Should Non-innovators Innovate? A Firm-level Study

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Paper Prepared for the IARIW-UNSW Conference
on Productivity: Measurement, Drivers and Trends

Sydney, Australia, November 26-27, 2013

Session 2B: R&D and Innovation

Time: Tuesday, November 26, 12:00-12:30

*** Preliminary results – not to be cited ***

Should non-innovators innovate? A firm-level study[1]

a very early draft for

IARIW-UNSW Special Conference on Productivity, 26-27 November

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[1] Thanks to Diane Braskic, Helen Teasdale and Francesco Tornatore from the ABS for making the analysis of the ABS data possible!

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Abstract

If firms never changed the way they operated we would not expect to see any improvement in their productivity. We expect therefore that, on average, innovative firms will enjoy faster productivity growth than their non-innovative counterparts. But if innovation systematically raises firm profits, why don't all firms do it? We suggest that not all firms have the necessary preconditions for successful innovation such as the appetite and ability of management for radical change. We test this idea using an SME dataset from the ABS and a large firm dataset from IBISWorld.

Introduction

The deductive case that change, spearheaded by improved knowledge, is necessary to enhance economic well-being is clear. If knowledge is static, increases in plant and equipment or worker skills will eventually run up against diminishing returns. Firm-level productivity will plateau unless new-to-the-firm or new-to-the-world products and methods of production are introduced into the workplace. By contrast, the returns to more knowledge are unbounded as it transforms physical capital, methods of business organisation and worker skills. It is difficult to see that there can be a limit to effects of the growth and diffusion in our stock of knowledge. Given this, we would expect that firms which innovate will achieve the higher productivity growth.

The main policy question is however not whether innovating firms are more productive, but whether we can mount a reasonable case that inducing non-innovators to innovate will be fruitful. The challenges in assessing this proposition are considerable. We must isolate the pre-conditions of successful innovation (such as strong competition, managerial risk taking and confidence) from those that are complementary to the innovation process (such as joint ventures). Furthermore, we need to measure innovation in a way that does not trivialise it to mere business-as-usual changes. In this respect, the convention in the literature is to define 'innovation' as a distinctly new or significant change to a product, operation, organisational form or marketing activity.

In this paper, we define undertaking innovation in a given year as a 'treatment' and estimate the effect on productivity of 'treating' non-innovating firms. We use variables which proxy for managerial acumen to construct the counterfactual. Two data sets of about 20,000 and 7000 Australia firm observations over the period 2005/06 to 2010/11 are used in the analysis.

Background

There are two firm-level stylised facts. First, large differences in output per worker exists across firms that cannot be explained by (measured) tangible capital. These differences are persistent.[2] Second, these differences, and their persistence, have been empirically 'explained' by R&D[3], innovation activity[4], and managerial acumen.[5] Both 'facts' have been found across many countries,

[2] See Bartelsman and Doms (2000) and Syverson (2011) for surveys; Palangkaraya, Stierwald and Yong (2009) for Australia evidence; Raymond et al (2013) for very recent evidence.

[3] R&D is typically only covers part of spectrum of innovative activities. It usually correlates with upstream technological activities surrounding product and process innovation but misses organisational, managerial and marketing innovations. It is also a very poor indicator of innovation in many industries, especially the primary and service sectors where innovation expenditure is often defined informally. Nonetheless, analyses using R&D data provide valuable information that cannot be gleaned elsewhere. In an extensive review of 58 firm-level studies,[3] Hall, Mairesse and Mohnen (2010) report that the evidence consistently finds that R&D spending by firms increases firm-level productivity. The average estimated elasticity is 0.08 which suggest that a 100 per cent increase in R&D spending per worker will raise output per worker by 8 per cent, ceteris paribus.

