DP2016/01

How exporters set prices: evidence from a large behavioural survey

Miles Parker

January 2016

JEL classification: E30, F31, F41

www.rbnz.govt.nz/research/discusspapers/

Discussion Paper Series

ISSN 1177-7567

DP2016/01

How exporters set prices: evidence from a large behavioural survey*

Miles Parker†

Abstract

This paper uses a survey of 1281 New Zealand exporters to investigate the role of firm characteristics in setting export prices. Larger, and more productive firms, are more likely to differentiate prices across markets. Primary sector firms are more likely to price to market than firms in other sectors, even taking into account other firm characteristics. This contrasts sharply with the commonly-held view that the price of these products is determined on the international market. In a further contribution to the literature, we find that service sector firms can also price to market, at similar rates to manufacturers.

* The views expressed in this paper are those of the author(s) and do not necessarily reflect the views of the Reserve Bank of New Zealand. The author would like to thank Martin Berka, Richard Fabling, Kevin Fox, Kathy Jackson, Ilan Noy, Lynda Sanderson, Christie Smith, two anonymous referees and participants at a seminar at the Reserve Bank of New Zealand and the 2013 Australasian Macroeconomics Workshop for comments.

† Address: Economics Department, Reserve Bank of New Zealand, 2 The Terrace, PO Box 2498, Wellington, New Zealand. *email address:* Miles.Parker@rbnz.govt.nz
ISSN 1177-7567

Disclaimer

The opinions, findings, recommendations and conclusions expressed here are those of the author and not necessarily those of the Reserve Bank of New Zealand, nor Statistics New Zealand. Statistics NZ and the Reserve Bank of New Zealand take no responsibility for any omissions or errors in the information contained here.

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

Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from `www.stats.govt.nz`.

Funding for the inclusion of the price-setting questions in the 2010 Business Operations Survey was provided by the Reserve Bank of New Zealand, the University of Tasmania and Victoria University of Wellington.

Non-technical summary

It is a widely documented phenomenon that prices of imported goods vary by less than movements in the bilateral exchange rate. This paper uses a large survey of New Zealand exporters to consider two causes of this lower volatility. The first cause considered here is where firms set prices differently across markets – referred to as *pricing to market*. The second cause is where a firm exporting from New Zealand invoices its customer in a currency other than New Zealand dollars, termed *local currency pricing*. The survey used here is the price-setting module from the 2010 *Business Operations Survey*, carried out by Statistics New Zealand. The survey had 5369 respondents, of whom over 1250 self-identified as exporters.

Around half of New Zealand exporters charge different prices (expressed in New Zealand dollars) across markets. Larger firms, and those firms with greater productivity than their competitors, are more likely to set different prices across markets, i.e. price to market. We find that New Zealand primary sector firms are more likely to price to market, in stark contrast to the normal assumption that prices for commodities are the same across countries. This is likely a result of New Zealand's primary products being primarily agricultural, rather than hard commodities such as metal ores. We also extend the literature by showing that service sector firms also price to market.

In terms of currency of invoice, around half of exporters primarily invoice in New Zealand dollars, around 30 percent invoice in the currency of the destination, with the remaining firms invoicing in a third-party currency, principally the United States dollar. There are significant differences across sectors, with manufacturers more likely to invoice in the currency of the destination, retailers and wholesalers in New Zealand dollars, and primary sector exporters predominantly invoicing in US dollars.

1 Introduction

How exporters set prices in foreign markets and the widely attested disconnect between exchange-rate movements and the local price of traded goods are the subject of a large literature. This paper contributes to that literature by analysing the responses to a large behavioural survey of 1281[1] exporting New Zealand firms. The use of surveys is relatively rare in the literature, which typically focuses on unit record customs data.

We focus on two main channels of incomplete pass-through of exchange-rate movements to the domestic price of goods prices: *pricing to market* (PTM) and *local currency pricing* (LCP). PTM is where a firm optimally chooses to differentiate prices across destinations, resulting in variable mark-ups. LCP is where a firm invoices its customers in foreign markets in a different currency to its own, producer, currency. Traditionally in the literature, the other currency was taken to be that of the destination market (hence 'local'), but more recently the literature also considers the use of third-party, or 'vehicle', currencies. These two channels of incomplete pass-through are related in practice, although not exclusively so. The majority of respondents to the survey that invoice in producer currency also charge the same price across destinations, and the majority of those that invoice in other currencies also typically price to market.

This paper makes a number of contributions to the literature. First, we find that primary producers do price to market, in stark contrast to what is commonly believed. Second, we demonstrate that service sector firms also price to market, a new finding for the literature that hitherto has concentrated on goods exporters. Finally, we investigate the firm characteristics that underly firms' decisions on currency of invoice and pricing to market. We find larger firms, and more productive firms, to be more likely to price to market. The sector the firm operates in has a significant bearing on the choice of invoice currency.

The commonly held view on primary exports is that such products are homogenous, and that the price is determined by the balance of international demand and supply, and hence the same across countries. The responses analysed here do not support this view. New Zealand primary exporters not only price to market, but are more likely to do so than firms in all other sectors, even taking into account other firm characteristics.

