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Quality management approaches and their impact on firms' financial performance – An Australian study

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ABSTRACT

The study of small manufacturing firms typically focuses on issues of entrepreneurship, business or operations strategy. Alternate issues remain scarce, and the implications for organisational performance are modest. In the Australian context, managers have often been criticised for their failure to recognise that quality and innovation are a key driving force to performance. This research utilises the work of several authors to develop quality orientations for small Australian manufacturing firms (SAMFs) to purposefully bridge the gaps in the business literature, and enable the evaluation of various performance outcomes. Specifically, this study investigates whether a firm's stated quality orientation is useful in differentiating firm performance. The research utilises longitudinal panel data gathered by the Australian Bureau of Statistics growth and performance survey over four years from financial year 1995 to 1998. We demonstrate that firm quality management orientation does provide a statistically significant financial performance advantage (and by inference survival advantage) over those SAMFs who do not engage in quality management. The research is a significant addition to the quality – financial performance literature, and provides a pathway forward for the use of two new financial (productivity) ratios as performance measures.

1. Introduction

A lack of empirical evidence in the literature linking the operationalization of quality management (QM) systems with objective financial performance measures was the motivation behind writing this paper. Research was undertaken collaboratively between the Australian Bureau of Statistics (ABS) and Monash University in Australia. It is an historical perspective, which incorporates longitudinal panel data from small manufacturing firms spanning the financial years 1995–1998.

High protection levels post-World War 2 characterised Australian productive capacity up to the early 1980s. This resulted in the slow adoption of advanced technologies and quality systems, and the rapid decline in the competitiveness of the Australian manufacturing industry. The floating of the Australian dollar in 1983 (depreciation by over 30 per cent to 1986), and the Button Plan of 1987 (a tariff reduction programme), heralded a period of massive rationalisation and restructuring to produce a more innovative, efficient and export oriented manufacturing sector. At the centre of this programme was a quality-based approach, from which firms sought to improve their operations, thereby enabling them to better meet the needs of local and export customers. Some key systemic changes associated with the Australian manufacturing industry have been:

- Make to order and inventory management systems,
- Integrated Quality Systems,
- Strategic relationships with key value chain members,
- Introduction of benchmarking systems to monitor and drive performance,
- Outsourcing of non-core business activities.

As a result, there was a rapid rise in the adoption of quality management (QM) practices from the late 1980s. However, it was not until the ABS's Growth and Performance survey (GAPS) that it was possible to determine, as well as measure, drivers of business performance and growth (i.e. from 1995 to 1998). An implicit challenge of the survey was to determine whether implementing quality management (QM) practices has a positive impact on a firm's financial performance. Many scholars have attempted to address this question, amongst the most recent, Klingenberg et al. (2013) and Duarte et al. (2011), but in general their results have failed to produce

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a positive link. This paradoxical link between QM practices and process performance, with little to no effect on financial performance, has renewed the call to uncover more suitable and objective measures. Our paper proposes the use of financial productivity ratios as a more appropriate means of determining links between QM practices and financial performance.

From here, Section 2 describes the literature and hypothesis. Section 3 outlines the research method adopted. This is followed by the findings (Section 4) and discussion (Section 4.2). The paper finishes with concluding remarks, limitations and future research (Section 5).

2. Literature and hypothesis

The achievement of economic advantage (via scale and/or scope) commenced with the implementation of quality control techniques in the early 20th Century, when increasing volumes meant methods of inspection had to be embedded into the production cycle to improve and maintain quality (Montgomery, 1989, p. 229; Taylor, 2003). The significant difference between early and late 20th Century quality approaches was the expansion of product/operational quality to the concept of total quality (Feigenbaum, 1961, 1983). This philosophy postulated that quality could be applied to every aspect of an organisation (Ishikawa, 1985). The awareness of quality was heightened by the superior quality of Japanese export products in the 1970s and '80's, due in large part to the impact of William Edwards Deming on Japanese manufacturing post World War II. The economic growth generated by Japanese international competitiveness in late 20th Century laid the groundwork for widespread change to technology and managerial principles of quality throughout the Western world.

The Standards Australia definition of quality was defined as (in quality management systems - Fundamentals and vocabulary SAI, 2000, p.8):

> Quality (is the) degree to which a set of inherent characteristics (distinguishing feature) fulfils requirements (need or expectation that is stated, generally implied or obligatory).

This definition reflects general use of the term by encompassing both a user-based and fitness for use definition of quality. Companies in general use such a quality strategy in an effort to develop "perceived quality" in the mind of existing and potential customers.

Although Deming never provided a formal definition of quality, the philosophy was embodied in the Deming Chain Reaction Theory (Deming, 1986). Simply stated, a chain reaction can be established if a firm first improves its quality, and then costs decrease because of fewer mistakes and delays. This should then result in reduced rework, improved use of time and materials, and ultimately improvement in total plant productivity (an argument supporting TQM practices). Arguably, the firm should be able to capture market growth with better quality, lower costs (and thus price setting power), and not only stay in business, but also raise employment levels (by virtue of scale and/or scope).

2.1. Quality management practices and their link to performance

Quality proponents such as Deming (1982) and Juran (1988) argued that quality was a fundamental driver of productivity and performance. Their writings, combined with the Japanese post-War success, established quality as a cornerstone for many production strategies, philosophies and techniques such as just-in-time (JIT), Lean Manufacturing, Total Quality Management (TQM), Total Productive Maintenance (TPM) and in recent times to address issues of environmental sustainability, Lean Green Six Sigma (Agarwal et al., 2013; Dhalgaard-Park et al., 2013; Klingenberg et al., 2013).

Yet the evolution of QM has not happened without controversies. Numerous studies have attempted to prove positive relationships between QM practices and performance (Abdullah and Tari, 2012; Duarte et al., 2011; Klingenberg et al., 2013; Zatzick et al., 2012), with some studies being more successful in determining that relationship than others (Corbett et al., 2005; Lo et al., 2009; Naveh and Marcus, 2005). Moreover, in reviewing 25 years of the QM literature, Dhalgaard-Park et al. (2013) discovered that although concepts such as TQM had been labelled a management fad, and have led to a declining number of published works, publications on other QM concepts such as JIT and Lean are trending upwards. Dhalgaard-Park et al. (2013) concluded that the study of QM has matured whereby research had shifted away from TQM to focus on tools, techniques, determinants of establishing positive quality–performance relationships (Abdullah and Tari, 2012; Agarwal et al., 2013; Gutierrez Gutierrez et al., 2012; Pinho, 2008) and improving measurement systems (Camacho-Minano et al., 2013; Garengo, 2009; Lobo et al., 2012; Lockamy III, 1998). In this respect, research into QM has taken on horizontal and vertical dimensions, where horizontal movement has seen a broadening of QM's conceptual framework and applicability; while vertical movement has seen investigations into deeper meanings of quality and firm behaviour (Dhalgaard-Park et al., 2013).

