Competition in New Zealand: An analysis using micro data

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Abstract

Understanding the relationship between competition and economic performance is critical to developing government policy and regulation to support a dynamic and growing economy. Recently it has been suggested that there exists an inverted U-Shaped relationship between competition and economic performance. Up to a certain point, increased competition stimulates more innovation as firms try to escape competition. However, innovation is often a costly activity and so requires the prospect of rents in order to be undertaken. Thus, it may be that in some sectors competition impedes innovation and growth, as Schumpeterian effects dominate and post-innovation rents are competed away. We currently have little or no information of the degree of competition in the majority of the sectors of the NZ economy and much less still of how this compares with other economies. This paper uses a rich source of information, the prototype Longitudinal Business Database, to examine the nature and extent of competition in New Zealand. Unlike most other studies in this area internationally, we have information on essentially the whole population of economically significant firms. Another innovation is that we have information on firms own perception of competition in a subset of firms.

JEL Classifications:

Keywords: Micro data; competition: firm performance;

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Access to the data used in this study was provided by Statistics NZ in accordance with security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular, business or organisation. The results in this paper have been confidentialised to protect individual businesses from identification.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information is published or disclosed in any other form, or provided back to Inland Revenue for administrative or regulatory purposes. Any person who had access to the unit-record data has certified that they have been shown, have read and have understood section 81 of the Tax Administration Act 1994, which relates to privacy and confidentiality. Any discussion of data limitations or weaknesses is not related to the data's ability to support Inland Revenue's core operational requirements.

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. Most economists believe that competition is an important determinant of economic performance and, hence, welfare. However, theory and evidence have not always been in accord. Recently, it has been suggested that there exists an inverted U-Shaped relationship between competition and economic performance. Up to a certain point, increased competition stimulates more innovation as firms try to escape competition. However, innovation is often a costly activity and so requires the prospect of rents in order to be undertaken. Thus, it may be that in some sectors competition impedes innovation and growth, as Schumpeterian effects dominate and post-innovation rents are competed away. We currently have little or no information of the degree of competition in the majority of the sectors of the NZ economy and much less still of how this compares with other economies. This paper uses a rich source of information, the prototype Longitudinal Business Database (LBD), to examine the nature and extent of competition in New Zealand.

In section 2 we consider why competition is considered important and present some methods suggested for measuring it. In section 3, we outline our method and in section 4, our data. In section 5, we present our results. Section 6 concludes.

2 Background

> 'The European Commission fined Intel a record 1.06 billion euros Wednesday for abusing its dominance in the computer chip market, the strongest sign yet that regulators worldwide are serious about opening the technology sector to competition'.
>
> New York Times 13 May 2009.

> 'As Richard Caves remarks, economists have a "vague suspicion that competition is the enemy of sloth" (Caves, 1980, p.88)'.
>
> Nickell (1995), p. 66.

Competition is important, but it is not always clear precisely what is meant by it. As the first quotation shows, many governments and inter-government agencies think

that a lack of competition is very bad for citizens' welfare. As the second quotation illustrates, whilst many economists think it is one if not the most important factors in the performance of economies, theories of what competition actually is and how it operates are often unconvincing, piecemeal and/or contradictory.

2.1 What is competition?

Nickell (1995) asks the question 'how does competition work?' and comes up with two broad mechanisms: managerial (and staff) effort, and its effects on innovation. The first is the essentially view that competition improves performance in static (efficiency) terms, the second relates to the dynamic context[1]. Nickel noted, however, that theory was ambiguous on the direction of the effect of competition in either of these contexts and evidence was sketchy. Whereas work like Vickers (1992) show that competition tends to raise managerial effort and hence company performance, Martin (1995) shows that a reduction in demand associated with an increase in the numbers of competitors. Similarly, whereas Porter (1990) strongly argues for the role in competition in promoting innovation, Schumpeter (1943) and subsequent writers such as Aghion and Howitt (1992) and Grossman and Helpman (1991) suggest that competition lowers both the rents from which innovative activity can be funded and the post innovation rents, the hope of which stimulates such activity.

This conclusion was mirrored ten years later in Aghion and Griffith (2006). The work of these two authors, with various other co-authors[2] brought the two alternative views together into a framework whereby the relationship between competition and outcomes is U-shaped. That is, by allowing the first derivative of economic performance with respect to competition to be both positive and negative at different points. Policy, therefore, depends crucially upon where we are on the competition-performance schedule.

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[1] Tirole (1988) concludes something similar when he considers the strategic interaction of firms in a game-theoretic industrial organisation framework. He classifies the many instruments firms use to compete in a market according to the speed at which they can be altered. In the short run, firms compete by altering their price, advertising and sales effort. In the medium term firms can change their cost structures and product characteristics (within given cost and production sets – technology, in economics parlance). Finally, in the long run, the product characteristics and the cost structures themselves (i.e. shift the frontier of the production and cost sets) can be changed through research and development (p. 205).

[2] E.g. Aghion, Bloom, Blundell, Griffith and Howitt (2002, 2005), Aghion, Griffith and Howitt (2006a and 2006b).

2.2 Competition in New Zealand

New Zealand is generally thought to have a good competition environment. It has sound competition law plus it has very low barriers to international trade and investment (Crawford, 2006). Crawford summarises the (sparse) economic literature on competition in New Zealand as falling into three main categories, or mixes of them:

- expert commentary on the application of competition policy in particular cases
- descriptive statistics on characteristics of New Zealand industry relevant to competition policy (of which he lists none)
- econometric studies (of which he lists just one: Fabling and Grimes, 2006)

This current paper sits in the second category, although as the first part of a two-year study that will include work that is firmly in the latter category.

2.3 Measuring Competition

The difficulties economists have defining precisely what competition is and how it works mean that there are many ways in which it might be measured. Since competition is essentially a process, we can divide the groups of potential measures into three that relate to the causes of competition being as it is, the activities that take place in the act of competing and the outcomes of competitive behaviour[3]:

Figure 1

Of course the world is seldom as simple as this. Outcomes of one 'round' of competition can be the strategic instruments in a longer game. Thus, a particular level of innovation may be the outcome of a competitive process, but as many authors have

[3] This three-way split is very much in the spirit of the structure-conduct-performance paradigm. See Sawyer (1985) for a critique and Nickell (1996) for an apology of sorts.

noted, innovation itself is a means whereby firms seek to compete (or indeed escape from competition).

Aghion and Griffith (2006) divide the determinants of competition into two: entry deterrents and the substitutability of products. Barriers to entry include patents and economies of scale (i.e. high fixed-costs). A literature matching patents to firm performance has recently grown up. However, whilst this is fine when using patents as a measure of innovative activity, it is often not clear which ones are actually active – i.e. relate to products being produced in the market. Such, measures may be useful in studies of single (or few) markets; as a general measure they are both resource-intensive to construct and suffer from problems of comparability across sectors and technologies (something other measures are not immune to either, of course).

Below we set out a section of the more popular measures of competition.

Concentration Ratio

Perhaps the simplest measure of a market's competitiveness is the concentration ratio. 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:

$$C_j^k = \frac{\sum_{l=1, l\in j}^{k} Sales_l}{\sum_{i\in j} Sales_i} \quad (1)$$

The downsides of this measure are threefold. First, it does not account for the competitive pressures from outside New Zealand, beyond the market for domestic firms (i.e. FDI). Imports are an important element in many markets. Second, it suffers from the problems of defining the extent of the market in terms of product or services. Such measures are based on industry classifications. Not only are these based on methods of production, rather than on products or services, but firms are assigned to an industry by some measure of predominance (e.g. sales). Third, the choice of the number of firms to include in the measure is essentially arbitrary, albeit informed by experience.

Market Share

Market share is a measure of the competitive pressure from the perspective of the firm. It is given simply by:

$$mksh_i = \frac{Sales_i}{\sum_l Sales_l} \text{ where } i, l \in j \quad (2)$$

Again, we come up against the problems of the definition of the market and the problems outlined above.

Herfindahl Index

Named after Orris C. Herfindahl[4], the *Herfindahl Index* is defined as the sum of the squares of the market shares of firms within the industry[5], where the market shares are expressed as percentages. The result is proportional to the average market share, weighted by market share

$$H = \sum_i mksh_i^2 \quad (3)$$

Many jurisdictions use the Herfindahl Index to determine whether mergers are detrimental to welfare. Take for example, the Antitrust Division of the United States Department of Justice. According to the 1992 Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission[6], the agencies will regard a market in which the post-merger Herfindahl Index is below 0.1 as 'unconcentrated'. Those between 0.1 and 0.18 are considered to be 'moderately concentrated', and those above 0.18 are considered 'highly concentrated'. A merger potentially raises 'significant competitive concerns' if it produces an increase in the Herfindahl Index of more than 0.01 points in a moderately concentrated market or more than 0.005 points in a highly concentrated market. A merger is presumed 'likely to create or enhance market power or facilitate its exercise' if it produces an increase in the Herfindahl Index of more than 0.01 points in a highly concentrated market'[7].