[4] Studies that use more general measures of innovation are fewer than the R&D studies and more recent. They are typically based on specially designed surveys of innovation activities. Using data from a sample of over 20,000 firms from Germany and the Netherlands between 2000 and 2008, Bartelsman, Dobbelaere and Peters (2013) show a positive effect of product innovation on labour productivity – an effect that is stronger for the most productive firms. However, they find no overall effect for process innovation – and a negative effect of process innovation on the most productive firms. Bloom, Sadun and van Reenen (2012) find evidence consistent with the view that the productive use of IT depends on complementary management practices. Raymond et al (2013) use two measures of innovation; a binary measure of whether an innovation has taken

across and within industries and using pooled and fixed-effects estimations. However, these studies typically do not allow us to answer the critical policy question which is: what affect would the adoption of an innovation strategy have on the firm performance of non-innovators? Or alternatively expressed: If innovation (either new-to-the-firm or new-to-the-world) systematically raises firm profits, why don't all firms do it? If it systematically lowers firm profits, why do any firms do it? To answer these questions we need to carefully construct a counterfactual and in this regard there are several complications.

First, there are certain prior characteristics firms possess that make it more likely they will be a successful innovator. These may relate either to the external environment – the force of competition and supply of opportunities to change – or the internal environment – primarily the aptitude and ability of managers to transform the organisation and its markets. Even if owners and managers have the appetite, not all firms have the in-house skills and experience to undertake innovation, especially new-to-the-world innovation. Furthermore, firms operate in differing external environments which may throw up greater or lesser opportunities for innovation. Encouraging firms, which do not possess the right combination of prior characteristics, to innovate without addressing these prior characteristics could be counterproductive.

Second, innovation, once in train, is not a standalone activity. When firms decide to develop and commercialise a new product, or introduce new processes into their organisation, the decision is typically accompanied by a constellation of complementary activities.[6] A new product may require certain types of collaborations; specialist in-house skills; legal forms of profit appropriation; and dedicated marketing activities *inter alia*. A new process may also require specific in-house skills, tangible capital investment; novel employee training and go hand-in-hand with new product development. We expect that the full impact of these combined activities is larger than the sum of its parts when used alone. Encouraging firms, which are not aware of or do not possess the means to obtain the right combination of complementary factors, to innovate could be counterproductive.

Because of the importance of prior conditions, we expect that not all firms will choose an innovation-focussed competitive strategy. Some firms may focus on operational efficiency, others on customer focus and others on cost minimisation via growth. These strategies may or may not overlap with an innovation strategy as we define it. Whether these strategies are successful *ex post* depends on the presence of the pre-conditions, the correct use of complementary activities and good fortune. As such, we expect that the pool of observed firms undertaking each strategy will be correlated with the characteristics of the firm and its external environment. Hence the observation that (nearly) all firms pursuing strategy x are highly profitable or productive does not mean that if other firms pursue strategy x they will also be profitable or productive.

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place and an intensity measure of the share of sales attributable to new products. Using a sample of about 3000 firms from the Netherlands and France, they find clear results that innovation raises productivity. Furthermore, they observe a pattern in the data that suggests that in the short run, innovation reduces labour productivity as firms adjust to their new production routines. Bartel, Ichniowski and Shaw (2007) use data on 290 distinct valve products made during 1999–2003 and find a clear positive effect of IT innovation on productivity. Hubbard (2003) also finds a positive impact of IT use on productivity in the trucking industry.

[5] Bloom and Van Reenen (2010).

6 See for example Bartel, Ichniowski and Shaw (2007)

Third, the assumption that all firms always make decisions that lead them to be fully efficient is a simplifying postulate (or tautology) that economists invoke for the purposes of deductive microeconomic price theory. We argue that this assumption does not belong in a study of firm innovative behaviour. A dual approach wherein deductive and inductive reasoning work together is more apt.[7] Unfortunately, this postulate of efficiency is so strongly held by economists that it can form a communication barrier across disciplines. As such, we believe it is important to explicitly draw attention to what we are not assuming. The coexistence of high and low efficiency (or low productivity) firms probably occurs because competition is neither as ruthless nor as fast as our a priori theories of competition maintain. Inefficient firms fail to challenge efficient firms through offering lower prices or better products. The inefficient firm merely pays the price in the form of lower profits and firms do not go bankrupt if they can meet their accounts payable.[8] Fortunately, the fact that similarly placed firms may co-exist at differing levels of efficiency, or innovation, provides analysts with a convenient set of counterfactuals.