When unpacking the relationship between QM practices and performance, scholars such as Wilkinson et al. (1998), Evans and Lindsay (1999), and Kaynak (2003) have argued for direct and indirect effects of hard (technique and tools driven) and soft (people focused) practices. Recent research by Abdullah and Tari (2012) provided a comprehensive review of hard and soft practices, while highlighting their direct and indirect effects on firm performance. Zatzick et al. (2012) broadened the discussion to include the notion of internal fit of TQM practices with strategy, concluding that TQM aligned well with cost leadership but not with a differentiation strategic orientation (Porter, 1980). Other studies have sought to group QM into 'universal' and/or 'contingent' practices (Agarwal et al., 2013; Chen, 2013; Duarte et al., 2011), in the hope of explaining why (dependent) outcomes vary from firm to firm.

Several scholarly efforts have sought to explain the occurrences of mixed outcomes from previous studies by analysing the period over which positive effects of QM practices can be realized. That is a better understanding of the time lag between implementation and expected outcomes can help researchers gain better insights into cause and effects, as opposed to attributing mixed outcomes to differing research designs. In particular, Chen (2013) postulated that the huge variety of TQM tools may have led numerous firms to select inappropriate tools for their business and/or had implemented those tools at an inappropriate time. De Meyer and Ferdows (1990) touched upon the concept of time in terms of a delay, which is commonly associated with the 'short-term negative, long-term positive' results that accompany the implementation of certain QM practices. But more importantly firms tend to underestimate the duration of negative impact (see De Meyer and Ferdows (1990)). Supporting this claim Tsai et al. (1991) report that high-quality strategies will increase costs and depress return on assets (ROA) in the short term, but that after four years, the negative effect of these early costs on ROA is dissipated. In contrast, Beal and Lockamy (1999) reported that quality differentiation was found to have a positive and significant effect on firm performance in the early stages of industry life cycles (but not the later stages).

Managers are particularly interested in knowing if the implementation of QM practices has any impact on their business. Measuring performance is generally regarded as a complex problem in organisational studies (Lentz, 1981; Venkatraman and Ramanujam, 1986). Data on performance is typically acquired through survey instruments, which measure perception (Chen, 2013; Lin et al., 2005; Prajogo and Brown, 2006); or rely on annual reports or databases to yield objective data such as profit margin

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Table 1
Recent studies linking quality practices and various performance measures.

Authors (a)	Journal Abrev./Book Pub. (a)	Quality indep. variables	Performance dep. variables	Country/ Industry	Method (b)	Finding (causal link)
SECONDARY + FINANCIAL						
Klingenberg et al. (2013)	IJPE	Assume JIT methodology: Inventory turnover Inventory/current asset Current–quick	Return on Asset (ROA) Return on equity (ROE) Basic Earning Power (BEP) Asset turnover Profit margin	Multi-nation Automotive Suppliers Manufacturing	9x Periods FE-REG	Partial
Duarte et al. (2011)	BAR	Quality practices Just-in-time practices ISO standards Services outsourcing level	Profitability Revenue growth rate	Brazil Manufacturing	2x Periods ML-REG	Not Supported
Hendricks and Singhal (1996)	MS	TQM criteria set by award	Operating income	US	Longitude	Partial support
Hendricks and Singhal (1997) Hendricks and Singhal (2000)	MS JOM	(Publicly traded award winners)	Sales Total assets Number of employees Return on sales (ROS) Return on Asset (ROA)	Various	Paired-differences *t*-values	
US Government General Accounting Office (1991)	GA/NSIAD	Baldrige award criteria (20 Winners 1989–99)	Employee relations Productivity Customer satisfaction Market share Profitability	US Various	2x Periods Differences	Supported
Buzzell and Gale (1987)	Free Press	Various	Return on sales (ROS) Return on investment (ROI)	USA/EU Manufacturing	Longitude REG	Supported
PRIMARY + PERCEPTUAL						
Abdullah and Tari (2012)	APMR	Management commitment Customer focus Employee involvement Training and education Reward and recognition Supplier relationship	Added value per employee Total output per employee Added value content Process efficiency Fixed asset per employee Added value per fixed assets Added value per labour cost Unit labour cost Labour cost per employee	Malaysia Manufacturing	X-Section SEM	Supported
Prajogo et al. (2012)	IJPE	Supplier assessment Strategic LT relationship Logistics integration	Quality Delivery Flexibility Cost	AUS Manufacturing	X-Section SEM	Supported
Sadikoglu and Zehir (2010)	IJPE	Leadership Training Employee management Information and analysis Supplier management Process management Customer focus Continuous improvement	Innovation performance Employee performance Firm Performance: -Reducing customer complaints -Level of customer satisfaction -Products/services quality to demands -Delivery lead-time of purchased materials -Delivery lead-time finished product/service	Turkey Manufacturing +Services	X-Section SEM	Supported
Phan et al. (2011)	IJPE	Top management leadership Formal strategic planning Small group problem solving Employee suggestions Cross-functional product design Housekeeping Information feedback Customer involvement Supplier quality involvement	Unit cost of manufacturing Conformance to product specifications On-time delivery performance Fast delivery Flexibility to change product mix Flexibility to change volume Inventory turnover Cycle time Speed of new product introduction Product capability and performance Customer support and service	Japan Manufacturing	2x Periods ANOVA	Partial

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Idris (2011)	IJBS	Leadership Strategy/objectives Best practices Productivity focus Customer Focus Community focus	Profitability Financial standing Productivity level Market share	Malaysia Manufacturing + Services	X-Section ML-REG	Partial
Sila (2007)	JOM	Leadership Customer focus Info+Analysis HRM Process Mgt Supplier Mgt	Organisational effectiveness Financial results Market results	USA Manufacturing +Services	X-Section SEM	Supported
Lakhal et al. (2006)	IJQRM	Top Mgt commitment Org for quality Employee training Employee participation Customer focus Info+Analysis Quality system improvement Org for quality	Financial performance Operational performance Product quality	Tunisia Manufacturing	X-Section SEM	Supported
Lin et al. (2005)	IJPE	Leadership Training P&S Design Supplier QM Proc Mgt Employee relations Customer relations Benchmarking Supplier participation Supplier selection	Satisfaction level Business result	Taiwan Hong Kong Delivery Freight Transportation Wholesales Trading Logistics	X-Section SEM	Supported
Prajogo and Brown (2006)	TQM	Leadership Strategic planning Customer focus Info+Analysis People Mgt Process Mgt	Product quality	AUS Manufacturing +Services	X-Section REG ANOVA	Supported

