Competition in New Zealand Industries: Measurement and Evidence

Hilary Devine, Tinh Doan, Kris Iyer, Penny Mok and Philip Stevens

Paper presented to the *Competition in New Zealand* special session of the New Zealand Association of Economists Annual Conference, Wellington, 29 June – 1 July 2010

June 2011

THE TREASURY
Kaitohutohu Kaupapa Rawa

Ministry of Economic Development
Manatū Ōhanga

WORK IN PROGRESS – DO NOT QUOTE WITHOUT AUTHORS' PERMISSION

Date: June 2011

Authors:

Hilary Devine	*Ministry of Economic Development*
Tinh Doan	*Ministry of Economic Development*
Penny Mok	*The Treasury*
Kris Iyer	*Ministry of Economic Development*
Philip Stevens	*Ministry of Economic Development*

Acknowledgements

This paper was part of the *Competition in New Zealand* project. This was funded by the Cross Departmental Research Programme. In-kind and financial support was provided by the Ministry of Economic Development, Treasury, Commerce Commission, and Ministry of Foreign Affairs and Trade. Thanks to Rachel Griffith, Karen Chant, Gus Charteris, Steen Videbeck, Francesca Wilson for input into the *Competition in New Zealand* project.

Disclaimer

Abstract

Understanding the degree of competition within and across industries is an important step towards understanding the impact of competition on economic growth. In this paper, we compare and discuss several measures of competition, including the Price-Cost Margin (PCM) or Lerner Index that has been extensively applied in the academic literature and the recently developed measure Profit Elasticity (PE). This paper provides the first empirical study of the degree of competition across a range of industries in New Zealand using firm level data from the prototype Longitudinal Business Database (LBD).

JEL Classification: D4, L1, L5

Keywords: *competition, measurement, competition policies, New Zealand industries*

Table of Contents

Competition in New Zealand Industries: Measurement and Evidence

1. Introduction

Understanding the relationship between competition and economic performance is critical to developing government policy and regulation to support a dynamic and growing economy. We currently have little or no information on the degree of competition in the majority of the sectors of the New Zealand economy. To fill this gap, the Ministry of Economic Development, the Treasury, the Commerce Commission and the Ministry of Foreign Affairs and Trade have jointly embarked on a research project with funding from the Cross Departmental Research Pool. The objective of this project is to determine the nature, extent and impact of competition in the New Zealand economy. At its inception, this was expected to involve answering the following questions:

1. How competitive are industries in New Zealand?
2. What is the link between the degree of competition and firm outcomes, such as innovation, productivity and management practices?
3. How do these compare with other countries?
4. What are the implications for competition policy and economic policy more generally?

The focus of this study is a broad picture of competition across the New Zealand economy. This is distinct from the extremely focussed, detailed analysis of clearly-defined, specific markets that are the provenance of competition agencies, for example. These require an in depth examination of the history and context of the

market, the nature of costs and production, barriers to entry, technological developments, product substitutability etc. that are well beyond the scope of this project.

The primary source for the analysis is the prototype Longitudinal Business Database (LBD). This is essentially a firm-level dataset, with firms classified according to sector by economic activity rather than product or service. Because of the available data, our primary focus for definitions of 'the market' will relate to standard industrial definitions (i.e. the Australian and New Zealand Standard Industrial Classification, or ANZSIC).

The present paper is the first output from this project and the first of a suite of three papers to be presented at a special session of the New Zealand Association of Economists Conference 2011, entitled *Competition in New Zealand*. The other two papers look at the dynamics of competition in New Zealand industries (Devine, Doan, Iyer, Mok and Stevens, 2011a) and the relationship between competition and firms' innovation and productivity (Devine, Doan, Iyer, Mok and Stevens, 2011b).

In this paper we consider the measurement of competition from a theoretical and an empirical perspective. We discuss a recently developed measure of competition that claims to be robust to some of the problems with more traditional measures used in the empirical analysis of competition. We calculate two measures of competition – the price-cost margin and profit elasticity – for a wide range of industries in New Zealand using the prototype Longitudinal Business Database. These measures will feed into the other two papers in this triptych (Devine, *et al.,* 2011a and 2011b).

The remainder of this paper is as follows. In section 2, we provide some background to the project and paper. Section 3 briefly discusses the nature of competition and methods for measuring it and section 4 outlines the data and model used. In section 5, we present our results for New Zealand industries. Section 6 concludes and discusses areas of future research.

2. Background

The policy context for this work can be neatly summed up as the 'New Zealand Paradox' [1]. New Zealand's policies compare favourably with international best

[1] McCann (2009)

practice in areas like ease of starting a business and the general regulatory environment. It is an open economy: tariffs and other protective mechanisms have all but been phased out and it has established free trade agreements with key trading partners, such as China. Nevertheless, New Zealand has a level of labour productivity that is about 80% of the OECD average (MED *et al.*, 2011). As the 2003 OECD economic survey of New Zealand noted: 'The mystery is why a country that seems close to best practice in most of the policies that are regarded as the key drivers of growth is nevertheless just an average performer' (OECD, 2003).

One potential explanation is a lack of competition. Economists generally think of competition as stimulating managerial effort and company performance (Vickers, 1992) and promoting innovation (Porter, 1990). Competition is seen as one of the fundamental driving forces of growth. The question remains why a country with the institutions considered necessary for a competitive environment is not reaping the benefits of this competition.

It may be the case that the introduction and maintenance of the legal institutions of 'good' competition policy are a necessary, but not a sufficient requirement for an economy to be successful. It may also be the case that competition is not unambiguously good for growth, or that it is good in some cases and not in others. This may be because: (a) it tends to curtail innovation (e.g. Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992); (b) that it is only appropriate at certain stages of development (Gerschenkron, 1961; Acemoglu, Aghion and Zilibotti, 2003; Crafts, 2004); or (c) that the relationship between competition and outcomes such as innovation and productivity itself is non-linear (e.g. Aghion, Bloom, Blundell, Griffith and Howitt, 2005; Aghion and Griffith, 2005).

