermore, the implications of the productivity decomposition change depending on the timeframe used to assess productivity changes. This raises questions about whether reliable inferences can reasonably be drawn from this sort of analysis.

Arguably, since multi-year comparisons look through short term dynamics and because productivity analysis is built on structural estimates of production technologies, it is more appropriate to make inferences using multi-year, rather than annual comparisons of productivity growth.

On the other hand, the key results presented in Figure 2 and Figure 3 do not show significant volatility. Instead, trends in productivity growth dynamics persist. For example, contributions of within firm productivity show a consistent decline and countervailing contributions of firm entry, which has been improving as within-firm contributions to productivity growth have declined.

The annual decompositions also show that the effects of within-firm growth switch from positive to negative after 2010 and the effects of entry on productivity growth switches from negative to positive after 2010. These reversals coincide with a period of contraction in the number of private not-for-profit firms in the measured sector in New Zealand, from 314,00 firms in 2008 to 302,000 in 2017. This has been caused by a significant decline in the rate of entry of new firms. Between 2001 and 2008 there was an average 1.7 new entrants for every 10 continuing firms. From 2009 to 2017 this figure declined to 1.3 new entrants for every 10 continuing firms.

[25] See the appendix for a version of Table 5 that excludes firms without employees.

FIGURE 2: ANNUAL PRODUCTIVITY GROWTH DECOMPOSITIONS, ALL FIRMS

Diewert and Fox (2010) method, population weighted, all industries[26]

FIGURE 3 ANNUAL PRODUCTIVITY GROWTH DECOMPOSITIONS, EXCLUDING FIRMS WITHOUT EMPLOYEES

Diewert and Fox (2010) method, population weighted, all industries

[26] Aggregated using input weights from pooled all-industry production function.

The effects of firm entry and exit on productivity growth has, however, been shown to be sensitive to inclusion of firms without employees. This raises the possibility that our findings could be unduly influenced by measurement error. But if we remove firms without employees we also lose potentially important information about firm dynamics.

Ultimately, uncertainty over which decompositions or which data sets to rely upon suggests that further research should consider predictive factors that could help to explain these trends and any deviations from trends, rather than make inferences from this sort of descriptive analysis.

In addition to varying over time, productivity dynamics vary significantly across industries. Figure 4 summarises this variation (in density plots on the diagonals) and observed correlations between the components in productivity growth decompositions based on decompositions of productivity growth for 39 industries between each of the 5 pairs of years as shown in Table 6.[27]

Correlations between components of productivity growth show that higher productivity growth is most correlated with higher contributions from firm entry and exit and leaving firms than from effects of (within) productivity growth of continuing firms or from reallocation of resources between continuing firms (between).[28] Indeed, correlations between reallocation between existing firms and total industry-specific productivity growth is small negative.

Note that the results in Figure 4 reflect decompositions of productivity growth by industry and without weighting the industries for overall size – thus the results will differ to the aggregate all-industry results in Table 6 where the decomposition is the sum of components weighted by relative size of industry's based on estimated industry shares of inputs.

It is tempting to make further industry-specific inferences based on this variation. But that could lead to misleading inferences without much more detailed consideration of industry dynamics.

That said, there are a few notable and clear industry-specific patterns that are worth mentioning:

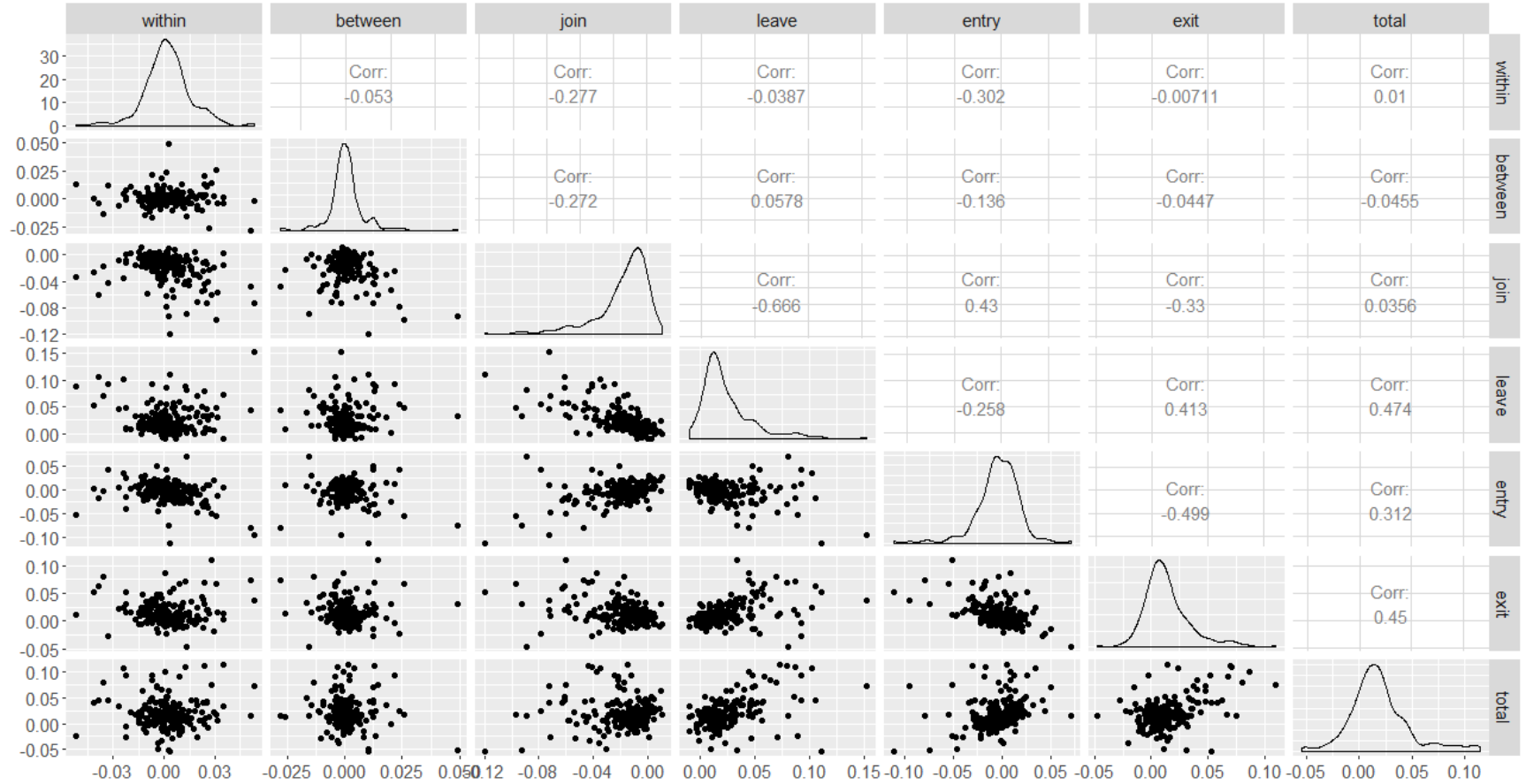
- Horticulture and Dairy cattle farming are the only industries with persistently[29] positive contributions from within productivity growth by continuing firms
- Agriculture, Forestry and Fishing Support Services is the only industry with persistently positive contributions from rising market shares (between) of higher productivity firms
- the Other Store-Based Retailing and Non Store Retailing industry is the only industry with persistently negative contributions from rising market shares (between) of lower productivity firms
- most industries show positive contributions from firm exit in each of the year pairs.[30]
- several industries exhibit persistently negative contributions from firm entry:

[27] The pairs of years are 2002-2005, 2005-2008, 2008-2011, 2011-2014, 2014-2017. The data is weighted for population weights.
[28] These results are robust to the inclusion of firms without employees.
[29] In this list persistence is defined as positive or negative contributions in each of the analysed year pairs from 2002 to 2017.
[30] Forestry and Logging is the only industry with persistently negative contributions from firm exit.