(a) IJBS – International Journal of Business and Society
BAR – Brazilian Administration Review
APMR – Asia Pacific Management Review
JOM – Journal of Operations Management
TQM – Total Quality Management
IJPE – International Journal Production Economics
IJQRM – International Journal of Quality & Reliability Management
JTMI – Journal of Technology Management & Innovation
MS – Management Science

(b) FE-REGFixed-Effect Regression
ML-REG Multiple Linear Regression

and/or return on assets (Duarte et al., 2011; Klingenberg et al., 2013; Zatzick et al., 2012). There is general agreement among organisation scholars that objective measures of performance are preferable to those based on managerial perceptions (Donaldson, 1995; Snow and Hrebiniak, 1980; Wayhan and Balderson, 2007a).

Productivity ratios using performance metrics, for example 'mean time between failures' and 'process yield percentage' (Lockamy III, 1998), though reflective of performance at the process or operations level, are not indicative of the performance at the firm level (Ahmad et al., 2004; Klingenberg et al., 2013). In essence scholars have argued for the holistic implementation of TQM across the firm in order to maximise and sustain benefits (Abdullah and Tari, 2012; Dhalgaard-Park et al., 2013). Therefore, the intent and level of enquiry are critical to the questions asked, the data used, and the conclusions drawn. One of the foci of this paper is to fill a need in the quality management literature for the use of secondary data to further test relationships between firms' quality management approaches and their financial performance.

Table 1 outlines a summary of the academic literature that has sought to determine causal links between quality management practices and financial performance. These various studies have analyse the impact of QM on the performance of firms, with some focusing specifically on financial performance measured by financial ratios such as ROA, ROE and profit margin, (for example see Benner and Veloso (2008), Eriksson and Hansson (2003)and Wayhan and Balderson (2007b)). Inputs for these ratios were obtained from either secondary sources such as financial reports of publicly traded firms, or perceived data from primary surveys. Unfortunately, there have been inconsistencies in the results. In an effort to address this problem, researchers have attempted to build more sophisticated models that also include performance metrics such as customer satisfaction and competitiveness (see for example Han et al. (2007)).

Kaynak (2003) *postulated that research on TQM implementation and financial performance provides inconsistent results, possibly due to the design of the studies,* i.e. *the attempt to use single constructs to measure TQM and financial performance. This was reiterated in a study by* Camacho-Minano et al. (2013)*, where the authors suggested moving away from using oversimplified single*

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constructs to using a combination of indicators and taking into account, contextual factors to capture the effect of QM practices on financial performance.

From Table 1 it is also possible to see that the impact of QM practices on financial performance has been mixed, even when using objective data such as financial ratios. *Direct and indirect effects of QM practices can be confounded by any number of variables such as marketing method and accounting practices* (Ahmad et al., 2004; Fullerton et al., 2003; Klingenberg et al., 2013; York and Mire, 2004). Therefore, the use of oversimplified single constructs may not truly reflect the complex forces that influence cross-functional and cross-firm relationships with firm level performance and soft factors (Ahmad et al., 2004; Kaynak, 2003; Klingenberg et al., 2013). For example, Milgrom and Roberts (1990) suggest that it is not possible to isolate the effects of different QM implementations from the effectiveness of marketing campaigns when analysing financial performance. Recent work by Klingenberg et al. (2013) and Duh et al. (2013) has given a critical analysis of the relationship between operations and financial performance, and concluded that ratios such as ROA and return on equity (ROE) are poor measures for the effect QM practices have on financial performance.

The trade-offs between long-term and short-term profitability, and the recognition that organisations depend for survival upon the contributions of many stakeholders with varying performance goals, can make traditional financial ratios problematic. Duh et al. (2013) reinforce the view that TQM implementations indirectly affect financial performance through non-financial means. For example Inman et al. (2011) showed that the effects of JIT on financial performance were mediated through the implementation of agile manufacturing.

The study of multi-national firms (MNCs) poses further challenges. For example, the practice of consolidating financial reporting into tax havens often means accurate pricing and costing of goods is obscured by the desire for a self-interested corporate view as opposed to a country view. In addition, the study of small firms can be problematic because they are private entities and owners may be unwilling to reveal information voluntarily to outsiders. Here again, when financial statements are available, they too may be inaccurate because of tax implications. Both these considerations reduce the importance of traditional financial performance measures that have links with taxation e.g. ROA, and (net) profit margins. Therefore, financial performance ratios without taxation implications are preferable (see Section 2.3). Given that quality management systems have been designed to drive productivity first and ultimately firm level performance (Abdullah and Tari, 2012; Klingenberg et al., 2013), we believe financial productivity performance measures are best able to capture this nexus.

2.2. Small medium enterprises

Despite unhealthy macro-economic environments, contributions from SMEs remain significant in all countries (Anthony et al., 2005; Clark et al., 2011; de Kok et al., 2011). Australian SMEs accounted for 57.7% of Australia's gross domestic product in financial year 2009 to 2010 (Clark et al., 2011), an increase from 34% in the 1990s (Lattimore et al., 1988). Such economic growth has been attributed to the increasing role of SMEs. Growth within the SME sector is known to have spill over effects that influence growth in non-SME sectors (de Kok et al., 2011). Examples of such spill over effects are technology transfers and acquisitions by MNCs seeking to improve their product pipeline and/or acquire complimentary technologies to enhance their offerings.

Additionally SMEs play a critical role in the internationalisation of MNCs, whereby SMEs provide competitively priced products and services that support the operations of MNCs (Anthony et al., 2005; Kaushik et al., 2012). If such products and services are unique, arguably these SMEs contribute positively to location advantages described in Dunning's Eclectic Paradigm (Dunning, 1988), which are highly sought after by MNCs. The need for an holistic implementation of quality strategy (De Meyer and Ferdows, 1990), for example through supply chain management (Kaynak, 2003), has led MNCs to demand quality management practices from their suppliers (Anthony et al., 2005; Kaushik et al., 2012). Thus pressures from MNCs, a desire for growth and a need to remain competitive have in general driven SMEs to adopt quality management practices (Kaushik et al., 2012; Khalid and Irshad, 2011; Lewis et al., 2006; Pinho, 2008).