The relative size and distance of the New Zealand economy from major markets is a important determinant of the competitive environment. Authors such as Gal (2003) have argued small distant economies may suffer from an inability to achieve economies of scale, from high levels of industrial concentration and high barriers to entry for international entrants[2]. The economic cost of distance has been looked at in the literature. Recent evidence suggests that despite falling transport costs and advances in communications technology, the economic costs of distance still remain

[2] The problems suffered by small, distant economies such as New Zealand are also discussed in Evans and Hughes (2003).

considerable (Boulhol and de Serres, 2008; McCann, 2009). There has however, been considerable literature showing the technological advances have reduced the impact of distance (Keller, 2002; Thompson, 2006; Friedman, 2005; Cairncross, 1997; Coyle, 1997; Griffith, Lee, and Van Reenen 2007).

3. Measuring competition

There is a long history of considering and reconsidering the meaning of competition in economics, from at least the 18th century (e.g. David Hume, Adam Ferguson and Adam Smith) onwards. Examples include: Ely (1901), Lerner (1934), Hayek (1948), Stigler (1957), McNulty (1968) and Boone (2000, 2008). Indeed, the last of the cited authors was moved to ask 'What is competition?' and replied 'More than two hundred years after Adam Smith we still don't know' (p. 1). Economists generally consider competition to be the absence of firm's market power. A firm has market power if it has ability to profitably raise price above marginal cost. This is constrained by supply side responses and entry by other firms and demand-side responses of consumers. A market is more competitive when these forces are stronger, i.e. when firms are more constrained from profitably raising price above marginal cost.

Early studies of competition employed measures such as concentration indices[3], or the Herfindahl (also called the Herfindahl–Hirschman) index[4]. Implicit in these measures is the idea that the structure of the market is the determinant of competition – that structure determines conduct, which in turn underlies the market's performance. The problem with this is that the structure of the market, in terms of the number of firms and their market shares, is itself the outcome of a competitive process. For example, an increase in competition may reallocate market share to more efficient firms with higher mark-ups such that the Herfindahl–Hirschman index actually *increases*.

[3] This takes a number of firms (say five) and measures the amount of the total market sales accounted for by these firms. Thus, the *k*-firm concentration ratio in industry *j* is given by:

$$C_j^k = \sum_{l=1, l\in j}^{k} Sales_l \Big/ \sum_{i\in j} Sales_i$$

[4] $$H = \sum_i \left(Sales_i \Big/ \sum_l Sales_l \right)^2$$

3.1. Price Cost Margin

What economists generally mean when they think of a market with low competition is the ability to mark up prices over marginal costs. This has led to the Price Cost Margin (PCM) or Lerner Index being a popular measure of competition (e.g. Nickel, 1995; Stevens, 2009). The PCM for firm i is given by:

(1) $$PCM_i = \sum_i \left(\frac{p_i - c_i}{p_i} \right)$$

where p is the price, c is marginal cost .

This is an indicator of the *firm's* market power, its ability to raise prices above marginal cost. In most circumstances, when competition increases, it will affect *all* firms' ability to mark-up prices over marginal cost. Thus, it seems that this is an excellent basis for a measure of the level of competition in the market. All one needs to do is aggregate it up by the firms' market share s. That is, the PCM measure of competition in industry j is given by:

(2) $$PCM_j = \sum_{i \in j} \left(\frac{p_i - c_i}{p_i} \times s_i \right)$$

A problem with the PCM as a measure of competition in an industry is that it ignores the impact on the overall mark up of competition on reallocation and firms exiting the market.

3.2. Relative profits difference and profit elasticity

Consider an industry where there is a distribution of firms with different PCMs, due say to differences in efficiency. An increase in competition is likely to have two effects: a *reallocation* and a *selection* effect.

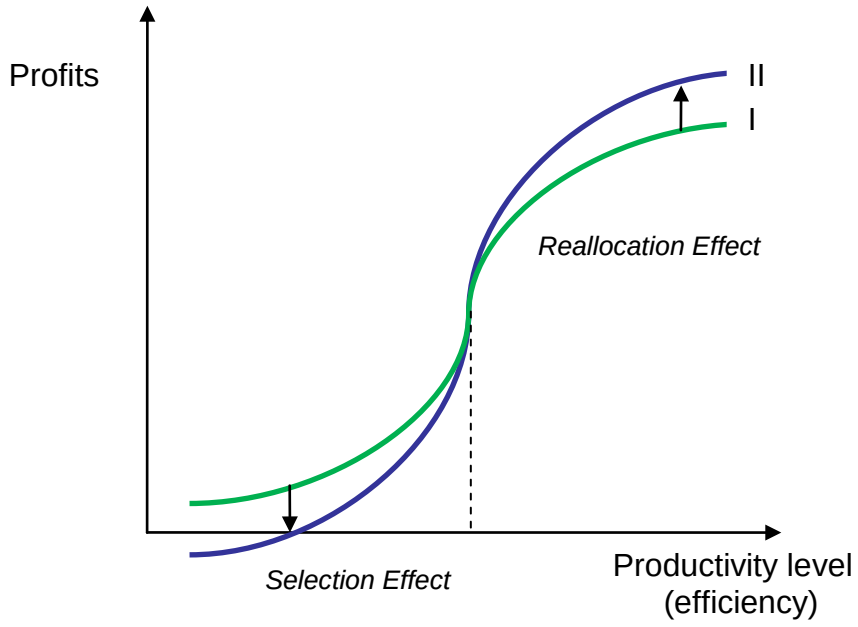
- The ***reallocation effect*** relates to the fact that profits will be reallocated from less efficient firms to more efficient firms. That is to say, competition hits the profits of inefficient firms harder than those of more efficient ones; inefficiency is punished in a competitive market.
- The ***selection effect*** operates through firm exit; where the profits of the least efficient firms' become negative and forces them to exit the market.

This output will be provided by the remaining, higher PCM, firms *ceteris paribus*.

The overall impact of an increase in competition on the industry average PCM depends on the balance between reducing the PCM of all firms and reallocating output to those with higher PCMs.