  - Horticulture
  - Dairy cattle farming
  - Food and Beverage Manufacturing
  - Petroleum and Chemicals Manufacturing
  - Electricity, Gas, Water and Waste Services
  - Wholesale Trade
  - Motor Vehicle and Motor Vehicle Parts and Fuel Retailing
  - Accommodation and Food Services
  - Postal, Courier Transport Support, and Warehousing Services.
  - Financial and Insurance Services
  - Auxiliary Finance and Insurance Services
- several industries exhibit persistently positive contributions from firm entry
  - Dairy Cattle Farming
  - Forestry and Logging
  - Agriculture, Forestry and Fishing Support Services and Hunting
  - Transport Equipment Manufacturing
  - Machinery and Other Equipment Manufacturing
  - Building Construction
  - Construction Services
  - Professional, Scientific and Technical Services
  - Arts and Recreation Services

Future research could use some of these industry differences as a starting point for investigating firm dynamics. That is, investigating reasons for these observed differences.

FIGURE 4: CORRELATIONS BETWEEN COMPONENTS IN PRODUCTIVITY GROWTH DECOMPOSITIONS



4. Recommendations for future research

In the early days of the development of the LBD it was observed that:

> *"The New Zealand economy is a complex system whose operation cannot be fully understood by pondering macroeconomic statistics. The policy process can be greatly improved by developing a deeper understanding of the microeconomic dynamics of the economy…"* (Fabling et al, 2008).

Over the past decade, the LBD and other firm-level data has lifted our descriptive understanding of the dynamics of New Zealand firms.

But research into firm dynamics can do more to live up to the promise of the LBD. To do so it needs to employ models and methods that provide reliable insights of policy relevance.

For example, diagnoses of a deficit in up or out dynamics ought to be based on dynamic models of firm behaviour – models that explicitly accommodate dispersion in firm productivity and that can uncover the role that selection plays in shaping distributions of firm performance.

To be practically useful, models of firm behaviour should also include an explicit role for policy or for market imperfections – i.e. frictions that distort resource reallocation. Research suggests that the most problematic of these are so-called correlated distortions, where impacts on firms increase at higher levels of firm productivity (Hopenhayn, 2014; Bento and Restuccia, 2017).

The observation has been made that explicit correlated distortions (such as higher taxes on larger and more productive firms) are not generally present in New Zealand (Meehan, 2020). However, policies do exist in New Zealand that implicitly have effects that vary with productivity (at least, by counterfactual productivity). For example, if high productivity firms are more likely to grow, it is reasonable to assume that they will be more affected by policy that constrains the extensive margins of economic activity, such as resource management requirements.

An important question for policy is whether observed distortions in the economy are of the kinds that are unavoidable or unavoidable (David and Venkateswaran, 2018), whether these are affecting resource allocation and what the trade-offs are from addressing any of these distortions – i.e. the cost-effectiveness of reforms or interventions and the impacts on resource allocation or productivity growth.

Consideration should also be given to industry-specific analyses, since firm dynamics appear to vary considerably across different industries and these industries exist in widely different operating environments in terms of competitive dynamics, capital intensity and policy frameworks.

Indeed, research ought to be attuned to substantial heterogeneity that exist even within fairly standard industry categories. The electricity, gas, water and waste industry is a case in point, with the industry containing network monopolies that are highly regulated as well as firms that compete with each other, albeit subject to lengthy and detailed rules of conduct.

Finally, more attention should be paid to analyses that can discern differences in competing effects by exploiting discontinuities from policy changes or similar natural experiments. The example of Fabling and Sanderson (2013) was cited earlier regarding investment dynamics under uncertainty. Importantly this paper provided insights into exporter behaviour that are highly relevant to policy in so far as strengthened international connections, export growth and expanding markets is a

perennial theme in productivity growth prognoses and an ongoing area of interventionist industrial policy. It is also a matter of interest for the private sector.

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Appendix

TABLE 7: RESULTS OF PRODUCTIVITY DECOMPOSITION UNDER DIFFERENT METHODS

Point-to-point percent changes, adjusted for population weights. All firms.

Baldwin and Gu (2006)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.45	-0.37	--	0.62	0.33	1.55	0.33	2.25
2005-2008	0.48	-0.02	--	0.10	0.26	1.06	0.26	1.62
2008-2011	0.15	0.22	--	0.00	0.23	1.13	0.23	1.50
2011-2014	-0.26	0.06	--	0.55	-0.18	1.72	-0.18	2.06
2014-2017	-0.43	0.09	--	0.87	-0.38	2.11	-0.38	2.64

Diewert and Fox (2010)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.77	-0.13	--	-1.52	2.56	-0.31	0.88	2.25
2005-2008	0.76	0.06	--	-1.70	2.00	-0.33	0.83	1.62
2008-2011	0.23	0.04	--	-1.66	1.95	0.04	0.90	1.50
2011-2014	-0.41	0.16	--	-1.39	1.76	0.49	1.46	2.06
2014-2017	-0.67	-0.36	--	-0.51	1.46	1.13	1.58	2.64

Foster, Haltiwanger and Krizan (2001)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.55	-0.11	-0.19	-0.59	1.69	0.51	0.41	2.25
2005-2008	0.58	0.11	-0.21	-0.89	1.33	0.29	0.40	1.62
2008-2011	0.27	0.21	-0.23	-1.01	1.32	0.46	0.48	1.50
2011-2014	-0.14	0.23	-0.26	-0.76	1.09	0.88	1.02	2.06
2014-2017	-0.35	-0.04	-0.15	-0.12	0.78	1.40	1.13	2.64

Griliches and Regev (1995)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.45	-0.15	--	-0.85	1.97	0.26	0.56	2.25
2005-2008	0.48	0.03	--	-1.07	1.52	0.14	0.52	1.62
2008-2011	0.15	0.08	--	-1.17	1.48	0.35	0.59	1.50
2011-2014	-0.26	0.11	--	-0.98	1.30	0.73	1.16	2.06
2014-2017	-0.43	-0.16	--	-0.38	1.08	1.21	1.32	2.64

