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# The impact of persistent innovation on business growth

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# Abstract

This paper assesses the relationship between Australian business innovation persistence and growth performance over the period 2007–08 to 2013–14. Descriptive analysis at the economy-level and the individual business-level suggests that persistent innovators significantly outgrow their less persistent and non-innovator counterparts in terms of sales, value added, employment and profit growth. Using a new business population-level database that links administrative, tax and survey data, we are able to control for a large number of business characteristics and thus minimise selection bias. We used propensity score matching (PSM) to confirm that the average effect of persistent innovation on a wide range of growth variables is significant, positive and direct for simple-structured businesses, particularly young Small- and Medium-sized Enterprises (SMEs) that make a disproportionate contribution to economic growth. For large, complex businesses, innovation has a weaker, positive influence on turnover, profit and employment growth but the benefits of innovation persistence are not found across their entire growth distribution. We argue that persistent innovation generates a disproportionate contribution to economic growth in Australia. Rather than support persistent innovation in all businesses we argue that government business innovation policy would be most effective in supporting young SMEs to overcome the downside risk of investing in the human, organisational and capital required to build lasting innovation capability.



**JEL Codes:** O32
**Keywords:** Australia, business, business innovation, growth, sales, employment, export, profit, value-added, performance, persistence

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## Key points

- **This study measured the contribution of persistent innovation to growth dynamics in the Australian economy over the period 2007–14 using the Australian Bureau of Statistics' (ABS) Business Longitudinal Analytical Data Environment (BLADE).**
- **During this period, high sales or employment growth businesses accounted for over 80 per cent of net positive sales, value added, employment and export growth in Australia. High growth start-up small to medium sized enterprises (SMEs) made a disproportionately high contribution to this growth.**
- **The evidence suggests that persistent innovation is critical for young SME growth and that young SMEs drive net positive employment and sales growth in the economy. It also points to persistent innovation underpinning high contribution to growth in employment, sales and value-added beyond the relative share of business counts, sales or employment.**
- **We know that innovation is risky for Australian businesses. The growth distributions in our study show that simple-structured businesses that are persistently innovating tend to be risk-takers. If they succeed, they grow faster than non-innovators and if they fail, they fail harder than non-innovators.**
- **On average, however, persistent SME innovators have superior growth performance compared to less persistent innovators and businesses that are not innovating. This relationship holds up for simple-structured businesses, particularly young, collaborative and finance- and skills-hungry SMEs.**
- **For large, mature and complex-structured businesses, innovation makes an important contribution to growth but the average effect is only significant for turnover, profit and employment.**
- **High growth, persistent innovators of all sizes tend to introduce more than one type of innovation and have a higher likelihood of introducing innovations that are more novel.**
- **These results are broadly consistent with a range of business population studies on innovation persistence from other countries. Combined with this literature, our results give the most compelling case for government support for young SMEs to overcome the downside risk of investing in the human, organisational and capital required to build innovation capability.**
- **Policies that address skills deficiencies and external finance constraints, encourage external cooperation and build Information, communication and technology (ICT) intensity appear to be the most important for young Australian SMEs. However, government support for these young SMEs should be time-limited to less than five years. Beyond this period, government support may be less effective.**
- **By contrast, our results suggest that large, mature and/or complex-structured businesses do not need government support for innovation, as they appear to be able to absorb the costs of innovation failure.**

# 1. Introduction

Growth is a useful but incomplete indicator of performance at the business and economy level.[1] Understanding what drives high growth episodes in businesses is fundamental for designing industry policies to drive employment and/or economic growth. Industry policies of successive Australian governments have predominantly focussed on innovation and science-driven policies as a mechanism to generate high growth in the economy.

The Australian Innovation System Report[2] has consistently demonstrated significant correlations between innovation activity and self-assessed business growth outcomes in Australian SMEs in either the same year or the following year of introduction to the market. An ongoing criticism of these innovation impact indicators is that of causation. A business could gain competitive advantage and grow market share and profit in many ways. The growth pattern of a business therefore cannot be determined by one characteristic alone.[3] For this reason, a strong correlation between growth and innovation may simply reflect other co-correlated aspects of a high quality, productive business.[4]

While high growth in business is often likened to a random process and therefore difficult to predict, researchers have suggested that the unpredictable and stochastic nature of business growth reflects in part the unpredictable and stochastic outcomes of innovation.[5] A small number of businesses in each sector often account for the majority of innovation output for that sector.[6] This phenomenon is also enduring over time and is similar to the observations made of the contribution of high growth businesses to aggregate employment, sales and value added growth in Australia.[7]

There have also been decades of qualitative research from around the world that demonstrate the causative link between innovation and growth in businesses.[8] While not new, PSM (pro) and nearest neighbour techniques are starting to be used more widely and successfully in innovation policy research to simulate randomised experiments and explore causative links.[9] Empirical research has also demonstrated quantitative links between innovation and business performance measures such as growth.[10] These results, while significant, are often small or inconsistent and vary by country, business size, age and sector, especially when using dummy variables based on Community Innovation Survey-style survey data.[11] This inherent uncertainty and inconsistent results continue to undermine the confidence of policy-makers in selecting innovation policy as an effective pro-growth policy.

Economics and management literature shows that businesses can themselves create persistent performance advantages such as growth over other

[1] Davidsson et al. 2009; Czarnitzki and Delanote 2013
[2] www.industry.gov.au/innovationreport
[3] Czarnitzki and Delanote 2013
[4] See Australian Innovation System report 2011
[5] Geroski 2000
[6] Capasso et al. 2013
[7] Hendrickson et al. 2015; AIS report 2016; Hendrickson et al. 2016
[8] Fagerberg and Mowery 2015
[9] Jaffe and Le 2015.
[10] Audretsch 2012; Mohnen and Hall 2013, Czarnitzki and Delanote 2013
[11] Mohnen & Hall 2013

businesses. Persistent differences in innovation activity are argued theoretically and shown empirically to be a major factor behind these performance advantages.[12] Research on British, Swedish, Italian, Spanish, Flemish, Finnish and French businesses show strong correlations between innovation persistence and growth in profitability, sales, employment and/or productivity growth.[13] It is rare however, that more than one growth indicator is measured. A study of young, small, innovative Flemish firms that had 11 per cent and 5 per cent higher sales and employment growth, respectively, compared to businesses with some of these characteristics but not all three.[14]

Persistent innovation is more complicated than the introduction of just one innovation. Panel studies of French and Luxembourg businesses show that those introducing more than one type of innovation are more persistent innovators than those introducing only one type in any given year with the authors arguing that there are synergistic relationships between new products and the new processes and the organisational changes required to support them.[15] Bartoloni and Baussola (2016) found that productivity advantages in persistent Italian innovators disappeared when they were only introducing product or process innovations.

Analysis of a ten-year panel of German businesses suggests that true innovation persistence exists for product innovation, with process and organisational innovation complementing product innovation but having spurious persistence themselves.[16] A conflicting study of Swedish businesses over the same period shows that true state dependence can be found in product, process and organisational innovation but not in marketing.[17] The balance of influences on product and process innovation persistence differs, with product innovation persistence linked more strongly to strategic factors and process changes more often driven by market pressures.[18] Persistent organisational innovation can have an equally profound and lasting effect on performance and growth as product and process innovation persistence.[19]

The introduction of a single innovation can often be the result of a series of lengthy, complementary investments. Potential innovations can be developed regularly but few survive internal selection and competition to go on to succeed in the market.[20] For these reasons we argue that the impact of innovation should be measured over multiple years.

[12] Baraldi et al. 2013; Capasso et al. 2013; Hecker and Ganter 2014; Bartoloni and Baussola 2016; Karlsson and Tavassoli 2015
[13] Cefis and Cicarelli 2005; Czarnitzki and Delanote 2013; Deschyreve 2014; Triguero et al. 2014; Lhuillery 2014; Baum et a;. 2015; Bartoloni and Baussola 2015, 2016
[14] Czarnitzki and Delanote, 2013
[15] Mohnen and Hall, 2013; Haned et al., 2014; Le Bas and Poussing, 2014; Hecker and Ganter, 2014
[16] Hecker and Ganter, 2014
[17] Karlsson and Tavassoli, 2015
[18] Roper and Hewitt-Dundas, 2008
[19] Hecker and Ganter, 2014; Haned et al., 2014
[20] Fagerberg 2013

The issue of causality has been addressed in a number of international research papers showing that higher innovation output or innovation quality precedes productivity or output growth in both businesses and economies.[21] However, the impact of persistent innovation on Australian business performance has not yet been investigated. Neither has the causative nature of this persistence relationship been tested in Australian businesses.

The objective of this paper were as follows:

- To establish the contribution of high growth businesses (Table 1.1) to the Australian economy (as measured by growth in employment, total sales, value-added and export sales); and
- On a representative sample of the above population, test whether persistent business innovation (Table 1.2) creates cumulative and multiple performance advantages (as measured by growth in profit, employment, sales, value-added, wages and salaries, labour productivity and export sales) over non-innovator businesses as well as less persistent innovators.

Box 1.1: Why do we see persistent innovation in businesses around the world?

There are three complementary theoretical arguments as to why researchers observe innovation persistence across so many business cohorts and countries. The first is that innovation activity involves significant learning and accumulation of knowledge that increases the probability of subsequent innovation ('dynamic increasing returns' hypothesis). The second argument is that successful innovators generate fast-decaying returns on uncertain investments that fund further innovation activities, thereby locking-in competitive advantages over other resource-constrained businesses ('success breeds success' hypothesis). The third argument is that businesses continue to innovate to avoid stranding or wasting investments into human, organisational and physical capital investments ('sunk cost account' hypothesis).

Source: Duguet and Monjon 2004; Haned *et al*. 2014; Hecker and Ganter 2014; Máñez et al. 2015

[21] Hasan and Tucci 2010; Bartoloni and Baussola 2016

## 1.1 Definitions

For growth accounting at the national level, we define high growth businesses as those that reported annual growth in sales and/or employment of greater than 20 per cent over the previous year (Table 1.1). We use a range of growth variables: total sales, export sales, value added and employment. We sub-classified businesses by age and size class combinations. Business age was defined as Start-up (0–2 years old), Young (3–5 years old) and Mature (6+ years old). Standard ABS size classes were used (SME businesses with 0–199 employees and large businesses with 200+ employees).

Innovation persistence describes the degree of continuity of innovation activity over time.[22] In this study, we examined the performance of Australian businesses that reported innovation persistence over a three-year period similar to the method used by Lhuillery (2014) and Bartoloni and Baussola (2016). Innovation persistence is defined by the number of years a business in a three-year panel reports that they introduced a new or significantly improved good or service (product), operational process, organisational/managerial or marketing method (See Table 1.2). For example, a business that introduced an innovation in two out of the three years is labelled a *Regular Innovator*. Longer panels were not possible because of the way the ABS rotates SMEs out of the sample frame every three to five years.

Table 1.1: Defining growth classes

| Growth class | Annual growth in sales and/or employment of businesses |
|---|---|
| High growth | More than 20 per cent |
| Moderate growth | 10–20 per cent |
| Low growth | 1–9 per cent |
| Nil or Negative growth | Equal to or less than zero per cent |

Table 1.2: Defining innovation persistence

| Innovation status | Incidence of innovation in a three-year panel |
|---|---|
| Non Innovator | Zero out of three years |
| Intermittent innovator | One out of three years |
| Regular innovator | Two out of three years |
| Persistent innovator | Three out of three years |

[22] Hecker and Ganter 2014

# 2. Results

We used 2007–08 to 2013–14 business level data extracted from the ABS Business Longitudinal Analytical Data Environment (BLADE). This includes innovation survey data merged with administrative data on all businesses in Australia. BLADE innovation information comes from the innovation module from the ABS Business Characteristics Survey (BCS) that is consistent with the Eurostat/OECD Oslo Manual. The data include all industries in the BCS sampling frame excluding SISCA2[23] businesses. For detailed information on the data and methodology see Appendix A. Supplementary data are provided at Appendix B.

## 2.1 The contribution of high growth businesses to the Australian economy

Figure 2.1 shows the net contribution to employment and sales growth in Australia by businesses of different age, size and growth rate classes. Over the seven-year period 2007–14, there were 1.4 million new jobs created (full time equivalents (FTEs)), total sales grew by $1.1 trillion, export sales grew by $0.14 trillion, and $0.23 trillion of value was added to the Australian economy. Underpinning this growth was significant creative destruction[24] in the Australian economy.

High employment growth or high sales growth businesses (*high growth*) generated the majority of Australia's growth, accounting for 92 per cent of net positive employment growth, 86 per cent of net positive sales growth, 92 per cent of net positive export growth and 89 per cent of net positive economic growth (Figure 2.1; Table B1). While the definition of a high growth business used here is broad, the results are consistent with other research using a narrower definition.[25]

High growth businesses are present in all firm size and age classes investigated but are a small fraction of the business population (Figure 2.1; Table B1). The contribution of high growth start-up SMEs to a particular growth indicator (employment, total sales, export sales, or value added) is generally two to four times higher than their respective share of that indicator (Figure B1). As businesses age their contribution to growth becomes more proportionate to their share of that particular indicator (Table B2). For example, the contribution of high growth start-up SMEs (0–199 employees) to employment growth is four times their initial share of employment. By contrast, the contribution of high growth mature businesses (of any size) is twice their share of employment.