[1] This number, and other firm counts appearing in this paper, has been randomly rounded to base three in accordance with Statistics New Zealand's policies for publishing summaries of confidential responses.

This result may be a consequence of the type of primary products exported by New Zealand, which for the main part are agricultural in nature. Agricultural products have greater potential for product differentiation (such as by taste, appearance, safety of consumption, or being free range) than other primary products such as metals. Primary sector firms are more likely than firms in other sectors to cite 'customer characteristics' as being 'very important' for determining price across markets. New Zealand exporters also account for a large market share in the exports of certain primary products, including milk, sheep meat and kiwifruit. This high market share may well provide some pricing power. In common with the literature, we show that primary products are frequently invoiced in vehicle currencies, most notably the US dollar.

There are a number of advantages in the use of a survey to consider firm decisions on export pricing relative to the unit record customs data that is widely used in the literature. First, the survey explicitly asks firms whether the price (in domestic currency terms) is the same across all markets, both foreign and domestic. Customs data do not, of themselves, include information on the domestic market, so are unable to identify cases where the export price (even if common to all foreign destinations) is different from the domestic price. Second, the survey used here covers the service sector. Customs data requires the physical movement of goods across borders, so is silent on the pricing behaviour of service sector firms, who account for a significant share of advanced countries' exports. Third, the survey directly asks firms the reasons for choosing to differentiate prices between markets. It also provides other information on the exporters to permit a more thorough understanding of the firm characteristics that contribute to the decisions on invoice currency and whether to price to market.

Service sector exports account for a fifth of total New Zealand exports, and for a significant share of exports of other advanced economies. Despite this significant share of exports, there is scant evidence in the literature on how service sector firms price exports. We provide evidence that some service sector firms invoice in currencies other than the New Zealand dollar and also price to market. Once other firm characteristics are taken into account, the export pricing behaviour of service sector firms is not significantly different from manufacturers.

Recent research has highlighted the role of firm characteristics in the decisions over currency of invoice and whether to differentiate prices between markets. Using the survey responses, we find that the sector the firm operates in has a significant impact on the currency of invoice. Neither size of the firm

nor productivity relative to competitors have a systematic bearing on the choice of currency of invoice. Conversely, larger firms are more likely to price to market, as are more productive firms. Taking into account these firm characteristics, the firm's sector does not affect the decision to price to market, with the sole exception of firms in the primary sector.

Survey data are not without disadvantages. The identification of price differentiation does require that firms act in the way that they respond to the survey. More importantly, PTM requires the exact same product to be sold at different prices in different markets. It is not uncommon for firms to differentiate between markets by sending different varieties to different destinations. The survey requests that the firm answers the question in terms of its main product, but it is possible that respondents did not carefully distinguish between the exact products sold in each market. Finally, as with all surveys, the quality of the responses rely on the quality of the survey itself. The large number of respondents, the detailed stratification of the sample, and the very high response rate (82 percent) of the survey used here provide comfort. That said, there is a marked lacuna in the coverage of firms selling to tourists located in New Zealand, who are exporters but do not always recognise themselves as such.

1.1 Related literature

The literature on the so-called 'exchange rate disconnect', where domestic prices for traded goods vary by less than the exchange rate is large, and is surveyed in Burstein and Gopinath (2013). Within this large literature, this paper is most closely related to studies of two particular channels – pricing to market and local currency pricing (and more broadly the choice of invoice currency). Recent work has highlighted the role of firm characteristics in the operation of these channels.

The theory of pricing to market dates back to the models of Dornbusch (1987) and Krugman (1987), and was first modelled in a general equilibrium framework by Betts and Devereux (1996). In monopolistically competitive markets firms set prices, and hence mark-ups, in relation to the elasticities of demand for their product. If an exporter wishes to maintain market share in an export market, it will lower its mark-up when the exporter's currency appreciates against that of the market in question, which is to say it will choose to price to market. Atkeson and Burstein (2008) develop the pricing to market framework, demonstrating the role of trade costs in the decision

to price to market. In their framework, larger firms are more likely to price to market.

A small number of recent papers have considered the role of firm characteristics on the decision of whether to price to market. Berman et al. (2012) study pricing by French exporters using unit record customs data. They provide evidence that high-performing firms maintain prices in foreign markets when the currency depreciates, increasing mark-ups at the cost of smaller change in export volumes. Amiti et al. (2014) study the impact of imported intermediates on export prices. They show that more productive firms, and those with a larger market share exhibit a lower exchange rate pass-through. Firms with low market share pass through exchange rate movements in almost their entirety, whereas the firms with the highest market share pass on around half of the exchange rate movement. Li et al. (2015) and Chatterjee et al. (2013) similarly find a key role for firm productivity in determining exchange-rate pass-through.

The widespread use of customs data in the literature results in most papers considering only the prices of goods that are internationally traded, and not any potential differences between how an exporter prices in the domestic and foreign markets. One rare exception is Fitzgerald and Haller (2014), who study pricing by Irish manufacturers exporting to the United Kingdom, using matched priced data from the Producer Price Index. For exporters invoicing in local currency, relative mark-ups between the domestic and the foreign market move one-for-one with the exchange rate.