Melitz and Polanec (2015)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.72	-0.09	--	-1.52	2.56	-0.31	0.88	2.25
2005-2008	0.67	0.15	--	-1.70	2.00	-0.33	0.83	1.62
2008-2011	0.08	0.19	--	-1.66	1.95	0.04	0.90	1.50
2011-2014	-0.44	0.19	--	-1.39	1.76	0.49	1.46	2.06
2014-2017	-0.59	-0.44	--	-0.51	1.46	1.13	1.58	2.64

TABLE 8: RESULTS OF PRODUCTIVITY DECOMPOSITION UNDER DIFFERENT METHODS, FIRMS WITH EMPLOYEES

Point-to-point percent changes, adjusted for population weights. Excludes owner-only firms

Baldwin and Gu (2006)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.25	-0.01	--	-0.17	0.70	2.10	0.70	2.17
2005-2008	0.45	0.07	--	-0.37	0.68	1.58	0.68	1.74
2008-2011	0.06	-0.01	--	-0.17	0.57	1.90	0.57	1.78
2011-2014	-0.34	-0.09	--	0.52	0.09	2.47	0.09	2.56
2014-2017	-0.43	-0.62	--	1.37	-0.21	3.02	-0.21	3.34

Diewert and Fox (2010)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.56	0.11	--	-0.06	0.38	1.98	-0.81	2.17
2005-2008	0.84	0.09	--	-0.05	0.07	1.69	-0.91	1.74
2008-2011	0.07	0.11	--	-0.04	0.42	1.84	-0.62	1.78
2011-2014	-0.64	-0.07	--	0.09	0.69	2.19	0.30	2.56
2014-2017	-0.76	-1.25	--	1.05	0.63	2.86	0.80	3.34

Foster, Haltiwanger and Krizan (2001)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.30	0.07	-0.11	0.01	0.52	2.14	-0.76	2.17
2005-2008	0.53	0.14	-0.16	-0.02	0.35	1.71	-0.81	1.74
2008-2011	0.18	0.15	-0.24	-0.05	0.48	1.86	-0.60	1.78
2011-2014	-0.21	0.08	-0.27	0.18	0.41	2.25	0.12	2.56
2014-2017	-0.37	-0.62	-0.12	0.91	0.23	2.79	0.52	3.34

Griliches and Regev (1995)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.25	0.06	--	-0.32	0.92	1.83	-0.57	2.17
2005-2008	0.45	0.08	--	-0.29	0.64	1.51	-0.65	1.74
2008-2011	0.06	0.05	--	-0.33	0.74	1.71	-0.44	1.78
2011-2014	-0.34	-0.03	--	-0.22	0.78	2.04	0.34	2.56
2014-2017	-0.43	-0.75	--	0.43	0.70	2.56	0.83	3.34

Melitz and Polanec (2015)

Years	Within	Between	Cross	Join	Leave	Entry	Exit	Total
2002-2005	0.51	0.16	--	-0.06	0.38	1.98	-0.81	2.17
2005-2008	0.78	0.15	--	-0.05	0.07	1.69	-0.91	1.74
2008-2011	-0.10	0.29	--	-0.04	0.42	1.84	-0.62	1.78
2011-2014	-0.73	0.02	--	0.09	0.69	2.19	0.30	2.56
2014-2017	-0.73	-1.28	--	1.05	0.63	2.86	0.80	3.34

TABLE 9: PRODUCTIVITY GROWTH DECOMPOSITIONS, FIRMS WITH EMPLOYEES

Diewert and Fox (2010) method, point-to-point percentage changes (over 3 years). Excludes owner-only firms.

Input shares weighted by population weights (firm size based on labour input):

Years	Within	Between	Join	Leave	Entry	Exit	Total
2002-2005	0.56	0.11	-0.06	0.38	1.98	-0.81	2.17
2005-2008	0.84	0.09	-0.05	0.07	1.69	-0.91	1.74
2008-2011	0.07	0.11	-0.04	0.42	1.84	-0.62	1.78
2011-2014	-0.64	-0.07	0.09	0.69	2.19	0.30	2.56
2014-2017	-0.76	-1.25	1.05	0.63	2.86	0.80	3.34

Unweighted results:

Years	Within	Between	Join	Leave	Entry	Exit	Total
2002-2005	0.57	0.21	-0.04	0.30	1.76	-0.76	2.05
2005-2008	0.98	0.25	-0.18	0.05	1.43	-0.82	1.72
2008-2011	0.18	0.43	-0.03	0.40	1.55	-0.59	1.94
2011-2014	-0.60	0.34	0.10	0.65	1.91	0.11	2.50
2014-2017	-0.72	0.32	1.05	0.62	2.46	0.51	4.24

TABLE 10: PRODUCTIVITY GROWTH DECOMPOSITIONS BY INDUSTRY

Diewert & Fox (2010) method, point-to-point percent changes

Horticulture and Fruit Growing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.5	-1.1	-5.3	4.7	-2.2	0.5	-2.8
2005-2008	3.1	-0.4	-5.7	3.1	-1.1	1.5	0.5
2008-2011	1.4	0.1	-3.9	4.5	-0.5	1.0	2.5
2011-2014	0.7	0.7	-3.8	3.4	-0.2	0.9	1.6
2014-2017	0.1	0.1	-2.3	3.1	-0.5	1.8	2.3
Sheep, Beef Cattle and Grain Farming							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.4	-0.3	-1.9	2.2	-1.2	0.3	-0.5
2005-2008	2.1	0.3	-3.3	2.2	-0.9	0.3	0.7
2008-2011	1.0	0.3	-2.4	2.2	-0.5	-0.2	0.3
2011-2014	-0.1	0.8	-3.6	1.4	-0.7	0.8	-1.4
2014-2017	-0.3	0.6	-1.3	1.0	-0.4	1.3	0.9
Dairy Cattle Farming							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.7	0.1	0.8	0.4	2.0	-1.0	2.9
2005-2008	0.7	0.4	0.0	-0.9	2.2	-1.1	1.3
2008-2011	0.1	-0.1	-0.8	-0.9	1.3	-1.1	-1.4
2011-2014	0.3	0.3	-0.3	0.0	1.4	0.7	2.3
2014-2017	0.2	0.3	0.3	0.5	2.5	1.3	5.1
Poultry, Deer and Other Livestock Farming							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.4	-0.3	-3.6	2.4	0.2	-2.0	-3.7
2005-2008	1.5	-0.4	-4.6	3.1	0.7	0.1	0.5
2008-2011	1.2	-0.8	-4.4	4.8	-0.5	1.0	1.4
2011-2014	2.5	1.2	-7.3	4.6	1.0	2.0	4.1
2014-2017	-0.1	1.8	-2.9	3.0	1.5	0.4	3.6
Forestry and Logging							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.7	2.2	-2.4	9.3	1.3	-0.2	9.3
2005-2008	1.3	-1.6	-8.9	8.1	7.2	-4.7	1.4
2008-2011	-3.3	1.2	-4.1	9.2	4.2	-2.8	4.5
2011-2014	0.1	2.4	-7.8	5.5	4.4	-2.2	2.3
2014-2017	-0.4	1.2	-2.1	4.8	5.1	-1.5	7.0
Fishing and Aquaculture							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.1	0.0	-0.9	2.9	0.8	-1.3	2.6
2005-2008	0.2	0.2	-1.5	1.9	1.1	1.9	3.7
2008-2011	-1.7	0.6	-1.5	3.3	0.8	0.3	1.7
2011-2014	-0.1	-0.3	-4.2	0.0	-0.1	1.5	-3.4
2014-2017	-2.7	-0.6	-0.8	4.6	0.5	2.3	3.3
Agriculture, Forestry and Fishing Support Services and Hunting							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.9	0.2	-1.8	0.5	2.1	-1.8	2.1
2005-2008	1.1	0.6	-1.9	0.9	1.0	-1.1	0.7
2008-2011	0.2	0.1	-1.8	2.2	1.2	-0.1	1.8
2011-2014	-0.4	0.3	-2.6	1.3	2.0	1.0	1.6
2014-2017	-0.2	0.0	-0.4	1.5	1.9	1.6	4.4

