INTERNATIONAL ENGAGEMENT AND PERFORMANCE OF NEW ZEALAND FIRMS

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Statistics New Zealand protocols were applied to the data sourced from the New Zealand Customs Service. Any discussion of data limitations is not related to the data's ability to support that agency's core operational requirements.

Abstract

This thesis examines the determinants and consequences of international engagement by New Zealand firms, with a particular focus on the relationship between international activities and firm performance. The thesis is based around two central questions:

1. How do characteristics of the firm and the economic environment influence the ability and incentives of New Zealand firms to become internationally engaged?

2. What effect does international engagement have on firm performance?

In order to examine the causal relationships between firm performance and international activities, four analyses are conducted using longitudinal firm-level data from the prototype Longitudinal Business Database. This database provides detailed information on the performance and behaviour of New Zealand firms from a wide range of administrative and survey data sources.

The four empirical chapters of the thesis investigate the relationships amongst firm performance, merchandise exporting and inward foreign direct investment. In Chapters 3 and 4, firm-level comparisons identify the types of firms that export and the factors driving those firms to expand into additional export markets and relationships. A range of determinants are considered including firm characteristics, destination market characteristics and localised spillovers. Having identified and controlled for the key firm-level factors which predict export market entry, subsequent performance outcomes are considered in Chapter 4. Chapter 5 examines the impact of new port infrastructure on the export behaviour and performance of local firms, while Chapter 6 turns attention to inward foreign direct investment, examining the pre-acquisition characteristics of foreign acquisition targets and their post-acquisition performance outcomes.

The analysis in Chapters 3 and 4 suggests that firm characteristics both influence, and are influenced by, initial entry into exporting and subsequent expansion into new export relationships. While self-selection into exporting by high performing firms explains much of the performance differential between exporters and non-exporters in New Zealand, entry into exporting and subsequent expansion into new markets lead to increases in scale and capital intensity, with attendant effects on both firm-level and aggregate labour productivity. In turn, the choices that firms make regarding expansion into new export relationships are characterised by substantial path dependence. Firms tend to expand their export horizons sequentially, building on their existing experience and networks. Moreover, there is evidence of path dependence across firms, with entry into new export relationships reflecting demonstration effects from the export activities of other firms in the local area.

Analysis of the uptake of new port infrastructure in Auckland in Chapter 5 suggests that the main determinants of uptake are product- and firm-related, rather than location specific. Firms use the new inland port in conjunction with the existing port in order to mitigate capacity constraints and/or access a greater range of transport options. However, there is no evidence that uptake of the new infrastructure is associated with improved export performance.

Finally, the analysis in Chapter 6 suggests that foreign acquisition targets tend to be positively selected. Unlike export market entry, there is no strong evidence for firm-level performance improvements following from foreign acquisition. However, there is suggestive evidence that outcomes of foreign acquisition may differ according to the initial characteristics of the acquired firm, with initially weak performers being more likely to experience positive effects from acquisition.

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The data used in this thesis come primarily from the prototype Longitudinal Business Database held by Statistics New Zealand. I am indebted to Hamish Hill, Claire Powell, Steve Walshe, Richard Fabling, Julia Gretton, Yolandi de Beer and others in the Business Performance team for the work they have done in developing and maintaining this resource.

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Chapter 1
Introduction

As a small, distant, developed country, international engagement is seen as a key factor in New Zealand's economic performance. Involvement in international markets provides firms with the opportunity to expand their customer base, increase scale, and raise profits. Internationalisation forces firms to confront world-class competitors, exposes them to new ideas and expertise, and encourages them to stay abreast of market trends. However, New Zealand firms face certain challenges to international engagement. Not the least of these is New Zealand's geographic isolation. Comparing New Zealand with Finland (a country which many Europeans would consider to be small, distant, and sparsely populated), a 2200km circle centered around New Zealand's capital, Wellington, would capture a potential market of a little over 4 million people. A similar sized circle around Helsinki would take in around 300 million (Poot 2004). Other challenges faced by New Zealand firms include a relatively volatile exchange rate, which can dramatically affect returns to offshore activities, and a small domestic market, which makes scaling up to enter export markets a more dramatic leap than those faced by firms in larger countries (Simmons 2002).

This thesis examines the determinants and consequences of international engagement by New Zealand firms, with a particular focus on the relationship between international activities and firm performance. The thesis is based around two central questions:

1. How do characteristics of the firm and the economic environment influence the ability and incentives of New Zealand firms to become internationally engaged?

2. What effect does international engagement have on firm performance?

While the term international engagement is defined broadly to include all aspects of firms' international activities and relationships, for practical purposes the focus of this thesis is restricted to two facets for which reliable data are available for a wide range of New Zealand firms – merchandise exports and inward foreign direct investment (FDI).

Four primary research questions form the basis of the thesis, each constituting a core empirical chapter. Chapter 3 considers the firm's decision to enter a new export relationship. Setting aside the question of what determines a firm's ability to export, the analysis in this chapter focuses on subsequent export behaviour, asking: for firms already exporting, what determines their choices about what and where to export? An export relationship is defined as the export of a specific product to a specific destination, and firm- and market-level determinants of entry are considered simultaneously. The analysis suggests that path-dependence, at both the firm and the regional level, is a substantial factor determining the future composition of export activities.

Chapter 4 provides New Zealand-specific evidence on the relationship between exporting and productivity, with a focus on the determinants and consequences of entry into new export markets. Extensive international literature shows that exporting firms tend to outperform domestically-focused firms on a range of performance metrics. However, an open debate remains as to whether this performance gap is driven by self-selection of high-performing firms into exporting, or by performance improvements brought on by the experience of exporting itself (eg, Bernard and Jensen 1999; Greenaway and Kneller 2004; Van Biesebroeck 2005; Greenaway and Kneller 2007; Wagner 2007). The analysis in Chapter 4 suggests that while self-selection accounts for much of the performance differential between exporters and non-exporters in New Zealand, entry into exporting and subsequent expansion into new markets lead to increases in the scale and capital intensity of domestic firms, with attendant effects on both firm-level and aggregate labour productivity.

Chapter 5 focuses on the question of whether the provision of additional transportation infrastructure allows firms to improve their export performance. Using the opening of a new inland port in Auckland as a form of natural experiment, this chapter examines the firm-level factors which influence uptake of the new infrastructure, and looks at whether uptake has an observable effect on firms' export performance. The results suggest that the main determinants of uptake are product- and firm-related, rather than location-specific. Firms use the new port infrastructure in conjunction with the existing port in order to mitigate capacity constraints and/or access a greater range of transport options. Taking early adoption of Metroport as a signal of an existing capacity constraint and analysing the effect of the new port on subsequent export growth shows an insignificant impact on export volumes.

Finally, Chapter 6 shifts the focus from exporting to another dimension of international engagement – inward foreign direct investment. This chapter considers the firm-level factors which attract inward direct investment, and examines the post-acquisition performance of

firms which transition to foreign ownership. The results suggest that foreign firms tend to target high-performing New Zealand companies, but that after controlling for these initial differences in performance, post-acquisition performance growth differs little between acquired and non-acquired firms. However, there is suggestive evidence for productivity improvements and growth in output and employment, particularly among initially weak performers.

The questions tackled in this thesis add a new perspective to a rapidly growing international literature on firm-level performance and international engagement. The four empirical chapters are among the first empirical studies of the relationship between international engagement and firm performance to be based on longitudinal data for a large sample of New Zealand firms, and the first to use this data to examine the specific questions considered. To date, New Zealand research in this area has been undertaken mainly through small-scale survey and case-study research, or has utilised cross-sectional or aggregate data only (eg, Gawith 2002; Simmons 2002; Shaw and Darroch 2004).

This thesis also adds to the international literature through the innovative use of a range of analytical techniques. Chapter 3 deals with the role of firms' past experience and the experience of other firms in determining whether they will enter into new export relationships. As the number of actual entries is small relative to the number of potential relationships which a firm could be involved in, this analysis uses modeling approaches designed to accommodate rare events. Chapters 4 and 6 follow the recent literature in using combined propensity score matching and difference-in-difference approaches to identify the causal relationships between export market entry and foreign acquisition respectively, and various measures of firm performance. Both chapters consider not only impacts on productivity but also a range of other outcomes, including firm size and capital intensity, giving a clearer sense of the mechanisms through which these events may be affecting performance. Chapter 4 also extends the international literature by considering the impact of subsequent expansion into new export destinations and the role of destination market characteristics, while Chapter 6 considers the role of heterogeneity in the pool of acquisition targets. Chapter 5 focuses on an unanticipated shock to firms' transportation options – the opening of an inland port in South Auckland – and uses survival analysis techniques to examine the factors which influence uptake of the new infrastructure. It then uses difference-in-difference methodology to examine the impact of the new port on firm-level export behaviour.

By utilising a range of statistical data and analysis techniques, this research provides insights into the causal relationships between international engagement and performance in a

small, distant, developed country. Further, as data are available on almost the full population of New Zealand firms, the results are representative of the entire New Zealand economy.

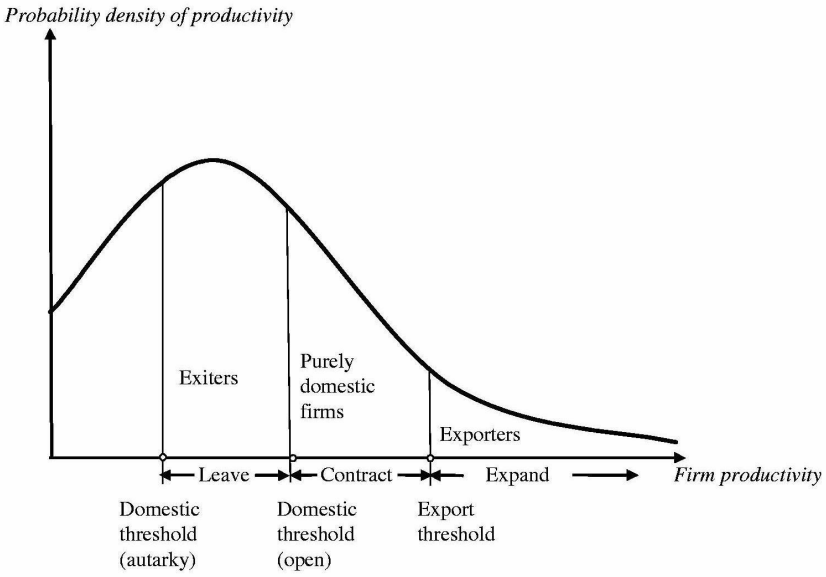
The approach taken builds on the international literature, particularly the focus on firm heterogeneity and international engagement inspired by early empirical work of authors such as Clerides, Lach, and Tybout (1998) and Bernard and Jensen (1999) and the seminal theoretical account of Melitz (2003). In considering the determinants of aggregate trade, trade theory has traditionally focused on macro-economic models based on the observed differences between countries, in terms of factor abundance (Heckscher-Ohlin models), differences in technology (Ricardian models), potential market size and the distance between countries (Gravity models). Sitting alongside models of comparative advantage are extensions based on imperfect competition, invoking scale economies and product differentiation (eg, Krugman 1980). While these models and their extensions capture much of the rich tapestry of international trade at the aggregate level, they remain, in general, based on the concept of a representative firm and a representative consumer. The focus is on differences across countries and between industries within countries.

Such aggregate models provide a useful starting point. However, to better understand the impact of policy and changes in the economic environment, we need to understand how these changes actually affect the behaviour of economic actors – the diverse firms and individuals which make up the aggregate. More recently, with the growing availability of large micro-datasets on firm performance and international engagement, an empirically-led revolution has taken place in which the central economic actor is the (heterogeneous) firm.

Theoretical treatments of trade and FDI in this setting have a number of empirical regularities to contend with. Core findings from the empirical literature on firm-level trade are: that only a small minority of firms are active in international markets; that firms' size and productivity are strongly associated with their level of international engagement – exporters are larger, more capital-intensive, more productive and pay higher wages than their domestic counterparts, but are in turn outperformed on at least some of these measures by multinationals; and that among those firms which do export, income from exports usually makes up only a small proportion of overall sales revenue (eg, Doms and Jensen 1998; Bernard and Jensen 1999; Mayer and Ottaviano 2008; Fabling and Sanderson 2008).

These findings suggest that traditional models based on a representative firm are misleading. A range of theoretical papers have emerged which put structure around the relationship between international engagement and firm performance, including influential papers from

Figure 1.1: Productivity, heterogeneity and industry reallocation.



Source: Greenaway and Kneller (2007, p.F138).

Bernard et al (2003), Melitz (2003), Helpman et al (2004) and Chaney (2008).

A seminal paper in the firm-level trade literature, Melitz (2003) develops a model of industry dynamics with heterogeneous firms. In a model of differentiated products and firm-specific productivity levels drawn from a common distribution in which exporting incurs a cost,[1] only those firms in the upper end of the productivity distribution will find it profitable to export. Melitz then shows that a fall in trade costs (for example through trade liberalization or improvements in transport and communications infrastructure) will lead to a reallocation of market shares and profits across firms. Those firms which are highly productive will find it profitable to enter export markets and will increase in size and profitability. Meanwhile, increased import competition as more foreign firms enter the market will have a deleterious effect on domestic firms, such that those firms which were in the lower parts of the productivity distribution under autarky will be forced to exit. This model has formed the basis of a wide range of empirical investigation and is summarized in Figure 1.1.

An alternative to the assumption of sunk costs to determine which firms export is put forward by Melitz and Ottaviano (2008). This model assumes an alternative demand structure

[1] Although this cost is assumed to be a sunk cost of initial investment on entering into export markets, it is modelled as an amortised per-period cost. This cost is assumed to be a one-off cost, equal across countries. As such, firms that export to any country will export to all countries. Both of these assumptions are made for modeling convenience and can be relaxed without altering the core results (p.1708).

which allows for endogenous mark-ups. Consumer preferences are defined over a continuum of differentiated varieties and a single homogeneous good. The production side of the model is very similar to that of Melitz (2003), except that there are no ongoing overhead costs beyond the initial investment required to commence production. Under Melitz and Ottaviano's model there is a threshold marginal cost such that firms over that marginal cost will never produce. The endogenous cutoff depends on the size of the market and the parameters of the demand function, and determines the competitive environment, such that prices, mark-ups, revenues and profits can all be summarized by the threshold cost, firm-specific marginal costs, market size and the degree of product differentiation. Firms with lower marginal costs set lower prices but gain higher mark-ups, are larger and earn higher profits. Markets with a tougher competitive environment have a low marginal cost threshold which precludes many firms from entering, leading to higher average productivity. Large or highly integrated markets feature lower average prices and markups due to the lower cost threshold; larger and more profitable firms; higher welfare; and more variation in firm size but less variation in productivity, prices and markups. Most notably, these predictions imply that beyond the standard 'gains from trade' through increases in variety (Krugman 1980) and through reallocation of resources (Melitz 2003), trade also invokes welfare increases through a pro-competitive effect.

These theoretical accounts, combined with the rapid expansion of detailed firm-level microdata in a range of countries, have inspired a wide range of empirical and theoretical extensions. These include examination of the margins of export growth (whether increasing export values are associated with an increase in the number of exporters or an increase in exports per firm) (eg, Mayer and Ottaviano 2008), home bias and the role of transport costs in determining trade patterns (eg, Hillberry and Hummels 2008), and the links between exchange rates and export prices (eg, Gopinath and Rigobon 2008). Literature specific to the topics covered in this thesis is discussed in detail in Chapters 3 to 6.

Alongside the rapid development of the literature on export performance, there has been a similar growth in research focused on the relationship between foreign direct investment (FDI) and firm performance. This literature has touched on questions including the impact of foreign acquisitions on the acquired firm, as well as potential spillovers to their competitors and vertically linked firms in the domestic economy (eg, Haskel et al 2007; Arnold and Javorcik 2009); the drivers of foreign direct investment, including the decision to invest rather than to serve foreign markets via exporting or offshore outsourcing, and the relationship between this and country-specific characteristics (eg, Helpman et al 2004); and the

differences in the drivers and impacts between various types of FDI (eg, market seeking vs resource seeking; horizontal vs vertical) (Grossman and Helpman 2002).

The empirical literature presents strong evidence that firms under complete or partial foreign ownership consistently perform better than wholly domestically-owned firms, in terms of profits, productivity, and employment and wage levels, and are more likely to be involved in R&D activities.[2] However, the observed higher productivity level among foreign-owned firms is no reason to assume that foreign ownership is inherently beneficial. Rather, it raises the question of whether this observed productivity is due to increased access to skills, technology or financial resources from the foreign parent, or whether it is simply that multinational enterprises (MNEs) tend to target high performing firms for acquisition. Further, the observed higher productivity of foreign-owned firms may reflect a compositional effect – that is, if offshore ownership is more common in certain industries and those industries exhibit higher labour productivity (mining, say, rather than agriculture), the comparison of productivity at the aggregate level may be misleading.

The following chapters provide New Zealand specific evidence on the relationships between firm performance, the economic environment, export behaviour and foreign ownership. Chapter 2 introduces the core dataset used throughout this thesis. Chapters 3 to 6 discuss the novel empirical research which constitutes the major contribution of this thesis. Chapter 7 summarises the work and provides suggestions for future extensions.

[2] See Fabling et al (2008) for early evidence of the superior productivity performance of foreign-owned firms in New Zealand.

Chapter 2
Data

The data used throughout this thesis are sourced primarily from the prototype Longitudinal Business Database (LBD). The LBD is a collection of administrative and survey data held by Statistics New Zealand, and provides detailed longitudinal information on the performance and behaviour of New Zealand firms. This chapter outlines the characteristics of the dataset as a whole, including some initial description of the trade and FDI data.[1] In order to address the specific questions at hand, each of the four empirical chapters of the thesis uses a different subset of the LBD data. These differences are outlined in the data and methodology sections of the individual chapters. However, there are also several commonalities across the chapters, which are discussed here. As the LBD is updated annually while the research contained within this thesis has taken place over a period of three years, the individual chapters also indicate the temporal coverage of the data available at the time of writing.

Access to all micro-data held by Statistics New Zealand is restricted under the Statistics Act 1975. At the discretion of the Government Statistician, access may be granted to employees of government departments for bona fide research or statistical purposes. In addition, where the Government Statistician sees a benefit to the Official Statistics System, he or she may authorise seconding researchers from non-government departments to Statistics New Zealand for a limited period of time. The data can only be accessed on Statistics New Zealand's premises, and all outputs undergo checks to ensure that respondents' confidential information is not inadvertently released. The research in this thesis was completed while the author was employed by the Reserve Bank of New Zealand, under a part-time secondment arrangement with Statistics New Zealand.

Developed from Statistics New Zealand's Longitudinal Business Frame (LBF), the LBD provides information on all economically significant firms in New Zealand from 2000 to

[1] See also Fabling (2009) for additional information about the LBD.

Table 2.1: Number of employing private-for-profit firms, entry and exit

	Firm Counts			Employment		
Year	Firms	Entrants	Exits	Firms	Entrants	Exits
2000	340,647		32,148	1,514,000		71,800
2001	341,937	44,397	34,887	1,537,000	97,600	79,500
2002	339,231	40,356	34,716	1,557,800	90,600	78,400
2003	342,630	41,490	36,126	1,593,700	87,500	84,100
2004	346,851	42,234	38,295	1,638,700	91,000	73,700
2005	348,033	41,220	39,861	1,679,500	90,100	84,200
2006	350,157	39,582	42,021	1,714,200	91,100	87,800
2007	353,592	41,079	44,973	1,735,800	89,400	84,800
2008	356,073	40,332	53,061	1,767,800	81,100	95,300
2009	345,669	32,079		1,742,800	63,600	

All firm counts have been random rounded (base three) in accordance with Statistics New Zealand confidentiality requirements. Graduated random rounding has been applied to employment counts. Entry (exit) defined as the year of first (last) observed employment. Employment includes employees and working proprietors. Entry and exit counts may be affected by censoring, leading to overestimates of entry (exit) in early (late) years.

2009.[2] Table 2.1 shows the total number of employing, private-for-profit firms in each year, plus the number of entering and exiting firms.[3] In any given year there are around 350,000 employing firms (including firms with working proprietors only). Each year around 40,000 new employing firms enter the population, but almost a similar number cease employing, such that the total firm count increased by less than two percent over the decade. In contrast, aggregate employment increased by around 15 percent.

The core elements of the LBD consist of: the LBF, which provides information on employment, areas of industrial activity, location and ownership; administrative data from the Inland Revenue Department (IRD) including goods and services tax (GST) returns, financial accounts (IR10s), and company tax returns (IR4s); information on employers, employees and wages aggregated to the firm level from the Linked Employer-Employee Dataset (LEED); and shipment-level merchandise trade data provided by the New Zealand Customs Service (Customs). In addition to the core administrative data, a number of additional data sources have been linked to the LBD, including sample surveys administered by Statistics New Zealand and details of firms' participation in assistance programs provided by five government agencies. Thus, the database provides a depth of information about individual firms far beyond that of any individual source.

[2]Economic significance is defined as employing any person or having an annual turnover of at least NZD40,000 (approximately USD32,000 as at 1 May 2011). Firm data is aggregated to an annual basis by allocating the balance date of each firm to the nearest March year (most New Zealand firms operate on a March balance date).

[3]The private-for-profit definition used here excludes households and the government sector but includes state-owned enterprises and producer boards.

Table 2.2: Share of employing private-for-profit firms by industry

	Share of firms		Share of employment	
	2000	2009	2000	2009
A – Agriculture, forestry, fishing and hunting	0.244	0.183	0.136	0.102
B – Mining	0.001	0.001	0.002	0.003
C – Manufacturing	0.069	0.065	0.168	0.148
D – Electricity, gas and water supply	0.000	0.000	0.002	0.002
E – Construction	0.121	0.139	0.076	0.094
F – Wholesale trade	0.047	0.043	0.069	0.069
G – Retail trade	0.121	0.112	0.152	0.148
H – Accommodation, cafes and restaurants	0.032	0.038	0.054	0.059
I – Transport and storage	0.036	0.036	0.048	0.048
J – Communication services	0.011	0.010	0.019	0.017
K – Finance and insurance	0.013	0.017	0.032	0.032
L – Property and business services	0.209	0.241	0.155	0.169
N – Education	0.006	0.008	0.006	0.011
O – Health and community services	0.039	0.046	0.043	0.056
P – Cultural and recreational services	0.021	0.026	0.018	0.021
Q – Personal and other services	0.030	0.034	0.020	0.021

Industries defined according to the Australia and New Zealand Standard Industrial Classification 1996 (ANZSIC96). Underlying firm counts have been random rounded (base three) in accordance with Statistics New Zealand confidentiality requirements.

The database is a work in progress, and continues to expand as new research needs are identified and new data become available (Fabling 2009). Recent additions to the database include the Manufacturing Energy Use Survey (MEUS) and the International Trade in Services and Royalties survey (ITSS). The "prototype" moniker is a technicality and reflects the fact that the LBD has not been "productionised" as part of the official statistics system, rather than concerns about the quality of the data or linking methods.

Tables 2.2 and 2.3 summarise the distribution of firms in New Zealand by industry and employment. In terms of firm numbers, the New Zealand economy is dominated by the Agriculture, forestry, fishing and hunting, and Property and business services industries, which together made up around 42 percent of all private-for-profit firms in 2009 (Table 2.2). However, as both these industries have a low average firm size (average employment of 2.8 and 3.5 respectively), they account for a much smaller share of aggregate employment. In contrast, with average employment of 11.5, manufacturing firms make up only 6.5 percent of all firms, but 14.8 percent of employment.

The relatively low average employment across industries reflects the full coverage nature of the data, which include a large number of very small firms. Table 2.3 shows firm size percentiles for the four aggregated industry groups which will be used in Chapter 6: Services,

Table 2.3: Employment size distribution by industry

	p25	p50	p75	p95	p99
Services	1.00	1.17	2.17	12.00	43.42
Wholesale and retail trade	1.00	2.00	4.67	16.67	74.42
Manufacturing	1.00	2.00	6.17	32.75	140.58
Other	1.00	2.00	2.42	7.67	23.17
Total	1.00	2.00	3.00	12.50	46.75

Rolling mean employment, including annual count of working proprietors.

Wholesale and retail trade, Manufacturing, and Other. Across three of the four groups, the median firm has only two employees (including working proprietors), while services firms tend to be even smaller, with median employment just above one. Manufacturing firms tend to be larger than those in other industries, but even the 99th percentile of firms has employment of only 140.58. This reflects the firm size distribution in New Zealand, which has few large firms relative to other developed countries (Mills and Timmins 2004).

The focus of this thesis is on the international engagement of New Zealand firms. The two main types of international engagement which are considered are merchandise exports, based on data sourced from the New Zealand Customs Service, and inward FDI, based primarily on indicators from company tax returns (IR4s).[4]

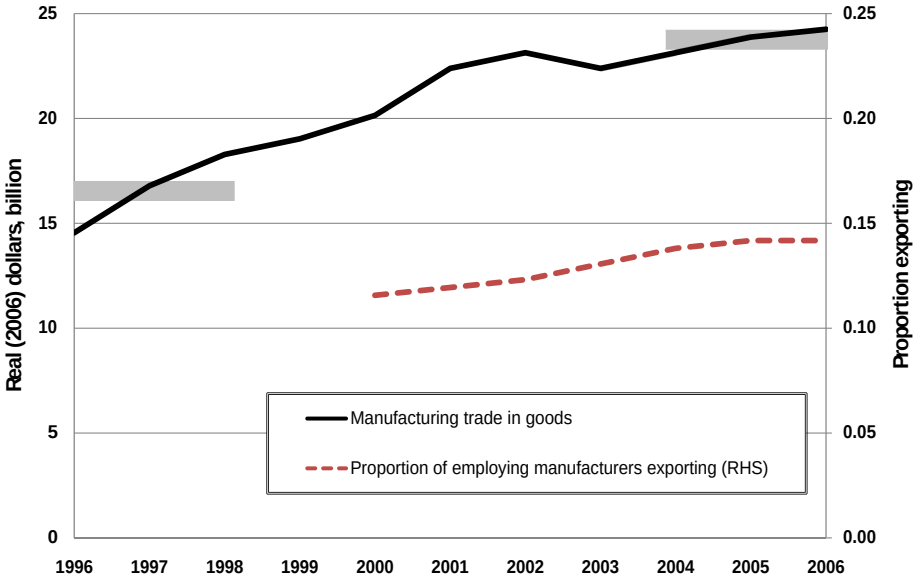
The Customs data included within the LBD are particularly rich and underlie the analysis in Chapters 3 to 5. Customs data are available at daily shipment-level frequency and contain detailed information including volume and value (both New Zealand dollar value and the value in the transaction currency), ten-digit Harmonised System product classifications,[5] final destination, port of loading, transportation method, and whether or not the transaction was hedged against exchange rate movements. All merchandise exports data are sourced from the Customs' Export Entry Form, a copy of which is appended as Appendix A. Customs data are available for the period from 1988 to 2010, but the quality of matches between Customs clients and firms falls prior to April 1999.[6]

[4]The LBD includes indicators of trade and FDI from several sources, but the Customs and IR4 data provide the most comprehensive coverage.

[5]This classification system has undergone a number of revisions over time, including full revisions in 2001 and 2007 as well as a large number of minor revisions. Throughout this thesis, the many revisions to the system are accounted for by grouping together goods that ever share the same code. In effect this slightly reduces the resolution at which goods are observed but has the advantage of consistently classifying goods over time, making it possible to identfy entry and exit at the product level. Fabling and Sanderson (2008) provide further detail on the motivation for, and implications of, the HS revisions.

[6]When matching the exports data to enterprise records, Statistics New Zealand follows a two part process. Initially, records are electronically matched based on the IRD numbers (if available) or names and addresses of the firms involved. In order to improve the match rate, there is then a second round of matching in which high value exporters are manually matched to enterprise numbers. Firms which exported prior to April 1999 but did not generate significant export value over the period covered by the LBF will not have undergone the manual stage of this process. Examination of the data suggests that match rates remain high at least back to 1996.

Figure 2.1: Aggregate real manufacturing trade and the proportion of firms exporting



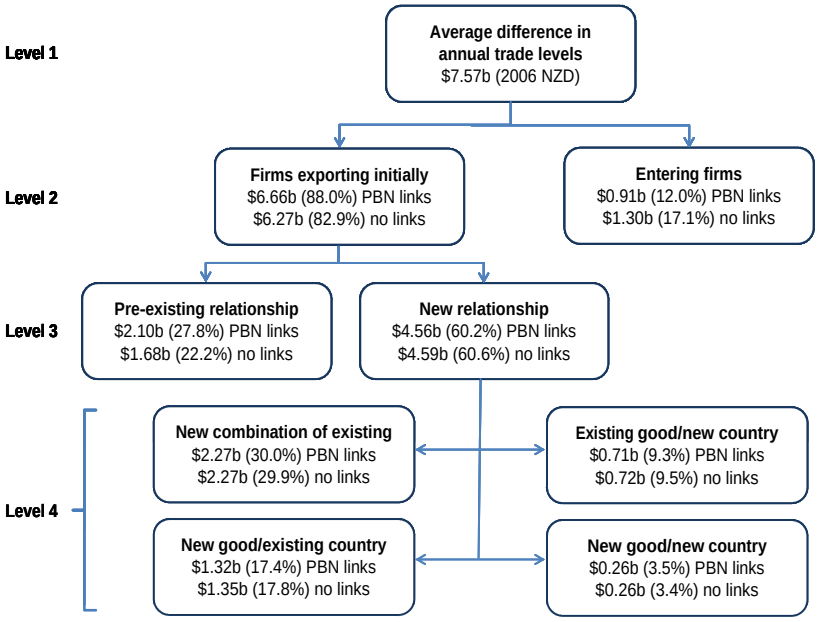
Source: Fabling and Sanderson 2010, Figure 2. Merchandise exports have been allocated to manufacturing firms according to the export allocation algorithm discussed below.

In real terms, New Zealand's aggregate merchandise export value grew steadily between 1996 and 2006 (Figure 2.1) (Fabling and Sanderson 2010). On average, the annual level of trade between 2004 and 2006 was $7.6 billion (real 2006 NZ dollars) higher than it was between 1996 and 1998 – a substantial improvement on the initial level. At the same time, a large number of firms entered exporting, with the proportion of employing manufacturers that export rising steadily from 12 percent in 2000 to 14 percent in 2006.[7] In contrast, the proportion of employing limited liability companies (IR4 filers) which were foreign owned fell from three percent to two percent between 2000 to 2008 (see Table 6.2), as increases in the number of foreign-owned firms failed to keep up with increases in the total number of limited liability companies.

Much of the growth in aggregate export value depicted in Figure 2.1 is associated with expansion along the intensive margins of exporting (increasing export value by existing exporters) rather than the extensive margin (entry into exporting by additional firms). Figure 2.2 decomposes manufacturing exports according to the degree of "novelty" involved, at both the firm level and the relationship level. The first level of the diagram reiterates the total growth in trade – the difference in the annual average level of trade between the periods 1996-1998 and 2004-2006. Level 2 splits this value into that coming from new exporters vs

[7] This measure is not available prior to 2000 due to the absence of employment data.

Figure 2.2: Decomposition of aggregate annual trade growth, 1996-1998 to 2004-2006



Source: Fabling and Sanderson 2010, Figure 3. The "PBN links" method uses the continuation of any plant (PBNs) to repair changes in firm identifiers. Conversely, the "no links" method assumes that firm identifier changes accurately reflect real-world entry and exit of firms. Merchandise exports have been allocated to manufacturing firms according to the export allocation algorithm discussed below.

incumbents from the 1996-1998 period, while the lower levels further decompose the value from incumbent firms into that coming from existing and new relationships. A relationship is defined as the export of a specific HS10 good to a specific destination (eg, apples to Japan or toasters to Australia). Each level of the diagram reports both the net dollar contribution and the share of that contribution to aggregate trade growth.

Figures 2.1 and 2.2 make use of a data repairing technology developed by Richard Fabling and documented in Fabling and Sanderson (2010). This technology is also applied in Chapters 3 and 4 and concerns the allocation of merchandise trade to manufacturers within vertically integrated business groups.

Trade data are linked to the LBD using exact matching on IRD numbers and, in the absence of those, probabilistic matching on business names and addresses. Within group structures (ie, independent firms with parent-subsidiary ownership relationships), this latter method of linking potentially causes problems as several firms within the group can have similar names and/or addresses.[8] Moreover, while each enterprise number represents a distinct legal unit, not all enterprises operate independently. In particular, groups of firms with parent-subsidiary linkages may operate in a vertically-integrated manner, with the products of the

[8]Tests by SNZ suggest that probabilistic matching is an adequate technique.

manufacturing firm being recorded as exports by a linked firm further up the production chain. Early investigations of the trade data (Fabling and Sanderson 2008) also suggest that restructures within parent-subsidiary groups can affect the apparent allocation of trade data among group members as reporting lines, Customs details, and/or enterprise identifiers change. Left unaddressed, this issue can result in a substantial proportion of aggregate goods trade allocated to sectors for which no such large-scale trade should exist (primarily in Business and financial services), and will overplay the role of entering firms in trade growth.

In Chapters 3 and 4, this issue is addressed by allocating merchandise exports back to the apparent production unit – the manufacturer – following the methodology of Fabling and Sanderson (2010).[9] First, all economically active firms which are linked by parent-subsidiary relationships in a given year are grouped together.[10] The task at hand is to identify which enterprise (or enterprises) within the group appears to be involved in merchandise exports, and whether it is possible to identify the production unit associated with those goods.[11] Enterprise groups which do not include any manufacturing firms (primarily independent wholesale and retail trade firms) are excluded, as the producer of the goods cannot be identified. Checks are then done for instances of non-manufacturing firms which are grouped with manufacturers, but where export data has been linked to the non-manufacturing units. If this is the case, and if there is only a single manufacturer within the group, those goods are reallocated to the manufacturer.

Where there is more than one possible producer within the group, trade is initially allocated to the manufacturer which can be identified as a trading firm (either because other Customs data is linked to them or because their GST filing indicates they are an exporter). If there are still multiple candidates within the group, it is not possible to identify which manufacturer produces the export good. In this case, all manufacturers within the group are merged together and treated as a single unit across all time. Remaining high value entrants are manually checked to ensure that they should not be part of a broader group structure and a small number of additional parent-subsidiary relationships are added (typically because an

[9] Chapter 5 instead identifies trade at the level of the enterprise group and looks at the locations of plants which are likely to be involved in the production or handling of merchandise trade: Agriculture, forestry and fishing; Manufacturing; Wholesale trade; and Transport and storage. Chapter 6 uses an alternative indicator of export performance, based on goods and services tax (GST) returns which include both merchandise and service exports.

[10] To be "economically active" a firm must be observed as either: selling products, purchasing intermediate inputs, employing staff or working proprietors, holding physical capital, or trading (exporting or importing) goods.

[11] This relies on an assumption that where an enterprise group is involved in both production and exporting, the exported goods will predominantly have been produced by the manufacturing members of the group.

existing group link is present only in a subset of the years in which the firm is observed in the Customs data).

The entire process results in a mere 0.5 percent of firm-year observations being of "merged manufacturers". In contrast 67 percent of aggregate trade is in merged manufacturers and 29 percent of trade has been reallocated from non-manufacturers to manufacturers. From manual investigation of the data it is clear that these numbers primarily reflect the vertically-integrated organisation of large New Zealand trading conglomerates. While there will almost certainly be cases where the reallocation of exports will overstate the true value of exports from a given manufacturer, the reallocation procedure provides a tractable means of linking trade to production, allowing the role of producer characteristics in determining trade behaviour to be considered.

A second challenge for the longitudinal data in the LBD relates to breaks in firm identifiers ("enterprise numbers") over time. Statistics New Zealand uses enterprise identifiers to track legal enterprises over time. However, tracking legal entities is not always the same thing as tracking firms. For example, if a sole proprietor were to incorporate their business into a limited liability company, they would be considered as a new legal entity and be issued a new enterprise number. Yet from an economic perspective, these two enterprise identifers would be considered to represent the same firm as there has been no change in the activities of the firm, which continues to employ the same people, in the same location and produce the same type of goods and services. By using information about employment at each of the firm's geographic units (plants) it is possible to repair these identifier breaks. Plants are represented in the data according to a "Permanent Business Number" (PBN). The analysis in Chapters 4, 5 and 6 treats two enterprise numbers as belonging to the same firm if one enterprise number ceases employing in a month, the other starts employing in the next month and all employing plants move from the first to the second enterprise number, following the methodology developed by Fabling (2011).[12] Figure 2.2 instead presents results for two extreme assumptions. The "PBN links" estimates are calculated under the assumption that the transfer of any plant between two enterprise identifiers indicates that these firms are linked, and hence treats the two enterprise numbers as belonging to the same firm. In contrast, the "no links" results assume that all changes in enterprise identifiers represent real world entry and exit, such that each enterprise number is counted as a separate firm. The two calculations therefore represent upper and lower bounds, with the "PBN links" method tending to overestimate the share of trade associated with continuing firms (and hence continuing

[12] See Fabling (2011) for more detail on the methodology and the implications for filing patterns. Chapter 3 restricts analysis to firms which were observed in all years.

exporters) while the "no links" method underestimates this measure, and overestimates the share associated with new exporters. The methodology used in Chapters 4, 5 and 6 represents an intermediate assumption, which imposes a reasonably strict yet plausible threshold for linking firm identifiers over time.

After applying these data repair technologies, level 2 of Figure 2.2 shows that new exporting firms contribute between 12 and 17 percent of the aggregate increase in trade between 1996-98 and 2004-06. While the \$0.91∼1.30 billion associated with new exporters represents a sizeable contribution to aggregate exports, particularly given the relatively short time period under examination, it is clear that the majority of export growth is associated with increases in export value among existing exporters. However, level 3 makes it clear that the share of growth associated with incumbent exporters does not imply that growth is driven by doing "more of the same". Rather, 60 percent of aggregate export growth (around two thirds of that coming from incumbent exporters) is derived from existing exporters entering into new export relationships.

Level 4 in turn decomposes new relationships according to four types, differentiated according to the degree of novelty involved.[13] This decomposition suggests that trade expansion tends to be incremental in nature. Of the \$4.6 billion in export growth associated with incumbent exporters entering into new relationships, around half is due to "new combinations of existing" export products and destinations – firms exporting a product from their existing product range to an existing trading partner which had not previously received that particular product. Depending on the degree of similarity in products and markets, this form of trade diversification is likely to incur relatively low costs, as it allows firms to make use of their existing trade networks and production capabilities. Conversely, the smallest category in terms of both contribution to aggregate value growth (Figure 2.2) and the number of new relationships (Table 3.4) is the category involving the most novelty – the export of a new export product to a country with which the firm has no prior export history.

Finally, Table 2.4 summarises the point in time diversity of export relationships at the firm level, showing substantial heterogeneity across firms. While the median firm is involved in only four export relationships, involving the export of three goods to two countries, the mean across firms is much higher. For example, while over a quarter of all exporters export only a single product, at the other end of the spectrum nearly 20 percent of firms export more than ten. Firms in their first year of exporting tend to be much less diverse in terms of the

[13] Table 3.4 provides a similar breakdown for counts of relationship entries among existing exporters, but is based on a slightly different time period and population definition.

Table 2.4: Number of export goods/countries/relationships per year, 2000-2006

	Mean	Median	Proportion	
			$N = 1$	$N \leq 10$
All exporters				
Goods	9.9	3	0.273	0.794
Countries	4.3	2	0.430	0.908
Relationships	18.6	4	0.239	0.714
In first year of exporting				
Goods	2.3	1	0.608	0.976
Countries	1.4	1	0.800	0.994
Relationships	2.7	1	0.574	0.966

Source: Fabling and Sanderson 2010, Table 1.

export portfolios, with most firms exporting only a single good to a single destination, and less than one percent of firms being involved in trade relationships with multiple countries.

Together, the decomposition of Figure 2.2 and the export diversification patterns in Table 2.4 suggest that increases in firm level export value tend to involve a process of incremental expansion in the number of products traded and the number of markets served. One possible explanation for this tendency is that fixed entry costs and/or risks may be correlated across markets and products. By concentrating their new relationships in areas where they already have some experience, firms may be able to gain from economies of scope, minimising the total entry costs across relationships. Meanwhile, if the outcome of potential relationships is uncertain, but the probability of success is correlated across markets, firms may prefer to enter sequentially, as they gain information about the potential success of each product-market combination. The next chapter digs more deeply into the relationship entry decision, focusing on the role of past experience in determining firms' product and market choices.

