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Firm Dynamics and Productivity Growth in Australian Manufacturing and Business Services

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Firm Dynamics and Productivity Growth in Australian Manufacturing and Business Services

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AUSTRALIAN BUREAU OF STATISTICS

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FIRM DYNAMICS AND PRODUCTIVITY GROWTH IN AUSTRALIAN MANUFACTURING AND BUSINESS SERVICES

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Australian Bureau of Statistics

ABSTRACT

Competitive markets foster the reallocation of inputs where resources are channelled from less competitive to more competitive firms, and hence increase aggregate productivity. The turnover of firms entering and exiting industries is part of this competitive process as entrants vie for market shares and exiters cease consuming inputs. There is a large body of theoretical and empirical work on firm dynamics, yet to date very few large scale studies have been conducted in Australia due to limited access to firm-level data. This study uses a large panel of businesses, drawn from administrative data provided to the Australian Bureau of Statistics (ABS), which allows us to track firms over the nine years from 2002–03 to 2010–11. Using this comprehensive panel we examine the productivity of firms in manufacturing and business services and, in particular measure the contribution of entry and exit to aggregate productivity growth.

We find that exiting firms not only have low productivity relative to established firms in the year prior to exit, but the productivity gap is observed many years before they depart the market. Entrants grow most rapidly in their second year of operation, but after five years are still ten per cent below the productivity level of established firms. At the division level, the main driver of productivity growth is continuing firms, and the net impact of firm turnover is relatively modest. However, among the studied industries, net entry can be significant – a fact masked by the higher level of aggregation. Over the nine year period, entry lowered aggregate productivity growth by 13 per cent in manufacturing and 23 per cent in business services as entrants were less productive than continuing firms. In contrast, exiting firms raised productivity by 12 per cent in manufacturing, and 23 per cent in business services.

1. INTRODUCTION

Firm entry and exit are important sources of business dynamics and in many cases have reshaped the picture of industry productivity growth over the years. The Schumpeterian concept of "creative destruction" attaches great importance to competition arising from entry and exit as the driving force behind aggregate productivity growth. As a result of successive waves of entry, exit and continuous resource reallocation from less productive to more productive firms, the industry productivity landscape evolves. This paper contributes to the study of micro-level productivity growth by evaluating these claims empirically using firm-level data for manufacturing and selected classes in business services in Australia. The data used in this study are drawn from comprehensive administrative data provided to the Australian Bureau of Statistics (ABS) and the ABS Business Register, which permit us to track a large panel of businesses over nine years from 2002–03 to 2010–11.

Since new firms are perceived to be innovative, their success in surviving and improving productivity post-entry is of great interest to business owners, credit lenders, economists and policy makers. Likewise, understanding of the productivity characteristics of exiting firms prior to their market departure is central to designing industry productivity-enhancing policies. Our analysis shows that entering and exiting firms in the industries studied have lower productivity than continuing firms. There is evidence of productivity catch-up for new firms post-entry with the productivity of entering firms increasing most in their second year of operation. Exiting firms exhibit consistently low productivity for years prior to exit. At exit, the productivity gap between continuers and exiters is more pronounced for firms in business services than in manufacturing.

In determining the firm contribution to aggregate productivity growth, we adopt the decomposition frameworks developed by Diewert and Fox (DF) (2010) and Melitz and Polanec (MP) (2013) to obtain the productivity contributions of entrants, exiters; within-firm productivity growth; and compositional shifts (i.e. between-firm).

We find that entrants lower aggregate productivity in their year of entry as they establish market share, while exiting firms raise industry productivity by ceasing to operate. For manufacturing, the net impact of entry and exit at the division level is modest while the within-firm effect dominates overall labour productivity growth. In business services, net entry accounts for about 15% of the change in overall labour productivity and the between-firm effect is large for the early years of the sample.

The paper is structured as follows. Section 2 describes the methodology. Section 3 details the data used and describes certain traits of entering and exiting firms. Section 4 presents the results of the productivity decompositions and the impact of entering and exiting firms to aggregate productivity growth. Section 5 concludes.

2. METHODOLOGY

In this section, we will examine the method of assessing the contribution of firm entry and exit to aggregate productivity growth. Several different but related methods have been suggested in the literature to decompose productivity growth (see Balk, 2014 for an extensive summary). A key feature that distinguishes these methods is the reference productivity level(s) or benchmark chosen to measure the contribution of firm entry and exit. Often, preference of one method over another is based on whether a benchmark is justifiable given the assumptions a researcher makes about the replacement process.

In this study, we apply methods proposed by DF (2010) and MP (2013), which depart from the existing literature by introducing two separate productivity level benchmarks for measuring the impact of firm entry and exit. The key argument of these methods is that comparing entering and exiting units to separate firm populations that are present at the points of entry and exit is more natural than using a single overall benchmark for comparison. We discuss why we agree with this view through evaluating counterfactual scenarios in Section 2.2. DF (2010) and MP (2013) are identical in their derivation of entry and exit, yet differ in their treatment of continuing units. We use both of these methods for sensitivity analysis and to better quantify key results.

DF and MP can be derived in two stages: the first decomposes the change in aggregate productivity into the contributions of continuing, entering and exiting firms. It will suffice to assess the contribution to productivity of these subsets without stepping into micro-data if the aggregate shares and productivity of these groups are known (de Haan and van den Berg, 2011). The second stage focuses on the disaggregated results of individual contributions and allow the measurement of the within-firm productivity changes of continuing firms and productivity changes due to changes in market shares of high-productivity and low-productivity continuing firms. The first stage of the decomposition and our added support via the development of counterfactual scenarios are summarised below. The second stage of the decomposition is further elaborated in Appendix A.3 and Appendix A.4.

2.1 Productivity growth contribution of the sub-aggregates

Let C denote the set of continuing firms which are present in both period 0 and 1. N and X are used to denote the sets of new firms and exiting firms that are present only in period 1 and 0, respectively.

Productivity growth from period 0 to 1 can be written as

$$\begin{aligned} P^1 - P^0 &= \sum_{i\in C} s_i^1 P_i^1 - \sum_{i\in C} s_i^0 P_i^0 + \sum_{i\in N} s_i^1 P_i^1 - \sum_{i\in X} s_i^0 P_i^0 \\ &= s_C^1 \sum_{i\in C} s_{Ci}^1 P_i^1 - s_C^0 \sum_{i\in C} s_{Ci}^0 P_i^0 + s_N^1 \sum_{i\in N} s_{Ni}^1 P_i^1 - s_X^0 \sum_{i\in X} s_{Xi}^0 P_i^0 \\ &= s_C^1 P_C^1 - s_C^0 P_C^0 + s_N^1 P_N^1 - s_X^0 P_X^0 \quad , \end{aligned} \tag{1}$$

where s_C^1, s_C^0, s_N^1, s_X^0 and P_C^1, P_C^0, P_N^1, P_X^0 refer to the shares and productivity of the subsets of C, N and X; and s_{Ci}^1, s_{Ci}^0 , s_{Ni}^1, s_{Xi}^0 and P_{Ci}^1, P_{Ci}^0, P_{Ni}^1, P_{Xi}^0 denote the shares and productivity of individual firms in the sets to which they belong.