Mining							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-2.4	0.4	-3.5	10.3	3.5	2.4	10.7
2005-2008	0.0	-0.1	-3.8	4.5	0.8	8.6	10.1
2008-2011	-5.2	1.3	-3.3	8.9	-5.2	1.1	-2.3
2011-2014	-2.3	0.8	0.1	1.1	-4.0	1.6	-2.6
2014-2017	0.5	0.5	-6.3	5.6	-2.1	5.8	4.1
Food, Beverage and Tobacco Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.9	-0.3	-2.4	2.3	-2.8	1.7	-0.5
2005-2008	-0.3	0.0	-1.6	3.2	-2.9	2.5	0.9
2008-2011	-0.1	-0.1	-1.3	1.5	-2.5	1.5	-0.9
2011-2014	0.3	0.3	-1.2	0.9	-2.1	0.9	-0.9
2014-2017	-0.8	-0.2	-0.9	1.9	-1.2	1.4	0.2
Textile, Leather, Clothing and Footwear Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.9	-0.2	-0.3	2.1	-0.5	1.8	3.9
2005-2008	0.0	-0.5	-1.3	1.9	0.4	0.7	1.2
2008-2011	0.5	0.5	-0.4	1.1	0.5	0.5	2.7
2011-2014	0.0	0.1	-0.8	0.9	-0.4	0.8	0.7
2014-2017	-0.8	-0.3	-1.3	2.1	0.7	0.0	0.3
Wood and Paper Products Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.3	-0.3	-0.2	1.2	-0.9	1.6	1.6
2005-2008	1.6	0.5	-1.9	1.2	-0.2	-0.1	1.1
2008-2011	-0.5	-0.1	-0.2	2.5	-0.3	1.4	2.7
2011-2014	-0.3	0.2	-0.8	0.9	0.3	0.1	0.4
2014-2017	0.2	-0.6	-0.7	0.6	0.3	1.3	1.0
Printing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.4	-0.3	-0.6	1.0	0.3	0.3	0.2
2005-2008	-1.5	0.2	-0.4	1.0	-0.7	1.5	0.1
2008-2011	2.4	0.3	-1.1	1.1	-2.2	0.3	1.0
2011-2014	0.8	-0.3	-1.2	1.0	-0.9	0.5	-0.1
2014-2017	0.8	-0.2	-0.7	0.7	-0.3	1.4	1.7
Petroleum, Chemical, Polymer and Rubber Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.6	-0.1	-0.9	0.3	-0.3	2.7	2.2
2005-2008	0.2	0.0	-1.0	1.4	-2.0	0.4	-1.0
2008-2011	0.7	-0.2	-0.4	1.9	-1.2	1.1	1.9
2011-2014	-0.1	0.3	-0.9	1.0	-2.0	0.6	-1.0
2014-2017	0.2	-0.1	-0.2	0.3	-0.3	1.3	1.2
Non-Metallic Mineral Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.6	0.3	-0.5	1.3	-0.5	0.6	1.8
2005-2008	2.6	-2.6	-2.3	0.9	1.2	1.4	1.2
2008-2011	0.1	0.2	0.4	1.2	2.3	0.5	4.6
2011-2014	1.8	0.1	0.5	-0.1	0.7	-0.6	2.5
2014-2017	-1.9	1.1	0.2	0.8	0.4	1.5	2.1
Metal Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.3	-0.2	-0.1	0.2	0.3	-1.1	0.5
2005-2008	0.6	0.2	-0.2	-0.3	-0.6	-0.8	-1.1
2008-2011	0.9	0.2	-0.8	-0.1	-1.1	-0.7	-1.7
2011-2014	-0.1	0.1	-0.9	-0.3	-0.2	0.7	-0.7
2014-2017	-0.1	-0.1	-0.3	0.7	0.1	0.0	0.3

Transport Equipment Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.3	0.2	-0.8	0.5	0.8	-0.4	0.6
2005-2008	2.3	0.3	-1.2	0.1	0.2	-1.2	0.5
2008-2011	0.9	0.6	-3.0	1.8	0.9	-1.1	0.1
2011-2014	-1.4	-0.1	1.1	-0.1	2.7	-0.5	1.6
2014-2017	-0.1	0.7	-0.5	-0.7	1.5	0.5	1.5
Machinery and Other Equipment Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.7	0.2	-0.4	1.2	1.2	-0.2	2.6
2005-2008	-0.8	0.3	0.0	2.4	1.9	0.5	4.2
2008-2011	-0.1	0.3	-0.5	1.6	0.7	-0.4	1.6
2011-2014	-1.5	-0.2	0.4	0.9	1.1	1.5	2.2
2014-2017	-1.0	-0.2	-0.2	1.2	1.5	-0.3	1.1
Furniture and Other Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.8	-0.1	-1.0	1.7	-0.3	0.7	1.9
2005-2008	0.7	0.0	-0.6	1.1	-0.3	0.2	1.1
2008-2011	-0.1	0.0	-1.4	2.0	-1.2	0.9	0.3
2011-2014	-0.7	0.3	-0.6	2.0	0.3	0.9	2.2
2014-2017	-0.7	-0.7	-0.2	1.4	0.4	0.2	0.4
Electricity, Gas, Water and Waste Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-1.0	-0.8	-1.0	1.7	-0.6	-0.1	-1.8
2005-2008	0.2	-0.1	-1.5	1.5	-1.3	-0.7	-1.9
2008-2011	-1.2	-0.1	-0.1	0.9	-2.2	1.7	-1.0
2011-2014	1.6	0.6	-1.8	1.1	-1.7	0.1	-0.1
2014-2017	1.7	0.3	-2.9	0.5	-0.7	0.1	-1.0
Building Construction							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.3	-0.1	-0.1	1.4	1.7	-0.4	2.3
2005-2008	0.7	0.1	-0.6	0.5	0.8	-0.5	1.0
2008-2011	0.6	-0.1	-0.7	0.2	1.1	-0.1	1.0
2011-2014	-0.9	0.0	0.5	0.8	1.9	0.6	2.9
2014-2017	-0.3	-0.5	0.4	0.5	1.8	0.4	2.4
Heavy and Civil Engineering Construction							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	3.5	-0.5	0.3	-1.0	0.7	0.3	3.3
2005-2008	-1.5	0.4	0.4	1.7	0.3	-0.5	0.7
2008-2011	0.0	-0.2	-0.6	-0.3	0.5	0.1	-0.4
2011-2014	-0.9	0.5	-0.2	0.8	0.9	1.5	2.7
2014-2017	-0.1	-0.5	-0.2	-0.2	1.4	-0.5	-0.1
Construction Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.0	-0.1	-0.1	1.1	1.4	-0.2	2.0
2005-2008	0.5	0.2	-0.3	1.2	0.8	0.0	2.4
2008-2011	-0.1	0.1	-0.7	1.1	0.9	0.2	1.5
2011-2014	-1.1	0.1	0.0	1.4	1.8	1.1	3.2
2014-2017	-0.6	-0.4	0.2	0.3	2.3	0.4	2.2
Wholesale Trade							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.6	-0.4	-2.3	4.7	-2.8	3.6	4.4
2005-2008	0.6	0.0	-2.9	3.9	-2.7	2.8	1.7
2008-2011	-0.5	0.3	-2.2	3.6	-1.2	4.1	4.2
2011-2014	-1.1	-0.1	-1.4	3.2	-1.3	3.6	2.9
2014-2017	-0.9	-0.4	-1.1	2.8	-1.1	3.5	2.8