Chapter 3

Whatever next? Export market choices of New Zealand firms*

The international literature provides broad support for the assumption that sunk costs influence firms' export decisions (Roberts and Tybout 1997; Bernard and Wagner 2001; Bernard and Jensen 2004b; Das, Roberts, and Tybout 2007). However, until recently firm-level research in this area tended to treat export status as a binary variable – firms are either exporting or they are not. Hence empirical studies of entry into exporting focused on the initial entry decision, particularly on identifying the firm-specific characteristics which set exporting firms apart from non-exporters. The research in this chapter focuses on a subsequent question: Given that a firm *has* the ability to export, what determines the choices they make about what and where to export? Chapter 4 returns to the issue of initial entry into exporting within the context of examining the impact of exporting on firm performance.

Focusing on the behaviour of already-exporting firms is essential for understanding the processes by which aggregate export value increases over time. As discussed in Chapter 2, a large proportion of aggregate trade growth in New Zealand over the past decade has come from expansion in the range of export activities undertaken by incumbent exporters. These firms account for over four fifths of net growth in the annual average value of merchandise trade between 1996-98 and 2004-06. In turn, over two thirds of that growth was created by incumbent exporters entering into new trade relationships. This effect dwarfs the impact of firms' initial export entry on overall export growth.[2]

The literature points to the importance of sunk costs in determining firms' initial export entry decisions. At least theoretically, this argument seems equally persuasive for subsequent

*A modified version of this chapter has been accepted for publication in Papers in Regional Science.

[2]In a similar decomposition, Bernard et al (2009) find that changes in the product-country mix of existing exporters account for 42 percent of net export growth among US exporters between 1993 and 2003, well above the share associated with net export entry and exit (24 percent) or net growth in existing relationships (35 percent).

entries. Every geographic or product market provides new challenges for firms, including setting up distribution networks and coming to grips with foreign consumer preferences and government regulations. However, firms may become more adept at handling these challenges over time, building up both market-specific knowledge and networks, and general exporting competencies.

To identify the existence of relationship-specific sunk export costs, this chapter looks at whether firms' past experience of exporting influences the choices they make about entry into new trade relationships – once a firm has exported a product to one country, is it more likely to send the same product to other destinations? Does an existing trade relationship tend to increase the probability that new products will be exported to the same country?[3] Finally, it considers whether one firm entering a new export market creates spillover benefits to other firms by providing an example which they can follow.

These questions are examined using firm-level longitudinal trade and performance data for New Zealand. Existing New Zealand and international literature shows that high performing firms self-select into exporting.[4] Firm performance variables are included to test whether this is also true for subsequent entry events.[5] Additional variables are included to reflect the incentives to enter specific markets, such as the size, wealth and openness of potential trade partners and the relative exchange rate. Finally, the firm's own history of international engagement and variables measuring demonstration effects from other exporting firms are included to identify differences in the sunk costs of entry into new trade relationships.

Section 3.1 describes the conceptual model, drawing on the existing literature on export market entry. Section 3.2 outlines the data, sampling strategy, and explanatory variables, while Section 3.3 outlines the estimation approach. Section 3.4 discusses the main empirical results and robustness tests. Section 3.5 concludes.

3.1 Conceptual framework

This chapter considers the determinants of entry into new trade relationships, where a relationship is defined as a firm exporting a specific product to a specific destination. As such,

[3] This type of incremental expansion is a key source of export growth, as discussed in Chapter 2, with the export of new or existing product lines to existing trade partners accounting for nearly half of aggregate export value growth.

[4] Wagner (2007) provides a recent review of the international literature and Chapter 4 provides estimates for New Zealand.

[5] More precisely, whether exporters that enter additional markets have higher initial productivity than exporters that don't enter additional markets.

a new entry may involve the export of an existing product to a new market, a new product to an existing market, a new product to a new market or a new combination of existing products and markets.

The research therefore sits at the confluence of two streams of research on firm level export performance. The first of these is focused on the geographic spread of trade. Authors such as Eaton et al (2008b) and Melitz and Ottaviano (2008) posit that incentives to export are determined by destination market characteristics (eg, market size and distance from the home market) as well as firm characteristics. These models imply a hierarchy of potential destinations in which low productivity firms choose to enter only the easier or more attractive markets while more productive firms export to a wider range of destinations.[6]

However, Eaton et al (2008b) and Lawless (2009) show that the assumption of hierarchical export markets is only weakly supported by the data. Lawless (2009) notes that while Irish exporters tend to focus first on a few, popular markets, there is considerable variation across firms, suggesting a firm- or product-specific dimension in the determination of which markets are the easiest or most attractive targets.

One possible explanation for substantial deviation from the hierarchical model predictions is the stochastic expansion of networks based on firms' existing trade patterns. Chaney (2011) develops a model of geographic expansion in which market entry is driven by the accumulation of trading contacts, through a combination of "random encounters" (or purposive attempts to seek out new markets) and the expansion of existing networks as firms expand their own network to include the contacts of their existing contacts. Thus, firms which already export to a given country are able to expand more easily into existing trading partners of that country, a prediction which Chaney (2011) shows is supported by the empirical data.

The second strand of this literature focuses on the product dimension. Bernard et al (2011) develop a model in which firm-level product diversity is driven by a combination of firm productivity (affecting production costs of all products) and a stochastic firm-product-country level "consumer tastes" draw (determining the destination-specific popularity of each of the firm's potential product lines). They show that a fall in trade costs will lead firms to concentrate their efforts on a smaller number of core products due to increasing competition. However, while the model generates empirically supportable predictions regarding

[6] An alternative model (Baldwin and Harrigan 2007) suggests that the source of firm heterogeneity is differences in product quality and that only those firms which produce high quality goods will enter more "difficult" markets.

product diversity, the nature of the consumer tastes variable means that actual outcomes for any given product-country relationship are random.[7] Eckel and Neary (2010) also consider the impact of trade liberalisation on product diversification, but in a model in which firms face increasing production costs as they move further away from their "core competencies." Again, their model predicts greater diversification among high productivity firms and a narrowing of focus in response to trade liberalisation. In each case, however, market entry costs are assumed to be exogenous to the individual firm.

The focus of this chapter is on "learning to export" – that is, on the relationship between past international experience and entry costs for new relationships. The method builds on the fact that exporting incurs many costs. Some of these are variable costs, including transport, insurance and tariffs, which lower the net value of each unit of exports to the firm. Others are fixed but incurred on an ongoing basis, such as costs for maintaining offshore sales offices or ongoing relationships with distributors. Finally, firms face sunk costs associated with entry into new markets, including information costs such as market research on the structure of demand, setting up distribution networks, and learning about the regulations and institutional requirements of foreign markets. Fixed costs of export market entry are generally believed to be significant relative to marginal shipping costs.[8]

Although geographic market entry costs are a more common feature of export theories, firms also incur costs from entry into new product markets. These include the direct costs of developing a new product but also many costs associated with market entry, such as tailoring marketing strategies to encompass these products.[9]

Over time, however, firms may develop capabilities which enable them to reduce the costs and/or risks associated with entry into new exporting activities. As firms develop experience in certain products or markets, they learn about relevant exporting opportunities (reducing risk), at the same time as developing distribution networks, and gaining understanding of the regulations and market environment relevant to their products (reducing information costs for future entries). Evenett and Venables (2002) provide evidence of this form of learning using aggregate export data by three-digit product and destination, for a panel of 23 developing and middle income countries, to examine what they call "the geographic spread of

[7] Bernard et al (2011) note the possibility of imposing greater structure on the consumer tastes draw to reflect correlations in tastes across countries and products.

[8] Das et al (2007) find that while initial entry costs are high, per period continuation costs are negligible on average, but important for at least some firms.

[9] As the data do not include product-level information on firms' domestic sales it is not possible to distinguish between existing product lines which are being newly exported and new product lines which are exported as soon as they are developed. If the latter situation dominates, the implied cost of export entry may be overstated as it will reflect both development and export-related costs.

trade" – the export of existing product lines to new trading partners. They find that geographic and linguistic proximity to both the home market and existing export destinations play a role in determining the probability of expansion into previously unsupplied markets, implying firms learn from past export experiences. However, the use of product line data prevents identification of the microeconomic channels underlying this pattern.

Only one paper is known to directly consider the issue of endogenous entry costs at the level of firm-product-destination export relationships. Álvarez et al (2010) use Chilean data to show that the probability of a firm entering a new export relationship is positively related to the cumulative value of both the firm's own past experience in exporting that product to other markets and exporting other products to the market in question, and the values of other firms exporting the same product, exporting to the same destination, or both. That is, expansion is more likely in the firm's core products and markets, and firms may learn from the export experience of others. This chapter takes this estimation one step further to consider the determinants of choices when firms may not have prior experience in the product or country concerned.

The discussion in this chapter is focused on the role of fixed costs, but the apparent learning effects uncovered may also reflect decreases in (perceived) risk. Given the large and often irreversible nature of market entry costs, firms face substantial risk in entering new markets, and have an apparently strong incentive to ensure that their forays into international trade are successful in order to recoup these costs. Yet low-value, short term relationships are common, and relationship entry and exit are pervasive (eg, Eaton et al 2008a; Lawless 2009; Fabling and Sanderson 2010). A recent strand of literature relates this finding to uncertainty on the part of both exporters and their trading partners, and a learning process by which firms gain information about potential export success through small-scale entry into international markets (Rauch and Watson 2003; Eaton et al 2010; Albornoz et al 2010; Iacovone and Javorcik 2010).

Eaton et al (2010) consider firm-to-firm trade relationships among Colombian exporter-US importer pairs. They show that many new exporters sell only small amounts and their trade relationships are very short-lived, but that those firms which continue exporting expand their exports dramatically over a short period of time. The authors attribute this to learning by the exporter, in an environment with costly export promotion. In their model, exporters can invest in promotion of their products, and the outcome of this promotion gives them additional information about whether their efforts are likely to be successful. Firms that initially experience a good response to their product increase in confidence that their product

will be profitable in the foreign market, making them more willing to spend on export promotion within that market.

Similarly, Albornoz et al (2010) work from the assumption that a firm's export profitability is correlated over time and across markets. While only some firms will find it profitable to export, firms initially have imperfect knowledge about which side of the break-even point they are on. However, due to similarities in supply and/or demand conditions across destination markets, firms which are successful in one market will infer that they may be successful in other markets, again encouraging them to bear the costs of market entry and leading to a sequential pattern of export expansion.[10]

The key assumption of sunk market entry costs suggests a number of testable hypotheses, many of which have been addressed in the literature. The remainder of this section recaps hypotheses associated with initial export entry and extends them to cover entry into additional markets and products. Consider the model developed by Clerides et al (1998) where "incumbent exporters continue to export whenever current net operating profits plus the expected discounted future payoff from remaining in exporting is positive, and non-exporters begin to export whenever this sum, net of start-up costs, is positive. Expected future payoffs include the value of avoiding start-up costs next period and any positive learning effects that accrue from foreign market experience."

More formally, define y_t as a dummy variable indicating whether a firm exports in the current period $(y_t = 1)$, or not $(y_t = 0)$; $\pi^f(c_t, z_t^f)$ as the profit available from foreign markets, given marginal cost c_t (assumed to be constant across units within any given time period) and the current conditions in foreign markets z_t^f; M_t as the per period fixed cost of being an exporter (eg, costs of dealing with intermediaries); $\delta[E_t(V_{t+1}|y_t = 1)] - E_t(V_{t+1}|y_t = 0)]$ as the expected future value in the next period, conditional on being an exporter in the current period, less the expected future value in the next period conditional on not being an exporter in the current period, all discounted by the one-period discount factor δ; and F as the fixed cost of market entry, incurred only when the firm was not exporting in the previous period $(y_{t-1} = 0)$. Firms export (ie, $y_t = 1$) whenever

$$\pi^f(c_t, z_t^f) - M_t + \delta[E_t(V_{t+1}|y_t = 1)] - E_t(V_{t+1}|y_t = 0)] \geq F(1 - y_{t-1}). \qquad (3.1)$$

For export relationships, rather than a binary export decision, country and product subscripts

[10] In contrast, Rauch and Watson (2003) focus on uncertainties on the part of the importing firm, suggesting that firms from developed countries may initiate "trial" relationships with developing country suppliers in order to test their quality and reliability, prior to committing to a longer term supply contract.

must be added to each of the relevant variables. Consider a firm deciding whether to export for the first time or an incumbent exporter deciding whether to export a new product or enter a new geographic market. These decisions are effectively identical to that proposed by Clerides et al (1998), with the addition that firms must choose which markets are likely to provide acceptable returns and, for multi-product firms, whether to export all or only part of their range.[11] Each geographic or product market entry involves additional fixed costs. However, firms may be able to gain economies of scope by entering into multiple relationships. For example, by exporting multiple products to a single country firms incur additional development and marketing costs for each new product but can spread the costs of learning about institutional settings across a wider range of goods.

Other factors which may lower relationship-specific entry costs include experience with other forms of international engagement, such as FDI, joint ventures, offshore production or direct imports, or demonstration effects from the export activities of other firms. Country- and relationship-specific import experience may reduce costs of market entry as a firm may already have some knowledge about conditions in the destination country. Past importing of a product may be important if firms are able to learn to produce a new variety by copying from an established offshore producer or if some portion of their export activities is actually in re-exports.[12]

As well as learning by experience, firms may also be able to learn from the experiences of others. Hausmann and Rodrik (2003) discuss the role of demonstration effects in allowing firms to recognise market opportunities. In their model, entrepreneurial behaviour is limited by the inherent risks associated with innovating. Firms may observe their competitors moving into new markets and follow suit, allowing them to better choose markets, reduce the risks associated with entry, and (potentially) bid away the rents accruing to the first mover. At the same time, demonstration effects may help firms to directly reduce the costs of market entry, through easier access to the information and networks needed to smooth their entry into that market.

Research looking at firms' overall export propensity (the probability of entering their first export relationship) has tended to find little evidence for export demonstration effects,[13] though there have been some exceptions. For example, Greenaway and Kneller (2004) find consistently positive export propensity spillovers and that a large number of new entries into

[11] While it is possible that export experience affects marginal production costs and firm performance, as shown in Chapter 4, this chapter focuses on the potential impact on fixed costs of additional market entry.

[12] That is, if some of their export products are brought in from offshore, undergo minor alterations (eg, repairs, repackaging), and are then re-exported.

[13] For example, Aitken et al (1997) and Bernard and Jensen (2004b).

exporting have a greater effect than a high concentration of existing exporters.[14] Álvarez et al (2010) find that learning from others is important for entry into new relationships, particularly in traditional comparative advantage products.

Finally, economic conditions both at home and abroad may impact on both the decision to export and which countries to target. Early studies of New Zealand export behaviour found that changes in manufacturing exports could be explained in a large part by domestic GDP – when domestic incomes were low, exports rose as firms sought new outlets for their output (Tweedie and Spencer 1981).[15] Conversely, export entry and domestic conditions might be positively related if lagged GDP growth reflects growing conditions, say, for agricultural exports. The expected effect of foreign market characteristics is similarly ambiguous. While factors such as market size or wealth may make some destinations more attractive to exporters than others, Mayer et al (2010) show that tougher competition in large markets may lead firms to focus on their best-performing products, potentially reducing overall entry rates.

3.2 Data

The primary source of data for this chapter is the prototype Longitudinal Business Database (LBD) developed by Statistics New Zealand. Specific datasets used are: the Longitudinal Business Frame (LBF), which provides information on industry, location and ownership; administrative data from the Inland Revenue Department including goods and services tax (GST) returns, financial accounts (IR10), and company tax returns (IR4); information on employers, employees and wages aggregated to the firm level from the Linked Employer-Employee Dataset (LEED); shipment-level merchandise trade data provided by the New Zealand Customs Service (Customs);[16] and value-added data from the Annual Enterprise Survey (AES).

Examination of past export experience is also complicated by breaks in longitudinal enter-

[14] This result may be driven in part by changing macroeconomic conditions either domestically or abroad. For example, if some firms are slower to react to new export incentives than others, the laggards will look as if they have been influenced by the early entrants. To mitigate this issue the current analysis includes explicit controls for macro-economic conditions.

[15] This study was completed before the economic reforms of the 1980s and the relationships may have changed dramatically since that time. This type of analysis does not appear to have been performed for New Zealand since the reforms.

[16] Adjustments have been made to the classification system to maintain a constant definition of products over time and exports associated with vertically linked groups of firms have been allocated to the manufacturing enterprise, as discussed in Chapter 2.

prise identification numbers. To mitigate the potential for this issue to affect measures of export experience, the population is restricted to those firms which were active in each of the years from 2000 to 2006 (the period over which all data sources are available).[17]

Finally, because the focus of this chapter is on *subsequent* export market choices, firms with no observed exports over the period 1996-2006 (the period over which consistently linked export data are available) are excluded and the remaining firms are included in the analysis only after their initial entry into exporting. This will tend to bias the population towards high-performing firms, as these firms will be more likely both to survive throughout the period and to have observed exports. By compressing the distribution of firm performance to the higher end this may in turn alter the estimated impact of performance on export entry.

The export performance of each firm is considered over five financial years, 2002-2006, with quarterly observations of export activities.[18] The final population includes 3,483 manufacturing firms, with between 2,286 and 2,919 firms included in each year,[19] and captures 71.8 percent of aggregate merchandise trade over the period 2002-2006.

3.2.1 Explanatory variables

Given the strong empirical relationship between firm performance and first time export entry (Wagner 2007), two lagged firm performance variables are included as explanatory variables – log of employment *(lagged total employment)* and multi-factor productivity *(lagged mfp)* relative to the industry-year average. A dummy variable is also included to distinguish independent enterprises from groups of linked manufacturers *(multi-enterprise firm)*.[20]

Export experience is explicitly allowed to determine entry decisions by including indicators of firms' past trade history. In examining each potential new relationship, the analysis takes account of whether the firm has previously exported other goods to the same country, or the same product to other countries. In addition to a set of simple dummy variables to indicate that the firm has some experience of the activity in question, experience is allowed to depreciate over time by including variables which measure the inverse length of time since a firm last dealt with that product or country (set to zero if the firm has no experience with the relevant export activity). Thus, the variables for the *inverse time since firm last:*

[17] This treatment differs from that used in Chapters 4, 5, and 6 as the current chapter was completed prior to the development of the longitudinal enterprise repair algorithm.

[18] The estimation period is constrained by the need for lagged employment data.

[19] All firm counts have been random rounded (base three) in accordance with Statistics New Zealand confidentiality requirements.

[20] Primarily to control for differences in data treatment, as discussed in the next section.

exported; exported this prod.; exported to this dest. will be equal to: zero if the firm has no experience (at all, in that product or in that country, respectively); one if they exported in the previous quarter; and somewhere between zero and one if they exported in a prior period, depending on the vintage of the most recent experience.[21]

Closely related experience is also allowed to influence later behaviour, by the inclusion of measures of experience in exporting "similar" products (other products in the same HS4 category) to the country in question or exporting the relevant product to "similar" countries – either geographically close to each other (countries in the same geographic region or sharing a contiguous land border), or sharing a common language other than English. Again, dummies for whether the firm has ever been involved in the export activity in question and a measure of the inverse number of quarters since the firm last exported a similar product (exported to a similar country) are both included.

Following the literature on multi-product firms and core competencies (Eckel and Neary 2010; Bernard et al 2011), a distinction is made between single- and multi-product exporters *(multi-prod. exporter)* and entry probabilities are allowed to differ depending on the centrality of a product to a firm's export strategy, through the inclusion of a variable which captures the share of each good in the firm's cumulative export value over the past five years *(share of exports in this prod.)*. In addition, a similar hypothesis is considered from the country perspective, noting that just as firms may have product-specific competencies in terms of the production cost or desirability of their goods, they may also have country-specific competencies (eg, a well developed distribution network). Therefore, explanatory variables are included to indicate whether a firm already exports to multiple countries, and the share of value in each specific country *(multi-dest. exporter; share of exports to this dest.)*. Being a multi-product or multi-destination exporter is expected to increase the probability of additional entries, because it may signal wider exporting competencies, and may expand the potential network of existing export contacts (as in, eg, Chaney 2011). Similarly, it is likely that firms will expand exports of their core products (exports to their core destinations), suggesting a positive relationship between the importance of a given good (destination) in their existing export receipts and future relationship entries.

Clearly, exporting is not the only way in which firms may learn about other potential markets. Other forms of engagement such as FDI, joint ventures, offshore production and direct imports also build firms' knowledge of, and experience dealing with, international markets. The dataset provides some indications of these alternative forms of international

[21] Recall, however, that the population is constrained to firms which have some past export experience.

engagement (though not a comprehensive set of measures). Additional explanatory variables include an indicator of foreign ownership *(foreign owned)* and a full set of import history variables, again distinguishing between whether the firm has any experience and the recency of that experience. While foreign ownership may provide firms with additional knowledge about potential export opportunities, the effect on exports will also depend on the motivations of the foreign owner (eg, whether the New Zealand operations were established to serve the local market or to acquire access to technology or resources to support the firm's global activities).[22]

In defining demonstration variables, it is assumed that firms will learn best through direct observation of other firms in the same local area. Two sets of demonstration variables are included, one reflecting employment in incumbent exporters and the other employment in entering exporters. While the activities of incumbent exporters are likely to be more visible and may provide a better example to follow (given that the incumbents have presumably had some success in maintaining their exports over time), newly entering exporters may provide more information about changing conditions in the relevant product and geographic markets. The demonstration variables are the proportion of employment in manufacturing firms in the same regional council[23] which, in the past twelve months, have continued or commenced: exporting *(incumbent exporters; new exporters)*; exporting to the country in question *(incumbent/new exporters to this dest.)*; exporting a similar (same HS 4-digit) product *(incumbent/new exporters of similar prod. (HS4))*; or both *(incumbent/new exporters in this reln. (HS4))*.

Annual estimates of population, GDP per capita and import intensity in destination markets and their three year growth rates are also included to reflect the likely benefits (and challenges) of targeting large, rich, open and growing economies.

Monthly bilateral exchange rate measures are used to indicate the purchasing power of foreign buyers. In all cases, the exchange rate is defined as foreign currency units per New Zealand dollar and the measure used is the deviation of the bilateral exchange rate from its average over the previous 36 months. Thus, values above (below) one imply that the New Zealand dollar is above (below) its historical mean with respect to the destination currency. As a high New Zealand dollar is expected to dampen trade, we would expect to see an increase in the exchange rate also dampening export market entry. Results are reported

[22] Manova and Zhang (2009) find that although foreign affiliated and joint venture firms in China trade more and exhibit more diversified imports, they export fewer products to fewer destinations than private domestic firms.

[23] New Zealand is divided into 16 regional councils, with populations ranging from 1.4 million in Auckland to 32,000 in the West Coast (Statistics New Zealand 2008b).

for both nominal and real exchange rates,[24] and the effect is allowed to differ depending on whether the exchange rate is above or below its historical average by including both the exchange rate deviation measure *(exchange rate)*, and that measure interacted with a dummy equal to one if *exchange rate* is above one *(exchange rate$*\delta$(high))*.

Annual change in New Zealand GDP *(1yr Δ in New Zealand GDP)* is included as an indicator of domestic demand conditions. Finally, log of distance from New Zealand *(distance to destination)* captures the effect of physical distance on both the fixed and marginal costs of exporting. A full list of explanatory variables is provided in Table 3.1, with detail on the source and construction of each variable. This table also summarises the expected sign of each coefficient.

3.2.2 Actual and potential entry events

A relationship entry is defined as being the first time a firm is observed to export a given product to a given country since January 1996 (the earliest consistently available firm-level export data). As all firms in the population have export experience, each entry event involves either the addition of a new product or destination to the firm's existing export portfolio, or a new combination of existing export products and destinations. In each quarter, and for each product-country combination, a firm can be either an entrant (*new relationship entry*$= 1$), a potential exporter (*new relationship entry*$= 0$), or an incumbent exporter. Incumbents, including firms which have exported the relevant product-country combination in the past, are excluded from the estimation, as they do not have the potential to enter that relationship for the first time.

To clarify these possibilities, consider a world of three possible export destinations – Australia, Tonga and Niue – and a hypothetical exporting firm – NZ Toasters Ltd. At time $t-n$, the firm is observed to export toasters to Tonga. At time t, they commence exporting toasters to Niue as well. Thus, at time t toasters to Niue is a new relationship for the firm (*new relationship entry*$= 1$), toasters to Australia remains a potential, but not actual, relationship (*new relationship entry*$= 0$), and toasters to Tonga is an incumbent relationship (excluded from the analysis of entry).

In order to estimate a relationship-level variant of equation 3.1, it is necessary to define the full set of firm-country-product relationships which have the potential to exist. Defining potential entries is complicated. In principle, all firms have the potential to export any good

[24] The use of real exchange rates requires restricting attention to a smaller set of destinations.

Table 3.1: Variable definitions for analysis of export market choices

Variable	Expected sign
Firm characteristics	
lagged total employment	+
lagged mfp	+
multi-factor productivity estimated using an industry-specific Cobb-Douglas production function with non-constant returns to scale, following Fabling and Grimes (2009).	
foreign owned	?
multi-enterprise firm	?
dummy equal to one for groups of manufacturers linked by parent-subsidiary relationships	
Macroeconomic conditions	
destination population	?
destination GDP per capita	?
destination import intensity	?
total imports/GDP	
distance to destination	−
For any variable Y: *Xyr* Δ *in Y*	
$\ln Y_t - \ln Y_{t-X}$	
nominal or real exchange rate	−
deviation of nominal or real bilateral exchange rate with destination from its mean over the past 36 months (foreign currency per NZD)	
nominal or real exchange rate$*\delta$*(high)*	−
exchange rate variable set to zero if it is below one	
Demonstration effects	
Share of manufacturing employment in the same regional council in firms which have exported in the past 12 months, excluding firms which exported for the first time. Distinguishing between:	
incumbent exporters	+
exports of any product to any destination	
incumbent exporters of similar prod. (HS4)	+
exports of a product from the same HS4 classification to any destination	
incumbent exporters to this dest.	+
exports of any product to this destination	
incumbent exporters in this reln. (HS4)	+
exports of a product from the same HS4 classification to this destination	
Share of manufacturing employment in the same regional council in firms which have commenced exporting in the past 12 months. Distinguishing between:	
new exporters	+
exports of any product to any destination	
new exporters of similar prod. (HS4)	+
exports of a product from the same HS4 classification to any destination	
new exporters to this dest.	+
exports of any product to this destination	
new exporters in this reln. (HS4)	+
exports of a product from the same HS4 classification to this destination	

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Variable	Expected sign
Own trade experience	
multi-dest. exporter	+
dummy equal to one if the firm exported to more than one destination in the past five years; zero otherwise	
share of exports to this dest.	+
this destination's share of firm export value over the past five years	
multi-prod. exporter	+
dummy equal to one if the firm exported more that one HS10 digit product in the past five years; zero otherwise	
share of exports in this prod.	+
this product's share of firm export value over the past five years	
Inverse time since firm last:	
[number of quarters since the firm's most recent experience]$^{-1}$, set to zero if the firm has no past experience in the relevant activity	
exported	+
any product to any destination	
exported this prod.	+
this HS10 product to other destination(s)	
exported to this dest.	+
other HS10 product(s) to this destination	
exported a similar prod. to this dest.	+
exported this prod. to dest. in same region	+
regions are Europe, North Asia, Central and South-East Asia, Australia, Oceania (excluding Australia), North America, Central and South America, North Africa and the Middle East, and sub-Saharan Africa	
exported this prod. to dest. with same language	+
a language other than English spoken by at least 20 percent of the population of both countries	
exported this prod. to contiguous dest.	+
sharing a land border	
imported	+
any product from any destination	
imported this prod.	+
this HS10 product from any destination	
imported from this dest.	+
any product from this destination	
imported this prod. from this dest.	+

All firm-level and demonstration variables are derived from the Longitudinal Business Database. Exchange rate data from International Financial Statistics database (1). GDP and imports data from United Nations Statistics Division, National Accounts Main Aggregates database (2). Population data from US Census Bureau International Database (3). Geographic and linguistic data from CEPII Distances dataset (4).
(1) http://www.imfstatistics.org/imf/
(2) http://unstats.un.org/unsd/snaama/Introduction.asp
(3) http://www.census.gov/ipc/www/idb/
(4) http://www.cepii.fr/anglaisgraph/bdd/distances.htm

to any country. As the data covers some 13,300 products, 224 destinations and 3,483 active firms this implies there are around 10.4 billion possible trade relationships. With 20 quarters of data there could be as many as 208 billion observations of non-entry. In reality, however, no firm could reasonably be expected to export every possible product. Therefore, a number of steps are taken to limit the definition of potential entry.

Firstly, restrictions are placed on the number of products a firm could possibly produce. For every product exported by firms in a given three-digit ANZSIC manufacturing industry, it is assumed that product is a potential export for all other firms in the same three-digit industry.[25] That is, if some firms in the Electrical equipment and appliance manufacturing industry export toasters, then every other firm in that industry has the potential to export toasters.[26]

The choice of macro-economic variables restricts the sample to 191 countries for which monthly nominal exchange rates, as well as annual GDP, population and import intensity, are available. The country sample is restricted to 153 when real exchange rates are used. These countries are listed in Table 3.2. The combination of these restrictions means the population covers 62.7 percent of aggregate trade. Table 3.3 shows the effect of each restriction on the proportion of trade captured. Over the period 2002-2006 a total of 82,983 actual relationship entry events and some thirteen billion observations of potential entry are observed. In keeping with the findings of Fabling and Sanderson (2010) for aggregate export value outlined in Chapter 2, the vast majority of actual relationship entries build on existing experience, with firms exporting either new or existing product lines to countries they had already exported to in the past (Table 3.4).

While entry appears to be a very rare event when viewed from the perspective of the range of possible entries that could occur, from the firm's perspective it is much less unusual. In any given quarter around one third of firms enter at least one relationship. Of those firms, around 40 percent enter a single new relationship and a further 40 percent enter less than six new relationships (Figure 3.1). The distribution of entry events has a long tail with around one percent of firms entering more than 25 new relationships in a quarter.

[25] ANZSIC is the Australian and New Zealand Standard Industry Classification. There are 46 three-digit ANZSIC manufacturing industries.

[26] Multi-enterprise firms are excluded from the definition of industry exports because it is not generally possible to associate these firms with a single manufacturing industry. Some single-enterprise firms export products which no other firm in their industry exports, which they export on only a small number of occasions, and which do not appear to be sensible products for their industry. One-off sales of capital equipment probably explain some of these events. The definition of potential products is therefore restricted to those for which there are at least two firms in the industry exporting within the same four-digit HS category.

Table 3.2: Countries included in analysis of export market choices

Countries with both nominal and real exchange rate data		
Albania	Greece	Norway
Algeria	Greenland	Pakistan
Andorra	Grenada	Palau
Angola	Guatemala	Panama
Argentina	Guinea-Bissau	Papua New Guinea
Armenia	Guyana	Paraguay
Aruba	Haiti	Peru
Australia	Honduras	Philippines
Austria	Hong Kong	Poland
Bahamas	Hungary	Portugal
Bangladesh	Iceland	Puerto Rico
Barbados	India	Romania
Belgium	Indonesia/Timor-Leste	Russian Federation
Belize	Iran, Islamic Rep. of	Rwanda
Benin	Ireland	Saint Lucia
Bolivia	Israel	Saudi Arabia
Botswana	Italy	Senegal
Brazil	Jamaica	Seychelles
Bulgaria	Japan	Sierra Leone
Burkina Faso	Jordan	Singapore
Burundi	Kazakhstan	Slovakia
Cambodia	Kenya	Slovenia
Cameroon	Kiribati	Solomon Islands
Canada	Korea, Rep. of	South Africa
Cape Verde	Kuwait	Spain
Chad	Kyrgyzstan	Sri Lanka
Chile	Lao People's Dem. Rep.	St Kitts and Nevis
China	Latvia	St Vincent and the Grenadines
Colombia	Lithuania	Sudan
Cook Islands	Luxembourg	Suriname
Costa Rica	Macao	Swaziland
Cote D'Ivoire	Macedonia	Sweden
Croatia	Madagascar	Switzerland
Cyprus	Malawi	Syrian Arab Republic
Czech Republic	Malaysia	Tanzania, United Rep. of
Dem. Rep. of Congo	Mali	Thailand
Denmark	Malta	Togo
Dominica	Marshall Islands	Tonga
Dominican Republic	Mauritius	Trinidad and Tobago
Egypt	Mexico	Tunisia
El Salvador	Micronesia, Federated States of	Turkey
Estonia	Moldova, Rep. of	Turks and Caicos Islands
Ethiopia	Mongolia	Tuvalu
Fiji	Morocco	Uganda
Finland	Mozambique	United Kingdom
France	Nauru	United States
Gabon	Nepal	Uruguay
Gambia	Netherlands	Vanuatu
Georgia	Netherlands Antilles	Venezuela
Germany	Niger	Vietnam
Ghana	Nigeria	Zambia
Countries with only nominal exchange rate data		
Afghanistan	Congo	Namibia
Anguilla	Djibouti	Nicaragua
Antigua and Barbuda	Ecuador	Oman
Azerbaijan	Equatorial Guinea	Qatar
Bahrain	Eritrea	Samoa
Belarus	Guinea	San Marino
Bermuda	Lebanon	Sao Tome and Principe
Bhutan	Lesotho	Tajikistan
Bosnia and Herzegovina	Liberia	Ukraine
Brunei Darussalam	Libyan Arab Jamahiriya	United Arab Emirates
Cayman Islands	Maldives	Yemen
Central African Republic	Montserrat	Zimbabwe
Comoros	Myanmar	

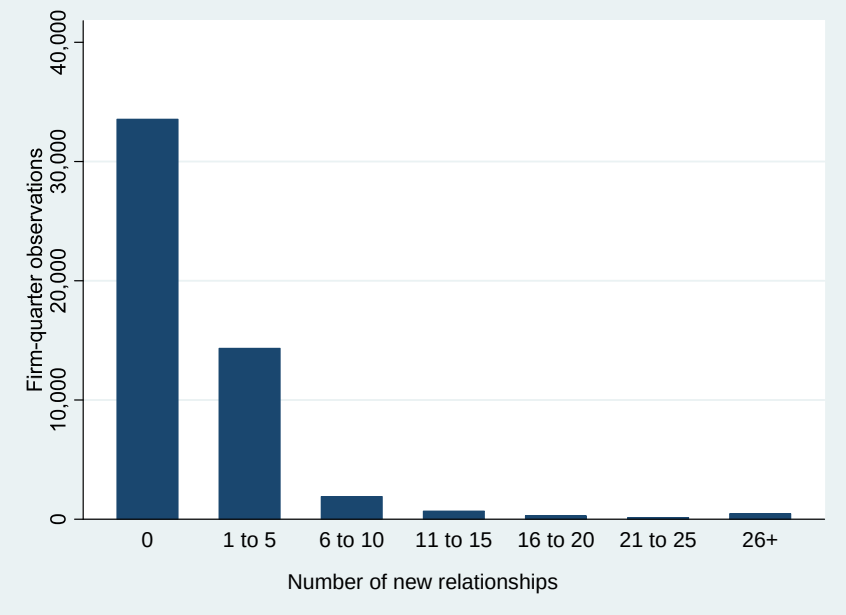


Figure 3.1: Number of new export relationships by firm-quarter, 2002-2006

3.3 Methodology

Thirteen billion observations remains an infeasibly large population over which to estimate an empirical model. Further, with only 82,983 observations of actual entry events in the population, the estimator must be appropriate for rare events.[27] To address the population size issue, a case-control sampling strategy is adopted, estimating over the entire population of actual entries and a random sample of potential entries to make up a total sample size of one million observations.[28]

The analysis follows the prior correction method for case-control studies of rare events described by King and Zeng (2001; 2004), using the ReLogit suite of Stata programmes created by Tomz et al (1999).[29] This approach corrects for selection on the dependent variable while also taking account of uncertainty in the underlying population size. While it is possible to calculate the exact number of entries and non-entries in the population, changing the potential products definition could yield substantially different population sizes. There-

[27] Rare events models have received limited attention in the economics literature. Among the small number of papers using these techniques are Wagner (2004), Caliendo et al (2009) and Criscuolo (2009).

[28] King and Zeng (2001) discuss criteria for determining the appropriate number of non-events to include in a rare event model. They suggest that two to five times as many non-events as events is sufficient, as the marginal information provided by each non-event falls as the number of non-events exceeds the number of events. As the current sample is limited only by computing power (rather than, say, data collection costs), a substantially higher proportion is used.

[29] See Appendix B for a summary of this methodology and the motivation for using it. Alternative methods are compared in section 3.4.1.

fore, a reasonably wide band is applied around the observed proportion of entry events.[30] However, if the population definition is seriously flawed, mis-estimating the entry rate is probably not the biggest issue, as there may also be bias in the pool of potential entrants. This possibility is addressed in Section 3.4.1 by considering a substantially more restrictive definition of potential export products.

Table 3.5 presents population statistics for explanatory variables using the one million observation sample, weighted to reflect the underlying population distributions.[31] Distributions for some variables, in particular those associated with product- and country-specific trade histories, are extremely skewed with less than five percent of potential firm-country-product observations having any past experience with the country or product in question. This skewness is an artifact of the definition of potential entry. That is, while the median New Zealand exporter exports only three products to two countries (Table 2.4), this analysis allows for firms to export to up to 191 countries and between 17 and 2,485 products depending on their industry. Thus, the chances of a firm having exported a specific good or to a specific country are slim.

3.4 Results

Results of the empirical estimation are presented as relative risks in Table 3.6. Relative risk (or the risk ratio) is defined here as $(P|_{x=b})/(P|_{x=a})$ for changes in the explanatory variable x (from a to b), holding all other variables at their mean. Under this specification, the null hypothesis that a variable has no effect on entry probability will be reflected in a risk ratio that is not significantly different from one. Risk ratios above one imply a positive effect and ratios below one a negative effect. We focus on confidence intervals, rather than point estimates, since the former allow for uncertainty in the underlying population incidence rate. For binary variables, the risk is calculated for a zero to one change. Where possible, relative risks for continuous variables are calculated as transitions from the 25th to the 75th percentile. Where the 25th and 75th percentile values are identical, relative risks are reported for the 5th and 95th percentiles or, in cases where the variable is almost always zero (eg, similar history variables), a 0 to 1 change. Table 3.5 shows the values of the relevant percentiles for each variable.

[30] The proportion of actual entries in the pool of potential entry events is around 6.45×10^{-06}. In estimation the bounds are set at 10^{-6} and 10^{-5}.

[31] All results are based on the weighted sample. Regression models also include a full set of month and two-digit ANZSIC industry dummies.

Some variables are intrinsically linked together. For example, a firm cannot have exported a certain product in the previous period without also having exported in that period. Where the values set for the variable of interest bind the values of other variables, the impact of the relevant change in the bound variable (eg, the change from mean to one in the *inverse time since firm last exported*) is reported first, followed by the combined effect of that and the specific change at issue (eg, the combined effect of the change from mean to one in the *inverse time since firm last exported* with a change from zero to one in the *inverse time since firm last exported this prod.*). Similarly, when determining the relative risk associated with a change from zero to one in the variables associated with the recency of a firm's exports, the dummy variable for whether the firm has ever had experience in that particular relationship is simultaneously switched from zero to one.[32]

In interpreting the risk ratios for firm variables, including own export experience, it is important to keep in mind the population definition. The estimated effects are conditional on the firm employing for seven years and having some past export experience. That is, the risk ratios do not indicate whether larger, more productive firms are more likely to enter exporting, but rather whether larger, more productive exporters are more likely to expand the range of products and countries in their export portfolio. The results in the top section of Table 3.6 suggest that larger firms, those under domestic ownership and control, and single enterprise firms show a stronger probability of entry into new export relationships. Firms at the 75th percentile in terms of their employment have between 2.4 and 22.0 percent higher probability of relationship entry than those at the 25th percentile, while the relative probabilities of foreign-owned and multi-enterprise firms are 15.5 to 35.9 and 44.2 to 62.4 percent lower respectively, when all other variables are held at their means.[33]

The negative estimated effect of being a multi-enterprise firm may be in part an artifact of the industry-based definition of potential products. That is, multi-enterprise firms are not included in the definition of potential products by industry (thus missing some products which are exported only by enterprise groups and reducing the number of actual events observed for these groups) while at the same time they are allowed to export the products associated with the industries of all their constituent manufacturing enterprises (thus increasing the number of potential non-events).

[32]Impacts of independently switching the "ever" dummies from zero to one are not reported. Reported effects are therefore a combination of having some experience in the relevant activity and the recency of this experience.

[33]Employment is correlated with the diversity of firms' export experiences. When variables indicating multi-product or multi-country export experience are excluded, the estimated effect of employment is larger. Meanwhile, including the log of the total number of past export relationships in which a firm has been involved causes the employment effect to become insignificant while not strongly affecting other coefficients.