Figure 1 demonstrates the relationship between changes in competition and firm's profitability. For this we consider the case where a firm's efficiency is the inverse of their relative productivity. There is a positive relationship between profitability and productivity at the initial level of competition. The slope reflects the intensity of competition; a steeper slope indicates fiercer competition. The effect of an increase in competition is to increase its slope and rotate the curve anticlockwise (from I to II). This rotation of the curve is the reallocation effect. More efficient and therefore relatively more productive firms earn greater profits and greater market share. Firms with low productivity earn relatively lower profit, with the least productive firms exiting the market (selection effect).

Figure 1: Profit-productivity Curve



Boone (2000, 2008) has presented a new measure of competition, based on the relative profits of firms measuring the sensitivity of profits to changes in competition relative to firm's efficiency.

Consider the case where there are two firms in the market with profit defined as $\pi(\eta)$ with the firms having different level of efficiency, η, where $\eta' > \eta$. The *Relative Profit Difference* is the ratio of the profits of the more efficient to the less efficient firm:

(3) $$RPD = \frac{\pi(\eta')}{\pi(\eta)}$$

The Relative Profit Difference (RPD) can measure the impact of competition via its impact on the relative profits of the two firms. If competition increases, say through another firm entering the market, the RPD will increase. This is because as firms respond to the increase in competition, this will reduce the profits of the more efficient firm by less than inefficient firm. This results in profits being reallocated from the less efficient firm (η), to the more efficient firm (η').

From Relative Profits to Profit Elasticity

The RPD measure is a two-way comparison of firms. Under certain conditions, an increase in competition will always result in all pairwise comparisons of more- to less-efficient firms yielding and increase in relative profitability. Less-efficient firms are hit harder.

Boone et al (2005) extended this concept to a more general, industry-wide measure of competition, *Profit Elasticity* (PE). PE measures the sensitivity of *profits* to changes in marginal cost and as such is similar to the competition measure introduced in Hay and Liu (1997). When competition increases, inefficient firms take a greater decrease to profits than more efficient firms. The advantages of this measure are that, under certain assumptions, it is monotonic in competition and requires the same data as the other methods. These assumptions include firms being completely symmetric except for their marginal cost levels. Boone (2000, 2008) also assumes that firms choose their strategic variables simultaneously and independently.

The Profit Elasticity measure is calculated by running an OLS regression of firms' profits (π) on their average variable costs (avc):

(4) $$PE_{ij} : \ln(\pi_{ij}) = \alpha - \beta_j \ln(avc_{ij}) + \varepsilon_{ij}$$

where profit equals gross output of firm i, (y_i) less total variable cost (tvc_i) (labour costs and intermediate consumption), and average variable costs are equal to total variable cost (tvc_i) divided by gross output. That is:

(5) $$PE_{ij} : \ln(y_{ij} - tvc_{ij}) = \alpha - \beta_j \ln\left(\frac{tvc_{ij}}{y_{ij}}\right) + \varepsilon_{ij}$$

PE measures how a change in marginal cost causes a change in profits of firms in an industry j. The relationship is such that in a competitive market more efficient firms are better able to exploit their advantage over inefficient firms implying efficient firms earn relatively more profit than inefficient firms (reallocation effect).

The β coefficient (sometime known as the Boone Indicator) estimates the elasticity of profits to changes in cost. β is expected to be negative, indicating that as average costs increase, profits of the firm will decrease. In a more competitive market, β will be more negative as profits are more sensitive to similar changes in average costs.

Boone (2000) provides two key advantages of this measure over other competition measures (under the assumptions outlined above). First, PE is monotonic with competition. As competition intensity increases, the negative relationship between average cost and profit becomes stronger. PE is robust to the ambiguity of the reallocation effect. Other measures such as the PCM and the HI are not. Second, PE can also be derived from the same data as other measures.

There are several assumptions underlying the PE measure that can make it potentially subject to bias (Schiersch and Schmidt-Ehmcke 2010). First, given that the indicator measures competition based on efficiency, it assumes that we are able to rank firms based on their efficiency (assuming a direct relationship between efficiency and cost). Second, the indicator assumes symmetry in the market. This means that firms respond the same way to changes in competition given their relative efficiency, 'firm i's profits are the same as firm j's profits would be if firm j was in firm i's situation' (Athey and Schmutzler 2001). This relationship is represented by the upward sloping curve of Figure 1. This is to ensure that the results are due to changes in competition, and not due to changes to the industry structure.

This theoretical ambiguity is reflected in a number of empirical studies. Several studies have compared competition measures. Generally they have found some correlation between PE and PCM. However, there is low correlation with either or both of these and previously popular measures such as the Herfindahl index (Boone *et al.*, 2005; Boone *et al.*, 2007; Creusen *et al.*, 2006; Maliranta *et al.*, 2007 and Stevens 2009).

4. Data and model

The data used in this paper comes from the Statistics New Zealand's prototype Longitudinal Business Database (LBD). The LBD is built around the Longitudinal Business Frame (LBF), which matches different data sources such as financial accounts (IR10), Goods and Services Returns (GST) provided by the Inland Revenue Department (IRD) and survey data such as the Annual Enterprise Survey (AES). The full prototype LBD is described in full detail in Fabling, Sanderson and Stevens (2008) and Fabling (2009).

The data used has three sources: Annual Enterprise Survey (AES), Business Activity Indicator (BAI) dataset, and IR10 forms. AES is the primary source for the variables of interest and is supplemented with data from the BAI or IR10 when missing. The firms are linked, starting in 2000 and at present continuing through 2009, allowing the tracking of individual firm performance over time. We have corrected for the discontinuity in firm identifiers based on the employment continuity rules (see Fabling, 2011).

Industries have been defined by ANZSIC 4-digit industries. This is standard for analyses such as this. However, it is clearly not perfect. Industries are defined according to methods of production. Markets can be defined according to products and/or firms as well as geographic extent. This is not issue that can be readily solved with the data at hand, but should be born in mind when interpreting the results.

Our analysis is restricted by the confidentiality issues around the data that are upheld by the data guardian, Statistics New Zealand. Information based on very small industries and/or those that are dominated by very few firms are not able to be released. This is to protect the identities and information on participants in that industry. When considering issues of competition, it is often these industries where there are a small number of dominant players where there could be the most

interesting results. The focus of this study is the degree of competition in the New Zealand economy, not to study specific markets.