With the majority of the literature focusing on large enterprises (El Shobery et al., 2010; Khalid and Irshad, 2011), quality management practices in SMEs remain an under researched area (Anthony et al., 2005; Khalid and Irshad, 2011; Pinho, 2008). Ahire and Golhar (1996) and Anthony et al. (2005) have claimed that quality management practices would provide benefits to SMEs as they had for large enterprises. However, it is argued that the ability to implement QM practices differs between large enterprises and SMEs (Anthony et al., 2005; El Shobery et al., 2010; Kalia and Ilir, 2012; Khalid and Irshad, 2011), resulting in different outcomes (Agarwal et al., 2013). Khalid and Irshad (2011) used a case study involving a textile manufacturer in Pakistan to highlight limitations in human resources and lack of involvement from non-production business functions as critical obstacles for SMEs.

Investigations into the relationship between quality and performance using large enterprises or industry level sampling have been mixed (Abdullah and Tari, 2012; Duarte et al., 2011; Klingenberg et al., 2013), and it is similar in the SME context. QM research which has sampled SMEs, e.g. those by Kaushik et al. (2012), Khalid and Irshad (2011), Pinho (2008), Valmohammadi (2011) and Singh et al. (2009), has shown positive relationships between (perceptual) quality management practices and performance. Whilst similar research undertaken by Kober et al. (2012), Phan et al. (2011) and Idris (2011) has revealed otherwise. Performance ratios such as ROA or net profits are particularly problematic when studying small firms, because such firms are typically young and may not reach profitability for an extended period (Biggadike, 1979; Weiss, 1981). Even though the mixed results echo findings from over three decades of research using industry and large enterprise samples, *we feel that the relationship between quality management practices and its effect on SME performance still warrants further investigation at firm level.*

2.3. Measures and hypotheses

In accord with Camacho-Minano et al. (2013) we take some tentative steps away from using oversimplified single constructs, to using a combination of indicators that take into account various contextual factors to capture the effect of QM practices on financial performance. We aim to determine the impact of QM on firm level performance using two financial productivity measures that have little relationship to taxation in most contexts (Rogers, 1998, 1999). The benefit of using financial productivity measures which are not affected by taxation is that they less likely to incorporate business activities or incentives that have no bearing on firms' productivity.

The use of the Capital Labour ratio provides an indicator of internal productivity, and when used in conjunction with other contextual factors, can provide a more accurate indicator of firm level performance. To provide a more accurate account of capital used by the firm, we derive the value of total capital stock as the summation of capital assets and leased capital assets. The rationale for including leased capital assets was provided by Rogers (1999), who highlighted that SMEs tend to operate more on leased assets

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rather than owned assets. If analysis of SMEs is based solely on the use of owned capital assets, the firm level view of capital usage may not be accurate. The definition of Capital Labour ratio (CAPLAB) is thus given by:

$$\text{CAPLAB} = (\text{capital assets} + \text{imputed value of leasing capital}) \div \text{FTEE}$$

where

$$\text{imputed value of leasing capital} = \text{leasing expense} \div \{1/(20+r)\}$$

where the average life of leasing capital is 20 years, r is the discount rate taken as the average 10 year bond interest rate (as at June 1994=9.63%), FTEE the full time equivalent number of employees.

A rise in CAPLAB is associated with the introduction of mechanisation and automation of production processes, but is also significant because it enables improvement in labour productivity. That is, overall economic gains are maximised when labour usage shrinks faster than the deployment of capital. In such a case, the rise of the capital–labour ratio thus signals an improvement in capital productivity, product quality, unit costs (e.g. see Stoneman (1995)), and ultimately retained earnings.

Measures of value added (VAD) or real output were originally designed to measure productive value that industries add to their intermediate inputs through relevant economic activities (e.g. see Griliches (1998)). Our definition of Value Added Labour (VADLAB ratio) leverages the measure of value added by Rogers (1998) and spread over the number of full-time equivalent employees in order to provide a financial value for labour productivity. VADLAB is given by:

$$\text{VADLAB} = (\text{total annual sales} + \text{closing stock} - \text{opening stock} - \text{purchases}) \div \text{FTEE}$$

Hence, by calculating a gross margin prior to the influence of other investment revenues or operating expenditures, the result is a clearer financial measure of firm level productivity. That is, effects of taxation policy, firm strategy and non-related production related expenditure (e.g. litigation fees) are minimised.

At the core of organisational paradigms is an economic orientation that assumes all firms seek profitability (or in the ecological paradigm – survival). From this assumption, organisational theorists have drawn the expectation that firms will value activities that earn revenues sufficient to produce profits (survival) and to seek out markets that offer the potential for such revenues (survival). Firm performance has as a result played a key role in organisational research particularly within IO economics, and generated considerable discussion on the appropriateness of the various conceptualisations and measurement of performance (e.g. see Venkatraman and Ramanujam (1986)). A perception of performance as multi-dimensional in nature has added complexity to the debate (Eccles, 1991; Matthyssens and Pauwels, 1996). Despite this, there is general agreement among organisational scholars that objective measures of performance are preferable, *and that a combination of contextual indicators would aid in linking the effect of QM practices to financial performance* (Camacho-Minano et al., 2013). To that end, we have included seven (7) additional contextual covariates in the formulation of our study, namely; return on assets, net margin on sales, wages expense ratio, other expense ratio, gross cost margin, unionisation, and employees to manager ratio. Each of these have been used in a variety of the studies highlighted in Table 1, and are defined in Table 7 in the Appendices.