Meanwhile, the lower entry probability for foreign-owned firms may suggest that market-seeking (rather than resource-, efficiency- or asset-seeking) is the dominant motivation for their establishment in New Zealand, or that the exports of foreign-owned firms are more limited in the range of products or countries involved (eg, exporting only to the country of the parent firm).

Keeping the reference group clearly in mind is also important with respect to own-firm export experience variables. As firms are included only in quarters after their first observed export activity, *inverse time since firm last exported* is constrained to be greater than zero, while all other experience variables can be – and in most cases actually are – zero. The results for own experience variables suggest that closely related forms of export experience (such as those associated with exporting a similar product to the country in question, or the same product to another country in the same region) dramatically increase the probability of additional relationship entry. Meanwhile the effect of *inverse time since firm last exported* shows that very recent export experience (in the previous quarter) is associated with between 29.8 and 68.4 percent higher chance of entry into a new relationship relative to a firm which last exported a year earlier.

Firms with recent import experience from a specific destination show between 50.8 and 103 percent higher chances of entering a new export relationship with that destination. In contrast, firms with experience importing a specific product show a five- to seven-fold higher probability of entering a new export relationship involving that good. Greater emphasis on the product dimension may reflect the "product cycle" model of Vernon (1966), in which importers of a product subsequently learn to produce and eventually export the product, and/or a mixed production and distribution model where diversified producer-distributors capitalise on economies of scale and scope in their domestic distribution systems by importing foreign varieties and marketing them domestically while simultaneously producing and exporting their own varieties.[34]

As expected, both multi-product and multi-destination exporters are more likely to expand into new trade relationships *(multi-prod./multi-dest. exporter).* As the share of past exports in a given product rises from the 5th to the 95th percentile, the probability of entering a new market with that product approximately doubles. That is, "core products" are more likely to be introduced to additional markets. In contrast, firms are no more likely to introduce

[34] Alternatively firms may import goods, make minor alterations or repairs, and re-export them under the same product classification. In an (unreported) robustness test the import history coefficients are allowed to differ for firms that have re-exported previously. The estimated impact of product imports on subsequent entry is lower for re-exporting firms, suggesting that re-exporting does not explain the stronger product effect.

additional products to the countries which account for the majority of their past exports than to countries which play only a minor role.

Macroeconomic conditions in destination countries are largely unrelated to entry probabilities, with only destination import intensity having a risk ratio different from (above) one. Distance, however, has a negative impact on entry, with an increase in distance from the 25th to 75th percentile of distance (approximately 5,000 kilometres) reducing entry probabilities by between 3.6 and 11.1 percent. Local conditions *(1yr Δ in New Zealand GDP)* show a positive relationship with entry propensities, in contrast to evidence from the pre-reform period (Tweedie and Spencer 1981).

The results also suggest that appreciations of the New Zealand dollar have a negative effect on relationship entry. Two sets of risk ratios are calculated for the exchange rate variable. Table 3.6 considers the impact of a change from the 5th percentile to one (parity with the 36 month historical average), and that of a change from one to the 75th percentile. However, as the magnitude of the latter change is much larger (a difference of 0.225 rather than 0.095) the comparison is also calculated over equal distances above and below parity. These latter results are reported in the top section of Table 3.7, and are calculated over a change of 0.095 either side of one. While the point estimates suggest a slightly stronger effect below parity (point estimate of 5.6 percent reduction rather than 4.5 percent), and (unreported) t-tests on the underlying logit coefficients show that the difference in slopes is statistically significant, there is substantial overlap between the confidence bands, implying that the difference is not material. Overall, however, exchange rate movements are important with both relative risks significantly different from one.

Turning to the evidence for demonstration effects (Table 3.6), the results suggest that there are few or no spillovers associated with the general export propensity of firms in the region (the risk ratio for *incumbent exporters* is not significantly different from one). However, there is a tendency for firms to follow in the footsteps of existing exporters in terms of both the products they export and the countries they export to. This effect appears strongest in relation to the activities of incumbent exporters, rather than new entrants, though this may in part reflect the distribution of the underlying demonstration variables which are more highly skewed towards zero for new entrants than for incumbent exporters (Table 3.5).

The effect of demonstration variables is thus best understood by considering differences across geographic regions, rather than considering the marginal impact of each additional exporting firm within a region. In particular, firms which are located in New Zealand regions

with high shares of employment in incumbent exporters to a specific destination will have a probability of entering a new relationship involving that destination that is between 82.5 and 113.4 percent higher than those in regions with low incumbent employment shares. The same comparison for product-specific demonstration effects is associated with a 21.4 to 31.4 percent higher entry propensity. The estimated effect of differences in the share of employment in *new exporters* is an order of magnitude lower, with point estimates ranging from 0.1 to 7.7 percent.[35]

Normalising the changes in the share of regional employment associated with each activity (Table 3.7) shows a somewhat different pattern. Comparing like-magnitude changes, relationships are still substantially stronger for destinations than products (for incumbents, 4.8 to 6.7 percent for products and 14.6 to 18.5 percent for destinations). However, the share of employment in firms which enter a destination for the first time is associated with a stronger demonstration effect than the share of employment in firms which are incumbent in a given country (in contrast to Table 3.6). The *new exporters to this dest.* variable is more likely to capture changes in conditions in the destination country (eg, changes in trade policy or the availability of transport which make certain countries more attractive, and which are not captured by the macro variables) than the incumbent measure because of hysteresis in export behaviour. That is, the behaviour of incumbent traders is less likely to convey a clear picture of current export conditions since they have previously "locked in" their export behaviour.

Table 3.8 compares the exchange rate estimates for nominal and real exchange rates over the sample of 153 countries for which both are available. For comparability, relative risks are reported for the same magnitude of change above and below par for both the nominal and real exchange rates. Again, there is substantial overlap between the confidence bands for the relative risks, implying that the effect is not materially different above and below "par". The similarity of the results across the nominal and real exchange rate, and between the nominal results for the larger and smaller country samples (Tables 3.7 and 3.8) gives confidence that using the nominal exchange rate (ie, maximising the country coverage) in the main estimates is acceptable.

Finally, while several explanatory variables are associated with large changes in the relative probability of entry (eg, recently *imported this prod. from this dest.*), the overall probability

[35] Alternative measures of demonstration effects according to the share of firms in the region which were observed in the relevant export activity were also considered. The employment based definition is preferred because it weights each firm according to its relative "visibility" (the activities of large firms are more likely to be noticed or the chances of an employee from one firm interacting with an employee from another firm is much higher when those firms are relatively large).

that a potential entry event will be realised remains very low. At the mean value of all the explanatory variables, only one in every 5.8 million potential entries is predicted to be an actual entry ($(1.73 \times 10^{-7})^{-1}$, top row of Table 3.6). Thus, even for firms which have exported a similar product to the very same destination the previous quarter, there is only a one in 9,000 chance they will commence a new relationship with that country in the following quarter. This is not surprising, given the broad definition of potential entry events, in which many firms are potential exporters of over 1,000 products and have the potential to export to 191 countries.

3.4.1 Robustness tests

This section describes two tests of robustness for the estimation approach. The first test considers the sensitivity of the results to changes in the estimation method. The second presents results for a more conservative definition of potential export products, where a firm can only export products "similar" to those it has already exported.

Estimation methods

The main estimates (Table 3.6) use the prior correction method, accounting for uncertainty in the true proportion of events in the population. As a sensitivity test, those results are compared to a rare events logit model using the alternative weighting method outlined in King and Zeng (2001) (Table 3.9).[36] Differences between the two methods are discussed in Appendix B.

Comparing the two methodologies suggests a need to be cautious about the strength of conclusions from the prior correction model, with several of the variables which are estimated to have small but significant impacts on entry probabilities in the prior correction model coming out as insignificant in the weighted logit. Further, while the two models are similar in terms of the relative effect of the different explanatory variables, the weighted correction model tends to predict less extreme effects for the relative risk associated with the past experience variables. This is balanced by a higher overall estimate of the probability of entry (at the mean of all explanatory variables). Overall, the sensitivity test suggests a need to be

[36] Standard logit and probit models were also estimated, weighted to reflect the case-control sampling method. Perhaps not surprisingly, given the similarities in methodology, the standard logit model generates almost identical results to the rare events logit model presented in this section. The estimated marginal effects from the probit model are stylistically similar to those of the standard logit model, though the probit specification tends to suggest stronger marginal effects (ie, more akin to those of the prior correction model).

somewhat cautious about the magnitude of the own-firm experience effect, but reinforces the finding that own-experience is indeed a significant factor in explaining firms' ongoing entry behaviour.

Conservative definition of potential exports

Finally, a more conservative definition of potential export products is considered, in which a firm can only export products "similar" to those it has already exported. Specifically, the population of both actual and potential entry events is restricted by requiring that for a certain HS ten-digit good to be a potential export product for a firm, that firm must have previously exported a good in the same four-digit HS group.[37]

Table 3.10 reports the relative risk results for this restricted population. The restrictions lead to a substantial reduction in population size – from nearly 13 billion potential entry events to a little over 1.2 billion. This is mainly due to a reduction in the number of products per firm, rather than the number of firms over the model is estimated. Around three-quarters of the initial population of 82,983 actual entry events were in firms which had some past export experience in a similar product line. The fact that a quarter of actual entries are lost implies that the narrower definition of potential export products is too tight – the reason for preferring the broader definition of potential entry in the main estimates. In contrast, less than ten percent of the initial population of non-entries involved relationships in which the firm had similar past experience. Thus, the overall probability of entry is substantially higher in this restricted population – around four times higher overall, and twelve times higher when evaluated at the mean of the explanatory variables.[38] The revised incidence rate, τ, sits outside the bounds set for the main model. Allowing for uncertainty in the population incidence rate, $\tau \in [0.00001, 0.0001]$ for the restricted regressions.

Despite the extreme change in the potential product assumption, the estimates in Tables 3.6 and 3.10 are remarkably similar. The key patterns associated with own-firm export experience remain significant, though the relationships are less strong. Only two significant variables (lagged employment and the relationship-level demonstration effect from incumbent exporters) change in sign. Among the import history and demonstration variables, the existing patterns are still evident but only the strongest relationships remain significant in the restricted sample.

[37] This remains a fairly broad definition in the case of many product groups – for example, electric water heaters, hairdryers and coffee makers all come under the same four-digit heading.

[38] The means themselves have also changed as those observations involving firm-product-quarters with no prior similar product experience have been dropped.

Table 3.3: Proportion of export value and entry events captured

Population definition and restrictions	**Trade**	**Entries**
Total aggregate merchandise exports	1.000	
Exports allocated to manufacturing firms	0.769	
Firm has positive employment in all seven years	0.718	1.000
Firm has some past export experience	0.718	0.987
Product exported by ≥ 1 independent manufacturer	0.684	0.942
Similar product exported by ≥ 2 firms in the industry	0.667	0.892
Firm has complete performance data available in year	0.652	0.768
Full set of macro-economic variables available	0.627	0.713

Table 3.4: Number of entry events by type

New product, old country	34,824
Old product, new country	6,373
New product, new country	2,800
New combination of existing	38,986
Total	82,983

A "new combination of existing" involves firms sending a product from their existing product range to a country they already export to. This is an entry because the mix of product and country has not been observed before.

Table 3.5: Descriptive statistics for export market choice analysis population

Variable	Mean	Standard deviation	Percentiles 5th	25th	75th	95th
new relationship entry	6.74×10^{-6}	0.003	0	0	0	0
Firm characteristics						
ln(lagged total employment)	2.688	1.536	0.606	1.642	3.555	5.423
lagged mfp	0.112	0.607	-0.788	-0.168	0.427	1.006
foreign owned	0.124	0.329	0	0	0	1
multi-enterprise firm	0.063	0.243	0	0	0	1
Macroeconomic conditions						
ln(destination population)	15.20	2.40	10.67	13.60	16.82	18.66
ln(destination GDP per capita)	7.779	1.562	5.442	6.639	8.966	10.352
ln(destination import intensity)	-0.719	0.712	-1.882	-1.103	-0.319	0.213
ln(distance to destination)	9.463	0.396	8.503	9.352	9.711	9.850
3yr Δ in dest. population	0.000	0.022	-0.002	0.000	0.000	0.002
3yr Δ in dest. GDP per capita	0.001	0.091	-0.101	-0.024	0.026	0.105
3yr Δ in dest. import intensity	0.003	0.328	-0.387	-0.093	0.104	0.398
1yr Δ in New Zealand GDP	0.032	0.011	0.016	0.027	0.040	0.049
nominal exchange rate	1.158	0.384	0.905	1.032	1.225	1.466
Demonstration effects						
Regional employment share of:						
incumbent exporters	0.685	0.045	0.583	0.667	0.716	0.725
incumbent exporters of similar prod. (HS4)	0.088	0.086	0.000	0.018	0.140	0.259
incumbent exporters to this dest.	0.091	0.113	0	0.001	0.130	0.332
incumbent exporters in this reln. (HS4)	0.001	0.008	0	0	0	0.002
new exporters	0.017	0.009	0.007	0.013	0.018	0.032
new exporters of similar prod. (HS4)	0.011	0.017	0	0.001	0.014	0.041
new exporters to this dest.	0.007	0.014	0	0	0.007	0.032
new exporters in this reln. (HS4)	0.000	0.004	0	0	0	0.000
Own trade experience						
multi-dest. exporter	0.653	0.476	0	0	1	1
share of exports to this dest.	0.005	0.058	0	0	0	0
multi-prod. exporter	0.795	0.404	0	1	1	1
share of exports in this prod.	0.001	0.019	0	0	0	0
Inverse time since firm last:						
exported	0.655	0.402	0.053	0.200	1	1
exported this prod.	0.005	0.060	0	0	0	0
exported to this dest.	0.017	0.117	0	0	0	0
exported a similar prod. (HS4) to this dest.	0.000	0.018	0	0	0	0
exported this prod. to dest. in same region	0.000	0.017	0	0	0	0
exported this prod. to dest. with same language	0.000	0.010	0	0	0	0
exported this prod. to contiguous dest.	0.000	0.006	0	0	0	0
imported	0.662	0.423	0	0.167	1	1
imported this prod.	0.010	0.084	0	0	0	0
imported from this dest.	0.018	0.121	0	0	0	0
imported this prod. from this dest.	0.000	0.007	0	0	0	0

Calculated from the one million observation sample, weighted to reflect the full population. Statistics reported as 0.000 are not precisely zero.

Table 3.6: Relative risks using prior-correction method

	Scenario	Point estimate	95% confidence interval	
Estimated probability of entry at mean values of explanatory variables		1.73×10^{-7}	2.73×10^{-8}	3.18×10^{-7}
Firm characteristics				
ln(lagged total employment)	p25 → p75	1.122	1.024	1.220
lagged mfp	p25 → p75	1.010	0.958	1.063
foreign owned	0 → 1	0.743	0.641	0.845
multi-enterprise firm	0 → 1	0.467	0.376	0.558
Macroeconomic conditions				
ln(destination population)	p25 → p75	0.921	0.840	1.001
ln(destination GDP per capita)	p25 → p75	1.053	0.946	1.160
ln(destination import intensity)	p25 → p75	1.111	1.069	1.154
ln(distance to destination)	p25 → p75	0.926	0.889	0.964
3yr Δ in destination population	p25 → p75	1.000^{-}	1.000^{-}	1.000^{+}
3yr Δ in destination GDP per capita	p25 → p75	0.998	0.979	1.017
3yr Δ in destination import intensity	p25 → p75	0.985	0.960	1.010
1yr Δ in New Zealand GDP	p25 → p75	1.057	1.016	1.098
nominal exchange rate	p5 → 1	0.942	0.918	0.966
nominal exchange rate$*\delta$(high)	1 → p75	0.896	0.852	0.939
Demonstration effects				
Regional employment share of:				
incumbent exporters	p25 → p75	0.956	0.881	1.032
incumbent exporters of similar prod. (HS4)	p25 → p75	1.264	1.214	1.314
incumbent exporters to this dest.	p25 → p75	1.979	1.825	2.134
incumbent exporters in this reln. (HS4)	p5 → p95	1.003	1.001	1.004
new exporters	p25 → p75	1.025	1.004	1.046
new exporters of similar prod. (HS4)	p25 → p75	1.012	0.994	1.030
new exporters to this dest.	p25 → p75	1.077	1.065	1.089
new exporters in this reln. (HS4)	p5 → p95	1.001	1.000^{-}	1.002
Own trade experience				
multi-dest. exporter	0 → 1	1.549	1.280	1.818
share of exports to this dest.**	p5 → p95	0.924	0.746	1.020
multi-prod. exporter	0 → 1	1.327	1.062	1.592
share of exports in this prod.**	p5 → p95	2.304	2.131	2.477
Inverse time since firm last:				
exported	p25 → p75	1.491	1.298	1.684
exported	mean → 1	1.183	1.116	1.250
& exported this prod.*	0 → 1	49.09	41.63	56.55
& exported to this dest.*	0 → 1	50.74	42.48	59.01
exported & exported to this dest.*	mean → 1	49.36	41.76	56.96
& exported a similar prod. to this dest.*	0 → 1	655.7	515.4	806.5
exported & exported this prod.*	mean → 1	48.52	40.96	56.08
& exported this prod. to dest. in same region*	0 → 1	425.2	314.8	536.7
& exported this prod. to dest. with same language*	0 → 1	113.9	71.13	156.9
& exported this prod. to contiguous dest.*	0 → 1	302.2	163.0	438.1
imported*	p25 → p75	1.317	1.148	1.486
imported*	mean → 1	1.120	1.058	1.181
& imported this prod.*	0 → 1	6.509	5.609	7.408
& imported from this dest.*	0 → 1	1.769	1.508	2.030
imported & imported this prod. & imported from this dest.*	mean → 1	10.29	8.149	12.42
& imported this prod. from this dest.*	0 → 1	215.5	106.5	324.4

Rare events logit model using prior correction method to account for case-control sampling. Estimated in Stata9 using ReLogit package (Tomz et al 1999). $\tau \in [0.000001, 0.00001]$. Regression includes (unreported) dummies for month, industry, and whether the firm has ever been active in the relevant relationship. +(-) indicates coefficient marginally above (below) one. * Includes switching the relevant dummy for ever exported (imported) this prod./dest./reln. from zero to one. ** Multi-dest. (multi-prod.) dummy set to zero; percentiles calculated across non-zero observations (dest. share: p5=0.000, p95=0.988; prod. share: p5=0.000, p95=0.262).

Table 3.7: Relative risks calculated across equal magnitude changes

	Scenario	Point estimate	95% confidence interval	
Exchange rates				
nominal exchange rate	0.905 →1	0.944	0.919	0.969
nominal exchange rate$*\delta$(high)	1 → 1.095	0.955	0.935	0.975
Demonstration effects				
Regional employment share of:				
incumbent exporters	0.001 → 0.03	0.973	0.926	1.020
incumbent exporters of similar prod. (HS4)	0.001 → 0.03	1.057	1.048	1.067
incumbent exporters to this dest.	0.001 → 0.03	1.166	1.146	1.185
new exporters	0.001 → 0.03	1.151	1.012	1.290
new exporters of similar prod. (HS4)	0.001 → 0.03	1.027	0.987	1.067
new exporters to this dest.	0.001 → 0.03	1.358	1.297	1.418

See Table 3.6 for notes on estimation method. Relationship-level demonstration effects excluded as the $0.001 \rightarrow 0.03$ transition exceeds the range observed in the data.

Table 3.8: Comparison of real and nominal exchange rates

	Scenario	Point estimate	95% confidence interval	
Estimated probability of entry at mean values of explanatory variables		1.78×10^{-7}	2.84×10^{-8}	3.27×10^{-7}
nominal exchange rate	0.905 →1	0.944	0.919	0.969
nominal exchange rate – high	1 → 1.095	0.955	0.935	0.975
Estimated probability of entry at mean values of explanatory variables		1.78×10^{-7}	2.83×10^{-8}	3.28×10^{-7}
real exchange rate	0.905 →1	0.924	0.888	0.961
real exchange rate – high	1 → 1.095	0.948	0.918	0.978

See Table 3.6 for notes on estimation method.

Table 3.9: Relative risks using weighted logit method

	Scenario	Point estimate	95% confidence interval	
Estimated probability of entry at mean values of explanatory variables		3.76×10^{-7}	3.31×10^{-7}	4.27×10^{-7}
Firm characteristics				
ln(lagged total employment)	p25 →p75	0.871	0.754	1.004
lagged mfp	p25 →p75	1.052	0.954	1.160
foreign owned	0 →1	0.934	0.763	1.155
multi-enterprise firm	0 →1	0.708	0.542	0.923
Macroeconomic conditions				
ln(destination population)	p25 →p75	0.901	0.747	1.078
ln(destination GDP per capita)	p25 →p75	0.719	0.600	0.863
ln(destination import intensity)	p25 →p75	1.054	0.947	1.171
ln(distance to destination)	p25 →p75	1.032	0.959	1.110
3yr Δ in destination population	p25 →p75	1.000^{-}	0.999	1.000^{+}
3yr Δ in destination GDP per capita	p25 →p75	0.986	0.934	1.037
3yr Δ in destination import intensity	p25 →p75	1.025	0.951	1.102
1yr Δ in New Zealand GDP	p25 →p75	1.057	0.982	1.142
nominal exchange rate	p5 →1	0.987	0.939	1.036
nominal exchange rate$*\delta$*(high)*	1 →75	0.970	0.902	1.047
Demonstration effects				
Regional employment share of:				
incumbent exporters	p25 →p75	0.957	0.856	1.062
incumbent exporters of similar prod. (HS4)	p25 →p75	1.063	0.941	1.198
incumbent exporters to this dest.	p25 →p75	1.778	1.569	2.007
incumbent exporters in this reln. (HS4)	p5 →p95	1.004	1.000^{+}	1.007
new exporters	p25 →p75	1.015	0.971	1.064
new exporters of similar prod. (HS4)	p25 →p75	0.997	0.946	1.052
new exporters to this dest.	p25 →p75	1.053	1.021	1.083
new exporters in this reln. (HS4)	p5 →p95	1.001	1.000^{-}	1.002
Own trade experience				
multi-dest. exporter	0 →1	1.832	1.504	2.232
share of exports to this dest.**	p5 →p95	1.901	1.451	2.496
multi-prod. exporter	0 →1	1.495	1.200	1.833
share of exports in this prod.**	p5 →p95	2.206	1.859	2.623
Inverse time since the firm last:				
exported	p25 →p75	2.053	1.691	2.491
exported	mean →1	1.365	1.249	1.486
exported this prod.*	0 →1	22.81	16.85	30.88
exported to this dest.*	0 →1	48.79	38.63	62.28
exported & exported to this dest.*	mean →1	47.76	37.84	60.25
& exported a similar product to this dest.*	0 →1	356.5	264.5	491.9
exported & exported this prod.*	mean →1	22.51	16.78	29.92
& exported this prod. to dest. in the same region*	0 →1	141.1	95.81	209.7
& exported this prod. to dest. with same language*	0 →1	44.98	21.48	90.62
& exported this prod. to contiguous dest.*	0 →1	22.86	9.458	55.02
imported*	p25 →p75	1.093	0.900	1.318
imported*	mean →1	1.034	0.957	1.120
& imported this prod.*	0 →1	5.519	4.190	7.509
& imported from this dest.*	0 →1	1.629	1.273	2.113
imported & imported this prod. & imported from this dest.*	mean →1	8.628	5.662	13.40
& imported this prod. from this dest.*	0 →1	20.00	10.46	40.79

Weighted rare events logit model. Variables defined in Table 3.1. Regression includes (unreported) dummies for month, industry, and whether the firm has ever been active in the relevant relationship. +(-) indicates coefficient marginally above (below) one. * Includes switching the relevant dummy for ever exported (imported) this prod./dest./reln. from zero to one. ** Multi-dest. (multi-prod.) dummy set to zero; percentiles calculated across non-zero observations (dest. share: p5=0.000, p95=0.259; prod. share: p5=0.000, p95=0.275).

Table 3.10: Relative risks using restricted definition of potential products

	Scenario	Point estimate	95% confidence interval	
Estimated probability of entry at mean values of explanatory variables		2.20×10^{-6}	3.45×10^{-7}	4.05×10^{-6}
Firm characteristics				
ln(lagged total employment)	p25 → p75	0.796	0.715	0.876
lagged mfp	p25 → p75	0.996	0.938	1.054
foreign owned	0 → 1	0.746	0.656	0.835
multi-enterprise firm	0 → 1	0.610	0.511	0.710
Macroeconomic conditions				
ln(destination population)	p25 → p75	1.043	0.941	1.144
ln(destination GDP per capita)	p25 → p75	1.153	1.041	1.266
ln(destination import intensity)	p25 → p75	1.077	1.038	1.115
ln(distance to destination)	p25 → p75	0.884	0.849	0.919
3yr Δ in dest. population	p25 → p75	1.000^{-}	1.000^{-}	1.000^{+}
3yr Δ in dest. GDP per capita	p25 → p75	1.005	0.986	1.023
3yr Δ in dest. import intensity	p25 → p75	0.976	0.952	1.001
1yr Δ in New Zealand GDP	p25 → p75	1.095	1.055	1.134
exchange rate	p5 → 1	0.977	0.960	0.995
exchange rate$*\delta$(high)	1 → p75	0.953	0.922	0.984
Demonstration effects				
Regional employment share of:				
incumbent exporters	p25 → p75	0.946	0.875	1.017
incumbent exporters of similar prod. (HS4)	p25 → p75	0.996	0.952	1.041
incumbent exporters to this dest.	p25 → p75	1.891	1.745	2.036
incumbent exporters in this reln. (HS4)	p5 → p95	0.983	0.977	0.988
new exporters	p25 → p75	1.014	0.995	1.032
new exporters of similar prod. (HS4)	p25 → p75	0.993	0.972	1.014
new exporters to this dest.	p25 → p75	1.083	1.069	1.098
new exporters in this reln. (HS4)	p5 → p95	1.002	0.999	1.006
Own trade experience				
multi-dest. exporter	0 → 1	1.699	1.334	2.064
share of exports to this dest.**	p5 → p95	0.982	0.926	1.038
multi-prod. exporter	0 → 1	1.230	0.940	1.519
share of exports in this prod.**	p5 → p95	1.780	1.699	1.861
Inverse time since firm last:				
exported	p5 → p95	1.317	1.096	1.537
exported	mean → 1	1.033	1.011	1.055
& exported this prod.*	0 → 1	19.39	17.13	21.60
& exported to this dest.*	0 → 1	31.99	27.40	36.58
exported & exported to this dest.*	mean → 1	29.45	25.27	33.62
& exported a similar prod. to this dest.*	0 → 1	180.9	156.3	210.6
exported & exported this prod.*	mean → 1	17.29	15.33	19.24
& exported this prod. to dest. in same region*	0 → 1	123.6	104.9	142.1
& exported this prod. to dest. with the same language*	0 → 1	34.21	26.18	42.24
& exported this prod. to contiguous dest.*	0 → 1	66.47	52.26	80.67
imported*	p5 → p95	0.919	0.769	1.068
imported*	mean → 1	0.988	0.964	1.012
& imported this prod.*	0 → 1	3.432	3.114	3.750
& imported from this dest.*	0 → 1	1.123	0.966	1.279
imported & imported this prod. & imported from this dest.*	mean → 1	3.794	3.137	4.451
& imported this prod. from this dest.*	0 → 1	30.39	22.42	38.38

See Table 3.6 for notes on estimation method. $\tau \in [0.00001, 0.0001]$. Variables defined in Table 3.1. Regression includes (unreported) dummies for month, industry, and whether the firm has ever been active in the relevant relationship. +(-) indicates coefficient marginally above (below) one. * Includes switching the relevant dummy for ever exported (imported) this prod./dest./reln. from zero to one. ** Multi-dest. (multi-prod.) dummy set to zero; percentiles calculated across non-zero observations (dest. share: p5=0.000, p95=0.259; prod. share: p5=0.000, p95=0.275).

3.5 Conclusion

Overall, the results suggest that sunk costs are a substantial factor determining not only whether firms will expand into new markets, but also which markets and products they will choose when expanding their export relationships. In particular, firms are more likely to introduce additional products to countries with which they already have an established trade relationship. At the same time, the costs of product development imply that firms will also choose to expand by introducing their existing, successful products to new geographic markets. That is, there is strong evidence of path dependence.

There is evidence that product- and relationship-level import experience play a role in determining the future expansion of export relationships, perhaps driven by some form of "product cycle" or reflecting the operation of diversified producer-distributors.

The results also suggest a role for export propensity spillovers from other domestic firms. These spillovers appear to be relationship-specific, in that a higher general propensity to export in the region has no impact on a firm's probability of entry into new export relationships, yet the observed experience of firms exporting similar products, or exporting to the destination in question is associated with a substantial increase in the probability of entry. The activities of both incumbents and new entrants seem to provide a demonstration effect for potential entrants.

The expansion of incumbent exporters into new trade relationships accounted for around 60 percent of total growth in aggregate trade in New Zealand between 1996-98 and 2004-06, far outweighing the 12 to 17 percent contribution of newly entering exporters (Fabling and Sanderson 2010) . As such, even small impacts on the ability of firms to expand their export products and markets may have substantial benefits for aggregate export earnings. This chapter has shown that the role of past experience has an important impact on firms' future export choices. Path dependence, both within the firm and across other firms in the same region, is thus a very real force acting on the overall size and distribution of the aggregate export portfolio.

Chapter 4

Exporting and performance: Market entry, expansion and destination characteristics

Where Chapter 3 digs deeply into the factors associated with expansion into new export relationships at the firm-product-country level, this chapter takes a step back to look at exporting at the firm and firm-country level and the causal relationships between firm performance and entry into new export destinations. In particular, this chapter examines whether observed higher performance among exporting firms is due to self-selection into exporting, post-entry performance improvements, or a combination of the two.

That exporters outperform domestically-focused firms has become an established fact in the empirical trade literature. Exporters have been found to be larger, more productive and to pay higher wages than their domestically-focused counterparts. Moreover, this "exporter premium" is found to exist before firms begin exporting, suggesting that it can be largely explained as self-selection of productive firms into export markets (eg, Bernard and Jensen 1999; Greenaway and Kneller 2004; Van Biesebroeck 2005; Greenaway and Kneller 2007; Wagner 2007).

In contrast, the jury remains out on what (if any) additional benefits exporting confers on firms. Theoretical models suggest three broad channels through which exposure to offshore markets in general, and exporting in particular, may lead firms to improve their productivity: forced efficiency gains due to increased competition;[1] improved access to new knowledge and technologies through greater contact with offshore suppliers, customers and competitors; and the opportunity to access larger markets, which in turn provides potential

[1]This channel is hard to reconcile with standard assumptions of profit maximising firms, but fits within the literature on X-inefficiencies. In practice, almost all empirical considerations of the effect of exporting on productivity use revenue-based estimates of productivity, which conflate changes in the prices received by firms with changes in the efficiency of their production processes. An increase in competition might therefore be observed as a fall in productivity due to reduced profit margins, even if the firm is making improvements in their underlying efficiency.

to gain higher profits, and to benefit from economies of scale or specialise in niche products. Despite the variety of possible channels through which it may occur, the notion of firms improving their productivity performance through exporting is generally referred to as "learning by exporting" (LBE).

While many empirical studies find evidence in support of LBE, many also fail to find such an effect (see reviews by Greenaway and Kneller 2007; Wagner 2007). Comparison of results is complicated by differences in methodology, data availability, explanatory variables controlled for and the wide range of countries which have been studied.

This chapter represents the first detailed study of LBE for New Zealand firms. On theoretical grounds, New Zealand appears to be a prime candidate for observing both a strong self-selection effect and productivity improvements due to exporting. The geographic distances between New Zealand and potential export markets (particularly the developed markets of Europe and North America) impose relatively high costs on exporters compared to many of the countries which have been studied previously, and hence may lead to more pronounced self-selection. Meanwhile, all three channels by which exporting is proposed to affect productivity may be relevant for New Zealand firms. While New Zealand is open in the sense of having relatively low barriers to foreign trade and investment, domestic market size and distance from other major markets are likely to have reduced the degree of effective competition in the domestic market. It is also likely that New Zealand firms reach the limit of domestic expansion possibilities at an earlier stage than firms in larger markets, thus enhancing the probability that exporting will be important for expansion, if not productivity. Finally, New Zealand's relatively poor aggregate productivity compared to other advanced economies and low observed investment in research and development (R&D) suggest that New Zealand firms may have plenty to learn from competitors, suppliers and customers offshore.

Following the recent empirical literature, self-selection is examined and controlled for through propensity score matching. In contrast to the existing literature, this chapter considers both first time entry into exporting and subsequent entry of existing exporters into new markets. The consideration of subsequent entry has the advantages of focusing on a more homogeneous group of firms (ie, exporters) and the ability to add variables with substantial explanatory power over the treatment variable (ie, export histories). From a theoretical perspective, one would also expect that subsequent market expansion may yield learning effects.

While much of the literature on the firm-level consequences of exporting has focused on

identifying labour or multifactor productivity improvements, this chapter follows the early work of Bernard and Jensen (1999) in expanding the set of variables of interest to include employment and the capital-labour ratio. Thus it addresses not only the question of whether entry into export markets leads to firm-level productivity improvements, but also whether exporting impacts on aggregate productivity or income through the reallocation of resources towards firms which were already productive or through increasing the returns to labour.

The results suggest that New Zealand firms do exhibit performance improvements from exporting, though these are largely limited to input growth. Employment effects appear to be persistent and exist for both first-time exporters and those expanding into new destinations. Contemporaneous labour productivity effects are also apparent for first-time exporters, driven largely by capital deepening in the year of entry. While there is tentative evidence of multifactor productivity (MFP) improvements following from new market expansion, these results are not robust to subsetting on high-income markets, where LBE effects might be expected to be largest.

The next section outlines the existing empirical literature on exporting and productivity and reviews methodological options for identifying LBE, before describing the data and empirical approach (Section 4.2). Section 4.3 presents results and robustness tests, while Section 4.4 summarises the findings of the analysis.

4.1 Literature review

Over the past 15 years, since the publication of seminal works by Bernard and Jensen (1995) and Roberts and Tybout (1997), research on the determinants and consequences of firm-level export performance has flourished. Studies of the exporting-productivity relationship in particular have been completed for over 30 countries, from Austria to Zimbabwe.[2] A wide range of studies has attempted to identify the proximate determinants of exporting ability, including innovative ability (eg, Roper and Love 2002), government support (eg, Görg et al 2008) and demonstration effects from other local firms (Greenaway et al 2004; Greenaway and Kneller 2008)[3]. Other studies have considered whether firm-specific characteristics interact with exporting to determine the existence and extent of productivity bene-

[2] Austria is one of 14 countries included in a cross-country comparative study by ISGEP (International Study Group on Exports and Productivity) (2008). Zimbabwe is one of nine sub-Saharan African nations studied by Van Biesebroeck (2005).

[3] The latter issue is addressed in Chapter 3 of this thesis.

fits from exporting.[4] Finally, methodological developments have allowed for a reassessment of a number of early results, using more sophisticated techniques (eg, Wagner 2002; Girma et al 2004). This review focuses on three areas particularly relevant to this chapter: the inclusion of multiple measures of firm performance; incorporation of destination country characteristics; and the appropriate method for establishing causal effects.

4.1.1 Exporting, productivity and reallocation

Because most LBE studies only consider productivity growth within the firm, it is often difficult to evaluate potential benefits to the aggregate economy through resource reallocation. However, a number of studies provide convincing evidence that reallocation from less productive domestically-focused firms towards more productive export-oriented firms is a significant source of aggregate productivity growth.

Bernard and Jensen (2004a) compare the performance of exporters and non-exporters in the US on a number of dimensions and find that while exporting does not lead to productivity improvements in firms, it does have a significant effect on firm growth in employment and sales (both domestic and foreign). They find that over 40 percent of total factor productivity growth in the US manufacturing sector can be attributed to the impact of exporting on resource reallocation. Baldwin and Gu (2003) find that continuing and new exporters together account for almost all aggregate productivity growth in Canadian manufacturing, through a combination of intra-firm improvements in productivity and inter-firm reallocations towards more productive firms. Similarly, Pavcnik (2002) considers the impact of trade liberalisation in Chile between 1979 and 1986. Characterising industries according to their trade orientation (export-oriented, import-competing, or non-traded goods sector) and comparing firm-level performance between sectors and over time, Pavcnik (2002) suggests that reallocation of resources within the economy accounted for around two-thirds of aggregate growth in Chilean manufacturing.

These results, alongside similar findings from Falvey et al (2004), Hansson and Lundin (2004) and others, imply that even if there is no firm-level productivity benefit from exporting, aggregate productivity may well be enhanced through resource reallocation and the expansion of already productive export-oriented firms. Such impacts are likely to be particularly important for New Zealand, where the small domestic market is likely to limit growth opportunities.

[4] For example, Baldwin and Gu (2003) consider differences between foreign- and domestically-controlled, and between young and old plants, while Fryges and Wagner (2008) focus on export intensity.

4.1.2 Heterogeneous destination markets

It seems plausible that many of the potential benefits from exporting are stronger for exports to large, highly developed destinations. First, the competitive disciplines imposed upon exporting firms are likely to be more severe in markets which already have a significant number of local suppliers and which may also attract a broader range of suppliers from abroad. At the same time, more sophisticated consumers are likely to place greater demands on exporters in terms of product quality and timelines. Second, opportunities to learn from offshore contacts will be more beneficial the greater the degree of sophistication of those contacts.[5] Finally, in imperfectly competitive markets, firms may be able to charge higher prices to consumers in wealthy countries, leading to higher observed value-added with no change in the underlying efficiency of the firm.[6]

If learning relies on the destination country having superior economic performance to the exporting country, we would expect to find that LBE is more commonly observed in less developed countries (LDCs). Martins and Yang (2009) perform a meta-analysis of 218 estimates drawn from 32 studies on the productivity impacts of exporting. They investigate the impact of both methodological and contextual differences on the likelihood of finding LBE effects. The methodological issues they consider include whether the study uses a matching approach to the evaluation of impacts, whether the measure of productivity used is labour or multifactor productivity, and whether the impacts are estimated for the year of entry or longer term.[7] Contextual issues are restricted to the sample size, the years covered, and the development level of the source country.[8]

Of the 218 estimates in the paper, 55 percent used data from developed countries and 41 percent used propensity score matching techniques. The authors perform meta-regressions using four different weighting systems, based on the rankings of the journals in which the studies are published. They provide two specifications – their standard results and one controlling for the standard error of the initial estimate. Over the eight resulting specifications of the model, only one result comes through consistently in all specifications: firms in LDCs are more likely to experience a stronger impact of LBE than those in developed countries.

[5] Provided that the exporting firm is itself sophisticated enough to benefit from these contacts. See Sanderson (2004) on the role of "absorbative capacity" in determining firms' ability to benefit from international engagement.

[6] Fabling et al (2009) find some indications of pricing-to-market based on destination GDP per capita. The extent to which charging higher prices to foreign markets affects observed productivity will depend on the degree to which these gains are offset by higher marginal costs (eg, transportation and insurance).

[7] Methodological issues are discussed further in Section 4.1.3.

[8] Development level is a binary variable based on the United Nations definition of a developed economy, but the authors note that their results are robust to alternative definitions.

While this is not conclusive evidence that destination country characteristics matter, it is consistent with a model in which firms are more likely to learn from exporting if their exports put them in contact with firms or consumers in countries more developed than their own.

Five recent papers directly address the importance of destination market characteristics using firm-level micro data. Trofimenko (2008) and Park et al (2010) provide perhaps the most comprehensive treatment of heterogeneity in LBE outcomes.

Trofimenko (2008) allows for the relationship to depend not only on the destination of exports, but also on the relative (*ex ante*) productivity of the firm and the level of sophistication of the industry (based on the share of highly skilled employment). Her results suggest that exporting does impart a productivity benefit to firms and that more productive firms gain an additional benefit from exporting to advanced economies. However, her ability to provide conclusive answers on the impacts of destination characteristics is limited by a lack of firm-specific data on export destinations. In the absence of firm-level destination data, Trofimenko links industry-year aggregate shares of exports by destination to firm-level productivity and performance data, which includes an indicator of whether the firm exported in a given year. She thus tests whether LBE effects are stronger for exporting firms in *industries* which export to high-income countries, rather than whether they are stronger for *firms* exporting to high-income countries.

Park et al (2010) use exchange rate shocks during the Asian financial crisis as instruments to identify exogenous variation in the export levels of Chinese firms. They allow for the effect of exporting to vary continuously with destination country GDP per capita, finding a positive relationship between subsequent multifactor productivity growth and initial trading partner characteristics.[9] Park et al (2010) suffer from similar data issues to Trofimenko (2008). In particular, destination of trade is only known prior to the period over which productivity growth is measured, and almost half the firms in the study initially trade through Hong Kong, in which case industry averages must be used to identify final export destinations. Data availability also constrains the analysis to foreign-owned firms already exporting in the initial time period.