Motor Vehicle and Motor Vehicle Parts and Fuel Retailing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.0	0.5	-1.4	1.7	-1.8	1.5	0.5
2005-2008	0.0	-0.1	-2.5	2.8	-2.7	2.8	0.3
2008-2011	-0.6	-0.6	-1.7	2.7	-1.6	2.8	1.0
2011-2014	-1.4	-0.1	-1.7	3.2	-0.9	2.4	1.6
2014-2017	-1.1	0.2	-1.9	2.0	-0.2	2.1	1.0
Supermarket, Grocery Stores and Specialised Food Retailing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.3	0.1	-2.4	3.3	-3.4	4.0	4.0
2005-2008	1.1	-0.7	-2.2	2.8	-2.8	3.2	1.4
2008-2011	1.0	0.1	-2.0	1.4	-2.7	2.7	0.5
2011-2014	-0.3	-0.1	-1.1	1.8	-0.6	2.6	2.3
2014-2017	-0.8	-0.2	-0.1	1.9	0.7	3.4	4.8
Other Store-Based Retailing and Non Store Retailing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.3	-0.3	-4.1	8.7	-1.7	7.1	11.0
2005-2008	0.9	-0.4	-2.2	5.9	-1.8	6.8	9.1
2008-2011	-0.4	-0.4	-2.2	5.0	0.4	4.8	7.3
2011-2014	-0.2	-0.4	-1.7	4.0	0.8	4.1	6.5
2014-2017	-1.3	-0.6	-0.8	2.8	1.4	4.8	6.4
Accommodation and Food Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.5	-0.3	-0.8	1.0	-2.6	1.5	0.4
2005-2008	1.2	-0.1	-1.0	1.3	-1.9	1.4	0.9
2008-2011	0.7	-0.3	-0.6	1.1	-1.0	1.3	1.2
2011-2014	0.0	-0.3	-0.3	1.0	-1.0	1.6	1.1
2014-2017	-0.8	0.2	-0.2	0.9	-0.5	2.1	1.7
Road Transport							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.6	-0.4	-1.1	1.3	0.0	0.7	-0.1
2005-2008	0.9	-0.1	-2.2	1.7	-2.2	-0.3	-2.1
2008-2011	1.0	0.0	-2.9	1.6	-1.3	0.2	-1.4
2011-2014	-0.6	-0.3	-1.9	2.9	-1.5	1.2	-0.2
2014-2017	-0.9	0.2	-1.5	1.7	-0.8	0.8	-0.4
Rail, Water, Air and Other Transport							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-3.6	-1.4	-1.8	6.9	-0.3	8.0	7.9
2005-2008	-0.7	0.2	-2.2	6.4	0.8	4.0	8.5
2008-2011	2.5	1.1	-1.3	3.2	-3.1	2.0	4.4
2011-2014	2.0	-1.0	-2.9	4.0	-1.0	2.5	3.6
2014-2017	0.3	-0.1	0.9	2.4	-0.1	3.1	6.4
Postal, Courier Transport Support, and Warehousing Services.							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.8	-0.2	-1.2	1.7	-1.2	1.5	1.3
2005-2008	0.1	0.2	-1.4	2.9	-0.9	0.5	1.4
2008-2011	1.0	-0.3	-2.0	1.5	-1.1	0.0	-0.9
2011-2014	-1.2	0.2	-1.5	2.0	-1.8	2.3	0.0
2014-2017	0.7	-0.6	-0.9	1.9	-1.5	1.5	1.1
Information Media Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.9	-0.6	-7.1	7.1	-4.7	0.8	-2.6
2005-2008	-1.0	0.9	-5.8	5.7	-1.9	2.7	0.6
2008-2011	0.1	-0.4	-6.1	8.6	0.9	2.1	5.2
2011-2014	-0.2	-1.0	-4.6	5.7	-0.5	4.8	4.2
2014-2017	-4.2	0.0	-2.6	5.3	0.3	5.3	4.1