[4] Also called the Herfindahl-Hirschman after Albert O. Hirschman
[5] This is sometimes limited to the top 50 firms, since once we get below the fiftieth largest firm, its squared market share is getting very small indeed.
[6] See U.S. Department of Justice and the Federal Trade Commission, *Horizontal Merger Guidelines* http://www.usdoj.gov/atr/public/guidelines/horiz_book/hmg1.html
[7] http://www.unclaw.com/chin/teaching/antitrust/herfindahl.htm

Similarly to the concentration ratio, the Herfindahl Index suffers from excluding an international dimension and problems defining the market in terms of a particular industry.

Price Cost Margin

In their investigation of various competition measures, Boone *et al*. (2005) also consider two more measures of competition. The first is the weighted price cost margin, or the gross profit margin:

(4) $$PCM_j = \sum_{i \in j} s_i \frac{Sales_i - TVC_i}{Sales_i}$$

The price-cost margin has the advantage over the concentration ratio and Herfindahl index in that by looking at the outcome of competition, irrespective of source, on domestic firms, it does not exclude the international dimension to competition in New Zealand. However, it does still rely on a definition of the market.

Lerner Index

Authors such as Nickell (1996) and Aghion *et al.* (2005) prefer to use a measure of rents called the *Lerner Index* as a measure of product market competition. This measure of market power was formalized by Lerner (1934) and is equivalent to the inverse of the formula for elasticity of demand in the case where price, p, is set to maximise profits. Formally it is given by:

(5) $$L = \frac{p - mc}{p}$$

where p = the market price set by the firm and mc is its marginal cost.

The Lerner Index is often preferred to market based measures such as the Herfindahl index as a firm-level measure of competition because it does not rely directly on defining the extent of the market, geographically or in terms of products. Of course, this is fine for individual firms (i.e. answering the questions: 'how much competition is this firm subset to?' Or, rather, 'what is its impact?'), but once we start asking how competitive markets are, we come to the problem of defining a market in order to aggregate. Still, it might well be argued that the question of how competitive

is New Zealand, could still be answered by such a measure, no matter how one calculated the figure at the sub-aggregate level.

Prices and marginal costs are difficult to observe. Therefore, empirical applications tend to use alternative definitions. Nickell (1996) uses the following measure:

$$\frac{\Pi + D + IP - C \cdot K}{VA} \tag{6}$$

where Π = profits before tax, D = depreciation, IP = interest payments, C = cost of capital, K = capital stock. The cost of capital is equal to

$$rr + \delta + \lambda\rho\,. \tag{7}$$

where rr is the real interest rate, δ the rate of depreciation, ρ is the risk premium, and λ is a weight ($0 \leq \lambda \leq 1$). The real interest rate is taken by Nickell to be equal to the annual real gross redemption yield on 2 percent Treasury index linked 1996 securities. The depreciation rate, δ, is assumed to be constant at 4 percent. The risk premium, ρ, is equal to the firm's average stock market return over the period 1972-86 less the average short-term interest rate over the same period. The three rent variables used in Nickell (1996) correspond to $\lambda = 0$, $\lambda = 1$ and λ = shareholders' funds divided by the sum of shareholders' funds, debentures, bank loans, other loans, bank overdrafts, acceptance credits and short-term borrowings. That is $\lambda \approx$ equity/(equity + debt).

Aghion *et al.* (2005) use the following measure based on operating profits n and an estimated financial cost of capital, divided by sales:

$$L_A = \frac{\Pi' - FC}{Sales} \tag{8}$$

where Π' is operating profit net of depreciation and provisions[8], FC is financial cost. The cost of capital is assumed to be 0.085 for all firms and time periods and the capital stock is measured using the perpetual inventory method. In an earlier working paper version of this paper, the authors report a version of this excluding the financial cost variable (Aghion *et al.*, 2002), but note that there is little difference in their results using each method.

[8] This is the same as including depreciation and provisions in profits and then including them in the cost of capital, as in Nickell (1996).

To obtain an industry-level competition measure, Aghion *et al.* (2005) use the average of their Lerner Index:

$$COMP_{A,j} = 1 - \frac{1}{N_j}\sum_{i \in j} L_{A,i} \tag{9}$$

where *i* indexes firms, j indexes industry and N_j is the number of firms in industry *j*.

In this paper we do not consider the Lerner index, for technical reasons. This is, however, one of the 'next cabs off the block' as we develop the paper and the project.

3 Method

In this current paper we shall focus on three measures of competition: a firm's market share, the industry's concentration ratio and Herfindahl Index. We also consider the price-cost margin, but because of some problems with its calculation this is merely exploratory at this stage. In this initial study, we shall define market/industry by both four and three digit ANZSIC code. In later work we shall examine theoretically more preferable measures such as the Lerner Index and Boone *et al.*'s (2005) relative profits measure.

The precise definitions of these variables are as follows.

Concentration Ratio

We shall employ a five firm concentration ratio for the 3- and 4-digit (i.e. where *j* = the 3-digit or 4-digit industries:

$$C_j^5 = \frac{\sum_{l=1, l \in j}^{5} Sales_l}{\sum_{i \in j} Sales_i} \tag{10}$$

Sales is BAI Sales, adjusted to an ex-GST basis using data on zero-rated sales[9].

Market Share

Likewise, market share as in equation (2), with sales as measured above, and defined for both 3-digit and 4-digit industries (*mksh3* and *mksh4*, respectively).

[9] For more on this, see the Data Appendix.

Herfindahl Index

The Herfindahl Index is simply the sum of the squares of the market shares as set out in equation (3), again defined for both 3-digit and 4-digit industries (*mksh3* and *mksh4*, respectively).

Price Cost Margin

We estimate the price cost margin using the following simple calculation:

$$PCM_j = \sum_{i \in j} s_i \frac{Sales_i - Wages_i - Purchases_i}{Sales_i} \quad (11)$$

where *Sales* and *Purchases* come from the BAI and *Wages* is gross earnings from LEED. One problem with this measure is that it combines revenue and expenditure from two different sources. A simple alternative would be to use the IR10 financial accounts. However, this would reduce the sample size somewhat and in particular we would loose a number of larger firms[10]. Since a major element to the analysis of competitive behaviour is the presence or absence of large and potentially dominant firms in a market or industry, this would be a serious omission. In future work we will bring these sources together (along with data from the Annual Enterprise Survey, which is skewed towards larger firms to maximise the proportion of value-added and employment it covers) to generate more comprehensive measures of competition.

4 Data

The data come from Statistics New Zealand's Longitudinal Business Database (LBD). The LBD is built around the Longitudinal Business Frame (LBF), to which are attached, among other things, Goods and Services Tax (GST) returns, financial accounts (IR10) and aggregated Pay-As-You-Earn (PAYE) returns, all provided by the Inland Revenue Department (IRD). The full LBD is described in more detail in Fabling, Grimes, Sanderson and Stevens (2008). The survey data considered in this paper relate to the Business Operations Survey (BOS) 2005, 2006 and 2007[11].

The administrative data we use have four sources: counts of employees from PAYE returns, the Business Activity Indicator (BAI) dataset, and IR10 forms. The

[10] For more on this see Fabling, Grimes and Stevens (2008).
[11] For a fuller description of the BOS and a comparison of both quantitative and qualitative data in the BOS to alternative administrative sources, see Fabling, Grimes and Stevens (2008).

BAI is derived from GST data, with the main manipulations applied being temporal and group return apportionment and limited imputation for single missing returns. In this paper, the BAI is the source for data on sales of goods and services, and purchases. Financial accounts returns (IR10) are the source for information on opening and closing stock. In later work we will use more comprehensive and theoretically-correct measures of capital stock and value-added from the AES. The variables used in this paper are discussed in more detail in the data appendix.

5 Results

Our measures of competition are presented in Table 1 to Table 6. These are calculated at the 3- and 4-digit industry level and aggregated up to the 2-digit (ANZSIC sub-division) level to prevent the paper turning into one long table. We present separate tables for each measure (five-firm concentration ratio, Herfindahl index and price-cost margin) and for each definition of the 'market' (3- and 4-digit level). We present summary statistics – mean, median, upper and lower quartile, weighted by value-added – for the (3- and 4-digit) markets that make up the (2-digit) industry. Therefore, for the measures that take the market to be the 3-digit industry, the first row of the table – A01 Agriculture – is made up of six markets. These correspond to the 3-digit ANZSIC industry Groups: A011 Horticulture and Fruit Growing, A012 Grain, Sheep and Beef Cattle Farming, A013 Dairy Cattle Farming, A014 Poultry Farming, A015 Other Livestock Farming, and A016 Other Crop Growing. For measures that take the market to be the 4-digit industry, A01 contains 21 markets, corresponding to 4-digit industry Classes from A0111 Plant Nurseries to A0169 Crop and Plant Growing not elsewhere classified. Note that the figures are pooled over financial years 2000 – 2007, so that the mean represents the average of all industries over the entire period.