Two papers using Slovenian data (Damijan et al 2004; De Loecker 2007) also consider

[9]Since the power of the instruments largely derives from an (unforeseen) exchange rate shock, it is not clear whether there is a weak instrument problem for the subsample of firms that initially traded to developed economies (since China maintained a peg with the US Dollar throughout the crisis). If such a problem exists, positive productivity-based self-selection into exporting could result in a biased positive relationship between productivity growth and destination characteristics.

the relationship between productivity growth and the characteristics of export destinations. Both papers find that exporting has a positive effect on productivity growth, but that this impact is limited to firms exporting to high-income countries.[10] The two papers differ in their estimates of the timing of such effects – Damijan et al suggest that the productivity boost from exporting is strong but short-lived, observed only in the first and second years of exporting, while De Loecker finds ongoing productivity gains as much as five years out from export entry.

It is worth noting, however, that the economic environment in Slovenia over the period covered by these studies was somewhat exceptional. Since gaining independence from Yugoslavia in 1991, Slovenia has undergone a substantial programme of privatisation and trade liberalisation. Given the specific circumstances faced by Slovenian firms over this period, it is not surprising that exports to developed countries may have provided rapid access to technologies and management styles not easily available domestically,[11] nor that exports to former-Yugoslav countries (which up until 1989 would not have even counted as exports) did not provide such benefits.[12]

The question therefore arises as to whether the results of Damijan et al (2004) and De Loecker (2007) – or, for that matter, Park et al (2010) – can be realistically assumed to apply for firms in open, developed economies. Evidence from Pisu (2008) suggests that the answer is no. Using data on Belgian manufacturing firms between 1998 and 2005, Pisu finds that while initial examination suggests that firms which enter export markets experience productivity gains relative to those that remain domestically focused and that this relationship is stronger among firms that export to high-income destinations, these results are not robust to more formal empirical tests. Specifically, when matching methods are applied to determine a suitable control group of non-exporting firms, all significant LBE effects disappear and the positive relationship between exporting and productivity is shown to be due entirely to self-selection.

[10] Damijan et al (2004) compare three possible destination groups: countries of the former Yugoslavia, OECD countries, and all others. De Loecker (2007) instead divides export destinations on regional boundaries, classifying North America, Western and Southern Europe as high income regions. Some noise may be introduced by this latter method. For example, under De Loecker's definition Japan would be counted as a low-income export destination.

[11] Damijan and Majcen (2003) also note that Slovenia received relatively low levels of inward FDI over the 1990s and that FDI does not seem to have had the strong effect on growth that it did in other transition economies.

[12] Weak product market competition and less demanding consumers in the former Yugoslav countries, especially combined with free-trade agreements between Slovenia and three of the four former Yugoslav countries imply that entry barriers to these countries are low (Damijan 2001), while at the same time providing little scope for LBE.

4.1.3 Methodology

If selection into exporting were random, a simple comparison of exporting and non-exporting firms would provide an appropriate test of the impacts of exporting. However, it has been widely shown that selection into exporting is non-random: exporting firms have superior performance prior to entry. A simple comparison of productivity outcomes for exporting firms relative to non-exporting firms would therefore pick up not only differences due to exporting, but also pre-existing differences in productivity levels and growth rates between exporters and non-exporters.

Figures 4.1 and 4.2 illustrate this point using New Zealand manufacturing data for the four performance metrics considered in this chapter – multifactor and labour productivity, the capital-labour ratio and log total employment.[13] Figure 4.1 provides kernel densities for three sub-populations – current exporters, past exporters and non-exporters. As in other countries, current New Zealand exporters are larger and more capital-intensive and, consequently, have higher labour productivity than past exporters (ie, their distributions sit to the right), who in turn perform better on these three measures than non-exporters.[14] In contrast, however, there is little difference in the multifactor productivity levels of the three groups. The question is whether differences in performance reflect LBE or some selection mechanism.

Figure 4.2 addresses this question by comparing the distribution of *pre-entry* performance of firms that subsequently enter into exporting for the first time (into either low- or high-income countries) with those firms that do not. Firms about to enter into exporting have higher average labour productivity, capital intensity and employment, suggesting that at least some of the cross-sectional performance differences observed in Figure 4.1 are due to the self-selection of larger, more capital-intensive firms into exporting.

Accounting for selection bias

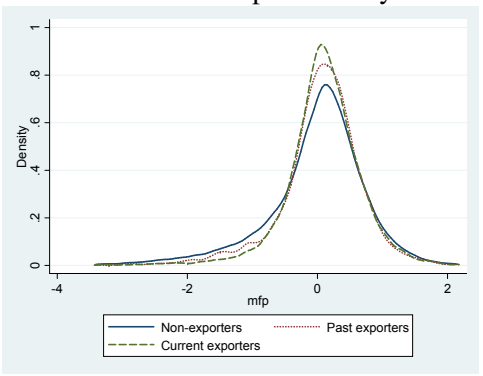
One of the more contentious questions in quantifying LBE effects has been the appropriate implementation of controls for non-random selection. That is, robust evaluation of the causal relationship between exporting and productivity requires the identification of a plau-

[13] All (two-digit ANZSIC) manufacturing industries are pooled together with industry-year averages removed.

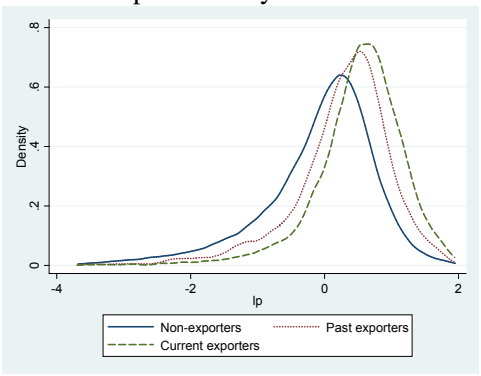
[14] Employment comparisons are affected by the prevalence of very small firms among non-exporters, in particular working-proprietor only firms. For this reason a working-proprietor only dummy is included in subsequent analysis.

Figure 4.1: Kernel density of performance by current export status

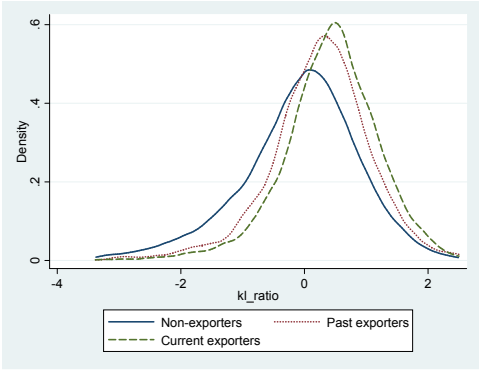
A. Multifactor productivity



B. Labour productivity



C. Capital-labour ratio



D. Employment

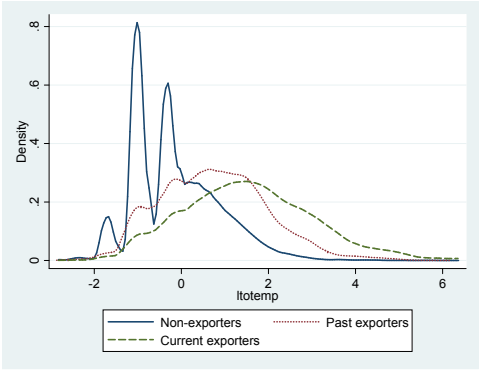
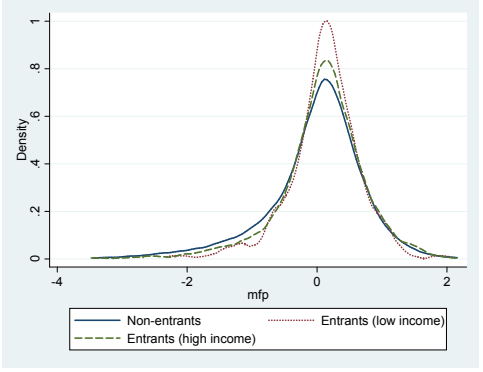
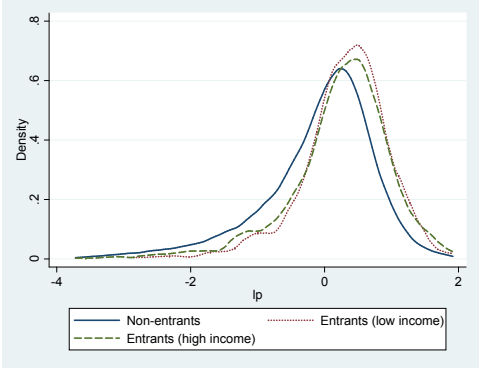


Figure 4.2: Kernel density of non-exporter performance by future export status

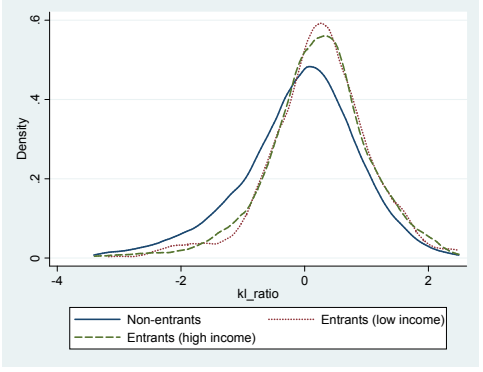
A. Multifactor productivity



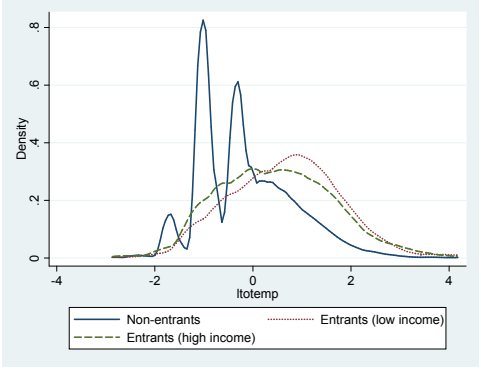
B. Labour productivity



C. Capital-labour ratio



D. Employment



sible counterfactual. Although authors have approached the question in various ways, two core methods can be identified in the literature to date. Most early papers (and many more recent ones) build on the approach introduced by Bernard and Jensen (1999), using a series of panel regressions (with or without controls for unobserved firm fixed effects) of the form

$$\ln(PROD_{it}) = \alpha + \beta(EXPORT_{it}) + \gamma(Z_{it-1}) + \epsilon_{it} \quad \text{or,}$$

$$\Delta \ln(PROD_{it}) = \alpha + \beta_1(START_{it}) + \beta_2(STOP_{it}) + \beta_3(CONTINUE_{it}) + \gamma(Z_{it-1}) + \epsilon_{it}$$

where $PROD_{it}$ is a measure of either labour productivity or multifactor productivity, $EXPORT_{it}$, $START_{it}$, $STOP_{it}$ and $CONTINUE_{it}$ are dummies representing the export status of the firm and the excluded category is non-exporters.[15] Hence, the estimated impact of exporting is the difference in the productivity growth rate of firms which have recently entered relative to those which do not export, beyond that which can be explained by differences in a set of control variables (Z_{it-1}). More sophisticated regression frameworks have also been applied, including the use of instrumental variables and system-GMM (eg, Baldwin and Gu 2003; Van Biesebroeck 2005; Park et al 2010).

Critics of the standard regression approach argue that a comparison of exporting firms with all non-exporting firms gives a biased estimate of the returns to exporting. In particular, these authors suggest that a matched firm model provides a more robust control for the differences between exporting and non-exporting firms. These methodologies draw heavily on the literature on programme evaluation (eg, Smith 2004; Imbens and Wooldridge 2008) and consider export entry as a "treatment."

Although the exact details of matching estimators differ, there is a standard two-step procedure which is common across methods. The first step involves determining a suitable control group of firms which look "similar" to the treatment group *ex ante* but which do not receive treatment. Firms which are not similar to the treated firms are then discarded or down-weighted.[16] The most common approach is to match firms based on the probability of receiving treatment conditional on pre-treatment characteristics – the "propensity score."[17] Rosenbaum and Rubin (1983) prove that as long as there are no unobserved characteristics

[15] $EXPORT_{it}$=1 if firm i exports at time t; $START_{it}$=1 if firm i exports at time t and was not exporting at time $t-1$; $STOP_{it}$=1 if firm i exports at time $t-1$ and does not exporting at time t; $CONTINUE_{it}$=1 if firm i exports in both t and $t-1$.

[16] Some treated firms may also be discarded if no suitable match can be found.

[17] Alternatives include matching firms based on the underlying observable characteristics (eg, firm size, industry, foreign ownership) or on a combination of propensity score and other characteristics (Mahalanobis matching).

which are associated with both the potential outcome and the probability of treatment ("unconfoundedness") and suitable control cases can be found for each treated case ("overlap"), conditioning on the propensity score is sufficient to remove all the bias associated with differences in pre-treatment characteristics between the treated and untreated groups. Thus, all systematic differences in outcomes between the treated and controls are attributable to the treatment. Once propensity scores have been calculated, a number of possible matching techniques may be applied, differing with respect to the number of matches between treated and control firms and the requirements for determining how similar two firms must be to be considered a valid match.[18] The second step is a comparison of the outcome variables of interest between the two groups some time after treatment.

A key question in matching models then is whether the observable differences between firms are sufficient to control for selection bias or whether there is instead some unobserved factor which determines both the probability of treatment and the firms' later outcomes. For exporting and productivity, one possible such factor might be managerial incentives and ability. Managers focused on growing their firm might be expected to be more likely both to enter export markets and to pursue performance-improving technologies in future periods, regardless of export market entry.

A range of options to help control for unobservable, time-invariant differences between treated and untreated firms have been developed. One option is to implement a difference-in-difference (DID) matching estimator, as suggested by Heckman et al (1998). This method has been implemented in a number of studies of exporting and productivity (eg, Girma et al 2004; Álvarez and López 2005; De Loecker 2007). While a standard matching model compares the ex-post performance of new exporters with that of matched non-entrants, the DID estimate instead compares the change in performance between the two groups in the period following market entry. Further alternatives include using a regression-adjusted or bias-corrected matching estimator, including relevant covariates in the second stage outcome regressions to capture any remaining observable differences between matched pairs (Caliendo and Kopeinig 2008).

The empirical evidence suggests that matching models may provide a more stringent test of the LBE hypothesis. Studies using matching methods are less likely to find significant LBE effects than those using panel methods (Greenaway and Kneller 2007; Martins and Yang 2009). However, it is also possible that the inability to find significant effects of exporting

[18] See Caliendo and Kopeinig (2008) for a practical discussion of matching methods.

is due to the reduction in sample size when using matching methods.[19] This chapter follows the guidance of the literature – a mixed matching-DID approach is implemented, with particular attention paid to the adequacy of the matching variables.

Other methodological issues

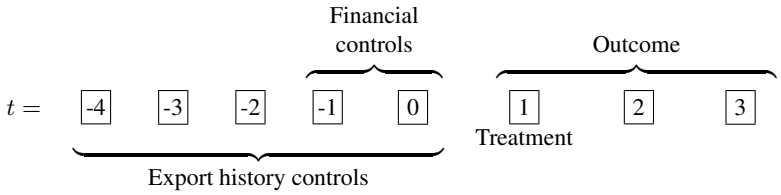
Other methodological issues discussed in the literature include the timing of any potential gains from exporting. As well as identifying whether future exporters show superior performance levels to non-exporters in the period prior to export market entry (the self-selection hypothesis) researchers have considered whether future exporters see a boost in productivity growth in the years leading up to market entry – the "learning to export" hypothesis (eg, Álvarez and López 2005). Productivity improvements in the years prior to export market entry are often explained in the literature as firms actively gearing up to enter foreign markets. In some cases they may also reflect active involvement by offshore potential customers (particularly for firms from developing countries). Questions of causality remain an issue here, however, as an unexpected positive productivity shock may also push firms into export markets. Finally, it is possible that a strategy of actively moving towards export markets may lead instead to a fall in productivity in the years prior to entry if firms are investing in capital equipment or R&D which will not be fully utilised until they expand into offshore markets (eg, Bellone et al 2008).

Similarly, many authors distinguish between the contemporaneous impacts in the year of export market entry and longer term effects (eg, Greenaway and Kneller 2008). Timing aspects of the export-productivity relationship are important as they provide insight into the channels through which exporting affects performance. For example, since efficiency gains due to learning or competitive pressures may take some time to realise, instantaneous productivity effects are more likely to reflect improved capacity utilisation.

Section 4.3 provides empirical estimates of performance benefits from exporting up to two years after the entry decision, after identifying and controlling for pre-entry investment decisions.

[19] For example, if only three percent of firms commence exporting over the study period and each is matched to a single control firm, 94 percent of all observations are discarded.

Figure 4.3: Timeline for analysis of export market entry and firm performance



4.2 Data and empirical strategy

Estimates are based on Statistics New Zealand's prototype Longitudinal Business Database (LBD). Firm performance measures (labour and multifactor productivity, the capital-labour ratio, and total employment) are derived from Inland Revenue Department and Annual Enterprise Survey data,[20] while merchandise export activity is identified from data collected by the New Zealand Customs Service. A full list of the variables used, their definitions and summary statistics by export status can be found in Tables 4.1 and 4.2.

The population is restricted to firms that ever have an employing manufacturing plant,[21] and to those firm-year observations for which a full set of the components necessary to calculate lagged outcome variables (employment, value-added, capital services) is available, since these are clearly important variables in the matching process (see Figure 4.2). As firm investments may also predict entry (eg, gearing up in anticipation of increased output), the population is further restricted to those firms for which lagged changes in capital and labour inputs can be calculated. These constraints yield an unbalanced panel of 87,270 observations, consisting of 25,977 firms over the six years 2001-2006.

Propensity score matching is implemented based on lagged firm characteristics and difference-in-difference outcomes are calculated between entrants and non-entrants compared up to two years after market entry. In order to implement this approach, firms are tracked over a five year window (Figure 4.3): performance levels in the *"control year"* $(t = 0)$ together with changes from the year prior $(t = -1)$ provide the *ex ante* matching variables; the *"treatment year"* $(t = 1)$ is the year in which an export market entry is either observed (treatment) or not (control); and the years including and following treatment $(t \in 1, 2, 3)$ are used to compare growth (relative to $t = 0$) in outcomes between the treated and matched

[20] Following the method of Fabling and Grimes (2009) and dropping observations in the top and bottom one percent of the capital-labour ratio and labour productivity distributions to remove implausible values.

[21] In a small number of cases, observed exports are reallocated from non-manufacturing to manufacturing enterprises within the same parent-subsidiary group, as discussed in Chapter 2. The term *firm* is used to refer to both individual enterprises and groups of manufacturers within a parent-subsidiary relationship.

Table 4.1: Variable definitions for export market entry and firm performance analysis

ltotemp	Log total employment ($\ln L$) where L is working proprietors plus average monthly employees
klratio	Capital-labour ratio ($\ln K - \ln L$) where K is capital services
LP	Labour productivity ($\ln Y - \ln L$) where Y is value-added
MFP	Multi-factor productivity, ϵ, from OLS regression: $\ln Y = \alpha \ln L + \beta \ln K + c + \epsilon$ with industry-specific α, β, c
Δtotemp	Normalised change in employment, L, ie $(L_t - L_{t-1})/(L_t + L_{t-1})$
Δklratio	Normalised change in capital-labour ratio, k ie $(k_t - k_{t-1})/(k_t + k_{t-1})$
wp_only	Dummy $= 1$ if working proprietors only
$\delta(\text{totemp}_{t=-1} = 0)$	Dummy $= 1$ if firm is non-employing at $t = -1$
fdi	Dummy $= 1$ if firm is foreign-owned (LBF foreign ownership $\geq$25% or IR4 foreign control)
first_activity($t = x$)	Dummy $= 1$ if x is the earliest year where sales observed in the prior five years
lcountry_incum	Log count of countries incumbent in over past 5 years ($= 0$ if none)
lcountry_entry	Log count of countries entered over past 5 years ($= 0$ if none)
lcountry_exit	Log count of countries exited over past 5 years ($= 0$ if none)
$\delta(\text{country\_X}) = 0$	Dummy $= 1$ if count of countries $= 0$, where X $\in$ (incum, entry, exit).
Δexports	Normalised change in total export value, X, between $t \in \{-4, -3\}$ and $t \in \{-1, 0\}$. ie, $(\sum_{-4}^{-3} X - \sum_{-1}^{0} X)/(\sum_{-4}^{-3} X + \sum_{-1}^{0} X)$
oz_export_share	Export share to Australia
$\delta(\text{oz\_exports} > 0)$	Dummy $= 1$ if oz_export_share > 0
non_oz_hi_export_share	Export share to other high-income countries
$\delta(\text{non\_oz\_hi\_exports} > 0)$	Dummy $= 1$ if nonoz_hi_export_share > 0
lavg_exports_per_emp	Log of average exports per employee
$\delta(\text{exports}_{t=0} > 0)$	Dummy $= 1$ if firm exported in $t = 0$

Performance variables follow Fabling and Grimes (2009) and have been industry-year demeaned. Data sources: L (LEED); Y and K (AES and IR10); fdi (LBF and IR4); trade (Customs); sales (BAI).

Table 4.2: Matching variable summary statistics by export status

	Non-exporter		Exporter	
	Mean	St. dev.	Mean	St. dev.
MFP	-0.017	0.768	0.082	0.596
klratio	-0.078	0.968	0.381	0.803
LP	-0.085	0.859	0.457	0.697
ltotemp	-0.171	0.998	1.386	1.540
Δtotemp	0.142	0.353	0.050	0.231
Δklratio	0.017	0.230	0.024	0.196
$\delta(\text{totemp}_{t=-1} = 0)$	0.119		0.038	
wp_only	0.468		0.102	
fdi	0.006		0.114	
first_activity($t = -4$)	0.693		0.907	
first_activity($t = -3$)	0.068		0.034	
first_activity($t = -2$)	0.072		0.028	
first_activity($t = -1$)	0.076		0.020	
lcountry_incum			0.566	0.914
lcountry_entry			0.483	0.726
lcountry_exit			0.299	0.606
Δexports			0.209	0.618
oz_export_share			0.502	0.418
non_oz_hi_export_share			0.273	0.368
lavg_exports_per_emp			8.066	2.415
$\delta(\text{exports}_{t=0} > 0)$			0.752	
$\delta(\text{country\_incum} = 0)$			0.381	
$\delta(\text{country\_entry} = 0)$			0.304	
$\delta(\text{country\_exit} = 0)$			0.526	
$\delta(\text{oz\_exports} > 0)$			0.774	
$\delta(\text{non\_oz\_hi\_exports} > 0)$			0.604	

Top and bottom 1% of labour productivity and capital-labour ratio dropped.

controls. In addition, export histories calculated over $-4 \leq t \leq 0$ are used to identify the appropriate population and to create additional matching variables, extending the data requirements up to a possible eight years.

Export history data are used to separate the population of firms into those with and without prior export experience. Two alternative forms of entry are then considered – *"first-time"* entry into exporting and *"incumbent"* entry into new markets by firms with export experience. The latter definition has not previously been considered in the international literature and allows an additional test of the LBE hypothesis.[22] Having already observed a firm exporting we can be more confident that they have the desire and ability to enter further export markets, reducing the chance that unobserved differences between treatment and control groups will bias the results. For example, the move into exporting can represent a significant increase in risk for New Zealand firms and many business owners may have no interest in making that leap, even if the firm's observable characteristics suggest an ability to export.[23] If performance gains from *first-time* exporting are caused by market expansion, or by learning driven by contact with new competitors, suppliers or consumers, we should expect that entry into *additional* offshore markets should also lead to LBE.

Tables 4.3 and 4.4 demonstrate the importance of export history to identifying firms that may enter new markets. Table 4.3 tabulates export status in the treatment year with a count of prior years spent exporting. Firms with some experience are an order of magnitude more likely to export at $t = 1$ than those with no export history – ie, comparing the proportion exporting between firms with one year of export experience, (0.306) to that for firms with no past export experience (0.020). Further, participation rates at $t = 1$ rise rapidly with the number of years of prior participation.

Table 4.4 summarises rates of entry into new export markets (ie, treatment rates). First-time entry is a rare event, with approximately two percent of firms entering in any given year (column 3). In contrast, incumbent entry is not rare with around a third of exporters adding one or more export destinations in a year (column 4). In fact, incumbent exporters, which make up 18 to 22 percent of all employing manufacturers (column 2), create the majority of new market entry events. Correspondingly, Fabling and Sanderson (2010) show

[22] This test bears some similarities with Park et al (2010) who focus on exogenous changes in exports for incumbent exporters, as opposed to looking specifically at effects associated with entry into new geographic markets.

[23] According to the 2007 Business Operations Survey over half of manufacturing firms with 6+ employees do not earn any overseas income. Of those firms, 21 percent cite prohibitive costs or barriers to exporting, 54 percent note that the New Zealand market is sufficient, while 59 percent state that their requirement for physical proximity to customers prevents them from entering offshore markets (Statistics New Zealand 2008a).

Table 4.3: Share of firms exporting by lagged export status

N. years exporting in $-4 \leq t \leq 0$	Number of firms	Exporting at t=1 No	Exporting at t=1 Yes	Proportion exporting at t=1
0	69,993	0.786	0.016	0.020
1	4,230	0.034	0.015	0.306
2	2,346	0.013	0.014	0.528
3	1,839	0.007	0.014	0.666
4	1,815	0.005	0.016	0.770
5	7,047	0.003	0.078	0.962

Table 4.4: Share of exporters and entrants by entry type and year

Year	Number of exporters	Incumbent share of manufacturers	Entry rate First-time	Entry rate Incumbent
2001	2,475	0.178	0.017	0.347
2002	2,646	0.185	0.021	0.332
2003	2,790	0.190	0.023	0.347
2004	2,994	0.203	0.024	0.352
2005	3,093	0.210	0.020	0.345
2006	3,282	0.219	0.017	0.318
Total	17,280	0.198	0.020	0.340

that a large proportion of aggregate trade growth comes from firms adding products or countries, implying that the dynamics of incumbent exporter expansion are important from a macroeconomic perspective.

To test whether relatively more sophisticated export markets yield greater opportunities for learning, entry events are classified into two groups – entry into any market and entry into high-income markets only, where these are defined as countries having GDP per capita greater than USD17,000.[24] This cut-off point roughly reflects the per capita income of New Zealand in the data and also splits the sample of New Zealand exports approximately equally between high- and low-income destinations.[25]

Table 4.5 summarises the four resulting populations and treatment variables. In each case the difference-in-difference estimate of the treatment effect is calculated for a matched sample of firms. Matching is based on predicted probabilities from a probit regression of the treatment variable on lagged firm performance variables, location,[26] and industry-year dum-

[24]GDP per capita comes from United Nations Statistics (GDP) and the US Census Bureau (population).

[25]In subsequent robustness testing, an alternative definition of high-income is applied, based on GDP per capita and OECD membership.

[26]Regional council dummies are included to control for regional differences in, eg, infrastructure, agglomeration or land quality which may affect both firm performance and the probability of exporting. See Maré (2008) and Chapter 3 for New Zealand evidence of agglomeration and localised export learning effects respectively. Location dummies that never have statistically significant coefficients are pooled and constitute the reference group.

Table 4.5: Definition of entry types

	Entry type	Population	Treatment
(1)	First-time (Any)	Firms that haven't exported in the past five years	Entry into exporting
(2)	First-time (High)	As above, excluding firms only entering low-income countries	Entry into a high-income country
(3)	Incumbent (Any)	Firms with prior export experience	Entry into a new country
(4)	Incumbent (High)	As above, excluding firms only entering low-income countries	Entry into a new high-income country

In high-income market entry models, firms that enter a low-income country are dropped from the potential control group so as to consistently compare entrants to non-entrants across models.

mies. Lagged financial performance characteristics are included in all specifications and follow the outcome variables of interest: MFP; log total employment; and the capital-labour ratio (labour productivity is dropped because of its high correlation with the MFP variables).[27] Lagged performance variables are entered into the probit as a set of twenty quantile dummies to allow for potential non-linearity in their effect.[28] Pre-entry changes in capital and labour inputs are also included as are a foreign ownership dummy, a dummy for working-proprietor only firms, and a set of dummies capturing the number of years the firm has been in operation. In specifications (3) and (4) export history variables are also included (as defined in Table 4.1 and discussed in Section 4.3.1).

The estimated probability of treatment (or propensity score) is then used to match each treated firm to untreated firms within the same industry, using radius matching with replacement and a caliper of 0.001. This caliper was chosen to maximise the number of treated firms for which suitable controls could be found while maintaining the balancing properties of the treated and control samples. Caliper matching was chosen over nearest neighbour matching as it makes use of the larger amount of information available when there are multiple potential comparator firms. Since all years are pooled, matches of treated firms to themselves in other years ("self-matches") are explicitly excluded. Where a treated firm is matched to N control firms, each control firm is given a weight of $1/N$ in the difference-in-difference comparison. Treated firms for which no suitable control can be found are dropped from the analysis.

[27] Balancing tests performed on the excluded labour productivity variable confirm that the inclusion of MFP is sufficient to balance lagged labour productivity.

[28] Quantiles boundaries are recalculated for each population since the distributions of non-exporters and exporters are quite different (Figure 4.1).

Observations are then pooled across all industries to compare the change in outcome between the treated and control groups. Standard errors are calculated by bootstrapping across both the first stage propensity score estimation and the second stage estimation of the treatment effect. The bootstrapped sample is drawn independently across four groups based on treatment status and availability of future outcome variables to maintain approximately the same matched sample size across repetitions.[29]

4.3 Results

4.3.1 Matching models

Table 4.6 reports the propensity score (probit) models on which the matching relies. If selection into treatment is non-random, as previous studies have shown, these models must adequately capture the systematic differences between entrants and non-entrants in order to validate the estimated causal effects. The dependent variables (treatments) of the four models relate to first-time or incumbent entry into either any market or only high-income markets (Table 4.5).

For presentation purposes, coefficients related to lagged performance quantile dummies appear in Appendix C. These coefficients confirm the picture conveyed by Figure 4.2 that larger, more productive and more capital intensive firms are more likely to self-select into exporting. Not only is this finding supported for first-time entry, but prior performance (or scale at least) is also important for selection into new markets by incumbent exporters.

Returning to Table 4.6, we see that pre-entry employment growth (Δtotemp) also predicts entry for both first-time and incumbent exporters consistent with some "gearing up" in production capacity pre-entry. Capital deepening (Δklratio) is also a precursor to market expansion for incumbent, but not first-time, entrants – a distinction we return to when discussing the investment dynamics subsequent to entry (Section 4.3.2).

Working-proprietor only firms are less likely to enter into exporting and so are hardly present in the incumbent population. In contrast, foreign-owned firms are more likely to enter high-income markets for the first time, even after conditioning out higher average productivity levels. Finally, for incumbents, firms that are younger are consistently more likely

[29]The probit model is estimated across all firms having the lagged performance variables. Variation in the bootstrap sample size still arises due to the possible selection of treated firms for which no control lies within the caliper.

Table 4.6: Export market entry – Marginal effects probit

	First-time		Incumbent	
	Any	**High**	**Any**	**High**
	(1)	(2)	(3)	(4)
Δtotemp	0.010***	0.007**	0.192***	0.178***
	[0.003]	[0.003]	[0.034]	[0.030]
$\delta(\text{totemp}_{t=-1}=0)$	0.001	0.001	-0.137***	-0.103***
	[0.003]	[0.003]	[0.030]	[0.021]
Δklratio	-0.001	0.000	0.043*	0.035*
	[0.002]	[0.002]	[0.022]	[0.020]
wp_only	-0.006***	-0.004***	0.004	-0.012
	[0.002]	[0.001]	[0.021]	[0.016]
fdi	0.007	0.009*	-0.007	-0.014
	[0.005]	[0.005]	[0.014]	[0.012]
first_activity ($t=-4$)	-0.003	-0.003	-0.200***	-0.162***
	[0.002]	[0.002]	[0.043]	[0.042]
first_activity ($t=-3$)	0.000	-0.001	-0.131***	-0.085***
	[0.002]	[0.002]	[0.033]	[0.025]
first_activity ($t=-2$)	0.000	-0.001	-0.117***	-0.082***
	[0.002]	[0.002]	[0.035]	[0.026]
first_activity ($t=-1$)	-0.001	-0.001	-0.077**	-0.056*
	[0.002]	[0.002]	[0.038]	[0.030]
$\delta(\text{exports}_{t=0}>0)$			0.076***	0.057***
			[0.012]	[0.010]
lcountry_incum			0.067***	0.044***
			[0.008]	[0.007]
lcountry_entry			0.131***	0.112***
			[0.008]	[0.007]
lcountry_exit			-0.023**	-0.027***
			[0.009]	[0.009]
$\delta(\text{country\_incum}=0)$			-0.053***	-0.036***
			[0.012]	[0.011]
$\delta(\text{country\_entry}=0)$			-0.080***	-0.045***
			[0.012]	[0.011]
$\delta(\text{country\_exit}=0)$			-0.055***	-0.043***
			[0.011]	[0.010]
Δexports			0.033***	0.040***
			[0.010]	[0.009]
oz_export_share			-0.013	0.019
			[0.016]	[0.015]
$\delta(\text{oz\_exports}>0)$			-0.055***	-0.072***
			[0.015]	[0.015]
non_oz_hi_export_share			0.037**	0.061***
			[0.017]	[0.015]
$\delta(\text{non\_oz\_hi\_exports}>0)$			0.034***	0.034***
			[0.013]	[0.011]
lavg_exports_per_emp			0.008***	0.007***
			[0.003]	[0.002]
MFP, klratio, ltotemp	+ (see Appendix C for quantile estimates)			
N	69,990	69,651	17,280	14,868
Pseudo R^2	0.084	0.078	0.210	0.194
Treatment rate	0.020	0.016	0.340	0.233

Robust (clustered on firm) standard errors in brackets (significance at * 10%; ** 5%; *** 1%). Regressions include (unreported) region and industry-year dummies.

to enter into exporting or new markets. For example, an incumbent exporter that is first observed with sales at $t = -4$ (first_activity($t = -4$)) is 20 percent less likely to enter a new export market than a firm that has just started up ($t = 0$ being the omitted category). Consistent with that picture, firms transitioning from non-employing at $t = -1$ to employing at $t = 0$ are around six to seven percent more likely to enter a new market than firms with static employment.[30]

Not only does subsetting on incumbent exporters raise the theoretical plausibility of controlling for self-selection, the explanatory power of the model (pseudo R^2) roughly doubles due to the population change and inclusion of export experience variables (columns (3) and (4)). Export-related variables are chosen to capture the dynamics of the firm's trade history – since matching on them increases the likelihood of selecting controls that have similar *treatment* histories, so that estimated effects of new market entry are not spuriously based on, say, lagged first-time entry effects.[31] In particular, variables are included to control for the change in the number of countries that a firm has traded to over the last five years, decomposing that into (log) counts of entering, exiting and incumbent countries,[32] and the (normalised) change in export value over the period. Firms with larger portfolios of destinations (lcountry_incum), those that have been adding destinations over the recent past (lcountry_entry), those that are growing their export value (Δexports), and those experiencing a continuous exporting spell (ie, $\delta(\text{exports}_{t=0} > 0)$) are more likely to enter a new country. Firms which have exited one or more countries (lcountry_exit) are less likely to enter new markets.

Additionally, since Australia is a geographically, culturally and institutionally close market variables are included to control for the fact that firms that send a large proportion of their exports there may not be well equipped or inclined to export elsewhere. Similarly, controls for other high-income country export shares are included on the grounds that these markets may selectively favour more "export able" firms, and for the possibility that more export-intensive firms are more likely to add new destinations. Consistent with these expectations, firms that trade to Australia ($\delta(\text{oz\_exports}_{t=0} > 0)$) are six to seven percent less likely to enter new markets while firms already exporting to other high-income countries are more likely to enter and this likelihood rises with the share of lagged exports going to high-income

[30] Being the sum of the Δtotemp and $\delta(\text{totemp}_{t=-1} = 0)$ coefficients since Δtotemp $= 1$ for entering employers.

[31] Unfortunately, there is insufficient data to match exactly on lagged treatment variables as these would require more than five years of consistently measured export history data, given the definition of treatment.

[32] Dummies are included and set to one where the relevant count of countries is zero, while the continuous (logged) variable is set to zero in these cases.

Table 4.7: Causal effect of first-time entry into exporting

	Any country			High-income country		
	$t=1$	$t=2$	$t=3$	$t=1$	$t=2$	$t=3$
	(1)	(2)	(3)	(4)	(5)	(6)
MFP	0.015	0.001	0.002	0.031	0.000	-0.012
	[0.016]	[0.020]	[0.023]	[0.020]	[0.024]	[0.028]
klratio	0.037**	0.048*	0.045*	0.042**	0.057**	0.052*
	[0.017]	[0.024]	[0.024]	[0.017]	[0.023]	[0.030]
LP	0.040**	0.033*	0.037	0.059***	0.037	0.030
	[0.017]	[0.020]	[0.025]	[0.050]	[0.024]	[0.030]
ltotemp	0.073***	0.091***	0.116***	0.078***	0.098***	0.125***
	[0.012]	[0.019]	[0.024]	[0.015]	[0.022]	[0.027]
N	55,104	41,100	29,826	54,816	40,872	29,664
Treatment rate	0.022	0.023	0.024	0.017	0.018	0.019
Proportion dropped						
Treated	0.018	0.022	0.025	0.013	0.025	0.032
Control	0.062	0.082	0.138	0.081	0.100	0.172

Difference-in-difference (DID) estimator, from $t = 0$ to outcome year, applied to matched sample. Radius matching (caliper 0.001, with replacement) with observations pooled across years and matched within two-digit industry (precluding self-matches). Bootstrapped standard errors in brackets (significance at * 10%; ** 5%; *** 1%). Bootstrapping encompasses both probit and DID stages (100 repetitions) and is stratified on treatment and the existence of future MFP to maintain approximately constant (weighted) population size (N) across estimates. The table also reports the treatment rate (average proportion of firms entering), and the proportion of treated (control) firms dropped because there is no control (treated) firm within the caliper distance. All balancing tests (equivalence of weighted means of matching variables across treated and controls) passed at the 5% level (one-sided test). For explanatory variables which are found to have a positive (negative) effect on acquisition propensity, the null hypothesis underlying the one-sided test is that, after matching, the average value of that explanatory variable is no longer higher (lower) in the treated sample than in the matched, untreated sample.

countries. Finally, firms with higher export sales per employee are also more likely to enter new markets.

4.3.2 Causal estimates

Having modelled treatment using lagged firm performance and trade history variables, the analysis now turns to the causal effects of exporting on performance. Tables 4.7 and 4.8 present difference-in-difference results for the weighted matched populations.

Beginning with the standard methodology of comparing first-time entrants with matched non-exporters, Table 4.7 reveals a positive causal relationship between exporting and three of the four performance variables. New exporters exhibit a growth premium of around 3-4 percent in labour productivity, 4-5 percent in the capital-labour ratio, and 7-12 percent in employment relative to non-exporters, but are not significantly different from non-exporters with respect to multifactor productivity. Consistent with a zero effect on MFP, labour productivity results are completely explained by higher post-entry capital-labour ratios. Growth in the capital-labour ratio appears to be immediate, one-off and persistent, while employ-

ment gains continue over time though with most growth occurring in the year of entry (reported coefficients are cumulative over time). However, since the employment differential between entrants and matched non-entrants grows and the capital-labour ratio differential stays approximately constant, net capital investment growth rates must also be (roughly two percent) higher for entrants after entry. Thus first-time entrants make large investments in the year of entry, with smaller ongoing investment in inputs over subsequent years and no obvious learning effects (ie, no impacts on MFP), at least over the time period considered here.

Results for first-time high-income market entry events are also reported in Table 4.7. Perhaps because around 76 percent of first-time entry involves a high-income destination market, no significant difference is identified between high-income and any country entry. However, the fact that point estimates of significant coefficients are always higher for high-income entrants is suggestive of the potential importance of destination country development levels in subsequent outcomes.

By comparison, input growth dynamics are weaker for entry into any new destination country by incumbent exporters (Table 4.8). These results may well reflect timing issues – recalling that gearing up in both employment and capital is a strong predictor of incumbent entry (Table 4.6). Under this interpretation, firms either learn about the need to scale up when entering new markets and do so in advance of entry, or have more certainty of likely success from future entry and so commit earlier to investment decisions. There is weak evidence that employment continues to expand post-entry (coefficients rise from 2.8 percent in the year of entry to 4.5 percent two years after entry), even after controlling for pre-entry growth trajectories.