A few general surveys about price-setting behaviour have also asked about export pricing. Greenslade and Parker (2010) survey the price-setting behaviour of UK firms and find that three quarters of exporters price to market. Exchange rate changes and transportation costs are cited as the most important factors in deciding on price within markets. Some of the country surveys reported in Fabiani et al. (2006) also enquire about export pricing, finding that half of firms price to market, even when exporting within the euro area. However, these surveys had a lower number of respondents than the New Zealand survey (Greenslade and Parker, 2010, had responses from 128 exporters), and lower response rates (typically around a third).

Several authors have investigated the role of currency of invoice on exchange-rate pass-through (ERPT). Theories of endogenous currency choice include minimising currency volatility (Donnenfeld and Haug, 2008), low macroeconomic volatility (Devereux et al., 2004) and choosing a currency with low transaction costs (Devereux and Shi, 2013). Gopinath et al. (2010) observe differential ERPT for US importers dependent on the currency of invoice.

They use this finding to motivate a theory of endogenous currency choice. Using customs unit record data, they show that differences in pass-through for (US) dollar and non-dollar denominated imports persist through several rounds of price adjustments, suggesting differences in desired pass-through between firms.

Goldberg and Tille (2008) use data on 24 countries to demonstrate a 'coalescing' effect where firms choose an invoice currency to minimise price movements relative to their competitors. Thus exporters to the United States choose to invoice in US dollars to help maintain their prices relative to domestic US firms. Similarly, exporters of homogenous goods, such as commodities, choose a common currency, usually the US dollar. Gopinath et al. (2010) similarly find that imports of homogenous goods to the United States are more likely to be invoiced in US dollars.

Goldberg and Tille (2009) use unit record customs data for Canadian imports to demonstrate that exporters tend to use the currency of the country that dominates the industry in which they operate. Large shipments into Canada are more likely to be priced in Canadian dollars than smaller ones, especially if the exporter has a large market share. Goldberg and Tille (2013) formalise this finding in a theoretical model of bargaining between exporters and importers over price and invoice currency.

There have been a small number of surveys that consider firm choices over the currency of invoice. Friberg and Wilander (2008) conclude that both the price and currency of invoice are subject to negotiation between the importer and exporter, using a survey of Swedish exporters. They also find that large orders are more likely to be invoiced in local currency, as are exports to large countries. Ito et al. (2012) survey a small number of Japanese manufacturing exporters and find invoicing in local currency is typical when exporting to advanced countries, whereas firms with highly differentiated goods or dominant global market shares are more likely to invoice in yen, even when exporting to advanced countries.

Martin and Méjean (2012) study a survey of euro-area manufacturers and find that large companies are more likely to both invoice in foreign currency and to hedge exchange rate risk. The survey used here does not give evidence on whether the respondents use financial instruments to hedge, but does provide information on primary and service sectors as well as pricing to market behaviour that the survey in Martin and Méjean (2012) does not. Evidence for New Zealand suggests the hedging strategies of exporters (at the very least, those to Australia) vary over time, and are related to perceptions of exchange rate momentum (Fabling and Grimes, 2015).

For New Zealand, there is little previous firm-level evidence on export pricing. Fabling and Sanderson (2015) examine exchange rate pass-through using shipment-level export data. They combine the approaches of Gopinath et al. (2010) and Berman et al. (2012) by considering the impact of both firm characteristics and currency of invoice. Similar to Gopinath et al. (2010) they find that short- and long-run pass-through differs by currency of invoice. They also find that higher-performing firms are more likely to absorb exchange rate fluctuations in their margins, in line with Berman et al. (2012). However, within currency groups, they find little role for firm characteristics. That is to say, the differences in observed pass-through by firm type is entirely explained by the choice of invoice currency with higher performing firms electing to invoice in local currency, with direct implications for pass-through.

2 New Zealand exports

This section briefly describes New Zealand's main exports to provide context for the remainder of the paper. We use 2010 data to be contemporaneous with the survey, but the main exports and main destinations are little changed in the most recent data. New Zealand is a commodity exporter, with over half of exports by value occurring in the primary sector. Agricultural products dominate these primary sector exports, although there are also important contributions from forestry and crude petroleum. New Zealand's biggest export is dairy, which accounts for 18.7 percent of all exports (table 1). Not only is dairy important for New Zealand exports, but New Zealand plays a significant role in world dairy exports. At the time the survey used in this paper was carried out, New Zealand accounted for 55 percent of world exports of whole milk powder and 58 percent of world butter exports (USDA, 2014). Around 90 percent of New Zealand dairy exports are carried out by one company – the dairy co-operative Fonterra.

New Zealand's second biggest export is meat, notably beef and lamb. New Zealand is a major world exporter of sheep meat; according to data from the United Nation's Food and Agriculture Organisation, New Zealand accounts for more than a third of overall world exports in sheep meat, and a higher share of world lamb exports. New Zealand also accounts for around a third of world kiwifruit exports. As with dairy, New Zealand kiwifruit exports are for the most part carried out by a single co-operative, Zespri, which markets all exports outside of those to Australia.