Making use of the property that shares of continuers in period 0 and shares of exiters add up to unity and similarly shares of continuers in period 1 and shares of new firms also add up to unity, one can write equation (1) as follows

$$\begin{aligned} P^1 - P^0 &= s_C^1 P_C^1 - s_C^0 P_C^0 + s_N^1 P_N^1 - s_X^0 P_X^0 \\ &= \left(1 - s_N^1\right) P_C^1 - \left(1 - s_X^0\right) P_C^0 + s_N^1 P_N^1 - s_X^0 P_X^0 \\ &= \left(P_C^1 - P_C^0\right) + s_N^1 \left(P_N^1 - P_C^1\right) - s_X^0 \left(P_X^0 - P_C^0\right). \end{aligned} \tag{2}$$

In the last line of the equation (2), the first group of terms denotes the contribution to productivity growth by continuing firms. In the absence of entry and exit, this is the only contributor to productivity growth. The second group of terms denotes the productivity contribution of new firms, which depends on the period 1 size of the N set and the period 1 productivity gap with the continuing firms. The last group of terms measures the contribution of exiting firms, determined by the period 0 share of the X subset and the period 0 productivity gap with continuing units.

2.2 Development of counterfactuals for entry and exit effects

Balk (2014) points out that one can choose an arbitrary scalar (therefore some degree of subjectiveness) to measure the contribution of entry and exit, though some reasonable choices exist. Here, using a counterfactual scenario, we find support for the benchmark productivity levels introduced in DF and MP.

To construct the counterfactual for entry, we assess what would have happened in the absence of entry and then examine the impact of entrants to aggregate productivity. In the presence of entrants, the productivity difference between two periods can be written as

$$\Delta P_A^{01} = \left(\sum_{i\in C} s_i^1 P_i^1 + \sum_{i\in N} s_i^1 P_i^1\right) - \sum_{i\in C} s_i^0 P_i^0 = \left(s_C^1 P_C^1 + s_N^1 P_N^1\right) - P_C^0 . \tag{3}$$

In the absence of entry, period 1 contains only continuing firms. Hence, the shares of these firms equal unity and the productivity change is

$$\Delta P \;=\; \sum s_{Ci}^{1} P_{Ci}^{1} - \sum_{i \in C} s_{i}^{0} P_{i}^{0} \;=\; P_{C}^{1} - P_{C}^{0} \,. \tag{4}$$

where s_{Ci}^{1} is the share of continuing firms that would have received in the absence of entrants.

The effect of having entrants is the difference between (3) and (4)

$$\begin{aligned} \Delta P_{Entry}^{01} &= \left(s_{C}^{1} P_{C}^{1} + s_{N}^{1} P_{N}^{1} - P_{C}^{0} \right) - \left(P_{C}^{1} - P_{C}^{0} \right) \\ &= s_{C}^{1} P_{C}^{1} + s_{N}^{1} P_{N}^{1} - P_{C}^{1} \\ &= s_{N}^{1} \left(P_{N}^{1} - P_{C}^{1} \right). \end{aligned} \tag{5}$$

The development of counterfactual for exit would follow the same reasoning, by following what would have happened to productivity change in the absence of exiting firms. The productivity change when exiting firms are included is,

$$\Delta P_{A}^{01} \;=\; \sum_{i \in C} s_{i}^{1} P_{i}^{1} - \left(\sum_{i \in C} s_{i}^{0} P_{i}^{0} + \sum_{i \in X} s_{i}^{0} P_{i}^{0} \right) \;=\; P_{C}^{1} - \left(s_{C}^{0} P_{C}^{0} + s_{X}^{0} P_{X}^{0} \right). \tag{6}$$

In the absence of exiting firms, period 0 comprises only continuing firms and hence the change in productivity that would have occurred is

$$\Delta P \;=\; \sum_{i \in C} s_{i}^{1} P_{i}^{1} - \sum_{i \in C} s_{Ci}^{0} P_{C}^{0} \;=\; P_{C}^{1} - P_{C}^{0} \,, \tag{7}$$

where s_{Ci}^{0} is the share of continuing firms that would have received in period 0 in the absence of exiting firms.

The effect of exiting firms is the difference between (6) and (7)

$$\begin{aligned} \Delta P_{Exit}^{01} &= \left(P_{C}^{1} - \left(s_{C}^{0} P_{C}^{0} + s_{X}^{0} P_{X}^{0} \right) \right) - \left(P_{C}^{1} - P_{C}^{0} \right) \\ &= P_{C}^{0} - \left(s_{C}^{0} P_{C}^{0} + s_{X}^{0} P_{X}^{0} \right) \\ &= -s_{X}^{0} \left(P_{X}^{0} - P_{C}^{0} \right). \end{aligned} \tag{8}$$

As seen in (5) and (8), the benchmark productivity levels to evaluate the contribution of entry and exit differ by the mean productivity levels of the continuing units in period 1 and 0, respectively.

3. DATA

The data used covers the period 2002–03 to 2010–11. Firm-level measures of value-added and employment are drawn from a combination of two data sets: Business Activity Statements (BAS) and Business Income Tax (BIT). These data are merged with information from the ABS Business Register to obtain industry classifications and exclude firms with complex accounting structures.[1] ABS price indices are used to calculate value-added in 2009–10 constant prices.[2] Due to restrictions on the level of detailed price indices and the need to combine ANZSIC93 and ANZSIC06 industrial classifications, we restrict our analysis to the industries in table 3.1.

3.1 Industries in scope

Division	*ANZSIC93 Classification*
Manufacturing	All except: 2190 – Cigarette and Tobacco Products 5124 – Bread and Cake Retailing (ANZSIC06 1174)
Business Services	Includes: 7810 – Scientific Research 7821 – Architectural 7822 – Surveying Services 7823 – Consulting Engineering Services 7834 – Computer Consultancy Services 7841 – Legal Services 7842 – Accounting Services 7851 – Advertising Services 7852 – Commercial Art and Display Services 7855 – Business Management Services

3.1 Descriptive statistics

Table 3.2 shows the entry and exit patterns over time for manufacturing and business services. The entry and exit rates are measured as percentages of the total firm count, total employment and total value-added. With regards to entry and exit rates measured by firm count, the harmonised definition in Scarpetta *et al.* (2002) is used. Entry rate is defined as the number of new firms divided by the total number of incumbent and entering firms in a given year. Exit rate refers to the number of firms departing the market in a given year divided by the population of origin, i.e. the incumbents in the previous year.

1 Firms with complex accounting structures are typically large businesses that operate across different industries and do not lodge all relevant information under one unique identifier. Consequently, including these firms will add a layer of complexity to the identification of firm entry and exit.

2 See the Appendix for a more thorough discussion of how we derive full-time equivalent employees and the deflators used.

3.2 Entry and exit patterns, 2003–04 to 2010–11

	Firm count		*Employment*		*Value added*	
	Entry rate	*Exit rate*	*Entry rate*	*Exit rate*	*Entry rate*	*Exit rate*
	%	%	%	%	%	%
Manufacturing						
2003–04	11.23	9.21	4.35	3.06	2.52	1.80
2004–05	10.67	9.29	4.53	3.51	2.56	2.19
2005–06	9.96	9.80	4.16	3.45	2.53	2.32
2006–07	9.44	10.35	4.03	3.58	2.97	2.45
2007–08	8.55	10.59	3.50	3.91	2.07	2.41
2008–09	7.05	10.61	3.13	3.63	2.06	2.30
2009–10	8.24	9.87	2.99	3.41	1.63	1.97
2010–11	7.51	10.43	2.82	3.48	1.48	1.93
2003–04 to 2010–11	9.08	10.02	3.70	3.51	2.22	2.17
Business Services						
2003–04	14.25	10.69	8.43	5.58	4.87	2.68
2004–05	13.53	10.52	7.96	5.50	4.67	2.83
2005–06	12.50	10.57	7.32	5.35	4.53	2.50
2006–07	12.74	10.58	7.67	5.31	5.62	2.69
2007–08	11.04	10.96	6.62	5.42	4.45	2.66
2008–09	9.90	11.01	5.42	4.97	3.46	2.49
2009–10	12.99	10.30	6.79	4.69	3.71	2.09
2010–11	11.41	11.09	5.76	6.26	3.47	3.19
2003–04 to 2010–11	12.27	10.72	6.92	5.38	4.30	2.64

Measured by firm count, the average annual entry and exit rates are 9.08% and 10.02% for manufacturing and 12.27% and 10.72% for business services. In both sectors, the entry rate bottomed and exit rate peaked in 2008–09, around the beginning of the Global Financial Crisis. In manufacturing, a revival of firm entry rate by firm count was seen in 2009–10. However, the increase in the number of entrants in this year did not translate into higher shares for entrants measured in employment or value-added output. This seems to lend support to the theory of experimentation, in which firms start out small, and under uncertainty, learn about the business environment and their capabilities.