Labour productivity growth estimates are similar between first-time and incumbent (any country) entrants, with point estimates for incumbents of around 3-5 percent. In the case of incumbents though, a differential capital investment rate cannot be invoked to explain higher productivity growth, since treated and control firms have been matched on pre-entry levels and growth rates of the capital-labour ratio and there are no significant post-entry differences in the capital-labour ratio. Where incumbent entry really differs from first-time entry is in the identified multifactor productivity effects, suggestive of true learning-by-exporting. However, when attention is restricted to high-income country entry events, productivity effects disappear while employment results remain similar. The absence of consistent estimates of the MFP results for a subset of firms that, at least on some theoretical grounds, should be *more* likely to benefit from LBE casts doubt on the underlying source of

Table 4.8: Causal effect of incumbent entry into new export markets

	Any country			High-income country		
	$t=1$	$t=2$	$t=3$	$t=1$	$t=2$	$t=3$
	(1)	(2)	(3)	(4)	(5)	(6)
MFP	0.026**	0.039**	0.024	-0.009	-0.010	-0.011
	[0.013]	[0.018]	[0.026]	[0.019]	[0.027]	[0.031]
klratio	-0.014	0.015	0.023	-0.013	0.024	0.034
	[0.014]	[0.017]	[0.025]	[0.018]	[0.024]	[0.032]
LP	0.026*	0.048***	0.041*	-0.008	0.003	0.005
	[0.013]	[0.018]	[0.025]	[0.020]	[0.028]	[0.030]
ltotemp	0.028***	0.032**	0.045**	0.036***	0.034**	0.021
	[0.008]	[0.015]	[0.020]	[0.010]	[0.016]	[0.026]
N	14,670	11,262	8,325	12,522	9,564	7,074
Treatment rate	0.354	0.363	0.364	0.243	0.250	0.252
Proportion dropped						
Treated	0.322	0.373	0.452	0.294	0.358	0.412
Control	0.305	0.371	0.482	0.378	0.477	0.529

See Table 4.7 for notes. All balancing tests passed at the 5% level (one-sided test) except in the case of the first_activity ($t=-4$) for specifications (1) and (3), and $\delta(\text{lcountry\_exit}=0)$ for specification (6).

the productivity gains.

Taking the first-time and incumbent employment and investment dynamics together it seems possible that the subsequent growth dynamics for first-time entrants are driven by expansion into additional export markets (ie, subsequent incumbent entry). That is, the continued employment growth among first time entrants shown in Table 4.7 may in fact be driven by a one-off increase at the time of first entry followed by additional employment growth as those firms enter into additional markets in the following two years. To test this idea, the analysis for first-time entry is repeated, excluding from the population firms which are treated (or re-treated) in years up to and including the year the effect is measured (Table 4.9). That is, column (2) of Table 4.9 follows the methodology used in Table 4.7 but excludes both non-exporters which enter for the first time in $t=2$ and new entrants which enter into additional markets in $t=2$, while column (3) extends these restrictions to $t=2$ and $t=3$.[33]

The exclusion of future-treated firms has the effect of removing the apparent ongoing employment growth effect from the first-entry event, consistent with the earlier interpretation that ongoing growth in employment may be driven by subsequent entry events. Taken at face value, these coefficients would imply a one-off scale benefit from first-time entry, rather than the dynamic gains implied by the estimates in Table 4.7. However, using future export decisions to determine the population is fraught with causality concerns. An alternative interpretation of the rising employment growth effect from first-time entrants is that the first

[33]Obviously this restriction places no constraint on the $t=1$ results and these are merely repeated for convenience. Only results for any entry event are reported for brevity, but the patterns are consistent for high entry events also.

Table 4.9: Causal effect of first-time entry excluding subsequently treated firms

	Any country		
	$t = 1$	$t = 2$	$t = 3$
	(1)	(2)	(3)
MFP	0.015	-0.008	-0.001
	[0.016]	[0.020]	[0.034]
klratio	0.037**	0.037	-0.009
	[0.017]	[0.024]	[0.040]
LP	0.040**	0.014	0.009
	[0.017]	[0.020]	[0.034]
ltotemp	0.073***	0.065***	0.067**
	[0.012]	[0.021]	[0.029]
N	55,104	36,324	23,397
Treatment rate	0.022	0.019	0.017
Proportion dropped			
Treated	0.018	0.026	0.022
Control	0.062	0.147	0.276

See Table 4.7 for notes. Population excludes firms treated in years after $t = 1$ and up to the and including the outcome year. All balancing tests passed at the 5% level (one-sided test) except in the case of the Auckland Regional Council dummy for specification (3).

entry event raises firm scale and this, coupled with the recent experience in exporting (as evidenced by Table 4.6), *causes* firms to enter additional markets. In this sense, the ongoing employment growth should be attributed to the initial decision to enter into exporting. The issue of serial (endogenous) treatment is returned to in the conclusions.

4.3.3 Robustness

Another possible explanation for the apparent rise in employment growth coefficients may be changes in the composition of the sample at different times due to attrition. To check this, two robustness checks are performed on the any country specifications. Firstly, since employment data have greater coverage than value-added data, causal effects are re-estimated solely for employment in Table 4.10 using all firms that have non-zero employment in the relevant outcome year. Additionally, in Tables 4.11 and 4.12 the model is re-estimated for all three time periods for the subset of firms that have a complete set of outcome data in every period (common sample tests). In both cases, results continue to show increasing employment gains over time for first-time entrants. While other previously significant point estimates remain positive in the common sample test, only the employment gains, the $t = 0$ capital-labour ratio results for first-time entrants, and the ($t = 2$) MFP and ($t = 2, 3$) labour productivity results for incumbents, are now significantly different from zero.

Table 4.10: Causal effect of entry on employment only

Entry type	$t = 1$	$t = 2$	$t = 3$
First-time entry	0.090***	0.097***	0.128***
(Any country)	[0.012]	[0.021]	[0.024]
First-time entry	0.094***	0.100***	0.131***
(High-income country)	[0.013]	[0.020]	[0.029]
Incumbent entry	0.063***	0.062***	0.057**
(Any country)	[0.011]	[0.014]	[0.023]
Incumbent entry	0.057***	0.052***	0.045
(High-income country)	[0.012]	[0.019]	[0.029]

See Table 4.7 for notes. Population includes all firms with non-zero employment in relevant outcome years.

Table 4.11: Causal effect of first-time entry, common sample

	Any country		
	$t = 1$	$t = 2$	$t = 3$
	(1)	(2)	(3)
MFP	-0.008	0.005	-0.006
	[0.025]	[0.027]	[0.027]
klratio	0.057***	0.034	0.016
	[0.019]	[0.025]	[0.027]
LP	0.022	0.030	0.019
	[0.026]	[0.027]	[0.028]
ltotemp	0.067***	0.084***	0.115***
	[0.016]	[0.023]	[0.025]
N	24,639	24,639	24,639
Treatment rate	0.025	0.025	0.025
Proportion dropped			
Treated	0.034	0.034	0.034
Control	0.181	0.181	0.181

See Table 4.7 for notes. Population restricted to firms with outcome data available in all outcome years.

Table 4.12: Causal effect of incumbent entry, common sample

	Any country		
	$t = 1$	$t = 2$	$t = 3$
	(1)	(2)	(3)
MFP	0.014	0.037*	0.030
	[0.022]	[0.023]	[0.023]
klratio	-0.020	0.008	0.019
	[0.022]	[0.028]	[0.028]
LP	0.012	0.045*	0.046*
	[0.022]	[0.023]	[0.023]
ltotemp	0.026*	0.035*	0.047**
	[0.013]	[0.019]	[0.023]
N	7,185	7,185	7,185
Treatment rate	0.371	0.371	0.371
Proportion dropped			
Treated	0.488	0.488	0.488
Control	0.518	0.518	0.518

See Table 4.7 for notes. Population restricted to firms with outcome data available in all outcome years.

Declining significance for some coefficients partly reflects the effect of sample size on standard errors, but may also suggest the possibility that the central estimates are biased by selective attrition from the sample. If export entry raises performance and firms exit based on competitiveness (eg, there is a market-specific productivity threshold below which it is unprofitable to remain in operation), then coefficients may be biased downwards. In the common sample test above we lose good (in a *match* sense) control firms which could be included in $t = 2$, say, with poor growth outcomes but which subsequently exit in $t = 3$ for performance reasons.

To test whether attrition bias is potentially an issue, treated firms are matched to controls ignoring the availability of future employment data, and tested to see whether the matched control group are more likely to have future employment data missing (ie, to exit).[34] Across all three time periods ($t = 1, 2, 3$), and for both first-time and incumbent entry, control firms are more likely to exit (significant at the ten percent level), suggesting that entering exporting and expanding markets reduce the probability of exit. As a consequence, Tables 4.7 and 4.8 may represent underestimates of the true causal effects of entry.

Additional robustness checks were also performed, focusing on the $t = 2$ (any country) estimates as generally representative. To test whether employment effects are driven by the small number of working-proprietor only firms entering into exporting, the causal analy-

[34] Employment is used as the measure because it is based on comprehensive mandatory PAYE tax filings, and so is not subject to idiosyncratic filing patterns.

sis was re-run excluding firms with two or fewer workers (including working proprietors). When low employment firms are excluded, estimated employment gains decline from 9.1 percent for first-time entrants to 5.8 percent (still significant at the one percent level). Incumbent entry employment results are almost unchanged, reflecting the fact that very few incumbent exporters are small. The labour productivity and capital-labour ratio coefficients become insignificant (at the ten percent level) for first-time entrants to any country, while productivity effects for incumbent entry remain significant and consistent with the main estimates.

Other robustness tests performed on all the $t = 2$ results include: changing the high-income criteria to require the country to also be an OECD member (thus excluding most oil-rich nations, tax havens, etc); and dropping from the population firms that have low historical export intensities (the bottom quartile of lavg_export_per_emp) or low shares of differentiated goods exports.[35] These tests indicate considerable robustness in the results. Specifically, only two changes occur in the significance of coefficients across these three tests.[36]

4.4 Conclusion

Visual investigation (Figure 4.2) and probit estimates (Table 4.6 and Appendix C) both support the expectation that better performing firms self-select into exporting. Given such self-selection, any credible attempt to estimate the effect of entry on firm performance must adequately account for pre-existing differences between entrants and non-entrants. This can be done by matching entering (treated) firms to non-entering (control) firms whose lagged characteristics indicate they were similarly likely to enter, and calculating bootstrapped difference-in-difference estimates of outcomes across treated and control groups.

Concern about the adequacy of the matching model for first-time entrants, and consideration of the theoretical bases for believing treatment effects might exist, lead to a strategy of subsetting on incumbent exporters and considering the effect on these firms of the decision to enter a new market for the first time. The results suggest that propensity score matching can be significantly improved in this manner since it can be plausibly argued that unobservable characteristics that would determine firms' ability to export are controlled for by having already observed these firms exporting (ie, exporters are matched to exporters),

[35] Less than ten percent of exports in differentiated products, as defined by Rauch (1999).

[36] With the modified definition of high-income countries the labour productivity effect becomes significant for first-time entrants (the point estimate increases to 4.1 percent). For the differentiated goods subsample, the incumbent (high-income) entrant employment coefficient becomes insignificant at the 10 percent level.

and by the fact that exporters have more available matching variables, in particular their detailed export histories. Inclusion of these variables is critical to the assertion that measured causal effects are due to the current treatment and not simply hangovers from some earlier (perhaps initial) entry into exporting.

For new exporters, entry is associated with strong employment growth coupled with ongoing capital investment and, hence, raised capital-labour ratios. As a consequence, first-time entrants have "permanently" higher measured labour productivity than they would otherwise have had. These effects are economically material – the year after entry, employment is 9.1 percent higher and labour productivity 3.3 percent higher. For incumbent exporter entry, causal effects are also observed on employment, though in a more modest 3-5 percent range. This finding holds despite the fact that incumbents gear up both employment and capital investment prior to entry (Table 4.6) – factors that are accounted for in the matching method.

Together, these investment dynamics raise questions as to whether the identified "first-time" entry effect should be interpreted as solely attributable to that event or also to subsequent export entry decisions. Firms already in an export market are more likely to expand into new ones (Chapter 3) and firms with prior experience are more likely to survive when they enter markets (Fabling and Sanderson 2010). Improvements to econometric techniques for analysing multiple (endogenous) treatment events are necessary before the relative impact of sequential entries can be fully unravelled.[37]

Employment effects are robust to population variations including dropping firms largely producing undifferentiated goods or with relatively low exports per employee, to changes in the population based on data availability, and to an alternative definition of high-income market entry. Only in the case where very small firms are dropped are employment coefficients materially lower for first-time entrants, though still significantly different from zero at the one percent level.

There is tentative evidence to suggest that exporting to high-income countries has a stronger effect on firm performance, with point estimates for this subsample generally higher than for the full population of entry events for first-time entrants (though the difference is never statistically significant). Evidence for multifactor productivity learning-by-exporting effects

[37] Lechner and coauthors appear to be the only researchers to have applied sequential causal matching models to economic questions (eg, Lechner 2009, Lechner and Wiehler 2011). Using such models in the current research would be difficult since their methodology relies on observing the entire sequence of treatments – a requirement that would yield a very small population of multiply-treated firms given the choice of treatment variable used in this chapter and the data available.

– as opposed to labour productivity increases driven by capital deepening – are restricted to incumbent entry into new markets. However, when attention is restricted to high-income entry events, these effects disappear, raising questions about the source of the estimated productivity gains. True learning effects should, if anything, be stronger for entry into markets from which more can be learned.

Even in the absence of compelling MFP effects, the results suggest that export market entry yields welfare gains through resource reallocation. Capital-intensity differences between exporters and non-exporters are striking – being in the top quartile of the capital-labour ratio is associated with a roughly two percent higher probability of entry into exporting (Appendix C), and this capital-intensity gap widens post-entry. Understanding differences in capital intensity and usage may represent a key area for deeper insight into why some firms can export and others cannot or will not. Expansion into new export markets draws employment into firms that have a clear (labour) productivity advantage – an advantage that is not lost as employment expands. Further, a lack of evidence for conclusive LBE-derived productivity gains does not in itself imply no "learning" has occurred. Expansion itself – growing employment by more than ten percent – may require learning in terms of management systems, quality control, etc. Understanding how firms adapt their business operations during this period of rapid growth should be a research priority.

Chapter 5

Any port in a storm? The impact of new port infrastructure on exporter behaviour

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A fall in the marginal cost of exporting can raise both the number of firms exporting and the extent of their exports (Crozet and Koenig 2010). In theoretical models, marginal trade costs are often linked to tariffs and other policy-induced costs. However, there are many other costs for exporting firms, including information costs, currency-related costs, and freight, insurance and time costs of transporting goods to their destination (Anderson and van Wincoop 2004).

This chapter considers an aspect of trade costs which could not be modelled within the framework of Chapter 3. Specifically, it focuses on the impact of domestically determined trade costs, in particular the cost of getting goods to an international port. Internal distances are clearly relevant to the export patterns of large countries, where the distance to the border differs dramatically according to whether firms are in central or peripheral locations. However, internal distance may be important for small countries as well. In the case of New Zealand, a small population combined with mountainous terrain and a relatively sparse road and rail network creates large effective distances between regional producers and access to international transport. Meanwhile, congestion in major cities may exacerbate the costs of transporting goods even for firms located close to a port.

One option for mitigating the impact of internal distance and congestion is the development of satellite terminals or dry ports (Slack 1999; Roso et al 2009). These inland port terminals are used to process, store and consolidate goods shipments prior to their transfer to the seaport. By effectively bringing the port closer to its users, inland ports can simultaneously reduce transport and logistics costs for exporting and importing firms, reduce pressure on the main port facilities, and minimise the impact of freight movements on road congestion and emissions. In addition, the advent of inland ports opens up opportunities for port companies

to compete for market share outside their traditional catchment, reducing the degree of monopoly power in the freight handling industry.

Combining plant-level information on location and industry with detailed firm-level merchandise trade data, this chapter examines the effect of inland port operations on exporter behaviour in Auckland city, with the opening of three inland ports between 1999 and 2005. It focuses on the uptake of Metroport, an inland port operated by Port of Tauranga Ltd, and examines subsequent growth in export values. From a research perspective, the opening of Metroport represents a valuable natural experiment for determining the causal relationship between infrastructure provision and export behaviour, as the new infrastructure was kept out of the public eye prior to its opening and hence represents an unanticipated shock to the transportation options available.

Substantial usage of the new port infrastructure implies that its opening has benefited at least some local firms, through lowering their export costs or improving their access to additional shipping options. Firm- and area-level characteristics of firms which have chosen to use Metroport are identified and the underlying timepath of adoption is considered. Early adoption of Metroport is then taken as a signal of an existing capacity constraint and the effect of the new port on consequent export growth for initially constrained firms is examined.

The analysis in this chapter differs from much of the existing literature on port and airport choice, in that rather than looking at the characteristics which determine the point-in-time decision of which port to use (eg, Malchow and Kanafani 2004; Tongzon 2009), the focus is on existing users of one port (Ports of Auckland) and the observed changes in their behaviour following a change in the local shipping options available.

The results suggest that firm size and past export intensity are positively associated with uptake of the new port, and that firms are more likely to use Metroport if they export goods with a relatively low value-to-weight ratio. In contrast, location-related factors – including distance to the major ports, characteristics of other firms in the local area, and the share of local employment in firms which have already adopted Metroport – do not affect uptake of the new infrastructure. Although adoption rates are high, implying that many firms have benefited from the new infrastructure, there is no evidence of resultant increases in exports.

The next section provides background to the infrastructural developments which form the basis of the analysis. Section 5.2 sets this chapter within the existing literature. Section 5.3 introduces the data and descriptive results, while Sections 5.4 and 5.5 detail the empirical

methodology and findings relating to port adoption and export growth respectively. Section 5.6 concludes.

5.1 Institutional background

One key difficulty with establishing the relationship between transport infrastructure, firm location and exporting is the endogeneity inherent in such an analysis. Throughout history cities and ports have developed in tandem. Many cities originally developed around access to water transport, but over time these developments became self-sustaining through economies of scale and scope associated with agglomeration and urbanisation (Fujita and Mori 1996; Duranton and Puga 2004). While the importance of water-based transport has declined for most firms as alternative modes of transport and communication have developed, urban structure still reflects the importance of the port in earlier times, with many modern cities and towns centred around either sea or river access.

The contemporary spatial distribution of firms therefore reflects both the current relevance of international transportation to the firms' activities, but also a more general desire to locate close to the amenities and inputs available in the central city. Meanwhile, the benefits of scale and scope associated with a central location, and higher land prices in central areas imply that those firms located in central areas will be more productive than peripherally-located firms. Substantial firm-level research has demonstrated that more productive firms are more likely to export, as shown in Chapter 4 for New Zealand manufacturers.

This chapter makes use of discrete changes in the location of key transport infrastructure nodes to consider the causal relationships underlying the observed spatial distribution and performance of exporting firms. On June 5th 1999 Port of Tauranga opened New Zealand's first inland port in Southdown, an industrial suburb in the south of Auckland City. The new facility, known as Metroport, acts as an extension of the main Port of Tauranga located some 200kms to the southeast, and created direct competition for Ports of Auckland Ltd in its home market. From a firm's perspective, the new inland port fulfils all the core functions of a normal seaport. Firms can complete all the requirements for merchandise imports and exports at the inland port, from which goods are transported to the seaport by rail (Port of Tauranga 2009). Thus, this new infrastructure effectively brings firms in the south of Auckland closer to a second international seaport.

In publicity and marketing campaigns for the new port, Port of Tauranga emphasised the

benefits available to firms through improved accessability and physical proximity relative to the existing Ports of Auckland. Figure 5.1 shows the location of major transport infrastructure nodes in the Auckland Regional Council area. Prior to the opening of Metroport in 1999, exporting firms had proximate access to only one international seaport – the main terminal of Ports of Auckland, located in the central business district of Auckland City.[1] By locating the new inland port in the south of Auckland City, Port of Tauranga not only made use of existing rail infrastructure which could be used to transport goods to the terminal in Tauranga, but also brought the port close to their main customer base in the industrial areas of South Auckland and Manukau, allowing firms to avoid the traffic congestion of the central city. In turn, Ports of Auckland opened inland ports in East Tamaki (February 2002) and Wiri (October 2005) also offering full import and export processing and storage facilities.[2]

This chapter examines the effect of changes in the effective distance to port for South Auckland firms, and the increase in options available to firms following the opening of Metroport. Although Ports of Auckland receives a larger number of vessel arrivals overall, around one-third of the vessels which visit Tauranga in a month do not go to Auckland, so the ability to access both ports provides firms with a significant increase in locally available shipping options.

The focus is on heterogeneity in firm and product characteristics and firm location, rather than port facilities, as differentiating between ports on the basis of either service levels or prices is complicated by the wide range of services offered by each port (eg, pilotage, storage, stevedoring etc).[3]

The opening of the new port appears to have had some effect on port usage patterns of firms located in the north of the North Island. Figure 5.2 plots the share of aggregate exports among those firms from 1997 to 2007, through Ports of Auckland, Auckland International Airport, Port of Tauranga, and an aggregate of all other ports. The share of exports through Port of Tauranga jumped from around three percent in the year prior to Metroport's opening to around ten percent in the first year of operation, increasing further over the following seven years. While the initial boost appears to have come mainly from a shift away from

[1] Port of Onehanga, also owned by Ports of Auckland, is almost exclusively used for domestic shipping.

[2] The East Tamaki inland port closed in 2007, following Fisher and Paykel's decision to move part of its production offshore.

[3] As the services required by shippers will differ depending on product and shipment characteristics, it is not generally possible to estimate a price differential between the two ports. Moreover, there are no clear differences in the level of port services provided – both ports are open 24 hours, are able to accommodate large vessels, handle both container and break-bulk cargo, and provide a similar set of services.

Figure 5.1: Location of main goods transport infrastructure nodes in Auckland

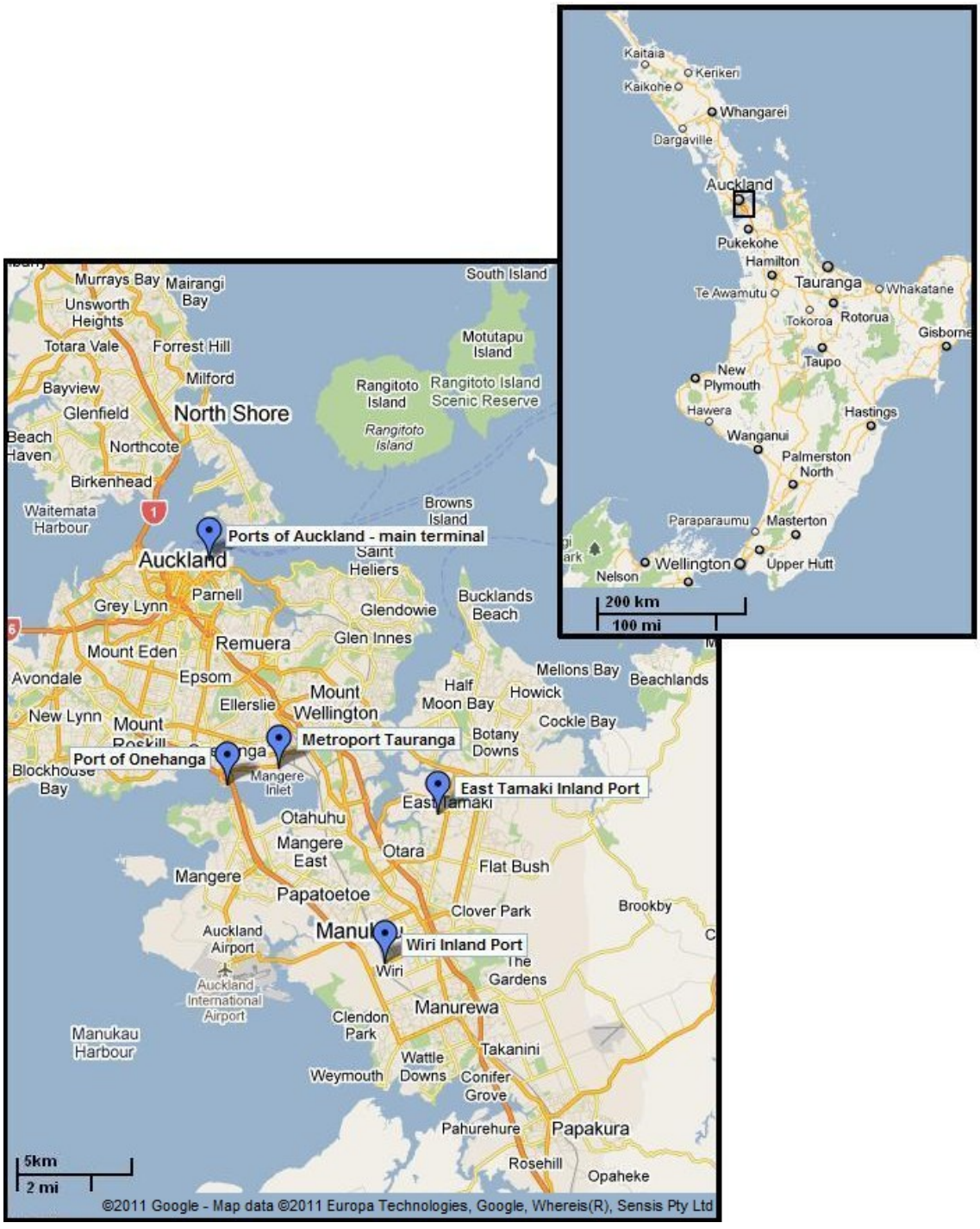
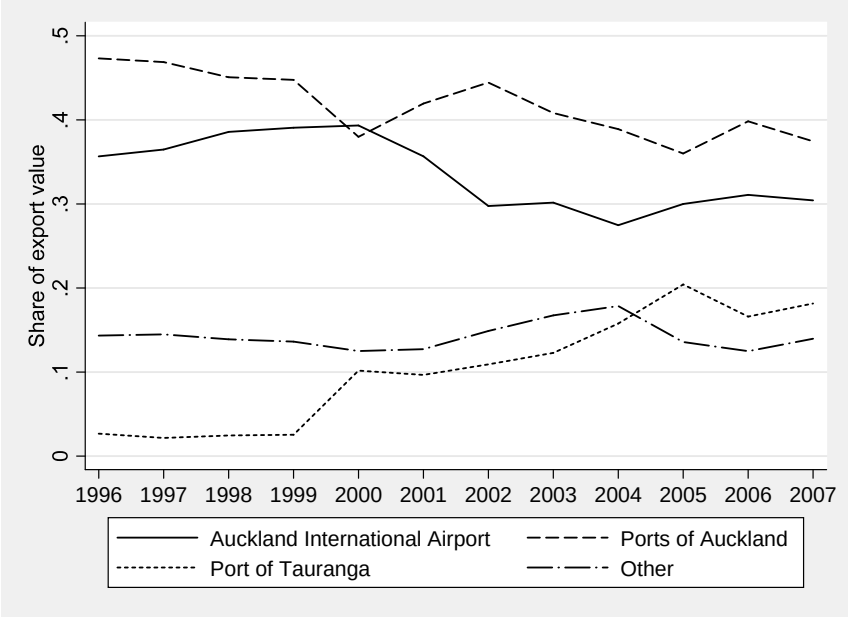


Figure 5.2: Port share of exports by firms located in Auckland and Northland regional councils



Years ending 31 May. Metroport commenced operation at the beginning of the year ending May 2000.

Ports of Auckland, the longer term increase has been at least as strongly associated with a shift among local firms away from using Auckland International Airport.[4]

From a research perspective, the opening of Metroport represents a valuable natural experiment for determining the causal relationship between infrastructure provision and export behaviour. For commercial reasons, Port of Tauranga kept their intention to establish Metroport under wraps until May 1999, the month before the new port opened (Graham 2005). Thus, the new infrastructure was unanticipated by the market, and we can be confident that firms did not alter either their export behaviour or their location decisions in anticipation of the new infrastructure. Meanwhile, although the choice of where to locate Metroport was clearly not random, it does not appear to have been directly influenced by any individual firm and can therefore be treated as both exogenous and unforeseen for the firms in the analysis.[5]

[4]The split of export value between air and sea freight for the country as a whole has remained fairly constant over the period in question, with between 11 and 14 percent of export value being air-freighted (author's calculations using Statistics New Zealand Tablebuilder www.stats.govt.nz).

[5]The location decision made by Port of Tauranga is likely to have been influenced by a number of factors, including the location of existing infrastructure (particularly railway lines and motorway ramps) and land availability as well as the location of the port's target users. If Port of Tauranga's decision also reflected an expectation of high export growth in the area (as opposed to an existing high level of exporting which is directly controlled for in the analysis, and the industrial composition of the area which is controlled for through the use of industry dummies) we would expect estimated effects of proximity on uptake to be positively-biased.

5.2 Literature review

Improving domestic infrastructure may affect aggregate export performance by reducing the time and transport costs associated with getting goods to port. Models of heterogeneous firm trade such as Melitz (2003), Chaney (2008) and Crozet and Koenig (2010) focus on the role of changing trade costs in determining export propensity and intensity. As trade costs fall, aggregate exports expand through two mechanisms. Reductions in the marginal cost of trade (such as transport and insurance costs) act on the intensive margin, raising exports per firm. Meanwhile, a fall in either the marginal or fixed costs of exporting increases the number of exporting firms, as firms which were not able to bear the fixed costs of entry under the higher cost regime now find it profitable to do so.

Most existing empirical work on the impact of infrastructure on trade has considered cross-country differences in the accessibility and efficiency of transport infrastructure by using augmented gravity models. For example, Bougheas et al (1999) consider the role of public infrastructure in predicting the value of bilateral trade relationships, while Djankov et al (2010) look at the impact of delays in getting goods to port (mainly bureaucratic delays involved in the processing of exports) on aggregate export values.

More closely related to the current study, Albarran et al (2009) provide a firm-level empirical analysis of export performance, using the development of highways to analyse the impact of infrastructure investments on Spanish firms. They focus on the change in export propensity by distance to a highway and find some evidence for a mildly positive effect of domestic transport improvements on firms' exporting probability.

Logistics costs are not limited to the direct costs of getting goods to market. Timeliness and flexibility are also important factors which exporting firms must consider. A series of papers (Hummels 2001; Evans and Harrigan 2005; Harrigan and Venables 2006; Hummels and Schaur 2010) has focused on the implications of transport time on firm location and export behaviour. These papers argue that timeliness has become increasingly important due to the rise of just-in-time production and inventory control. In particular, timeliness of delivery allows firms to cope better with unanticipated demand shocks. Harrigan and Venables (2006) relate the need for short reaction times to firm location decisions and geographic clustering, while Evans and Harrigan (2005) consider the impact of distance to export destinations, and hence delivery times, on demand for goods. Meanwhile, Hummels and Schaur (2010) consider whether firms are able to use rapid, but more expensive, air transport to reduce the impact of uncertainty on firm profits.

Within the transportation and logistics literature, emphasis has been placed on the role of port and product characteristics. The location and accessibility of nodal transportation infrastructure has been shown to play an important role in the choice of departure point for both passenger transportation (eg, Pels et al 2003; Hess et al 2007; Brons et al 2009) and freight (Malchow and Kanafani 2004; Tongzon 2009). However, these authors also draw attention to other characteristics of transportation nodes – flight and shipping schedules, air fares and freight prices, etc – which may influence the choice of departure point. Such factors are particularly relevant where ports share a common or contestable hinterland – that is, an area where neither port has substantive competitive advantage because of lower overall transport costs (de Langen 2007) – as may be the case in Auckland following Metroport's establishment. Finally characteristics of the shipments themselves, such as time sensitivity or whether the good requires refrigeration, can interact with port characteristics to determine the final allocation of shipments to ports (eg, Malchow and Kanafani 2004 and references therein).

Meanwhile, other authors focus on the role of traffic congestion for freight transportation. For example, Golob and Regan (2001) report that congestion is perceived as a "somewhat serious" or "critically serious" problem for over 80 percent of 1,177 trucking company managers operating in California. Intermodal operators involving deliveries to airports are particularly affected, but private operators serving rail terminals and (to a lesser extent) seaports are also more likely to report congestion as a serious problem for their business. The authors suggest that this is due to a combination of constraints imposed by rail schedules and port operating hours which often require that carriers work during the most congested peak times, and the location of intermodal nodes in urban areas where congestion is particularly noticeable. Similarly, Holguín-Veras et al (2006) suggest that transport operators in New York and New Jersey have little scope to alter their delivery times in response to time-of-day pricing, as delivery times are set by customer requirements. Similar studies do not appear to have been undertaken in New Zealand. However, these international results suggest that congestion minimisation and, correspondingly, an improved ability to predict actual travel times associated with usage of Metroport may have a substantial impact on firms involved in the transport of goods to the port.

The choice of port between Auckland and Tauranga is unlikely to be related to just-in-time factors since most markets for New Zealand firms involve days or weeks of shipping time, making sea-freighted goods from New Zealand relatively unsuitable for just-in-time inventory processes. However, increased availability of transport infrastructure must allow

firms to reduce their marginal export costs, either through reducing the distance they have to transport their goods to port, by providing logistical benefits such as lower cost storage and a reduction in average travel times and the uncertainty associated with traffic congestion, or access to alternative shipping lines and schedules. In addition, as competition between Ports of Auckland and Port of Tauranga is no longer based purely on physical location, both port companies have an incentive to improve service and/or lower costs in order to attract customers. This fall in costs may in turn increase firm export activity.

The investigation of infrastructure uptake is framed within the context of innovation diffusion models. In this sense, the arrival of Metroport in the Auckland region is equivalent to the development of a new product or technology. In the past, firms located in the north of New Zealand usually either did not export or did so using one of the old "technologies" – sea freight via Ports of Auckland, or air freight through Auckland International Airport.[6] Metroport's arrival alters the options available to northern firms. While not all firms will find the new option attractive, for some firms it will represent a clear improvement over the existing technologies, inducing them to switch. Meanwhile, other firms may view Metroport as a beneficial addition, taking up the new opportunity but also continuing to use Ports of Auckland. Ongoing usage provides evidence that the innovation has been beneficial, at least for some firms, potentially leading to a second wave of uptake from late adopters who benefit from a demonstration effect.

5.3 Data description

Data are sourced from Statistics New Zealand's prototype Longitudinal Business Database (LBD). The Longitudinal Business Frame (LBF) provides information on the location and industrial sector of all plants, and the ownership links between plants and enterprises. Location and employment data are available from April 1999.

Location, employment and industry data are available at the plant level, while merchandise exports data are recorded at the enterprise level. Where enterprises are linked by parent-subsidiary relationships, exports are aggregated within these groups to capture trade by vertically-integrated firms and to accommodate the possibility that group restructuring has

[6] Port Whangarei and its successor Northport located at Marsden Point would not be an acceptable substitute for Ports of Auckland for most firms, as they are much smaller ports and do not have container facilities. Port Whangarei/Northport is primarily an import port, supplying crude oil to the Marsden Point oil refinery. It accounts for around one percent of export value and five percent of export volume by sea (Statistics New Zealand Infoshare, Overseas Cargo Statistics) most of which comprises log exports. Firms which ever use Port Whangarei are excluded from the following analysis.

led to changes in Customs reporting responsibilities within the group. Trade is then allocated to those enterprises within the group whose industry designation indicates they are likely to handle physical merchandise.[7]

"Potential export industries" are defined as the four main two-digit ANZSIC industry classifications which deal primarily with physical merchandise (excluding Mining): Agriculture, forestry and fishing (AFF), Manufacturing (MANU), Transport and storage (TS), and Wholesale trade (WST). The population is restricted to firms with at least one employing plant which is ever categorised as being in an export industry. For example, if a firm is made up of two plants, one in Finance and insurance and one in Manufacturing, it is assumed that only the manufacturing plant is likely to be involved in the trade and transport of goods. This assumption is supported by the data, with 97 percent of all merchandise exports being associated with firms with at least one export-industry plant.

Merchandise trade data in the LBD includes daily shipment-level data on the value and volume of exports by product, destination, mode of transport and port of loading. The trade data are aggregated to an annual frequency, using a 31st May year-end to correspond to the opening of Metroport (5th June 1999).

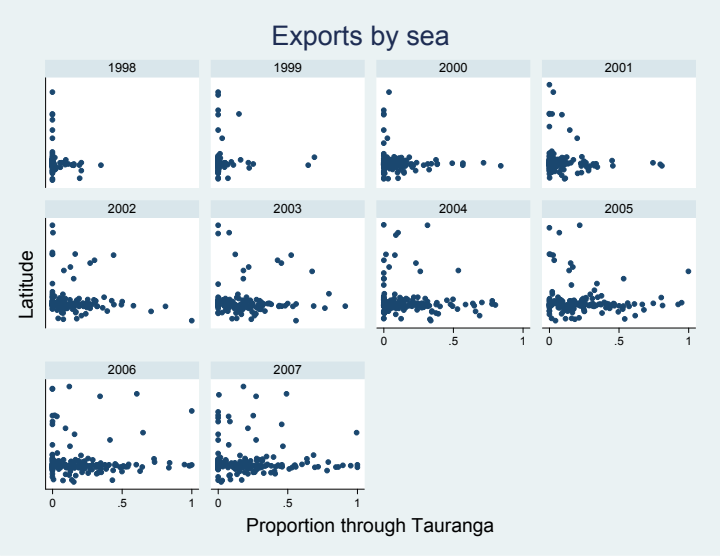
As inland port use is not identified separately in the Customs data, identification of Metroport use is based on a combination of load port information and the location(s) of the exporting firms. If a firm has no employing locations south of Auckland Regional Council, any exports through Port of Tauranga from June 1999 onwards are assumed to be directed through the inland port. This relies on an assumption that when firms have the choice of delivering their goods to a local depot or transporting them around 200km further to the main terminal they will choose to make use of the local option.

Figure 5.3 plots usage of Port of Tauranga (either location) by firms in the Auckland and Northland regions against log of latitude. Each dot represents one area unit and shows the share of Port of Tauranga in sea-freighted export value by firms located only in that area unit.[8] Metroport is located in the south of Auckland city, towards the bottom of the concentrated mass of area units. This mass covers firms in Auckland city and suburbs, while the sparser areas towards the top of each plot cover firms in the less populated areas to the

[7] In the analysis of port adoption the individual enterprises within the group are taken as the unit of observation. For the export growth analysis, all variables are aggregated to the group level in order to prevent double counting.

[8] Area units can be thought of as largely equivalent to suburbs. In order to maintain confidentiality, area units with only a single exporting firm are excluded, log latitudes of the remaining area units are slightly perturbed, and labels have been removed from the y-axis.

Figure 5.3: Share of trade through Port of Tauranga by log of latitude of area unit, 1998-2007



Years are to 31st May year-end. Metroport opened at the beginning of the 2000 year. Latitudes have been slightly perturbed and the scale has been removed to comply with Statistics New Zealand confidentiality requirements.

north.[9]

Figure 5.3 supports the assumption that firms are likely to be using Metroport if they are located in Auckland and observed to use Port of Tauranga. Prior to 2000, there are very few area units in which firms made any use of Port of Tauranga, and in all but two area units less than a quarter of sea-freighted exports were directed through Port of Tauranga. After Metroport opens in June 1999 (ie, at the start of the 2000 year), there is an immediate increase in the share of value directed through Port of Tauranga in and around Auckland city. This is reflected in both an increase in the number of area units where at least some use is made of Port of Tauranga and an increase in the share of value going through Port of Tauranga. This pattern continues through to 2007.

Figure 5.3 also suggests differences in uptake rates across geographic regions. Very little use was made of Port of Tauranga by firms in Northland (represented by the small upper set of dots) until 2001, a year after the opening of Metroport. However, once this first use of Tauranga had been made, uptake continued to grow, and by 2007 a substantial share of sea-freight was exported through Tauranga in many northern areas. The next section considers the firm- and area-level factors determining adoption of Metroport, in order to better understand this geographic heterogeneity. As the focus of this chapter is on new

[9]To ensure that the observed patterns are not simply an artifact of the higher density in the Auckland region, the graph was re-plotted randomly excluding 90 percent of Auckland regions. The observed adoption patterns appear the same.

adopters of Metroport, the small number of northern firms which had already used Port of Tauranga prior to June 1999 are excluded from the analysis.