In this paper we use two measures of competition for industry level, the share-weighted price-cost margin and the profit elasticity measure.

Recall that price cost-margin is calculated as follows:

(6) $$PCM_j = \sum_i \left(\frac{p_i - c_i}{p_i} \times s_i \right)$$

where p_i is the price of firm i's output, c_i its marginal cost and s_i the firm's market share in industry j.

The problem one faces with implementing this measure, however, is that marginal costs (and in many cases, prices) are seldom observed in practice. Thus, in order to calculate it we use average variable costs (and introducing time subscripts):

(7) $$PCM_{jt} = \sum_{i \in j} \left(\frac{p_{it} - c_{it}}{p_{it}} \times s_{it} \right) \approx \sum_{i \in j} \left(\frac{y_{it} - ic_{it} - w_{it}}{y_{it}} \times s_{it} \right)$$

where y_{it} is gross output at time t, ic_{it} is intermediate consumption, w_{it} is labour cost, s_{it} is the firms market share of the industry.

The estimates of the price elasticity of profits (PE) come from a set of industry-year OLS regressions of the form:

(8) $$PE_{jt} : \ln\left(y_{ijt} - tvc_{ijt}\right) = \alpha_{jt} - \beta_{jt} \ln\left(\frac{tvc_{ijt}}{y_{ijt}} \right) + \varepsilon_{ijt}$$

where total variables costs (tvc_i) are the sum of intermediate consumption and wage costs.

5. Results

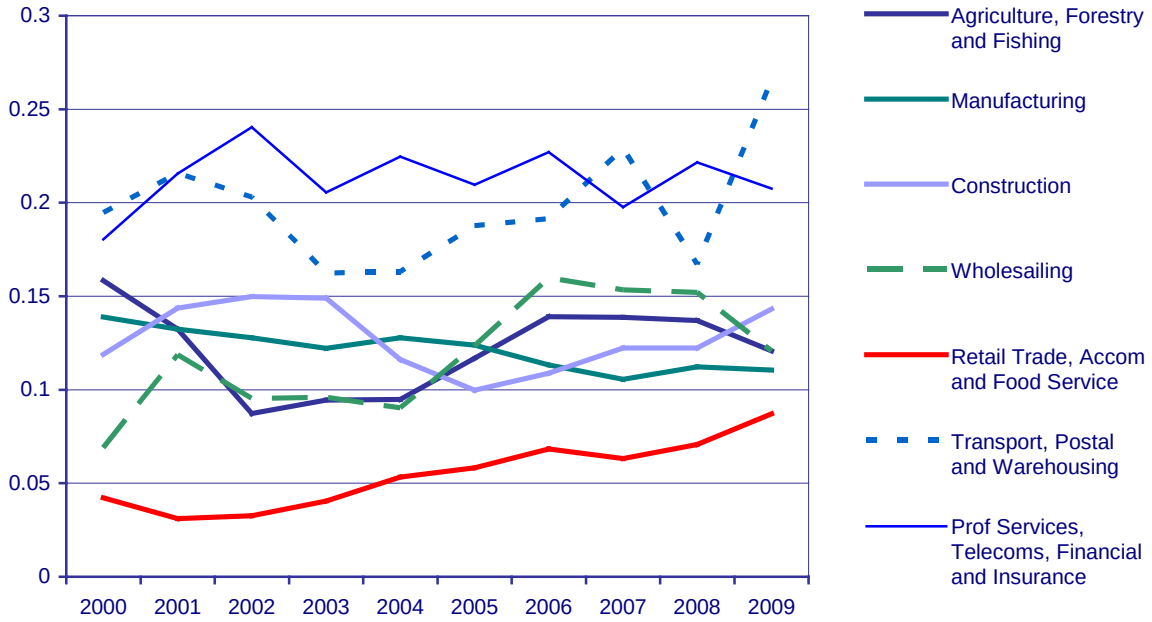
5.1. Competition in New Zealand Industries, 2000 - 2009

In this section we look at competition in New Zealand industries, both how they compare across broad sectors and how they have changed over time.

Figure 2 summarises the 4-digit industry PCMs at the 1-digit level. The least competitive sectors from the perspective of the PCM of the sub-industries are the

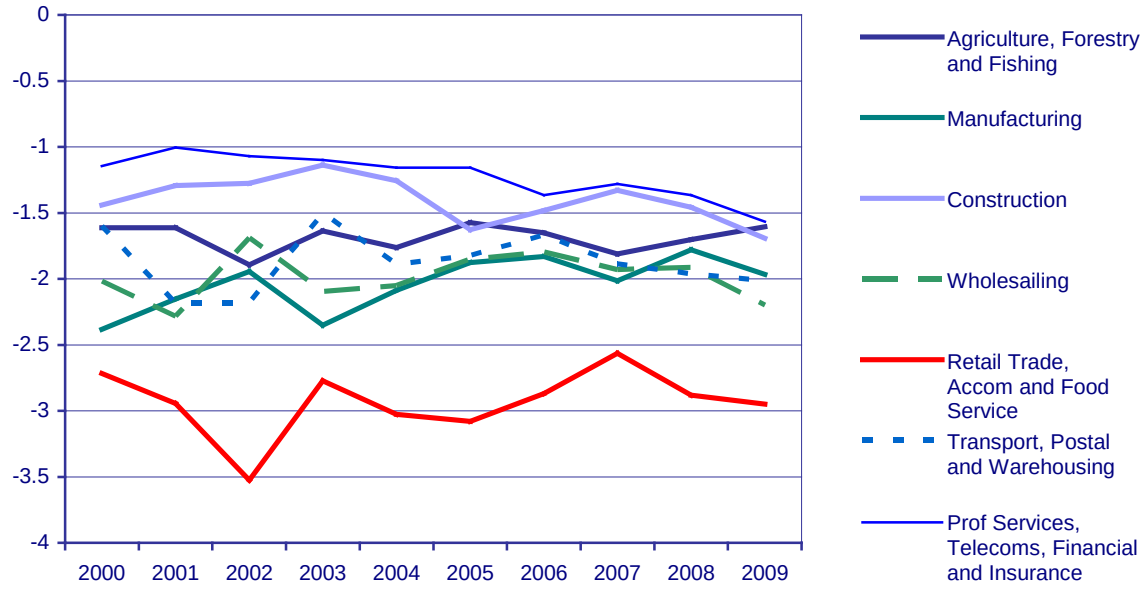
'Professional services, Telecommunications, and Finance and Insurance Services' and the 'Transport, Postal and Warehousing' sectors. The mark-ups in the 'Transport, Postal and Warehousing', 'Wholesaling' and 'Agriculture, Forestry and Fishing' sectors appear to follow a similar cycle over the decade. That of the 'Construction' sector follows a similar cycle, but an opposite direction, with mark-ups rising in the early part of the decade and falling in the latter. Finally, the PCM in the 'Retail Trade, Accommodation and Food Service' industries appear to have experienced a secular increase. Nevertheless, the level of competition implied by this measure is still higher than in the other sectors.