Telecommunications, Internet and Library Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	5.1	-2.8	-4.7	4.5	-7.9	7.5	1.6
2005-2008	2.8	1.4	-6.1	3.4	-5.1	11.0	7.4
2008-2011	3.5	0.1	-1.5	7.3	0.6	1.4	11.4
2011-2014	-2.2	0.2	-1.2	4.8	2.6	5.2	9.3
2014-2017	-2.3	-0.1	-0.8	0.9	-1.5	3.2	-0.5
Financial and Insurance Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	5.3	-0.2	-7.2	15.3	-9.5	3.7	7.4
2005-2008	0.4	1.0	-12.0	11.1	-11.2	5.3	-5.4
2008-2011	0.3	4.9	-9.3	3.4	-7.5	3.1	-5.2
2011-2014	3.0	2.6	-9.7	4.8	-5.5	6.7	1.8
2014-2017	-3.8	-0.4	-6.1	10.5	-1.8	6.2	4.6
Auxiliary Finance and Insurance Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.6	-0.3	-4.0	2.5	-3.7	2.1	-0.8
2005-2008	-0.4	1.0	-3.0	1.1	-4.6	1.1	-4.9
2008-2011	-0.5	0.2	-2.4	1.8	-1.2	3.5	1.4
2011-2014	2.4	2.0	-5.3	0.0	-2.4	3.1	-0.1
2014-2017	0.0	-0.3	-2.6	3.1	-0.3	2.4	2.4
Rental and Hiring Services (except Real Estate)							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.2	-1.1	-5.4	5.1	-3.1	4.4	2.1
2005-2008	2.3	1.3	-4.4	7.9	-3.0	7.0	11.1
2008-2011	0.0	1.2	-2.9	2.7	-3.0	3.2	1.2
2011-2014	1.1	1.3	-2.3	0.9	-1.0	2.5	2.5
2014-2017	-0.7	-1.7	-0.7	4.0	0.8	3.3	5.0
Professional, Scientific and Technical Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.8	0.2	-1.4	2.4	1.7	-0.4	3.4
2005-2008	0.0	0.0	-0.7	1.7	1.6	-0.2	2.4
2008-2011	-0.4	-0.1	-1.4	1.8	1.5	0.7	2.1
2011-2014	-1.3	0.1	-1.1	1.5	2.1	1.2	2.6
2014-2017	-1.1	-1.5	0.0	1.5	3.2	1.6	3.6
Administrative and Support Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.3	0.1	-0.8	3.1	-0.5	0.9	3.1
2005-2008	0.7	0.3	-1.5	0.9	-0.9	0.6	0.1
2008-2011	0.6	-0.2	-1.5	1.0	-1.1	1.0	-0.1
2011-2014	-0.4	0.3	-1.2	2.2	-0.6	1.7	2.0
2014-2017	-0.9	-1.2	-0.4	1.5	1.2	2.2	2.5
Arts and Recreation Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.9	0.0	-0.6	3.4	0.1	-0.3	4.4
2005-2008	0.7	-0.3	-2.1	1.8	0.1	-1.0	-0.7
2008-2011	0.6	0.6	-2.5	5.1	1.5	-1.4	3.9
2011-2014	0.0	-0.3	-2.0	3.7	2.0	0.1	3.6
2014-2017	-1.4	0.1	-0.4	2.1	0.9	0.9	2.2
Other Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.9	-0.1	-1.0	1.3	-0.8	0.7	1.0
2005-2008	0.5	-0.1	-0.7	1.1	-0.8	0.5	0.4
2008-2011	0.8	0.1	-1.2	0.8	-0.6	0.8	0.6
2011-2014	0.3	0.0	-0.6	1.3	0.1	0.6	1.7
2014-2017	-0.2	-0.1	-0.3	0.8	0.6	0.7	1.5

TABLE 11: PRODUCTIVITY GROWTH DECOMPOSITIONS BY INDUSTRY, FIRMS WITH EMPLOYEES

Diewert & Fox (2010) method, point-to-point percent changes. Excludes owner-owner firms.

Horticulture and Fruit Growing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-2.4	-1.1	-2.0	2.6	-2.1	-1.9	-6.9
2005-2008	2.1	0.3	-1.2	-0.9	-1.0	-0.3	-0.9
2008-2011	1.9	0.2	0.0	2.2	0.1	-1.2	3.2
2011-2014	0.8	0.1	-1.5	1.9	0.5	-1.7	0.1
2014-2017	0.9	-0.4	1.0	2.2	-0.8	1.1	4.0
Sheep, Beef Cattle and Grain Farming							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.8	-0.1	2.1	-2.1	-0.9	-1.0	-1.3
2005-2008	2.8	0.1	0.8	-1.0	-0.9	-0.9	1.0
2008-2011	1.2	0.1	1.8	-1.3	-0.3	-1.8	-0.3
2011-2014	0.0	0.0	-0.6	-1.5	-0.5	-0.4	-3.0
2014-2017	-0.2	-0.6	1.9	-1.1	-0.1	0.1	0.0
Dairy Cattle Farming							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.4	0.0	1.7	-1.7	2.8	-2.6	1.6
2005-2008	1.5	0.3	-0.5	-5.1	3.7	-2.7	-2.8
2008-2011	1.7	0.0	0.6	-8.2	2.4	-2.7	-6.1
2011-2014	0.7	-0.6	1.7	-4.1	2.0	0.4	0.1
2014-2017	0.8	-1.4	5.3	-1.3	3.1	1.5	8.1
Poultry, Deer and Other Livestock Farming							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-2.0	0.5	0.3	-0.7	0.2	-2.9	-4.7
2005-2008	0.3	-0.3	-0.4	0.1	1.2	-1.9	-1.0
2008-2011	1.1	-1.1	-2.3	1.4	-0.1	0.3	-0.7
2011-2014	2.4	0.5	-5.4	1.7	1.7	1.4	2.3
2014-2017	-0.4	0.2	0.3	-0.5	1.4	-1.0	0.0
Forestry and Logging							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.7	2.2	-2.4	9.3	1.3	-0.2	9.3
2005-2008	1.3	-1.6	-8.9	8.1	7.2	-4.7	1.4
2008-2011	-3.3	1.2	-4.1	9.2	4.2	-2.8	4.5
2011-2014	0.1	2.4	-7.8	5.5	4.4	-2.2	2.3
2014-2017	-0.4	1.2	-2.1	4.8	5.1	-1.5	7.0
Fishing and Aquaculture							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-3.5	-1.4	2.6	2.9	1.1	-1.5	0.3
2005-2008	-2.5	0.1	-0.3	-0.5	1.6	1.4	-0.2
2008-2011	-4.0	0.7	1.4	3.3	2.7	-0.4	3.7
2011-2014	0.1	0.0	-0.5	-4.1	0.7	-0.2	-3.9
2014-2017	-4.4	-1.4	3.6	3.5	1.0	1.6	3.9
Agriculture, Forestry and Fishing Support Services and Hunting							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	4.6	-0.3	-0.4	-3.0	2.2	-3.0	0.0
2005-2008	3.0	1.3	-1.0	-2.5	1.0	-2.7	-1.0
2008-2011	1.3	0.1	0.7	-1.2	2.4	-1.1	2.3
2011-2014	0.7	0.3	0.3	-2.4	3.4	-0.4	1.9
2014-2017	-0.9	-0.7	1.7	0.2	2.1	1.1	3.5