Empirical framework

We specify that the period t output of each firm i (Y_{it}) is given by a common Cobb-Douglas production function of the form

$$Y_{it} = A_{it} K_{it}^{\alpha_k} L_{it}^{\alpha_l} M_{it}^{\alpha_m} \qquad (1)$$

where A_{it} denotes a Hicks-neutral productivity term, K_{it} denotes the capital stock, L_{it} denotes the size of employment, and M_{it} denotes raw material inputs. Using the corresponding lower case letters to denote the logarithmic values of the inputs and output above, equation (1) can be re-written as

$$y_{it} = a_{it} + \alpha_k k_{it} + \alpha_l l_{it} + \alpha_m m_{it} \qquad (2)$$

Furthermore, we assume productivity A_{it} depends not only on the firm's management (C_i^M) and innovative (C_i^N) capabilities, but also on their interaction such that:

$$a_{it} = \beta_M C_i^M + \beta_N C_i^N + \beta_{MN} C_i^M C_i^N + \boldsymbol{x_{it}\beta_X} + \theta_i + \varepsilon_{it} \qquad (3)$$

where $\boldsymbol{x_{it}}$ is a vector of control variables such as firm and market characteristics which might affect worker efficiency and θ_i and ε_{it} denote unobserved firm-specific and random effects, respectively.

Substituting (3) into (2) yields our augmented Cobb-Douglas function to be estimated as follows

[7] As promulgated by JN Keynes and Marshall (1890).

[8] Bloom and van Reenen (2013) speculate that non-innovating managers do not introduce (tried and tested) operational techniques because of informational constraints on the value or existence of alternative techniques. Their empirical work has found that many non-innovating managers believe that their existing profits were satisfactory and new-to-the-firm practices would not raise profits. There are three types of reasons, well-recognised in the managerial literature, for why firms do not undertake potentially beneficial improvements. First, managers may know what would improve performance but lack the incentives to implement it, perhaps because of limited competition from other firms, agency considerations or lack of delegatory power. Secondly, decision makers may know they are not efficient and but not know how to implement the necessary changes and thirdly, the firm's decision makers may not realise they are inefficient. Bloom and Van Reenen (2007) give examples of managerial innovations that were initially resisted but gradually adopted across developed economies

$$y_{it} = \alpha_k k_{it} + \alpha_l l_{it} + \alpha_m m_{it} + \beta_M C_i^M + \beta_N C_i^N + \beta_{MN} C_i^M C_i^N + \boldsymbol{x_{it}\beta_X} + \theta_i + \varepsilon_{it} \qquad (4)$$

Estimating equation (4) is a common way to estimate the effect on productivity if non-innovating firms adopted an innovation business focus. The estimated coefficient for the innovation variable, C_i^N, is derived from firms which switch from innovating in one year and not the next and vice versa. The counterfactual for an innovating firm therefore, is itself in a non-innovating year. The problem with relying on this calculation is that the time lags between the introduction of a change and a rise in net output are unknown and could vary by type and magnitude of innovation, industry and technology. In the immediate investment phase of an innovation, the effect on productivity could well be negative. Therefore, when we calculate the innovation coefficient we may be averaging the effects over different phases of different life cycles (ie a negative, neutral and positive phase).