As they age, the proportion of businesses with negative growth increases in each size class (Figure 2.1). While the contribution of mature businesses is still significant to the economy, many mature businesses are shrinking, particularly

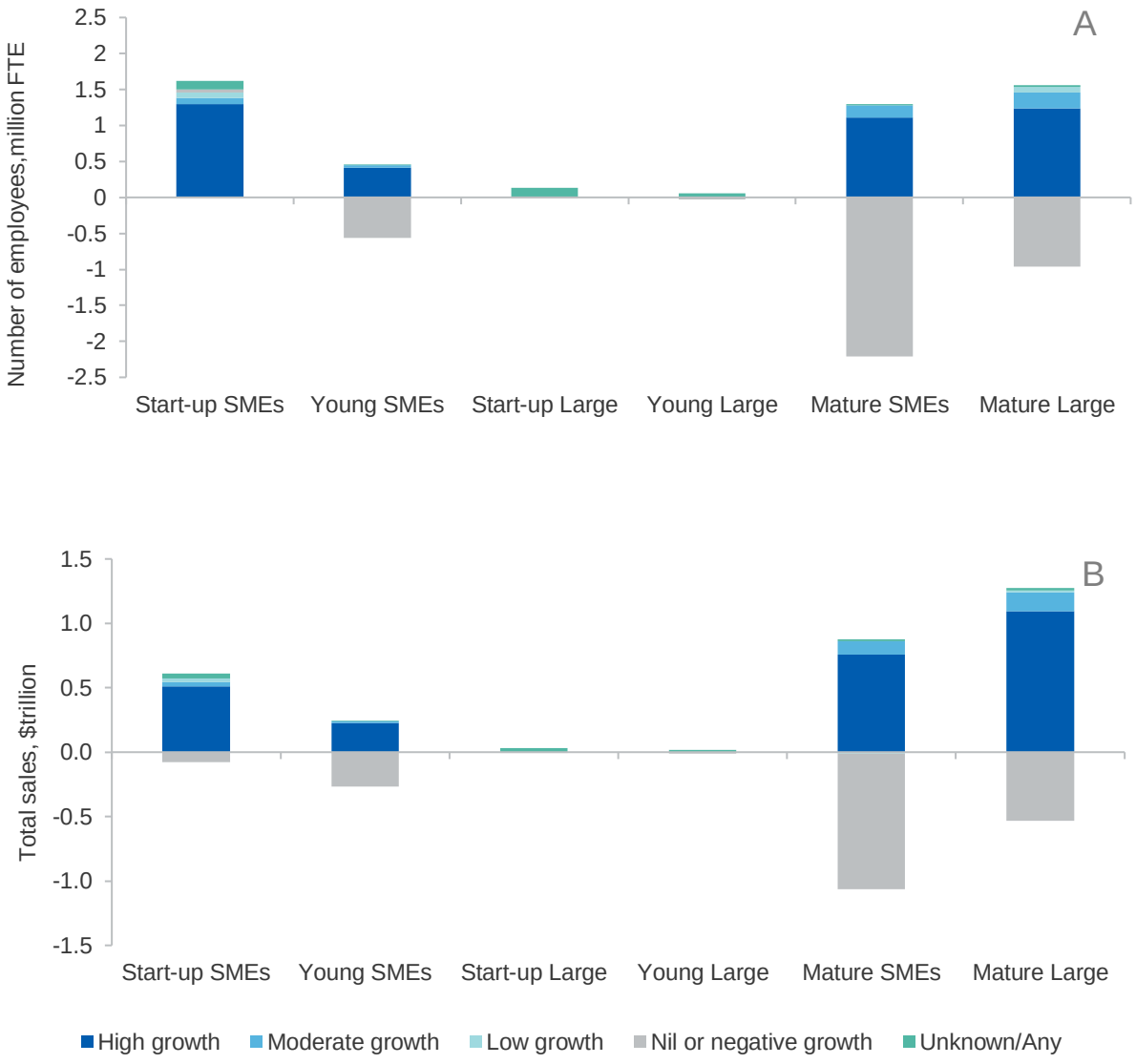
[23] Financial corporations, see ABS (2013) *Standard Economic Sector Classifications of Australia (SESCA), 2008 (Version 1.1)* Cat. No. 1218.0

[24] Schumpeter (1942)

[25] Hendrickson et al. 2015; Moreno and Coad 2015; AIS report 2016

mature SMEs. The result is that the overall contribution of mature businesses to the economy can sometimes be a net negative e.g. employment. Mature large businesses still make an overall net positive contribution to growth, particularly for export sales, but it is often masked by the net negative growth of mature SMEs (Table B1).

Figure 2.1: The contribution of businesses to Australia's employment (panel A) and sales (panel B) growth, by business growth class, size and age, 2007–14




Notes: Employment growth is measured in FTEs. Sales dollar values were deflated using ABS implicit price deflators (Table 4, 5204.0 Australian System of National Accounts). Each bar is a net growth total of all businesses in the sample. Business growth classes are defined by the annual growth rate in either sales or employment.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

## 2.2 Establishing the relationship between innovation persistence and growth

We used a sub-sample from the same business population covered in the above analysis that were annually surveyed on their innovation activity. Descriptive analysis suggests that innovation and notably persistent innovation has a positive correlation with sales, value-added, profit and job growth outcomes in Australia. Figure 2.2 shows the combined results for SMEs (0–199 employees) and large businesses (200+ employees) in two winsorised three-year panels over 2008–14. For example, median annual sales growth for non-innovators was –$1,900 between 2011–12 and 2013–14. By contrast median annual sales growth for persistent innovators was +$41,600 over the same period (Figure 2.2).

The median values presented in Figure 2.2 are heavily influenced by the high proportion of SMEs in the sample. Similar trends were found for SME and large businesses when analysed separately, though the effect of persistence appears weaker for large businesses (Figures B2 and B3). Similar to the results from Czarnitzki and Delanote (2013), a stronger effect of innovation and innovation persistence on growth performance was found at the higher percentiles of the growth distributions for all four growth indicators examined: total sales, employment, value added and gross operating profit (Tables 2.1; B3 to B5).

Table 2.1: Percentile distribution of annual total sales growth, by business size, by innovation persistence, 2008–14

| Dollars | 10th | 25th | 50th | 75th | 90th |
|---|---|---|---|---|---|
| 0–199 employees | | | | | |
| Non-innovator | –221,903 | –42,990 | –1,888 | 29,942 | 182,973 |
| Intermittent innovator | –381,992 | –85,248 | –2,083 | 52,616 | 408,008 |
| Regular innovator | –503,590 | –93,734 | 2,221 | 120,339 | 748,378 |
| Persistent innovator | –592,666 | –92,209 | 12,763 | 266,125 | 1,361,946 |
| 200+ employees | | | | | |
| Non-innovator | –91,155,379 | –14,778,788 | 1,153,330 | 16,018,009 | 73,736,458 |
| Intermittent innovator | –63,557,534 | –10,329,479 | 1,769,610 | 16,548,274 | 79,237,937 |
| Regular innovator | –52,282,001 | –7,241,229 | 3,795,328 | 24,198,324 | 117,231,369 |
| Persistent innovator | –60,691,206 | –8,241,485 | 4,078,270 | 29,018,317 | 120,282,134 |

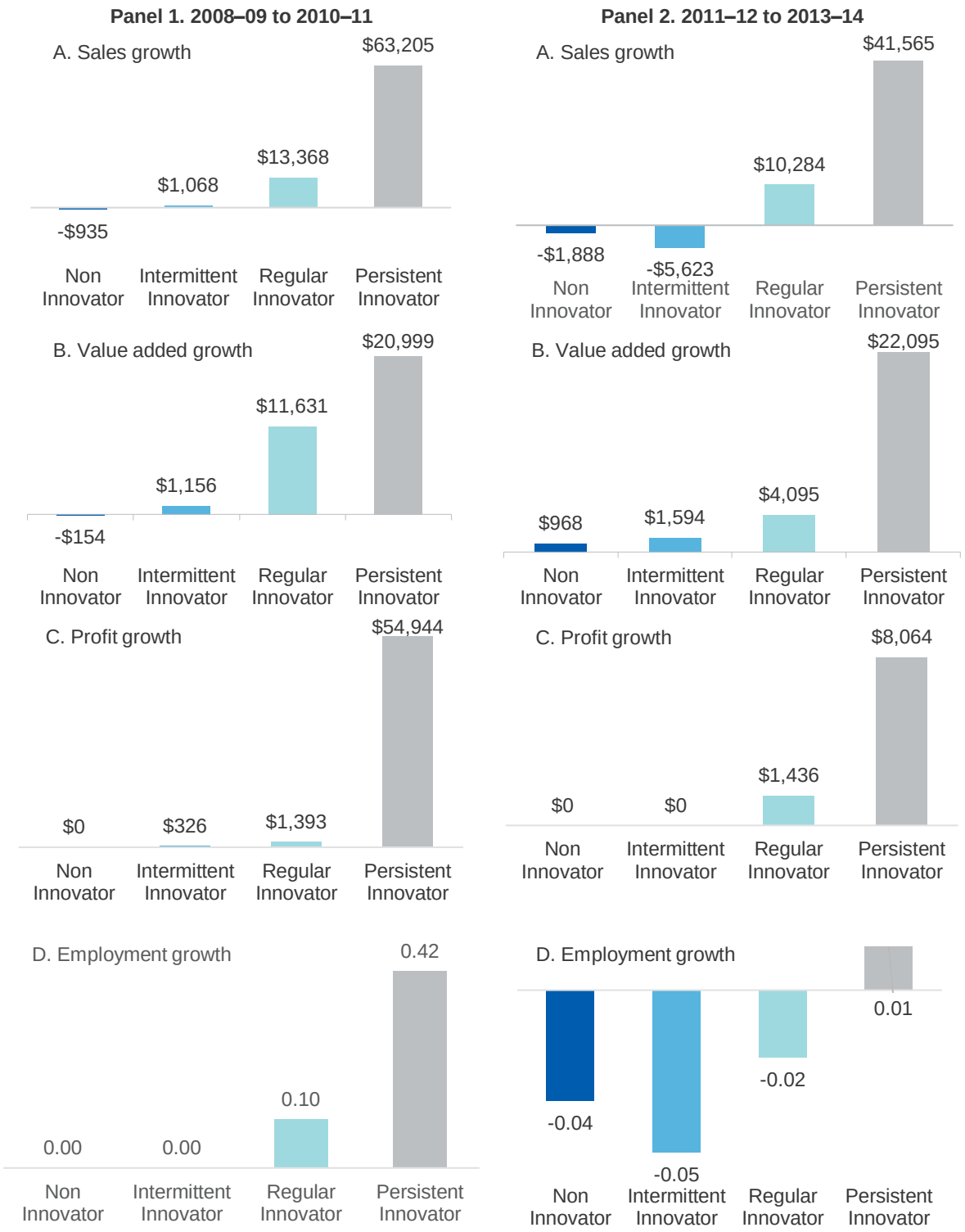
Notes: Sales figures are not deflated. Total sales is measured as the difference between *Turnover* and *Goods and Services Tax payable* (Table A5).

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Analysis of variance on these two three-year panels showed that the mean differences in growth performance were significantly different between businesses of varying innovation persistence. The largest effects were found in the 'persistent innovator' category where businesses innovated every year. The less regularly businesses innovated over a three-year period, the weaker the differences between innovator and non-innovator growth rates became. Differences in growth rates between 'intermittent' innovators and non-innovators were often insignificant except at higher/lower percentiles in the growth distribution where the differences became more distinct (Tables 2.1; B3 to B5). Both three-year panels showed a similar correlation between business growth performance and innovation persistence despite sometimes-different scales of performance, particularly for employment growth (Figure 2.1). We controlled for size but only where the two panels were pooled.

For large, complex businesses, the median or average effects of persistent innovation were positive but generally weaker relative to non-innovators. Persistent innovation appears to confer a growth advantage at the higher percentiles of the growth distribution for large, complex businesses but does not significantly disadvantage them at lower percentiles. Quantile regression, beyond the scope of this study, may confirm the broader significance of innovation persistence in large complex businesses. The positive impacts of innovation were evident at the higher percentiles of the large firm growth distribution.

Figure 2.2: Median annual sales, value added, gross operating profit and employment growth, by innovation persistence, by panel, 2008–09 to 2010–11 and 2011–12 to 2013–14




Notes: Each bar is a median of all businesses in the sample. Employment growth is measured in FTEs. Sales, value-added and gross operating profit dollar values are not deflated. ANOVA and interaction effects tests showed significant positive differences between innovation persistence least squares means for sales growth ($F=42.2$, $p<0.0001$), value added growth ($F=15.9$, $p<0.0001$), gross operating profit growth ($F=16.8$, $p<0.0001$) and employment growth ($F=11.6$, $p<0.0001$). ANOVA results are for pooled panel data. ANOVA results for individual panels showed similar results.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

## 2.3 Exploring the causal nature of the relationship

We used kernel method PSM on the 2010–13 balanced sample to control for business age, size, sector, information and communication technology intensity, capital expenditure, competition, foreign ownership, government assistance, flexible working arrangements, skills base, skills shortages experienced, export status and debt or equity finance seeking behaviour.

By simulating a randomised control trial with the broadest range of business characteristics available at the time, we were able to investigate the causal influence of innovation persistence on 2013 outcomes, using business characteristics from 2011 as covariates and non-innovators as the control group. Our definition of growth was the difference between the first and third year values of each performance variable. The results provide evidence for a significant, positive and direct link between innovation and a range of growth outcomes, particularly for simple-structured businesses.

Table 2.2 shows the results for two Ordinary Least Squares (OLS) regression models using persistence group dummy variables for a range of growth variables. The estimated OLS coefficients for the persistence variables show the significant added effect of innovation persistence on outcome growth (per cent) between the beginning and the end of the study period compared to businesses not undertaking innovations during the period. Complete regression outputs are available in Appendix B.

The results showed positive and significant growth coefficients for the persistence variables under both models, confirming the cumulative effects of innovation persistence measured by ANOVA (Table 2.2; Tables B7 to B12).[26] This effect was present in simple-structured businesses, which were mostly SMEs. Effects on growth were tested for the earlier panel 2008–09 to 2010–11. Similar positive and statistically significant treatment effects were found in the simple-structured business sample (data not shown).

Similar to the ANOVA results, the effect of innovation weakened the less persistently simple-structured businesses innovated over the three-year period. For example, persistent simple-structured innovators had 16 per cent and 17 per cent higher gross output and value added output growth, respectively, compared to businesses that did not innovate in any of those three years (Table 2.2).

A consistent, significant effect was found in large, complex businesses for turnover and profit. However, unlike the simple-structured business sample, large, complex businesses appeared to benefit from the presence of innovation rather than any innovation persistence per se. This result was consistent with the descriptive statistics and the ANOVA tests.

Simple-structured businesses that are young, have high ICT and skills intensity, have cooperative arrangements and demand for external finance are more likely

[26] Preliminary testing for average treatment effects found no significant, positive results for labour productivity or labour productivity growth in either panel, although it is worth noting that these indicators had a high number of missing observations, between 21 and 37 per cent of the total derived sample (data not shown).

to carry out innovations after controlling for other covariates (Tables B7 to B12). These results are consistent with the findings of Smith and Hendrickson (2016) and Alinejad et al. (2015) who found correlations between young innovation-active Australian SMEs, collaboration, skills deficiencies and external finance seeking activity.

Interestingly, once matched to similar businesses, the results all agree that innovation activity is less likely in simple-structured businesses that have foreign ownership. There are some effects from business size although only statistically significant in one size category (20–199 employees). The presence of competitors had a positive effect on the simple-structured business sample but no influence on the larger, complex businesses. Innovation appeared to have a significant negative effect on export sales growth in large, complex businesses but this data was not consistent between all test results.

Innovation persistence and innovation novelty were also found to be correlated in both large and SME businesses (Figure B4). The percentage likelihood of a persistent SME innovator introducing a *New-to-Market*[27] innovation is two to six times higher than less frequent innovators. Innovation persistence and multiple types of innovation are likewise correlated. Of the persistent innovators in the matched, balanced panel sample, the majority of these were introducing multiple innovations in a single year, typically of different innovation types and many introducing three or more types of innovation in any given year of the panel (Table A1).

[27] A new-to-market innovation is one that is new-to-world, new-to-Australia or new-to-industry.