Figure 2: New Zealand industry average PCM (2000-2009)



'Retail Trade, Accommodation and Food Services' still appears to be the most competitive sector, when we consider PE (Figure 3). There is less evidence, however, of the decline of competition in these industries. 'Professional services, Telecommunications, Financial and Insurance Services' is still one of the sectors with the lowest levels of measured competition, although there is some evidence of an improvement in the degree of competition. However, the industries in the 'Transport, Postal and Warehousing' look rather more competitive when we use the PE measure than that indicated by the PCM. Conversely, the 'Construction' industries look rather less competitive using the PE than they do with the PCM

Figure 3: New Zealand industry average PE (2000-2009)



One important caveat to the above discussion is that we are implicitly assuming that the changes in the level of competition in a 1-digit industry sector reflect the changes in the underlying 4-digit industries. It may also be the case that it is changes in the relative sizes of the component industries that are driving the aggregate results. Competition in the 1-digit industry may occur because the component industries are becoming more competitive, or it might occur because the more competitive industries are growing. For example, in their study of competition in the Netherlands, Creusen *et al*. (2006a) show that the changes in economy-wide competition they observe are due to partly a shift in the industry structure towards less competitive industries.

We now turn our attention to *changes* in competition in the underlying industries. Figure 5 and Figure 6 show how competition has changed across New Zealand 4-digit industries over the 2000-2009 period. As competition increases firms' ability to mark-up decreases (↓PCM), but the sensitivity of profits to costs increases (↑PE). Therefore a negative change in PCM indicates an increase in competition whereas a positive change in PE indicates an increase in competition.

Figure 4: Distribution of change in PCM by industry (2000-2009)

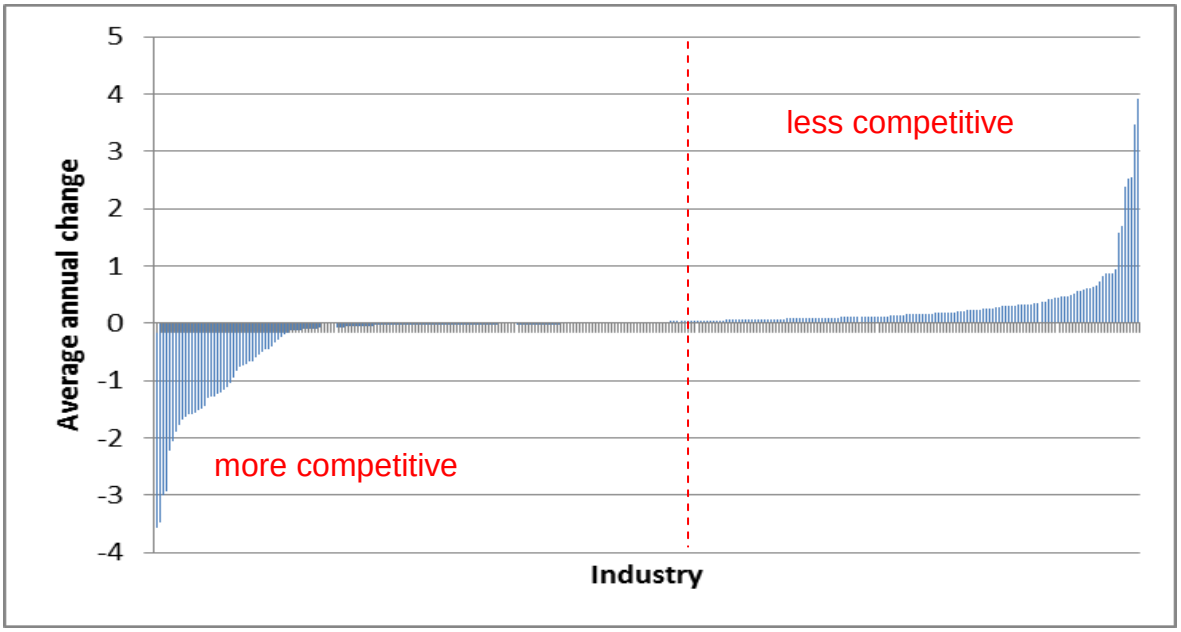
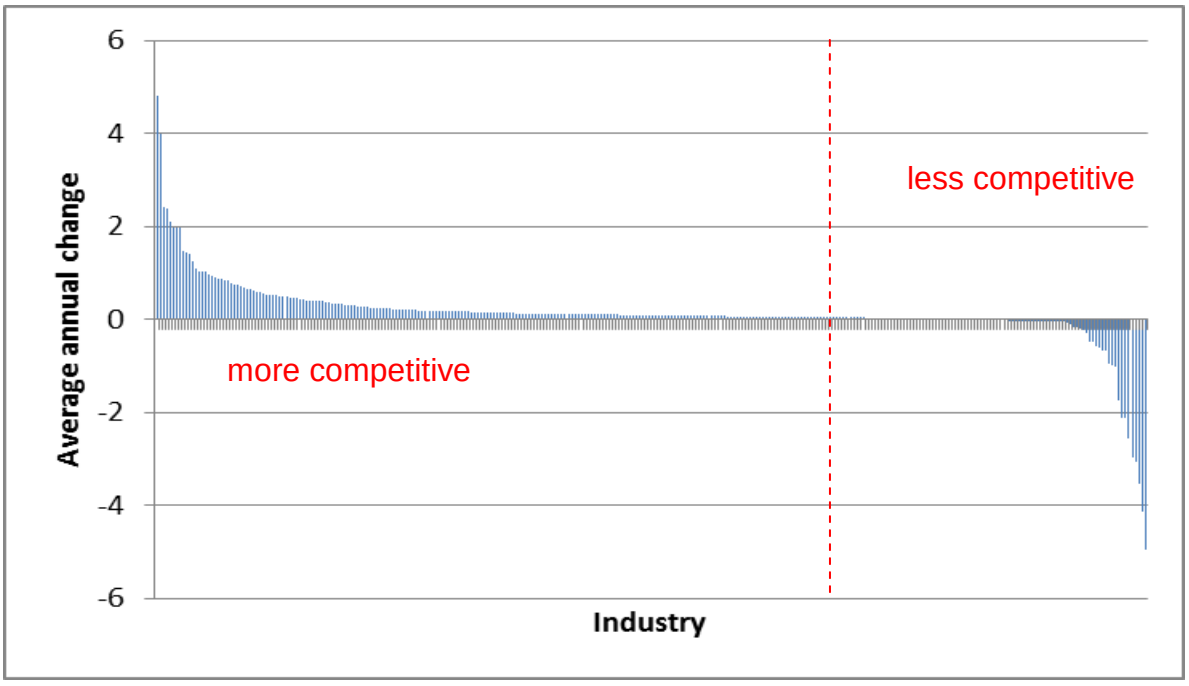