Measured against total employment and value-added, entering and exiting firms account for smaller shares than by firm count. For the period 2003–04 to 2010–11, entry rates measured in employment (value-added) shares are 3.7% (2.22%) and 6.92% (4.3%) for manufacturing and business services, respectively. The difference in entry and exit rates of these alternative measures reflects the relative small size (compared to continuing firms) of entering and exiting firms in employment and production. This evidence is consistent with international observations that entrants are smaller on average than incumbents (Scarpetta *et al.*, 2002; Ciobanu and Wang, 2012; Harrison and Laincz, 2008).

Table 3.3 details the average entry and exit rates at the ANZSIC subdivision in manufacturing and class level in business services. While firm entry and exit rates by firm count vary noticeably across industries, industries in manufacturing tend to have more similar entry and exit rates than in business services. In a number of manufacturing subdivisions, a negative association of entry and exit rates is evident. Textile, Clothing, Footwear and Leather has the highest exit rate while exhibiting low entry rate. Conversely, Food and Beverage shows high entry and moderate exit rates. While it is hard to pinpoint all reasons for this negative correlation, it may reflect the role of sectoral profitability shocks; that is, industries with positive profit shocks will have high entry and low exit rates, whereas 'sunset' industries show high exit and low entry rates.

In business services, the classes with high entry rates are mostly associated with high exit rates. Legal Services has the lowest entry and exit rates, while Advertising Services displays the highest entry and exit rates.

3.3 Sample characteristics

		Firm count		*Employment*		*Value added*	
Industry	*N*	*Entry*	*Exit*	*Entry*	*Exit*	*Entry*	*Exit*
		%	%	%	%	%	%
Manufacturing	76,383	9.08	10.02	3.70	3.51	2.22	2.17
21 – Food and Beverages	6,143	10.65	9.93	4.15	4.02	2.07	2.64
22 – Textile, Clothing, Footwear and Leather	8,095	8.59	12.87	3.51	4.33	1.82	2.62
23 – Wood and Paper Products	5,678	8.95	9.86	4.08	3.63	2.32	2.34
24 – Printing, Publishing and Recorded Media	6,999	8.58	10.30	3.66	3.96	2.17	2.84
25 – Petroleum, Coal, Chemical and Associated Products	4,903	8.92	8.89	2.90	2.49	1.82	1.56
26 – Non-Metallic Mineral Products	3,444	8.77	10.31	4.05	3.84	2.39	1.92
27 – Metal Products	15,205	9.98	9.70	3.84	3.12	2.59	2.17
28 – Machinery and Equipment	15,321	8.92	9.20	3.57	3.22	2.19	1.79
29 – Other Manufacturing	10,595	8.39	9.82	3.69	3.76	2.19	2.43
Business Services	163,335	12.27	10.72	6.92	5.38	4.30	2.64
7810 – Scientific Research	2,472	12.49	9.35	4.56	2.84	4.11	1.76
7821 – Architectural Services	12,625	9.01	9.27	5.37	4.52	3.64	2.27
7822 – Surveying Services	3,016	8.58	7.96	3.95	2.87	3.17	1.74
7823 – Consulting Engineering Services	25,932	10.10	9.38	5.30	4.58	3.45	2.31
7834 – Computer Consultancy Services	36,558	13.84	12.52	7.01	5.92	4.02	2.60
7841 – Legal Services	15,255	7.73	6.38	6.29	3.80	4.21	2.28
7842 – Accounting Services	26,251	11.17	9.85	7.38	5.49	4.78	3.06
7851 – Advertising Services	9,043	14.45	13.93	7.75	6.83	3.63	2.86
7852 – Commercial Art and Display Services	10,494	12.44	11.75	6.95	6.33	3.81	2.52
7855 – Business Management Services	39,838	15.41	11.94	8.96	6.41	6.02	3.41

3.4 Inter-temporal correlation for entry rate, by firm count

	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Manufacturing								
2004	1							
2005	0.64	1						
2006	0.79	0.88	1					
2007	0.86	0.48	0.60	1				
2008	0.66	0.74	0.85	0.77	1			
2009	0.31	0.67	0.54	0.45	0.71	1		
2010	0.54	0.63	0.74	0.66	0.90	0.60	1	
2011	0.66	0.74	0.85	0.77	1.00	0.71	0.90	1
Business Services								
2004	1							
2005	1.00	1						
2006	0.89	0.89	1					
2007	0.89	0.89	1.00	1				
2008	1.00	1.00	0.89	0.89	1			
2009	0.97	0.97	0.86	0.86	0.97	1		
2010	0.86	0.86	0.97	0.97	0.86	0.89	1	
2011	0.86	0.86	0.97	0.97	0.86	0.89	1.00	1

3.5 Inter-temporal correlation for exit rate, by firm count

	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Manufacturing								
2004	1							
2005	1.00	1						
2006	0.65	0.65	1					
2007	0.82	0.82	0.84	1				
2008	0.29	0.29	0.63	0.48	1			
2009	0.00	0.00	0.35	0.25	0.67	1		
2010	0.53	0.53	0.56	0.73	0.75	0.44	1	
2011	–0.15	–0.15	–0.13	0.01	0.26	0.72	0.31	1
Business Services								
2004	1							
2005	1.00	1						
2006	1.00	1.00	1					
2007	1.00	1.00	1.00	1				
2008	1.00	1.00	1.00	1.00	1			
2009	1.00	1.00	1.00	1.00	1.00	1		
2010	1.00	1.00	1.00	1.00	1.00	1.00	1	
2011	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1

Next, we look at the persistence of entry and exit rates over time, which is thought to be influenced by industry-specific factors. The inter-temporal correlation in tables 3.4 and 3.5 indicates whether a higher than average entry or exit rate (by firm count) in one year is associated with a higher than average entry or exit rate in other years. In business services, both entry and exit rates are consistently high. In manufacturing, the inter-temporal correlation is positive for both entry and exit rates (except for exit rate in 2011). The degree of persistence for entry and exit rates in manufacturing is smaller than those in business services and considerably weakened since 2008–09.

3.6 Inter-temporal correlation between entry and exit rates

	Year of entry							
Year of exit	*2003–04*	*2004–05*	*2005–06*	*2006–07*	*2007–08*	*2008–09*	*2009–10*	*2010–11*
Manufacturing								
2003–04	0.17							
2004–05		–0.25						
2005–06			–0.19					
2006–07				0.07				
2007–08					–0.53			
2008–09						0.09		
2009–10							–0.36	
2010–11								0.32
Business Services								
2003–04	0.86							
2004–05		0.86						
2005–06			0.97					
2006–07				0.97				
2007–08					0.86			
2008–09						0.89		
2009–10							1.00	
2010–11								1.00

Table 3.6 shows the degree of correlation between entry and exit counts for industries over time. The high positive correlation indicates that industries with higher than average entry rates also tend to have higher than average exit rates, contemporaneously. For the period 2003–04 to 2010–11, the average correlation of entry and exit rates is –0.08 for manufacturing and 0.92 for business services. The observation of high entry associated with high exit rates in business services exemplifies the concept of creative destruction that entrants replace unproductive exiting firms, leaving the number of firms in the industry relatively constant. This result is in line with Bartelsman *et al.* (2004), who find that entry and exit rates are positively correlated in most countries they study.