Table 2.2: Impacts of innovation persistence on business growth using a derived balanced panel and OLS regression, 2010–11 to 2012–13

| | | Persistence (model 1) | | | Persistence (model 2) |
|---|---|---|---|---|---|
| Sample | Variable | Innovators for 3 years | Innovators for 2 years only | Innovators for 1 year only | Number of years of innovation |
| Simple-structured businesses | | | | | |
| | Profit growth | 0.111 | 0.007 | 0.053 | 0.029 |
| | Employment (FTE) growth | 0.173*** | 0.107*** | 0.006 | 0.057*** |
| | Salary & Wage growth | 0.202*** | 0.102*** | 0.048 | 0.063*** |
| | Turnover growth | 0.173*** | 0.115*** | 0.034 | 0.057*** |
| | Export sales growth | –0.039 | 0.036 | 0.001 | –0.008 |
| | Gross output growth | 0.163*** | 0.113*** | 0.008 | 0.055*** |
| | Value added growth | 0.174*** | 0.093*** | –0.008 | 0.055*** |
| Large, complex-structured businesses | | | | | |
| | Profit growth | 0.169** | –0.018 | 0.360*** | 0.044* |
| | Employment (FTE) growth | 0.027 | 0.061** | 0.090*** | 0.012* |
| | Salary & Wage growth | –0.012 | 0.077 | 0.106* | 0.002 |
| | Turnover growth | 0.070*** | 0.060** | 0.096*** | 0.024*** |
| | Export sales growth | –0.341*** | –0.251** | –0.340** | –0.112*** |
| | Gross output growth | 0.025 | 0.014 | –0.015 | 0.008 |
| | Value added growth | –0.079 | –0.021 | –0.091 | 0.008 |
| Total sample | | | | | |
| | Profit growth | 0.174*** | 0.011 | 0.125*** | 0.047*** |
| | Employment (FTE) growth | 0.098*** | 0.087*** | 0.025 | 0.035*** |
| | Salary & Wage growth | 0.110*** | 0.083*** | 0.067** | 0.038*** |
| | Turnover growth | 0.159*** | 0.119*** | 0.073*** | 0.054*** |
| | Export sales growth | –0.212*** | –0.138 | –0.244** | –0.068*** |
| | Gross output growth | 0.114*** | 0.081*** | 0.011 | 0.039*** |
| | Value added growth | 0.091*** | 0.067*** | –0.009 | 0.039*** |

Notes: Model 1 treated persistence as a categorical/dummy variable while Model 2 used one variable to capture the number of innovation years. Values are the percentage difference from the non-innovator control dummy. * p<0.1; ** p<0.05; *** p<0.01; Detailed regression outputs, including covariates, are found in Appendix B. FTE = Full Time Equivalent.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

# 3. Discussion

By combining an innovation persistence study (measuring a dose effect) on growth with PSM (limiting selection bias) on a micro-aggregate panel dataset we show the strongest possible quantitative evidence of a causal relationship between innovation and a wide range of Australian business growth indicators simultaneously.

The results of this paper are consistent with the current literature on innovation persistence.[28] These studies report strong individual effects on growth in innovating businesses, especially persistent innovators. Our data also supports the argument that the performance advantage of persistent innovators also reflects the compounding benefits of several types of innovation being introduced together.[29]

The results re-inforce the idea that Australian entrepreneurship and innovation and its impact on business dynamics reflect strategic, contextual and path dependent factors interacting in a systemic way. Our results suggest that rapidly growing young businesses first concern themselves with building up the human, organisational and/or physical capital required to capture and retain market share. The higher likelihood of new-to-market innovations and multiple types of innovation in a given year support this argument and is consistent with their rapidly growing turnover, and output growth. A focus on maintaining large market shares or optimising profit may come later as a business matures.[30]

Large businesses have higher rates of innovation persistence than SMEs and that this is associated with having a larger market share and potentially a greater capacity to exploit and appropriate innovations.[31] Our evidence would support these arguments with our growth distribution data also showing that large, complex businesses can also absorb the costs of failed innovations.

## 3.1 Policy implications

Our data shows that persistent innovators can have high growth and high growth businesses account for the majority of Australia's growth. The data also suggests that the growth of successful government-supported innovators could offset the losses of unsuccessful innovators if the number of government-supported businesses was high enough and there was some return on investment for government.

We know that innovation is risky for Australian businesses and our aggregate growth accounting results observe Schumpeterian dynamics. The growth percentile distributions in our study show that persistently innovating SMEs tend to be either boom or bust risk-takers: If they succeed they growth faster and if they fail, they fail harder than non-innovators. This finding clearly shows why the results from average treatment effects do not give a complete understanding of the impact of innovation investment on the Australian economy. It appears that

[28] Cefis and Cicarelli 2005; Deschyreve 2014; Triguero et al. 2014; Lhuillery 2014; Baum et al. 2015; Bartoloni and Baussola 2015, 2016
[29] Antonelli et al. 2012; Goedhuys and Veugelers 2012
[30] Duguet and Monjon, 2004; Máñez et al., 2015
[31] Roper and Hewitt-Dundas, 2008; Cefis and Orsenigo, 2001; Máñez et al., 2015

persistent innovation 'right-shifts' growth distributions in all the indicators observed, implying that either, 1) policies that encourage persistent innovation are a pro-growth economic strategy and/or, 2) persistent innovation is a useful business strategy for scarce resource competition.

Australian policy-makers might conclude that they should encourage innovation persistence in all businesses as a broad pro-growth economic strategy. However, the evidence from UK, Japanese, Irish, Norwegian, US, French, Swedish, German, Spanish, Italian, Taiwanese and Dutch panel data suggest that innovating businesses are highly likely to remain innovators and that this process is path-dependent.[32]

Innovation persistence literature suggests that helping businesses develop an early innovation orientation or culture is more important to economic success than an ongoing subsidy of innovation activity, particularly in older businesses that are more likely to shrink than to grow.[33] The first five years of consecutive innovation appears the most critical to establishing an innovation culture.[34]

If these international findings also apply to Australian businesses, our results would suggest that government innovation policy should support young SMEs (less than five years old) that are innovating for the first time. Beyond this period, government support may be less effective. The results also suggest that policy should avoid repeatedly supporting businesses that are known persistent innovators,[35] or large enough that they do not suffer from resource-limitations that might hinder the human, organisational and/or physical capital investment required to innovate. Large, mature and/or complex-structured businesses do not need government support for innovation as they appear to be able to absorb the costs of innovation failure.

Our data shows that direct government financial support may reduce the downside risk of innovation investment for young SMEs that are more exposed to the costs of failure than larger businesses. However, policy-makers need to understand, accept and communicate the inherent uncertainty in government programs that support young SME innovation. Many government-supported businesses may fail to grow or even exit their market. We therefore argue that a broad portfolio approach to government support is required in terms of government financial investment but also in the types of support.

Our data does not suggest financial support alone. Breadth of skills, reporting skills deficiencies and external cooperation are significant covariates with both innovation and growth. These covariates also provide further evidence for the type of systemic innovation policy support needed by young SMEs with high growth potential.

[32] See review of the literature by Antonelli et al. 2013; Karlsson and Tavassoli 2015
[33] Máñez et al. 2015
[34] Triguero et al. 2014
[35] Peters 2005

## 3.2 Further research opportunities

No study to date has simultaneously observed whether different types of growth (total sales, export sales, profit, value-added, productivity and employment) are supported by persistence in different types of innovation (product, process, organisational and marketing). As business data collections become larger and more available to researchers these studies may lead to more targeted innovation policy.

Analysis using the same Australian dataset suggests that product and marketing innovation drives mostly sales and output growth[36], whereas employment growth may be driven more by organisational and process innovation.[37] This is consistent with the theoretical framework proposed by Bartoloni and Baussola (2016) in their study of Italian manufacturers where the outcomes of process/organisational innovation are more similar than product/marketing innovations, which are likewise linked.

While this study used 36 indicators to develop a propensity score, there will always exist the possibility of additional or hidden business characteristics that account for innovation persistence. The most obvious is strategic management capability, which when measured, accounts for significant variation in business performance[38] and compounds turnover growth outcomes over and above the effects of innovation.[39] Evidence is mounting that Australian high growth businesses have superior management capability. Ongoing government support for consecutive years of the new Management Capability Survey linked into the BLADE may unearth more specific empirical support for this argument.[40] The higher likelihood of complementary innovations in persistent innovators found in our study also suggest that persistent innovators are more strategic than their less persistent counterparts. This argument is consistent with the 'dynamic increasing returns' argument for innovation persistence and is consistent with our recent results on high turnover growth businesses.

Innovation-active businesses, particularly persistent innovators tended to be larger within their own size class compared to non-innovators. There are a number of other output measures that were also correlated such as annual turnover, employment numbers and wages. Further research needs to include a greater number of variables in the PSM technique, particularly tighter turnover, output and employment ranges to account for these differences. This would improve the robustness of the results.

[36] Majeed et al. 2018
[37] Hendrickson et al. 2016
[38] Peters 2005; Bloom et al. 2014
[39] Majeed et al. 2018
[40] Hendrickson et al. 2016

# Appendix A: Methodological notes

## Data

We used 2007–08 to 2013–14 business level data extracted from the ABS' BLADE. This includes innovation survey data merged with tax and business register administrative data. While growth accounting covered all economically active businesses in Australia (approximately 2.1 million per annum) innovation activity could only be measured on a randomised, stratified and representative sub-sample (approximately 14,000 businesses per annum) using the BCS.

The datasets we used for descriptive analysis and ANOVA include pooled data across two three-year panels: 2008–09 to 2010–11, and 2011–12 to 2013–14. There were 16,740 units in the first panel and 18,834 units in the second. The units are not all unique across the years within each panel, there are many businesses reporting over multiple years. The datasets were unweighted for the purposes of the analysis. The panels were divided into SME businesses with fewer than 200 employees and large businesses with 200 or more employees. Persistent innovators comprised 13,107 individual observations or 37 per cent of the sample (Table A1).

The data set was winsorised to manage extreme outliers in the distribution. For example there were a number of cases where finance and insurance sector businesses reported zero employees and yet over $1 billion in sales. Values below the 1st percentile or above the 99th percentile were adjusted to be the 1st or 99th percentile values, respectively.

### Propensity score matching panel

To confirm the presence of cumulative effects from innovation persistence we used a balanced panel sample derived from the BCS and additional units selected into the Business Longitudinal Database SME panels that exist in all financial years from 2010–11 to 2012–13.

Most businesses and organisations in Australia are required to obtain an Australian Business Number (ABN) and are included on the whole-of-government register of businesses, the Australian Business Register. The ABS then allocates businesses from this register to one of two sub-populations, namely the non-profiled and profiled business group.

Non-profiled population of simple-structured businesses

These are businesses with simple structures and a single ABN. For these businesses, the ABS aligns its statistical unit structure with the ABN and data from ATO can be directly linked to ABS survey data. In this study, this population is referred to as simple-structured businesses.

Profiled population of large, complex-structured businesses

This population of businesses consists of large, diverse and complex-structured business groups, where their multiple ABNs are not considered suitable for ABS statistical requirements. Hence, the ABS maintains its own unit structure through direct contact with the business. For this population, Australian Tax Office data from all ABNs under a given 'Enterprise Group' is aggregated and then

apportioned to the ABS Business Register profiled units based on employment information. This population is referred to in this study as large, complex-structured businesses.

The majority of large, complex-structured businesses have 300 or more employees while the simple-structured businesses are concentrated in the small to medium business size group (i.e. employing fewer than 200 employees). This is proportionate with the large business population distribution in Australia.

You can find out more about ABS profiling and these two populations here.

Tables A2 to A4 further describe both panels. In total, there were 6,142 businesses, among these, 74 per cent were simple-structured businesses and 26 per cent were large, complex-structured businesses. The proportion of innovators was much higher in the large complex-structured business sample (84 per cent) compared to the simple-structured sample (63 per cent) consistent with general findings on the impact of size on the likelihood of innovation. It is worth noting that businesses that had abandoned innovation projects or had innovation projects still in development were excluded from the sample. The balanced sample had a high proportion of persistent innovators at 30 per cent. While the panel is balanced overall on innovation counts, the sample had a high proportion of manufacturing businesses.

Table A1: Balanced panel, by innovation persistence, by sample, 2007–08 to 2012–13

| **Balanced sample 2007–08 to 2009–10** | | | | | |
|---|---|---|---|---|---|
| Per cent | Product only innovators | Process only innovators | Product and/or Marketing innovators only | Organisational and/or Process innovators only | Mixed mode innovators (Three or more types of innovation ticked) |
| Persistent innovator | 4.3 | 4.2 | 7.5 | 10.3 | 16.3 |
| Regular innovator | 3.7 | 4.4 | 7.5 | 9.0 | 6.5 |
| Intermittent innovator | 3.7 | 3.3 | 6.7 | 7.0 | 2.8 |
| **Balanced sample 2010–11 to 2012–13** | | | | | |
| Per cent | Product only innovators | Process only innovators | Product and/or Marketing innovators only | Organisational and/or Process innovators only | Mixed mode innovators (Three or more types of innovation ticked) |
| Persistent innovator | 4.1 | 2.7 | 8.5 | 9.5 | 19.1 |
| Regular innovator | 3.7 | 3.0 | 7.6 | 8.9 | 8.0 |
| Intermittent innovator | 3.0 | 2.9 | 6.9 | 6.3 | 2.9 |

Note: Numbers may not add up to 100 due to rounding.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table A2: Derived balanced panel by innovation-activity, 2010–11 to 2012–13

| | Simple-structured businesses | Large, complex-structured businesses | Total sample |
|---|---|---|---|
| Innovation-active (per cent) | 63 | 84 | 69 |
| Non-innovation active (per cent) | 32 | 13 | 27 |

Notes: N = 6,142. Innovation-active businesses are businesses that had undertaken any innovative activity during the reference period including: introduction of any type of innovation; and/or the development or introduction either still in progress or abandoned. Numbers may not add due to rounding.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table A3: Derived balanced panel by innovation-activity, 2007–08 to 2009–10

| | Simple-structured businesses | Large, complex-structured businesses | Total sample |
|---|---|---|---|
| Innovation –active (per cent) | 59 | 84 | 66 |
| Non-innovation active (per cent) | 38 | 13 | 31 |

Notes: N = 5,678

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table A4: Balanced panel business counts, by innovation-activity, 2007–08 to 2012–13

| Sample | Treatment and Control | 2010–11 to 2012–13 | | 2007–08 to 2009–10 | |
|---|---|---|---|---|---|
| | | n | Per cent | n | Per cent |
| **Large, complex-structured businesses** | | | | | |
| | Innovation-active | | | | |
| | Innovator | 1,349 | 84 | 1,297 | 84 |
| | Ongoing and/or abandoned innovation | 48 | 3 | 50 | 3 |
| | Sub-total | 1,397 | 87 | 1,347 | 87 |
| | Non-innovation-active | 210 | 13 | 198 | 13 |
| | Subtotal | 1,607 | 100 | 1,545 | 100 |
| **Simple-structured businesses** | | | | | |
| | Innovation-active | | | | |
| | Innovator | 2,870 | 63 | 2,423 | 59 |
| | Ongoing and/or abandoned innovation | 221 | 5 | 130 | 3 |
| | Sub-total | 3,091 | 68 | 2,553 | 62 |
| | Non-innovation-active | 1,444 | 32 | 1,580 | 38 |
| | Subtotal | 4,535 | 100 | 4,133 | 100 |
| Total sample | | 6,142 | | 5,678 | |

Notes: Innovation-active businesses are businesses that had undertaken any innovative activity during the reference period including: introduction of any type of innovation; and/or the development or introduction either still in progress or abandoned. Numbers may not add due to rounding.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

## Outcome and performance measures

A range of growth performance measures and other business size measures were used to estimate innovation persistence outcomes. These included turnover, total sales (turnover – goods and services tax), export sales, gross operating profit (sales of goods and services – cost of goods sold), gross output (total business income + the value of changes in inventories of goods produced as outputs), value added output (total sales – intermediate expenditure) and employment (estimated FTE). The derivations are described in Table A5.