Furthermore, to the extent innovative activity and managerial acumen (C_i^M and C_i^N) are time-invariant, these characteristics will be conflated with the firm-specific fixed effects. Therefore, to disentangle them we proceed, following Black and Lynch (2001), in two stages. In the first stage, we estimate:

$$y_{it} = \alpha_k k_{it} + \alpha_l l_{it} + \alpha_m m_{it} + \boldsymbol{x_{it}\beta_X} + \varepsilon_{it} \qquad t>0 \qquad (5)$$

and construct the short-run measure of firm productivity in terms of the residuals ($resid_{it} \equiv y_{it} - (\hat{\alpha}_k k_{it} + \hat{\alpha}_l l_{it} + \hat{\alpha}_m m_{it} + \boldsymbol{x_{it}\widehat{\beta}_X}$). In the second stage, we compute the firm-specific average of $resid_{it}$ across time to obtain a long-run measure of firm performance (TFP_i) and regress this on our firm level, proxy measures of management and innovative capabilities in an earlier time period:

$$TFP_i = \beta_M C_{i0}^M + \beta_N C_{i0}^N + \beta_{MN} C_{i0}^M C_{i0}^N + \mu_i \qquad (6)$$

Hypothesis: $\beta_M > \beta_N \geq 0;\ \beta_{MN} > 0$

In specifying equation (3) and thus equations (4)-(6), we assume that management and innovative capabilities (C_i^M and C_i^N) are not closely related. If, however, the capability of management matters in driving firm innovation and determining how innovation affects firm performance, then estimating equation (6) to test Hypothesis 1 may suffer from multi-collinearity. To avoid this problem, we split the sample according to the level of managerial acumen and estimate equation (6) as several separate regressions. (Note to reader: as of 22 November we have not been able to get output on these estimations).

The data

The empirical analysis is at a very early stage, therefore the results should be regarded as preliminary. We use two firm-level datasets. The first dataset is from the Australian Bureau of Statistics, specifically linked data from the Business Characteristics Survey and the Business Longitudinal Database (which includes data from the Australian Taxation Office (ATO) Business Activity Statement (BAS)). The dataset represents the population of Australian businesses that are registered for an Australian Business Number (ABN) that remit Goods and Services Tax. At the time of writing, only the SME population of firms over the period 2005/06 to 2009/10 was available for analysis. After exclusions for missing variables there are 23,014 observations (12,160 distinct firms) for inclusion in our main panel estimation (Note to reader: there is one production function estimate with an additional year 2010/11).

The second smaller dataset is based on the IBISWorld population of large firms, where large is defined as firms with annual turnover over AUD50million. IBISWorld data is consolidated accounting data where the reporting unit is the highest accounting unit in Australia. The data covers the period 2006 to 2012. This data is linked to qualitative data from a Melbourne Institute survey. After exclusions for missing variables we have 7570 observations (1755 distinct firms) for inclusion in the estimation.

A full description of the variables is presented in the appendix, but briefly: The value of output is total sales; the value of investment is tangible capital purchases;[9] the value of capital is total assets, and the value of materials is non-capital purchases. Following Klette (1999) we divide these nominal values by the mean value for each firm's 2-digit industry as a substitute for a price deflator.[10] Employment is the number of persons working in the firm during the last pay period. The indicators of innovation and managerial acumen are categorical survey data from the ABS Business Characteristics Survey and Business Longitudinal Database. Flow variables refer to activity up until year end 30 June and stock variables are as of 30 June. The variable 'Innovation business focus' is a dummy variable which indicates whether the business had, at some level, an innovation focus.

Deriving measures of managerial acumen has proven to be more difficult. The management literature typically uses extensive face-to-face interviews with senior managers to derive rich and comprehensive scores for managerial practice. Replicating these measures inside our data sets is not an option and accordingly we rely on proxies for managerial competence based on the interview-evaluation tool constructed by Bloom and van Reenen and applied to almost 6,000 firms across 17 countries. In their study, Bloom and van Reenen found that managerial competence was positively correlated with strong product market competition; foreign ownership; being an exporter; not being managed by the founder (or family member); non-government ownership; intensive use of human capital and size.