Figure 5: Distribution of change in PE by industry (2000-2009)



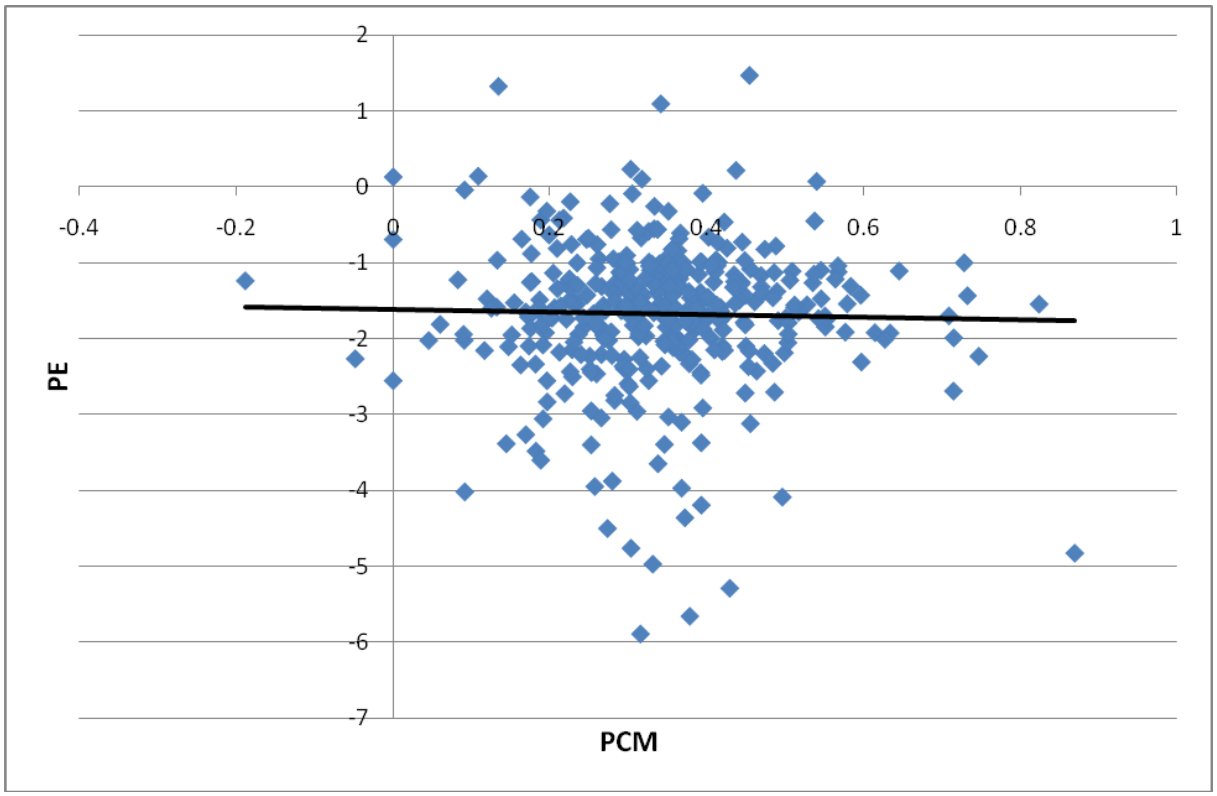
Both measures suggest that there is a group of industries that appear to have experienced a positive shock to competition. This group of industries appears to be larger when considering PE. This shock seems to have affected the sensitivity of profits to costs by more than it has affected the average mark-ups.

These measures tell us a similar story at an aggregated level. However, in some sectors PE and PCM differ markedly, both for levels and trends. Therefore, in the next section we directly compare the predictions of both methods at the 4-digit level industries.

5.2. Comparison of competition measures

In this section, we compare the two competition measures to further investigate the consistency of their predictions. We have seen that in theory, whilst they would often be negatively related to each other – as competition increases firms' ability to mark-up decreases (↓PCM), but the sensitivity of profits to costs increases (↑PE) – they may also be positively correlated (i.e. PCM indicating a decrease in competition and PE an increase). Figure 6 shows a negative relationship between PCM and PE.

Figure 6: PCM and PE over New Zealand Industries (2000-2009)



The difference in these two measures reflects the fact that in some industries the reallocation effect dominates or those inefficient firms are forced to leave the market. PE is monotonic to competition regardless of the reallocation effect of market share. If the reallocation effect is large PCM will incorrectly report the intensity of competition. We expect reallocation effect to dominate in industries with already high concentration and small number of dominant firms or where there is greater

dispersion in efficiency. This lack of coherence in the indicators has been also found by others (Boone *et al.*, 2005; Boone *et al.*, 2007; Creusen *et al.*, 2006; Maliranta *et al.*, 2007).