2.3.1. Hypotheses

In order to meet the goals of this paper, we propose the following hypothesises:

H1: Firms that have quality assurance programs (formal) will show a positive association with firm performance (Capital Labour or Value Added Labour)

H2: Firms that have quality assurance programs (informal) will show a positive association with firm performance (Capital Labour or Value Added Labour)

H3: Firms that have quality assurance programs (externally assisted) will show a positive association with firm performance (Capital Labour or Value Added Labour)

3. Method

The purpose of this study is to explain the phenomena of continuous improvement in small manufacturing firms within the quality theoretic paradigm (Deming, 1994). The hypothesises seek to test the applicability of predominantly large firm theories to link quality and performance in small Australian manufacturing firms (SAMFs, defined here to have up to 99 employees) over a three-year period from 1996 to 1998. A quantitative research design is appropriate for this explanatory paper due to reasons of determining causality and the wealth of research available in manufacturing quality domains. Manufacturing is a mature but turbulent macro-environment within Australia, and due to government interest and funding, the Growth and Performance Surveys (GAPS) provided a rich and significant quantitative data set for our research. A longitudinal study was deemed appropriate for this investigation for two reasons. Firstly, despite longitudinal approaches being deployed in prior research in QM (Kober et al., 2012; Naveh and Marcus, 2005; Zatzick et al., 2012), there still remains a need for longitudinal studies to observe the effects of QM practices and their effects on organisational performance (Abdullah and Tari, 2012; Gutierrez Gutierrez et al., 2012; Lakhal et al., 2006). Secondly, Ferdows and De Meyer (1990) and Tsai et al. (1991) raised the notion of time lag between implementing QM practices and outcomes of those implementations. Regardless of outcome, there is a period of about four years before outcomes are realized (Tsai et al., 1991). As mentioned in Section 1, much of QM practices in Australia were adopted in the early 1990s. In order to accurately evaluate the outcomes of those QM practices, a data set derived from the second half of the 1990s would be more accurate as opposed to other periods in time because it is the most relevant period once the time lag is considered. Therefore, the longitudinal panel data collection that was undertaken here (i.e. during the second half of the 1990s) is deemed appropriate. In summary, a longitudinal approach was chosen for this paper because the approach allows incorporation of time lags between implementation and outcomes to give a more accurate view of cause and effect relationships.

The GAPS was commissioned by the Australian Federal Government to collect longitudinal data from the period of 1995 to 1998 on the growth and performance of small and medium firms. The secondary objective of the GAPS was to provide an instrument for the collection of information on government policy areas e.g. employment opportunities, export orientation, managerial and technological innovation, training and regulations. To achieve these objectives a thorough consultation programme was conducted with meetings held in all major capital cities. All known interested parties were invited to participate in an informal review of the survey just completed and to contribute to the development of the next issue of the survey. Participants included representatives from various Federal and State Government Departments, academics as well as private sector researchers and users. Following these meetings the Australian Bureau of Statistics Technical Committee, a committee established to advise on the conduct of the longitudinal survey, in conjunction with the Office of Small Business, reviewed the questions included in the previous survey along with feedback gathered in the consultation programme to establish questions to be included in the questionnaire. Response to Australian Bureau of Statistics surveys is typically very high due

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Table 2
Growth and performance survey respondents 1994–95 to 1997–98.

Respondents	Less	1994–95	1995–96	1996–97	1997–98
Mail out		13002	6402	6273	6630
	Non-responses	1016	532	647	998
Returned questionnaires		11,986	5870	5626	5632
Gross response rate		92.19%	91.69%	89.69%	84.95%
	Out of scope, failure, take-over, non-employing businesses	3081	901	569	583
Total usable responses		8905	4969	5057	5049
Effective response rate		68.49%	77.62%	80.62%	76.15%
Manufacturing Industry subset					
Respondents		3272	2043	2056	2031
% of usable responses		36.74%	41.11%	40.66%	40.23%
Longitudinal sample subset					
Responses		1651			
% of manufacturing responses		50.46%	80.81%	80.30%	81.29%
	Un-incorporated firms	195			
	Medium and large firms	302			
Total usable sample		1154			

(a) Out of scope is defined as firms that have discontinued operations or were non-employing.
(b) The four year panel represents those businesses that operated for the whole four years of the survey.
(c) All sizes equate to small, medium and large management units.

Table 3
Quality management orientation 1995–96[a].

Quality improvement programme (Group no.)	No programme (1)	Informally in place (2)	Formal programme developed in-house (3)	Externally assisted programme (4)	Totals
	$NFORM_Q$	$INFRM_Q$	$FORM_Q$	EXT_Q	
Per cent	44.3%	23.9%	18.1%	13.7%	100%
Respondent companies	511	276	209	158	1154
Orthogonal sample frame	158	158	158	158	632

[a] Note that 1995–96 orientation was used to set the baseline from which the orthogonal sample was established for the 3 year period.

to the possibility of legal and financial penalties for non-response, and in keeping with this trend the response rate of GAPS was more than 85 per cent. This data thus represents the most comprehensive and costly data (approximately $3million) ever available in Australia on small business performance and general health. The longitudinal nature of the database thus provides a very rare opportunity for the performance of small firms to be analysed.

As can be seen from Table 2, the total usable response was adjusted to exclude out of scope, non-responses, and non-employing businesses to give an effective usable response rate for each year of 68.5 per cent, 77.6 per cent, 80.6 per cent, and 76.2 per cent. The manufacturing industry represented the largest single industrial component of the survey at approximately 40 per cent of the effective usable response rate. Of these firms the longitudinal component (i.e. present in all four survey years) was 1651 firms, which was further adjusted for un-incorporated firms (e.g. partnerships), and medium and large firms, to give a usable longitudinal sample of 1154 SAMFs.

Ideally, samples should be selected according to criteria which provide controls for the measured properties and ensure representation of the population to which the results are to be generalised (Zikmund, 1997). Sample size provides a basis for the estimation of sampling error. With large sample size (exceeding 400), the technique becomes 'too sensitive' and almost any difference is detected (Bagozzi, 1981; Marsh and Hocevar, 1985). In the current study an orthogonal sample size of 158 was used, and this is considered adequate by most standards (see for example Hoelter (1983)). Overall, the sample was representative of the population. Based on the recommendations of Krejcie and Morgan (1970), a sample frame of 576 cases is required to represent a population of 50,000 (i.e. small Australian manufacturing firms as at 1998). In this study, a sample frame of 1154 cases was achieved, exceeding the recommended number of cases. It is therefore appropriate to provide a brief overview of the sample with respect to the population in order to highlight the generalisability of the findings to SAMFs.

In this study quality differentiation was only measured in the 1995–96 survey (question 18) using a four-item Likert scale asking whether the business had any of the following business improvement programs in place; quality assurance, total quality management, just-in-time management, or process engineering? Formal quality programs developed in-house ($FORM_Q$) were understood to mean that the organisation had undertaken significant organisational wide quality programs, and had efficient or best practice organisational structures and reporting mechanisms in place. On the other hand, firms that demonstrated informal quality systems ($INFRM_Q$) were understood to have undertaken minor organisational quality programs to provide some improvement to organisational structure and reporting mechanisms. Lastly, firms which had demonstrated practice based quality systems driven by an external agency (EXT_Q), such as a parent firm and/or consulting firm, were understood to have experienced limited organisational impact by way of quality programs, structure and reporting mechanisms.