In the second stage equation (6), we regress mean TFP against prior measures of innovation status and managerial acumen. The latter is represented by variables which represent product market competition; foreign ownership; being an exporter; not being managed by the founder (or family member); and size. We do not include government ownership as there are few government entities in our sample and we do not have a good measure for intensive use of human capital.

Results from the ABS dataset

We proceed with our analysis first by estimating a Cobb-Douglas production function augmented with different measures of innovation: either innovation intentions (having an innovation business focus) or actual activities (having introduced new goods, services and process *inter alia*). The results which are presented in Table 1 show that these innovation variables are not significant. The insignificance of these results is consistently found whether or not we use lagged explanatory variables, adjust nominal values, and measure innovation in different ways.

[9] This is a temporary measure pending the ability to use the ATO Business Income Tax data which will have data on total capital assets.

[10] The alternative is using either a combination of broader GDP or sector price deflators or nominal values. Our estimates are robust to whether of not we use nominal values.

Next we modify our approach to cater for the (probable) variable lags in effect. First, we estimate the mean residual in equation (5). We seek to explain the firm's average Total Factor Productivity over the 5 year period 2006/07 to 2010/11 by measure of innovation and a measure of management quality in 2005/06.[11] Table 2 presents the first stage regression which estimate the TFP. TFP is calculated as the mean of the fixed effect and time varying residual from these regressions. Table 3 presents the determinants of these fixed effects.

Results from the IBISWorld dataset

The first stage results from the large firm IBISWorld dataset differ from the ABS results because they use a stock value of capital instead of current investment (we expect to replace the investment variable with capital when the latter variable is available). The second stage is modelled quite differently. We regress mean TFP from the first stage (covering the period 2005 to 2012) on measures of innovation and management practices from 2001 to 2003. We define 'innovation' as the extent to which the firm introduced new or significantly changed products or services and underwent major change in the production or service technology. For our management variables, we selected items from the Melbourne Institute Business Survey that most closely aligns with the Bloom and van Reenen evaluation tool constructed. Details are given in the Appendix.

The results from the first stage are uncontroversial. However, the results from the second stage show that while innovation and management are not significant on their own, their interaction term is significant and positive. To identify further which type of managerial practice is producing this result, we included separately each of the four components that were used to construct the management variable. These were (a) Measures the relative extent of firm management in implementing lean shopfloor/operation management; (b) Measures the relative extent of firm management in implementing performance monitoring; (c) Measures the relative extent of firm management in implementing best practice on target setting; and (d) Measures the relative extent of firm management in implementing best practice on talent management. We found that ths significance of the management – innovation interaction term was principally driven by (b) and (d) – performance monitoring and talent management.

[11] Raymond et al (2013) found in their dynamic model of innovation and productivity that the lagged feedback effect of labour productivity on innovation is not economically nor statistically significant (that is, there was no feedback from labour productivity to innovation.

***** Preliminary results – not to be cited *****

Table 1: Dep var: Value of output, SME firms, fixed-effects estimation

Explanatory variables	Estimated coefficient	Estimated coefficient	Estimated coefficient
Ln(investment)†	0.018***	0.015***	0.015***
	(0.003)	(0.003)	(0.003)
Ln(employment)†	0.135***	0.111***	0.097***
	(0.009)	(0.012)	(0.011)
Ln(materials)†	0.517***	0.503***	0.513***
	(0.008)	(0.012)	(0.011)
Innovation business focus (0-3)	0.005		
	(0.005)		
Innovation business focus-lagged one year (0-3)		0.008	
		(0.006)	
New good or service lagged one year (1/0)			0.012
			(0.013)
New operational process lagged one year (1/0)			-0.003
			(0.012)
New organisational/managerial process lagged one year (1/0)			0.032
			(0.013)
New marketing method lagged one year (1/0)			0.021
			(0.014)
Period	2006/07 to 2009/10	2006/07 to 2009/10	2006/07 to 2009/10
R^2-overall	0.843	0.850	0.850
Obs	22324	12455	22960
Groups	11959	7045	12147
Rho	0.853	0.881	0.854