Table 1
Major New Zealand exports and main merchandise export destinations in 2010

Product	Share	Destination	Share
Dairy	18.7	Australia	23.0
Meat	9.1	China, PR	11.1
Tourism	7.8	United States	8.6
Wood	5.3	Japan	7.8
Transportation	4.4	United Kingdom	3.5
Mineral fuels	3.7	Korea, Rep. of	3.2
Education travel services	3.2	Indonesia	2.1
Machinery	3.1	India	2.1
Fruit and nuts	2.6	Hong Kong (SAR)	2.0
Beverages, liquor	2.4	Taiwan	1.9

Source: Statistics New Zealand (2011).

Service sector exports account for over a fifth of total exports. New Zealand's principal exports of services are tourism, transportation and education travel services. Tourism represents the spending of non-residents within New Zealand. As noted below, since the expenditure takes place within New Zealand, not all firms recognise these sales as exports. Transportation includes not just sea freight, but also transport of foreign tourists by resident airlines. Education travel services are the provision of education within New Zealand to non-residents, such as foreign residents attending university in New Zealand.

Australia is the biggest destination for New Zealand's merchandise exports, accounting for around a quarter of exports. China is the second largest export partner, and is the main destination for dairy exports. The United States is the third largest destination. Emerging markets in South East Asia combined account for around a third of exports.

3 Business Operations Survey

This paper uses the responses to module on price and wage setting in the 2010 Business Operations Survey carried out by Statistics New Zealand.[2]

[2] A full copy of the survey questionnaire is available at `http://www2.stats.govt.nz/domino/external/quest/sddquest.nsf/12df43879eb9b25e4c256809001ee0fe/6233ea80fe191165cc25777d007a8490/$FILE/BOS%202010_Sample.pdf`.

The survey sample was stratified by industry and firm size (see Parker, 2014, for a fuller description of the survey design) . The survey had 5369 responses, which is approximately one seventh of the total population of firms in New Zealand with at least 6 employees and 30,000 annual GST (New Zealand equivalent of Value Added Tax) turnover. The high response rate of 81.8 percent is explained by the legal requirement for firms to respond to survey requests by Statistics New Zealand. Of these respondents, 1281 self-identified as being exporters. The survey questions on how exports are priced are provided in the appendix.

Results in the tables are weighted using the stratification weights provided by Statistics New Zealand, in order to represent the averages for the population of private sector New Zealand firms. Since export volumes tend to be dominated by larger firms, the summary tables also include a total figure weighted by employment share. This employment share is calculated using average employment by industry and firm size strata: small (6-19 employees), medium (20-100 employees) and large (100+ employees).

Firms were asked who reviews and sets the price for the firm's main products. The vast majority – 82 percent – set their own price. A further 8 percent have their price set by their parent firm. The remaining 10 percent of firms selected 'other' for the price setter. Firms that were majority owned by foreigners were more likely to have prices set by the parent – 23 percent versus 7 percent for domestically owned firms.

It is worth noting that the survey relies on firms self-identifying as exporters. In general, the proportion of exporting firms by sector within the survey is well correlated with the share of that sector's output that is exported, according to the 2007 input-output tables. There are a few exceptions, most notably in accommodation and food services where 29 percent of sector output is exported, but firms did not identify themselves as exporters. Since these firms export by providing services to non-residents physically located within New Zealand (i.e. tourists) they may not consider themselves to be exporters. This hypothesis is supported by the 73 percent of firms in that sector who responded that they derived some share of their revenue from tourism. Overall, 33 percent of firms self identified as being either exporters or selling to tourists.

4 Export-pricing behaviour

Overall, 15 percent of firms identify themselves as exporting (table 2). A large proportion of firms in agriculture and manufacturing self-identified as exporting. There were also a large proportion of firms in certain service sectors – mostly those that had other businesses as their main customer – that self-identified as exporters. For example, half of firms in the computer design industry exported, with 11 percent of firms in the sector exporting more than 75 percent of their output. Conversely firms in construction and certain service sectors, mostly those serving households or individuals, rarely export.

The 36 industries in the sample are grouped in the rest of the paper to facilitate the presentation of the results, with the groupings set out in table 2. Service sectors have been split between business services and personal services, determined by their main customer. Sectors where the most firms report 'individuals or households' as their main customer have been allocated to personal services, whereas those sectors where most firms report other businesses as their main customer have been allocated to business services.[3]

4.1 Currency of invoice

Firms were asked in what currency they predominantly invoiced. The four options given were *currency of the destination market*, *New Zealand dollar*, *United States dollar*, *other*.[4] Half of firms invoice in New Zealand dollars, with the remaining firms roughly evenly split between currency of destination and vehicle currencies (table 3). These responses closely match the results found by Friberg and Wilander (2008) for Swedish exporters.

Manufacturers are the most likely to invoice in the destination currency, whereas firms in the primary sector are the most likely to price in US dollars. Two thirds of firms in the distribution sector price in New Zealand dollars. Use of vehicle currencies other than the US dollar is rare. There is

[3] In what follows, the results for 'other industry' and 'personal services' have been omitted from the tables given the low number of exporters within these sectors. However, all exporters are included in the 'overall' figures.

[4] The intention of the ordering of the question was for firms that export to the United Stated and invoice in US dollars would selected currency of the destination market, but it is possible that some firms in this scenario selected US dollars. In any case, the share of respondents that principally invoice in US dollars far exceeds the share of exports that goes to the United States.