Table A5: Variable sources and definitions

| Covariate | Source | Definition | Derivation |
|---|---|---|---|
| Total Sales (S) | BAS | Turnover – GST on sales | BAS_TURNOVER – BAS_GST_PAYABLE |
| Intermediate Expenditure (IE) | BAS | (Operating Expenses – (Operating Expenses / (Operating Expenses + Capital Expenses))*GST on purchases) | (BAS_OEXP – (BAS_OEXP / (BAS_OEXP +BAS_CAPEX)) *BAS_CREDIT_FOR_GST_PAID) |
| Value Added (VA) | BAS | Total Sales – Intermediate expenditure | S – IE |
| Employment (EMP) | PAYG | Estimated FTE | FTE derived from PAYG |
| Intermediate expenditure per $ sales | BAS | (Operating Expenses – (Operating Expenses / (Operating Expenses + Capital Expenses))*GST on purchases) /Total sales | (BAS_OEXP – (BAS_OEXP / (BAS_OEXP +BAS_CAPEX)) *BAS_CREDIT_FOR_GST_PAID) /S |
| Gross Operating Profit (GOP) | BIT | Sales of goods and services – cost of goods sold | C_SALES_OF_GOODS_AND_SERV_DRV – C_COST_OF_SALES |
| | | | I_SALES_OF_GOODS_AND_SERV_DRV – I_COST_OF_SALES |
| Export Sales | BAS | Export sales | BAS_EXPORTS_AMT |
| Value Added (VA) per employment (EMP) | BAS/ PAYG | (Total Sales – Operating Expenditure) / Estimated FTE | (S – BAS_OEXP)/ FTE derived from PAYG |

## Descriptive analysis and Analysis of Variance (ANOVA)

We used percentile distribution analysis to describe variation in business growth variables by innovation persistence and business size-age classes.

We undertook a cross-sectional ANOVA and measured interaction effects for innovation novelty and average sales, value-added, profit and employment growth outcomes against innovation persistence. In this study we measured average annual growth over a three-year period.

In order to breakdown the results by standard ABS size classes (SME businesses with 0–199 employees and large businesses with 200+ employees) and avoid confidentiality restrictions based on low business counts it was necessary to pool data from both panels. In reality, some units will have multiple observations contributing to the panel, and so observations will not be completely independent. This may have generated serial correlation bias in the results. However, data trends and ANOVA results by size were consistent with unpooled results (data not shown).

### Innovation novelty

We used *new-to-market* innovation as our measure of novelty. New-to-market innovations are all innovations that are reported either as new-to-the-World, New to Australia, or New to the Industry as defined by the ABS.

As the new-to-market innovation (novelty) question is only asked every second year values were imputed based on highest response from the years the questions were asked. Where an imputed value could not be determined, a value of –1 was assigned. We fitted a multinomial logistic regression for new-to-market innovation using Persistence of innovation as the single explanatory variable. Estimated probabilities for each new-to-market innovation category, for a given "Persistence of Innovation" value were calculated.

## Propensity score matching

Propensity score matching (PSM) is a technique that simulates a randomised, controlled experiment. This technique limits selection bias by matching each innovating business with one or more non-innovating businesses that otherwise have the same or similar observed characteristics.[41]

In this paper, a propensity score therefore refers to the probability that a business innovates given a set of observed variables. PSM allows us to isolate the impact of innovation from other variables that could influence the performance of a business.

The correct specification of the propensity model as well as the correct identification of the covariates to be included in the model are two important choices that need to be made in estimating the propensity scores. A logit or probit model is usually employed in most PSM applications. The current analysis utilises a standard linear probit model following the method of Rotaru et al. (2013). There will usually be no clear and comprehensive list of relevant

[41] Rosenbaum and Rubin, 1983

covariates that would assure that the matching will provide an unbiased estimate of the innovation impact. However, Heinrich et al. (2010) noted that one should consider explicit or existing criteria when determining the treatment participation (in our case, the business to innovate).

In the current study, the inclusion and creation of the key business characteristics for the propensity modelling are based from the previous innovation studies and analysis already conducted and/or published at the ABS.[42] The list of covariates are found in Table A6. *Public Administration and Safety* and *Education and training* sectors were excluded from the analysis.

A large number of these covariates were found to have a significant influence on the propensity scores and several were found to have variable impact on sub-sample propensity scores. We repeated this test with or without capital expenditure included as a continuous variable and found it did not have a significant influence on propensity scores. Empirically, we compute the propensity scores by using a binary probit model given by:

*Innovation = Binary Probit* $(X_1)$

Where $X_1$ is a vector comprising of the following variables:

- Business age (in years post registration)
- Business size (the number of employees)
- Industry of operation (based on Australia New Zealand Standard Industry Classification 2006)
- Information, communication and technology (ICT) intensity
- Reported capital expenditure
- Cooperative arrangements and collaboration reported by the business
- Degree of competition reported by the business
- Degree of foreign ownership
- Receipt of government assistance
- Reporting flexible working arrangements for staff
- Reporting specific skill usage
- Reporting having experienced a skill shortage or deficiency
- Exporting activity or behaviour
- Whether the business has sought external debt and/or equity financing

[42] ABS, 2008; Todhunter and Abello, 2011; Tiy et al. 2013; Rotaru et al. 2013; Rotaru 2013; and Soriano and Abello 2015

Table A6: Covariates used to develop a propensity score

| Description | Range of values |
|---|---|
| Age<br>Young business (Less than 6 years old)<br>Mature business (6 years or older) | 0/1 dummy (each category) |
| Number of employees (business size)<br>Non-employers<br>1–4 Employees<br>5–19 Employees<br>20–199 Employees<br>200–499 Employees<br>500+ Employees | 0/1 dummy (each category) |
| Degree of competition in the market<br>No effective competition (0 competitor)<br>Minimal (1–2 competitors)<br>Moderate to strong (3 or more competitors) | 0/1 dummy (each category) |
| Degree of foreign ownership<br>100% Australian owned<br>> 0% to 50% foreign owned<br>> 50% foreign owned | 0/1 dummy (each category) |
| Cooperative arrangements (binary)<br>Business involved/not-involved in any form of collaborative arrangements (i.e., joint research and development, joint buying, joint production of goods or services, integrated supply chain, joint marketing or distribution, and, other collaborative arrangements | 0/1 dummy |
| Industry division<br>*(ANZSIC2006)*<br>Agriculture, Forestry and Fishing<br>Mining<br>Manufacturing<br>Electricity, water, gas and waste services<br>Construction<br>Wholesale<br>Retail Trade<br>Accommodation and food service<br>Transport, postal and warehousing<br>Information, media and telecommunications<br>Financial and insurance services<br>Rental, hiring and real estate services<br>Professional, scientific and technical services<br>Administrative and support services<br>Health care and social assistance<br>Arts and recreation services<br>Other services | 0/1 dummy (each category) |
| Capital expenditure | Continuous variable |
| ICT intensity | 0/1 dummy (each category) |

| Description | Range of values |
|---|---|
| Intense<br>Business had broadband connection, web presence, and places or receives orders via the internet or web<br>High<br>Business had broadband connection, web presence, but does not receive orders via the internet or web<br>Moderate<br>Business had broadband connection, but has no web presence<br>Low<br>Business does not use broadband connection | |
| Flexible Working Arrangement (binary)<br>Business offered the following working arrangements to their employees:<br>Flexible working hours<br>Flexible leave<br>Job sharing<br>Working from home | 0/1 dummy |
| Government financial assistance (binary)<br>Business received/not received any form of assistance (i.e. grants, on-going funding, tax concession, subsidies, rebates, other government financial assistance) | 0/1 dummy |
| Skills deficiency (binary)<br>Business reported having/not having shortage or deficiency in the following skills: Engineering, Scientific and research; IT professionals; IT support technicians Trades; Transport other machinery; Marketing; Project management; Business management; and, Financial | 0/1 dummy |
| Skills used (binary)<br>Business reported using/not using any of the following skills: Engineering, Scientific and research; IT professionals; IT support technicians Trades; Transport other machinery; Marketing; Project management; Business management; and, Financial | 0/1 dummy |
| Other finance (binary)<br>Business sought/not sought any debt and equity finance | 0/1 dummy |
| Exporting activity (binary)<br>Business received/not received income from directly exporting goods and/or services | 0/1 dummy |

Table A**Error! No text of specified style in document.**7: Innovation propensity probit-modelled results using the kernel method without capital expenditure, 2010–11 to 2012–13

| Covariates | Simple-structured businesses | Large complex-structured businesses | Total sample |
|---|---|---|---|
| Age (compared to a young business aged 0–5 years) | | | |
| Mature (6 or more years) | –0.295*** | 0.641 | –0.268*** |
| Number of employees (compared to non-employing businesses) | | | |
| 1–4 Employees | –0.096 | | –0.104 |
| 5–19 Employees | 0.146 | | 0.129 |
| 20–199 Employees | 0.361*** | | 0.351*** |
| 200–299 employees | 0.358 | –0.213 | 0.124 |
| 300+ employees | –0.062 | | 0.142 |
| Market competition (compared to businesses reporting no effective competition) | | | |
| Minimal | 0.339*** | 0.067 | 0.304*** |
| Moderate to strong | 0.353*** | 0.068 | 0.333*** |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | |
| Intense | 0.961*** | 1.601** | 0.957*** |
| High | 0.761*** | 1.371* | 0.732*** |
| Moderate | 0.333*** | 1.248 | 0.374*** |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | |
| >0 to 50 per cent | –0.421** | 0.448** | 0.029 |
| >50 per cent | –0.314** | 0.059 | –0.073 |
| Government financial assistance (compared to businesses reporting no government assistance) | | | |
| Received government assistance | 0.121* | 0.284*** | 0.167*** |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | |
| Involved in any cooperative arrangements | 0.349*** | 0.249*** | 0.306*** |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | |
| Have flexible working arrangements | 0.256*** | 0.136 | 0.272*** |
| Exporting activity (compared to businesses reporting no exporting activity) | | | |
| Engaged in exporting activity | 0.397*** | –0.106 | 0.151** |
| Skills used (compared to businesses reporting no cooperative arrangements) | | | |
| Used some skills | 0.326*** | 0.276* | 0.326*** |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | |
| Reported | 0.246*** | 0.262** | 0.253*** |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | |
| Sought | 0.335*** | 0.188** | 0.280*** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | |
| Mining | –0.115 | –0.307 | –0.134 |
| Manufacturing | 0.193 | –0.039 | 0.185 |
| Electricity, water, gas and waste services | 0.125 | –0.426 | 0.031 |

| Covariates | Simple-structured businesses | Large complex-structured businesses | Total sample |
|---|---|---|---|
| Construction | 0.116 | 0.123 | 0.172 |
| Wholesale Trade | 0.511*** | 0.009 | 0.449*** |
| Retail Trade | 0.333*** | 0.482 | 0.430*** |
| Accommodation and food services | 0.374*** | 0.184 | 0.398*** |
| Transport, postal and warehousing | –0.038 | –0.078 | 0.036 |
| Information, media and telecommunications | 0.265* | 0.172 | 0.330** |
| Financial and insurance services | 0.313 | –0.048 | 0.235 |
| Rental, hiring and real estate services | 0.147 | –0.185 | 0.149 |
| Professional, scientific and technical services | 0.148 | –0.270 | 0.123 |
| Administrative and support services | 0.353*** | –0.031 | 0.325*** |
| Health care and social assistance | 0.705*** | –0.038 | 0.400*** |
| Arts and recreational services | 0.486*** | –0.276 | 0.445*** |
| Other services | 0.394*** | 0.068 | 0.395*** |
| Intercept | –1.02 | –1.77 | –1.04*** |
| Number of observations (N) | 3,635 | 1,492 | 5,128 |
| Number of treated units | 2,490 | 1,289 | 3,780 |
| Number of control units | 1,117 | 157 | 1,330 |
| Off support | 28 | 46 | 18 |
| Pseudo-$R^2$ | 0.196 | 0.072 | 0.187 |
| Log likelihood | –1,820 | –551 | –2,403 |

Notes: *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively, for P>|z|. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table A8: Innovation propensity probit-modelled results using the kernel method with capital expenditure, 2010–11 to 2012–13

| Covariates | Simple-structured businesses | Large complex-structured businesses | Total sample |
|---|---|---|---|
| Age (compared to a young business aged 0–5 years) | | | |
| Mature (6 or more years) | –0.302*** | 0.642 | –0.275*** |
| Number of employees (compared to non-employing businesses) | | | |
| 1–4 Employees | –0.085 | | –0.095 |
| 5–19 Employees | 0.153 | | 0.134 |
| 20–199 Employees | 0.362*** | | 0.356*** |
| 200–299 employees | 0.344 | | 0.128 |
| 300+ employees | –0.095 | 0.213 | 0.146 |
| Market competition (compared to businesses reporting no effective competition) | | | |
| Minimal | 0.344*** | 0.067 | 0.306*** |
| Moderate to strong | 0.352*** | 0.068 | 0.330*** |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | |
| Intense | 0.955*** | 1.601** | 0.952*** |
| High | 0.759*** | 1.371* | 0.729*** |
| Moderate | 0.323*** | 1.248 | 0.365*** |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | |
| >0 to 50 per cent | –0.425** | 0.447** | 0.029 |
| >50 per cent | –0.313** | 0.058 | –0.068 |
| Government financial assistance (compared to businesses reporting no government assistance) | | | |
| Received government assistance | 0.118* | 0.283*** | 0.166*** |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | |
| Involved in any cooperative arrangements | 0.350*** | 0.249*** | 0.306*** |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | |
| Have flexible working arrangements | 0.253*** | 0.135 | 0.267*** |
| Exporting activity (compared to businesses reporting no exporting activity) | | | |
| Engaged in exporting activity | 0.396*** | –0.106 | 0.151** |
| Skills used (compared to businesses reporting no cooperative arrangements) | | | |
| Used some skills | 0.320*** | 0.276* | 0.321*** |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | |
| Reported | 0.241*** | 0.261** | 0.249*** |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | |
| Sought | 0.331*** | 0.188** | 0.281*** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | |
| Mining | –0.136 | –0.306 | –0.142 |
| Manufacturing | 0.186 | –0.038 | 0.179 |
| Electricity, water, gas and waste services | 0.052 | –0.425 | 0.024 |
| Construction | 0.112 | 0.123 | 0.168 |

| Covariates | Simple-structured businesses | Large complex-structured businesses | Total sample |
|---|---|---|---|
| Wholesale Trade | 0.501*** | 0.008 | 0.441*** |
| Retail Trade | 0.325** | 0.482 | 0.427*** |
| Accommodation and food services | 0.360*** | 0.183 | 0.384*** |
| Transport, postal and warehousing | –0.048 | –0.077 | 0.028 |
| Information, media and telecommunications | 0.247* | 0.172 | 0.314*** |
| Financial and insurance services | 0.291 | –0.045 | 0.228 |
| Rental, hiring and real estate services | 0.148 | –0.185 | 0.153 |
| Professional, scientific and technical services | 0.134 | –0.270 | 0.111 |
| Administrative and support services | 0.351*** | –0.030 | 0.320*** |
| Health care and social assistance | 0.761*** | –0.038 | 0.407*** |
| Arts and recreational services | 0.449*** | –0.275 | 0.416*** |
| Other services | 0.386*** | 0.068 | 0.388*** |
| Capital expenditure | $1.69E^{-08}$ | $-2.72E^{-12}$ | $-1.31E^{-12}$ |
| Intercept | –1.003*** | –1.987* | –1.02*** |
| Number of observations (N) | 3,604 | 1,492 | 5,097 |
| Number of treated units | 2,490 | 1,289 | 3,780 |
| Number of control units | 1,117 | 157 | 1,330 |
| Off support | 28 | 46 | 18 |
| Pseudo-$R^2$ | 0.195 | 0.072 | 0.184 |
| Log likelihood | –1,804 | –551 | –2,388 |

Notes: *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively, for P>|z|. See Table A5 for a description of each covariate.