5.1 Concentration ratios

Our calculations of the proportion of total sales in a market accounted for by the five largest firms are set out in Table 1 and Table 2. The first thing we note is the considerable heterogeneity in the numbers. The average concentration ratio in sub industries varies from under 5% in A01 Agriculture to over 90% in a couple of the mining industries. As one would expect, the measures calculated at the 4-digit

industry are generally higher than those at the 3-digit level (there are a couple of exceptions, caused by our weighting by value added, which is sometimes negative[12]).

The 2-digit industries containing the most concentrated markets are: B15 Services to Mining, B13 Metal Ore Mining, D37 Water Supply, Sewerage and Drainage Services, I64 Air and Space Transport, and J71 Communication Services. Whilst the ordering changes when we define the market as the 3- or 4-digit industry, the top five remain the same. These all look like industries that potentially have large fixed costs. Theory suggests that industries with high fixed costs will be characterised by higher levels of concentration.

[12] Weighting by sales would ensure that 4-digit measures are always greater than or equal to3-digit measures, but value added gives a feel for the 'importance' of sub industries in economic terms.

Table 1 5-firm concentration ratio for 3-digit industry (2000-07)

ANZSIC 1996 Industry (Sub Division)		*N*	mean	P25	Median	P75
A01	Agriculture	76,353	0.033	0.010	0.038	0.038
A02	Services to Agriculture; Hunting and Trapping	7,602	0.144	0.141	0.141	0.141
A03	Forestry and Logging	6,282	0.389	0.389	0.389	0.389
A04	Commercial Fishing	2,718	0.264	0.272	0.272	0.272
B13	Metal Ore Mining	111	0.903	0.903	0.903	0.903
B14	Other Mining	246	0.338	0.252	0.252	0.252
B15	Services to Mining	105	0.914	0.923	0.923	0.923
C21	Food, Beverage and Tobacco	2,133	0.691	0.576	0.630	0.894
C22	Textile, Clothing, Footwear and Leather Manufacturing	2,766	0.396	0.239	0.343	0.480
C23	Wood and Paper Product Manufacturing	2,937	0.481	0.338	0.399	0.775
C24	Printing, Publishing and Recorded Media	2,802	0.350	0.307	0.307	0.401
C25	Petroleum, Coal, Chemical and Associated Product Manufacturing	1,488	0.528	0.434	0.643	0.671
C26	Non-Metallic Mineral Product Manufacturing	990	0.684	0.645	0.645	0.753
C27	Metal Product Manufacturing	4,290	0.438	0.174	0.174	0.866
C28	Machinery and Equipment Manufacturing	7,077	0.363	0.099	0.472	0.544
C29	Other Manufacturing	4,092	0.163	0.140	0.140	0.142
D36	Electricity and Gas Supply	66	0.729	0.769	0.769	0.769
D37	Water Supply, Sewerage and Drainage Services	78	0.811	0.811	0.811	0.811
E41	General Construction	19,470	0.254	0.145	0.145	0.414
E42	Construction Trade Services	31,656	0.094	0.051	0.118	0.118
F45	Basic Material Wholesaling	4,203	0.522	0.320	0.674	0.674
F46	Machinery and Motor Vehicle Wholesaling	6,951	0.177	0.134	0.134	0.134
F47	Personal and Household Good Wholesaling	11,505	0.261	0.150	0.159	0.416
G51	Food Retailing	12,936	0.282	0.243	0.243	0.321
G52	Personal and Household Good Retailing	22,983	0.297	0.109	0.188	0.263
G53	Motor Vehicle Retailing and Services	12,372	0.143	0.134	0.148	0.148
H57	Accommodation, Cafes and Restaurants	14,637	0.131	0.095	0.175	0.175
I61	Road Transport	10,494	0.125	0.076	0.076	0.076
I63	Water Transport	414	0.557	0.557	0.557	0.557
I64	Air and Space Transport	588	0.732	0.732	0.732	0.732
I65	Other Transport	216	0.288	0.288	0.288	0.288
I66	Services to Transport	3,051	0.250	0.195	0.195	0.195
I67	Storage	417	0.399	0.399	0.399	0.399
J71	Communication Services	4,305	0.823	0.895	0.895	0.895
K73	Finance	5,361	0.401	0.378	0.378	0.378
K74	Insurance	159	0.648	0.651	0.651	0.651
K75	Services to Finance and Insurance	5,016	0.239	0.220	0.255	0.255
L77	Property Services	73,968	0.110	0.059	0.059	0.149
L78	Business Services	61,812	0.235	0.152	0.163	0.355
N84	Health Services	3,066	0.200	0.107	0.107	0.349
O86	Community Services	13,722	0.113	0.033	0.033	0.189
O87	Motion Picture, Radio and Television Services	1,746	0.129	0.098	0.141	0.141
P91	Libraries, Museums and the Arts	2,646	0.695	0.281	0.890	0.890
P92	Sport and Recreation	4,188	0.215	0.151	0.151	0.250
P93	Personal Services	4,245	0.563	0.225	0.887	0.887

** N = Average number of firms in the 2-digit industry sub division over entire period*

** Counts of firms random-rounded to base 3 for confidentiality reasons*

3-digit measures summarised at the 2-digit level weighted by value-added

Table 2 5-firm concentration ratio for 4-digit industry (2000-07)

ANZSIC 1996 Industry (Sub Division)		*N*	mean	P25	Median	P75
A01	Agriculture	76,353	0.055	0.010	0.042	0.069
A02	Services to Agriculture; Hunting and Trapping	7,602	0.161	0.158	0.158	0.158
A03	Forestry and Logging	6,282	0.415	0.133	0.319	0.695
A04	Commercial Fishing	2,718	0.311	0.234	0.354	0.383
B13	Metal Ore Mining	111	0.803	0.953	0.953	0.953
B14	Other Mining	246	0.445	0.372	0.372	0.383
B15	Services to Mining	105	0.946	0.965	0.965	0.965
C21	Food, Beverage and Tobacco	2,133	0.813	0.655	0.885	0.976
C22	Textile, Clothing, Footwear and Leather Manufacturing	2,766	0.517	0.239	0.512	0.718
C23	Wood and Paper Product Manufacturing	2,937	0.589	0.417	0.417	0.969
C24	Printing, Publishing and Recorded Media	2,802	0.439	0.336	0.336	0.531
C25	Petroleum, Coal, Chemical and Associated Product Manufacturing	1,488	0.786	0.620	0.857	0.994
C26	Non-Metallic Mineral Product Manufacturing	990	0.814	0.795	0.857	0.857
C27	Metal Product Manufacturing	4,290	0.552	0.241	0.334	0.972
C28	Machinery and Equipment Manufacturing	7,077	0.531	0.283	0.607	0.861
C29	Other Manufacturing	4,092	0.276	0.115	0.230	0.359
D36	Electricity and Gas Supply	66	0.729	0.769	0.769	0.769
D37	Water Supply, Sewerage and Drainage Services	78	0.884	0.818	0.818	0.970
E41	General Construction	19,470	0.305	0.057	0.319	0.389
E42	Construction Trade Services	31,656	0.140	0.088	0.123	0.134
F45	Basic Material Wholesaling	4,203	0.615	0.402	0.717	0.922
F46	Machinery and Motor Vehicle Wholesaling	6,951	0.334	0.271	0.317	0.444
F47	Personal and Household Good Wholesaling	11,505	0.407	0.211	0.349	0.534
G51	Food Retailing	12,936	0.323	0.299	0.321	0.321
G52	Personal and Household Good Retailing	22,983	0.359	0.161	0.243	0.449
G53	Motor Vehicle Retailing and Services	12,372	0.169	0.097	0.142	0.142
H57	Accommodation, Cafes and Restaurants	14,637	0.131	0.095	0.175	0.175
I61	Road Transport	10,494	0.146	0.076	0.076	0.076
I63	Water Transport	414	0.710	0.708	0.708	0.708
I64	Air and Space Transport	588	0.846	0.858	0.858	0.858
I65	Other Transport	216	0.323	0.292	0.292	0.292
I66	Services to Transport	3,051	0.387	0.323	0.323	0.329
I67	Storage	417	0.402	0.400	0.400	0.400
J71	Communication Services	4,305	0.836	0.895	0.895	0.895
K73	Finance	5,361	0.382	0.378	0.378	0.378
K74	Insurance	159	0.684	0.679	0.679	0.679
K75	Services to Finance and Insurance	5,016	0.284	0.252	0.255	0.255
L77	Property Services	73,968	0.131	0.062	0.062	0.149
L78	Business Services	61,812	0.310	0.195	0.242	0.333
N84	Health Services	3,066	0.213	0.107	0.107	0.349
O86	Community Services	13,722	0.166	0.038	0.099	0.282
O87	Motion Picture, Radio and Television Services	1,746	0.181	0.098	0.147	0.147
P91	Libraries, Museums and the Arts	2,646	0.797	0.590	0.977	0.977
P92	Sport and Recreation	4,188	0.272	0.072	0.072	0.542
P93	Personal Services	4,245	0.620	0.234	0.618	0.995

** N = Average number of firms in the 2-digit industry sub division over entire period*

** Counts of firms random-rounded to base 3 for confidentiality reasons*

4-digit measures summarised at the 2-digit level weighted by value-added

5.2 Herfindahl indices

Our calculation of Herfindahl indices for 3- and 4-digit industries are summarised in Table 3 and Table 4, respectively. Again there is considerable heterogeneity in our measure across industries. The rankings of industries are similar to the concentration ratios, although this is not an identity. When we define the market as the 3-digit industry, the Herfindahl index yields the same top five industries in terms of concentration as the five-firm concentration ratios. However, when we define the market as the 4-digit industry, the Herfindahl index yields a couple of new entries in the top five most concentrated industries: D37 Water Supply, Sewerage and Drainage Services, B15 Services to Mining, I64 Air and Space Transport, C21 Food, Beverage and Tobacco, and C25 Petroleum, Coal, Chemical and Associated Product Manufacturing.