5.4 Empirical analysis: Adoption

5.4.1 Specification

Differences in uptake rates between firms located in the urban and industrial areas of Auckland relative to the more sparsely populated northern region may reflect:

1. that firms in Northland have less to gain from the opening of the new port, as Ports of Auckland remains the closest port;

2. that it takes time for information about the new port to filter northwards; and/or

3. that lower uptake in the north is determined by intrinsic differences between firms rather than being directly geographic in nature.[10]

To test these three hypotheses, the analysis includes explanatory variables relating to distance to the new and existing infrastructure, measures of potential knowledge spillovers from neighbouring firms, and a set of firm-specific characteristics. Overall uptake rates of the new infrastructure are also examined, and conclusions drawn about the barriers to switching, before turning to an analysis of the impact of the new infrastructure on adopting firms.

Survival analysis techniques are used to identify the factors affecting adoption rates (Kiefer 1988; Van Den Berg 2001). The central concept of survival models is that they focus not on the unconditional probability of an event occuring (eg, the probability that a particular firm will export through Metroport within a year of its opening) but rather on the instantaneous probability of uptake conditional on survival until that time (eg, the probability that a firm will adopt Metroport in the fifth year, given that the firm has not adopted in the preceding four years). Duration analysis is framed in terms of hazard functions, describing the conditional probability of adoption at any given time: $\lambda(t) = f(t)/S(t)$, where $f(t)$ is the number of firms exporting through Metroport for the first time at time t and $S(t)$ is the number of firms that had not yet adopted Metroport up to time t.

[10] Indirectly, firm sorting may of course be influenced by geography.

A hazard function parameterisation allows a comparison of the pattern of adoption rates over time with the S-shaped adoption patterns common in the innovation literature. Survival models are also designed to handle some of the idiosyncratic difficulties associated with the collection and analysis of duration data (Kiefer 1988), including right-censoring and the treatment of time-varying covariates, providing a tractable framework to consider the relationship between firm and geographic characteristics and infrastructure usage.

To avoid imposing restrictions on the shape of the underlying adoption curve, a Cox Proportional Hazard model is used (Cox 1972). The key assumption of this model is that the hazard (adoption) rate depends on a vector of explanatory variables $\mathbf{x}$, with unknown coefficients $\boldsymbol{\beta}$, which have a multiplicative effect on the baseline hazard function λ_0. The effect of the explanatory variables is to multiply the baseline hazard by a factor ϕ which does not depend on duration t: $\lambda(t, \mathbf{x}, \boldsymbol{\beta}, \lambda_0) = \phi(\mathbf{x}, \boldsymbol{\beta})\lambda_0(t)$. The effect of each explanatory variable can then be expressed as a hazard ratio – an estimate of the multiplicative effect of that variable on the conditional probability of adoption. The analysis below reports the estimated hazard ratio for each explanatory variable. A coefficient of one implies that the variable has no effect on the probability of adoption, values less than one imply a negative effect and values above one imply a positive effect.

While the opening of Metroport represented an exogenous, unanticipated shock, firms may subsequently change location to exploit the new infrastructure. To avoid such behaviour affecting the estimation of distance-related parameters, plant locations are defined immediately prior to Metroport opening, and those firms which alter their mix of locations within the Auckland and Northland regions are excluded from the population.[11]

Firms that have ever had an employing plant outside the Northland and Auckland regional councils are excluded from the population, in order to allow for identification of Port of Tauranga uptake via Metroport. Adoption of Metroport Tauranga is defined as the first observed use of Port of Tauranga after the opening of Metroport, excluding from the analysis any firm which had used Port of Tauranga prior to June 1999. Usage is then tracked over the following eight years to May 2007.

Finally, in order to consider the impact of area-level characteristics on uptake rates, attention is restricted to firms located in area units where the initial population includes at least ten incumbent exporters. This allows for the creation of indicators of local uptake which should not be unduly affected by the activities of a single firm. With this last restriction in place,

[11] Relaxing this latter restriction does not materially change the results.

around 6.2 percent of the trade directed through Ports of Auckland and Auckland International Airport in the two years prior to Metroport's opening is captured by the population of firms – a substantial amount of trade in dollar terms, but a low share of the aggregate due to the exclusion of large, multi-location exporters. All firm-level initial conditions (industry, employment, etc) are based on characteristics of the firm in the two months prior to Metroport's opening, while export history variables are based on data for the preceding two years (June 1997-May 1999).

Explanatory variables for firm-specific adoption rates include firm size – the firm's average export-industry employment in April-May 1999 (*log_emp*) – and several indicators of the firm's past export intensity: a dummy equal to one if the firm is observed to export in 1998 or 1999 (*initial_exporter*); a count of the number of months in which the firm exported in 1999 (*n_X_months99*); log of the mean number of shipments the firm made per exporting month (*log_n_shipments99*); and a dummy for whether the firm used sea freight in 1998 or 1999 (*X_sea98_99*). These variables are designed to capture the firm's historical intensity of port use. Firms which are intensive users of sea freight are expected to have a stronger reaction to the opening of Metroport, as any savings they can make by directing exports through Metroport will accrue over a larger volume of shipments. Explanatory variables are defined in Table 5.1 and summary statistics for firm-level variables are presented in Table 5.2.

A set of (largely) three digit Australia New Zealand Standard Industrial Classification (ANZSIC) dummies is included to control for differential exporting rates and product characteristics across industries. Industries are defined according to the primary activity of each employing plant in April-May 1999, so multi-plant firms may belong to more than one industry.[12]

The log of the value-to-weight ratio of a firm's exports between June 1997 and May 1999 (*log_value_to_weight*) is included as a more direct indicator of product type. Although the services provided by the two ports are largely the same, Port of Tauranga has traditionally been more closely associated with exports of bulk commodities. The port was originally set up to service the forestry industry in the upper North Island, and container facilities were not established until 1992 (Port of Tauranga 2010).[13]

[12] An additional category is included for plants observed to be in an export industry at some point during the analysis period, but which are in non-export industries in the initial two months.

[13] By comparison, Ports of Auckland's first dedicated container wharf opened in 1971 (Ports of Auckland 2008). Although historical port services differ, there is no evidence that this creates a barrier to using either port for any particular products. There are only a small number of (4-digit) products which are exported exclusively by one port over the period in question, and the exclusion of these products does not materially alter the results.

Table 5.1: Variable definitions for analysis of port infrastructure uptake

Variable name	Definition	Expected sign	Source
log_emp	log of initial export-industry employment, April-May 1999	?	LEED
initial_exporter	dummy equal to one if the firm exported in June 1997-May 1999	+	Customs
n_X_months99	number of months in which the firm exported, June 1998-May 1999	+	Customs
log_n_shipments99	log of the average number of export shipments per month in exporting months, June 1998-May 1999	+	Customs
X_sea98_99	dummy equal to one if the firm exported via sea-freight, June 1997-May 1999	+	Customs
log_dist_Metroport	log of the distance in kilometres from Metroport to the firm's closest export-industry plant in April-May 1999	-	LBF
akl_10km	dummy variable equal to one if the firm is located within 10 km of the main terminal of Ports of Auckland	+	LBF
log_value_to_weight	value to weight ratio of firm's exports, June 1997-May 1999	?	Customs
log_AU_emp_density	log of employment per km^2 in area units in which the firm is located, April-May 1999	?	LEED
AU_exporter_share	exporter share of export-industry employment in the area units in which the firm is initially located, (June 1997-May 1999)	?	LEED, Customs
spillovers_incumbent	share of incumbent-to-AU firm (April-May 1999) employment in firms which exported through Metroport in the previous year	+	LEED, Customs
spillovers_new	share of new-to-AU firm (post April-May 1999) employment in firms which exported through Metroport in the previous year	+	LEED, Customs
zero_emp	dummy equal to one in years in which the firm has no export-industry employment	-	LEED
ANZSIC dummies	set of dummy variables for three-digit ANZSIC equal to one if the firm has a plant in that industry in April-May 1999. A small number of industries were aggregated to the two-digit level.	?	LBF

Data sources: Longitudinal Business Frame (LBF); Linked Employer-Employee Data (LEED); Overseas Merchandise Trade Data (Customs)

Table 5.2: Summary statistics for infrastructure uptake analysis population

	All firms		**Exporters**		**Non-exporters**	
	Mean	StdDev	Mean	StdDev	Mean	StdDev
log_emp	1.583	1.076	2.018	1.073	1.386	1.017
log_dist_Metroport	2.166	1.000	2.035	0.913	2.225	1.032
akl_10km	0.486		0.492		0.484	
initial_exporter	0.311					
n_X_months99			4.427	4.113		
log_n_shipments99			0.525	0.775		
log_value_to_weight			3.313	1.613		
X_sea98_99			0.607			
N(firms)	4,533		1,410		3,123	

Summary statistics not presented for regional level variables, zero employment and ANZSIC dummies.

A time-varying dummy set to one in any year in which the firm has no export-industry employment (*zero_emp*) is used to control for firm closures while avoiding dropping firms from the population. In principle, firms with working proprietors may still export even though they have no observed employment, while others experience intermittent periods of zero-employment without closing down. In practice, the coefficient on this variable was effectively zero in all specifications of the model, and is not reported in the results.

The locations of ports and airports are identified using a range of publicly available information, and their locations mapped to meshblocks – the smallest geographical area available for Statistics New Zealand data.[14] Distance is a straight-line measure from the centroid of the meshblock in which a port is located to the centroid of the nearest meshblock in which the firm has an employing export-industry plant.[15]

Two variables are included to capture the effect of geographic location – the log distance in kilometres to Metroport in April-May 1999 (*log_dist_Metroport*), and a dummy for firms which were initially located within ten kilometres of Ports of Auckland's main terminal (*akl_10km*). The former reflects the relative value of the new port's location for firms in different areas based on potential savings in transportation costs, and is expected to have a negative sign.[16] The latter variable is designed to control for the firms' existing location decisions, by reflecting their initial choice to locate close to an international seaport.[17] Firms which place a high value on being located close to Auckland port initially may also have a stronger distance-elasticity with respect to uptake of Metroport.

Area unit (AU) measures of export propensity – the initial (April-May 1999) share of employment in firms which were observed to export between June 1997 and May 1999 (*AU_exporter_share*) – and employment density – log of the number of employees per square kilometre in April-May 1999 (*log_AU_emp_density*)– are included to separate out the location-specific factors from those related to the activity of neighbouring firms.[18] Finally, the AU share of export-industry employment in firms which exported through Port of Tauranga in the previous year is used to identify information spillovers from nearby firms, distinguishing between incumbent firms in April-May 1999 (*spillovers_incumbent*)

[14] Using Statistics New Zealand's 2006 Census-based Digital Boundaries (available from www.stats.govt.nz). The LBD identifies firm locations according to 2007 meshblock boundaries. A small number of meshblocks are aggregated to match 2006 definitions.

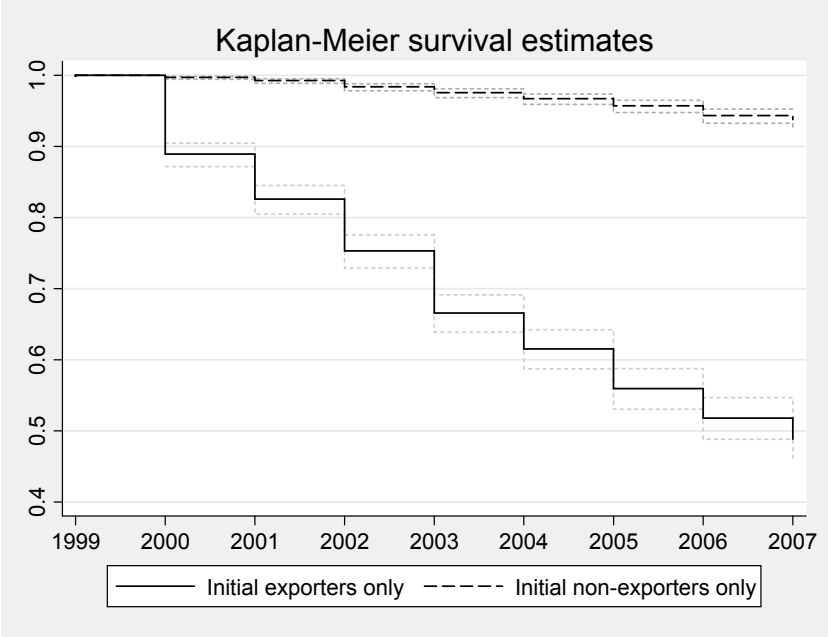
[15] An alternative specification in which distance is determined as an employment-weighted average of plant-specific distances does not alter the results.

[16] Consistently measured road distances for Auckland and Northland meshblocks are not available.

[17] Alternative thresholds were considered with no change to the results.

[18] Where firms have export-industry plants in more than one AU, the firm's measure of each variable is defined as an employment-weighted average across all the firm's locations.

Figure 5.4: Adoption rate of Metroport Tauranga by initial export status



Calculated for firms located only in Northland or Auckland with export-industry employment in May-June 1999, according to whether they exported in the two years to June 1999. 95 percent confidence intervals shown. Excludes firms which already used Port of Tauranga prior to the opening of Metroport.

and those which opened or moved to the area since June 1999 (*spillovers_new*). If information gaps are a substantial explanation for the late adoption of Metroport by northern firms, these variables would be expected to have positive coefficients.

5.4.2 Results

In examining the determinants of uptake, a distinction is made between those firms which were already exporting prior to Metroport's opening in June 1999 (initial or incumbent exporters) and those which were not (initial non-exporters or entering exporters). These two groups exhibit very different patterns of adoption, as shown in Figure 5.4. Incumbent exporters experience strong initial uptake, with over ten percent of employing export-industry firms beginning to use Port of Tauranga by May 2000 (solid line). The adoption rate then falls away over the following years. Rapid initial adoption suggests that the factors usually associated with delayed adoption, such as risk aversion, lock-in, and network externalities, are not particularly relevant for adoption of new port infrastructure.

In contrast, uptake among firms that had not previously exported is slow in the first years after Metroport opens, but increases steadily throughout the analysis period. However, even by 2007 cumulative adoption is an order of magnitude lower for the initially non-exporting

population compared to incumbent exporters. While the uptake decision for incumbent exporters is a choice of whether to use Metroport either instead of, or as well as, Ports of Auckland, the decision for non-exporters combines the decision to use Metroport with a decision to enter exporting, an event which itself is quite rare for New Zealand firms, as discussed in Chapter 4.

Table 5.3 presents central results of the Cox Proportional Hazard model, comparing the full population (column 1) with initial exporters (column 2) and initial non-exporters (column 3). Firm size, past export activity, and the intensity of this activity show up as significant predictors of adoption. The coefficient on *initial_exporter* in column 1 confirms the picture implied by Figure 5.4, with incumbent exporters over seven times more likely to begin using Metroport than initial non-exporters.

Among incumbent exporters (column 2), a ten percent increase in initial employment is associated with 2.3 percent higher probability of starting to use Metroport in any given year, while an additional month of exporting in 1999 is associated with a nine percent higher probability of adoption. Firms already exporting by sea in 1998 or 1999 are almost twice as likely to commence using Metroport as those firms whose previous exports were via air freight.

An additional significant predictor of adoption is the value-to-weight ratio of past exports, with a ten percent increase in the ratio associated with approximately 2.5 percent lower probability of adoption. As Port of Tauranga's traditional focus has been on the export of bulk commodities this may reflect differences in port facilities, cost structures or shipping schedules between Ports of Auckland and Port of Tauranga.[19] Alternatively, it is likely that Ports of Auckland's central city location acts as a greater deterrent for exporters of bulk commodities due to a lack of storage space at the port and the need to transport the goods by truck through the central city.

While accessibility and storage space may be factors which encourage firms to use Metroport, this does not carry over to a proximity effect on uptake among existing exporters. There is no evidence of a significant relationship between distance to the new port and the probability of adoption. Nor does proximity to other users of the new infrastructure appear to affect uptake, with the coefficients on both spillover variables insignificant in all specifications.

The lack of any apparent learning effect also holds for the population of initially non-

[19] Though the majority of goods are shipped through both ports.

exporting firms (column 3), with no significant relationship with adoption rates apparent for either area characteristics or spillover variables. However, among initial non-exporters there is a negative and significant relationship between distance and uptake of the new facilities. As new exporters do not have a pre-existing relationship with Ports of Auckland, they may be more sensitive to small differences in accessibility and transport costs, relative to established exporters. Alternatively, if access to the new port does affect marginal costs of exporting, some firms may have been drawn into exporting by the availability of the new infrastructure.

Table 5.4 presents supplementary results for different sub-populations from the incumbent export population. Column 1 tests that the significant relationship between firm size, export intensity and adoption is not driven by the fact that large and intensive exporters are more likely to maintain their export activities over time (thus giving them greater opportunity to use Metroport) by restricting the sample to firms which export in at least six of the eight years of the sample. Columns 2 and 3 compare results across the two main industries in the population – Manufacturing and Wholesale trade. Column 4 focuses on the sub-population of firms within 10km of the main terminal of Ports of Auckland, since choosing to be proximate to the pre-existing infrastructure may indicate greater sensitivity to distance.

Finally, columns 5 and 6 allow for the possibility that the decision to export through Metroport exclusively may be quite different from the decision to use both Ports of Auckland and Metroport depending on, say, shipping schedules, product or destination characteristics, or levels of congestion at each port at particular times.[20] A mere seven percent use the new port exclusively in the year after adoption. The majority of firms (42 percent of adopters) use both Metroport and Ports of Auckland, while 28 percent return to using only Auckland in the year following their first use of Metroport.[21] Two years out, usage of both ports is still the most common pattern, accounting for 40 percent of adopters.

Columns 5 and 6 of Table 5.4 compare the pre-existing characteristics of firms which begin to use Metroport in addition to Ports of Auckland – the primary usage pattern observed in the data – with those adopters following other paths.[22]

Together, these results reinforce the picture from the central estimates – adoption of Metro-

[20] The main specifications focus on first usage of Metroport, regardless of whether the firm continues to use Metroport in the following years, and whether or not the firm continues to use Ports of Auckland.

[21] Remaining adopters either did not export or exported only via air or through other seaports in the following year.

[22] In each regression, firms which start using Metroport in year t but do not exhibit the relevant pattern are treated as censored in the year of adoption.

port is more likely among large, export intensive firms, particularly those dealing in low value-to-weight products. In contrast, geographic factors – including distance to the major ports, characteristics of other firms in the local area, and the share of local employment in firms which have already adopted Metroport – play no significant role in determining firms' usage of the new infrastructure.[23]

5.5 Empirical analysis: Export growth

5.5.1 Specification

Having considered the determinants of port infrastructure uptake, the analysis now turns to an investigation of the impact of adoption on firm-level export performance. The difficulty for this analysis is that distance to port has shown up as insignificant in the adoption regression, removing that as an obvious candidate for an exogenous instrument to measure the relative impact of the port on all firms. Rather, the factors that determine uptake are related to the firm's own performance, which in turn is likely to be related to their future growth prospects. In particular, firms receiving a positive shock to their exports may begin to use Metroport to accommodate higher volumes of trade.[24]

Measuring the impact of Metroport instead relies on identifying those firms which appeared to be constrained in their initial access to shipping options and examining their relative growth while controlling for their characteristics prior to Metroport's opening. In particular, firms which start using Metroport within one year of its opening ($early\_adopter = 1$) are compared with those which adopt later or not at all ($early\_adopter = 0$). By using early adoption, and controlling for the existing export-related characteristics of the firm at the time of adoption, firms which commence using Metroport later due to a positive shock to their exporting are distinguished from those which adopt early (implying the relaxation of an existing constraint).

Overall export growth is decomposed into that coming from increases in the number of

[23] A number of other specifications were also considered but are not reported including: a specification incorporating firm-specific heterogeneity; a range of different measures reflecting distance to Metroport (eg, the relative distance to Metroport with respect to the main terminal of Ports of Auckland allowing the impact of distance to Metroport to depend on distance to an alternative port); and a specification in which the spillover variables were dropped and the population extended to include firms in regions with at least ten firms initially, rather than at least ten exporters. In all cases, results remained substantively the same.

[24] Indeed, a regression of export growth over the full period on a dummy for whether the firm has ever used Metroport by 2007 suggests a strong, consistent and positive relationship between adoption of the new port and export value growth.

Table 5.3: Determinants of Metroport adoption

	(1)	(2)	(3)
	ALL	X	NX
log_emp	1.303***	1.231***	1.555***
	[0.053]	[0.053]	[0.147]
initial_exporter	7.478***		
	[1.362]		
n_X_months99	1.100***	1.099***	
	[0.015]	[0.015]	
log_n_shipments99	0.989	1.016	
	[0.068]	[0.068]	
X_sea98_99	1.981***	1.988***	
	[0.225]	[0.223]	
log_value_to_weight	0.773***	0.756***	
	[0.026]	[0.026]	
log_dist_Metroport	0.952	0.982	0.843*
	[0.042]	[0.048]	[0.081]
akl_10km	0.963	0.989	0.786
	[0.083]	[0.091]	[0.170]
AU_log_emp_density	0.947	0.963	0.935
	[0.052]	[0.057]	[0.127]
AU_exporter_share	2.388*	1.990	2.310
	[1.151]	[1.021]	[2.690]
spillovers_new	1.248	1.097	1.693
	[0.383]	[0.376]	[1.066]
spillovers_incumbent	1.253	1.166	1.900
	[0.230]	[0.250]	[0.755]
N(firms)	4,533	1,410	3,123
N(adopters)	732	603	129
time at risk	24,105	6,786	17,319
χ^2 (p-value)	1,516 (0)	411 (0)	128 (0)
pseudo-R^2	0.116	0.046	0.061

Cox Proportional Hazard model where the dependent variable is number of years until first use of Metroport. Specifications: Full population of firms (ALL); Initial exporters only (X); Initial non-exporters only (NX). Robust standard errors in brackets (***;**;* significant at 1%;5%;10% respectively). All regressions include (largely) three-digit industry dummies and a dummy for zero employment (not reported). All counts random rounded (base three) in accordance with Statistics New Zealand confidentiality requirements.

Table 5.4: Determinants of Metroport adoption – robustness tests for initial exporters

	(1)	(2)	(3)	(4)	(5)	(6)
	6+	MANU	WST	AKL_10km	BOTH	NOT BOTH
log_emp	1.163***	1.255***	1.228***	1.215***	1.190**	1.124*
	[0.055]	[0.087]	[0.072]	[0.079]	[0.090]	[0.078]
n_X_months99	1.038**	1.124***	1.091***	1.103***	1.094***	1.000
	[0.016]	[0.023]	[0.021]	[0.021]	[0.026]	[0.022]
log_n_shipments99	1.064	0.949	1.037	1.032	1.117	0.998
	[0.075]	[0.092]	[0.103]	[0.100]	[0.106]	[0.107]
X_sea98_99	1.891***	2.129***	1.836***	1.989***	2.822***	1.604***
	[0.221]	[0.349]	[0.295]	[0.340]	[0.637]	[0.254]
log_value_to_weight	0.745***	0.728***	0.760***	0.730***	0.665***	0.802***
	[0.027]	[0.036]	[0.038]	[0.036]	[0.037]	[0.043]
log_dist_Metroport	1.047	1.017	0.950	0.897	1.012	1.075
	[0.054]	[0.075]	[0.062]	[0.062]	[0.077]	[0.085]
akl_10km	1.078	0.984	1.030		1.120	1.031
	[0.105]	[0.138]	[0.125]		[0.158]	[0.151]
AU_log_emp_density	0.921	0.872	1.025	0.908	1.007	0.890
	[0.063]	[0.080]	[0.092]	[0.112]	[0.106]	[0.079]
AU_exporter_share	2.736*	2.033	2.364	1.523	3.500	1.526
	[1.570]	[1.596]	[1.708]	[1.268]	[2.894]	[1.195]
spillovers_new	0.715	1.279	1.257	1.876	0.558	1.014
	[0.272]	[0.639]	[0.617]	[0.973]	[0.388]	[0.476]
spillovers_incumbent	1.239	1.483	1.096	1.406	1.541	0.953
	[0.263]	[0.491]	[0.354]	[0.570]	[0.487]	[0.273]
N(firms)	798	591	735	693	798	798
N(adopters)	513	261	318	270	225	261
time at risk	3,972	2,895	3,492	3,432	3,702	3,702
χ^2 (p-value)	271 (0)	237 (0)	177 (0)	258 (0)	204 (0)	2,449 (0)
pseudo-R^2	0.036	0.065	0.044	0.059	0.072	0.021

Cox Proportional Hazard model where the dependent variable is number of years until first use of Metroport (except specifications 5 and 6, see below). All regressions restricted to initial exporters. Additional population constraints: Firms exporting in at least 6 of the 8 years (6+); Firms with at least one manufacturing plant (MANU); Firms with at least one wholesale trade plant (WST); Firms located within 10km of the main terminal of Ports of Auckland (AKL_10km); Firms exporting in at least 6 years, excluding first use of Metroport in 2007 (BOTH, NOT BOTH). Specifications 5 and 6 have different dependent variables: Firm uses Metroport for the first time in year t, and uses both Metroport and Ports of Auckland in year t+1 (BOTH); Firm uses Metroport for the first time in year t, but does not use both Metroport and Ports of Auckland in year t+1 (NOT BOTH). Robust standard errors in brackets (***;**;* significant at 1%;5%;10% respectively). All regressions include (largely) three-digit industry dummies and a dummy for zero employment (not reported). All counts random rounded (base three) in accordance with Statistics New Zealand confidentiality requirements.

shipments per year and that coming from increases in average shipment value. In principle, improved port access should impact strongly on shipment frequency, as the marginal cost of each shipment falls and firms can benefit from greater timeliness. The expected effect on average shipment value is therefore ambiguous – if firms adapt to improved access by splitting their existing shipments across a greater number of voyages, average values will fall. However, if the lower cost and/or improved access encourages firms to increase their overall exports there may be no change, or even a rise, in average shipment size. For completeness, the analysis also considers whether early adopters show differential growth rates in terms of the number of products they export or the number of export destinations they target.

The population for this analysis is broadly the same as that used for the analysis of adoption rates – firms which have at least one employing plant in the Auckland or Northland region prior to Metroport's opening, which have not used Port of Tauranga prior to the opening of Metroport, and which are deemed unlikely to begin exporting directly through the main port in Tauranga after Metroport opens due to their location. However, to maximise sample size, firms which have locations outside of the Auckland and Northland regional councils are also included, so long as they do not initially have employing plants in the central North Island (Waikato, Bay of Plenty or Gisborne regional councils) as plants in these locations might be expected to export directly through the main port in Tauranga.[25]

The following variables are included to control for the firms' existing characteristics and export propensity, all based on two-year periods prior to Metroport's opening: log of total sales in 1998/99 and the log change in sales value between 1996/97 and 1998/99;[26] exports as a proportion of sales in 1998/99 and the change in exports as a proportion of sales between 1996/97 and 1998/99; a dummy set equal to one for firms which were observed to export in 1998/99 but not in 1996/97; a dummy set equal to one for firms with observed sales in 1998/99 but not in 1996/97; a dummy for firms which initially exported only via air freight, not sea freight; and a full set of regional council dummies for each of the firms' locations. A full set of export product dummies, set equal to one if the firm exported a good from that two-digit Harmonised System (HS) product group in 1998/99, is included in place of industry dummies.[27]

[25]The results are robust to a broader definition of central North Island which includes Taranaki, Manawatu/Wanganui and Hawke's Bay regional councils. Firms located further south in the North Island are likely to use Port of Wellington (Centreport).

[26]Sales are used as the measure of firm size rather than employment as sales data are available over a longer time period prior to Metroport's opening. 1996/97 refers to the two-year period from 1st June 1995 to 31st May 1997.

[27]HS dummies may be more appropriate than industry dummies when dealing solely with exporters as

Table 5.5: Estimated export growth premium of early adopters

A: All incumbent exporters

	exports	shipments	avg. value	countries	goods	N
2000/01	0.334***	0.248***	0.086	0.090**	0.251***	2,784
	[0.077]	[0.056]	[0.053]	[0.039]	[0.050]	
2002/03	0.122	0.059	0.064	0.024	0.062	2,394
	[0.102]	[0.084]	[0.063]	[0.051]	[0.068]	
2004/05	0.110	0.062	0.048	0.020	0.109	2,214
	[0.124]	[0.095]	[0.073]	[0.059]	[0.081]	
2006/07	0.050	0.043	0.008	0.025	0.174**	1,932
	[0.140]	[0.110]	[0.076]	[0.065]	[0.088]	

B: Pre-existing users of Ports of Auckland

	exports	shipments	avg. value	countries	goods	N
2000/01	0.250***	0.229***	0.020	0.079*	0.206***	1,575
	[0.082]	[0.059]	[0.058]	[0.042]	[0.050]	
2002/03	0.028	0.022	0.006	0.020	0.008	1,377
	[0.107]	[0.088]	[0.069]	[0.053]	[0.071]	
2004/05	0.013	0.025	-0.012	0.003	0.071	1,281
	[0.131]	[0.103]	[0.077]	[0.064]	[0.087]	
2006/07	-0.062	-0.010	-0.053	0.002	0.165*	1,125
	[0.149]	[0.120]	[0.080]	[0.071]	[0.097]	

Robust standard errors in brackets (***;**;* significant at 1%;5%;10% respectively). Ordinary least squares regression where dependent variables are log changes between 1998/99 and the relevant two-year end period in: total export value (exports), number of export shipments (shipments), average value of exports per shipment (avg. value), number of countries exported to (countries), and number of distinct HS2 product categories exported (goods). Unreported control variables include initial: sales, sales growth, export share, change in export share, new exporter dummy, new firm dummy, air freight only dummy, location (regional council) dummies, and two-digit HS dummies.

Table 5.5 reports the estimated coefficients on $early\_adopter$ across the five outcome variables listed above and across four time periods. Export value growth measures are calculated as the log difference between the two years prior to Metroport's opening (1998/99) and a later two year period (shown in column 1). The top panel includes the entire sample, while the lower panel is restricted to those firms which are observed to export through Ports of Auckland in the two years prior to Metroport's opening. This subset of firms represents the group which is most likely to benefit from access to the new port, as they are already users of sea-port infrastructure in Auckland.

The results show no evidence for a positive export growth effect due to the relaxation of infrastructural and shipping constraints. While early adopters of Metroport show relatively higher export growth in the first two years following the opening of the new port, their long term export growth is no different from that of the combined comparison group of

they capture more detailed differences in activities across firms as well as product-specific demand and price changes.

late-adopters and non-adopters.

One possible interpretation of this pattern is that rather than early adoption being symptomatic of a pre-existing constraint, firms are instead reacting to an idiosyncratic positive shock to their exports. That is, a positive shock to exports in 2000 pushes them into using Port of Tauranga (most likely in addition to Ports of Auckland, as discussed above). Later adopters may in turn be driven to use Tauranga by their own positive export shocks, occurring in later years.

As the opening of the new port primarily represents an expansion of the export options available to firms, its effect on export performance may be minimal. In particular, given the distance between New Zealand and major international markets, time in transit is already substantial. Further, the marginal improvement may not be sufficient to substantially affect their outcomes. Alternatively, the major benefit of Port of Tauranga's entry may be through competition with Ports of Auckland. In this case, a difference-in-difference estimator will not capture the full effect because non-adopters also benefit through improved service or lower prices from Ports of Auckland. Along similar lines, Ports of Auckland's subsequent opening of inland ports could also reduce the estimated effect.

5.6 Conclusion

This chapter has examined the determinants and consequences of new infrastructure uptake among New Zealand export firms. The focus has been on the opening of New Zealand's first inland port, established by Port of Tauranga in 1999 in the Auckland suburb of Southdown. Considering the unanticipated opening of a new port mitigates the difficulties associated with attributing causal interpretations to long-lived, immobile infrastructure nodes.

By considering the types of firms which use Metroport and the implications for their export performance, this chapter provides a bridge between largely theoretical discussions of the benefits associated with satellite terminals and inland ports (eg, Slack 1999; Roso, Woxenius, and Lumsden 2009) and empirical examinations of port choice (eg, de Langen 2007; Malchow and Kanafani 2004). Revealed preferences from comprehensive administrative data show that uptake of the new facilities is rapid and widespread. For most firms the apparent benefit is an expansion of the available shipping options, as most of the firms which adopt Metroport also continue to use the main Ports of Auckland. Despite the location advantages emphasized by the port company, there is no evidence that distance to port

influences the decision of existing exporters to use Metroport.

However, there is suggestive evidence that geography does play a role in determining port usage. Firstly, the dramatic increase in usage of Port of Tauranga following Metroport's opening shows that distance to port is a factor over longer distances – many firms do not export through Tauranga until the logistics are made easier for them. Second, there is a positive relationship between distance and uptake for new exporters. This may be because new exporters do not have established ties to Ports of Auckland, or it may be that proximity to port actually has a positive effect on their export propensity. Third, Ports of Auckland opened inland ports in competition, consistent with proximity to customers yielding competitive advantage to the port company. Finally, accessibility does not necessarily equate with distance. Exporters of bulk commodities are more likely to use Metroport, which may be due in part to the greater accessibility afforded by not needing to transport goods through the central city.

The lack of a clear geographic effect on uptake by existing firms creates challenges for the identification of an exogenous instrument for analysing the impact of the new port. The analysis of export growth therefore focuses on the set of "initially constrained firms" – those which begin using Metroport within a year of its opening – and considers their subsequent export performance relative to later adopters and non-adopters, controlling for pre-Metroport characteristics. However, early adoption of Metroport does not appear to confer any on-going improvements in export performance.

Finally, Metroport's opening may have had benefits for northern firms that are not captured in the current comparative analysis. In particular, the increase in effective competition due to Ports of Tauranga's new Auckland location may provide benefits for non-users of Metroport as well, forcing Ports of Auckland to reduce prices and/or improve service. Ports of Auckland's move to open inland ports at Wiri and East Tamaki provides some support for this hypothesis.

Chapter 6
Foreign acquisition and the performance of New Zealand firms

Despite its geographic isolation, New Zealand is ranked ninth in the OECD in terms of inward foreign direct investment (FDI) as a percentage of gross domestic product (GDP) (OECD 2010).[1] While a substantial body of international literature shows that foreign-owned firms outperform local firms on a wide range of metrics and many countries have explicit policies designed to attract foreign investment, public opinion on the value of FDI to the New Zealand economy is strongly divided. Media accounts frequently draw attention to negative aspects of foreign investment, focusing on stories of downsizing by foreign owners, bemoaning the loss of promising New Zealand companies and technologies, and emphasising public fears of a loss of control of New Zealand's natural resources to offshore owners. Anecdotally, however, the owners and directors of New Zealand-based firms extol the benefits of foreign investment, including not only improved access to capital but also access to the new owners' stock of technology, networks and management experience (Simmons 2002).

This chapter provides an empirical analysis of cross-border mergers and acquisitions (M&As) using data for the population of companies operating in New Zealand between 2000 and 2008. It considers both the firm-level factors which attract foreign investors and the performance of firms after foreign acquisition. This work builds on the existing literature by considering a range of performance measures including outcomes both for acquired firms and for the workers within those firms. In this way, it is similar to the research of Arnold and Javorcik (2009) who consider post-acquisition performance of Indonesian manufacturing plants, finding evidence of both positive selection and post-acquisition performance gains. This chapter provides a small, distant, developed country perspective on this ques-

[1] Of the eight countries which rank higher, seven are small European countries with Luxembourg, the Netherlands and Switzerland taking out the top three spots.

tion, while also extending the analysis to include non-manufacturers and by allowing for the effects of foreign acquisitions to differ according to the characteristics of the target firm.

By including a range of outcome measures, the analysis considers not only whether firm outcomes improve following foreign acquisition, but also whether the benefits of any performance improvements are shared with workers or, conversely, come at the expense of the local workforce. Firm performance outcomes considered include labour and multi-factor productivity, capital intensity, and gross output. Worker outcomes include total employment, average wage, and labour turnover.

The results suggest that New Zealand acquisition targets are positively selected. Firms acquired by foreign owners tend to be larger, pay higher wages, have higher capital intensity and exhibit higher labour productivity than other domestic firms prior to acquisition. Evidence for performance upgrading among acquired firms is weak, though suggestive, with consistent patterns of treatment effects observed for some outcome variables and sub-populations but few statistically significant coefficients. Average treatment effects for the population as a whole suggest that firms experience a one-off increase in employment following acquisition, compared to the matched control group of domestic firms, and that this employment increase may be associated with increases in output and average wage, but potentially lower labour and multifactor productivity.

Examination of the estimated treatment effects for sub-populations based on initial performance and industry suggests that the aggregate results may conceal contrasting acquisition effects for different types of acquisition targets. These splits seem to imply broadly positive effects for firms which were initially small and below-average productivity and for the manufacturing and wholesale and retail trade industries, and possible negative effects for larger, higher productivity firms and those in service industries. However these results remain tentative, being based on consistency of coefficients rather than statistical significance.

The next section outlines the existing literature on FDI, focusing on cross-border M&As. Section 6.2 describes the data and empirical methodology, while Section 6.3 presents the results. Section 6.4 summarises the findings and suggests avenues for further work.

6.1 Literature review

Theoretical and empirical studies of the determinants of FDI abound, reflecting the complexity of real world investment decisions. The decisions ultimately taken by heteroge-

neous firms reflect a confluence of firm, industry, and country characteristics. This section briefly reviews the main theoretical accounts of FDI, focusing on motivations for international M&As. Understanding the factors which drive cross-border acquisitions motivates the choice of explanatory variables in the selection model. The literature on plant- and firm-level outcomes following foreign acquisition is then reviewed.[2]

A wide range of empirical literature shows that foreign affiliates outperform domestic firms (eg, Doms and Jensen 1998; Bernard and Sjöholm 2003; Bellak 2004; Greenaway and Kneller 2007). Comparisons between foreign-owned firms, locally owned multi-nationals and purely domestic firms suggest that the difference is driven by the performance gap between domestic and multi-national enterprises, rather than a "foreign premium" *per se* (Bellak 2004; Criscuolo and Martin 2009). It is commonly asserted that in order for foreign firms to be competitive they must have some firm-specific advantages – such as proprietary brands or product lines, high performance production processes or managerial expertise – to make up for the market-specific knowledge and networks of their local competitors and the additional costs of doing business abroad (Markusen 1995; Melitz 2003; Dunning and Lundan 2008). Empirical evidence suggests a productivity hierarchy in which only the highest productivity firms engage in outward direct investment, while less productive firms export, and the least productive firms retain a purely domestic focus (Greenaway and Kneller 2007).

However, positive self-selection into FDI does not necessarily imply positive selection of acquisition targets. Harris and Robinson (2002) contrast two theories of M&A: managerial discipline and operating efficiency. The theory of managerial discipline suggests that M&As are a form of natural selection, in which inefficient plants are bought out by new owners and undergo some form of managerial change or restructuring to improve their efficiency. In contrast, the operating efficiency theory suggests that M&As occur when the acquiring firm sees a complementarity between their existing operations and those of the target plant. In this case, the acquiring firm will be more likely to target high-performing plants. Post-acquisition performance may decline if there is difficulty in assimilating the new plants into the firm's existing operations, or improve if the new parent introduces complementary assets or processes. Harris and Robinson (2002) find support for the operating efficiency hypothesis for cross-border acquisitions, with foreign firms tending to target "good" plants, but note significant differences between industries and across acquiring firms from different coun-

[2]The data used in this chapter are at the firm level, while much of the existing empirical literature uses plant-level data. The theoretical literature does not make a distinction. In the discussion that follows the terms are used almost interchangeably.

tries. Guadalupe et al (2010) take a similar approach in considering whether foreign targets are positively or negatively selected. They attribute observed positive selection on performance to an imperfect ability on the part of owners to transfer managerial or production technologies to the local subsidiary.

While relative firm-level performance provides one lens with which to view cross-border M&A decisions, industry-, country-, and other firm-specific factors have also been shown to influence the FDI decision. Dunning and Lundan (2008) provide a comprehensive review of the main motivations for offshore investment, using the Ownership-Location-Internalisation (OLI) or "eclectic" framework (Dunning 1977). Under this framework, the decision to invest abroad is driven by a combination of: the firm-specific attributes of the investing firm which provide them with an advantage over local competitors such as managerial or technological capabilities, reputation and brand ownership (Ownership advantages); country-specific motivations such as lower production or transport costs, access to protected markets or favourable tax treatments (Location advantages); and the benefits to ownership and internalisation over outsourcing and market-based transactions such as minimising spillovers of proprietory technology or methods to local firms, reducing transactions and contracting costs, and allowing the acquiring firm greater control of management process and quality control (Internalisation advantages).

Empirical support for the concept of ownership and internalisation advantages comes from observed patterns of the industry distribution of investment. Multinationals tend to be more prevalent in industries and firms where intangible assets are important. This includes industries with high levels of product differentiation and advertising, products that are new or technically complex, high R&D intensity, and high shares of professional and technical workers (Markusen 1995). Intangible assets are likely to encourage FDI because of their non-rival nature[3] which allows firms to duplicate production in several locations. As many intangible assets are only semi-excludable[4] and, in the case of brand names and reputation, there is potential for degradation of the asset, firms with these assets may be less willing to undertake market transactions.