Table 2
Share of firms that export and share of output exported by sector[(a)]

Industry name	Number of firms	Firms that export (%)	Share of sales exported: 25% or less	50% or less	75% or less	More than 75%
Primary	**3216**	**28**	**4**	**2**	**2**	**20**
Agriculture	2103	40	6	3	3	29
Commercial fishing[(b)]	42	29	0	0	7	14
Forestry & logging	210	6	0	0	4	0
Agr., forestry, & fishing support serv.	762	2	0	0	0	2
Mining	99	18	3	0	6	6
Manufacturing	**5016**	**36**	**19**	**6**	**5**	**5**
Food, beverage, & tobacco	921	46	16	11	11	8
Textile, clothing, footwear, & leather	357	48	29	10	3	5
Wood & paper product	528	28	17	2	5	4
Printing, publishing, & recorded media	306	17	12	3	1	0
Petroleum, coal, chemical, & assoc. prod.	414	63	39	10	7	7
Non-metallic mineral product	165	18	18	2	0	0
Metal product	912	21	15	4	1	1
Transport and ind. machinery & equip.	831	36	17	6	5	8
Other machinery & equipment	210	57	29	9	0	20
Other manufacturing	369	33	19	6	4	4
Other industry	**3582**	**2**	**1**	**0**	**0**	**0**
Electricity, gas, water, & waste services[(b)]	114	8	3	0	3	0
Construction	3468	2	1	0	0	0
Distribution	**7077**	**20**	**15**	**1**	**1**	**2**
Machinery & equipment wholesaling	903	36	31	0	0	4
Other wholesale trade	1959	40	31	3	1	5
Retail trade	4215	7	5	0	1	0
Business services	**6807**	**16**	**8**	**2**	**2**	**3**
Transport, postal, & warehousing	1362	9	2	3	2	2
Publishing	120	23	13	3	0	3
Motion picture	135	16	11	2	2	0
Telecommunications[(b)]	87	28	17	3	0	3
Auxiliary finance	303	13	12	0	1	0
Other professional scientific	2907	15	8	3	1	4
Computer systems design	558	49	26	4	8	11
Administrative & support services	1335	9	5	1	1	2
Personal services	**9609**	**2**	**1**	**0**	**0**	**1**
Accommodation & food services	4194	0	0	0	0	0
Finance	159	4	0	0	2	2
Insurance[(b)]	45	7	7	0	0	0
Rental, hiring, & real estate services	804	3	3	0	0	0
Education & training	717	7	2	0	0	5
Health care & social assistance	2226	0	0	0	0	0
Arts & recreation services	486	2	1	0	1	1
Other services	978	5	4	0	0	0
Overall	**35307**	**15**	**8**	**2**	**2**	**4**

Notes: (a) Shows share of firms in each sector that export and proportion of firms in each sector by share of output exported. Rows may not correctly sum due to rounding, or where results are suppressed to protect the anonymity of individual respondents.
(b) The number of respondents for these sectors is low, so results should be treated with caution.

Table 3
Predominant currency of invoice for export market contracts

	Destination	NZD	USD	Other
Firm size				
Small	26	50	20	4
Medium	34	45	19	3
Large	29	41	26	4
Sector				
Primary	32	18	44	9
Manufacturing	36	44	17	4
Distribution	25	65	9	1
Business services	23	51	22	4
Price reviewer / setter				
Firm itself	29	54	15	2
Domestic parent	20	26	47	6
Foreign parent	8	20	43	29
Other	37	14	44	10
Overall	29	48	20	4
Employment weight	29	44	25	3

Note: Firms were asked to mark one response. A small number of firms marked more than one, particularly those where the price-setter was 'other'. The multiple responses have been retained.

a noticeable difference in currency of invoice for those firms that do not set their own price. In particular, the majority of such firms use vehicle currencies. The use of vehicle currencies is most pronounced when the price is set by a foreign parent – 72 percent of these firms price in vehicle currencies.

To understand the influence of firm characteristics on the choice of invoice currency, we carry out a number of multinomial probit models. A multinomial probit extends the standard probit model framework to consider the case where there are more than two choices and where there is no particular order between the choices.[5] We allocate the predominant currency of invoice between three categories – New Zealand dollar, currency of the destination market and vehicle currencies. For each multinomial probit there are two equations, estimating the impact of firm characteristics on the decision to invoice in, respectively, the destination currency and an invoice currency,

[5] The estimation of probit models is briefly outlined in the appendix. See Greene (2012) (p.752-5) for a more detailed exposition of multinomial probits.

relative to the base currency choice, New Zealand dollars. In terms of firm characteristics, the reference firm is taken to be a small manufacturer. To mitigate potential mis-specification of the error terms such as heteroscedasticity, the multinomial probits are estimated using White (1980) robust standard errors.

The average marginal effects from the multinomial probits are shown in tables 4 and 5. Table 4 shows the impact of firm characteristics on the likelihood a firm chooses to invoice in destination currency relative to New Zealand dollars. Table 5 shows the impact on the choice to invoice in a vehicle currency relative to New Zealand dollars. The parameter estimates from the underlying equations are provided in the appendix.