We noted in our introduction that the U.S. Department of Justice and the Federal Trade Commission regard a market in which the post-merger Herfindahl Index above 0.18 as 'highly concentrated'. An interesting exercise is to consider how many of our 2-digit industries look 'highly concentrated' on average by this definition. When we calculate the Herfindahl index using the definition of a market as the 3-digit industry (Table 3) we find that six out of 47 industries are highly concentrated. When we define the market as the 4-digit industry, we find 13. We must, however, add a number of caveats to this exercise. First, the US economy is considerably larger than the New Zealand one, and so a large firm in the US context might well be larger than the whole industry in New Zealand. Second, we have not included the international dimension to our analysis. New Zealand is a small, open economy and imports play an important part in many markets. Third, many of the large firms in New Zealand are international firms, exporting a large portion of their commodities and goods abroad.

Table 3 Herfindahl index for 3-digit industry (2000-7)

ANZSIC 1996 Industry (Sub Division)		*N*	mean	P25	Median	P75
A01	Agriculture	76,353	0.001	0.000	0.001	0.001
A02	Services to Agriculture; Hunting and Trapping	7,602	0.007	0.006	0.006	0.006
A03	Forestry and Logging	6,282	0.055	0.055	0.055	0.055
A04	Commercial Fishing	2,718	0.024	0.026	0.026	0.026
B13	Metal Ore Mining	111	0.378	0.378	0.378	0.378
B14	Other Mining	246	0.067	0.032	0.032	0.032
B15	Services to Mining	105	0.442	0.490	0.490	0.490
C21	Food, Beverage and Tobacco	2,133	0.251	0.093	0.095	0.477
C22	Textile, Clothing, Footwear and Leather Manufacturing	2,766	0.055	0.021	0.036	0.076
C23	Wood and Paper Product Manufacturing	2,937	0.083	0.039	0.049	0.184
C24	Printing, Publishing and Recorded Media	2,802	0.036	0.026	0.026	0.049
C25	Petroleum, Coal, Chemical and Associated Product Manufacturing	1,488	0.131	0.057	0.123	0.123
C26	Non-Metallic Mineral Product Manufacturing	990	0.157	0.134	0.134	0.204
C27	Metal Product Manufacturing	4,290	0.164	0.010	0.010	0.376
C28	Machinery and Equipment Manufacturing	7,077	0.074	0.005	0.111	0.112
C29	Other Manufacturing	4,092	0.012	0.008	0.008	0.009
D36	Electricity and Gas Supply	66	0.099	0.145	0.145	0.145
D37	Water Supply, Sewerage and Drainage Services	78	0.295	0.295	0.295	0.295
E41	General Construction	19,470	0.025	0.007	0.007	0.052
E42	Construction Trade Services	31,656	0.004	0.001	0.005	0.005
F45	Basic Material Wholesaling	4,203	0.072	0.033	0.101	0.101
F46	Machinery and Motor Vehicle Wholesaling	6,951	0.013	0.007	0.007	0.007
F47	Personal and Household Good Wholesaling	11,505	0.023	0.009	0.011	0.042
G51	Food Retailing	12,936	0.037	0.021	0.021	0.055
G52	Personal and Household Good Retailing	22,983	0.057	0.004	0.015	0.021
G53	Motor Vehicle Retailing and Services	12,372	0.007	0.006	0.006	0.007
H57	Accommodation, Cafes and Restaurants	14,637	0.006	0.004	0.007	0.007
I61	Road Transport	10,494	0.010	0.004	0.004	0.004
I63	Water Transport	414	0.112	0.112	0.112	0.112
I64	Air and Space Transport	588	0.288	0.288	0.288	0.288
I65	Other Transport	216	0.029	0.029	0.029	0.029
I66	Services to Transport	3,051	0.038	0.017	0.017	0.017
I67	Storage	417	0.046	0.046	0.046	0.046
J71	Communication Services	4,305	0.332	0.393	0.393	0.393
K73	Finance	5,361	0.047	0.046	0.046	0.046
K74	Insurance	159	0.121	0.125	0.125	0.125
K75	Services to Finance and Insurance	5,016	0.019	0.018	0.020	0.020
L77	Property Services	73,968	0.008	0.002	0.002	0.009
L78	Business Services	61,812	0.025	0.008	0.008	0.051
N84	Health Services	3,066	0.025	0.006	0.006	0.043
O86	Community Services	13,722	0.009	0.001	0.001	0.012
O87	Motion Picture, Radio and Television Services	1,746	0.008	0.006	0.009	0.009
P91	Libraries, Museums and the Arts	2,646	0.171	0.028	0.238	0.238
P92	Sport and Recreation	4,188	0.020	0.008	0.008	0.020
P93	Personal Services	4,245	0.223	0.017	0.414	0.414

** N = Average number of firms in the 2-digit industry sub division over entire period*

** Counts of firms random-rounded to base 3 for confidentiality reasons*

3-digit measures summarised at the 2-digit level weighted by value-added

Table 4 Herfindahl index for 3-digit industry (2000-7)

ANZSIC 1996 Industry (Sub Division)		*N*	mean	P25	Median	P75
A01	Agriculture	76,353	0.003	0.000	0.001	0.003
A02	Services to Agriculture; Hunting and Trapping	7,602	0.009	0.008	0.008	0.008
A03	Forestry and Logging	6,282	0.090	0.008	0.054	0.175
A04	Commercial Fishing	2,718	0.043	0.019	0.043	0.052
B13	Metal Ore Mining	111	0.514	0.514	0.514	0.514
B14	Other Mining	246	0.085	0.043	0.043	0.071
B15	Services to Mining	105	0.464	0.542	0.542	0.542
C21	Food, Beverage and Tobacco	2,133	0.374	0.128	0.391	0.616
C22	Textile, Clothing, Footwear and Leather Manufacturing	2,766	0.100	0.021	0.085	0.139
C23	Wood and Paper Product Manufacturing	2,937	0.186	0.056	0.056	0.353
C24	Printing, Publishing and Recorded Media	2,802	0.080	0.032	0.032	0.106
C25	Petroleum, Coal, Chemical and Associated Product Manufacturing	1,488	0.361	0.133	0.308	0.637
C26	Non-Metallic Mineral Product Manufacturing	990	0.326	0.204	0.272	0.272
C27	Metal Product Manufacturing	4,290	0.225	0.024	0.059	0.478
C28	Machinery and Equipment Manufacturing	7,077	0.183	0.025	0.101	0.340
C29	Other Manufacturing	4,092	0.061	0.006	0.019	0.040
D36	Electricity and Gas Supply	66	0.099	0.145	0.145	0.145
D37	Water Supply, Sewerage and Drainage Services	78	0.473	0.449	0.449	0.504
E41	General Construction	19,470	0.044	0.002	0.033	0.047
E42	Construction Trade Services	31,656	0.018	0.003	0.006	0.007
F45	Basic Material Wholesaling	4,203	0.131	0.055	0.170	0.220
F46	Machinery and Motor Vehicle Wholesaling	6,951	0.039	0.022	0.032	0.059
F47	Personal and Household Good Wholesaling	11,505	0.067	0.014	0.050	0.106
G51	Food Retailing	12,936	0.066	0.055	0.055	0.080
G52	Personal and Household Good Retailing	22,983	0.073	0.012	0.017	0.088
G53	Motor Vehicle Retailing and Services	12,372	0.023	0.003	0.008	0.010
H57	Accommodation, Cafes and Restaurants	14,637	0.006	0.004	0.007	0.007
I61	Road Transport	10,494	0.019	0.004	0.004	0.004
I63	Water Transport	414	0.174	0.174	0.174	0.174
I64	Air and Space Transport	588	0.411	0.449	0.449	0.449
I65	Other Transport	216	0.046	0.030	0.030	0.030
I66	Services to Transport	3,051	0.066	0.035	0.039	0.039
I67	Storage	417	0.048	0.047	0.047	0.047
J71	Communication Services	4,305	0.360	0.393	0.393	0.393
K73	Finance	5,361	0.038	0.046	0.046	0.046
K74	Insurance	159	0.137	0.134	0.134	0.134
K75	Services to Finance and Insurance	5,016	0.028	0.020	0.020	0.022
L77	Property Services	73,968	0.016	0.002	0.002	0.009
L78	Business Services	61,812	0.057	0.011	0.018	0.037
N84	Health Services	3,066	0.032	0.006	0.006	0.043
O86	Community Services	13,722	0.020	0.001	0.005	0.028
O87	Motion Picture, Radio and Television Services	1,746	0.020	0.006	0.011	0.011
P91	Libraries, Museums and the Arts	2,646	0.254	0.116	0.339	0.339
P92	Sport and Recreation	4,188	0.041	0.003	0.003	0.093
P93	Personal Services	4,245	0.289	0.018	0.156	0.587

