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

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Abstract

This paper investigates the impact of port infrastructure on exporter behaviour, focusing on the opening of Metroport, a new inland port in Auckland. We model adoption of the new port facilities among local firms, and then relate uptake to future export growth performance. We find 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. We take early adoption of Metroport as a signal of an existing capacity constraint and analyse the effect of the new port on subsequent export growth, finding a positive but insignificant impact on export volumes.

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Disclaimer

This research uses data that was accessed while Richard Fabling and Lynda Sanderson were on secondment to Statistics New Zealand in accordance with security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Act are allowed to see data about a particular business or organisation. The results of this work have been confidentialised to protect individual businesses from identification. The analysis and interpretation of these results were undertaken while Richard Fabling and Lynda Sanderson were at the Reserve Bank of New Zealand and Arthur Grimes was at Motu. The opinions, findings, recommendations and conclusions expressed in this report are those of the authors. Statistics New Zealand, the Reserve Bank of New Zealand, Motu and the University of Waikato take no responsibility for any omissions or errors in the information contained here.

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

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.

1 Introduction

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 and time costs of transporting goods to their destination (Anderson and van Wincoop 2004).

This paper focusses on 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.

Using a dataset combining plant-level information on location and industry with detailed firm-level merchandise trade data, we examine the effect of inland port operations on exporter behaviour in Auckland city, with the opening of three inland ports between 1999 and 2005. We focus on the uptake of Metroport, an inland port operated by Port of Tauranga Ltd, and examine 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. We first identify the firm- and area-level characteristics of firms which have chosen to use Metroport and the underlying timepath of adoption. We then take early adoption of Metroport as a signal of an existing capacity constraint and analyse the effect of the new port on consequent export growth for constrained firms.

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

We find 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 for resultant increases in exports.

The next section provides background to the infrastructural developments which form the basis of our analysis. Section 3 sets this paper within the existing literature. Section 4 introduces the data and descriptive results, while sections 5 and 6 detail the empirical methodology and findings relating to port adoption and export growth respectively. Section 7 concludes.

2 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 become 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 firm's 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 shown that more productive firms are more likely to export.[1]

We make 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 emphasises the benefits available to firms through improved accessability and physical proximity relative to the existing Ports of Auckland. Figure 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.[2] 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

[1] Fabling and Sanderson (2010) demonstrate this for New Zealand manufacturers.

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

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.[3]

We initially examine 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.

We focus 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).[4]

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 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 Ports of Auckland, the longer term increase has been at least as strongly associated with a shift away from using Auckland International Airport among local firms.[5]

From a research perspective, the opening of Metroport represents a valuable

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

[4] 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.

[5] 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 (authors' calculations using Statistics New Zealand Tablebuilder www.stats.govt.nz).