Each case company was assigned a quality management (QM) orientation based on their reported implementation of quality assurance, total quality management, just-in-time management and process engineering. This was achieved via weighed average calculation, with the highest weighting given to companies in the following order; formal programs developed in-house, externally assisted programs, informally programs, and lastly limited/no programme. The final classifications of the responses are shown in Table 3. Additionally Tabachnick and Fidell (1996, p.344, 401, 406) report there is increased risk of sum of squares error generated from non-orthogonal samples. In an effort to minimise this risk we created an orthogonal random sample of 158 cases based on the smallest collected group, i.e. externally assisted programs.

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Table 3 notes that slightly more than 55 per cent of firms in the sample had made a step towards some form of quality programme. However, even more interesting was that by the end of 1996 almost 45 per cent of these small Australian manufacturing firms recorded that they had not instituted any form of quality assurance programme ($NFORM_Q$). There are a variety of possible reasons for this, most notably that the operation is a component supplier to a larger organisation where quality assurance is undertaken on either the subassembly and/or finished products. This is supported by data which shows that over 25 per cent of respondents with the $NFORM_Q$ orientation were from Australian and New Zealand Standard Industrial Classification subdivision Machinery and Equipment Manufacturing (e.g. Motor Vehicle and Parts, Transport Equipment and Electronic Equipment Manufacturing).

4. Results and discussion

In accord with the literature, quality differentiation has the potential to produce demonstrable performance outcomes at firm level, particularly in maturity stages where price competition is evident (Beal and Lockamy III, 1999; Matthyssens and Pauwels, 1996). We next test whether the longitudinal impact of quality has an impact on the value added performance outcomes of SAMFs.

To test this data was averaged over the three-year longitudinal panel for those variables, which were consistently collected across the four-year panel. The items that were consistently collected were variables associated with VADLAB, CAPLAB measures and contextual covariates, wages expense, other expense, return on assets, net profit margin, gross profit, union membership, and employee/manager ratio.

4.1. Discrimination of quality management on performance

As can be seen in Table 4, averaging the two performance variables (CAPLAB and VADLAB) and (contextual) covariates over the three years following a quality assurance commitment in the 1995–96 panel shows that there was a significant difference in the performance across groups (Pillais' multivariate $F=2.72$, $p=0.013$, df$=6$). At first glance, the hypothesised performance differences can be claimed to be supported in the Averaged Quality Assurance Orientation data. That is, formal quality assurance programs ($FORM_Q$) show a strong

Table 4
MANCOVA results for 1996–98 (Three year) average quality management orientation[a].

Performance		Capital labour				Value added		
Quality orientation[b] *(Baseline = $NFORM_Q$)*		$FORM_Q$	$INFRM_Q$	EXT_Q		$FORM_Q$	$INFRM_Q$	EXT_Q
Univariate *F*-value	2.71				3.20			
Univariate significance	0.044				0.023			
Power	0.66				0.74			
Multivariate *t*-value[c]		−2.53	1.25	1.62		1.60	−2.99	0.93
Multivariate significance		0.01	0.21	0.12		0.12	0.003	0.35
Power		0.71	0.24	0.37		0.360	0.845	0.174
Multivariate effect across Quality assurance orientation	Hyp. df	Approx.F	Sig. of F		Power			
Pillais *F*-value[d]	6	2.72	0.013	0.87				

[a] All variables averaged over 3 years 1995–96, 1996–97, 1997–98 for an orthogonal design where $n_{1-4}=158$ for $n_s=632$.
[b] Baseline $NFORM_Q$ – No formal quality programme, compared to those companies with: $FORM_Q$ – Formal; $INFRM_Q$ – Informal; EXT_Q – External programs.
[c] Estimates adjusted for 7 covariates: Wages Expense, other expense, gross cost margin, unionisation, employee–manager ratio, Return on Assets, net margin on sales.
[d] Bonferroni confidence intervals two-tailed observed power taken at 0.05 and Bartlett test of sphericity = 255.9 with df = 1, $p<0.001$.

Table 5
MDA results for 1996–98 (Three year) average quality management classifications.

Discriminating variable	F-ratio [a]	Sig.	Rotated discriminant loadings			Potency index	Group means[b]			
			F1	F2	F3		1 $NFORM_Q$	2 $INFORM_Q$	3 $FORM_Q$	4 EXT_Q
CAPLAB	3.11	0.00	0.64	−0.15	0.08	0.213	13.06	14.13	16.27	15.39
VADLAB	3.05	0.00	0.50	0.09	0.13	0.185	10.82	11.47	12.40	12.26
Wages expense	3.25	0.02	−0.17	−0.44	0.07	0.093	0.71	0.71	0.68	0.66
Other expense	2.92	0.01	−0.08	−0.08	−0.55	0.072	0.62	0.57	0.59	0.58
Return on assets	2.44	0.01	0.14	0.11	−0.35	0.036	0.37	0.32	0.40	0.39
Net margin on sales	2.48	0.00	0.34	0.18	−0.35	0.112	0.24	0.22	0.29	0.29
Gross cost margin	2.56	0.00	0.26	0.30	0.33	0.139	0.24	0.26	0.27	0.28
Unionisation	2.62	0.00	0.27	0.17	0.35	0.109	0.08	0.13	0.15	0.16
Employee-mgr. ratio	3.11	0.00	0.68	0.27	−0.01	0.386	1.07	1.11	1.23	1.22
Per cent correctly classified (*hit ratio*)										
Proportional chance criterion	25.0									
Maximum chance criterion	31.3									
Overall sample	38.1									
Effect size[c]	0.36									

[a] Box's $M<0.01$ but impact minimised with orthogonal design (see Tabachnick and Fidell (1996), p.382).
[b] $NFORM_Q$ – No programme; $FORM_Q$ – Formal; $INFRM_Q$ – Informally; EXT_Q – External programme.
[c] Effect size is a standardised measure of group differences typically expressed as the differences in group means divided by their standard deviation (Hair et al., 1979, p. 328).

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preference for CAPLAB in support of H1, and informal quality assurance programs ($INFRM_Q$) show a strong preference for VADLAB in support of H2. However, externally assisted Quality Assurance Orientations (EXT_Q) showed no performance linkage/preference to either CAPLAB or VADLAB (H3 not supported).