Notes: † Variables have been normalised with respect to the corresponding 2-digit ANZSIC average. Hence, no industry dummy is used during regression (see Klette 1999). Standard errors are in parentheses. The notations *, ** and *** indicate that the coefficient estimates are statistically significant at the 10%, 5% and 1% level respectively.

Source: ABS Business Characteristics Survey and Business Longitudinal Database and ATO Business Activity Statement data.

Table 2: Dep var: Value of output, SME firms, fixed-effects estimation

Explanatory variables	Estimated coefficient	Estimated coefficient	Estimated coefficient
Value of investment†	0.018***	0.016***	0.019***
	(0.002)	(0.003)	(0.002)
Level of employment†	0.133***	0.112***	0.100***
	(0.009)	(0.010)	(0.008)
Value of materials†	0.517***	0.463***	0.524***
	(0.008)	(0.009)	(0.008)
Year dummies	Yes		Yes
Year x 2-digit industry dummies		Yes	

Period	2005/06 to 2009/10	2006/07 to 2009/10	2006/07 to 2010/11
R^2-overall			
Obs	23014	19471	24007
Groups	12160	10675	12554
Rho	0.856	0.921	0.878

Notes: † Variables have been normalised with respect to the corresponding 2-digit ANZSIC average. Hence, no industry dummy is used during regression (see Klette 1999). Standard errors are in parentheses. The notations *, ** and *** indicate that the coefficient estimates are statistically significant at the 10%, 5% and 1% level respectively.

Source: ABS Business Characteristics Survey and Business Longitudinal Database and ATO Business Activity Statement data.

Table 3: Dep var: Mean firm residual (TFP) from 2005/06 to 2009/10 (Table 2), OLS estimation

Explanatory variable (as reported in 2005/06)	Estimated coefficient	Estimated coefficient
	Dep var from col 1	Dep var from col 2
Innovation business focus (1/0)	0.201***	0.233***
	0.034	(0.048)
Age of business (years)	0.005***	0.005***
	0.001	(0.001)
Exported (1/0)	0.298***	0.339***
	0.041	(0.054)
2-digit industry dummies	Yes	Yes
Obs	3166	1690
R^2	0.1386	0.3615

Notes: Standard errors are in parentheses. The notations *, ** and *** indicate that the coefficient estimates are statistically significant at the 10%, 5% and 1% level respectively.

Source: ABS Business Characteristics Survey and Business Longitudinal Database and ATO Business Activity Statement data.

Results from the IBISWorld panel of firms

Table 4: Dep var: Value of output, Large firms, fixed-effects estimation

Explanatory variables	Estimated coefficient
Value of capital†	0.248***
	(0.008)
Level of employment†	0.206***
	(0.008)
Value of materials†	0.406***
	(0.006)
Year dummies	Yes
Period	2005-2012
R^2-overall	0.8831

Obs	7570
Groups	1755
Rho	0.926

Notes: † Variables have been normalised with respect to the corresponding 2-digit ANZSIC average. Hence, no industry dummy is used during regression (see Klette 1999). Standard errors are in parentheses. The notations *, ** and *** indicate that the coefficient estimates are statistically significant at the 10%, 5% and 1% level respectively.

Source: IBISWorld dataset supplemented with 2-digit wage data from the ABS.