Column (1) displays the average marginal effects from a multinomial probit that uses the sector the firm operates in, its size and share of production that is exported as explanatory variables for the choice of currency of invoice. The sector that a firm operates in has a large bearing on invoicing in the destination currency, with all sectors being less likely than manufacturers to choose this currency of invoice. Primary sector firms are more likely to choose to invoice in vehicle currencies than manufacturers. Medium-sized firms are more likely than small firms to invoice in the destination currency, and large firms are more likely to invoice in vehicle currencies. However, there is not a systematic relationship between firm size and invoice choice as large firms are as likely as small firms to invoice in destination currency, and medium-sized firms are as likely as small firms to invoice in vehicle currencies.

Firms that export a greater share of their production are more likely to invoice in foreign currencies. A 10 percent increase in the share of production that is exported increases the probability of invoicing in the destination currency by 1 percent, and the probability of invoicing in vehicle currencies by 3 percent. This finding is in line with that of Fabling and Sanderson (2015), who find that firms with high export receipts are more likely to use local or vehicle currencies.

The impact of foreign ownership is considered in the equation reported in column (2). We construct a dummy variable equal to 1 if the firm is 51 percent or more owned by an overseas firm and zero otherwise. A second dummy variable is constructed that takes the value of 1 if the firm's price is both set by the parent, and that parent is foreign, and zero in all other cases. Foreign-owned parents are around 12 percent less likely than domestic owned firms to price in the currency of the destination market, although vehicle currency use is the same. Fabling and Sanderson (2015) similarly find that foreign-owned firms are more likely to use producer currency pric-

Table 4
Average marginal effects from multinomial probits on predominant currency of invoice – destination currency relative to New Zealand dollars

	(1)	(2)	(3)	(4)
Sector – Primary	−0.122**	−0.127**	−0.128**	−0.127**
Manufacturing	*reference*	*reference*	*reference*	*reference*
Other industry	−0.208*	−0.191*	−0.195*	−0.193*
Distribution	−0.091*	−0.066	−0.061	−0.066
Business services	−0.091*	−0.066	−0.065	−0.070*
Personal services	−0.270**	−0.261**	−0.240**	−0.262**
Size – Small	*reference*	*reference*	*reference*	*reference*
Medium	0.054	0.072*	0.062*	0.072*
Large	−0.001	0.031	0.018	0.030
Export share	0.001**	0.002**	0.002**	0.002**
Foreign owned		−0.121**	−0.119**	−0.121**
Price set by foreign parent		−0.083	−0.071	−0.084
Main customer type				
Households			−0.091	
Business within group			−0.043	
Retailer / wholesaler			0.032	
Other business outside group			*reference*	
Government			0.075	
Productivity rel. to competitors				
Lower				0.003
On par / don't know				*reference*
Higher				0.011
N	1281	1281	1281	1281

Note: * Significant at 5 percent level, ** Significant at 1 percent level. Average marginal effects show the percentage point increase in probability of selecting to invoice in respectively currency of destination and vehicle currencies relative to choosing to invoice in New Zealand dollars of a one unit increase in the explanatory variable. Underlying estimation coefficients given in table 9 in the appendix.

Table 5
Average marginal effects from multinomial probits on predominant currency of invoice – vehicle currencies relative to New Zealand dollars

	(1)	(2)	(3)	(4)
Sector – Primary	0.169**	0.171**	0.172**	0.172**
Manufacturing	*reference*	*reference*	*reference*	*reference*
Other industry	0.140	0.131	0.115	0.133
Distribution	−0.038	−0.041	−0.039	−0.042
Business services	0.006	−0.004	−0.021	−0.005
Personal services	−0.008	−0.015	−0.014	−0.011
Size – Small	*reference*	*reference*	*reference*	*reference*
Medium	0.018	0.016	0.019	0.014
Large	0.076*	0.077*	0.087*	0.077*
Export share	0.003**	0.003**	0.003**	0.003**
Foreign owned		−0.001	−0.003	−0.001
Price set by foreign parent		0.152*	0.142*	0.155*
Main customer type				
Households			−0.041	
Business within group			−0.003	
Retailer / wholesaler			−0.073**	
Other business outside group			*reference*	
Government			−0.031	
Productivity rel. to competitors				
Lower				0.062
On par / don't know				*reference*
Higher				0.026
Observations	1281	1281	1281	1281

Note: * Significant at 5 percent level, ** Significant at 1 percent level. Average marginal effects show the percentage point increase in probability of selecting to invoice in respectively currency of destination and vehicle currencies relative to choosing to invoice in New Zealand dollars of a one unit increase in the explanatory variable. Underlying estimation coefficients given in table 9 in the appendix.

ing. However, when the price setter is also taken into account, firms where the foreign parent sets the price are 15 percent more likely to use vehicle currencies than where the foreign-owned firm sets its own price.

Column (3) includes the firm's main customer type as an additional explanatory variables, using a dummy variable equal to 1 if the firm ticked the respective customer type as its main customer, and 0 otherwise.[6] Beyond firms selling to retailers / wholesalers being less likely to use vehicle currencies, customer type appears to have little impact on the choice of invoice currency.