Figure 1
Location of main goods transport infrastructure nodes in Auckland

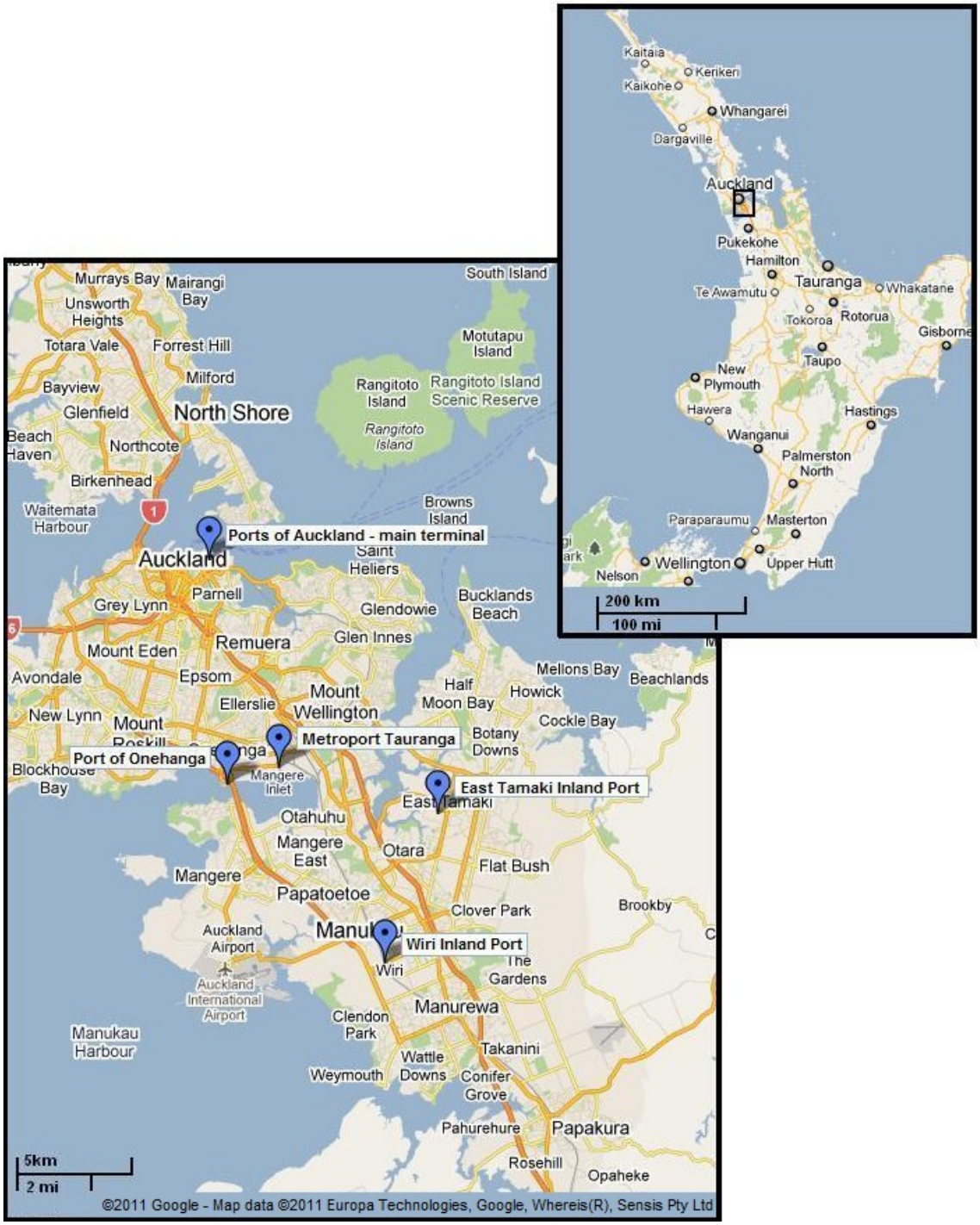
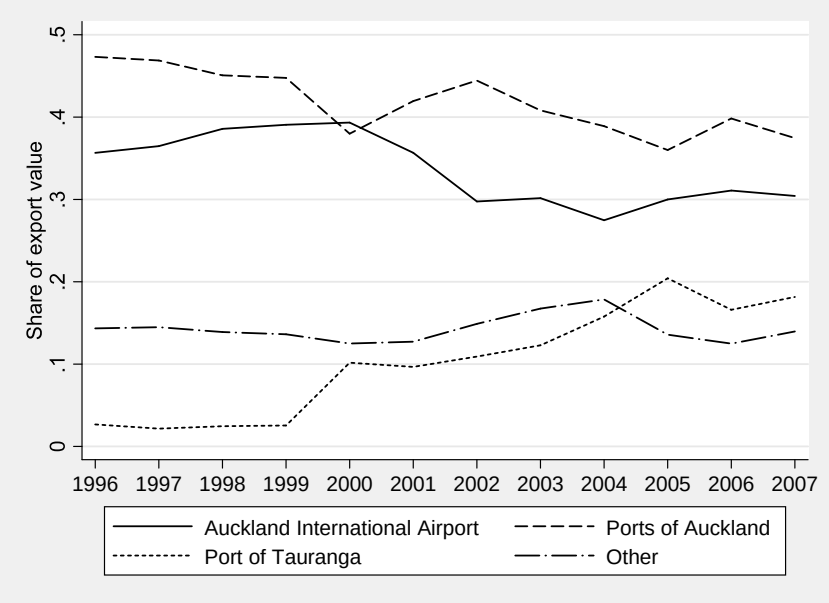


Figure 2
Port share of exports by firms located in Auckland and Northland Regional Councils



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

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 our analysis.[6]

[6] The location decision made by Port of Tauranga is likely to have been influences 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 ports 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 we directly control 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.