Table 3.7 provides descriptive statistics on firms included in our study. It records averages of revenue (column 2), intermediate inputs (column 3), value-added per full-time equivalent (column 4), and full-time equivalent employees (column 5). Firms in manufacturing are larger than in business services both in revenue and employment size. However, value added in manufacturing firms accounts for a smaller proportion of revenue. The firms in our sample are relatively small, which is a consequence of excluding firms with complex accounting structures.

3.7 Summary statistics

Industry	*Revenue*	*Int. Inputs*	*VA per FTE*	*FTE*
	'000	'000		
Manufacturing	1,314.0	891.3	54,219	5.75
21 – Food and Beverages	2,312.1	1,724.6	55,973	7.11
22 – Textile, Clothing, Footwear and Leather	769.1	523.4	38,000	4.95
23 – Wood and Paper Products	1,333.7	920.5	55,203	5.72
24 – Printing, Publishing and Recorded Media	800.3	485.6	44,669	5.51
25 – Petroleum, Coal, Chemical and Associated Products	2,431.1	1,752.8	62,060	7.75
26 – Non-Metallic Mineral Products	1,218.8	800.2	57,215	5.13
27 – Metal Products	1,236.7	785.3	61,433	5.79
28 – Machinery and Equipment	1,488.0	1,007.1	60,254	5.75
29 – Other Manufacturing	853.4	557.0	47,695	4.94
Business Services	443.7	224.7	63,798	2.76
7810 – Scientific Research	861.3	640.9	33,715	5.07
7821 – Architectural Services	325.2	132.6	59,467	2.56
7822 – Surveying Services	617.3	243.8	70,715	4.42
7823 – Consulting Engineering Services	696.8	389.8	79,471	2.96
7834 – Computer Consultancy Services	350.0	157.5	47,813	2.74
7841 – Legal Services	702.8	305.6	142,214	3.08
7842 – Accounting Services	312.1	124.3	57,624	2.56
7851 – Advertising Services	710.3	504.1	52,319	2.85
7852 – Commercial Art and Display Services	254.4	138.4	38,332	2.37
7855 – Business Management Services	340.5	175.2	54,333	2.56

Note: All results are averages of deflated values over 2002–03 to 2010–11.

As we decompose aggregate productivity, it is instructive to compare ABS estimates of value-added (columns 2 and 3), labour input (columns 4 and 5) and labour productivity (columns 6 and 7) with the sample estimates. In the sample, value-added growth is 16 per cent over nine years for manufacturing while labour input declines by one and a half per cent. This results in an 18 per cent increase in labour productivity in the sample as opposed to 12 per cent in the national accounts. In business services, productivity growth is 3.8 per cent in the national accounts and 4.5 per cent in the sample. Yet value-added and labour input growth are both higher in the sample by five and four per cent respectively.

3.8 Comparison of ABS and sample totals: Value-added, Labour Inputs and Productivity

	Value-Added		*Labour input*		*Labour productivity*	
	ABS 5204	*Sample*	*ABS 5204*	*Sample*	*ABS 5204*	*Sample*
Manufacturing						
2002–03	100.00	100.00	100.00	100.00	100.00	100.00
2003–04	101.09	106.76	96.30	101.46	104.97	105.21
2004–05	99.87	105.46	97.57	102.47	102.35	102.91
2005–06	99.51	108.94	94.27	104.46	105.55	104.29
2006–07	101.43	112.68	93.67	105.45	108.28	106.86
2007–08	105.49	115.59	97.20	104.20	108.55	110.93
2008–09	100.09	108.16	93.35	100.97	107.23	107.12
2009–10	100.56	114.17	90.46	99.50	111.17	114.75
2010–11	100.61	116.32	90.17	98.58	111.58	118.00
Business Services						
2002–03	100.00	100.00	100.00	100.00	100.00	100.00
2003–04	104.79	104.52	102.51	105.05	102.22	99.49
2004–05	106.21	109.49	106.99	112.86	99.26	97.01
2005–06	110.45	116.70	115.26	121.70	95.82	95.89
2006–07	112.95	126.27	120.02	128.23	94.12	98.48
2007–08	116.50	135.04	125.97	131.85	92.49	102.41
2008–09	121.85	136.47	125.41	134.73	97.16	101.29
2009–10	131.85	137.89	133.06	136.37	99.09	101.11
2010–11	141.72	146.63	136.59	140.31	103.76	104.51

ABS cat. no. 5204.0 is the *Australian System of National Accounts*.

The differences are in part due to the exclusion of large businesses, and certain classes of services due to our difficulty of concording ANZSIC93 and ANZSIC06 classifications at the firm level. Furthermore, estimates for the growth among the classes in business services vary substantially, and hence excluding certain classes would lead to a difference with the industry aggregate.

3.2 Productivity characteristics of entrants and exiters

In this section, we examine various performance metrics of firms that enter and exit. We first consider the productivity of entering and exiting firms at the year of entry and exit, relative to that of continuing firms. Table 3.9 shows the difference in labour productivity weighted by employment shares where the productivity level of continuing units is normalised to 100. At the division level, exiting and entering firms in manufacturing are 40 per cent less productive than continuing firms, while in business services they are 54 (exiting) and 39 (entering) per cent.

3.9 Relative Labour Productivity at entry and exit, by Industry

Industry	*Exit*	*Entry*
Manufacturing	61.03	59.22
21 – Food and Beverages	64.77	48.40
22 – Textile, Clothing, Footwear and Leather	58.85	49.82
23 – Wood and Paper Products	63.46	57.03
24 – Printing, Publishing and Recorded Media	68.92	58.77
25 – Petroleum, Coal, Chemical and Associated Products	60.23	61.20
26 – Non-Metallic Mineral Products	52.17	58.61
27 – Metal Products	67.79	66.60
28 – Machinery and Equipment	54.79	60.58
29 – Other Manufacturing	63.46	57.93
Business Services	46.49	60.64
7810 – Scientific Research	62.47	88.08
7821 – Architectural Services	49.26	67.33
7822 – Surveying Services	56.95	78.19
7823 – Consulting Engineering Services	46.27	63.33
7834 – Computer Consultancy Services	41.74	56.29
7841 – Legal Services	58.47	64.04
7842 – Accounting Services	54.69	63.30
7851 – Advertising Services	36.09	47.05
7852 – Commercial Art and Display Services	39.56	52.90
7855 – Business Management Services	50.05	65.75

While the results for finer levels of classification vary, broadly they confirm that exiting and entering firms are less productive than continuing firms, which is consistent with many other Australian and international studies (Nguyen, 2009; Baldwin and Lafrance, 2011). In business services, entering firms are typically more productive than exiting firms, whereas the opposite is true for most manufacturing industries.

To assess how entering firms progress over time, we compare the share-weighted productivity of cohorts of entrants with firms that operated continuously throughout the panel. Table 3.10 contains the results for six entering cohorts. For example, column 2 gives the results for the 2003–04 cohort post entry where zero is the year of entry. The final column contains the mean of all cohorts post entry and the final value is for the 2003–04 cohort in 2010–11.