Mining							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-5.6	-2.0	-6.0	21.8	11.1	10.3	29.5
2005-2008	-2.3	1.5	-16.4	1.5	16.8	19.7	20.9
2008-2011	-3.2	1.9	-1.5	9.5	-1.3	-1.8	3.6
2011-2014	-5.4	4.2	-0.5	4.5	3.1	4.4	10.2
2014-2017	4.2	3.6	-19.4	6.7	-5.1	6.8	-3.2
Food, Beverage and Tobacco Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	5.7	-0.7	-1.6	-0.8	1.5	-3.0	1.1
2005-2008	-0.8	-0.6	2.5	2.5	1.3	-0.1	4.9
2008-2011	-1.0	0.3	0.4	2.3	-0.5	0.6	2.1
2011-2014	-3.1	-0.3	4.0	-1.3	0.5	-1.2	-1.4
2014-2017	-0.1	0.3	0.3	0.0	2.1	-1.0	1.7
Textile, Leather, Clothing and Footwear Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-1.2	-0.1	-0.1	0.4	-0.9	2.5	0.6
2005-2008	0.4	-0.5	0.6	2.6	2.1	-1.0	4.3
2008-2011	-0.6	1.1	4.4	-1.0	1.8	-0.7	5.0
2011-2014	-0.7	0.7	0.0	0.7	-0.8	-1.0	-1.1
2014-2017	1.5	-1.1	0.2	-0.6	2.0	-1.1	1.0
Wood and Paper Products Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.7	0.2	2.4	-1.3	0.8	-0.3	2.5
2005-2008	5.4	1.2	-3.0	-1.6	1.5	-4.5	-1.0
2008-2011	-0.4	0.3	3.1	3.6	-0.7	1.4	7.2
2011-2014	-1.5	0.3	0.2	0.5	1.0	-1.6	-1.2
2014-2017	0.8	-2.1	0.6	-1.1	1.7	1.0	1.0
Printing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.6	-0.1	0.9	-0.3	3.3	-0.2	4.2
2005-2008	-1.0	1.5	0.4	-1.2	2.0	1.8	3.5
2008-2011	4.7	1.2	-0.5	1.4	-2.9	-3.1	0.9
2011-2014	0.7	-0.1	0.3	1.3	0.9	0.9	4.0
2014-2017	0.5	-1.2	-1.4	1.3	0.9	1.8	1.9
Petroleum, Chemical, Polymer and Rubber Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	5.6	1.0	-2.3	-3.4	5.8	-3.3	3.5
2005-2008	-8.4	-2.4	6.4	0.4	1.6	-2.1	-4.4
2008-2011	2.5	-2.4	5.4	-4.1	2.5	0.7	4.6
2011-2014	-7.8	-0.2	5.9	-0.6	-0.4	0.3	-2.7
2014-2017	2.6	0.6	2.8	-2.3	5.5	-8.6	0.5
Non-Metallic Mineral Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.5	2.3	1.1	0.7	1.9	-3.9	1.6
2005-2008	8.6	-11.4	-2.5	0.3	6.1	-1.5	-0.4
2008-2011	0.7	3.1	2.6	-0.3	4.7	0.4	11.1
2011-2014	4.9	-0.9	4.2	-2.7	1.8	-4.5	2.8
2014-2017	-2.7	0.4	1.1	0.6	4.2	1.1	4.8
Metal Product Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.6	-0.6	1.2	-2.8	3.2	-3.7	-0.1
2005-2008	1.8	-0.1	1.1	-0.9	0.3	-3.1	-0.9
2008-2011	0.4	0.2	-0.3	-1.0	-1.6	-1.8	-4.0
2011-2014	-2.0	0.7	-1.2	-1.0	1.0	1.3	-1.2
2014-2017	0.9	-1.1	-1.1	0.6	0.7	-1.0	-1.0

Transport Equipment Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.1	1.0	-0.6	0.3	5.2	-1.6	4.3
2005-2008	7.0	0.9	-4.2	-0.9	4.6	-4.8	2.7
2008-2011	2.7	0.5	-6.5	2.8	3.5	-3.2	-0.2
2011-2014	-1.3	-0.2	3.7	-1.5	8.4	-5.0	4.1
2014-2017	1.2	0.3	0.7	-3.8	4.1	-3.4	-0.9
Machinery and Other Equipment Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.7	1.0	1.6	-2.8	5.8	-3.1	1.8
2005-2008	-3.0	0.9	2.1	4.1	6.0	-1.5	8.6
2008-2011	-2.6	1.0	0.7	1.8	3.9	-2.2	2.5
2011-2014	-2.2	-0.3	2.9	-0.3	4.9	-0.4	4.6
2014-2017	-2.6	-0.8	0.4	1.2	3.7	-1.4	0.5
Furniture and Other Manufacturing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.1	0.1	-0.9	2.1	0.5	0.3	1.9
2005-2008	0.4	0.3	1.0	-0.2	1.3	-0.9	1.9
2008-2011	-1.3	0.1	-0.4	2.2	-1.0	0.4	-0.1
2011-2014	-3.5	0.6	1.2	3.6	1.4	0.7	4.0
2014-2017	0.3	-1.6	0.1	0.9	1.3	-0.7	0.3
Electricity, Gas, Water and Waste Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-4.7	-0.5	-0.2	-0.9	2.5	-0.1	-4.0
2005-2008	-2.0	1.5	-0.7	0.9	0.9	-0.3	0.2
2008-2011	-0.7	0.5	0.2	0.5	-2.0	0.7	-0.9
2011-2014	1.7	0.8	-1.9	-0.9	-0.4	0.5	-0.2
2014-2017	-0.3	0.0	-2.8	-0.5	2.9	-0.8	-1.5
Building Construction							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-1.0	0.2	0.0	0.5	2.6	-0.9	1.4
2005-2008	1.0	0.0	0.0	-0.7	1.6	-1.4	0.6
2008-2011	1.4	0.0	-0.1	-0.8	2.1	-0.4	2.2
2011-2014	-1.5	-0.2	1.9	0.1	3.0	0.4	3.8
2014-2017	0.0	-1.3	1.1	-0.3	2.8	-0.1	2.2
Heavy and Civil Engineering Construction							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	11.4	0.8	0.9	-6.1	4.4	-1.9	9.6
2005-2008	-4.0	0.3	4.1	0.1	5.3	-3.8	2.2
2008-2011	-0.4	-1.3	2.0	-3.1	3.2	0.3	0.6
2011-2014	-2.7	1.1	0.3	1.1	3.6	2.8	6.2
2014-2017	-2.1	-2.6	0.1	-2.4	7.0	-1.4	-1.5
Construction Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.1	0.0	0.1	0.5	2.3	-0.9	2.1
2005-2008	0.9	0.3	-0.4	0.4	1.5	-0.6	2.1
2008-2011	-0.2	0.3	-0.5	0.8	1.7	-0.3	1.7
2011-2014	-1.4	0.0	0.8	1.3	2.6	1.0	4.2
2014-2017	-1.0	-1.1	0.8	-0.2	3.3	0.6	2.3
Wholesale Trade							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.9	0.0	0.2	2.1	1.6	2.4	8.3
2005-2008	2.5	0.3	-2.5	-0.1	1.3	-0.7	0.8
2008-2011	-1.6	0.4	0.6	1.3	3.0	2.4	6.1
2011-2014	-2.4	-0.1	1.6	1.3	2.8	1.8	5.0
2014-2017	-0.9	-2.1	0.8	0.1	3.1	2.1	3.1