** N = Average number of firms in the 2-digit industry sub division over entire period*

** Counts of firms random-rounded to base 3 for confidentiality reasons*

4-digit measures summarised at the 2-digit level weighted by value-added

5.3 Price-cost margins

Our calculations of price-cost margins are presented in Table 5 and Table 6. Once more there is considerable variety in our calculated scores. One thing to note is that in some industries we find weighted mean price-cost margins that are negative. This may be the case for a number of reasons relating to data quality or the way different firms account for income. Because of this we do not stress these results, but merely note that in this preliminary analysis we find many negative numbers, even when we only include wage costs in the calculations. Without changing things on the income side, more complex price-cost margin or Lerner indices are likely to throw up considerably more negative numbers. Given this and the very different way it is calculated, the top five concentrated industries do change slightly. Calculating the price-cost margin at the 3-digit level yields the following five industries as having the lowest levels of competition: I66 Services to Transport, I63 Water Transport, I64 Air and Space Transport, P91 Libraries, Museums and the Arts, and J71 Communication Services. Defining the market as the 4-digit industry yields the following industries: B13 Metal Ore Mining, I66 Services to Transport, I63 Water Transport, I64 Air and Space Transport, and K73 Finance. There is some similarity with between these firms and the industries thrown up by the concentration ratios and Herfindahl indexes, with a few service industries entering the mix.

We examine the correlation between the measures in more detail in the following section.

Table 5 Price-cost margin for 3-digit industry (2000-07)

ANZSIC 1996 Industry (Sub Division)		*N*	mean	P25	Median	P75
A01	Agriculture	76,353	0.125	0.136	0.138	0.138
A02	Services to Agriculture; Hunting and Trapping	7,602	0.075	0.075	0.075	0.075
A03	Forestry and Logging	6,282	0.100	0.100	0.100	0.100
A04	Commercial Fishing	2,718	0.120	0.133	0.137	0.138
B13	Metal Ore Mining	111	-0.159	-0.206	-0.206	-0.206
B14	Other Mining	246	0.137	0.120	0.121	0.121
B15	Services to Mining	105	-0.088	-0.139	-0.139	-0.139
C21	Food, Beverage and Tobacco	2,133	0.226	-0.010	0.129	0.228
C22	Textile, Clothing, Footwear and Leather Manufacturing	2,766	0.096	0.079	0.097	0.110
C23	Wood and Paper Product Manufacturing	2,937	0.122	0.089	0.127	0.153
C24	Printing, Publishing and Recorded Media	2,802	0.135	0.111	0.111	0.167
C25	Petroleum, Coal, Chemical and Associated Product Manufacturing	1,488	0.191	0.110	0.130	0.264
C26	Non-Metallic Mineral Product Manufacturing	990	0.156	0.155	0.156	0.156
C27	Metal Product Manufacturing	4,290	0.124	0.093	0.120	0.151
C28	Machinery and Equipment Manufacturing	7,077	0.143	0.108	0.125	0.213
C29	Other Manufacturing	4,092	0.108	0.090	0.090	0.150
D36	Electricity and Gas Supply	66	0.191	0.170	0.170	0.170
D37	Water Supply, Sewerage and Drainage Services	78	0.062	0.059	0.065	0.065
E41	General Construction	19,470	0.068	0.066	0.066	0.070
E42	Construction Trade Services	31,656	0.120	0.120	0.120	0.131
F45	Basic Material Wholesaling	4,203	0.115	0.058	0.158	0.159
F46	Machinery and Motor Vehicle Wholesaling	6,951	0.060	0.066	0.069	0.070
F47	Personal and Household Good Wholesaling	11,505	0.096	0.053	0.117	0.129
G51	Food Retailing	12,936	0.073	0.011	0.124	0.133
G52	Personal and Household Good Retailing	22,983	0.071	0.053	0.058	0.102
G53	Motor Vehicle Retailing and Services	12,372	0.041	0.017	0.054	0.054
H57	Accommodation, Cafes and Restaurants	14,637	0.089	0.082	0.082	0.108
I61	Road Transport	10,494	0.084	0.085	0.085	0.085
I63	Water Transport	414	0.505	0.505	0.505	0.505
I64	Air and Space Transport	588	0.374	0.373	0.373	0.373
I65	Other Transport	216	0.049	0.050	0.050	0.050
I66	Services to Transport	3,051	0.605	0.636	0.637	0.637
I67	Storage	417	0.068	0.068	0.068	0.068
J71	Communication Services	4,305	0.255	0.302	0.302	0.302
K73	Finance	5,361	0.122	-0.023	-0.023	0.103
K74	Insurance	159	0.129	0.170	0.170	0.170
K75	Services to Finance and Insurance	5,016	0.079	-0.106	0.231	0.231
L77	Property Services	73,968	0.042	0.014	0.014	0.082
L78	Business Services	61,812	0.143	0.059	0.125	0.161
N84	Health Services	3,066	0.125	0.119	0.142	0.142
O86	Community Services	13,722	0.170	0.129	0.215	0.215
O87	Motion Picture, Radio and Television Services	1,746	0.011	-0.052	-0.052	0.176
P91	Libraries, Museums and the Arts	2,646	0.269	0.141	0.330	0.330
P92	Sport and Recreation	4,188	0.114	0.095	0.095	0.152
P93	Personal Services	4,245	0.230	0.034	0.392	0.392

** N = Average number of firms in the 2-digit industry sub division over entire period*

** Counts of firms random-rounded to base 3 for confidentiality reasons*

3-digit measures summarised at the 2-digit level weighted by value-added

Table 6 Price-cost margin for 4-digit industry (2000-07)

ANZSIC 1996 Industry (Sub Division)		*N*	mean	P25	Median	P75
A01	Agriculture	76,353	0.129	0.115	0.138	0.138
A02	Services to Agriculture; Hunting and Trapping	7,602	0.090	0.064	0.064	0.064
A03	Forestry and Logging	6,282	0.100	0.098	0.101	0.101
A04	Commercial Fishing	2,718	0.127	0.056	0.126	0.138
B13	Metal Ore Mining	111	0.030	0.030	0.030	0.030
B14	Other Mining	246	0.142	0.096	0.143	0.143
B15	Services to Mining	105	0.326	0.083	0.083	0.083
C21	Food, Beverage and Tobacco	2,133	0.235	0.043	0.115	0.302
C22	Textile, Clothing, Footwear and Leather Manufacturing	2,766	0.097	0.078	0.110	0.135
C23	Wood and Paper Product Manufacturing	2,937	0.124	0.081	0.137	0.137
C24	Printing, Publishing and Recorded Media	2,802	0.135	0.110	0.128	0.137
C25	Petroleum, Coal, Chemical and Associated Product Manufacturing	1,488	0.270	0.122	0.152	0.344
C26	Non-Metallic Mineral Product Manufacturing	990	0.163	0.116	0.116	0.193
C27	Metal Product Manufacturing	4,290	0.124	0.112	0.124	0.160
C28	Machinery and Equipment Manufacturing	7,077	0.147	0.098	0.120	0.155
C29	Other Manufacturing	4,092	0.109	0.088	0.088	0.151
D36	Electricity and Gas Supply	66	0.191	0.170	0.170	0.170
D37	Water Supply, Sewerage and Drainage Services	78	0.066	0.065	0.067	0.067
E41	General Construction	19,470	0.069	0.063	0.063	0.070
E42	Construction Trade Services	31,656	0.122	0.113	0.117	0.125
F45	Basic Material Wholesaling	4,203	0.117	0.051	0.128	0.161
F46	Machinery and Motor Vehicle Wholesaling	6,951	0.069	0.058	0.065	0.094
F47	Personal and Household Good Wholesaling	11,505	0.109	0.067	0.091	0.190
G51	Food Retailing	12,936	0.079	0.011	0.037	0.132
G52	Personal and Household Good Retailing	22,983	0.073	0.054	0.059	0.109
G53	Motor Vehicle Retailing and Services	12,372	0.066	0.016	0.099	0.106
H57	Accommodation, Cafes and Restaurants	14,637	0.089	0.082	0.082	0.108
I61	Road Transport	10,494	0.085	0.085	0.085	0.085
I63	Water Transport	414	0.551	0.605	0.605	0.605
I64	Air and Space Transport	588	0.388	0.410	0.410	0.410
I65	Other Transport	216	0.053	0.047	0.047	0.047
I66	Services to Transport	3,051	0.627	0.684	0.684	0.723
I67	Storage	417	0.068	0.068	0.068	0.068
J71	Communication Services	4,305	0.256	0.302	0.302	0.302
K73	Finance	5,361	0.371	-0.023	-0.023	0.103
K74	Insurance	159	0.129	0.169	0.169	0.169
K75	Services to Finance and Insurance	5,016	0.068	-0.077	0.231	0.231
L77	Property Services	73,968	0.043	0.018	0.018	0.112
L78	Business Services	61,812	0.149	0.111	0.141	0.146
N84	Health Services	3,066	0.124	0.124	0.142	0.142
O86	Community Services	13,722	0.171	0.125	0.183	0.219
O87	Motion Picture, Radio and Television Services	1,746	0.017	-0.076	-0.076	0.176
P91	Libraries, Museums and the Arts	2,646	0.281	0.099	0.397	0.397
P92	Sport and Recreation	4,188	0.111	0.068	0.068	0.150
P93	Personal Services	4,245	0.229	0.082	0.307	0.403