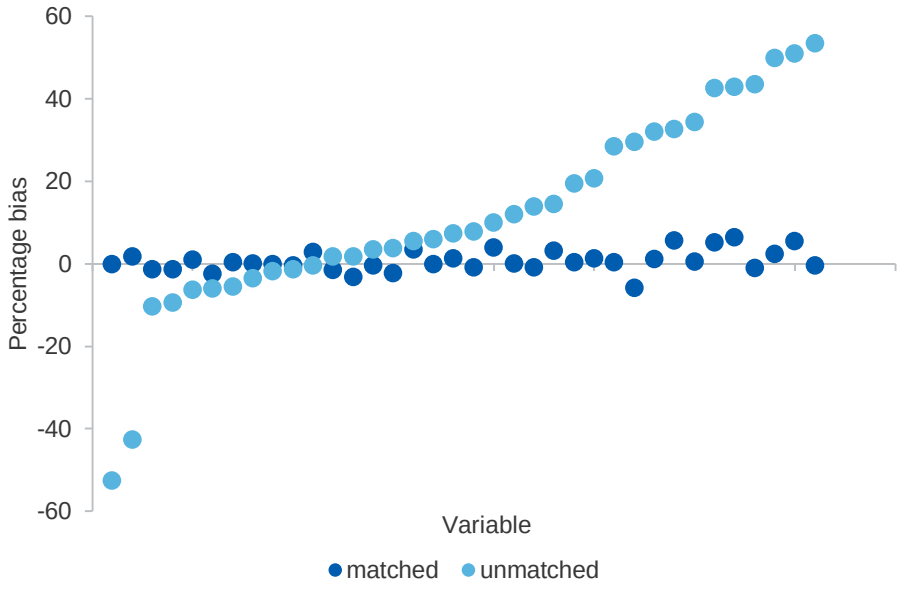
Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

## Choosing a matching algorithm

Once the propensity scores were computed, we examined different algorithms to match the two types of businesses, those innovators and those that are non-innovators. We tested three of the most commonly employed matching algorithms nearest neighbour matching, caliper matching and kernel matching.[43] To assess matching quality we calculated standardised bias reduction, mean tests, pseudo-$R^2$, and plotted the standardised bias for all the covariates, before and after matching. These aim to check whether the matching procedure is able to balance the distribution of relevant covariates. Looking at the difference in the covariate means between the two groups being eliminated after matching, we chose the kernel algorithm because of its superior reduction in bias (using a default bandwidth of 0.06 we reduced bias to 1.9 per cent, down from a raw 19.7 per cent). Figure 1 shows how the bias reduction works with kernel matching.

[43] Caliendo and Kopeinig 2008; Heinrich et al. 2010

Figure A1: Comparing standardised percentage bias across variables before and after kernel matching, all sample, 2011–13




Notes: Covariates are ordered from lowest to highest percentage bias pre-matching and each covariate corresponds to one point. Thirty six co-variates were matched using the kernel method.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

To ensure the validity of the PSM, we tested whether two central assumptions are satisfied: the conditional independence assumption and the common support condition. The conditional independence assumption cannot be directly tested. However, we used a transparent and well-controlled selection process of the covariates, we used a large set of covariates which were stable over time and our control and treatment datasets come from the same source. While the deterministic nature of some of the covariates is debatable, most of the covariates chosen have at different times been argued or shown to significantly influence innovation activity.

We tested the assumptions of overlap and common support by visual analysis of propensity score distribution, including graphical plots of the histogram and kernel density of propensity scores for treated and untreated groups, before and after matching. These aimed to check whether matching was able to make distributions more similar between the two groups. The histogram and kernel density of propensity scores showed that propensity score distributions became more similar between the treated and control groups after matching. Plots revealed a clear overlapping of the distributions (data now shown). After matching businesses based on their propensity score we estimated the significance of innovation persistence using regression modelling.

## Regression modelling

We assessed the magnitude of the cumulative effect of the persistence of innovation on selected business growth outcomes. We ran ordinary least square regressions on the ‘matched sample’, defined as the observations in the treatment group plus the matched observations in the control group.

The model in this case can be written as:

$$Log\ (Ratio\ of\ two\ outcome) = F\ (Innovation\ persistence, X_{1,})$$

where:

$$X_{1,} = a\ vector\ of\ covariates\ defined\ as\ in\ the\ propensity\ model,$$

Innovation persistence was a categorical innovation variable with the subcategories as in Table 1.2. Two different model specifications were used. The first one used a dummy variable for each of the innovation persistence variables, while the second one uses the years of persistence as a variable in the model.

Two different model specifications were used. The first one used a dummy variable for each of the innovation persistence variables, while the second one uses the years of persistence as a variable in the model.

We ran OLS regression on all growth variables except labour productivity growth and gross output per employee growth. We ran OLS regression with and without controlling for capital expenditure and found no major difference in the results. The results presented in this paper are those without controlling for capital expenditure. In this study we measured growth as the difference between time t and time $t_{-3}$ for simple and complex-structured businesses. An additional sample (called total sample) was used where we added a simple/complex dummy variable in the covariates for the propensity score modelling. This addressed the issue of a simple-structured business being matched to a large, complex business, and vice versa.

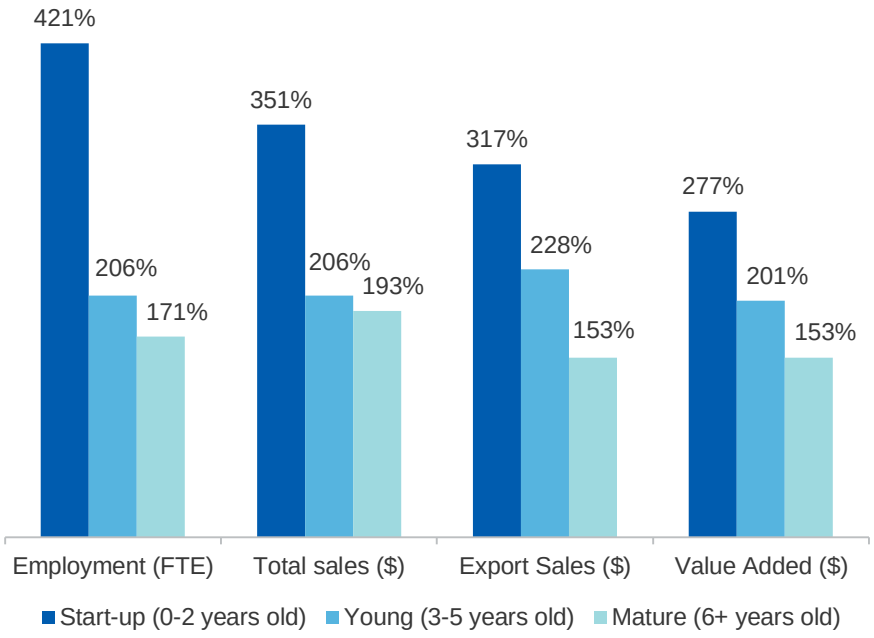
# Appendix B: Supplementary data

Table **Error! No text of specified style in document.**1: Net contribution to growth in employment, total sales, export sales and value-added by all Australian businesses, by age, size and growth class, 2007–14

| | | Contribution to | | | |
|---|---|---|---|---|---|
| Size/Age class | Annual growth | Employment (FTE) | Total sales ($ billion) | Export Sales ($ billion) | Value Added ($ billion) |
| Start-up (0–2 years old) SMEs | | | | | |
| | High | 1,296,907 | 511.1 | 21.24 | 157.58 |
| | Medium | 87,403 | 31.9 | 0.62 | 9.22 |
| | Low | 76,891 | 27.9 | 1.28 | 8.77 |
| | Nil or Negative | 7,989 | –75.6 | –3.58 | –29.79 |
| | Unknown/Any | 122,636 | 40.5 | 2.79 | 11.35 |
| Start-up (0–2 years old) large | | | | | |
| | Nil or Negative | –13,094 | –2.9 | –0.48 | –0.85 |
| | Unknown/Any | 131,109 | 32.9 | 1.39 | 9.27 |
| Young (3–5 years old) SMEs | | | | | |
| | High | 412,653 | 225.3 | 12.34 | 106.80 |
| | Medium | 37,703 | 16.7 | –0.04 | 6.08 |
| | Low | 1,209 | –3.8 | –0.98 | –0.91 |
| | Nil or Negative | –560,489 | –265.5 | –9.26 | –117.50 |
| | Unknown/Any | 229 | 0.1 | 0.06 | 0.04 |
| Young (3–5 years old) large | | | | | |
| | Nil or Negative | –31,266 | –9.0 | –0.42 | –3.42 |
| | Unknown/Any | 57,263 | 15.2 | 0.88 | 6.74 |
| Mature (6+ years old) SME | | | | | |
| | High | 1,110,139 | 759.2 | 108.80 | 322.49 |
| | Medium | 168,611 | 103.5 | 4.32 | 29.92 |
| | Low | –2,689 | –12.6 | –7.56 | –7.21 |
| | Nil or Negative | –2,203,708 | –1,049.9 | –106.33 | –426.13 |
| | Unknown/Any | 16,725 | 11.5 | 1.41 | 3.25 |
| Mature (6+ years old) large | | | | | |
| | High | 1,239,271 | 1,095.6 | 182.88 | 298.21 |
| | Medium | 219,350 | 144.8 | 20.24 | 29.36 |
| | Low | 74,865 | 14.6 | –15.66 | –18.69 |
| | Nil or Negative | –961,571 | –533.0 | –80.13 | –164.60 |
| | Unknown/Any | 28,720 | 21.0 | 1.56 | 3.11 |

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Figure B1: Contribution of high growth businesses of different ages to growth relative to their share of employment, total sales, export sales or value added in Australia, 2007–14




Notes: Each bar is an average of all businesses in the economy. Averages incorporate all industry classes except SISCA2 businesses. Relative growth contribution is calculated as the percentage contribution to total aggregate growth (e.g. employment) divided by that sector's total share of that indicator (i.e. relative to 100 per cent of all employment growth).

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

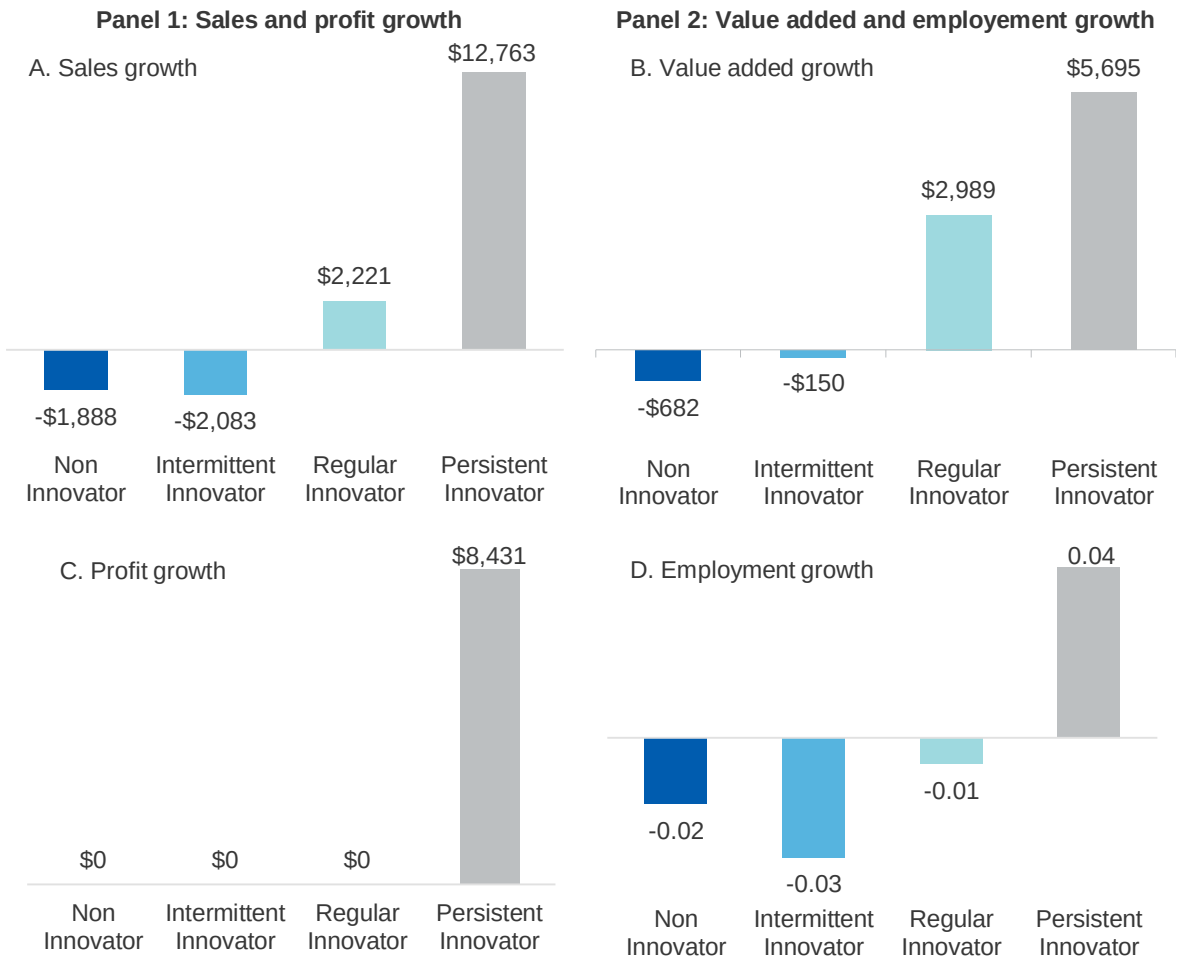
Table B2: Contribution of businesses to growth relative to their share of employment, total sales, export sales or value added in Australia, by growth class, by age, 2007–14

| Growth class | Age class | Contribution to growth in X indicator relative to its share of total X: | | | |
|---|---|---|---|---|---|
| | | Employment | Total sales | Export sales | Value Added |
| High growth | Start-up | 421% | 351% | 317% | 277% |
| | Young | 206% | 206% | 228% | 201% |
| | Mature | 171% | 193% | 153% | 153% |
| Medium growth | Start-up | 222% | 171% | 196% | 130% |
| | Young | 87% | 59% | 84% | 68% |
| | Mature | 59% | 61% | 73% | 60% |
| Low growth | Start-up | 189% | 131% | 193% | 107% |
| | Young | 59% | 22% | 75% | 49% |
| | Mature | 29% | 22% | 31% | 40% |

Notes: Relative growth contribution is calculated as the percentage contribution to total aggregate growth (e.g. employment) divided by that sector's total share of that indicator (i.e. relative to 100 per cent of all employment growth). Each value is an average of all businesses in the sector except young, large businesses. Averages incorporate all industry classes except SISCA2 businesses.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