Dunning and Lundan (2008) identify four principal types of offshore investment, which they classify as *resource-seeking, market-seeking, efficiency-seeking* and *strategic asset-* or *capability-seeking*.[5] Resource-seeking investments are those designed to access the spe-

[3]They can be used in multiple locations simultaneously without reducing their effectiveness.

[4]Once another firm learns the technology it is very difficult to stop them from using it for their own purposes.

[5]They also note three additional possibilities – *escape investments* (eg, strategies designed to avoid home country taxes or regulations), *support investments* (eg, wholesale and retail distribution and marketing) and

cific location advantages available in the target country – physical resources such as primary products or manufactured inputs, low-cost labour, or proximity to technological, management or marketing expertise (eg, research "listening posts" in advanced countries). Market-seeking investment is designed to increase the firm's reach, while providing them with better knowledge about local tastes, or the ability to reduce production, transport or transactions costs through proximity. Efficiency-seeking investment allows firms to take advantage of economies of scale and scope and to benefit from risk diversification, by concentrating production in a limited number of locations to supply multiple markets, while taking advantage of differing factor costs and local supply capabilities. Finally, capability-seeking FDI generally involves M&A with existing firms, as acquirers seek to access specific competitive advantages held by those firms such as technology, market power and distribution channels, or to create R&D synergies or production economies through streamlining and sharing facilities and knowledge.

Given the diversity of FDI motivations, the selection mechanisms and consequences of cross-border M&As remain very much an empirical question. As noted by Harris and Robinson (2002), negative selection on performance may occur if offshore acquirers identify firms which are underperforming and invest with the intention of improving their performance, while positive selection is likely if acquirers seek to integrate the target within their own production system. Meanwhile, offshore owners seeking to gain technological advantages may be inclined towards purchasing small firms, while those seeking marketing networks may be more inclined to target larger organisations (Grimpe and Hussinger 2008).

The summary above suggests that the selection model for target firms should control for measures of firm size and performance, but does not give a clear prediction for the sign of coefficients. Ideally these characteristics of target firms would also be linked to attributes of the acquiring firm, however the data available do not provide information on the origin or characteristics of acquirers.

Similarly, outcomes for both performance and labour markets may depend on the motivation for acquisition. If managerial discipline is considered an issue, acquisition may be followed by a period of restructuring, leading to job losses or a change in the focus of the target firm. In contrast, if foreign owners provide access to new sales opportunities and networks or are able to access investment finance at lower cost than firms in the domestic market, capital intensity, output and employment may increase.

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passive investments (eg, investments in real estate or portfolio investments in existing companies).

In keeping with this ambiguity, empirical results have been mixed. Empirical papers tackle a range of different outcome metrics, including those related to productivity performance (Arnold and Javorcik 2009), labour market impacts (Almeida 2007), innovation and R&D behaviour (Bertrand 2009), and effects on plant survival (Bandick and Görg 2010). As well as considering the average effect of all FDI, various authors have also considered differences according to the origin country of the acquiring firm (Chen 2011), whether the acquisition was horizontal or vertical (Conyon et al 2002), and the characteristics of the target firm (Girma 2005).

Broadly speaking, the empirical literature tends to suggest that most FDI is positively selected – that is, that target firms tend to be larger, more productive, and to pay higher wages than firms which remain under domestic ownership (eg, Harris and Robinson 2002; Almeida 2007; Heyman et al 2007; Guadalupe et al 2010). This finding is not unanimous – for example, Conyon et al (2002) find that foreign acquisitions of UK firms target smaller firms and those with relatively low productivity – but suggests that in general, at least part of the observed higher performance of foreign-owned firms can be attributed to selection of targets which are already successful.

Empirical studies of post-acquisition effects show little consensus. Some studies suggest that this may reflect differences in the characteristics of the acquiring and acquired firms or plants. Arnold and Javorcik (2009) provide a comprehensive study of a wide range of firm-level outcomes for Indonesian manufacturers following foreign acquisition. Their results are indicative of both positive selection of acquisition targets and also improvements in performance following acquisition, with productivity, output, employment, investment, and average wages all increasing relative to non-acquired plants. They also note that foreign acquisition appears to improve plants' connections to the international economy, with increases in both exports and imported inputs. In contrast, using data from the UK, Harris and Robinson (2002) find negative effects on productivity, at least in the first few years after acquisition, which they attribute to difficulties assimilating these plants into the broader organisation.

On the labour market side, Huttunen (2007) finds that foreign acquisition of Finnish plants leads to increases in wage rates for both high- and low-skill worker groups, but as this is accompanied by a fall in the share of highly-skilled workers in employment, it does not necessarily translate to an increase in average wage rates. Heyman et al (2007) find small positive effects on average wages in Swedish target firms, but that at the individual level, workers who remain with the newly acquired firm show lower wage growth than those in

similar, non-acquired firms.

Existing New Zealand empirical evidence on the reasons for foreign acquisitions and the impact on domestic firms is limited. Based on a survey of 516 foreign-owned companies, Scott-Kennel (2010) suggests that market-seeking investment is the dominant motivation for foreign firms investing in New Zealand, although many foreign-owned firms are also involved in exporting and R&D. This survey also suggests a number of mechanisms through which foreign parents may raise the performance of their local affiliates, including technical assistance, staff training, and provision of information about markets, suppliers and contacts.

Cartwright (2001) examines the motivations and activities of foreign multinational enterprises (MNEs) in New Zealand, focusing on the industry groups which account for the greatest turnover. He identifies three main types of foreign investors in New Zealand. The majority of large foreign firms operating in New Zealand seem to be focused on supplying the domestic market, providing distribution and marketing services for their foreign parent. A second group of MNEs is the resource-based producers (eg, forestry and wood-processing, food processing), set up to access the physical resources available in New Zealand. Finally, Cartwright (2001) also notes an emerging tendency for foreign firms to target relatively small New Zealand companies with sophisticated capabilities in areas such as electronics, information technology and engineering. These abilities may then either be fostered onshore, in conjunction with the MNE network, or the intellectual capital relocated offshore.

In a small-scale longitudinal study of successful manufacturing exporters, Gawith (2002) finds that the outcomes that foreign-acquired firms experience differ dramatically and depend heavily on the motivation of the acquirer. Among recent acquisitions, there has been a tendency to target firms which can provide strategic assets or capabilities, such as patents and R&D ability. In some cases, the acquired firms expect to see a decline in manufacturing output, as they focus on providing R&D and product development services for the overseas owner. Further, while some New Zealand firms saw foreign acquisition as a means to international expansion, providing access to existing distribution and marketing channels, not all the foreign-acquired firms in the study were satisfied with the outcomes. Some felt that the requirements to fit into the new parent companies' networks meant they lost direct control over their distribution channels and missed out on valuable knowledge about their markets and customers.

Overall, the New Zealand research echoes the theoretical ambiguity discussed above – while

foreign acquisitions generate potential for positive effects on domestic firms, these positive outcomes are not guaranteed and depend heavily on the motivation of the new foreign parent.

6.2 Empirical strategy

The empirical analysis considers seven firm outcomes which may be affected by foreign acquisition. Firm performance measures (labour and multifactor productivity, gross output, and the capital-labour ratio) are derived from Inland Revenue Department and Annual Enterprise Survey data following the method in Fabling and Maré (forthcoming). Excess turnover is defined as the difference between the observed number of worker accessions (separations) and the minimum number of accessions (separations) required to account for net change in employment over a year. The measure is normalised by the summed count of jobs at the start and end of the year and is derived from the Linked Employer-Employee Dataset (LEED), which is based on pay-as-you-earn (PAYE) tax data and other tax records. This variable is included to identify worker churn due, for example, to restructuring or worker dissatisfaction. Average wages and total employment (which includes working proprietors) are also sourced from LEED data. All outcome variables are expressed as deviations from the industry-year mean.[6] A full list of the variables used, their definitions and summary statistics can be found in Table 6.1.

In keeping with the international literature, foreign-owned firms in New Zealand outperform domestic firms on almost all of these metrics (Figure 6.1). They are larger (in terms of both output and employment), more capital intensive, pay higher average wages, and have higher labour productivity. However, Figure 6.2 suggests that at least part of this difference is due to positive selection of FDI targets. Dividing the population of domestically-owned firms according to their future ownership status – whether or not they will be acquired by a foreign owner in the following year – suggests that pre-acquisition firm characteristics more closely mirror the patterns for foreign-owned firms shown in Figure 6.1 than those of other non-acquired domestic firms. That is, foreign owners seem to "cherry pick" high performing firms.

To examine both the firm-level factors influencing selection and post-acquisition effects on

[6]Industry defined as (primarily) two-digit industries from the Australia New Zealand Standard Industrial Classification (ANZSIC). Firms with extreme year-on-year changes in values are dropped to remove implausible observations.

Table 6.1: Variable definitions for analysis of foreign acquisition and firm performance

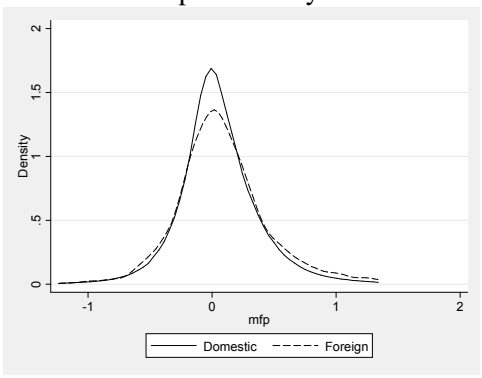
Variable	Definition	Mean	Std Dev
lngo	Log gross output (Y)	0.349	1.199
lntotemp	Log total employment $(\ln L)$ where L is working proprietors *(WP)* plus average monthly employees (E)	0.318	0.989
lp	Labour productivity $(\ln(Y-M)-\ln L)$	0.044	0.692
klratio	Capital labour ratio $(\ln K-\ln L)$ where K is capital services	-0.023	0.956
mfp	Multi-factor productivity, ϵ, from OLS regression: $\ln Y=\alpha\ln L+\beta\ln K+\gamma\ln M+c+\epsilon$ with industry-specific α, β, γ, c where M is intermediate consumption	0.064	0.345
lnavg_wage	$\ln(W/E)$ where W is total wages	0.023	0.568
excess_turnover	$\max_Z[\frac{Z-\lvert njobs_{end}-njobs_{start}\rvert}{njobs_{end}+njobs_{start}}]$ where $Z\in$ (number of accessions, number of separations), and $njobs_{start}$ ($njobs_{end}$) is the number of employees at the start (end) of the year	0.003	0.246
ΔX	Normalised change in X, ie $(X_t-X_{t-1})/(X_t+X_{t-1})$		
Δ klratio		0.006	0.213
Δ totemp		0.123	0.315
Δ avg_wage		0.016	0.111
δ(zero_lagged_totemp)	Dummy = 1 if $L_{(t=-1)}=0$	0.088	
δ(zero_lagged_wage)	Dummy = 1 if $E_{(t=-1)}=0$	0.116	
δ(exporter)	Dummy = 1 if the zero-rated GST sales >0	0.157	
export_intensity	Zero-rated GST sales / Total GST sales	0.033	0.141
δ(subsidiary)	Dummy = 1 if the enterprise is a subsidiary of another enterprise	0.049	

Summary statistics calculated for the population used in the probit model (Table 6.3). N(observations)=223,713
Means of binary variables calculated after random rounding (base 3) in accordance with Statistics New Zealand confidentiality protocols. Performance variables follow Fabling and Maré (forthcoming).
Data sources:

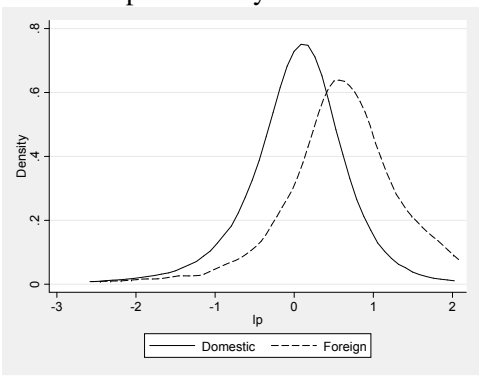
L, E, W, Z, WP	Linked Employer-Employee Dataset
Y, K, M	Annual Enterprise Survey and IR10 tax returns
GST sales	Business Activity Indicator
Subsidiary	Longitudinal Business Frame

Figure 6.1: Kernel density of performance by current ownership status

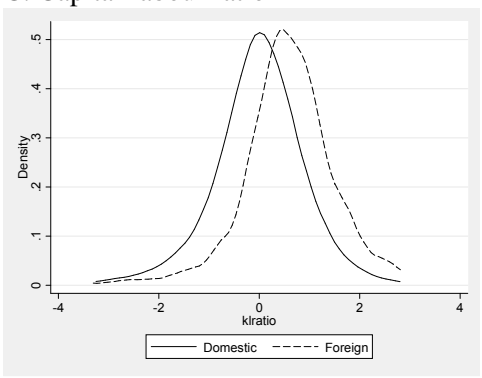
A. Multifactor productivity



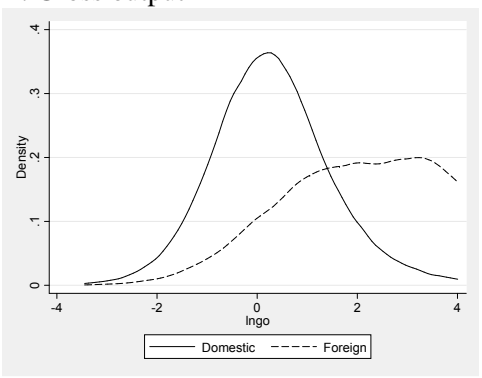
B. Labour productivity



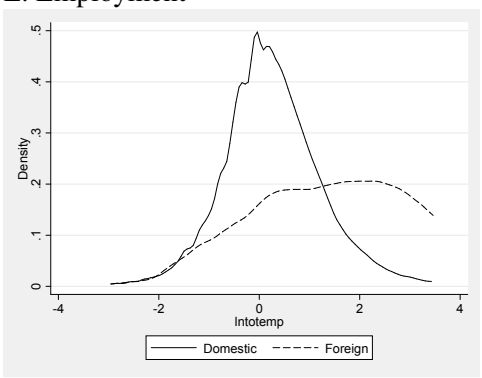
C. Capital-labour ratio



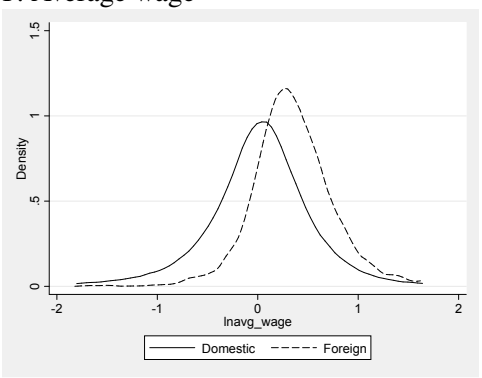
D. Gross output



E. Employment



F. Average wage



G. Excess turnover

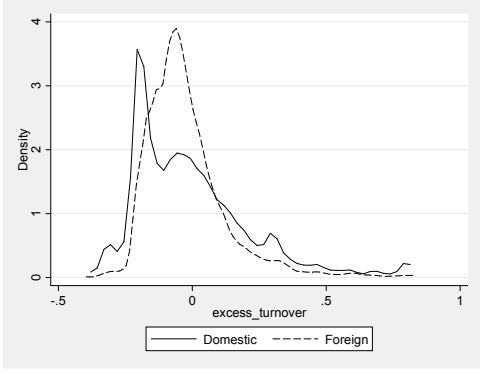
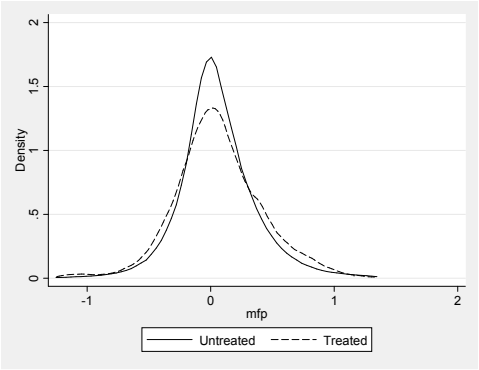
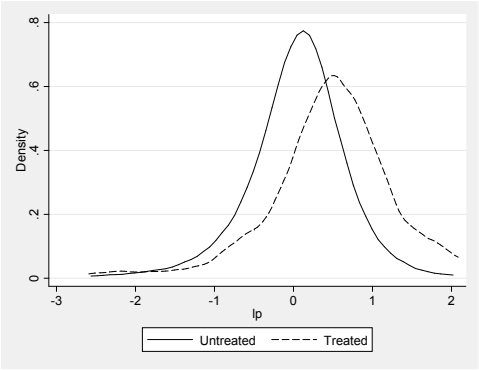


Figure 6.2: Kernel density of performance of domestically-owned firms by ownership status in following year

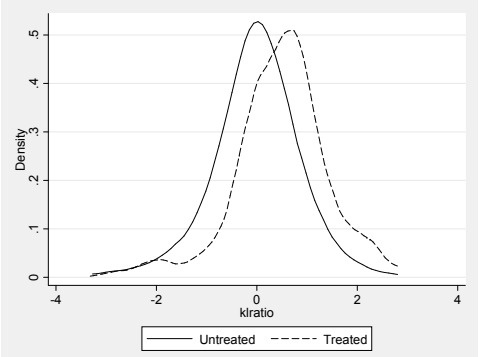
A. Multifactor productivity



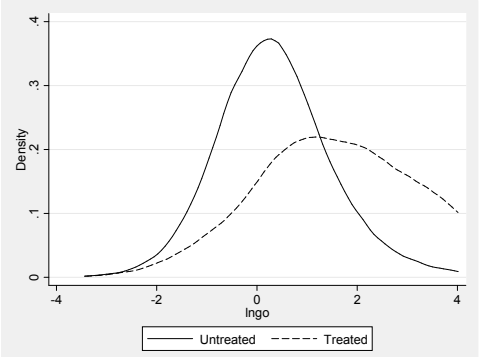
B. Labour productivity



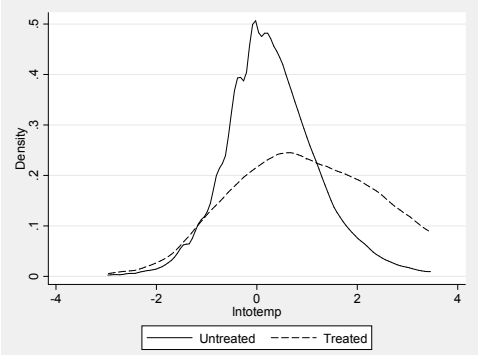
C. Capital-labour ratio



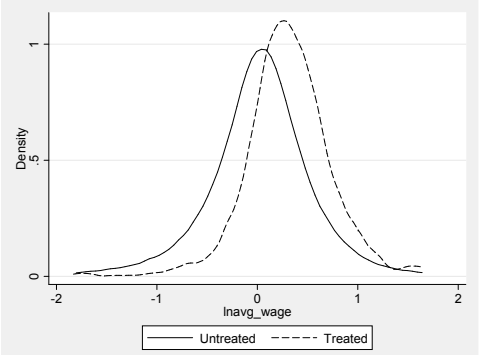
D. Gross output



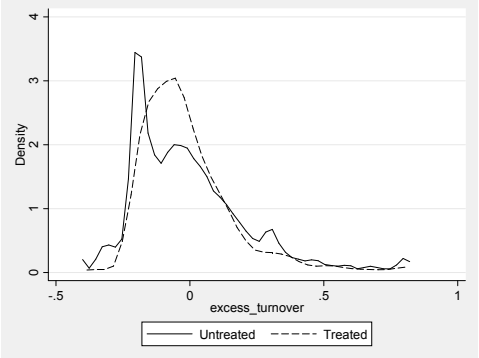
E. Employment



F. Average wage



G. Excess turnover



Untreated: firm remains domestically-owned in following year. Treated: firm transitions to foreign ownership in following year.

performance, a combined difference-in-difference and propensity score matching (PSM) approach is used, following the recent literature (eg, Girma and Görg 2007; Heyman et al 2007; Huttunen 2007; Arnold and Javorcik 2009). This methodology draws heavily on the literature on programme evaluation (eg, Smith 2004; Imbens and Wooldridge 2008) and considers foreign acquisition as a "treatment." As discussed in Chapter 4, the basic principle of propensity score matching is that as long as there are no unobserved characteristics which are associated with both the potential outcome and the probability of treatment ("unconfoundedness") and suitable control cases can be found for each treated case ("overlap"), conditioning on the propensity score is sufficient to remove all the bias associated with differences in pre-treatment characteristics between the treated and untreated groups. Thus, all systematic differences in outcomes between the treated and controls are attributable to the treatment. The implementation is very similar to the procedure followed in Chapter 4.

The PSM methodology involves two steps. The first step is to establish a suitable control group. A probit model is estimated to determine the pre-acquisition characteristics which predict that a firm will be targeted for foreign acquisition. The predicted probability of acquisition (propensity score) is calculated and each treated firm is matched to one or more firms which have similar probability of acquisition.[7] Matching occurs within industry and precludes self-matches (matching a treated firm to itself in a previous year), using radius matching with a caliper of 0.003.[8]

In the second stage, outcomes are compared between treated and control firms. To mitigate any remaining unobserved, time-invariant differences between the two groups, a difference-in-difference approach is followed, comparing changes in outcomes (relative to the pre-acquisition year) rather than levels. Finally, standard errors are estimated by bootstrapping across both stages to account for uncertainty in the matching equation.

Treatment is defined as a transition from domestic to foreign ownership, based on the answer to the disclosure statement: "Is the company controlled or owned by non-residents?" from annual company tax returns. This limits the population to employing, limited liability companies which were initially domestically-owned.[9] Table 6.2 shows the overall level of foreign ownership by industry for 2000 and 2008, and average treatment rate across the eight years, by industry. These suggest substantial differences in foreign ownership rates,

[7] Where a treated firm is matched to N control firms, each control firm is given a weight of $1/N$ in the difference-in-difference comparison. Treated firms for which no suitable control can be found are dropped from the analysis.

[8] This caliper was chosen to maximise the number of treated firms for which suitable controls could be found while maintaining the balancing properties of the treated and control samples.

[9] Transitions from foreign to domestic ownership are not considered in the analysis.

Table 6.2: Foreign ownership rate and acquisition rate by industry

	Foreign ownership		Average
	2000	2008	acquisition rate
A – Agriculture, forestry, fishing and hunting	0.007	0.004	0.001
B – Mining	0.082	0.143	0.008
C – Manufacturing	0.033	0.027	0.004
E – Construction	0.007	0.003	0.001
F – Wholesale trade	0.102	0.088	0.011
G – Retail trade	0.007	0.006	0.001
H – Accommodation, cafes and restaurants	0.013	0.007	0.002
I – Transport and storage	0.034	0.029	0.004
K – Finance and insurance	0.102	0.070	0.008
L – Property and business services	0.040	0.030	0.005
P – Cultural and recreational services	0.021	0.018	0.003
Total	0.031	0.021	0.003

Underlying firm counts have been random rounded (base three) in accordance with Statistics New Zealand confidentiality requirements. Electricity, gas and water (D), Communications services (J), and Personal and other services (Q) suppressed as counts are too low for random-rounded results to be meaningful.

with relatively high rates in Wholesale trade and Finance and insurance, and low rates in Agriculture, forestry, fishing and hunting, and Construction. Falling foreign ownership rates between 2000 and 2008 reflect increases in the total number of firms, with higher entry rates of domestic than foreign firms.

Figure 6.3 sets out the timeline for the analysis. Firms are tracked over a six year period.[10] The first two years ($t = -1, 0$) of data provide the explanatory variables for the propensity score matching. $t = 1$ is the treatment year. Estimates of the average treatment effect are reported for the treatment year and the following three years, out to $t = 4$. This time period reflects the availability of data, as the available sample falls with each additional outcome year considered.

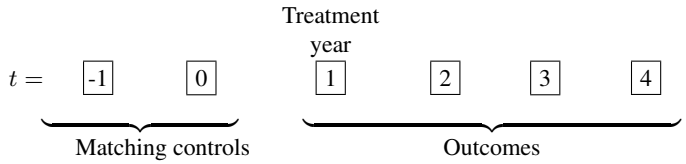
The probit model is estimated across all firms which can provide the control and treatment variables, and the outcome analysis uses all firms which additionally have a full set of outcome variables for the relevant year.[11] The variables used in the first stage probit equation reflect firm-level factors which may attract prospective foreign buyers. To account for possible non-linear relationships between firm performance and acquisition, a set of quantile dummies is included for each of log total employment, the capital-labour ratio, labour productivity, average wages and multifactor productivity.[12] Average wages are included as a

[10] Statistics New Zealand's enterprise identifiers can be broken by changes in legal structure. These breaks are repaired using permanent plant-level identifiers as discussed in Chapter 2.

[11] Future analysis will also consider firm survival as an outcome variable.

[12] In contrast to Chapter 4, labour productivity is required in the selection model in order to balance the treated and control samples.

Figure 6.3: Timeline for analysis of foreign acquisition and firm performance



proxy for skill intensity as the LBD does not have comprehensive measures of the share of highly skilled or educated employees in the workforce. Gross output is excluded from the selection model due to high correlation with employment and labour productivity. Excess turnover is included in linear form, rather than quantiles, as it is not expected to have a strong impact on the selection decision.[13]

The following additional variables are included to capture changing input dynamics: one-year growth rates of total employment, average wages, and the capital-labour ratio, alongside dummies for firms with zero employment in the previous year.[14]

A dummy indicating whether the firm exports, and the intensity of exporting, defined as the share of sales which are exempt from goods and services tax (GST) as a share of total sales, are also included.[15] Export intensity may affect both the perceived value of the firm (as an indicator of productivity) and its international visibility. For example, foreign companies may be more likely to notice firms which are already trading in their existing markets.

A full set of regional council dummies is included as some geographic locations may be more attractive to foreign owners than others (eg, cities with an international airport will be more accessible for foreign executives). Finally, a full set of year and (largely) two-digit industry dummies is included to capture differences over time and across industries.

Balancing tests are performed to ensure that the matching procedure is sufficient to provide a suitable group of control firms against which the post-acquisition performance of the treated group can be benchmarked, at least with respect to observable characteristics. For

[13] This expectation is confirmed by the empirical estimation. Excess turnover is barely significant in the probit equation for the full population, and is insignificant in eight of the nine sub-populations considered.

[14] Two dummies are used to reflect the different definition of employment for the average wage calculation (employees only) compared with total employment and the capital-labour ratio (employees plus working proprietors).

[15] Although zero-rated GST sales is an imperfect proxy for exports, it has the benefit of being available for all industries. The GST-based export intensity measure is strongly correlated with export measures available for a sample of firms from the Business Operations Survey, giving confidence that they provide at least a reasonable indication of firms' actual export intensity (correlation coefficient of 0.59 for export intensity, tetrachoric correlation of 0.79 for the exporter dummy).

the full population, there are no significant differences in the mean of each of the outcome and matching variables between the treated firms and the matched controls.[16]

In addition to the full population, firms which are above and below the industry-year average in terms of MFP, employment and average wages are considered separately. Separate analyses are also performed for three main industry groups – Manufacturing, Services, and Wholesale and retail trade. These subsets are chosen because the acquisition of different types of firms may be driven by different motivations on the part of the foreign owner and thus may lead to different post-acquisition performance trajectories.

6.3 Results

Table 6.3 reports selection equation results for the full population. Panel A gives the estimated coefficients of the five sets of performance variables which are included as twenty quantile dummies (with the first quantile dummy dropped). Panel B provides the coefficients for the remainder of the matching variables. Regional council, industry and year dummies are included but not reported.

The inclusion of multiple measures of firm performance is necessary in order balance the matched and control samples, but makes it difficult to separately interpret the coefficients (eg, the average wage level captures elements of skill composition which are correlated with measured MFP and labour productivity). Overall, however, Panel A suggests positive selection of target firms. The most consistent result is the positive association between acquisition and average wages, which show increasing coefficients throughout the distribution. There is also some evidence of positive selection on labour productivity and firm size, though only the very top quantiles have a significantly different probability of acquisition relative to the bottom quantile. Meanwhile, the residual effect of MFP on acquisition probabilities appears to be negative.

Alternative specifications of the model, which exclude labour productivity and average wages, show that the inclusion of multiple correlated measures is indeed affecting the estimated coefficients. When labour productivity is dropped as an explanatory variable, the results suggest positive selection on capital-intensity. When average wages are also dropped,

[16] Based on a one-sided test with significance level of 0.05. For explanatory variables which are found to have a positive (negative) effect on acquisition propensity, the null hypothesis underlying the one-sided test is that, after matching, the average value of that explanatory variable is no longer higher (lower) in the treated sample than in the matched, untreated sample. Balancing issues arise for some sub-populations as indicated in the table notes.

the negative coefficients on MFP disappear. These variables appear to be capturing largely the same characteristics. However, keeping these variables in the model is important for the purposes of the matching, as excluding them leads to failure to balance on the labour productivity variable.

In addition to these performance metrics, foreign acquisition is also found to be positively selected on employment growth and export intensity. Finally, firms are much more likely to be acquired by foreign owners if they are subsidiaries of an existing enterprise group, rather than independent enterprises.

Post-acquisition performance growth comparisons between acquired firms and matched domestically-owned firms are reported in Table 6.4. While the reported treatment effects are quite consistent in size and direction across years, they are significant in only a few cases. Applying a rule of thumb which places positive weight on both consistency and statistical significance, the only outcome variable which seems to be affected by acquisition is employment, which increases by around three percent in the treated population compared to matched control firms. While other estimated treatment effects are not statistically significant, the patterns across outcome years suggest that the relative increase in employment among acquired firms may have been associated with an increase in gross output of between three and five percent, and smaller increases in average wages and excess turnover. However, there is no evidence for an increase in either labour productivity or MFP, with point estimates for these variables suggesting, if anything, lower productivity growth relative to similar non-acquired firms.

As discussed above, differences in acquisition motivations or in acquired firm characteristics may alter post-acquisition outcomes. For example, if firms are targeted due to perceived under-performance relative to their peers we might expect to see improvements in productivity following acquisition. Similarly, it may be that high-performing firms suffer from dislocation following acquisition and take time to return to normal or, alternatively, that these firms experience large inflows of investment from the new parents which allow them to expand. If different groups of firms experience opposing effects from acquisition, aggregation may reduce the potential for identifying these effects.

Table 6.5 presents outcome comparisons for nine subsets of the population, according to whether firms are above or below the industry average in terms of employment, average wages and MFP, while Table 6.6 provides results for three industry groups – Manufacturing, Wholesale and retail trade, and Services.

In the performance based sub-populations, there are again only a few cases in which significant acquisition effects are observable. However, the consistency and size of the coefficients provide suggestive evidence of positive performance effects among initially low-performing firms. The results for low-MFP firms suggest that these firms may experience post-acquisition expansion in both employment and gross output, with the strength of the effect increasing over time. This increase in size is associated with a smaller, one-off increase in labour productivity and MFP in the year after acquisition. In contrast, firms with initially high MFP experience a relative fall in both labour and multi-factor productivity compared to non-acquired firms. These outcomes suggest that acquisitions motivated by "managerial efficiency" may be more common than previously thought, with foreign owners identifying targets which are underperforming relative to their potential and where there is seen to be potential for these firms to benefit from foreign acquisition.

Similar patterns occur for the employment sub-populations, although with large standard errors, suggesting that small firms may experience post-acquisition increases in output and average wage (which may proxy for skill), accompanied by increases in labour and multi-factor productivity from the year after acquisition. Meanwhile initially larger firms may experience increased employment growth, but this appears to be associated with lower growth in capital intensity and a relative fall in productivity. The low wage sub-population sees increases in average wage rising from two percent in the year after acquisition to 14 percent two years later. Because low wage acquired firms are matched to low wage control firms, this result is unlikely to simply reflect mean reversion. Meanwhile, high average wage firms see no increase in wages, but may see some expansion in terms of output and employment.

Results for the industry sub-populations suggest possible negative effects on labour productivity, MFP and output among service industry firms, alongside increased labour turnover. To the extent that services firms are more dependent on human capital rather than physical capital, these effects may be related, with worker disruption leading to decreases in productivity or changes in managerial processes affecting both worker satisfaction and productivity performance.

Manufacturing and wholesale and retail trade industries both appear to see post-acquisition expansion in output and employment. Among manufacturing firms this appears to be associated with improvements in labour quality, with consistent positive coefficients on both average wage and productivity variables. In contrast, output increases among wholesale and retail trade firms occur alongside a rise in the capital-labour ratio, associated with increased labour productivity but not wages. If anything, relative wages appear to fall slightly

among acquired firms. A possible explanation for the latter result is that foreign owners introduce new technologies (eg, in areas of inventory control or logistics) which improve the performance of trading firms.

While the patterns discussed above are internally consistent, and fit with theoretical expectations on the effect of foreign acquisition, the scarcity of statistically significant results implies that caution is required in interpreting the coefficients. Balancing test failures in some sub-populations also cast doubt on the ability of the matching model to account for pre-acquisition characteristics, although this is mitigated somewhat by the use of difference-in-difference estimates. Overall, however, the results are suggestive of positive acquisition effects among some firms, particularly those with initially below average employment and multifactor productivity, and those in the manufacturing and wholesale and retail trade industries. In contrast, firms in services industries and those that were initially above average performers appear to suffer dislocation effects, with decreases in productivity and mixed results for other performance measures.

6.4 Conclusion

This chapter examines the impact of foreign direct investment on firm performance and worker outcomes in recently acquired firms. Following recent literature, combined propensity score matching and difference-in-difference estimation is used to isolate observed post-acquisition outcome changes from differences due to target selection.

Overall, the results suggest that the main factor underlying observed performance premia for foreign-owned firms in New Zealand is related to positive target selection. Foreign acquisition targets tend to be firms which were already larger and more capital intensive, had higher labour productivity, paid higher wages, and were more likely to be exporting than their competitors.

Evidence of treatment effects is weak but suggestive, with internally consistent patterns but few statistically significant coefficients. Patterns of estimated treatment effect suggest that foreign acquisition may lead, on average, to increases in employment, output and average wages, but that on balance these changes are associated with a relative fall in the productivity of acquired firms. However, dividing the population into subsets based on industry or initial performance characteristics suggests that aggregate results may obscure underlying heterogeneity associated with either acquisition motivation or the pre-acquisition character-

istics of acquired firms.

Where consistent patterns occur, these seem to suggest that positive effects are largely restricted to firms which were initially below-average on one or more performance characteristic. One possible explanation is that these firms were targeted on the basis that they were under-performing relative to the acquiring firm's expectations of their potential, and by introducing new resources or management processes, the foreign owners were able to improve their performance. Meanwhile, high performing firms were more likely to see decreases in performance following foreign acquisition, perhaps reflecting adjustment costs or a change in focus towards incorporating the knowledge or processes of the new acquisition within the wider organisation. Industry sub-populations also saw differences in relative outcomes, with broadly positive effects for manufacturing and wholesale and retail trade firms, but negative impacts among services firms.

One firm outcome which has not been considered in this chapter is the role of foreign investors in firm-level export performance. In a survey of firms, Simmons (2002) finds that a key reason why domestic firms pursue foreign investment is in order to access the offshore distribution networks controlled by their new owners. Thus, foreign ownership may lead to expansion of export markets. However, the analysis in Chapters 3 and 4 casts some doubt on this proposition, suggesting that foreign ownership has, if anything, a negative impact on expansion into new export relationships (though not necessarily on export revenues). Future work could restrict the sample to manufacturing firms and focus on the development of exporting capability, as evidenced by both the value and volume of exports, and by firm-level entry into new markets and products.

Table 6.3: Foreign acquisition - probit model

Panel A: Selection on performance					
	lntotemp	klratio	mfp	lp	lnavg_wage
q2	0.104	-0.243*	-0.075	-0.052	0.114
	[0.091]	[0.142]	[0.089]	[0.122]	[0.186]
q3	-0.094	-0.267*	-0.227**	0.061	0.001
	[0.107]	[0.147]	[0.102]	[0.121]	[0.208]
q4	-0.116	-0.312**	-0.170	-0.072	0.259
	[0.106]	[0.149]	[0.107]	[0.134]	[0.169]
q5	-0.131	-0.105	-0.169	-0.004	0.189
	[0.116]	[0.130]	[0.117]	[0.137]	[0.178]
q6	-0.146	-0.195	-0.126	-0.076	0.396**
	[0.117]	[0.133]	[0.111]	[0.142]	[0.157]
q7	-0.168	-0.298**	-0.413***	-0.074	0.222
	[0.125]	[0.140]	[0.124]	[0.142]	[0.171]
q8	-0.164	-0.021	-0.312***	0.111	0.312*
	[0.124]	[0.112]	[0.120]	[0.128]	[0.168]
q9	-0.110	-0.197	-0.238**	-0.198	0.405***
	[0.119]	[0.124]	[0.114]	[0.150]	[0.155]
q10	-0.089	-0.070	-0.414***	0.158	0.454***
	[0.111]	[0.116]	[0.124]	[0.126]	[0.153]
q11	-0.011	-0.118	-0.272**	-0.038	0.539***
	[0.112]	[0.121]	[0.122]	[0.141]	[0.149]
q12	0.018	-0.310**	-0.309***	0.101	0.313**
	[0.106]	[0.128]	[0.120]	[0.130]	[0.157]
q13	-0.139	-0.068	-0.297**	0.014	0.435***
	[0.117]	[0.112]	[0.121]	[0.133]	[0.150]
q14	-0.005	-0.159	-0.255**	0.109	0.511***
	[0.109]	[0.119]	[0.117]	[0.132]	[0.147]
q15	-0.014	-0.171	-0.398***	0.089	0.433***
	[0.108]	[0.118]	[0.133]	[0.132]	[0.151]
q16	0.023	-0.083	-0.426***	0.036	0.670***
	[0.107]	[0.114]	[0.128]	[0.133]	[0.145]
q17	0.020	0.014	-0.373***	0.165	0.594***
	[0.104]	[0.111]	[0.123]	[0.130]	[0.146]
q18	-0.073	0.040	-0.360***	0.154	0.700***
	[0.102]	[0.112]	[0.122]	[0.131]	[0.144]
q19	0.160*	0.051	-0.328***	0.236*	0.672***
	[0.091]	[0.113]	[0.123]	[0.133]	[0.144]
q20	0.293***	0.108	-0.407***	0.332**	0.683***
	[0.089]	[0.116]	[0.129]	[0.139]	[0.147]

Panel B: Additional selection variables		
excess_turnover	0.131*	[0.074]
Δklratio	0.022	[0.081]
Δtotemp	0.257**	[0.119]
Δavg_wage	-0.022	[0.151]
δ(zero_lagged_totemp)	-0.126	[0.179]
δ(zero_lagged_wage)	-0.063	[0.139]
δ(exporter)	0.196***	[0.043]
export_intensity	0.270***	[0.082]
δ(subsidiary)	0.971***	[0.035]
N(Observations)	223,713	
pseudo R^2	0.320	
N(treated)	681	

Significant at: * 10 percent, ** 5 percent, *** 1 percent. Regression includes a full set of (primarily) two-digit industry, year and regional council dummies.

Table 6.4: Difference-in-difference estimates of average treatment effect

	t=1	t=2	t=3	t=4
mfp	-0.007	-0.016	-0.040	-0.031
	[0.020]	[0.022]	[0.028]	[0.036]
lp	-0.043	0.021	-0.026	-0.015
	[0.038]	[0.042]	[0.054]	[0.081]
klratio	-0.052*	-0.007	-0.025	0.047
	[0.030]	[0.043]	[0.050]	[0.079]
lngo	0.033	0.049	0.046	0.039
	[0.023]	[0.033]	[0.052]	[0.065]
lntotemp	0.036**	0.032	0.086**	0.036
	[0.017]	[0.030]	[0.037]	[0.049]
lnavg_wage	0.013	0.016	0.016	0.031
	[0.009]	[0.014]	[0.019]	[0.022]
excess_turnover	0.013	0.013	0.020*	0.016
	[0.008]	[0.011]	[0.011]	[0.017]
N	193,320	143,601	104,838	73,902
Treatment rate	0.003	0.003	0.003	0.003
Proportion dropped:				
Treated	0.109	0.119	0.142	0.163
Control	0.144	0.228	0.467	0.605

Difference-in-difference (DID) estimator, from $t = 0$ to outcome year, applied to matched sample. Radius matching (caliper 0.003, with replacement) with observations pooled across years and matched within two-digit industry (precluding self-matches). Bootstrapped standard errors in brackets (significant at * 10%; ** 5%; *** 1%). Bootstrapping encompasses both probit and DID stages (100 repetitions) and is stratified on treatment and the existence of future outcomes to maintain approximately constant (weighted) population size (N) across estimates. The table also reports the treatment rate (average proportion of firms entering), and the proportion of treated (control) firms dropped because there is no control (treated) firm within the caliper distance. All balancing tests (equivalence of weighted means of matching variables across treated and controls) passed at the 5% level (one-sided test).