** N = Average number of firms in the 2-digit industry sub division over entire period*

** Counts of firms random-rounded to base 3 for confidentiality reasons*

4-digit measures summarised at the 2-digit level weighted by value-added

5.4 Comparing measures

It is useful also to compare these measures with each other. A cross-plot of the 2-digit weighted mean of the concentration ratios and Herfindahl indices along with (ln) labour productivity are presented in Figure 2[13]. As one might expect, the measures of competition calculated at the 3- and 4-digit level are closely related to each other, with the relationship between the concentration ratios and Herfindahl indices being non-linear. There are signs of a positive relationship between competition and labour productivity, but there appears to be some variance in this. The relationship between the other concentration indices and the price-cost margin are rather less clear (see Figure 4) and indicative of a number of outliers in the data that warrant further examination.

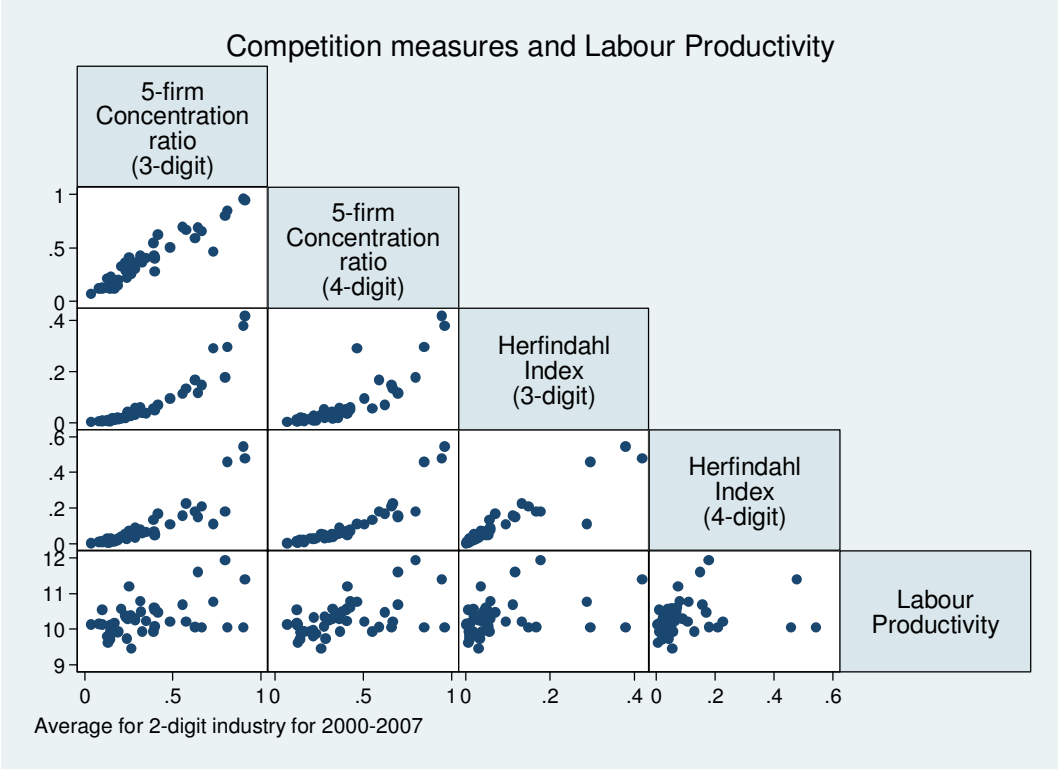


Figure 2 Pairwise comparison of competition measures and productivity

We can test the similarity of the measures more formally. Table 7 and Table 8 present results of Pearson and Spearman (rank) correlations, respectively. These are

[13] A larger matrix of scatter plots including the price-cost margin is presented in the appendix (Figure 4).

based on industry averages over the entire period (2000-07). The Pearson correlations are weighted by value-added.

The five firm concentration ratios are highly (and significantly) correlated, as they are with their respective Herfindahl Indices. The higher rank correlations confirm the non-linearity apparent in Figure 2. The price-cost margin indicators are highly-correlated with each other, but not with the concentration ratios and Herfindahl Indices.

The concentration and Herfindahl measures are all correlated with labour productivity at varying levels of significance. The price-cost margin indicators exhibit an even higher (Pearson) correlation with (ln) labour productivity still. However this is not true when we consider the (Spearman) rank correlation. This may be a product of the weighting, with the relation being greater in larger sub-industries (in terms of value added).

Table 7 Pearson correlations

	cr53	cr54	herf3	herf4	pcm3	pcm4
cr54	0.908 (0.0000)	1				
herf3	0.916 (0.0000)	0.759 (0.0000)	1			
herf4	0.870 (0.0000)	0.932 (0.0000)	0.806 (0.0000)	1		
pcm3	0.169 (0.2572)	0.241 (0.1033)	0.214 (0.1478)	0.142 (0.3400)	1	
pcm4	-0.008 (0.9574)	0.137 (0.3593)	-0.049 (0.7423)	0.028 (0.8502)	0.892 (0.0000)	1
ln(LP)	0.414 (0.0038)	0.486 (0.0005)	0.355 (0.0143)	0.310 (0.0338)	0.558 (0.0000)	0.499 (0.0004)

- *Variables relate to averages over the whole 2000-07 period.*
- *Weighted by value added*
- *p-values in parenthesis*

Table 8 Spearman correlations

	cr53	cr54	herf3	herf4	pcm3	pcm4
cr54	0.941 (0.0000)	1				
herf3	0.977 (0.0000)	0.943 (0.0000)	1			
herf4	0.923 (0.0000)	0.967 (0.0000)	0.954 (0.0000)	1		
pcm3	0.092 (0.5394)	0.122 (0.4140)	0.151 (0.3124)	0.178 (0.2314)	1	
pcm4	0.014 (0.9262)	0.076 (0.6134)	0.062 (0.6790)	0.120 (0.4207)	0.908 (0.0000)	1
ln(LP)	0.422 (0.0031)	0.464 (0.0010)	0.416 (0.0037)	0.382 (0.0082)	0.241 (0.1026)	0.186 (0.2102)

- *Variables relate to averages over the whole 2000-07 period.*
- *p-values in parenthesis*

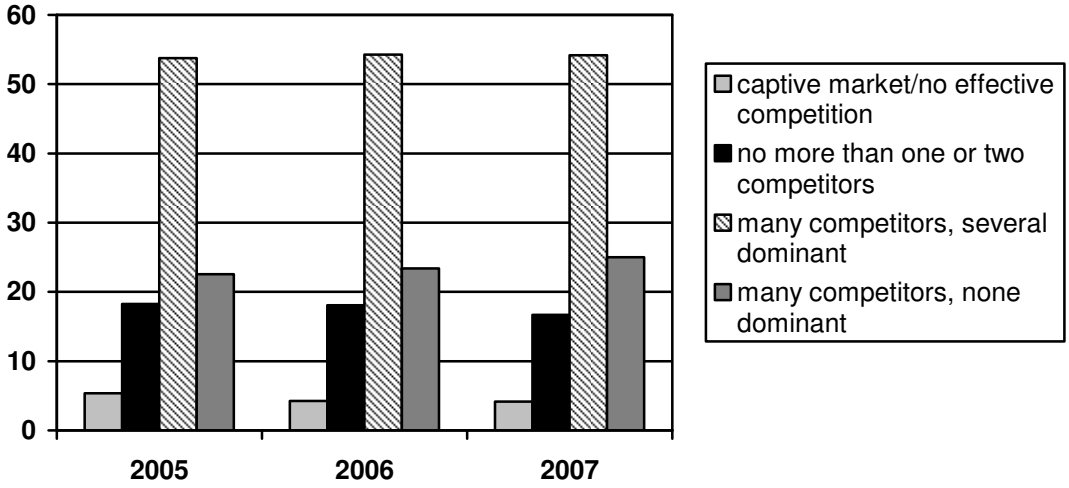
5.5 Firms' own perception of competition

One advantage of the data at our disposal is the presence of a measure of firms' own perception of the degree of competition. Firms are asked to 'How would you describe this business's competition?' and are given four levels of competition:

- *captive market/ no effective competition*
- *no more than one or two competitors*
- *many competitors, several dominant*
- *many competitors, none dominant*

These responses broadly correlate with economists' concepts of monopoly, duopoly, monopolistic/Chamberlain/Robinson competition and perfect competition. The overall percentages of firms reporting to be operating in each type of market are outlined in Figure 3. Over half of firms report that they are operating in a market where there are many competitors and several are dominant. Just over a fifth report that they operate in what is effectively a perfectly competitive market, and just under a fifth report that they are operating within a market that is effectively a duopoly. The figures are extremely similar in each year (there are no signs of large increases or decreases in the competitive environment).