Motor Vehicle and Motor Vehicle Parts and Fuel Retailing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.8	1.2	-0.8	-5.6	1.1	-1.9	-3.3
2005-2008	-0.5	-0.6	-4.5	3.7	-2.0	2.7	-1.1
2008-2011	-1.3	-0.3	-1.3	4.1	0.1	3.0	4.2
2011-2014	-1.1	0.0	-1.8	3.0	-1.0	1.3	0.4
2014-2017	-3.7	-1.8	-2.6	1.5	0.5	0.2	-6.0
Supermarket, Grocery Stores and Specialised Food Retailing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	3.7	-0.1	-1.3	1.5	-2.3	1.6	3.1
2005-2008	-1.5	-0.3	-1.6	2.9	-1.1	2.1	0.5
2008-2011	-1.0	0.5	0.7	0.6	-1.1	1.6	1.3
2011-2014	-1.9	-0.5	1.4	-0.2	-0.1	1.0	-0.3
2014-2017	-1.2	-1.8	1.3	0.4	2.6	4.0	5.4
Other Store-Based Retailing and Non Store Retailing							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	2.5	-0.9	0.4	4.7	5.7	5.8	18.1
2005-2008	1.6	-0.5	3.4	2.3	3.1	6.9	16.8
2008-2011	0.7	-0.9	3.0	2.5	5.2	1.7	12.2
2011-2014	1.3	-1.2	0.7	3.5	5.1	2.7	12.2
2014-2017	-0.9	-2.3	1.0	2.6	3.3	4.9	8.5
Accommodation and Food Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.5	0.3	1.5	-2.0	-3.5	-1.5	-3.6
2005-2008	1.0	0.2	2.5	0.3	-1.6	-1.0	1.4
2008-2011	-0.1	-0.4	3.8	-1.7	0.4	-1.8	0.2
2011-2014	-0.2	-0.6	2.9	-0.6	0.0	0.2	1.8
2014-2017	-1.8	0.2	3.0	1.4	-0.7	2.2	4.4
Road Transport							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-2.4	0.2	-1.0	0.1	1.2	0.2	-1.7
2005-2008	1.9	-0.3	-1.7	0.6	-2.1	-1.3	-2.9
2008-2011	1.2	-0.1	-2.1	0.2	-1.2	-0.9	-2.8
2011-2014	-0.7	-0.3	-0.7	2.0	-1.0	0.4	-0.3
2014-2017	-1.3	0.1	-0.6	0.7	0.1	0.3	-0.6
Rail, Water, Air and Other Transport							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.6	2.2	-1.2	0.4	6.8	7.5	15.1
2005-2008	0.1	-1.1	2.7	0.3	13.3	-1.6	13.9
2008-2011	5.8	-0.3	4.1	-0.5	-2.2	-1.8	5.1
2011-2014	2.4	-0.9	1.4	0.6	0.9	1.5	6.0
2014-2017	3.6	0.1	1.7	2.6	1.8	2.5	12.2
Postal, Courier Transport Support, and Warehousing Services.							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.5	0.3	-1.9	0.9	0.5	0.0	0.2
2005-2008	-0.8	0.4	-0.7	1.9	0.6	-1.5	-0.1
2008-2011	3.1	-0.1	-1.7	-0.5	0.1	-2.4	-1.5
2011-2014	-1.6	0.2	-0.1	0.8	0.6	0.6	0.4
2014-2017	1.7	-0.5	-1.2	1.0	0.4	-0.2	1.3
Information Media Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.9	0.2	-8.4	7.0	-1.8	-1.4	-2.5
2005-2008	-4.3	0.4	-2.5	4.9	1.0	2.0	1.5
2008-2011	-1.7	-0.8	-3.9	11.6	4.6	1.5	11.2
2011-2014	0.0	-2.2	-4.4	6.8	0.4	4.6	5.3
2014-2017	-2.4	-0.5	-3.1	5.6	3.5	5.3	8.5

Telecommunications, Internet and Library Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-1.1	-4.2	-5.5	12.2	-2.1	13.4	12.6
2005-2008	6.5	1.5	-7.2	8.9	0.1	10.9	20.8
2008-2011	-2.4	1.8	-0.1	7.0	6.6	-3.1	9.8
2011-2014	-1.3	0.3	-2.3	6.4	9.9	1.0	14.0
2014-2017	1.8	-1.9	-3.4	-4.7	1.9	-1.9	-8.2
Financial and Insurance Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	4.2	2.1	1.8	-3.2	10.7	-4.8	10.7
2005-2008	2.0	0.9	3.2	-2.8	3.3	-12.1	-5.6
2008-2011	-9.7	2.6	7.3	0.6	8.6	-4.3	5.0
2011-2014	2.0	-1.3	5.4	-6.9	4.8	-3.8	0.2
2014-2017	-5.5	3.3	2.7	4.3	4.0	-3.8	5.1
Auxiliary Finance and Insurance Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	-0.3	0.4	-2.5	1.6	-0.7	1.1	-0.3
2005-2008	-2.2	0.8	-2.2	1.3	-1.0	-0.3	-3.7
2008-2011	-2.0	1.0	-3.1	0.6	3.6	0.8	0.9
2011-2014	3.3	0.7	-5.4	-0.7	1.0	2.5	1.4
2014-2017	0.0	-0.1	-0.1	2.1	3.2	1.6	6.8
Rental and Hiring Services (except Real Estate)							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	3.2	0.0	-4.0	-0.4	-0.4	2.4	0.8
2005-2008	-0.4	0.9	-0.8	5.5	0.9	5.5	11.7
2008-2011	0.0	1.7	-1.3	-2.9	-2.3	1.3	-3.5
2011-2014	0.8	1.1	4.9	-2.7	1.1	-0.9	4.3
2014-2017	0.7	-2.8	2.3	2.9	5.1	-1.1	7.1
Professional, Scientific and Technical Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.5	0.3	-0.9	1.3	5.7	-2.1	4.9
2005-2008	-0.4	0.0	0.5	0.8	5.0	-1.8	4.1
2008-2011	-1.0	0.0	-1.2	1.4	4.1	-0.6	2.7
2011-2014	-1.4	0.0	-0.8	1.4	4.1	-0.1	3.2
2014-2017	-1.5	-2.6	0.8	1.6	5.9	1.0	5.2
Administrative and Support Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	0.1	0.6	-0.6	0.5	2.4	0.0	3.0
2005-2008	1.1	0.3	-0.4	-1.0	0.2	-1.0	-0.9
2008-2011	0.0	0.3	-0.1	0.5	0.1	-0.3	0.5
2011-2014	-0.3	-0.4	0.1	2.0	0.6	0.8	2.8
2014-2017	-0.6	-1.5	0.9	0.7	2.1	1.3	2.8
Arts and Recreation Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.4	0.6	-0.8	3.5	1.0	-1.0	4.7
2005-2008	0.0	-0.3	-1.1	-0.7	1.4	-1.8	-2.5
2008-2011	-0.7	0.4	-1.4	5.7	2.9	-1.6	5.3
2011-2014	-0.1	0.5	-0.7	3.4	2.6	-0.2	5.4
2014-2017	-1.8	-0.7	1.9	1.0	1.6	1.1	3.1
Other Services							
Years	**Within**	**Between**	**Join**	**Leave**	**Entry**	**Exit**	**Total**
2002-2005	1.7	0.2	-1.4	0.7	-0.1	0.1	1.3
2005-2008	0.4	-0.3	-0.7	1.2	0.0	0.0	0.5
2008-2011	0.5	0.1	-1.1	0.3	0.3	0.4	0.5
2011-2014	-0.3	0.3	0.8	1.1	2.3	-0.1	4.2
2014-2017	0.0	-0.1	0.1	0.4	2.0	0.3	2.7