3.10 Relative Labour Productivity trajectory post-entry, by Industry

Years Post-Entry	Entry cohort 2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	Mean
				Manufacturing			
0	66.35	65.30	66.44	82.10	58.13	65.96	67.38
1	80.97	82.42	89.99	77.60	80.66	81.64	82.22
2	86.56	87.75	88.23	83.46	83.93	92.55	87.08
3	92.50	89.95	87.73	81.16	84.47		87.16
4	91.28	95.47	89.51	84.58			90.21
5	93.02	92.97	90.22				92.07
6	86.78	99.60					93.19
7	90.66						90.66
				Business Services			
0	60.15	59.59	63.69	73.95	64.31	61.50	63.86
1	83.08	85.75	85.01	80.97	86.24	80.19	83.54
2	86.90	88.12	86.93	90.54	89.86	85.29	87.94
3	91.83	87.96	93.11	92.28	89.71		90.98
4	90.41	87.10	90.19	92.89			90.15
5	91.18	89.53	91.77				90.83
6	94.43	91.73					93.08
7	98.01						98.01

Across all cohorts the pattern is similar: entrants that survive experience their largest productivity growth in the second year of operation, which may reflect that the lag in investment returns from the first year of operation are only realised in the second year. Entering firms in manufacturing go from 66 to 80 per cent as productive as established firms, and business services firms from 64 to 84 per cent, in the second year of operation. This finding supports a common observation that the entrant-incumbent productivity gap closes as time passes.

Entrants in business services generally catch up to incumbents faster than entrants in manufacturing. Three years after entry, entrants are about 90% as productive as incumbents. Similarly van der Wiel (1999), finds that entrants in business services in the Netherlands catch up to incumbents after five years.

A common finding in firm-level studies is that firms with low productivity have a higher likelihood of exit (Foster *et al.*, 2001). Similarly, Griliches and Regev (1995) use Israeli data to show the so-called "shadow of death" effect, where exiting firms experience lower productivity levels several years prior to exit. To evaluate whether this is the case we track productivity performance for cohorts of exiting firms years prior to their exit relative to continuously operating firms whose value is normalised to 100. These results are presented in table 3.11.

3.11 Relative Labour Productivity Trajectory Pre-Exit by Industry

Years Pre-Exit	Exit cohort						
	2010–11	*2009–10*	*2008–09*	*2007–08*	*2006–07*	*2005–06*	*Mean*
	Manufacturing						
8	80.35						80.35
7	77.84	81.55					79.69
6	76.36	80.78	75.57				77.57
5	76.74	79.78	75.18	77.08			77.20
4	72.28	75.44	73.47	78.97	83.49		76.73
3	73.26	71.84	71.09	78.33	74.14	77.34	74.33
2	65.40	66.78	67.65	74.56	72.67	69.25	69.39
1	52.16	54.32	58.63	57.20	62.94	61.75	57.83
	Business Services						
8	84.14						84.14
7	84.63	80.81					82.72
6	78.13	76.85	79.96				78.31
5	78.70	75.46	75.70	79.00			77.22
4	73.79	71.98	75.18	76.49	101.60		79.81
3	71.59	70.72	71.16	64.79	91.37	67.08	72.79
2	67.61	62.28	66.20	60.56	63.38	60.17	63.37
1	41.00	39.09	44.23	45.17	44.60	40.53	42.44

Firms that exit in both manufacturing and business services have productivity levels around 40 to 60 per cent below established firms in the year immediately prior to exit and are well below the productivity level of established firms years before that. The average productivity of all exiting cohorts three years prior to exit is around 27 per cent below continuously operating firms. This finding suggests that low productivity is an important determinant of firm exit. Foster *et al.* (2005) highlight the key distinction between low productivity and low profitability (arguably the 'real' reason behind firm exit), being the different pricing strategies of firms at various stages of development. As our data does not contain pricing information, this data caveat is acknowledged.

When assessing the long-term impact of entry to productivity growth, the proportion of entering firms that survive the initial years is also of interest. Table 3.12 contains the proportion of entering firms by cohort that become incumbents post entry. What is striking is the degree of similarity in survival rates in manufacturing and business services–the mean difference is only around one per cent over all years. These survival probabilities are slightly higher than those found by the OECD where around 60–70 per cent of new firms remain in operation after two years (OECD, 2001).

However, aggregate survival rates conceal the heterogeneity in surviving profiles across the constituent industries, an issue examined in table 3.13.

3.12 Proportion of entrants that survive

Years of operation	Entry cohort						Mean
	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	
	Manufacturing						
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1	87.82	85.82	85.84	84.66	85.14	84.63	85.65
2	75.11	71.51	71.90	70.67	71.77	70.20	71.86
3	64.32	61.57	61.09	60.51	60.19		61.54
4	56.17	54.35	52.82	52.30			53.91
5	49.22	48.41	46.70				48.11
6	43.80	43.03					43.42
7	39.64						39.64
	Business Services						
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1	86.27	86.69	86.46	86.00	86.74	86.29	86.41
2	72.12	72.08	72.18	71.29	72.96	70.64	71.88
3	62.05	61.12	61.43	61.26	62.18		61.61
4	53.84	53.15	53.97	52.65			53.40
5	47.41	47.27	47.54				47.41
6	42.47	41.90					42.18
7	38.20						38.20

As shown in table 3.3, entry rate in business services is higher than in manufacturing. However, the importance of entrants hinges on not only their birth rates, but also on the rate at which they exit. Table 3.13 examines cross-industry variability in survival rates for subdivisions in manufacturing and classes in business services. The survival rate for each period is the ratio of failures to total number of entrants.

In business services, new firms exhibit a higher likelihood of survival over time if they operate in Legal (7841) or Surveying (7822) Services. Specifically, a new firm has a 93% and 90% likelihood of surviving beyond its first year if it operates in these industries. On the contrary, industries that show a lower likelihood of survival include Advertising Services (7851) and Textile, Clothing, Footwear and Leather (22). These industries are characterised by very low relative labour productivity for entrants at birth as shown in table 3.9. Conversely, industries with higher entrant (relative) productivity tend to have a higher probability of surviving. Though the reasons for survival are varied and complex (e.g. industry structure and competition, industry-specific shocks, regulatory environment), relative productivity of entrants at birth seems to play a role in survival.

3.13 Survival rates of entrants, 2002–02 to 2010–11

	Duration (years post-entry)						
	1	*2*	*3*	*4*	*5*	*6*	*7*
	%	%	%	%	%	%	%
Manufacturing	85.78	72.04	61.66	54.00	48.15	43.43	39.64
21 – Food and Beverages	86.97	72.85	62.34	55.98	50.83	45.31	39.66
22 – Textile, Clothing, Footwear and Leather	83.15	67.63	56.62	47.84	41.30	36.58	33.08
23 – Wood and Paper Products	87.31	74.10	63.19	55.15	48.36	43.47	39.97
24 – Printing, Publishing and Recorded Media	85.70	71.93	61.02	53.26	46.44	40.96	36.45
25 – Petroleum, Coal, Chemical and Associated Products	86.14	72.59	62.70	54.71	49.12	42.83	38.84
26 – Non-Metallic Mineral Products	87.04	73.01	63.14	54.82	48.12	42.04	38.21
27 – Metal Products	84.60	70.83	61.10	54.07	49.03	45.80	42.93
28 – Machinery and Equipment	86.66	73.32	62.91	55.89	50.32	46.28	43.51
29 – Other Manufacturing	86.40	73.48	62.92	54.13	48.12	42.66	37.83
Business Services	86.41	71.90	61.59	53.40	47.40	42.19	38.20
7810 – Scientific Research	86.85	76.32	67.85	62.15	56.59	51.93	45.16
7821 – Architectural Services	88.00	75.00	64.99	56.36	50.00	45.23	42.86
7822 – Surveying Services	90.40	79.86	71.15	63.87	59.14	54.48	50.00
7823 – Consulting Engineering Services	88.36	75.63	66.58	58.54	52.55	47.66	42.85
7834 – Computer Consultancy Services	85.11	69.34	58.17	49.60	42.92	37.31	33.38
7841 – Legal Services	93.17	84.44	77.27	70.60	65.13	59.35	55.04
7842 – Accounting Services	87.13	73.34	62.94	55.62	49.88	45.47	40.56
7851 – Advertising Services	82.52	65.34	52.94	43.51	37.69	32.22	30.78
7852 – Commercial Art and Display Services	85.37	69.54	59.18	50.06	44.20	38.41	34.96
7855 – Business Management Services	85.56	70.08	59.62	51.49	45.79	40.64	36.44