Figure 3 Self-reported competition



- *Responses to the following question: 'How would you describe this business's competition?'*
- *Source: Business Operations Survey*
- *Note that percentages exclude approx 6% who respond 'don't know'*
- *Weighted and stratified*

In what follows we drop the price-cost margin, but include the firm's market share. This is because firms may be reporting competitive pressure as much from their own perspective as from that of the whole market. We can see from Table 9 that firms reporting higher levels of competition do indeed appear to be experiencing more competition, as evidenced by the lower averages of market-share, concentration ratios and Herfindahl indices. However, such figures do not reveal what within-group variation exists in the figures.

Table 9 Firms' own perception of competition

	captive market/ no effective competition	no more than one or two competitors	many competitors, several dominant	many competitors, none dominant
	(1)	(2)	(3)	(4)
2005				
mktshare3	0.0039	0.0031	0.0032	0.0024
mktshare4	0.0120	0.0106	0.0091	0.0068
cr53	0.2297	0.2347	0.2188	0.1731
cr54	0.2681	0.2885	0.2702	0.2189
herf3	0.0314	0.0308	0.0250	0.0156
herf4	0.0530	0.0540	0.0455	0.0297
2006				
mktshare3	0.0034	0.0037	0.0032	0.0021
mktshare4	0.0059	0.0109	0.0088	0.0061
cr53	0.1925	0.2229	0.2139	0.1713
cr54	0.2305	0.2802	0.2661	0.2062
herf3	0.0273	0.0278	0.0246	0.0156
herf4	0.0405	0.0507	0.0449	0.0265
2007				
mktshare3	0.0054	0.0039	0.0035	0.0021
mktshare4	0.0168	0.0133	0.0092	0.0055
cr53	0.2066	0.2283	0.2238	0.1761
cr54	0.2192	0.3064	0.2797	0.2332
herf3	0.0286	0.0290	0.0257	0.0156
herf4	0.0397	0.0559	0.0463	0.0311

- *Table shows the mean value of each variable, by response type to the question 'How would you describe this business's competition?'*
- *Weighted and stratified*

We can test the differences and hence the presence of such a relationship more formally. We can conduct a Wald test to see if the respondents that, for example, report that they are operating in market with many competitors, with none dominant do in fact tend to operate in 3- or 4-digit industries with lower Herfindahl indices, say. Results of pair-wise comparisons are reported in Table 10.

The indices of competition we have calculated for firms reporting that they are operating in industries that are either a 'duopoly'[14] or 'monopolistic competition'[15] can indeed be distinguished statistically from those for firms operating in a 'perfectly

[14] column (2) 'no more than one or two competitors'
[15] column (3) of Table 9, 'many competitors, several dominant'

competitive market'[16]. This result holds at the 1% significance level and across all years[17]. There is much more variability in our ability to distinguish between other groups, depending on the variable used and the year the comparison is made. In particular firms who report that they are operating in a market that is effectively a monopoly[18] can be statistically distinguished from other groups in less than half of the comparisons. This group is, almost by definition, a small one. Nevertheless, the fact that our measures of competition do allow us to distinguish between competitive and non-competitive markets is an encouraging piece triangulation/cross-validation.

In future work we will probe into the data contained in the BOS in more detail. As Fabling, Grimes and Stevens (2008) have noted, firms' perceptions as measured in the BOS contain useful information because the often match the concepts we are interested in more closely than the 'objective' alternatives.

[16] column (4) of Table 9, 'many competitors, none dominant'
[17] With the exception of our market share variables in 2005, that do so only at the 5% or 10% level in three cases.
[18] column (1) of Table 9, 'captive market/no effective competition'

Table 10 *F*-tests of competition measures across BOS responses

	F-test (1)=(2)	F-test (1)=(3)	F-test (1)=(4)	F-test (2)=(3)	F-test (2)=(4)	F-test (3)=(4)
2005						
mktshare3	0.467	0.442	2.056	0.012	2.760*	4.701**
	(0.4946)	(0.5063)	(0.1516)	(0.9130)	(0.0967)	(0.0302)
mktshare4	0.201	0.898	2.931*	0.940	6.292**	6.890***
	(0.6539)	(0.3433)	(0.0870)	(0.3323)	(0.0122)	(0.0087)
cr53	0.060	0.348	9.105***	2.169	32.273***	34.452***
	(0.8061)	(0.5554)	(0.0026)	(0.1408)	(0.0000)	(0.0000)
cr54	0.646	0.009	4.343*	1.418	17.165***	17.202***
	(0.4215)	(0.9236)	(0.0372)	(0.2337)	(0.0000)	(0.0000)
herf3	0.013	1.759	10.912***	3.524*	26.609***	34.250***
	(0.9094)	(0.1848)	(0.0010)	(0.0605)	(0.0000)	(0.0000)
herf4	0.009	0.589	5.390**	2.837*	20.283***	15.659***
	(0.9252)	(0.4430)	(0.0203)	(0.0922)	(0.0000)	(0.0001)
2006						
mktshare3	0.053	0.025	1.617	0.612	8.233***	10.770***
	(0.8174)	(0.8750)	(0.2035)	(0.4342)	(0.0041)	(0.0010)
mktshare4	7.259***	4.015**	0.019	2.292	11.132***	11.064***
	(0.0071)	(0.0451)	(0.8908)	(0.1301)	(0.0009)	(0.0009)
cr53	2.724*	1.684	1.579	0.727	21.251***	34.737***
	(0.0989)	(0.1944)	(0.2089)	(0.3939)	(0.0000)	(0.0000)
cr54	4.289**	3.213*	1.360	0.709	17.212***	26.746***
	(0.0384)	(0.0731)	(0.2436)	(0.3997)	(0.0000)	(0.0000)
herf3	0.012	0.299	5.803**	1.485	21.574***	23.899***
	(0.9141)	(0.5848)	(0.0160)	(0.2231)	(0.0000)	(0.0000)
herf4	1.490	0.342	3.542	1.241	21.901***	26.305***
	(0.2223)	(0.5587)	(0.0599)	(0.2653)	(0.0000)	(0.0000)
2007						
mktshare3	0.815	1.389	3.995**	0.483	8.751***	13.058***
	(0.3668)	(0.2387)	(0.0457)	(0.4869)	(0.0031)	(0.0003)
mktshare4	0.201	0.993	2.193	5.283**	19.036***	22.531***
	(0.6539)	(0.3191)	(0.1387)	(0.0216)	(0.0000)	(0.0000)
cr53	1.113	0.850	2.581	0.156	21.107***	39.764***
	(0.2915)	(0.3566)	(0.1082)	(0.6931)	(0.0000)	(0.0000)
cr54	10.654***	7.465***	0.327	2.167	12.368***	10.378***
	(0.0011)	(0.0063)	(0.5675)	(0.1411)	(0.0004)	(0.0013)
herf3	0.006	0.382	7.867***	1.499	26.770***	32.388***
	(0.9358)	(0.5367)	(0.0051)	(0.2210)	(0.0000)	(0.0000)
herf4	3.278*	0.709	1.074	2.973*	16.968***	12.320***
	(0.0703)	(0.3999)	(0.3002)	(0.0847)	(0.0000)	(0.0005)

- *Weighted and stratified*
- ** significant at 10%; ** significant at 5%; *** significant at 1%*

Note that we have been describing these measures as if they do indeed firms', or rather their general manager's, perception of their market. It may of course be that they are referring to their *own* competitive environment. If a market is effectively a monopoly, but there are some other firms still managing to survive, how would firms respond? It may be that the monopolist reports that they are in a monopoly, but that other firms do not. The largest firm may think that they are operating as a (non-monopoly) competitor in an international market, whereas the other firms think of themselves as operating in a national market, dominated by one big domestic player, or even in a more competitive local market. This speculation throws up the distinction between an absolute (or technical) definition of the market and a relative one. What an observer might describe as the extent of the market as determined by technical aspects such as product classifications and transport costs, may not accord with that of firms operating in that market. This is important as the firm's competitive behaviour will depend upon with whom it is they are competing. However, this perception might be itself be the outcome of competition. The firm may not consider foreign firms as its rivals because it cannot compete with them – hiding, as it were, in a local market, protected by obscurity, transport costs or legal barriers.