3 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) reports that congestion is perceived as a "somewhat serious" or "critically serious" problem for over 80 percent of 1177 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, Wang, Xu, Ozbay, Cetin, and Polimeni (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. To our knowledge, no similar studies have been undertaken in New Zealand. However these international results suggests 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 in-

volve 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.

We frame our investigation of infrastructure uptake 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.[7] 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 useage 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.

4 Data description

We use data from Statistics New Zealand's prototype Longitudinal Business Database (LBD). The LBD includes a range of administrative data sourced from the Inland Revenue Department, sample surveys administered by Statistics New Zealand, and comprehensive merchandise trade data from the New

[7] 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 of log exports. Firms which ever use Port Whangarei are excluded from the following analysis.

Zealand Customs Service, linked to a frame of all New Zealand businesses meeting minimal materiality conditions. The business frame provides information on the location and industrial sector of all plants, and the ownership links between plants and enterprises. Location and employment data is available from April 1999.[8]

Location, employment and industry data is available at the plant level, while merchandise exports data are recorded at the enterprise level. Where enterprises are linked by parent-subsidiary relationships, we aggregate exports within these groups to capture trade by vertically-integrated firms and to accommodate the possibility that group restructuring has led to changes in Customs reporting responsibilities within the group. We then allocate trade to those enterprises within the group whose industry designation indicates they are likely to handle physical merchandise.[9]

We define "potential export industries" to include the four main two-digit ANZSIC industry classifications which deal primarily with physical merchandise: agriculture, forestry and fishing (AFF), manufacturing (MANU), transport and storage (TS), and wholesale trade (WST). We then restrict our population 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, we assume 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. We aggregate this 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

[8] See Fabling (2009) for further detail on the LBD.

[9] In the analysis of port adoption we take the individual enterprises within the group as our unit of observation. For the export growth analysis we aggregate all variables to the group level in order to prevent double counting.

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 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.[10] 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 covers firms in the less populated areas to the north.[11]

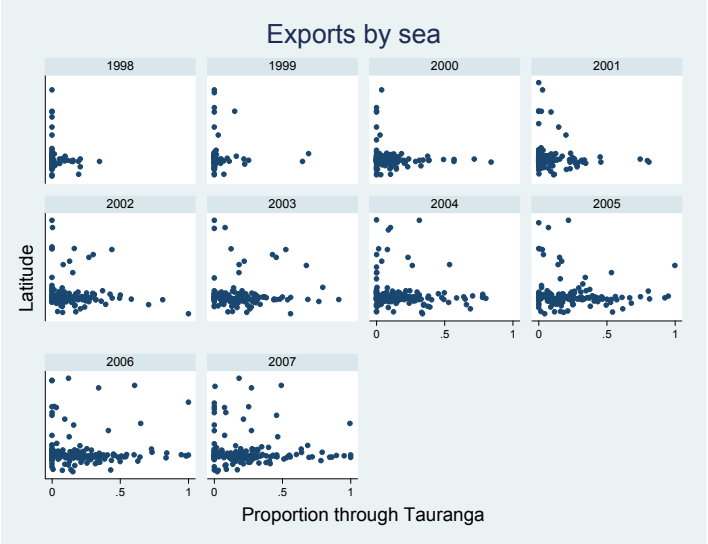
Figure 3 supports the assumption that firms are likely to be using Metroport if they are located in Auckland and observed to use Port of Tauranga. Prior to 2000, there are very few area units in which firms made any use of Port of Tauranga, and in all but two area units less than a quarter of sea-freighted exports were directed through Port of Tauranga. After Metroport opens in June 1999 (ie, in 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 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. In the next section, we consider the firm- and area-level factors determining adoption of Metroport, in order to better understand this geographic heterogeneity. As our focus is on new adopters of Metroport, we exclude from the analysis the small number of northern firms which had already used Port of Tauranga prior to June 1999.