4. DECOMPOSING LABOUR PRODUCTIVITY

We now decompose the productivity contribution of continuing firms into a within and between-firm effect (see Appendix A.3 and Appendix A.4)

Following DF, the within-firm effect measures the change in productivity of individual firms keeping their shares constant, whereas the between-firm effect is a measure of share change for individual firms keeping their productivity level unchanged. In MP, the within-firm effect reflects the unweighted mean change in productivity of continuing firms while the between-firm effect is related to the covariance between market share and productivity for continuing firms.[3]

Manufacturing

The decomposition results for the period of 2003–04 to 2010–11 are presented in table 4.1, where the components of each method sum to the overall productivity change. The final row in table 4.1 denotes the contribution to aggregate productivity change of each component for the whole period.

The dominant source of labour productivity growth is the within-firm effect – 17.04 and 10.97 percent for MP and DF respectively.[4] While the individual contributions of entry and exit are important, the net effect is small (a cumulative contribution of –1.34 per cent or –7 per cent of the aggregate change in productivity over the entire period). Further, entering firms reduce productivity growth by 13.15 per cent as new firms are typically less productive while exiting firms raises productivity by 11.81 per cent.

While the contribution of the within and between-effects varies, it is clear that during the period where aggregate productivity changes substantially (2008–09 to 2009–10), the within-firm effect is dominant. The decline in labour productivity due to the within-firm effect in 2008–09 seems to be at odds with Scarpetta *et al.* (2002)'s observation that during periods of economic contraction the contribution of the between-firm and net entry effects are more important. Compared to MP, the DF between-firm effect is more stable while the within-firm effect largely dictates aggregate productivity change.

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3 To arrive at the decomposition in productivity level, MP method involves a covariance-related common scaling factor so that the individual terms add up to total change in aggregate productivity. This somehow dilutes the interpretation that the unweighted productivity change as a pure measure of within-firm effect, and also makes it difficult to be conclusive about the direction and magnitude of differences in components' contribution arising from application of MP and DF.

4 This finding is consistent with previous Australian studies (Bland and Will, 2001; Parham, 2002; and Nguyen, 2009).

4.1 Labour productivity decomposition – Manufacturing

Year	Labour productivity growth	Within		Between		Net entry	Of which	
		MP	DF	MP	DF		Entry	Exit
2003–04	5.21	5.46	5.12	0.46	0.80	–0.71	–2.02	1.30
2004–05	–2.30	0.45	–2.67	–2.08	1.05	–0.67	–2.12	1.44
2005–06	1.38	1.83	1.36	0.13	0.60	–0.58	–1.78	1.20
2006–07	2.56	4.38	2.34	–1.86	0.18	0.04	–1.19	1.23
2007–08	4.07	2.28	2.04	1.76	2.00	0.03	–1.64	1.67
2008–09	–3.80	–5.71	–4.90	1.55	0.74	0.36	–1.18	1.54
2009–10	7.63	2.99	6.93	4.65	0.71	–0.02	–1.61	1.59
2010–11	3.25	5.35	0.74	–2.32	2.30	0.22	–1.62	1.83
2003–04 to 2010–11	18.00	17.04	10.97	2.31	8.38	–1.34	–13.15	11.81

Business Services

Table 4.2 shows the decomposition results for business services. The change in labour productivity is more modest in business services than manufacturing – 4.51 compared to 18 per cent over the entire period. Compared to manufacturing, the relative contributions of entry and exit are much larger in business services, which stems from the higher employment shares of entrants and exiting firms (see table 3.3). While the net entry effect is not large, the separate contribution of entering (–22.71) and exiting firms (23.39) is far larger than that of continuing firms (3.82). In 2008–09 and 2010–11, the exit of unproductive firms had a marked impact on aggregate productivity. Overall, the impact of entry and exit on labour productivity is more pronounced in business services than in manufacturing.

The roles that the within and between-firm effects play in lifting aggregate productivity are inconspicuous in business services. The decline in labour productivity in 2008–09 was driven by continuing units: the MP within-firm effect is positive prior to 2008–09, which indicates an increasing (unweighted) mean productivity pre-2008–09. Yet DF within-firm effect is negative prior to 2006–07. This indicates large employers were more likely to experience declining productivity than smaller-sized firms prior to 2006–07.

4.2 Labour productivity decomposition – Business Services

Year	Labour productivity growth	Within		Between		Net entry	Of which	
		MP	DF	MP	DF		Entry	Exit
2003–04	–0.51	0.50	–1.31	–0.37	1.44	–0.64	–3.86	3.22
2004–05	–2.48	1.22	–1.12	–3.12	–0.78	–0.58	–3.46	2.88
2005–06	–1.12	0.75	–3.09	–1.96	1.88	0.09	–2.83	2.92
2006–07	2.59	1.66	2.61	0.46	–0.49	0.47	–2.17	2.64
2007–08	3.94	1.40	2.02	2.20	1.58	0.34	–2.40	2.74
2008–09	–1.13	–3.28	–3.56	1.58	1.86	0.57	–2.12	2.69
2009–10	–0.17	–2.95	0.02	3.30	0.33	–0.53	–3.34	2.81
2010–11	3.39	2.59	–0.45	–0.17	2.87	0.97	–2.53	3.50
2003–04 to 2010–11	4.51	1.88	–4.87	1.94	8.69	0.68	–22.71	23.39

Most firm-level studies note the heterogeneity of productivity among firms, even in narrowly-defined industries. This is readily apparent when examining the finer industrial classifications. Tables 4.3 and 4.4 show total labour productivity change relative to 2002–03 for subdivisions in manufacturing and classes in business services.

In subdivisions where productivity growth is highest (i.e. 22, 24, and 28), the contribution of net entry is almost negligible. In these industries, while the role of between-firm is important, the key driver of aggregate productivity is the productivity improvement of continuing firms. In contrast, in productivity-lagging industries (i.e. subdivisions 25, 27), the negative effect of net entry effect is more significant.