Table 5: Dep var: Mean firm residual (TFP) from 2005 to 2012 (Table 4), OLS estimation

Explanatory variable (as reported in 2005/06)	Estimated coefficient	Estimated coefficient	Estimated coefficient	Estimated coefficient	Estimated coefficient
Innovation	-0.019		-0.0174	-0.0222	-0.0187
	(0.0241)		(0.0260)	(0.0253)	(0.0245)
Management		-0.0282	-0.0204		
		(0.0242)	(0.0260)		
Innovation*Management			0.0579**		
			(0.0259)		
Perfmon				-0.0077	
				(0.0242)	
Innovation*Perfmon				0.0501**	
				(0.0243)	
Talent					-0.0161
					(0.0259)
Innovation*Talent					0.0638***
					(0.0242)
1-digit industry dummies	Yes	Yes	Yes	Yes	Yes
Obs	237	236	234	237	237
R^2	0.2307	0.2331	0.2536	0.2462	0.2553

Notes: Standard errors are in parentheses. The notations *, ** and *** indicate that the coefficient estimates are statistically significant at the 10%, 5% and 1% level respectively.

Source: IBISWorld dataset, and the Melbourne Institute Business survey various years.

Appendix

Table A1: ABS sample by industry

Industry (ANZSIC06)	Freq.	%
Agriculture, Forestry And Fishing	8,621	14.83
Mining	2,344	4.03
Manufacturing	9,044	15.56
Electricity, Gas, Water And Waste Services	842	1.45
Construction	3,664	6.3
Wholesale Trade	4,534	7.8
Retail Trade	3,052	5.25
Accommodation And Food Services	3,732	6.42
Transport, Postal And Warehousing	3,893	6.7
Information Media And Telecommunications	2,260	3.89
Financial And Insurance Services	1,495	2.57
Rental, Hiring And Real Estate Services	2,262	3.89
Professional, Scientific And Technical Services	3,024	5.2
Administrative And Support Services	2,394	4.12
Public Administration And Safety	25	0.04
Education And Training	140	0.24
Health Care And Social Assistance	885	1.52
Arts And Recreation Services	2,502	4.3
Other Services	3,407	5.86
Total	58,120	100

Table A2: ABS sample by Type of Legal Organisation

Type Of Legal Organisation	Frequency
00	290
Private	
Private, Proprietary or Limited	1303
Private, Proprietary Limited	27,818
Private, No Liability	12
Other Registered Company	997
Sole Proprietor	9220
Family Partnership	7547
Other Partnership	2541
Trust	9555
Cooperative Society, Social and Sporting Clubs, Trade Unions and Other Associations	9
Other Unincorporated Entity	269
Public	
Australian Government Other Statutory Authority, Australian Government Other (inc. govt owned co's), State Government Department	14

Local Government Authority	8
State Government Other (inc. govt owned co's	34
Total observations	59,617

Note: 2002 TOLO Classification

Variable definition - IBISWorld

Variable	Description
Production	
Sales	Sales revenue
Capital	Total assets
Labour	Number of employees
Materials	Cost of sales less labour cost.
Capability	
Lean	Resources devoted to new machines, computers, organisational change; competitive strategy focussed on operational efficiency, productivity
Perfmon	Focus on customer retention, frequent changes in marketing practices; use internet enabled business practice knowledge directories and manuals; measures and reports information to employees; uses customer satisfaction measures, uses knowledge performance measures
Target	Managers favour high risk projects, are bold and aggressive strategic decision are detailed and formal; firms good at implementing ideas and strategies
Talent	Practices strategic human management, promotes employees on merit; provides training, rewards employees on how well the firm performs; employees aligned with firm values.
Management	Based on the sum of LEAN, PERFMON, TARGET and TALENT.
Innovation	Likert scale response to question on new lines of products or services; major changes in products or services; changes in production/service technology over last 3 years.

Note: All production variables are in log and normalized with respect to industry average. All capability measures are standardized variables with zero mean and unit standard deviation. Cost of sales is approximated by sales revenue less net profit before tax less depreciation less fees. Labour cost is approximated by number of employees multiplied by industry average wage/salary per employee. We provide further details on the variable definition in the Appendix.

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