[10] 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.

[11] To ensure that the observed patterns are not simply an artifact of the higher density in the Auckland region, we tried randomly excluding 90 percent of Auckland regions. The observed adoption patterns appear the same.

Figure 3
Share of trade through Port of Tauranga (Metroport) 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.

5 Empirical analysis: Adoption

5.1 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.[12]

To test these three hypotheses, we include explanatory variables relating to distance to the new and existing infrastructure, measures of potential

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

knowledge spillovers from neighbouring firms, and a set of firm-specific characteristics. We also examine overall uptake rates of the new infrastructure and draw conclusions about the barriers to switching, before turning to an analysis of the impact of the new infrastructure on adopting firms.

In order to examine the factors affecting adoption rates, we use survival analysis techniques (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.

A hazard function parameterisation allows us to compare 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 we use a Cox Proportional Hazard model (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. In the analysis below we report 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 infrastruc-

ture. To avoid such behaviour affecting the estimation of distance-related parameters we only use employing plant locations immediately prior to Metroport opening, and exclude from the sample those firms which alter their mix of locations within the Auckland and Northland regions.[13]

We require that the firm never has an employing plant outside the Northland and Auckland regional councils to allow for identification of Port of Tauranga uptake via Metroport. We define adoption of Metroport Tauranga 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. We then track usage over the following eight years to May 2007.

Finally, as we wish to consider the impact of area-level characteristics on uptake rates, we restrict our attention to firms located in area units where the initial population includes at least ten incumbent exporters. This allows us to create indicators of local uptake which should not be unduly affected by the activities of a single firm. With this last restriction in place, we capture 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 – 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).

As explanatory variables for firm-specific adoption rates we use 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 1 and summary statistics for firm-level variables are presented in table 2.

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

Table 1
Variable definitions

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	+	OMT
n_X_months99	number of months in which the firm exported, June 1998-May 1999	+	OMT
log_n_shipments99	log of the average number of export shipments per month in exporting months, June 1998-May 1999	+	OMT
X_sea98_99	dummy equal to one if the firm exported via sea-freight, June 1997-May 1999	+	OMT
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	?	OMT
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, OMT
spillovers_incumbent	share of incumbent-to-AU firm (April-May 1999) employment in firms which exported through Metroport in the previous year	+	LEED, OMT
spillovers_new	share of new-to-AU firm (post April-May 1999) employment in firms which exported through Metroport in the previous year	+	LEED, OMT
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 (OMT)

Table 2
Summary statistics

	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	

To control for differential exporting rates and product characteristics across industries we include a set of (largely) three digit Australia New Zealand Standard Industrial Classification (ANZSIC) dummies. 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.[14]

We also include a more direct indicator of product type – the log of the value-to-weight ratio of a firm's exports between June 1997 and May 1999 (*log_value_to_weight*). 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).[15]

We include a time-varying dummy set to one in any year in which the firm has no export-industry employment (*zero_emp*). This dummy 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, however, 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.[16] 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.[17]

[14] 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.

[15] 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.

[16] 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.

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

We include two variables 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.[18] 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.[19] 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.

In order to split out the location-specific factors from those related to the activity of neighbouring firms, we include 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 kilometer in April-May 1999 (*log_AU_emp_density*).[20] Finally, to identify information spillovers from nearby firms, we include the AU share of export-industry employment in firms which exported through Port of Tauranga in the previous year, distinguishing between incumbent firms in April-May 1999 (*spillovers_incumbent*) 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, we would expect these variables to have positive and significant coefficients.