Table 6.5: Difference-in-difference estimates for firms initially above and below industry average performance

	High MFP				**Low MFP**			
	t=1	t=2	t=3	t=4	t=1	t=2	t=3	t=4
mfp	-0.034	-0.054	-0.072*	-0.051	0.035	0.076*	0.076	0.042
	[0.025]	[0.035]	[0.041]	[0.051]	[0.031]	[0.042]	[0.049]	[0.066]
lp	-0.072*	-0.021	-0.046	-0.056	0.000	0.143	0.102	0.104
	[0.043]	[0.054]	[0.060]	[0.097]	[0.071]	[0.095]	[0.118]	[0.150]
klratio	-0.046	-0.036	-0.123	-0.079	-0.062	0.009	-0.057	0.073
	[0.046]	[0.073]	[0.080]	[0.134]	[0.048]	[0.054]	[0.076]	[0.095]
lngo	0.035	0.021	-0.023	-0.090	0.037	0.14*	0.115	0.232*
	[0.028]	[0.044]	[0.070]	[0.083]	[0.051]	[0.077]	[0.095]	[0.133]
lntotemp	0.053**	0.011	0.052	0.004	0.019	0.043	0.118*	0.126
	[0.024]	[0.041]	[0.058]	[0.067]	[0.027]	[0.041]	[0.069]	[0.105]
lnavg_wage	0.009	0.012	0.012	0.027	-0.004	0.001	-0.012	0.013
	[0.015]	[0.021]	[0.031]	[0.037]	[0.012]	[0.024]	[0.031]	[0.046]
excess_turnover	0.026**	0.002	0.023	0.027	-0.007	0.015	0.014	-0.026
	[0.012]	[0.018]	[0.019]	[0.023]	[0.015]	[0.02]	[0.023]	[0.034]
N	103,569	77,340	56,967	40,533	84,558	62,490	45,144	31,470
Treatment rate	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Proportion dropped:								
Treated	0.119	0.169	0.197	0.217	0.207	0.259	0.283	0.324
Control	0.247	0.383	0.501	0.680	0.325	0.386	0.576	0.631

	High employment				**Low employment**			
	t=1	t=2	t=3	t=4	t=1	t=2	t=3	t=4
mfp	-0.005	-0.028	-0.057	-0.078*	-0.053	0.017	0.077	0.066
	[0.021]	[0.030]	[0.037]	[0.040]	[0.054]	[0.079]	[0.102]	[0.128]
lp	-0.037	-0.035	-0.089	-0.107	-0.109	0.153	0.331**	0.378
	[0.041]	[0.053]	[0.057]	[0.074]	[0.100]	[0.150]	[0.163]	[0.270]
klratio	-0.045	0.002	-0.063	-0.034	-0.057	0.039	0.117	0.340
	[0.036]	[0.05]	[0.059]	[0.092]	[0.1]	[0.151]	[0.237]	[0.321]
lngo	0.016	0.007	-0.036	-0.026	0.056	0.016	0.328**	0.286
	[0.027]	[0.038]	[0.053]	[0.082]	[0.073]	[0.113]	[0.146]	[0.239]
lntotemp	0.020	0.003	0.048	0.044	0.095	0.007	0.076	0.019
	[0.015]	[0.035]	[0.037]	[0.062]	[0.061]	[0.098]	[0.118]	[0.183]
lnavg_wage	0.006	-0.006	0.016	0.017	0.003	0.048	0.035	0.061
	[0.009]	[0.012]	[0.016]	[0.024]	[0.038]	[0.063]	[0.091]	[0.101]
excess_turnover	0.015*	0.011	0.016	-0.011	0.012	0.010	-0.018	0.041
	[0.009]	[0.012]	[0.014]	[0.021]	[0.034]	[0.050]	[0.059]	[0.072]
N	121,965	93,273	69,342	49,461	54,756	38,814	27,519	19,053
Treatment rate	0.003	0.003	0.004	0.004	0.002	0.003	0.003	0.003
Proportion dropped:								
Treated	0.114	0.136	0.171	0.210	0.163	0.212	0.217	0.278
Control	0.246	0.451	0.560	0.570	0.439	0.419	0.538	0.734

	High average wage				**Low average wage**			
	t=1	t=2	t=3	t=4	t=1	t=2	t=3	t=4
mfp	-0.010	-0.021	-0.038	-0.031	0.035	-0.029	-0.059	0.019
	[0.024]	[0.028]	[0.035]	[0.042]	[0.051]	[0.089]	[0.086]	[0.113]
lp	-0.039	0.024	-0.017	0.032	-0.067	0.035	-0.102	-0.028
	[0.036]	[0.047]	[0.065]	[0.09]	[0.104]	[0.161]	[0.167]	[0.221]
klratio	-0.047	0.006	-0.030	0.082	-0.096	-0.120	-0.127	-0.051
	[0.037]	[0.052]	[0.057]	[0.104]	[0.092]	[0.115]	[0.169]	[0.164]
lngo	0.046*	0.039	0.021	0.047	0.073	0.050	-0.011	-0.055
	[0.026]	[0.042]	[0.060]	[0.074]	[0.058]	[0.098]	[0.127]	[0.203]
lntotemp	0.026	0.011	0.084**	0.048	0.084*	0.048	-0.061	-0.114
	[0.018]	[0.032]	[0.040]	[0.055]	[0.046]	[0.077]	[0.100]	[0.165]
lnavg_wage	0.019**	0.015	-0.005	0.002	0.001	0.026	0.104*	0.135*
	[0.009]	[0.016]	[0.021]	[0.031]	[0.028]	[0.046]	[0.054]	[0.072]
excess_turnover	0.008	0.006	0.019	0.010	0.039	0.021	-0.024	0.043
	[0.01]	[0.013]	[0.016]	[0.019]	[0.031]	[0.044]	[0.045]	[0.057]
N	103,746	78,300	57,966	41,274	73,266	53,520	38,547	26,835
Treatment rate	0.004	0.004	0.005	0.005	0.001	0.001	0.001	0.002
Proportion dropped:								
Treated	0.119	0.134	0.161	0.227	0.219	0.261	0.263	0.357
Control	0.181	0.361	0.491	0.622	0.419	0.501	0.782	0.846

See Table 6.4 for notes. Balancing tests for continuous variables passed at the 5% level (one-sided test) except for klratio in the sub-populations for high MFP (t=1), low wage (t=2,4), high employment (t=1,2).

Table 6.6: Difference-in-difference estimates by industry

	Services			
	t=1	t=2	t=3	t=4
mfp	-0.057	-0.089*	-0.075	-0.157**
	[0.038]	[0.051]	[0.065]	[0.065]
lp	-0.069	-0.038	-0.079	-0.171
	[0.066]	[0.065]	[0.102]	[0.135]
klratio	-0.096	0.040	-0.060	-0.163
	[0.068]	[0.082]	[0.122]	[0.186]
lngo	-0.013	-0.011	-0.044	-0.189
	[0.060]	[0.066]	[0.104]	[0.119]
lntotemp	0.028	-0.005	0.098	-0.018
	[0.030]	[0.062]	[0.077]	[0.110]
lnavg_wage	-0.001	0.015	0.041	0.066
	[0.019]	[0.024]	[0.036]	[0.047]
excess_turnover	0.035*	0.005	0.041*	0.043
	[0.018]	[0.025]	[0.023]	[0.033]
N	57,342	41,358	29,373	20,223
Treatment rate	0.003	0.003	0.004	0.004
Proportion dropped:				
Treated	0.156	0.167	0.222	0.233
Control	0.032	0.127	0.420	0.434

	Wholesale and Retail Trade			
	t=1	t=2	t=3	t=4
mfp	0.022	-0.009	-0.038	0.018
	[0.033]	[0.042]	[0.052]	[0.063]
lp	-0.002	0.070	0.040	0.105
	[0.062]	[0.081]	[0.098]	[0.122]
klratio	0.004	0.014	0.010	0.080
	[0.050]	[0.072]	[0.089]	[0.133]
lngo	0.072	0.056	0.064	0.144
	[0.044]	[0.064]	[0.096]	[0.103]
lntotemp	0.009	0.012	0.057	0.076
	[0.031]	[0.040]	[0.058]	[0.076]
lnavg_wage	0.017	-0.008	-0.031	-0.040
	[0.014]	[0.022]	[0.039]	[0.038]
excess_turnover	0.007	0.021	0.008	0.004
	[0.015]	[0.019]	[0.025]	[0.030]
N	59,232	44,826	33,237	23,778
Treatment rate	0.003	0.003	0.004	0.004
Proportion dropped:				
Treated	0.058	0.041	0.050	0.103
Control	0.015	0.261	0.315	0.434

	Manufacturing			
	t=1	t=2	t=3	t=4
mfp	-0.004	0.039	0.045	0.027
	[0.025]	[0.038]	[0.041]	[0.052]
lp	-0.047	0.055	0.076	0.035
	[0.086]	[0.082]	[0.121]	[0.157]
klratio	-0.007	0.011	-0.050	0.074
	[0.053]	[0.078]	[0.089]	[0.130]
lngo	0.001	0.036	0.192**	0.168
	[0.058]	[0.059]	[0.097]	[0.117]
lntotemp	0.010	0.012	0.121	0.089
	[0.039]	[0.045]	[0.076]	[0.105]
lnavg_wage	0.033	0.019	0.045	0.054
	[0.022]	[0.025]	[0.035]	[0.051]
excess_turnover	-0.012	0.003	0.052*	-0.024
	[0.015]	[0.026]	[0.028]	[0.031]
N	24,828	19,293	14,661	10,719
Treatment rate	0.005	0.005	0.005	0.005
Proportion dropped:				
Treated	0.175	0.188	0.346	0.333
Control	0.592	0.595	0.606	0.633

See Table 6.4 for notes. Balancing tests for continuous variables passed at the 5% level (one-sided test).

Chapter 7
Conclusion

This thesis has examined four aspects of the link between international engagement and the performance of New Zealand firms. The research has added to the empirical literature in this area in a number of ways. Firstly, it provides a small, distant, developed country perspective on a number of issues which have been addressed in the international literature. This perspective is important for understanding the challenges and the returns to international engagement in New Zealand, as international results may not be applicable to New Zealand's situation. It has also added to the international literature in a number of areas, applying novel methodological approaches to issues such as the determinants and consequences of expansion into new markets and new export relationships and the impact of new infrastructure on exporter behaviour. This final chapter reiterates the conclusions of each empirical study, and indicates commonalities across the empirical results. Finally, it suggests additional avenues for research into the international performance of New Zealand firms.

Chapter 3 considers the factors driving firms' choices to enter into new export relationships. As entry into new product and geographic markets incurs fixed costs associated with product development, marketing, and the acquisition of market information, firms may be more likely to expand their export activities sequentially, building on their existing experience and networks. The analysis in Chapter 3 suggests that measures of general and specific trade experience play an important role in determining firms' future export activities. That is, there is evidence of path dependence within firms. There is also evidence of path dependence across firms, with entry into new relationships reflecting demonstration effects from the export activities of other firms in the local area. These results are robust to the inclusion of other determinants of exporting, including the macroeconomic performance of destination countries, exchange rate movements, and the past performance of the exporting firm.

Chapter 4 tackles the question of whether observed performance premia among exporting firms are due to self-selection of high-performance firms into exporting or a positive causal link from exporting to improved performance. As well as providing a small, distant, developed country perspective on this question, this chapter adds to the literature by considering both initial entry into exporting and subsequent entries into new markets. Standard arguments for why exporting might lead to performance improvements – increased market size, tougher competition, and learning spillovers from new contacts – are equally persuasive for additional market entry as for first entry, especially where the destination concerned is a sophisticated, developed market. In addition, examining incumbent entry into new markets provides additional matching variables which help to control for unobservable differences in export propensity across firms, allowing for a more stringent test for learning-by-exporting effects. The focus on incumbent entry also generates a larger sample of treated firms, making it more likely that such effects can be statistically identified if they do exist. The results suggest that both self-selection and post-entry performance improvements contribute to the higher observed performance of exporters over non-exporters. New exporters experience continuing employment growth together with permanently raised capital-labour ratios and labour productivity. Incumbent entrants exhibit positive employment effects and may also see productivity improvements, although there is some doubt about the latter effect as the results are not consistent for high-income market entry.

Chapter 5 turns to a specific factor influencing firms' incentives and ability to export – the ease of getting goods to an international port. While international distances may play a larger role in the time and freight costs of getting goods to their destination, domestically determined costs may also matter, and are potentially more amenable to intervention by domestic firms or policy makers. In particular, improvements to domestic transportation infrastructure may lower the costs of getting goods to their destination, reducing the overall marginal cost of exporting. This chapter investigates the impact of new port infrastructure on exporter behaviour, focusing on the opening of Metroport, an inland port in Auckland. The analysis involved two stages – identification of the firm characteristics associated with rapid uptake of the new infrastructure, and an examination of the impact of uptake on future export growth. The main determinants of uptake are found to be product- and firm-related, rather than location-specific. Firms use the new port infrastructure in conjunction with the existing port in order to mitigate capacity constraints and/or access a greater range of transport options. Taking early adoption of Metroport as a signal of an existing capacity constraint and analysing the effect of the new port on subsequent export growth suggests that use of the new port did not contribute to export expansion among local firms. However,

there may still have been gains to northern firms from additional competition between port companies, encouraging them to raise their service standards or to lower prices.

Finally, Chapter 6 shifts in focus from the export performance of New Zealand firms to the influence of foreign ownership on firm performance. Considerable international literature shows that foreign-owned firms (or at least, multi-nationals) outperform domestic firms on a number of metrics. This chapter examines the firm-level determinants of foreign acquisitions of New Zealand companies, and the consequences for both the purchased firms and the workers within those firms. The results suggest that foreign firms tend to target high-performing New Zealand companies. However, after controlling for these initial differences in performance, there is little evidence for post-acquisition performance effects. Positive changes tend to be concentrated among initially low-performing firms, suggesting that some foreign owners target under-performing firms in the expectation that by providing either managerial discipline or access to additional resources, they can rapidly improve the acquired firm's performance. In contrast, initially high performing acquisition targets appear to experience some dislocation, with relatively lower productivity growth than non-acquired firms, at least in the years immediately following acquisition. The results are also suggestive of differences between industries, with broadly positive effects indicated for firms in manufacturing and wholesale and retail trade industries, but negative effects for services firms.

There are several common themes which run across the four main chapters. The first of these is the importance of hysteresis in exporting, brought about (it would seem) by the substantial fixed costs associated with entering into a new export relationship. This theme runs throughout the thesis, and the wider literature on firm-level export performance. Chapters 3 and 4 include a direct focus on the importance of past export experience in determining future export performance. Firms appear to incur substantial costs from entry into new geographic and product markets, leading to path dependence in the nature of export activities.

A second consistent theme which runs across the empirical chapters is the finding that both exporting and foreign acquistion are positively selected. That is, international engagement appears to be primarily an outcome, rather than a cause, of high performance. However, the analysis in Chapter 4 suggests exporting firms increase in size and capital intensity, leading to both firm-level and aggregate improvements in labour productivity. Meanwhile, the analysis in Chapter 6 tentatively implies that similar benefits may result from foreign investment in New Zealand firms, at least in terms of firm expansion.

Together, these themes raise interesting challenges for policy makers looking to improve living standards in New Zealand through raising labour productivity. The finding that firm performance is a primary determinant of export performance may lead policy makers to focus their attention on initiatives to raise the overall performance of New Zealand firms. As well as having direct effects on labour productivity, this may encourage more firms into exporting, by pushing them over the performance threshold at which exporting becomes profitable. Exporting in turn provides opportunities for these firms to expand, take on additional staff and invest in additional capital, increasing both firm and aggregate productivity. However, this leaves open the underlying question of what measures can be employed to improve firm performance, and where these efforts should be best targeted.

Alternatively, the threshold level of performance required to induce firms to enter exporting may itself be amenable to policy, through actions that reduce the fixed costs of entry. Reducing market entry costs may lead to a virtuous cycle of exporting, through positive effects of path dependence and firm expansion, and has the additional benefit that policies designed to reduce entry costs may be more clear-cut than those to raise firm performance. However, as the threshold at which firms are able to enter exporting falls, each additional exporting firm will have lower initial productivity and hence have less effect on aggregate productivity through reallocation.

A final theme of this thesis is the importance of having detailed longitudinal data to guide our understanding of the New Zealand economy. Research using longitudinal microdata presents an exceptional opportunity for understanding how changes in economic policy and the economic environment affect different types of firms, allowing for a more nuanced understanding of aggregate outcomes. The Longitudinal Business Database provides an unprecedented level of detail on New Zealand firms, particularly in the area of merchandise exports, and should prove to be an invaluable resource to the economic and policy community in future. Indeed, its export coverage and links to other longitudinal firm data make it an almost unparalleled data source internationally.

The research contained in this thesis represents merely the tip of the iceberg of empirical topics which could be considered using the LBD. Throughout the preparation of the thesis, a number of specific questions have arisen which would provide additional insights into the determinants and consequences of international engagement by New Zealand firms.

One of the more challenging technical aspects of this thesis has been dealing with the attribution of merchandise exports to the goods-producing or handling enterprises within ver-

tically integrated groups. The recognition that a substantial proportion of New Zealand's aggregate exports are sourced from large, integrated groups of enterprises raises questions about the decisions firms make about structure. Consideration of the differences in export patterns between integrated groups and individual firms could provide insights into the incentives underlying group structures, and the role of wholesale traders within enterprise groups.

An additional area for research could be the factors which determine firms' survival in export markets, and the impact of exit on firm performance. Chapter 3 implies that positive exchange rate shocks may induce firms to expand into new export relationships, while Chapter 4 shows that such expansion leads to increases in firm size. Meanwhile, Fabling and Sanderson (2010) show that firm size and past export experience are associated with higher survival rates in export markets. Future research could address the overall impact of exchange rate variability on firm export performance by examining whether firms which enter into new markets on the back of a favourable exchange rate are able to sustain their export activities when the exchange rate moves against them.

Chapter 6 considered the relationship between foreign acquisitions and firm performance, finding that the positive performance premia of foreign-acquired firms are driven largely by targeting on performance prior to acquisition, rather than post-acquisition increases in performance. While this chapter considered a range of firm and worker outcomes, one area which we might expect foreign acquisition to affect, but which was not considered in the analysis, is the degree of international trade engagement. Case study research suggests that some firms see foreign acquisition as an opportunity to gain entry into international markets. However, the analysis in Chapter 4 shows little evidence to suggest that foreign-owned firms are more likely to enter into exporting after controlling for their other performance characteristics, while the analysis in Chapter 3 suggests that foreign-owned exporters are, if anything, *less* likely to expand into new geographic and product markets. Future work could focus on the activities of firms in goods-producing sectors and examine the impact of foreign acquisition on the level and diversity of their export performance.

Finally, this thesis has been largely constrained to two areas of international engagement – merchandise exports and inward foreign direct investment. Additional types of international engagement – outward direct investment, off-shoring, merchandise imports and trade in services – have been relatively neglected, due in a large part to data constraints. However, over the course of this research, there have been several additions to the LBD which begin to fill some of these gaps. The Business Operations Survey 2007 includes a module of questions

on firms' wider international activities, including both overseas income generation and the offshore production of goods and services. This module will be re-run in 2011, providing two snapshots of internationalisation behaviour which will be linked to longitudinal data within the LBD. Services trade data has also been improved, with the linking of the International Trade in Services and Royalties Survey (ITSS) to the LBD in 2009. Potential future additions to the LBD, such as the Quarterly International Investment Survey, and potential new data sources such as Foreign Affiliate Trade Statistics, and Off-shore Manufacturing Statistics will also help to round out our understanding of the international activity of New Zealand firms.

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Appendix A
Customs Export Entry Form

Form C5

Te Mana Arai o Aotearoa

EXPORT ENTRY

Client Reference		Entry Type	Entry Number
Payment Method (Drawback)			
Exporter/Licensee	Code	Agent	Code
Customs Controlled Area	Code		Declarants Code
Country of Destination		I ..... Exporter/Agent of Exporter declare that the particulars contained in this entry are true and correct	
Deposit (Refund)	**Process Indicator** Sold/Consignment	..... Signature	..... Date

COMPLETION OF SIGHT/TEMPORARY ENTRY	PERMIT INFORMATION		OTHER INFORMATION	
Original Entry Number	Authority	Number	Code	Data
Remarks				

SHIPPING DETAILS

Mode of Transport	Voyage No.	Craft/Flight	Date of Export	Total Gross Weight *(kg)*
Sea / Air / Mail				
Port of Loading	Port of Discharge	Delivery Authority		Code

CONTAINER AND PACKAGE INFORMATION

Number & Type of Packages	Container Number	Container Status	Bill Number	Bill Type

DETAIL LINE INFORMATION

Detail Line No.	Description of Goods	Tariff Item
1		Country of Origin

Statistical Unit	Statistical Quantity	Supplementary Unit	Supplementary Quantity

FOB *(Whole NZ$)*	Exchange Rate Indicator	Currency Code	Exchange Rate	FOB *(Foreign)*

Misc. Reason Code	Misc. Amount *NZ$*	Drawback Duty *NZ$*	Drawback GST *NZ$*	Total Drawback *NZ$*

PERMIT INFORMATION		PROHIBITED GOODS	OTHER INFORMATION	
Authority	Number	Code	Code	Data

ENTRY TOTAL

	Total Drawback *NZ$*

* An Export Entry Transaction Fee is payable when making this entry.

Appendix B
Technical summary of Rare Events models

The core estimation method used in Chapter 3 is the rare events logit model specification for situations with limited knowledge of the population incidence rate. The models are estimated using the ReLogit suite of Stata programmes created by Tomz et al (1999) to implement the methods described by King and Zeng (2001, 2004). Rare events models have received limited attention in the economics literature. Among the small number of papers using these techniques are Wagner (2004), Caliendo, Fossen, and Kritikos (2009) and Criscuolo (2009). As these estimation methods may be unfamiliar to some readers, this appendix provides a brief explanation of the details and the motivation for using this methodology.

The current analysis of export market entry presents a number of complications beyond those experienced in standard binary dependent variable analyses. As discussed in the main text, potential entry events vastly outnumber actual entries, and the number of non-entries reaches into the billions. At the same time, there is uncertainty about the true ratio of events to non-events. King and Zeng (2001, 2004) outline a series of adjustments to the standard logit model to correct for rare event bias in a case-control sample design, to allow for the uncertainty in the underlying population incidence rate, and also to provide more readily interpretable results.

Consider a binary dependent variable model, in which the observed dependent variable Y_i is equal to 1 if an entry event occurs, and 0 if it does not

$$Y_i \sim Bernoulli(y_i|\pi_i) = \begin{cases} 1 & \text{with probability } \pi_i \\ 0 & \text{with probability } 1-\pi_i. \end{cases}$$

The observed variable Y_i is assumed to be the realisation of an unobserved latent variable

Y_i^{*1}

$$Y_i^* \sim Logistic(Y_i^* | -\mathbf{X}_i\boldsymbol{\beta}).$$

Our goal is to estimate the probability of relationship entry π_i as a function of the explanatory variables $\mathbf{X}_i$

$$Pr(Y_i = 1|\boldsymbol{\beta})) = \pi_i = \frac{1}{1 + e^{-\mathbf{X}_i\boldsymbol{\beta}}}.$$

As a case-control sampling method is used, in which all the observed events and a random sample of non-events are selected, the observed proportion of entry events in the sample is purely a sampling decision and bears no relationship to the actual share of entry events in the population. King and Zeng (2001) suggest two methods to correct for this sample design: *prior correction* and *weighting*. The prior correction model relies on the result that the MLE logit estimate $\hat{\boldsymbol{\beta}}_1$ is a consistent estimate of the true $\boldsymbol{\beta}_1$ as the case-control sampling method affects only the intercept term β_0. By correcting the intercept term β_0 to reflect the true population incidence rate τ and the sample incidence rate $\bar{y}$ according to the adjustment $\hat{\beta}_0 - ln[(\frac{1-\tau}{\tau})(\frac{\bar{y}}{1-\bar{y}})]$, prior correction can be used to provide consistent and asymptotically efficient estimates of true population probabilities and risk ratios.

Alternatively, the weighting method (Manski and Lerman 1977) weights the data to compensate for differences between the sample incidence rate $\bar{y}$ and the population incidence rate τ, by calculating the weighted log-likelihood

$$\begin{aligned} lnL_w(\boldsymbol{\beta}|y) &= w_1 \sum_{Y_i=1} ln(\pi_i) + w_0 \sum_{Y_i=0} ln(1 - \pi_i) \\ &= -\sum_{i=1}^{n} w_i ln(1 + e^{(1-2y_i)\mathbf{X}_i\boldsymbol{\beta}}) \end{aligned}$$

where the weights are $w_1 = \tau/\bar{y}$ and $w_0 = (1-\tau)/(1-\bar{y})$ and where $w_i = w_1 Y_i + w_0(1 - Y_i)$.

King and Zeng (2001) note that weighting is preferable to prior correction when the model is mis-specified, but is asymptotically slightly less efficient. Moreover, standard methods of calculating standard errors and applying corrections for rare events are not appropriate for the weighted model (though King and Zeng (2001) provide an alternative specification which can be used). Most crucially, from our perspective, as the population incidence rate is

[1] Clearly there are many other possible distributions that could be assumed for the latent variable. The implications of assuming a normal distribution (ie, a probit model) are considered as a robustness test in Section 3.4. However, the logit model is maintained as the preferred model as the adjustments developed by King and Zeng (2001) cannot be applied to a probit model.

included within the likelihood estimation, there is no simple way for the weighting method to allow for uncertainty in τ. Prior correction is therefore favoured as the main estimation method, and the weighted results are presented only as a robustness check.

A second issue King and Zeng (2001) discuss is that logit models are known to be biased in small samples (eg, McCullagh and Nelder 1989), and this bias carries over to the case of rare events, due to the small number of observed events relative to non-events. Moreover, they show that bias in the coefficients is compounded in the estimation of relevant quantities of interest, such as the absolute and relative risks, by failure to account for uncertainty in the estimated coefficients. These biases imply that both coefficients and associated probabilities will be underestimated in the case of rare events.

King and Zeng (2001) show that bias in the coefficients will be reduced as the sample size n increases, but amplified by the rarity of the event (see footnote 7 and appendices of King and Zeng 2001 for the derivation). They go on to suggest bias correction methods, as outlined below. In practice, it seems likely that these two factors will counteract each other in the current estimation, which has a large sample size but relatively rare events. This assumption is borne out by the data, in that estimates using the weighted rare events correction method show very little difference to a simple weighted logit without the rare event correction. However, the (more technically correct) rare events finite sample corrections are maintained in the main estimates (Section 3.4).

King and Zeng (2001) show that the bias in the coefficient can be estimated using weighted least squares as

$$\text{bias}(\hat{\boldsymbol{\beta}}) = (\mathbf{X}'\mathbf{W}\mathbf{X})^{-1}(\mathbf{X}'\mathbf{W}\boldsymbol{\xi})$$

where $\mathbf{W} = \text{diag}\{\hat{\pi}_i(1-\hat{\pi}_i)w_i)\}$, $\boldsymbol{\xi}_i = 0.5\mathbf{Q}_{ii}[(1+w_i)\hat{\pi}_i - w_i]$ and $\mathbf{Q}_{ii}$ is the diagonal element of $\mathbf{Q} = \mathbf{X}(\mathbf{X}'\mathbf{W}\mathbf{X})^{-1}\mathbf{X}'$.

This can be estimated by running a weighted least-squares regression with $\mathbf{X}$ as the "explanatory variables", $\boldsymbol{\xi}$ as the "dependent variable," and $\mathbf{W}$ as the weight, and used to create a bias corrected estimate $\tilde{\boldsymbol{\beta}} = \hat{\boldsymbol{\beta}} - \text{bias}(\hat{\boldsymbol{\beta}})$. As well as correcting the bias on the coefficients, this correction also has the benefit of reducing variance, as $V(\tilde{\boldsymbol{\beta}}) = (\frac{n}{n+k})^2 V(\hat{\boldsymbol{\beta}})$ and $(\frac{n}{n+k})^2 < 1$.

Estimates of the absolute risk (and hence the relative risks) can then be computed by aver-

aging over the uncertainty in $\tilde{\boldsymbol{\beta}}$

$$Pr(Y_i = 1) = \int Pr(Y_i = 1|\boldsymbol{\beta}*)P(\boldsymbol{\beta}*)d\boldsymbol{\beta}*$$

through stochastic simulation, where $\boldsymbol{\beta}*$ is the integration dummy, and to summarise estimation uncertainty $P(\cdot)$ we take the Bayesian viewpoint and use the posterior density of $\boldsymbol{\beta}$, $N(\boldsymbol{\beta}|\tilde{\boldsymbol{\beta}}, V(\tilde{\boldsymbol{\beta}}))$. This method involves taking a random draw of $\boldsymbol{\beta}$ from $P(\boldsymbol{\beta})$, inserting it into $[1 + e^{-\mathbf{X}_i\boldsymbol{\beta}}]^{-1}$, repeating 2,000 times and then averaging over the simulations to give confidence intervals for the actual $Pr(Y_i = 1)$.[2] Relative risks can then be calculated by inserting two chosen levels of $\mathbf{X}_i$ and computing the ratio of the absolute risks.

Finally, King and Zeng (2004) deal with the issue of uncertainty in the underlying population incidence rate τ. In the discussion above, τ is treated as a known quantity and used directly in the case-control and rare-event corrections to estimate the relationships of interest at the population level. However, as in this study, there may be substantial uncertainty about the population incidence rate.

Past work in this area has used a variety of extreme assumptions, including the "full information assumption" implied in the discussion above, in which complete knowledge of τ is assumed; Manski's (1999) "ignorance assumption," in which no prior knowledge of τ is assumed; and the "rare disease assumption" used in epidemiology, in which τ is assumed to be approximately zero. King and Zeng (2004) suggest an alternative approach which assumes only that τ can be identified within reasonable bounds $\tau \in [\tau_0, \tau_1]$ – the "available information" assumption.[3] The authors describe this as a "robust Bayesian" approach, in that the choice of an interval for τ is not equivalent to imposing a prior density within those bounds (as per a fully Bayesian model), but effectively narrows the possible priors to the subset for which $\int_{\tau_0}^{\tau_1} P(\tau)d\tau = 1$. This method has the benefit of allowing researchers to be specific about their knowledge of τ, neither under- nor over-stating the degree of confidence they have, but means that the results are limited to a statement of the credible interval for the quantity in question, rather than an exact estimate. This in turn implies that relative risks and any other quantity of interest must be calculated based on these same bounds eg, the appropriate band for the relative risk is $RR \in [min(RR_{\tau_0}, RR_{\tau_1}), max(RR_{\tau_0}, RR_{\tau_1})]$.

The estimation method employed must be able to cope with each of these issues (rare events, case-control sampling, and uncertainty about τ). The main estimates in Chapter 3 thus

[2] King and Zeng (2001) also discuss analytic methods for computing the risks.

[3] This assumption can be relaxed further, by assuming that $\tau \in [\tau_0, \tau_1]$ with a specified probability, then defining a density function for the tails.

follow the following procedure (carried out within the ReLogit program). First, a standard logistic regression is run, estimating the slope vector $\hat{\boldsymbol{\beta}}_1$ (which is consistent in case-control models), and the unadjusted constant $\hat{\beta}_0$ (which is not).[4] τ is assumed to lie within the interval $[10^{-6}, 10^{-5}]$, based on the observed population incidence rate of 6.45×10^{-6}. Two thousand simulations of $\boldsymbol{\beta}$ are drawn from the posterior density, $N(\boldsymbol{\beta}|\hat{\boldsymbol{\beta}}, \hat{V}(\hat{\boldsymbol{\beta}}))$. Half of the estimates for the intercept $\hat{\beta}_0$ are then adjusted with respect to the lower bound on τ ($\tau_x = 10^{-6}$) and the other half are adjusted with respect to the upper bound ($\tau_x = 10^{-5}$), using the correction formula

$$\tilde{\beta}_0 - ln\left[\left(\frac{1-\tau_x}{\tau_x}\right)\left(\frac{\bar{y}}{1-\bar{y}}\right)\right]$$

to give bounds on the estimates of $\tilde{\boldsymbol{\beta}}$. Confidence intervals for the absolute risk are then constructed by simulation (2,000 reps) using each of the two bounds, τ_0 and τ_1. Absolute risks are estimated directly, with relative risks computed as the ratio of the two absolute risks. Reported point estimates are the median value from these simulations, while the 2.5^{th} and 97.5^{th} percentiles give the 95 percent confidence interval.

[4] Because of the bias in the intercept and the difficulty interpreting the logit coefficients, these are not reported in the thesis.

Appendix C
Export selection quantiles for export market entry probit model

Table C.1: Export market entry selection equation – MFP quantile dummies

	(1)	(2)	(3)	(4)
Quantile 2	0.001	0.000	-0.006	-0.021
	[0.003]	[0.003]	[0.024]	[0.020]
Quantile 3	0.000	-0.001	-0.011	-0.013
	[0.003]	[0.002]	[0.024]	[0.020]
Quantile 4	0.004	0.001	-0.032	-0.039**
	[0.004]	[0.003]	[0.023]	[0.019]
Quantile 5	0.001	0.000	0.015	0.006
	[0.003]	[0.003]	[0.025]	[0.022]
Quantile 6	-0.001	-0.002	-0.034	-0.025
	[0.003]	[0.002]	[0.024]	[0.020]
Quantile 7	-0.002	-0.003	-0.016	-0.005
	[0.003]	[0.002]	[0.024]	[0.021]
Quantile 8	-0.002	-0.003	0.016	-0.001
	[0.003]	[0.002]	[0.025]	[0.021]
Quantile 9	-0.001	-0.002	-0.023	-0.033*
	[0.003]	[0.002]	[0.024]	[0.019]
Quantile 10	0.000	-0.003	-0.021	-0.017
	[0.003]	[0.002]	[0.024]	[0.021]
Quantile 11	0.004	0.000	0.012	0.006
	[0.003]	[0.002]	[0.025]	[0.022]
Quantile 12	0.004	0.001	0.005	-0.008
	[0.003]	[0.003]	[0.025]	[0.022]
Quantile 13	-0.002	-0.003	0.011	-0.010
	[0.003]	[0.002]	[0.025]	[0.021]
Quantile 14	0.000	-0.002	0.010	0.008
	[0.003]	[0.002]	[0.025]	[0.022]
Quantile 15	0.004	0.001	0.021	0.006
	[0.004]	[0.003]	[0.025]	[0.022]
Quantile 16	-0.001	-0.001	0.034	0.008
	[0.003]	[0.002]	[0.025]	[0.022]
Quantile 17	0.006	0.003	0.042*	0.019
	[0.004]	[0.003]	[0.025]	[0.022]
Quantile 18	0.002	0.001	0.045*	0.009
	[0.003]	[0.003]	[0.025]	[0.021]
Quantile 19	0.006	0.003	0.016	-0.002
	[0.004]	[0.003]	[0.025]	[0.021]
Quantile 20	0.013***	0.009**	0.038	0.003
	[0.005]	[0.004]	[0.026]	[0.022]

Table 6.3 lagged MFP quantile dummies.

Table C.2: Export market entry selection equation – klratio quantile dummies

	(1)	(2)	(3)	(4)
Quantile 2	-0.002	-0.001	0.004	0.001
	[0.003]	[0.003]	[0.025]	[0.023]
Quantile 3	0.003	0.003	0.039	0.006
	[0.004]	[0.004]	[0.026]	[0.022]
Quantile 4	0.003	0.003	0.028	0.027
	[0.004]	[0.003]	[0.026]	[0.024]
Quantile 5	0.005	0.003	0.043	0.015
	[0.004]	[0.003]	[0.026]	[0.023]
Quantile 6	0.008*	0.006	0.063**	0.035
	[0.005]	[0.004]	[0.027]	[0.024]
Quantile 7	0.008*	0.007	0.025	0.006
	[0.004]	[0.004]	[0.026]	[0.022]
Quantile 8	0.011**	0.009**	0.023	0.016
	[0.005]	[0.004]	[0.026]	[0.023]
Quantile 9	0.008*	0.007*	0.043	-0.008
	[0.004]	[0.004]	[0.027]	[0.022]
Quantile 10	0.010**	0.010**	0.020	0.008
	[0.005]	[0.004]	[0.026]	[0.023]
Quantile 11	0.012**	0.011**	0.032	-0.002
	[0.005]	[0.005]	[0.026]	[0.023]
Quantile 12	0.014***	0.008**	0.056**	0.028
	[0.005]	[0.004]	[0.027]	[0.024]
Quantile 13	0.013**	0.011**	0.057**	0.014
	[0.005]	[0.005]	[0.027]	[0.023]
Quantile 14	0.017***	0.013***	0.019	-0.012
	[0.006]	[0.005]	[0.026]	[0.022]
Quantile 15	0.018***	0.016***	0.034	0.022
	[0.006]	[0.005]	[0.026]	[0.024]
Quantile 16	0.021***	0.018***	0.065**	0.026
	[0.006]	[0.006]	[0.027]	[0.024]
Quantile 17	0.013**	0.011**	0.000	-0.002
	[0.005]	[0.005]	[0.026]	[0.022]
Quantile 18	0.018***	0.015***	0.032	0.002
	[0.006]	[0.005]	[0.026]	[0.022]
Quantile 19	0.017***	0.015***	0.060**	0.017
	[0.006]	[0.005]	[0.027]	[0.023]
Quantile 20	0.029***	0.023***	0.051*	0.032
	[0.007]	[0.007]	[0.027]	[0.024]

Table 6.3 lagged klratio quantile dummies.

Table C.3: Export market entry selection equation – ltotemp quantile dummies

	(1)	(2)	(3)	(4)
Quantile 2	0.014**	0.011**	0.020	0.015
	[0.006]	[0.005]	[0.029]	[0.025]
Quantile 3	0.008	0.010*	0.019	0.019
	[0.006]	[0.006]	[0.028]	[0.025]
Quantile 4	0.014**	0.012**	0.045	0.032
	[0.006]	[0.006]	[0.031]	[0.027]
Quantile 5	0.013**	0.011**	0.106***	0.046
	[0.006]	[0.005]	[0.034]	[0.029]
Quantile 6	0.012**	0.009*	0.076**	0.054*
	[0.006]	[0.005]	[0.033]	[0.031]
Quantile 7	0.020***	0.015**	0.094***	0.042
	[0.007]	[0.006]	[0.035]	[0.030]
Quantile 8	0.016**	0.017***	0.107***	0.081**
	[0.006]	[0.006]	[0.034]	[0.032]
Quantile 9	0.020***	0.020***	0.129***	0.078**
	[0.007]	[0.007]	[0.035]	[0.032]
Quantile 10	0.024***	0.023***	0.105***	0.068**
	[0.008]	[0.007]	[0.035]	[0.032]
Quantile 11	0.029***	0.019***	0.155***	0.058*
	[0.008]	[0.007]	[0.035]	[0.031]
Quantile 12	0.032***	0.028***	0.145***	0.109***
	[0.009]	[0.008]	[0.035]	[0.034]
Quantile 13	0.028***	0.022***	0.170***	0.082**
	[0.008]	[0.007]	[0.036]	[0.032]
Quantile 14	0.029***	0.025***	0.166***	0.115***
	[0.008]	[0.008]	[0.035]	[0.035]
Quantile 15	0.038***	0.031***	0.184***	0.128***
	[0.010]	[0.009]	[0.036]	[0.035]
Quantile 16	0.045***	0.035***	0.233***	0.128***
	[0.011]	[0.009]	[0.035]	[0.034]
Quantile 17	0.048***	0.038***	0.225***	0.141***
	[0.011]	[0.010]	[0.036]	[0.036]
Quantile 18	0.063***	0.045***	0.265***	0.171***
	[0.013]	[0.011]	[0.035]	[0.037]
Quantile 19	0.077***	0.063***	0.236***	0.187***
	[0.014]	[0.013]	[0.036]	[0.037]
Quantile 20	0.112***	0.092***	0.297***	0.236***
	[0.018]	[0.017]	[0.041]	[0.041]

Table 6.3 lagged ltotemp quantile dummies.