This difference in the performance outcomes of the two groups would seem to emanate from the requirement or drivers to install the quality programme in the first place. In follow-up discussions with typical SAMFs we discovered that in the case of $FORM_Q$, the requirement was for traceable external compliance to a national or international standard to secure or maintain market access. In this process there may be little or no value added to the product other than a certification of the product's quality features. Whereas in $INFRM_Q$ there would seem to have be no requirement for external compliance but rather a highly regimented internal quality system targeting a customer's requirement specification. In this case, the focus is on targeting customer needs and extracting a price premium and/or added margin from the needs matching.

To further investigate the direction and intensity of the covariates (utilised in Table 4) on the overall group differences, discriminant analysis has been used to determine the weights of the combination of criterion variables. Univariate ANCOVA procedures and multivariate discriminant analysis (MDA) shown in Table 5 reveal that six variables are statistically significant at the 0.001 level, and the potency index (>0.1) is also significant on the same six attributes (namely; CAPLAB, VADLAB, net margin on sales, gross cost margin, unionisation and employee–manager ratio).

As an additional check, the predictive validity of the discriminant function was assessed by comparing the overall hit ratio of 38.1 per cent with the proportional chance criterion of 25 per cent (i.e. a balanced design). Hair et al. (1979) suggest that the classification accuracy reflected in the overall hit ratio should be at least 25 per cent higher than the proportional chance criterion (i.e. should be 31.25 per cent or more) before one can have confidence in the predictive validity of the MDA function. Because this criterion is met, and six attribute differences are statistically significant with a moderate effect size of 0.36, the hypothesised H1 and H2 performance differences can be claimed to be supported in the averaged quality management data.

4.2. Discussion

Deming and Shewhart (1986) and Skinner's (1969) views of quality are portrayed in the Chain Reaction Theory. The theory's central proposition is that if a firm firstly improves its quality (e.g. by the analysis and improvement of cross-functional processes), it can lead to decreased cost, reduced rework, time and materials, and an improvement in total plant productivity. The operations management literature has also laid claim to the benefits of quality approaches to removing waste from processes and in so doing improving performance across a sandcone of measures i.e. quality, delivery, flexibility and ultimately cost (Ferdows and De Meyer, 1990). At a practice level, these quality paradigms imply that implementation can only be achieved with a process (and improvement) perspective built into all internal business operations (O'Neill and Sohal, 1998). Within these perspectives lies a sophisticated understanding of quality (perhaps a Resource Based View), that quality is not an organisational function, but rather a Totally disciplined way of doing business (e.g. see the total quality discussion in Reed et al. (2000) and Yong and Wilkinson (2002)).

However as noted in our literature review of various authors (see Table 1), little evidence has been published demonstrating how nominal/perceptual operational quality improvements manifest to firm level financial productivity improvements. In this paper, we set out to find whether a stated quality orientation could be differentiated across an appropriate set of financial performance measures at firm level. In the MDA above, we found that there is significant discrimination across the QM orientations for net margin on sales (NMoS), gross cost margin (GCM), unionisation (UNIS) and employee–manager ratio (EMR). In our study both NMoS and GCM represent financial efficiency measures while UNIS and EMR can be viewed as representative of cultural/behavioural productivity measures. We suggest that the discrimination provided by these measures is supportive of the outcomes expected by both Chain Reaction and Sandcone Models of quality improvement. However in the case of Wages and Other Expenses, and RoA there was limited discrimination. We believe this result again demonstrates that some measures are not suitable for financial performance analysis, in particular those that are susceptible to firm level manipulation e.g. for tax purposes (as noted from the literature).

Our MANCOVA analysis further shows that in companies with formal quality programs ($FORM_Q$) there was a positive relationship with CAPLAB, while in companies with informal quality programs ($INFRM_Q$) there was a positive relationship with VADLAB. This difference in the performance outcomes of the two groups would seem to emanate from the requirement or drivers to install the quality programme in the first place (Mendez and Narasimhan, 2002; Smunt and Watts, 2003).

In the case of $FORM_Q$, the requirement seems to be for traceable external compliance to an inter/national standard to secure or maintain market access (Sun and Cheng, 2002). In this process there may be little or no value added to the product other than a certification of the product's quality features (Anderson et al., 1999). This maybe particularly true of early stage quality management implementations that have not progressed from process to leadership, cultural and behavioural improvement.

In $INFRM_Q$ there would seem to be no requirement for external compliance but rather a highly regimented internal quality system targeting a customer's requirement specification. In this case, the focus is on targeting customer needs and extracting a price premium and/or added margin from the needs matching. This seems to support Beal and Lockamy III's (1999) claim that in later stages (e.g. maturity/decline), small manufacturing firms cannot achieve high levels of performance by differentiating themselves based on product quality alone i.e. quality management can be used to drive costs downwards, and thus enable price to be a key negotiable factor in contract negotiations.

These results may also help in explaining the variety of findings in previous studies. That is researchers must be conscious and active in their application of statistical control measures in their designs e.g. to establish quality orientation, life cycle and context. A failure to put these control measures in place provides little foundation to advance the quality field beyond practice based certification.

In this study, we hypothesised that a positive association between quality commitment (implementation of formal and informal quality programs) and productivity would be found; and the outcome of this relationship can be manifested at firm level through financial performance ratios (CAPLAB and VADLAB). From our findings, we have shown that such a positive relationship exists, though perhaps not as expected, in that $FORM_Q$ has an impact on CAPLAB, $INFRM_Q$ impacts VADLAB, and EXT_Q has no discernible impact.

In an extension of the studies by we can confirm that QM orientation does positively differentiate financial performance outcomes (even amongst small firms), the effect is independent of winning a quality award, but is dependent on QM maturity (i.e. Nil QM, $FORM_Q$, $INFRM_Q$, and EXT_Q). We can also confirm that

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doing better financially does not necessarily equate to traditional measures of profit, capital-intensity, or number of employees.

Lastly, while CAPLAB and VADLAB ratios have not been used in mainstream production or operations management literature (Table 1), we propose that these ratios are better alternatives to profit margin, ROA and ROE as financial measures of firm level performance. We justify our proposition in the following ways: firstly, CAPLAB and VADLAB are primarily driven by capital and labour utilisation, both of which are associated with productivity. Secondly, CAPLAB and VADLAB are ratios that use predominantly book values, which are more accurate because book values are not manipulated or inflated using mark-ups to reflect desired profit. Thirdly, CAPLAB and VADLAB are not influenced by short-term profit and loss items such as interests resulting from short-term debt or investments, depreciation or operational expenses unrelated to productivity (e.g. advertising and incentives). Just as importantly, the influence of stakeholder demands on the firm's financials as well as taxation is avoided, so as to give a more accurate account of productivity. Fourthly, it is easy to access the financial data required to calculate the ratios, i.e. CAPLAB and VADLAB can be derived from firms' annual reports. This access can benefit both cross sectional as well as longitudinal analysis of secondary data. Fifthly, longitudinal panel studies are a better way of taking time lags into account when attempting to capture the effects of QM implementations.