5.2 Results

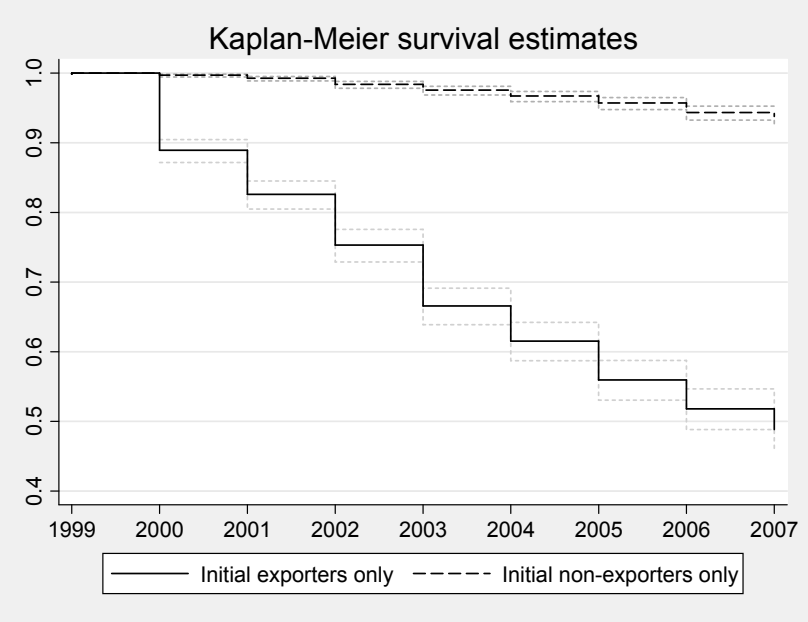
In examining the determinants of uptake, we distinguish between those firms which were already exporting prior to Metroport's opening in June 1999 (initial or incumbent exporters) and those which were not (initial non-exporters or entering exporters). These two groups exhibit very different patterns of adoption, as shown in figure 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

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

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

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

Figure 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 interval shown. Excludes firms which already used Port of Tauranga prior to the opening of Metroport.

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 (Fabling and Sanderson 2010).

Table 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 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.[21] 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-exporting firms (column 3), with no significant relationship with adoption rates apparent for either area characteristics or spillover variables. However, among initial non-exporters we see 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 4 presents supplementary results for different sub-populations from the

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

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 our 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, in columns 5 and 6, we 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.[22] 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.[23] 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 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.[24]

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

[22] Our 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.

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

[24] 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.

mining firms' usage of the new infrastructure.[25]

6 Empirical analysis: Export growth

6.1 Specification

Having considered the determinants of port infrastructure uptake, we now turn 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.[26]

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, we distinguish between those firms which start using Metroport within one year of its opening ($early\_adopter = 1$) and 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, we separate out those firms that commence using Metroport later due to a positive shock to their exporting from those which adopt early (implying the relaxation of an existing constraint).

We decompose overall export growth into that coming from increases in the

[25] 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.

[26] 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 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 regression 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 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 first use of Metroport (except specifications 5 and six, 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 regression 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.

number of 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, we may see no change, or even a rise in average shipment size. For completeness, we also consider 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, we also include firms which also have locations outside of the Auckland and Northland regional councils, 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.[27]

To control for the firms' existing characteristics and export propensity, we include the following variables, 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;[28] 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. In place of industry controls we include 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

[27] 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).

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

in 1998/99.[29]

Table 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 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 to that of the combined comparison group of 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 to 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.

[29] HS dummies may be more appropriate than industry dummies when dealing solely with exporters as they capture more detailed differences in activities across firms as well as product-specific demand and price changes.

Table 5
Export growth

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.

7 Conclusion

We examine the determinants and consequences of new infrastructure uptake among New Zealand export firms. We focus on the opening of New Zealand's first inland port, established by Port of Tauranga in 1999 in the Auckland suburb of Southdown. By considering the unanticipated opening of a new port we mitigate 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, we provide a bridge between largely theoretical discussions of the benefits associated with satellite terminals and inland ports (eg, Slack 1999; Roso et al 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 as well. Despite the location advantages emphasized by the port company, we find 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. We see that 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. We therefore focus on the set of "initially constrained firms" – those which begin using Metroport within a year of its opening – and consider their subsequent export performance relative to later adopters

and non-adopters, controlling for their pre-Metroport characteristics. However, early adoption of Metroport does not appear to confer any on-going improvements in export performance.

Finally, we note that 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.

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