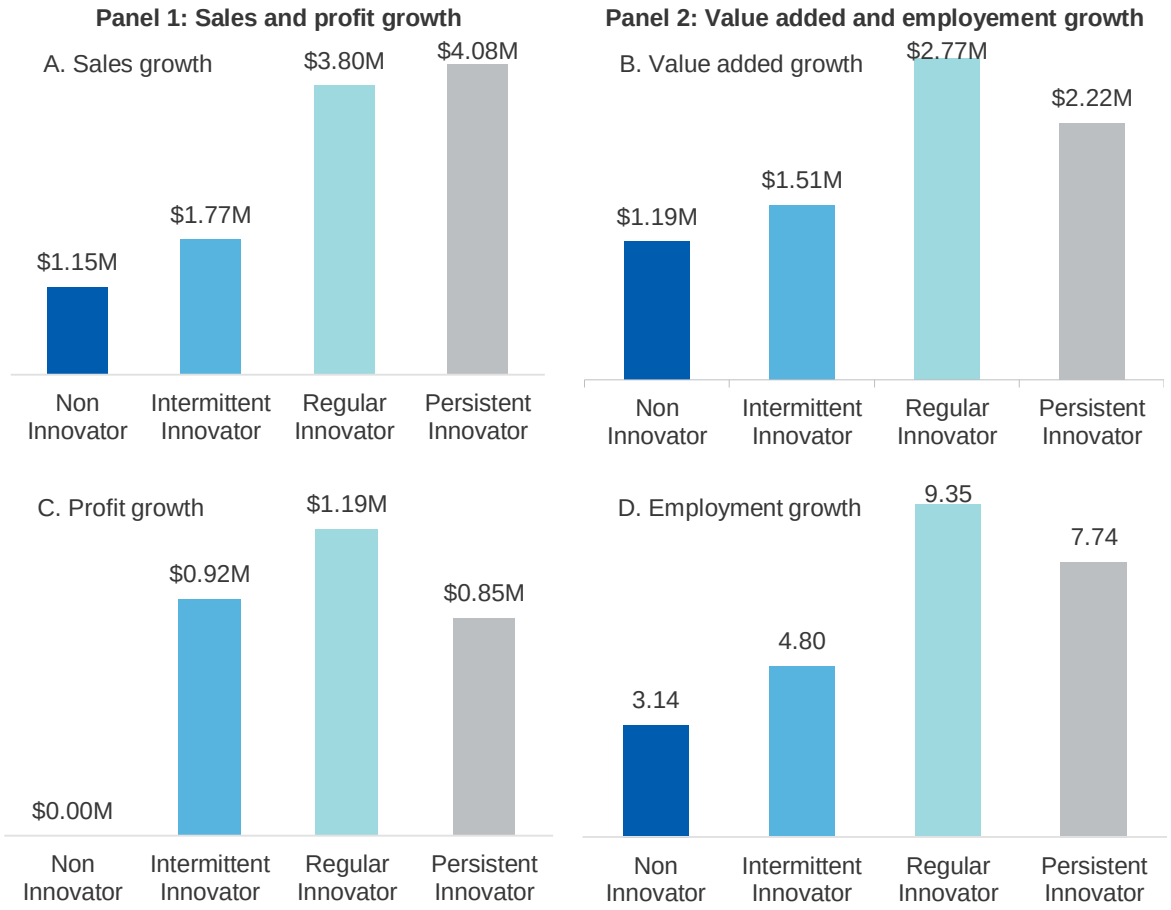
Figure B2: Median annual sales, value added, gross operating profit and employment growth for SME businesses, by innovation persistence, 2008–09 to 2013–14




Notes: ANOVA and interaction effects tests showed a significant positive differences between innovation persistence least squares means for sales growth (F=42, $p$<0.0001), value added growth (F=537, $p$<0.001), gross operating profit growth (F=17, $p$<0.0001) and employment growth (F=12, $p$<0.05). Note that the panel data was pooled and is unlikely to satisfy the independence test. Employment growth is measured in FTEs. Sales, value-added and gross operating profit dollar values are not deflated. Each bar is a median of SME businesses (with 0–199 employees).

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Figure B3**Error! No text of specified style in document.**: Median annual sales, value added, gross operating profit and employment growth for large businesses, by innovation persistence, 2008–09 to 2013–14




Notes: ANOVA and interaction effects tests showed a significant positive differences between innovation persistence least squares means for sales growth (F=9.41, *p*<0.0001), value added growth (F=5.23, *p*<0.001), gross operating profit growth (F=8.71, *p*<0.0001) and employment growth (F=2.87, *p*<0.05). Note that panel data was pooled and is unlikely to satisfy the independence test. Employment growth is measured in FTEs. Sales, value-added and gross operating profit dollar values are not deflated. Each bar is a median of large businesses (with 200+ employees).

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B3: Percentile distribution of annual employment growth, by business size, by innovation persistence, 2008–14

| Full Time Equivalent | 10th | 25th | 50th | 75th | 90th |
|---|---|---|---|---|---|
| 0–199 employees | | | | | |
| Non-innovator | –1.59 | –0.42 | –0.02 | 0.20 | 1.03 |
| Intermittent innovator | –2.14 | –0.65 | –0.03 | 0.46 | 2.26 |
| Regular innovator | –2.95 | –0.77 | –0.01 | 0.72 | 3.54 |
| Persistent innovator | –3.47 | –0.77 | 0.04 | 1.21 | 4.79 |
| 200+ employees | | | | | |
| Non-innovator | –138.30 | –50.95 | 3.14 | 37.73 | 124.80 |
| Intermittent innovator | –145.85 | –43.27 | 4.80 | 48.06 | 153.20 |
| Regular innovator | –129.08 | –34.95 | 9.35 | 64.67 | 189.61 |
| Persistent innovator | –135.73 | –38.07 | 7.74 | 60.07 | 191.37 |

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B4: Percentile distribution of annual gross operating profit growth, by business size, by innovation persistence, 2008–2014

| Dollars | 10th | 25th | 50th | 75th | 90th |
|---|---|---|---|---|---|
| 0–199 employees | | | | | |
| Non-innovator | –179,667 | –25,420 | 0 | 20,216 | 149,989 |
| Intermittent innovator | –285,439 | –55,800 | 0 | 40,128 | 321,896 |
| Regular innovator | –366,731 | –43,358 | 0 | 105,256 | 601,694 |
| Persistent innovator | –534,008 | –73,214 | 8,431 | 200,821 | 921,049 |
| 200+ employees | | | | | |
| Non-innovator | –46,594,473 | –6,745,392 | 0 | 11,202,898 | 62,077,811 |
| Intermittent innovator | –33,175,103 | –4,541,182 | 922,449 | 13,053,741 | 61,505,880 |
| Regular innovator | –35,983,241 | –6,099,021 | 1,194,237 | 17,746,055 | 82,336,628 |
| Persistent innovator | –38,049,123 | –5,144,156 | 46,827 | 18,212,972 | 79,112,200 |

Notes: Gross operating profit is measured as the difference between *Sales of goods and services* and the *Cost of goods and services sold* (Table A5).

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

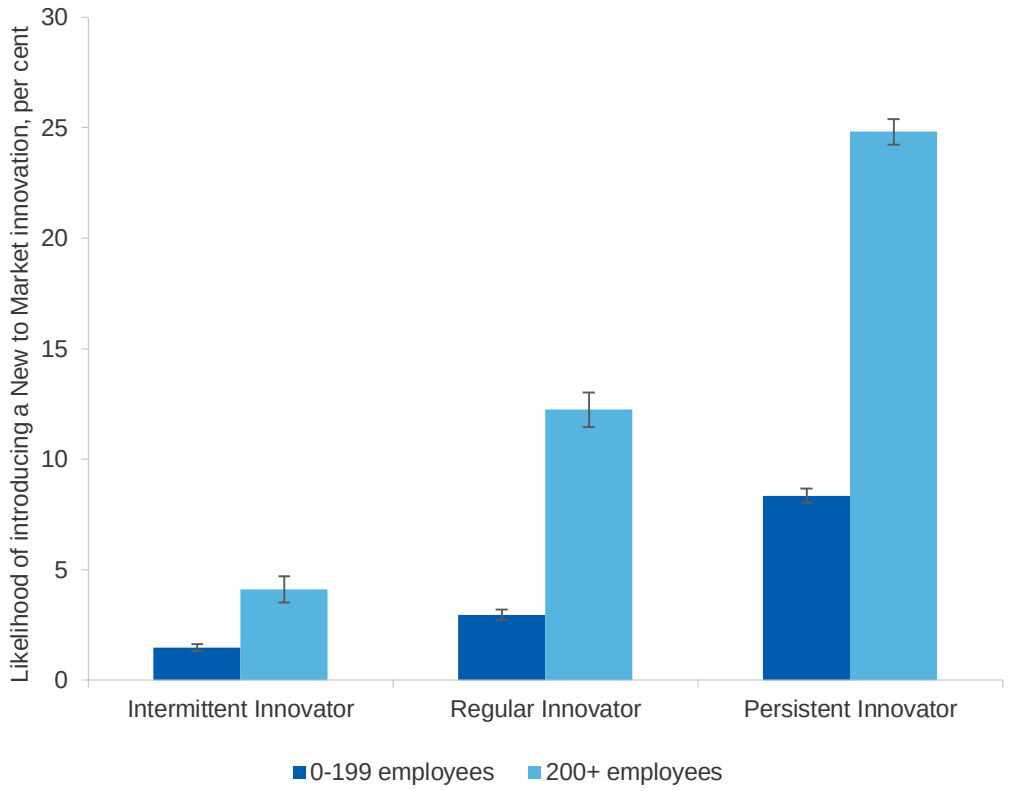
Table B5: Percentile distribution of annual value added growth, by business size, by innovation persistence, 2008–2014

| Dollars | 10th | 25th | 50th | 75th | 90th |
|---|---|---|---|---|---|
| 0–199 employees | | | | | |
| Non-innovator | –162,712 | –31,846 | –682 | 29,391 | 154,064 |
| Intermittent innovator | –250,082 | –50,058 | –150 | 49,416 | 305,218 |
| Regular innovator | –315,714 | –62,014 | 2,989 | 92,820 | 461,198 |
| Persistent innovator | –520,205 | –91,864 | 5,695 | 145,408 | 808,004 |
| 200+ employees | | | | | |
| Non-innovator | –35,666,990 | –6,273,784 | 1,193,879 | 10,097,008 | 44,703,740 |
| Intermittent innovator | –28,478,544 | –6,400,136 | 1,505,868 | 9,854,900 | 37,284,945 |
| Regular innovator | –25,823,623 | –4,309,105 | 2,771,787 | 12,235,818 | 49,281,398 |
| Persistent innovator | –32,162,724 | –5,503,307 | 2,214,568 | 15,299,613 | 60,482,821 |

Notes: Value added is calculated as the difference between *Total Sales* and *Intermediate Expenditure* (see Table A5).

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Figure B4: Percentage likelihood of introducing a new to market innovation, by innovation persistence, 2008–2014




Notes: *New to Market* innovation includes New to Industry, New to Australia and New to World degrees of novelty.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B6: Gross output growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large, complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active businesses) | | | | | | |
| Innovators for 3 years | 0.163*** | | 0.025 | | 0.114*** | |
| Innovators for 2 years only | 0.113*** | | 0.014 | | 0.081*** | |
| Innovators for 1 year only | 0.008 | | –0.015 | | 0.011 | |
| Innovation Persistence — categorical | | 0.055*** | | 0.008 | | 0.039*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –0.157*** | –0.158*** | –0.189 | –0.191 | –0.165*** | –0.166*** |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | 0.181*** | 0.183*** | | | 0.198*** | 0.200*** |
| 5–19 employees | 0.075 | 0.079 | | | 0.081 | 0.084 |
| 20–199 employees | 0.124** | 0.128** | | | 0.144** | 0.147** |
| 200–299 employees | 0.187 | 0.189 | 0.147 | | 0.360*** | 0.364*** |
| 300+ employees | 0.118 | 0.121 | | –0.147 | 0.245*** | 0.248*** |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | –0.022 | –0.018 | –0.088 | –0.088 | –0.058 | –0.056 |
| Moderate to strong | 0.055 | 0.058 | –0.262*** | –0.261*** | –0.031 | –0.029 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.179*** | –0.170** | 0.279 | 0.276 | –0.168** | –0.162** |
| High | –0.102 | –0.094 | 0.231 | 0.227 | –0.151** | –0.146** |
| Moderate | –0.123* | –0.117* | 0.365 | 0.362 | –0.105 | –0.100 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | –0.132 | –0.128 | –0.019 | –0.019 | –0.079* | –0.079* |
| >50 per cent | –0.095 | –0.091 | –0.005 | –0.004 | 0.041 | 0.043 |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Received government assistance | –0.000 | 0.001 | 0.005 | 0.005 | 0.019 | 0.019 |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | 0.019 | 0.020 | –0.010 | –0.009 | –0.022 | –0.021 |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | 0.002 | 0.003 | 0.176 | 0.178 | 0.007 | 0.008 |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | 0.006 | 0.006 | 0.002 | 0.002 | –0.017 | –0.017 |
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |
| Used some skills | 0.008 | 0.009 | 0.007 | 0.007 | 0.018 | 0.019 |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | –0.149*** | –0.148*** | –0.021 | –0.021 | –0.127*** | –0.127*** |