4.3 Cumulative productivity change relative to 2002–03 – Manufacturing Subdivision

Subdivision	Labour productivity growth	Within		Between		Net entry	Of which	
		MP	DF	MP	DF		Entry	Exit
21	19.52	44.13	25.08	–18.22	0.84	–6.39	–18.20	11.81
22	33.90	25.14	26.12	8.09	7.12	0.66	–15.88	16.54
23	6.37	7.10	10.04	3.38	0.44	–4.11	–15.27	11.15
24	48.50	37.24	44.63	14.94	7.55	–3.68	–14.69	11.01
25	–0.21	15.64	1.38	–14.42	–0.16	–1.43	–8.81	7.38
26	11.88	10.61	0.16	–1.04	9.41	2.32	–14.31	16.62
27	–0.90	1.77	–0.56	–0.21	2.11	–2.46	–10.09	7.63
28	23.84	25.39	12.99	–1.95	10.44	0.40	–12.64	13.04
29	15.70	5.05	2.33	11.99	14.71	–1.35	–13.65	12.30

4.4 Cumulative productivity change relative to 2002–03 – Business Services Class

Class	Labour productivity growth	Within		Between		Net entry	Of which	
		MP	DF	MP	DF		Entry	Exit
7810	–9.62	–32.04	–11.08	18.98	–1.98	3.44	–4.41	7.85
7821	10.55	0.06	–10.02	6.11	16.19	4.39	–16.09	20.48
7822	–7.03	–4.65	1.88	–4.94	–11.46	2.56	–6.37	8.93
7823	–9.18	–12.94	–30.21	1.16	18.42	2.61	–15.92	18.52
7834	42.60	23.32	13.73	17.18	26.76	2.11	–30.08	32.18
7841	–16.05	–3.78	–4.55	–7.80	–7.03	–4.47	–16.00	11.53
7842	1.66	–0.57	–3.65	3.95	7.03	–1.72	–21.42	19.70
7851	–8.08	–5.44	–28.56	–0.68	22.44	–1.96	–31.72	29.76
7852	21.31	21.35	10.79	–5.86	4.71	5.81	–29.41	35.22
7855	20.60	12.24	22.44	9.16	–1.04	–0.80	–29.15	28.35

In business services, net entry plays a substantial role in the productivity growth of all classes, except Computer Consultancy (7834) and Business Management services (7855). The impact of exit is positive and entry negative as these firms are less productive than continuing firms. The sign of net entry term is mixed: it is positive in six of the 10 classes, but when negative is more prominent in the classes where the entrants do not have a productivity edge over exiting firms (table 3.9), such as Legal services (7841), Accounting services (7842) and Advertising services (7851). However for the division as a whole, the significance of net entry diminishes as a result of aggregation.[5]

5 Year-by-year analysis may lower the contribution of new firms as it does not include the impact of successful entrants learning. In addition, net entry is affected by the interval over which productivity growth is calculated (Scarpetta *et al.*, 2002).

5. CONCLUSION

This study examines the impact of entry and exit on productivity growth for businesses in Australian manufacturing and business services.

Entering and exiting firms in both manufacturing and business services have lower productivity than established firms. Entrants experience their largest increase in productivity in the second year of operation but after five years are still ten per cent below established firms. By tracking cohorts of exiting firms from 2002–03, we find they have lower productivity than established firms up to eight years prior to exit. At the point of exit, the productivity gap between exiting and continuing firms is more pronounced in business services than manufacturing. At a division level, survival rates of entering firms are similar in manufacturing and business services at just over seventy per cent after two years of operation.

The net impact of entry and exit is modest for manufacturing, but more significant for business services. In aggregate, entering firms lowered productivity growth by 13 per cent in manufacturing, and 23 per cent in business services. Exiting firms raised productivity growth by 12 per cent in manufacturing, and 23 per cent in business services. However at finer levels of industry classification, the results vary considerably and reinforce the notion that firm productivity is disperse even in narrowly-defined industries.

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REFERENCES

Australian Bureau of Statistics (2013) *Australian System of National Accounts*, cat. no. 5204.0, ABS, Canberra.
< http://www.abs.gov.au/AUSSTATS/abs@.nsf/MF/5204.0 >

—— (2014) *Producer Price Indexes, Australia*, cat. no. 6427.0, ABS, Canberra.
< http://www.abs.gov.au/AUSSTATS/abs@.nsf/MF/6427.0 >

Baldwin, J.R. and Lafrance, A. (2011) "Firm Turnover and Productivity Growth in Selected Canadian Services Industries, 2000 to 2007", Economic Analysis Division, Statistics Canada.
< http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1918929 >

Balk, B.M. (2014) "The Dynamics of Productivity Change: A Review of the Bottom-Up Approach", paper presented to the *IARIW–UNSW Conference on Productivity: Measurement, Drivers and Trend*, 26–27 November 2013, Sydney.
< http://www.iariw.org/papers/2013/BalkPaper.pdf >

Bartelsman, E.; Haltiwanger, J. and Scarpetta, S. (2004) *Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries*, World Bank.
< http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-3464 >

Bland, S. and Will, L. (2001) "Resource Movements and Labour Productivity, an Australian Illustration: 1994–95 to 1997–98", *Productivity Commission Staff Research Paper*, AusInfo, Canberra.

Ciobanu, O. and Wang, W. (2012) *Firm Entry and Exit in Canada, 2000 to 2008*, Economic Insights, No. 004, Statistics Canada, Catalogue no. 11-626-X.
< http://www.statcan.gc.ca/pub/11-626-x/11-626-x2012004-eng.pdf >

de Haan, J. and van den Berg, A. (2011) "Decomposing Changes in Aggregate Loan-to-Value Ratios", paper presented to the *Economic Measurement Group (EMG) Workshop*, 30 November – 2 December 2011, Sydney.

Diewert, W.E. and Fox, K.J. (2010) "On Measuring the Contribution of Entering and Exiting Firms to Aggregate Productivity Growth", in W.E. Diewert, B.M. Balk, D. Fixler, K.J. Fox and A.O. Nakamura (eds), *Price and Productivity Measurement: Volume 6 – Index Number Theory*, Trafford Publishing, Victoria, Canada.

Foster, L.; Haltiwanger, J. and Krizan, C.J. (2001) "Aggregate Productivity Growth: Lessons from Microeconomic Evidence", in C. Hulten, E. Dean and M. Harper (eds), *New Developments in Productivity Analysis*, NBER Studies in Income and Wealth, Volume 63, University of Chicago Press, Chicago.

Foster, L.; Haltiwanger, J. and Syverson, C. (2005) "Reallocation, Firm Turnover and Efficiency: Selection on Productivity or Profitability?", *NBER Working Papers*, No. 11555, National Bureau of Economic Research.

Griliches, Z. and Regev, H. (1995) "Firm Productivity in Israeli Industry: 1979–1988", *Journal of Econometrics*, 65(1), pp. 175–203.

Harrison, T.D. and Laincz, C.A. (2008) "Entry and Exit in the Nonprofit Sector", *The B.E. Journal of Economic Analysis and Policy*, 8(1).

Melitz, M.J. and Polanec, S. (2013) "Dynamic Olley–Pakes Productivity Decomposition with Entry and Exit", *NBER Working Papers*, No. 18182, National Bureau of Economic Research.

Olley, S. and Pakes, A. (1996) "The Dynamics of Productivity in the Telecommunications Equipment Industry", *Econometrica*, 64(6), pp. 1263–1297.

OECD (2001) "Productivity and Firm Dynamics: Evidence from Microdata", in *OECD Economic Outlook*, 69.
< http://www.oecd.org/eco/economicoutlookanalysisandforecasts/2079019.pdf >

Parham, D. (2002) "The Role of Exit and Entry in Australian Productivity Growth", *OECD Science, Technology and Industry Working Papers*, 2002/06, OECD Publishing.
< http://dx.doi.org/10.1787/340288838242 >

Nguyen, T.V. (2009) *Returns to Scale, Technical Progress and Firm Dynamics in Australia*, Unpublished PhD Thesis, University of New South Wales, Sydney.

Scarpetta, S.; Hemmings, P.; Tressel, T. and Woo, J. (2002) "The Role of Policy and Institutions for Productivity and Firm Dynamics: Evidence from Micro and Industry Data", *OECD Economics Department Working Papers*, No. 329, OECD Publishing.
< http://dx.doi.org/10.1787/547061627526 >

van der Wiel, H.P. (1999) *Firm Turnover in Dutch Business Services*, Research Memorandum 159, CPB Netherlands Bureau for Economic Policy Analysis, The Hague.