Creusen *et al.* (2006a) discuss the economic concepts behind why these measures contradict. Higher dispersion in efficiency levels across firms in an industry creates a greater increase in the reallocation effect. Higher levels of product substitutability also increase the reallocation effects. Higher rate of entry into the market increasing firm size may also lead to increased competition, however, incorrectly identify competition by PCM.

6. Conclusion

In this paper we have considered the measurement of competition both from a theoretical and an empirical perspective. In particular, we have examined two measures of competition – the Price-Cost Margin and the Profit Elasticity recently developed due to Boone (2000, 2008). The latter is claimed to be robust to the effects of reallocation and selection that afflict more traditional measures used in the empirical analysis of competition. We calculate these two measures for a wide range of industries in New Zealand using the prototype Longitudinal Business Database.

The two indicators of competition explored here show that competition in New Zealand has increased between 2000 and 2009. There is considerable heterogeneity in the experiences of individual industries. Nevertheless, in aggregate competition appears to have increased, particularly in recent years; it is possible that the recent financial crisis has created a more competitive environment where inefficient firms are forced to exit from the market.

We have found that the two competition indicators often contradict each other. Theoretically this is the case if outputs or profits are reallocated in the market to more efficient firms or inefficient firms are forced from the market. The interesting puzzle about this is what a large reallocation of selection effect means for the New Zealand market. Is it the lack of scale in the market or the large turnover of firms that could drive this result? Further work in this area we will look at how the determinants of competition such as entry and exit of firms and competition with imports.

References

Acemoglu, D., Aghion, P., and Zilibotti, F., (2003), 'Vertical Integration and Distance to Frontier' *Journal of the European Economic Association*, Vol. 1, No. 2-3, pp. 630-638.

Aghion, P, Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2005), 'Competition and Innovation: An Inverted-U Relationship', *The Quarterly Journal of Economics*, 120(2), pp. 701-728. Aghion, P, and Griffith, R. (2006), *Competition and Growth: Reconciling Theory and Evidence*, MIT Press.

Aghion, Philippe, and Peter Howitt, (1992), 'A Model of Growth through Creative Destruction', *Econometrica*, 60(2), pp. 323-51.

Athey, S., and Schmutzler, A. (2001). Investment and marlet dominance. *RAND Journal of Economics.* 32(1), 1-26.

Boone, J., (2000), 'Competition', Centre for Economic Research Working Paper Series No. 2636. Boone, J., (2008), 'A new way to measure competition', *The Economic Journal.* 118, 1245-1261.

Boone, J., Griffith, R. and Harrison, R. (2005). *Measuring Competition*. AIM Research Working Paper No. 22.

Boone, J., van Ours, J. and van der Wiel, H. (2007). *How (not) to measure competition*. CPB Netherlands Bureau for Economic Policy Analysis, No. 91.

Creusen, H., Minne, B. and van der Wiel, H. (2006a). *Measuring Competition in the Netherlands*. CPB Netherlands Bureau for Economic Policy Analysis, CPB Memorandum No. 163.

Cairncross, F., (1997), *The Death of Distance: How the Communications Revolution Will Change Our Lives*, Harvard: Harvard Business School Press

Coyle, D., (1997), *Weightless World*, Princeton: Princeton University Press

Creusen, H., Minne, B. and van der Wiel, H. (2006b). *Competition in the Netherlands: An Analysis of thr period 1993-2001*. CPB Netherlands Bureau for Economic Policy Analysis,No. 136.

Devine, H., Doan, T., Iyer, K., Mok. P. and Stevens, P. (2011a). *The Dynamics of Competition in New Zealand*. Paper presented at the 2011 NZAE Annual Conference, Wellington.

Devine, H., Doan, T., Iyer, K., Mok. P. and Stevens, P. (2011b). *A Firm-level analysis of Competition, Innovation and Productivity in New Zealand*. Paper presented at the 2011 NZAE Annual Conference, Wellington.

Ely, R. T. (1901), 'Competition: its nature, its permanency, and its beneficence', Publications of the American Economic Association, 3rd series, 2.1, S. 55-70.

Evans, L., and Hughes, P., (2003), 'Competition Policy in Small Distant Open Economies: Some Lessons from the Economics Literature', Treasury Working Paper Series 03/31, New Zealand Treasury.

Fabling, R. (2009). 'A rough guide to New Zealand's Longitudinal Business Database', Global COE Hi-Stat Discussion Paper Series, Institute of Economic Research, Hitotsubashi University, Tokyo. Available online at http://gcoe.ier.hit-u.ac.jp/english/research/discussion/2008/gde09-103.html

Fabling, R. (2011). *Keeping it Together: Tracking Firms in New Zealand's Longitudinal Business Database*. MOTU Economic and Public Policy Research Working Paper 11-01.

Fabling, R., Grimes, A., Sanderson, L., and Stevens, P.A., (2008). 'Some rise by sin, and some by virtue fall: Firm dynamics, market structure and performance', Ministry of Economic Development Occasional Paper 08/01. Available online at http://www.med.govt.nz/templates/MultipageDocumentTOC____34197.aspx

Friedman, Thomas (2005), *The World is Flat*, New York: Farrar, Strauss and Giroux;

Gal, M.S., (2003), *Competition Policy for Small Market Economies*, Harvard University Press.

Gerschenkron, Alexander, (1962), *Economic Backwardness in Historical Perspective, a Book of Essays*. Cambridge: Belknap Press.

Griffith, R., Lee, S., and Van Reenen, J., (2007), 'Is distance dying at last? Falling home bias in fixed effects models of patent citations', CEPR Working Paper 6435.

Grossman, G., and Helpman, E. (1991). *Innovation and Growth in the World Economy*, Cambridge, MA: MIT Press.

Hay, D.A. and Liu, G.S. (1997), 'The efficiency of firms: What difference does competition make?', *The Economic Journal*, 107, pp. 597-617.