| | Simple-structured businesses | | Large, complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | 0.111*** | 0.112*** | 0.111*** | 0.110*** | 0.126*** | 0.126*** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | –0.089 | –0.093 | 1.805*** | 1.801*** | 0.036 | 0.034 |
| Manufacturing | 0.045 | 0.045 | 1.766*** | 1.764*** | 0.129*** | 0.1290*** |
| Electricity, water, gas and waste services | –0.256 | –0.257 | 1.883*** | 1.881*** | 0.076 | 0.077 |
| Construction | 0.050 | 0.049 | 1.703*** | 1.701*** | 0.136** | 0.136** |
| Wholesale Trade | –0.136** | –0.137** | 1.796*** | 1.794*** | 0.036 | 0.035 |
| Retail Trade | –0.176*** | –0.175*** | 1.571*** | 1.568*** | –0.032 | –0.032 |
| Accommodation and food services | –0.090 | –0.091 | 1.801*** | 1.800*** | 0.041 | 0.041 |
| Transport, postal and warehousing | 0.058 | 0.057 | 1.761*** | 1.759*** | 0.161*** | 0.160*** |
| Information, media and telecommunications | –0.075 | –0.077 | 1.583*** | 1.581*** | 0.034 | 0.033 |
| Financial and insurance services | 0.131 | 0.133 | 1.639*** | 1.639*** | –0.001 | 0.001 |
| Rental, hiring and real estate services | –0.004 | –0.004 | 1.731*** | 1.730*** | 0.121** | 0.121** |
| Professional, scientific and technical services | –0.058 | –0.057 | 1.880*** | 1.879*** | 0.126** | 0.127** |
| Administrative and support services | 0.044 | 0.044 | 1.872*** | 1.870*** | 0.172*** | 0.171*** |
| Health care and social assistance | 0.102 | 0.107 | 1.854*** | 1.854*** | 0.193*** | 0.194*** |
| Arts and recreational services | –0.006 | –0.008 | 1.647*** | 1.644*** | 0.132** | 0.131** |
| Other services | 0.031 | 0.029 | 1.465*** | 1.459*** | 0.125** | 0.124** |
| Intercept | 0.034 | 0.012 | –1.76*** | –1.61*** | –0.03 | –0.04 |
| Number of observations | 4,046 | 4,046 | 1,931 | 1,931 | 6,101 | 6,101 |
| R-squared | 0.05 | 0.05 | 0.09 | 0.09 | 0.04 | 0.04 |
| Log likelihood | –4,203 | –4,205 | –2,081 | –2,081 | –6,557 | –6,557 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of gross output between 2012–13 and 2010–11. Gross output is total business income + the value of changes in inventories of goods produced as outputs. *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B7: Value added growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active) | | | | | | |
| Innovators for 3 years | 0.174*** | | –0.079 | | 0.091*** | |
| Innovators for 2 years only | 0.093*** | | –0.021 | | 0.067*** | |
| Innovators for 1 year only | –0.008 | | –0.091 | | –0.009 | |
| Persistence — categorical | | 0.055*** | | 0.008 | | 0.039*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –0.155*** | –0.157*** | –0.213 | –0.226 | –0.152 | –0.153*** |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | 0.206*** | 0.208*** | | | 0.212*** | 0.214*** |
| 5–19 employees | 0.112* | 0.116* | | | 0.098 | 0.103 |
| 20–199 employees | 0.160** | 0.164** | | | 0.174*** | 0.179*** |
| 200–299 employees | 0.245 | 0.242 | 0.120 | 0.120 | 0.402*** | 0.407*** |
| 300+ employees | 0.172* | 0.175* | | | 0.292*** | 0.296*** |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | –0.046 | –0.041 | –0.177 | –0.176 | –0.075 | –0.072 |
| Moderate to strong | 0.043 | 0.046 | –0.346*** | –0.343*** | –0.044 | –0.043 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.128* | –0.116** | 0.891 | 0.891 | –0.079 | –0.070 |
| High | –0.038 | –0.027 | 0.707 | 0.705 | –0.111 | –0.104 |
| Moderate | –0.089 | –0.081* | 0.961* | 0.961* | –0.043 | –0.036 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | –0.344*** | –0.338*** | 0.103 | 0.099 | –0.118** | –0.118** |
| >50 per cent | –0.183** | –0.177** | –0.057 | –0.055 | –0.028 | –0.026 |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Received government assistance | –0.024 | –0.023 | –0.033 | –0.032 | –0.008 | –0.007 |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | 0.086*** | 0.089*** | –0.025 | –0.025 | 0.001 | 0.002 |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | –0.056* | –0.053* | 0.127 | 0.135 | –0.044 | –0.043 |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | –0.005 | –0.003 | 0.052 | 0.052 | –0.006 | –0.006 |
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Used some skills | 0.014 | 0.016 | 0.122 | 0.120 | 0.040 | 0.041 |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | –0.145*** | –0.144*** | 0.034 | 0.033 | –0.111*** | –0.111*** |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | 0.084*** | 0.086*** | 0.096** | 0.096** | 0.108*** | 0.109*** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | –0.021 | –0.027 | 2.050 | 2.040*** | 0.073 | 0.071 |
| Manufacturing | 0.057 | 0.057 | 1.856*** | 1.846*** | 0.163*** | 0.162*** |
| Electricity, water, gas and waste services | –0.193 | –0.195 | 1.798*** | 1.799*** | 0.023 | 0.024 |
| Construction | 0.010 | 0.009 | 1.679*** | 1.670*** | 0.080 | 0.079** |
| Wholesale Trade | –0.009 | –0.010 | 1.939*** | 1.927*** | 0.154*** | 0.153 |
| Retail Trade | –0.141** | –0.139** | 1.660*** | 1.648*** | –0.002 | –0.002 |
| Accommodation and food services | –0.084 | –0.085 | 1.955*** | 1.947*** | 0.077 | 0.076 |
| Transport, postal and warehousing | 0.032 | 0.031 | 1.739*** | 1.729*** | 0.123** | 0.122*** |
| Information, media and telecommunications | –0.077 | –0.080 | 1.652*** | 1.640*** | 0.056 | 0.057 |
| Financial and insurance services | 0.140 | 0.143 | 1.658*** | 1.650*** | –0.037 | –0.036 |
| Rental, hiring and real estate services | 0.020 | 0.019 | 1.840*** | 1.831*** | 0.170*** | 0.168** |
| Professional, scientific and technical services | –0.077 | –0.077 | 1.922*** | 1.916*** | 0.126** | 0.127** |
| Administrative and support services | –0.036 | –0.036 | 1.909*** | 1.899*** | 0.100* | 0.099*** |
| Health care and social assistance | 0.099 | 0.105 | 2.003*** | 1.997*** | 0.224*** | 0.226*** |
| Arts and recreational services | –0.024 | –0.027 | 1.696*** | 1.685*** | 0.129* | 0.127** |
| Other services | 0.002 | –0.000 | 1.590*** | 1.580*** | 0.110* | 0.108** |
| Intercept | 0.03 | –0.00 | –2.29*** | –2.28*** | –0.07 | –0.09 |
| Number of observations | 3,978 | 3,978 | 1,835 | 1,835 | 5,882 | 5,882 |
| R-squared | 0.04 | 0.04 | 0.11 | 0.11 | 0.03 | 0.03 |
| Log likelihood | –4495 | –4497 | –2129 | –2130 | –6845 | –6846 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of valued added output between 2012–13 and 2010–11. Value added is calculated as the difference between Total Sales and Non-Capital Expenditure (see Table A5). *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B8: Gross operating profit growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active) | | | | | | |
| Innovators for 3 years | 0.111 | | 0.1694** | | 0.1741*** | |
| Innovators for 2 years only | 0.007 | | –0.0179 | | 0.0112 | |
| Innovators for 1 year only | 0.0528 | | 0.3603*** | | 0.1245*** | |
| Persistence — categorical | | 0.029 | | 0.0438* | | .0474*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –0.1433* | –0.1421* | –1.5479*** | –1.4513*** | –0.151 | –0.1473 |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | 0.1949 | 0.1914 | (omitted) | (omitted) | 0.264 | 0.2565 |
| 5–19 employees | 0.2761** | 0.2722** | (omitted) | (omitted) | 0.3149 | 0.3046 |
| 20–199 employees | 0.2133 | 0.2095 | (omitted) | (omitted) | 0.2717 | 0.2605 |
| 200–299 employees | –0.5459* | –0.5604* | (omitted) | 0.2261 | 0.0576 | 0.0412 |
| 300+ employees | –0.0838 | –0.0923 | –0.2275 | (omitted) | –0.0131 | –0.0243 |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | 0.1362 | 0.1321 | –0.1184 | –0.1299 | 0.0615 | 0.0561 |
| Moderate to strong | 0.0063 | 0.0061 | –0.1189 | –0.1397 | –0.0289 | –0.0306 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.295* | –0.2949* | 0.5783 | 0.5545 | –0.2425 | –0.2473 |
| High | –0.1114 | –0.11 | 0.5196 | 0.5129 | –0.1541 | –0.1577 |
| Moderate | –0.3701** | –0.3701** | 0.8345 | 0.8105 | –0.2336 | –0.2379 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | –0.6185 | –0.6112 | 0.261** | 0.2738*** | 0.2005 | 0.2097* |
| >50 per cent | 0.1582 | 0.1551 | 0.2567*** | 0.249*** | 0.3034 | 0.3017*** |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Received government assistance | 0.045 | 0.0446 | 0.073 | 0.0726 | 0.0329 | 0.0328 |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | 0.3709*** | 0.3736*** | 0.0408 | 0.0356 | 0.1505*** | 0.153*** |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | 0.1108 | 0.113 | 0.245 | 0.1863 | 0.139** | 0.1393** |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | 0.0069 | 0.0065 | –0.0799 | –0.0794 | –0.0591 | –0.0603 |

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |
| Used some skills | –0.0057 | –0.005 | 0.0154 | 0.0263 | 0.0019 | 0.002 |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | 0.0344 | 0.0334 | 0.0077 | 0.0072 | 0.0094 | 0.0093 |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | 0.0225 | 0.0215 | 0.0683 | 0.0723 | 0.0683 | 0.0666 |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | 0.2929 | 0.2948 | –0.014 | –0.066 | 0.0939 | 0.0921 |
| Manufacturing | 0.0734 | 0.0765 | 0.1176 | 0.0841 | 0.0487 | 0.0547 |
| Electricity, water, gas and waste services | 0.5695 | 0.5754 | 0.3094 | 0.257 | 0.3562 | 0.344 |
| Construction | 0.411** | 0.4155** | 0.33 | 0.2898 | 0.3314** | 0.3373** |
| Wholesale Trade | 0.0702 | 0.0748 | 0.1475 | 0.1268 | 0.062 | 0.0713 |
| Retail Trade | –0.1468 | –0.1444 | 0.1535 | 0.1213 | –0.0387 | –0.035 |
| Accommodation and food services | 0.0796 | 0.0836 | 0.3684 | 0.3655 | 0.1865 | 0.1924 |
| Transport, postal and warehousing | 0.0176 | 0.0193 | 0.1915 | 0.168 | 0.1537 | 0.1581 |
| Information, media and telecommunications | –0.0767 | –0.0745 | 0.0793 | 0.0551 | –0.0073 | –0.0022 |
| Financial and insurance services | 0.9593*** | 0.9655*** | 0.4486 | 0.409 | 0.4432*** | 0.4539*** |
| Rental, hiring and real estate services | 0.2151 | 0.2152 | 0.3651 | 0.3141 | 0.3269** | 0.3273** |
| Professional, scientific and technical services | –0.0278 | –0.0276 | 0.4006 | 0.3478 | 0.1411 | 0.1416 |
| Administrative and support services | –0.0172 | –0.0134 | 0.4857 | 0.439 | 0.1484 | 0.1533 |
| Health care and social assistance | 0.5553** | 0.554** | 0.5486 | 0.5031 | 0.4394*** | 0.4408*** |
| Arts and recreational services | 0.266 | 0.2696* | 0.0752 | 0.0512 | 0.2921** | 0.2955** |
| Other services | 0.384** | 0.389*** | | | 0.429*** | 0.435*** |
| Intercept | –0.133 | –0.135 | 0.439 | 0.263 | –0.025 | –0.039 |
| Number of observations | 2,348 | 2,348 | 1,286 | 1,286 | 3,701 | 3,701 |
| R-squared | 0.055 | 0.055 | 0.078 | 0.068 | 0.038 | 0.037 |
| Log likelihood | –3,886 | –3,886 | –1,810 | –1,817 | –5,911 | –5,914 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of gross operating profit between 2012–13 and 2010–11. Gross operating profit is measured as the difference between Sales of goods and services and the Cost of goods sold (Table A5). *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B9: Employment (FTE) growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active) | | | | | | |
| Innovators for 3 years | 0.173*** | | 0.027 | | 0.098*** | |
| Innovators for 2 years only | 0.107*** | | 0.061** | | 0.087*** | |
| Innovators for 1 year only | 0.006 | | 0.090*** | | 0.025 | |
| Persistence — categorical | | 0.057*** | | 0.012* | | 0.035*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –0.046* | –0.047* | –0.219* | –0.220* | –0.049** | –0.049** |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | –0.375* | –0.375* | (omitted) | (omitted) | –0.348* | –0.350* |
| 5–19 employees | –0.357 | –0.354 | (omitted) | (omitted) | –0.344* | –0.345* |
| 20–199 employees | –0.350 | –0.347 | (omitted) | (omitted) | –0.336* | –0.337* |
| 200–299 employees | –0.229 | –0.228 | 0.097** | 0.097** | –0.212 | –0.212 |
| 300+ employees | –0.480** | –0.478** | (omitted) | (omitted) | –0.304 | –0.306 |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | –0.027 | –0.024 | –0.009 | –0.009 | –0.022 | –0.021 |
| Moderate to strong | –0.015 | –0.014 | –0.000 | –0.004 | –0.008 | –0.008 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.081 | –0.068 | 0.196 | 0.213 | –0.088 | –0.086 |
| High | –0.110 | –0.098 | 0.164 | 0.183 | –0.109* | –0.107* |
| Moderate | –0.011 | –0.002 | 0.260 | 0.276 | –0.030 | –0.028 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | 0.037 | 0.040 | 0.016 | 0.017 | 0.033 | 0.032 |
| >50 per cent | 0.145*** | 0.148*** | –0.021 | –0.022 | 0.031 | 0.032 |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Received government assistance | 0.031 | 0.032 | –0.042** | –0.043** | 0.002 | 0.002 |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | 0.048** | 0.050** | 0.014 | 0.009 | 0.027* | 0.026* |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | –0.026 | –0.023 | –0.104 | –0.108 | –0.034 | –0.034 |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | –0.120*** | –0.119*** | –0.015 | –0.017 | –0.030 | –0.031 |