While we did not set out to prove that companies who invest in QM efforts experience significant improvements in the traditional measures of financial performance, we have taken several significant steps towards capturing and quantifying the financial effects of implementing QM practices. The study was an historical assessment of the early stages of quality management implementations in Australia up to the end of the 1990s. For these reasons, we encourage other researchers to use CAPLAB and VADLAB as alternatives to the traditional financial measures of QM practices. We further dispel the suggestion that regardless of which QM approach is adopted performance outcomes could be the same or at best temporary (e.g. see Klingenberg et al. (2013)). This provides added support for leadership models that engage QM with broader organisational dynamics in mind, namely that QM can be used as a transformational tool to sustain differential and productive performance outcomes (Kotnour, 2001).

5. Conclusions

The importance of manufacturing to western economies is increasing despite the shift of mature operations to less mature industrial environments. In all environments the (positive) association between quality commitment and financial performance (i.e. productivity) is worthy of further study so as to expand the strategic understanding and nature of quality management programs and their impact on a objective financial productivity variables defined here.

Dangayach and Deshmukh (2001) report that longitudinal studies were less reported compared to cross-sectional and other approaches, and in their 15 year review of manufacturing strategy literature uncovered the following breakdown of methodological approaches: empirical/cross-sectional studies accounted for 67%, descriptive/conceptual studies make up 29%, and the remaining 4% are exploratory/longitudinal studies. As such this study followed the less common and more difficult longitudinal (panel) research traditions undertaken in studies by e.g. Buzzell and Gale (1987), Hendricks and Singhal (2000) and Klingenberg et al. (2013).

Our findings from this longitudinal study show that a positive relationship exists between QM implementations and with both CAPLAB and VADLAB ratios. Encouraged by our findings, CAPLAB and VADLAB have been proposed as better measurements of firm level financial performance. We hope that having alternate (albeit better) means of measuring outcomes of QM practices via these two new measures will ultimately give a more accurate account of whether QM practices have an effect on the competitiveness of manufacturing firms.

The secondary implications of our results are that many organisational characteristics (i.e. net margin on sales, gross cost margin, unionisation and employee–manager ratio, wages/other expenses, and RoA) moderate the benefits of QM implementation. Although not all of these characteristics are directly controllable by managers (e.g. unionisation and expenses), we suggest that a proactive leadership model does impact the benefits from QM. The benefits from CAPLAB and VADLAB validate the importance of QM practices for smaller firms and environments that are often viewed as more labour intensive and less productive.

Several limitations arose during the research. Firstly the study was undertaken within SAMFs and as such there is limited generalisability to the wider manufacturing, service and international contexts. Secondly, the validity of the survey questionnaires could only be tested posthoc due to the ABS restrictions placed on third party involvement in the survey. This shortcoming was mitigated somewhat by the longitudinal nature of the questionnaire and the continuous panel of respondents. Thirdly, due to the confidentiality requirements of the ABS it was not possible to identify respondent firms in the quantitative study for follow-up telephone consultation, or to invite participation in a qualitative study, and as such some continuity may have been lost in the method. Lastly, there are insufficient studies to conclude that CAPLAB and VADLAB are more accurate measures of effects of QM practices on firm level financial performance. Further studies and comparative analysis between CAPLAB and VADLAB with traditional ratios such as ROA and ROE are encouraged.

In conclusion, the authors add to (Dobyns and Crawford-Mason, 1991, p.281) expose of the Total Quality revolution:

> *The economy is everything we do that involves money. It is, in short, how you live or could live if things get better or worse... many factors including quality, which together… drives productivity, productivity drives standard of living, and standard of living is the future.*

Appendix

See Appendix Tables 6 and 7.

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Table 6
Structure of growths and performance survey.

Core questions – collected in all surveys	Indicative items collected on entry to the survey but available in all years	Collected in 1994–95 only	Collected in 1995–96 only	Collected in 1996–97 only
Number of locations	Age of firm	Countries exported to	Business links	Contracting out activities previously undertaken in-house
Locations closed/opened	Type of legal organisation	Expenditure on training	Sources of business information	Use of computers
Type of business activity ANZSIC classification	Foreign ownership	Level of management training	Reasons for not using government programs	Use of Internet
Employment	Franchising	Expenditure on innovation E.g. Marketing	Use of quality programs	Whether business has a web site
Union membership	Characteristics of single decision maker			
Union membership				
Employment conditions				
Days and hours business operated				
Major changes in the business				
E.g. Advertising				
Use of government programs				
Business intentions				
Business improvement				
E.g. Quality programs				
Export income				
Income items				
Expense items				
R&D expenditure				
Trading stocks				
Assets and liabilities				
Capital expenditure (not collected in 1994–95)				
Labour turnover (not collected in 1994–95)				

Table 7
Definitions of variables.

Financial constructs/ variable names (a)	Ratio	Calculation	Authors
Firm structure			
	Total number of fulltime employees adjusted for part-timers to give number of fulltime equivalent employees (FTEE).	No. working proprietors and directors + no. managers + no. full-time + (no. part-time*0.42)	Rogers (1999 , p. 10)
	Managerial staff per employee	(No. working proprietors and directors + no. managers) ÷ FTEE	
	Unionisation	Per cent of unionised workers in the business	
Financial ratios			
	Return on total assets	(net profit before tax + interest paid) ÷ total assets	McMahon, 1998 (2000)
	Net margin on sales	(net profit before tax + interest paid) ÷ total annual sales	As above
	Wages expense ratio	(wages + salaries) ÷ total annual sales	As above
	Gross cost on sales Ratio	(opening stock – closing stock + purchases) ÷ total annual sales	Demsetz, (1972, 1973, 1997)
Productivity performance			
	Capital labour ratio	(tot assets + (leasing expense ÷ ((1/20) + 0.07))) ÷ total adjusted employees	Rogers and Tseng (2000)
	Value added labour ratio	(total annual sales + closing stock – opening stock – purchases) ÷ total adjusted employees	Rogers and Tseng (2000)

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