Keller, W., (2002), 'Geographic Localization of International Technology Diffusion', *American Economic Review*, 92.1, pp. 120-142

Lerner, Abba P., (1934), 'The Concept of Monopoly and the Measurement of Monopoly Power', *Review of Economic Studies*, 1.3, pp. 157-175.

Maliranta, M., Pajarinen, M., Rouvinen, P, and Yla-Anttila, P. (2007). *Competition in Finland: Trends across Business Sectors in 1994-2004*. Ministry of Trade and Industry Publications 13/2007.

Philip McCann (2009), 'Economic geography, globalisation and New Zealand's productivity paradox', *New Zealand Economic Papers*, Volume 43, Issue 3, pp. 279-314

McNulty, Paul J., (1968), 'Economic Theory and the Meaning of Competition', *The Quarterly Journal of Economics*, 82.4, pp. 639-656

MED, Treasury and SNZ, (2011), *Economic Development Indicators*, Ministry of Economic Development, The Treasury and Statistics New Zealand.

Nickell, S.J. (1996). Competition and Corporate Performance. *Journal of Political Economy, 104*(4).

Romer, Paul M, (1990), 'Endogenous Technological Change', *Journal of Political Economy*, vol. 98(5), pages S71-102.

Schiersch, A. and Schmidt-Ehmcke, J. (2010). *Empiricism Meets Theory: Is the Boone-Indicator Applicable?* DWI Berlin Discussion Papers No. 1030.

Stevens, P. (2009). *Competition in New Zealand: An analysis using micro data.* Paper presented at the 2009 NZAE Annual Conference, Wellington.

Stigler, George J., (1957), 'Perfect Competition, Historically Contemplated', *Journal of Political Economy*, 65, pp.1-17

Thompson, Peter (2006), 'Patent Citations and the Geography of Knowledge Spillovers: Evidence from Inventor- and Examiner-Added Citations', *Review of Economics and Statistics*, 88 (2), pp. 383-389

Appendix A1. Data Appendix

The source of our data is the prototype Longitudinal Business Database (LBD). The full LBD is described in more detail in Fabling, Grimes, Sanderson and Stevens (2008) and Fabling (2009).

A1.1 Data

Annual Enterprise Survey (AES)

The Annual Enterprise Survey (AES) is Statistics New Zealand's primary data source for the production of National Accounts, providing the benchmark for estimating value added. The survey covers all large firms, with a stratified sample for smaller firms and has industry specific questions in order to accurately measure aggregated GDP.

IR10

IR10s are essentially a set of company accounts composed of profit and loss statements and a balance sheet Included is information on sales (and other income) and purchase, as well as detailed breakdown of expenditure including depreciation, R&D costs and salaries and wages. Balance sheet items include fixed assets (vehicle; plant and machinery; furniture and fittings; land and buildings; and other), liabilities (current and term) and shareholders' funds.

Business Activity Indicator (BAI)

The Business Activity Indicator (BAI) is derived from GST data including sales and purchases collected by the Inland Revenue Department (IRD). Statistics New Zealand create the BAI by temporally apportion the GST data down to a monthly frequency, apportion returns across GST group members, and apply limited imputation where a single return is missing.

Sales

The sales data in the BAI relate to 'Total sales and income for the period (including GST and any zero-rated supplies).' This is adjusted to an ex-GST basis using data on zero-rated sales as follows

$$S_E = \frac{8}{9}(S_I - Z) + Z$$

where S_E = Sales excluding GST, S_I = Sales including GST, Z = zero rated sales.

Purchases

The purchases data in the BAI also come from the Goods and Services Tax return form, GST 101. They relate to 'Total purchases and expenses (including GST) for which tax invoicing requirements have been met' and include an estimate for imported goods and the use of private goods and services in taxable activity adjusted by 8/9.

Linked Employer-Employee Data (LEED)

Linked Employer-Employee Data (LEED) is constructed by Statistics New Zealand from IRD Pay-As-You-Earn (PAYE) returns for employees. LEED variables are aggregated to the firms level for confidentiality reasons. It is generally assumed by researchers that missing employment data implies zero employees on the grounds that personal income tax non-compliance is negligible in the population of firms that comply with mandatory GST. Variables available include counts of employers (on an annual firm level basis) and employees (on a monthly plant level basis). Summary characteristics are available by gender, and age-band breakdowns, tenure distributions of employees and summary measures of wage distribution within the firm.

Employees

Employment is measured using an average of twelve monthly PAYE employee counts in the year. These monthly employee counts are taken as at 15th of the month. This figure excludes working proprietors and is known as Rolling Mean Employment (RME).

Working proprietors

The working proprietor count is the number of self-employed persons who were paid taxable income during the tax year (at any time). In LEED, a working proprietor is assumed to be a person who (i) operates his or her own economic enterprise or engages independently in a profession or trade, and (ii) receives income from self-employment from which tax is deducted.

From tax data, there are five ways that people can earn self-employment income from a firm:

- As a sole trader working for themselves (using the IR3 individual income tax form [this is used for individuals who earn income that is not taxed at source]);
- Paid withholding payments either by a firm they own, or as an independent contractor (identified through the IR348 employer monthly schedule);
- Paid a PAYE tax-deducted salary by a firm they own (IR348);

- Paid a partnership income by a partnership they own (IR20 annual partnership tax form [this reports the distribution of income earned by partnerships to their partners] or the IR7 partnership income tax return);
- Paid a shareholder salary by a company they own (IR4S annual company tax return [this reports the distribution of income from companies to shareholders for work performed (known as shareholder-salaries)]).

Note that it is impossible to determine whether the self-employment income involves labour input. For example, shareholder salaries can be paid to owner-shareholders who were not actively involved in running the business. Thus there is no way of telling what labour input was supplied, although the income figures do provide some relevant information (a very small payment is unlikely to reflect a full-year, full-time labour input).

A1.2 Variables and Source

y_{it}	Gross Output	AES supplemented with IR10 and BAI	NZ$ (constant 2009)
ic_{it}	Intermediate Consumption	AES supplemented with IR10 and BAI	NZ$ (constant 2009)
w_{it}	Wage Costs	LEED	NZ$ (constant 2009)