6 Conclusions

In this paper we have painted a picture of competition in New Zealand. We have done this by calculating a number of alternative measures of competition suggested by the literature. We have also compared them with each other, and a measure of performance. Furthermore, we have also compared them to a measure of firms' own perception of their competitive environment.

We have found that there is considerable heterogeneity in the degree of competition both within and between 2-digit industries as measured by our indicators. As one might expect because of their similarity of construction, we have found a high degree of correlation between the market share-based measures of competition. The preliminary results of our calculations of price-cost margins suggest that: (a) we need to do some more work on them to make sure we are obtaining the correct measure, particularly if we seek to calculate Lerner indices; and (b) whilst there is commonality between them and the concentration ratios and Herfindahl indices, they are also likely

to pick up other aspects of competition, such as international competition, and overcome some of the problems of market definition, with respect to products/industries.

This paper is a piece of preliminary work as part of a two-year project on *Competition in New Zealand*, funded by the Cross-Departmental Research Pool. The team is made up of representatives of the Ministry of Economic Development, the Treasury and the Commerce Commission. In later work we will develop this work in a number of ways. First we shall develop our measures of domestic competition. Second, we will attempt to supplement our analysis with international information (such as information on foreign ownership, exporting, imports of goods and (potentially) services), to provide a more robust measure of competition. We shall compare these measures more comprehensively with self-reported measures of competition and other measures of the extent of markets in the BOS. Finally, we shall investigate the impact of the competitive environment on economic outcomes such as productivity and innovation.

7 Data Appendix

The sample is based on firms that were never in the following institutional sectors 5111 'Households' and 6111 'Rest of World'.

inst_sector96	
1111	Private Corporate Producer Enterprises
1121	Private Non-corporate Producer Enterprises
1211	Producer Boards
1311	Central Government Enterprises
1321	Local Government Enterprises
2111	Central Bank
2211	Private Registered Banks
2212	Central Government Registered Banks
2213	Local Government Registered Banks
2221	Private Other Broad Money (M3) Depository Organisations
2222	Central Government Other Broad Money (M3) Depository Organisations
2223	Local Government Other Broad Money (M3) Depository Organisations
2291	Private Other Depository Organisations nec
2292	Central Government Other Depository Organisations nec
2293	Local Government Other Depository Organisations nec
2311	Private Other Financial Organisations except Insurance and Pension Funds
2312	Central Government Other Financial Organisations except Insurance and Pension Funds
2313	Local Government Other Financial Organisations except Insurance and Pension Funds
2411	Private Insurance and Pension Funds
2412	Central Government Insurance and Pension Funds
2413	Local Government Insurance and Pension Funds
3111	Central Government (excluding Funded Social Security Schemes)
3121	Funded Social Security Schemes
3211	Regional Authorities
3291	Other Local Authorities
3311	Rūnanga Iwi
4111	Private Non-profit Organisations Serving Households

They were in business types 1 through 7.

business type	business_type96_text
1	Individual Proprietorship
2	Partnership
3	Registered Limited Liability Company (non Co-op)
4	Co-operative Companies
5	Joint Ventures and Consortia
6	Branches of Companies Incorporated Overseas
7	Government Owned Trading Entity
8	Central Government
9	Local Authority Trading Enterprise (LATE)
10	Local Government
11	Incorporated and Unincorporated Societies and Associations
12	Charitable Trusts
13	Trusts/Estates
14	Consulates and Foreign Embassies.
20	Other Business Types

It excludes SOEs (inst_sector96_code=1311 and business_type96_code=7) and firms that were ever ANZSIC code M (Government Administration and Defence) or had missing ANZSUC codes.

7.1 Business Activity Indicator (BAI) Data

The Business Activity Indicator uses GST data from the Inland Revenue Department matched to the SNZ Business Frame. The BAI data come from the Goods and *Services Tax return form*, GST 101. In order to create the BAI dataset, SNZ temporarily apportion the data down to a monthly frequency, apportion returns across GST group members and apply limited imputation in cases where a single return appears to be missing. As noted in Fabling et al. (2008), the GST-based sales and purchases data is potentially contaminated by capital income and expenditure. In particular this includes sales of second-hand assets and businesses, purchases of land, buildings, plant, machinery and businesses. For more on this subject see section 5.4 of Fabling *et al.* (2008).

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 using data on zero-rated sales as follows

$$S_E = \frac{8}{9}(S_I - Z) + Z \tag{12}$$

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' as include an estimate for imported goods and the use of private goods and services in taxable activity.

7.2 IR10 Data

The IR10 data used in this paper come from page 1 of the IRD form Accounts information IR10 form. More information on what should appear in the IR10 form can be found in the IRD guide IR10G. Note that a table of descriptive statistics for all items on page 1 of the IR10 is provided in Table 21 of Appendix 2.

Sales

The sales data recorded in the IR10 form relate to Box 2 'Gross income from sales and/or services' and are GST exclusive.

Other income/revenue

The 'other income/revenue' variable used in Table 5 is the sum of Box 7 'interest received', Box 8 'dividends', Box 9 'rental and lease payments' and Box 10 'other income'.

Profit

The profits data recorded in the IR10 form relate to Box 29 'Total current year taxable profit'. Note that this includes changes in stocks.

Other expenditures

'Other expenditures' in Table 5 is the sum of Box 4 'Purchases' (less the change in stocks from Box 3 'Opening stock' and Box 5 'Closing stock' (both of which include work in progress)), plus Boxes 13-16, 18, 19, and 21-27. For a list of the box numbers, the names of the variables and descriptive statistics, see Table 21 of Appendix 2.

7.3 LEED/PAYE Data

Our data on employment come from the Linked Employer-Employee Database. It has two components, counts of employees and working proprietors.

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.

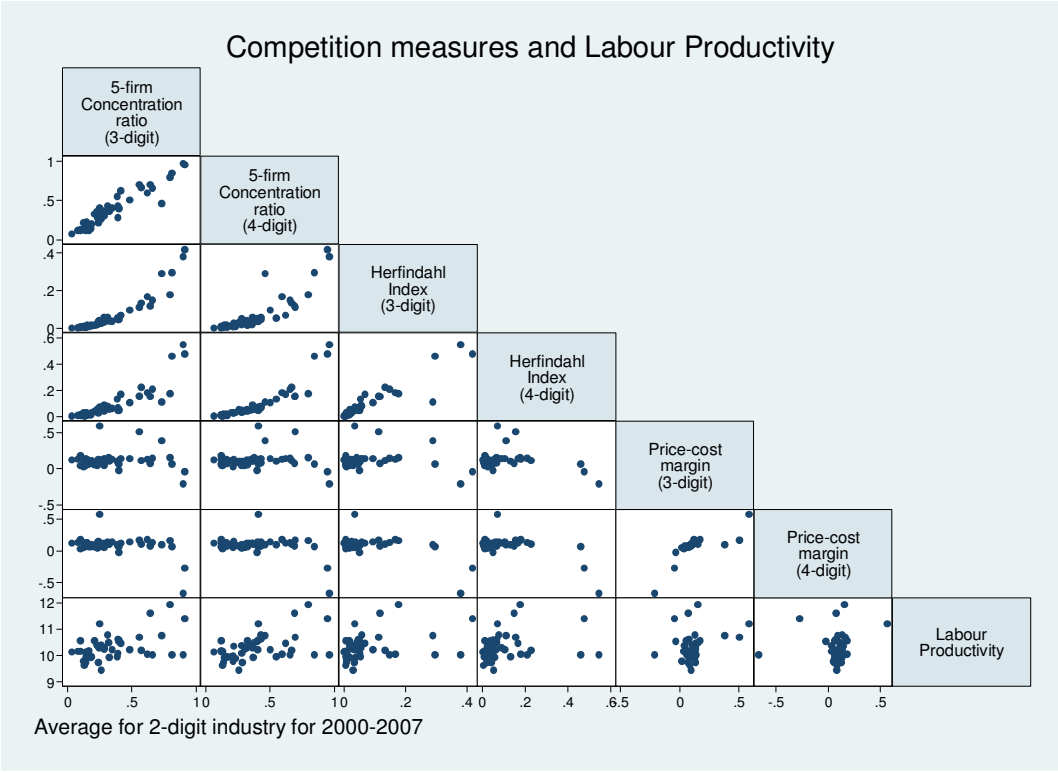
From tax data, there are five ways that people can earn self-employment income from a firm:

- 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).

8 Additional Graphs and Tables

Figure 4 Competition measures, including price-cost margin, and productivity



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