All URLs last viewed on 24 September 2014

APPENDIX

A.1 Deflators and Industry Classification

Using producer price indexes (ABS cat. no. 6427.0), value-added is expressed in 2009–10 constant prices. Although results in the paper are presented in terms of ANZSIC93 classifications, the ABS stopped publishing producer price indexes for ANZSIC93 in 2009. The ANZSIC06 and ANZSIC93 codes are from the ABS Business Register. Firms that entered after ABS stopped updating ANZSIC93 classifications in the Business Register were assigned an ANZSIC93 code.[6]

A.2 Construction of Full Time Equivalent employee estimates

To derive an estimate of the number of employees we use unpublished survey data from the ABS Survey of Average Weekly Earnings to derive the average weekly wage for all persons at a three digit level for manufacturing and four digit level for business services. Following this the wage bill of the firm is divided by the annualised average wage bill to calculate full time employee equivalents. Given the data set contains owner operators with no wage data, a value of one was imputed for units with zero wages and non-missing value-added.

A.3 Diewert–Fox decomposition

DF (2010) and MP (2013) depart from existing decomposition methods by introducing two separate productivity levels to derive the contribution of firm entry and exit.[7] Both DF and MP share the first-stage decomposition outlined in equation (2). In what follows, we outline the second-phases which further separate the contribution of continuing firms in two parts: one reflecting the change in productivity within firms and the other the change in shares between firms.

The contribution of continuing units as in equation (2) can be written as

$$P_C^1 - P_C^0 = \sum_{i \in C} s_{Ci}^1 p_{Ci}^1 - \sum_{i \in C} s_{Ci}^0 p_{Ci}^0 = \sum_{i \in C} s_{Ci}^1 (p_i^1 - p_i^0) + \sum_{i \in C} p_{Ci}^0 (s_{Ci}^1 - s_{Ci}^0), \qquad (9)$$

or alternatively as

$$P_C^1 - P_C^0 = \sum_{i \in C} s_{Ci}^1 p_{Ci}^1 - \sum_{i \in C} s_{Ci}^0 p_{Ci}^0 = \sum_{i \in C} s_{Ci}^0 (p_i^1 - p_i^0) + \sum_{i \in C} p_{Ci}^1 (s_{Ci}^1 - s_{Ci}^0). \qquad (10)$$

6 Note ANZSIC06 class 1174 (Non-Factory based Bakery Product Manufacturing) is excluded as it is in Retail Trade under ANZSIC93.

7 Balk (2014, 34) notes that these separate productivity levels are natural benchmarks and hence their advantage is the distribution of contributions coming from entry, exit and continuing units remain unchanged.

Both are valid but, as DF note, both fail the time reversal test.[8] This is resolved by taking the mean of equation (9) and equation (10), which leads to:

$$\begin{aligned} P_C^1 - P_C^0 &= \frac{1}{2}\sum_{i\in C}(s_{Ci}^0 + s_{Ci}^1)(p_i^1 - p_i^0) + \frac{1}{2}\sum_{i\in C}(p_{Ci}^0 + p_{Ci}^1)(s_{Ci}^1 - s_{Ci}^0) \\ &= \sum_{i\in C}\overline{s}_{Ci}\Delta p_i + \sum_{i\in C}\overline{p}_i\Delta s_{Ci}\ . \end{aligned} \tag{11}$$

The change in aggregate productivity can then be decomposed into four components,

$$\Delta P = \underbrace{\sum_{i\in C}\overline{s}_{Ci}\Delta p_i}_{\text{Within-firm}} + \underbrace{\sum_{i\in C}\overline{p}_i\Delta s_{Ci}}_{\text{Between-firm}} + \underbrace{s_N^1\left(P_N^1 - P_C^1\right)}_{\text{Entry}} - \underbrace{s_X^0\left(P_X^0 - P_C^0\right)}_{\text{Exit}}\ . \tag{12}$$

Finally to make the decomposition invariant to units of measurement all components are divided by the level of base period productivity.

A.4 Melitz–Polanec adaptation of Olley–Pakes decomposition

Olley and Pakes (1996) show that a weighted mean can be written as the sum of the unweighted mean and a covariance term:

$$\begin{aligned} P^t &= \sum s_i^t p_i^t \\ &= \sum\left(\overline{s}^t + s_i^t - \overline{s}^t\right)\left(\overline{p}^t + p_i^t - \overline{p}^t\right) \\ &= N\overline{s}^t\overline{p}^t + \sum\left(s_i^t - \overline{s}^t\right)\left(p_i^t - \overline{p}^t\right) \\ &= \overline{p}^t + \mathrm{cov}(s_i^t, p_i^t)\ . \end{aligned} \tag{13}$$

MP adapt the derivation in equation (13) for the productivity contribution of continuing firms. Productivity change for continuing units can be expressed (in a scale-independent covariance: $\tilde{\mathrm{c}}\mathrm{ov} = \frac{\mathrm{cov}}{P}$) as

$$\begin{aligned} \Delta P_C &= P_C^1 - P_C^0 = (\overline{P}_C^1 - \overline{P}_C^0) + (\mathrm{cov}_C^1 - \mathrm{cov}_C^0) \\ &= \Delta\overline{P}_C + \left(\frac{P_C^1\,\mathrm{cov}_C^1}{P_C^1} - \frac{P_C^0\,\mathrm{cov}_C^0}{P_C^0}\right) \\ &= \Delta\overline{P}_C + \left(P_C^1\,\tilde{\mathrm{c}}\mathrm{ov}_C^1 - P_C^0\,\tilde{\mathrm{c}}\mathrm{ov}_C^0\right) \\ &= \Delta\overline{P}_C + \left(\Delta P_C\,\overline{\tilde{\mathrm{c}}}\mathrm{ov}_C + \overline{P}_C\Delta\,\tilde{\mathrm{c}}\mathrm{ov}_C\right). \end{aligned} \tag{14}$$

8 The time reversal test requires that the index number comparison between any two points in time should not depend on the choice of which period is the base. Specifically, the time reversal test is satisfied if the absolute value of the change from base to end year is the same as the absolute value of the change from end to base year.

Collecting terms we have

$$\begin{aligned} \Delta P_C(1-\bar{\tilde{c}}\mathrm{ov}_C) &= \Delta \bar{P}_C + \bar{P}_C \Delta\, \tilde{c}\mathrm{ov}_C \\ \rightarrow \Delta P_C &= \frac{\Delta \bar{P}_C}{(1-\bar{\tilde{c}}\mathrm{ov}_C)} + \frac{\bar{P}_C \Delta\, \tilde{c}\mathrm{ov}_C}{(1-\bar{\tilde{c}}\mathrm{ov}_C)}\,. \end{aligned} \tag{15}$$

The change in aggregate productivity can then be decomposed into four components,

$$\Delta P = \underbrace{\frac{\Delta \bar{P}_C}{(1-\bar{\tilde{c}}\mathrm{ov}_C)}}_{\text{Within-firm}} + \underbrace{\frac{\bar{P}_C \Delta\, \tilde{c}\mathrm{ov}_C}{(1-\bar{\tilde{c}}\mathrm{ov}_C)}}_{\text{Between-firm}} + \underbrace{S_N^1\left(P_N^1 - P_C^1\right)}_{\text{Entry}} + \underbrace{S_X^0\left(P_C^0 - P_X^0\right)}_{\text{Exit}}. \tag{16}$$

Finally, to make the decomposition invariant to units of measurement, all components are divided by the base-period aggregate productivity.[9]

9 MP divide through the average of the base and end-year productivity. Here we divide through the base period productivity to make it comparable with DF.

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