Column (4) includes the impact of firm perceptions of productivity relative to competitors on currency choice. We use the responses made by firms in an earlier part of the survey on their perceptions of relative productivity. Firms were given four options: *lower than competitors*, *on a par with competitors*, *higher than competitors* and *don't know*. Fabling et al. (2012) demonstrate that firm responses to the BOS on their perceptions of relative productivity are representative of actual productivity differentials. The included explanatory variables are a dummy variable that takes the value of 1 if the firm believes its productivity to be lower than its competitors and zero otherwise, and the equivalent for firms that believe they have higher productivity than their competitors. The results show that productivity has no significant impact on the choice of currency of invoice.

4.2 Pricing across markets

Firms were asked whether the New Zealand dollar price of their main product was the same across different countries, including sales in New Zealand and all export markets. Responses were roughly evenly split between those firms that had the same price across markets and those that differentiated, with 48 percent differentiating (table 6). The share of firms differentiating is markedly lower than the recent UK survey where three quarters of firms differentiated prices between foreign markets (Greenslade and Parker, 2010, p.26), but in line with the euro area, where approximately 50 percent of firms differentiate prices across markets (Fabiani et al., 2006, p.21). As noted previously, there are a number of firms that sell to tourists, but do not self identify as exporters. Assuming those firms set the same price to domestic and tourists, the overall share of exporters that do not differentiate increases

[6] Firms were asked to select *one* main customer type, but a small number ticked more than one option. These multiple responses have been maintained.

Table 6
Proportion of firms where the price (in New Zealand dollars) is not the same across countries

	%		%
Firm size		**Productivity relative to competitors**	
Small	45	Lower	57
Medium	51	On par / don't know	44
Large	61	Higher	54
Sector		**Invoice currency**	
Primary	75	Currency of destination	64
Manufacturing	50	New Zealand dollar	29
Distribution	37	US dollar	68
Business services	42	Other vehicle	62
Overall	**48**	**Employment weight**	**57**

to around three quarters – in line with the recent UK survey.

Larger firms are more likely to differentiate prices – 61 percent of large firms differentiated compared with 45 percent of small firms. Weighted by employment shares, 57 percent of firms differentiated price across markets. In terms of sectors, firms in manufacturing are split evenly, but firms in the distribution and business services sectors are more likely to have the same New Zealand dollar price across countries. The striking finding is that three quarters of firms in the primary sector differentiate prices. This is a higher share than any other industry, and in contradiction to the assumption made in previous surveys that prices in this sector are determined by the balance of international supply and demand.

There is a strong, but not perfect, correlation between currency of invoice and the decision to differentiate prices. 71 percent of firms that invoice in New Zealand dollars charge the same price to all countries. Conversely around two thirds of firms that invoice in other currencies differentiate prices.

To understand the joint influence of firm characteristics on the decision to differentiate prices between markets, we carry out a number of probit regressions. The explanatory variable is a dummy variable that takes the value of 1 if the firm differentiates the price of its main product across markets and a value of 0 otherwise. The reference firm is a small manufacturer selling to businesses outside its group other than retailers or wholesalers. The results are unweighted, and full parameter estimates of the underlying probit

models are included in the appendix. The probits are estimated using White (1980) robust standard errors. Table 7 shows the average marginal effects from these regressions.

Column (1) provides the average marginal effects from a probit model that uses the sector the firm operates in, firm size and the share of output that is exported as explanatory variables. Larger firms are more likely to differentiate prices, with a medium-sized firm 11 percent more likely to differentiate prices than a small firm, and a large firm 20 percent more likely to differentiate. That larger firms are more likely to price to market is consistent with the implications of the model of Atkeson and Burstein (2008), and recent empirical studies of the influence of firm characteristics on the decision to price to market. Firms are more likely to differentiate prices the greater the share of their output that is exported. A 10 percentage point increase in the share of output that is exported increases the likelihood of differentiating prices by 2 percent.

The sector that the firm operates in has an important influence on the decision to differentiate prices. Firms operating in other industry and personal services are less likely than manufacturers to differentiate prices. Conversely firms in the primary sector are more likely to differentiate, even taking into account firm size and export share. This result appears somewhat counter-intuitive since primary products are normally assumed to be homogenous commodities with the price set by the balance of international supply and demand. Indeed, earlier surveys of price setting explicitly excluded primary firms on the basis of this assumption (see e.g. Blinder et al., 1998; Fabiani et al., 2006; Greenslade and Parker, 2010).

There are a number of candidate explanations for why New Zealand primary firms are more likely to differentiate prices. First, as noted in section 2, New Zealand has a large share of world exports of a number of its main primary exports, including milk powder, lamb meat and kiwifruit. In both the models of Atkeson and Burstein (2008) and Amiti et al. (2014), a larger market share results in a greater degree of price differentiation.