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |
| Used some skills | –0.072*** | –0.070*** | 0.028 | 0.026 | –0.030 | –0.030 |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | –0.027 | –0.025 | 0.021 | 0.020 | –0.014 | –0.014 |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | –0.039* | –0.038* | 0.045** | 0.044** | 0.007 | 0.007 |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | –0.023 | –0.023 | 0.532*** | 0.545*** | 0.045 | 0.046 |
| Manufacturing | –0.108** | –0.104** | 0.321*** | 0.324*** | –0.0573 | –0.058 |
| Electricity, water, gas and waste services | –0.099 | –0.097 | 0.345*** | 0.347*** | –0.014 | –0.013 |
| Construction | –0.073 | –0.071 | 0.314*** | 0.325*** | –0.034 | –0.034 |
| Wholesale Trade | –0.123** | –0.119** | 0.281*** | 0.285*** | –0.099** | –0.100** |
| Retail Trade | –0.230*** | –0.223*** | 0.211** | 0.216** | –0.130*** | –0.131*** |
| Accommodation and food services | –0.039 | –0.036 | 0.324*** | 0.330*** | –0.024 | –0.024 |
| Transport, postal and warehousing | 0.026 | 0.029 | 0.344*** | 0.350*** | 0.031 | 0.031 |
| Information, media and telecommunications | –0.195*** | –0.193*** | 0.214* | 0.216** | –0.153*** | –0.153*** |
| Financial and insurance services | –0.295*** | –0.288*** | 0.308*** | 0.307*** | –0.093* | –0.094* |
| Rental, hiring and real estate services | –0.057 | –0.053 | 0.206* | 0.210* | –0.047 | –0.047 |
| Professional, scientific and technical services | –0.058 | –0.055 | 0.382*** | 0.384*** | –0.012 | –0.012 |
| Administrative and support services | –0.213*** | –0.209*** | 0.237** | 0.240** | –0.152*** | –0.152*** |
| Health care and social assistance | 0.036 | 0.045 | 0.388*** | 0.389*** | 0.007 | 0.006 |
| Arts and recreational services | –0.109** | –0.106** | 0.373*** | 0.378*** | –0.047 | –0.048 |
| Other services | –0.144*** | –0.142*** | 0.172 | 0.185 | –0.105** | –0.105** |
| Intercept | 0.630*** | 0.600*** | –0.179 | –0.177 | 0.556*** | 0.557*** |
| Number of observations | 3,975 | 3,975 | 2,480 | 2,480 | 6,597 | 6,597 |
| R-squared | 0.049 | 0.048 | 0.057 | 0.053 | 0.028 | 0.028 |
| Log likelihood | –3,381 | –3,383 | –1,237 | –1,242 | –4,930 | –4,931 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of employment between 2012–13 and 2010–11. *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B10: Total salaries and wages growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active) | | | | | | |
| Innovators for 3 years | 0.202*** | | –0.012 | | 0.110*** | |
| Innovators for 2 years only | 0.102*** | | 0.077 | | 0.083*** | |
| Innovators for 1 year only | 0.048 | | 0.106* | | 0.067** | |
| Persistence — categorical | | 0.063*** | | 0.002 | | 0.038*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –0.024 | –0.025 | –0.152 | –0.148 | –0.019 | –0.020 |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | –0.001 | 0.007 | (omitted) | (omitted) | 0.083 | 0.076 |
| 5–19 employees | –0.059 | –0.052 | (omitted) | (omitted) | 0.012 | 0.003 |
| 20–199 employees | –0.059 | –0.052 | (omitted) | (omitted) | 0.026 | 0.018 |
| 200–299 employees | 0.086 | 0.087 | 0.159* | 0.158* | 0.347* | 0.339 |
| 300+ employees | –0.151 | –0.145 | (omitted) | (omitted) | 0.175 | 0.167 |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | –0.087* | –0.087* | 0.110 | 0.111 | –0.034 | –0.034 |
| Moderate to strong | –0.077* | –0.077* | –0.002 | –0.008 | –0.029 | –0.030 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.103 | –0.099 | 0.261 | 0.289 | –0.079 | –0.086 |
| High | –0.078 | –0.073 | 0.188 | 0.222 | –0.102 | –0.108 |
| Moderate | –0.078 | –0.074 | 0.325 | 0.354 | –0.049 | –0.054 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | –0.093 | –0.092 | –0.053 | –0.052 | –0.053 | –0.054 |
| >50 per cent | –0.032 | –0.032 | –0.031 | –0.033 | 0.047 | 0.046 |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Received government assistance | 0.044* | 0.044* | –0.017 | –0.018 | 0.045** | 0.044** |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | 0.031 | 0.032 | –0.049 | –0.055 | –0.051** | –0.052** |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | –0.060** | –0.058** | –0.255* | –0.261* | –0.048 | –0.050* |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | –0.089** | –0.088** | 0.022 | 0.019 | –0.011 | –0.011 |
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Used some skills | –0.003 | –0.002 | –0.000 | –0.004 | 0.029 | 0.028 |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | –0.058** | –0.057** | –0.011 | –0.013 | –0.075*** | –0.075*** |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | 0.087*** | 0.083*** | –0.014 | –0.011 | 0.047** | 0.046** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | –0.020 | –0.021 | 2.362*** | 2.378*** | 0.183*** | 0.184*** |
| Manufacturing | –0.090 | –0.088 | 2.084*** | 2.085*** | 0.038 | 0.036 |
| Electricity, water, gas and waste services | –0.170 | –0.169 | 2.026*** | 2.036*** | –0.081 | –0.081 |
| Construction | –0.138** | –0.136** | 2.124*** | 2.134*** | 0.066 | 0.065 |
| Wholesale Trade | –0.181*** | –0.178*** | 2.168*** | 2.170*** | 0.021 | 0.019 |
| Retail Trade | –0.150*** | –0.146*** | 1.900*** | 1.905*** | 0.009 | 0.006 |
| Accommodation and food services | –0.066 | –0.063 | 2.075*** | 2.077*** | 0.071 | 0.069 |
| Transport, postal and warehousing | –0.010 | –0.009 | 2.155*** | 2.161*** | 0.147** | 0.146** |
| Information, media and telecommunications | –0.092 | –0.090 | 1.939*** | 1.934*** | 0.040 | 0.039 |
| Financial and insurance services | –0.037 | –0.032 | 2.067*** | 2.061*** | –0.0207 | –0.025 |
| Rental, hiring and real estate services | –0.123** | –0.121** | 2.102*** | 2.099*** | 0.065 | 0.063 |
| Professional, scientific and technical services | –0.076 | –0.074 | 2.481*** | 2.478*** | 0.245*** | 0.243*** |
| Administrative and support services | –0.178*** | –0.175*** | 2.316*** | 2.318*** | 0.078 | 0.076 |
| Health care and social assistance | 0.020 | 0.024 | 2.214*** | 2.207*** | 0.161** | 0.157** |
| Arts and recreational services | –0.058 | –0.055 | 1.993*** | 2.010*** | 0.116* | 0.115* |
| Other services | –0.108* | –0.106* | 1.851*** | 1.897*** | 0.041 | 0.039 |
| Intercept | 0.301 | .280 | –1.815*** | –1.817*** | –0.022 | 0.008 |
| Number of observations | 3,505 | 3,505 | 1,901 | 1,901 | 5,510 | 5,510 |
| R-squared | 0.040 | 0.039 | 0.135 | 0.133 | 0.034 | 0.034 |
| Log likelihood | –3,167 | –3,167 | –2,044 | –2,047 | –5,615 | –5,615 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of total salaries and wages between 2012–13 and 2010–11. *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B11: Total turnover growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active) | | | | | | |
| Innovators for 3 years | 0.173*** | | 0.0695*** | | 0.159*** | |
| Innovators for 2 years only | 0.115*** | | 0.0597** | | 0.119*** | |
| Innovators for 1 year only | 0.034 | | 0.0956*** | | 0.073*** | |
| Persistence — categorical | | 0.057*** | | 0.024*** | | 0.054*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –0.185*** | –0.186*** | –0.0731 | –0.072 | –0.158*** | –0.157*** |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | 0.153*** | 0.154*** | (omitted) | (omitted) | 0.186*** | 0.185*** |
| 5–19 employees | 0.063 | 0.065 | (omitted) | (omitted) | 0.065 | 0.064 |
| 20–199 employees | 0.078 | 0.080 | (omitted) | (omitted) | 0.096* | 0.094* |
| 200–299 employees | 0.177 | 0.178 | 0.098* | 0.097 | 0.270*** | 0.269*** |
| 300+ employees | 0.069 | 0.071 | (omitted) | (omitted) | 0.186*** | 0.184*** |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | –0.085* | –0.083* | –0.045 | –0.045 | –0.075** | –0.076** |
| Moderate to strong | –0.014 | –0.013 | –0.042 | –0.044 | –0.013 | –0.013 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.152** | –0.147** | 0.289 | 0.297 | –0.075 | –0.080 |
| High | –0.203*** | –0.198*** | 0.163 | 0.175 | –0.180*** | –0.184*** |
| Moderate | –0.129* | –0.125* | 0.281 | 0.290 | –0.089 | –0.093 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | –0.155 | –0.154 | 0.117*** | 0.119*** | 0.033 | 0.032 |
| >50 per cent | 0.115** | 0.117** | 0.082*** | 0.081*** | 0.174*** | 0.173*** |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Received government assistance | –0.009 | –0.009 | –0.028 | –0.029 | 0.003 | 0.002 |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | 0.027 | 0.028 | 0.023 | 0.020 | 0.020 | 0.019 |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | –0.039 | –0.038 | –0.101 | –0.105 | –0.033 | –0.034 |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | –0.005 | –0.005 | –0.185*** | –0.186*** | –0.131*** | –0.131*** |
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Used some skills | 0.032 | 0.033 | –0.038 | –0.039 | 0.011 | 0.010 |
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | –0.068*** | –0.068*** | 0.048** | 0.048** | –0.015 | –0.015 |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | 0.118*** | 0.119*** | 0.010 | 0.010 | 0.049*** | 0.049*** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | 0.003 | 0.002 | 0.381*** | 0.392*** | –0.028 | –0.027 |
| Manufacturing | 0.080 | 0.081 | 0.278** | 0.283*** | 0.073 | 0.072 |
| Electricity, water, gas and waste services | –0.241 | –0.239 | 0.342*** | 0.345*** | 0.155* | 0.154* |
| Construction | 0.109* | 0.110* | 0.271** | 0.282** | 0.098* | 0.097* |
| Wholesale Trade | 0.033 | 0.034 | 0.174 | 0.180 | –0.011 | –0.012 |
| Retail Trade | –0.117* | –0.115* | 0.076 | 0.083 | –0.085* | –0.087* |
| Accommodation and food services | 0.015 | 0.016 | 0.139 | 0.144 | –0.005 | –0.006 |
| Transport, postal and warehousing | 0.089 | 0.090 | 0.280** | 0.286** | 0.100* | 0.099* |
| Information, media and telecommunications | –0.087 | –0.086 | –0.017 | –0.013 | –0.098* | –0.099* |
| Financial and insurance services | 0.143 | 0.146 | –0.224* | –0.222* | –0.670*** | –0.673*** |
| Rental, hiring and real estate services | 0.021 | 0.022 | 0.147 | 0.152 | 0.022 | 0.020 |
| Professional, scientific and technical services | –0.020 | –0.018 | 0.362*** | 0.366*** | 0.058 | 0.057 |
| Administrative and support services | 0.063 | 0.065 | 0.209* | 0.213* | 0.043 | 0.041 |
| Health care and social assistance | 0.164 | 0.168* | 0.350*** | 0.352*** | 0.185*** | 0.182*** |
| Arts and recreational services | 0.108* | 0.109* | 0.233* | 0.239* | 0.105* | 0.103* |
| Other services | 0.032 | 0.033 | –0.097 | –0.088 | 0.013 | 0.012 |
| Intercept | 0.089 | 0.076 | –0.189 | –0.188 | 0.023 | 0.035 |
| Number of observations | 4,724 | 4,724 | 2,499 | 2,499 | 7,350 | 7,350 |
| R-squared | 0.040 | 0.040 | 0.118 | 0.116 | 0.071 | 0.071 |
| Log likelihood | –5,211 | –5,212 | –1,725 | –1,728 | –7,575 | –7,575 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of total turnover between 2012–13 and 2010–11. *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

Table B12: Total export sales growth regression results, 2010–11 to 2012–13

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Covariates | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Innovation persistence (compared to non-innovation-active) | | | | | | |
| Innovators for 3 years | –0.039 | | –0.341*** | | –0.212*** | |
| Innovators for 2 years only | 0.036 | | –0.251** | | –0.138 | |
| Innovators for 1 year only | 0.001 | | –0.340** | | –0.244** | |
| Persistence — categorical | | –0.008 | | –0.112*** | | –0.068*** |
| Age (compared to a young business aged 0–5 years) | | | | | | |
| Mature (6 or more years) | –1.235*** | –1.232*** | –0.704 | –0.501 | –1.023*** | –0.969*** |
| Number of employees (compared to non-employing businesses) | | | | | | |
| 1–4 employees | –0.975* | –0.979** | (omitted) | (omitted) | –0.809 | –0.794 |
| 5–19 employees | –0.187 | –0.183 | (omitted) | (omitted) | 0.450 | 0.475 |
| 20–199 employees | –0.984** | –0.979** | (omitted) | (omitted) | –0.298 | –0.264 |
| 200–299 employees | –0.811 | –0.793 | (omitted) | –0.224 | –0.266 | –0.227 |
| 300+ employees | –0.973 | –0.977 | 0.2445 | (omitted) | 0.010 | 0.035 |
| Market competition (compared to businesses reporting no effective competition) | | | | | | |
| Minimal | 0.082 | 0.079 | 1.110*** | 1.084*** | 0.480** | 0.466** |
| Moderate to strong | –0.190 | –0.193 | 0.317* | 0.313* | 0.081 | 0.078 |
| ICT Intensity (compared to businesses reporting low ICT intensity) | | | | | | |
| Intense | –0.759 | –0.764 | –0.250 | –0.267 | –0.090 | –0.099 |
| High | –1.211* | –1.215* | –0.533 | –0.552 | –0.440 | –0.452 |
| Moderate | –0.791 | –0.793 | –0.172 | –0.185 | –0.104 | –0.118 |
| Foreign ownership (compared to businesses reporting 100 per cent Australian ownership) | | | | | | |
| >0 to 50 per cent | 0.050 | 0.042 | –0.084 | –0.079 | 0.033 | 0.035 |
| >50 per cent | 0.687*** | 0.687*** | 0.193** | 0.197** | 0.301*** | 0.307*** |
| Government financial assistance (compared to businesses reporting no government assistance) | | | | | | |
| Received government assistance | 0.202 | 0.204 | –0.088 | –0.090 | 0.040 | 0.034 |
| Cooperative arrangements (compared to businesses reporting no cooperative arrangements) | | | | | | |
| Involved in any cooperative arrangement | –0.052 | –0.053 | –0.002 | 0.007 | 0.107 | 0.112 |
| Flexible Working Arrangements (compared to businesses reporting no flexible working arrangements) | | | | | | |
| Have flexible working arrangements | 0.671*** | 0.672*** | –0.619* | –0.563 | 0.264 | 0.267 |
| Exporting activity (compared to businesses reporting no exporting activity) | | | | | | |
| Engaged in exporting activity | –0.112 | –0.113 | –0.096 | –0.094 | –0.102 | –0.103 |
| Skills used (compared to businesses reporting none of the skills listed) | | | | | | |
| Used some skills | –0.875*** | –0.877*** | 0.278 | 0.286 | –0.160 | –0.152 |

| | Simple-structured businesses | | Large complex businesses | | Total sample | |
|---|---|---|---|---|---|---|
| Skills deficiency or shortage (compared to businesses reporting no deficiency or shortage) | | | | | | |
| Reported | 0.253* | 0.248* | –0.305*** | –0.306*** | –0.186** | –0.187** |
| Sought debt or equity finance (compared to businesses reporting that they didn't seek external finance) | | | | | | |
| Sought | 0.843*** | 0.837*** | 0.455*** | 0.454*** | 0.406*** | 0.408*** |
| Industry (compared to Agriculture, Forestry and Fishing businesses) | | | | | | |
| Mining | 0.266 | 0.270 | 0.824*** | 0.786** | 0.897*** | 0.871*** |
| Manufacturing | 1.166*** | 1.163*** | 0.251 | 0.238 | 0.770*** | 0.765*** |
| Electricity, water, gas and waste services | (omitted) | (omitted) | 0.302 | 0.290 | 0.503 | 0.494 |
| Construction | 1.684** | 1.685** | 0.179 | 0.133 | 0.610** | 0.578** |
| Wholesale Trade | 0.6842** | 0.6870** | 0.2692 | 0.252 | 0.615** | 0.604** |
| Retail Trade | 0.6265 | 0.6419 | 0.2397 | 0.210 | 0.824*** | 0.807*** |
| Accommodation and food services | (omitted) | (omitted) | –0.607 | –0.652 | 0.018 | –0.015 |
| Transport, postal and warehousing | 0.832* | 0.838* | 0.471 | 0.454 | 0.771*** | 0.759*** |
| Information, media and telecommunications | 0.181 | 0.183 | 0.002 | –0.036 | 0.073 | 0.045 |
| Financial and insurance services | (omitted) | (omitted) | –0.954*** | –0.951*** | –0.702*** | –0.698*** |
| Rental, hiring and real estate services | 0.801* | 0.808* | –0.310 | –0.308 | 0.498 | 0.504 |
| Professional, scientific and technical services | 0.969*** | 0.973*** | 0.533* | 0.515* | 0.977*** | 0.972*** |
| Administrative and support services | 0.584 | 0.597 | 0.932*** | 0.914*** | 1.266*** | 1.254*** |
| Health care and social assistance | 1.305 | 1.287 | 0.503 | 0.485 | 0.856*** | 0.851*** |
| Arts and recreational services | 0.897 | 0.908 | –0.414 | –0.452 | 0.479 | 0.468 |
| Other services | 0.339 | 0.340 | 0.231 | 0.212 | 0.391 | 0.371 |
| Intercept | 1.790* | 1.799* | 0.716 | 0.70 | 0.285 | 0.199 |
| Number of observations | 469 | 469 | 1,276 | 1,276 | 1,794 | 1,794 |
| R-squared | 0.272 | 0.272 | 0.139 | 0.137 | 0.145 | 0.144 |
| Log likelihood | –765 | –765 | –2107 | –2,109 | –3,024 | –3,025 |

Notes: Derived balanced sample results. The dependent variable is the log of the ratio of export sales between 2012–13 and 2010–11. *** ,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively. See Table A5 for a description of each covariate.

Source: ABS (2017) Business Longitudinal Analysis Data Environment 2001–02 to 2013–14

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