The second explanation relates to the nature of New Zealand's main primary exports. Primary exports are generally assumed to be homogenous and invariant to origin – a copper rod is the same worldwide irrespective of where the ore was mined. Crude oil varies along two principal dimensions: viscosity and sulphur content. Agricultural products, conversely, have the potential for a wider differentiation along a number for dimensions, including appearance, taste, and inputs used. Auer and Chaney (2009) develop a model where even under perfect competition differing tastes of consumers can lead

Table 7
Average marginal effects of firm characteristics on pricing to market

	(1)	(2)	(3)	(4)
Sector				
Manufacturing	*reference*	*reference*	*reference*	*reference*
Primary	0.126*	0.128*	0.127*	0.116*
Other industry	−0.207*	−0.152	−0.159	−0.136
Distribution	−0.062	−0.060	−0.063	−0.066
Business services	−0.067	−0.037	−0.042	−0.016
Personal services	−0.145*	−0.110	−0.112	−0.038
Size				
Small	*reference*	*reference*	*reference*	*reference*
Medium	0.105**	0.101**	0.100**	0.081*
Large	0.200**	0.192**	0.192**	0.171**
Export share	0.002**	0.002**	0.002**	0.001*
Main customer				
Households		−0.046	−0.047	−0.008
Business within group		−0.011	−0.008	0.008
Retailer / wholesaler		0.070*	0.073*	0.083**
Other business outside group		*reference*	*reference*	*reference*
Government		−0.070	−0.070	−0.084
Productivity rel. to competitors				
Lower			−0.005	−0.018
On par / don't know			*reference*	*reference*
Higher			0.069*	0.058*
Invoice currency				
Destination market				0.278**
New Zealand dollars				*reference*
Vehicle currency				0.268**
Observations	1281	1281	1281	1281
Observed frequency	53	53	53	53
Predicted frequency	58	57	57	57
Log likelihood	-837	-833	-830	-780
Pseudo R^2	0.05	0.06	0.06	0.12
Pearson Chi^2	560 (0.14)	869 (0.14)	1020 (0.21)	1140 (0.27)

Note: * Significant at 5 percent level, ** significant at 1 percent level. Average marginal effects show the percentage increase in the probability of choosing to differentiate prices of a one unit increase in the explanatory variable. Underlying estimation coefficients given in table 11 in the appendix.

to pricing-to-market behaviour, with PTM more prevalent for higher quality goods.

There are a number of examples where this applies to New Zealand's agricultural exports. New Zealand lambs are free range, grass fed, are not injected with growth hormones and the geographic isolation has protected New Zealand from diseases such as scrapie and foot and mouth. This allows the lamb meat to be marketed overseas as a clean, green brand (Clemens and Babcock, 2004). Exports of infant formula to China increased markedly after the 2008 Sanlu scandal, where a Chinese-based company mixed melamine with infant formula, resulting in six deaths and 50,000 babies hospitalised. New Zealand infant formula was seen as a 'safe' source, with New Zealand formula reaching prices of $70 in China, compared with $20 in the domestic market (Galtry, 2013). Zespri focuses on the health benefits when marketing kiwifruit, and its own market research has indicated that repeat sales are heavily influenced by customer experiences of taste and consistency (Zespri, 2010, p. 15). Zespri also has a large research programme to establish new cultivars, such as the gold kiwifruit SunGold®, which receives a much higher return than the standard green cultivar.

Column (2) provides the average marginal effects from a probit model that also includes the main customer type of the firm. The reference category is a business outside the firm's group, other than a retailer or wholesaler. For the most part, the type of main customer has little bearing on the decision to differentiate prices, the sole exception being firms that mainly sell to retailers and wholesalers. Such firms are 7 percent more likely to differentiate prices than those selling to other types of firm. This finding is in line with the model of Corsetti and Dedola (2005), where the presence of additive distribution costs result in variable mark-ups at the producer level.

Recent research on the impact of firm characteristics has highlighted the role of productivity in the decision to differentiate prices. Column (3) shows the results from a model that includes dummy variables for firms with lower and higher productivity relative to their competitors, as used in the multinomial probit in section 4.1. In line with the previous findings in the literature, high productivity firms are more likely to differentiate prices, by 7 percent relative to firms who perceive their productivity to be on a par with their competitors.

Finally, column (4) presents the results from a probit model that additionally includes the currency of invoice as explanatory variables. The reference category is invoicing in New Zealand dollars. We include a dummy variable that takes the value of 1 if the firm invoices in the currency of the destination and

0 otherwise and another dummy variable which takes the value of 1 if the firm invoices in US dollars or other vehicle currencies and 0 otherwise. For both invoicing dummy variables, the firms that invoiced in currencies other than New Zealand dollars were markedly more likely to differentiate prices, even when controlling for the other characteristics discussed above. The strength of the marginal response does suggest that the decisions on whether to differentiate prices and the currencies of invoice are related and not independent. Given this potential endogeneity, the exact coefficient estimates should be treated with caution.

Throughout the individual models presented in table 7 there are a number of consistent conclusions that can be drawn on the firm characteristics that bear on the decision to differentiate prices. In keeping with the recent literature on the subject, we find that firms that are larger, export a greater share of their production, sell to retailers or wholesalers and are more productive are more likely to differentiate prices. In contrast to the literature, we also find that firms in the primary sector are more likely to differentiate prices than other types of firms, even when accounting for these other firm characteristics.

4.3 Factors influencing price differentiation across markets

Those firms that differentiate were asked to indicate the importance of a number of potential factors for determining price in the foreign market, rating each of the given list of factors as *not important*, *moderately important*, *very important*, or *don't know*.

The factors most commonly cited as being 'very important' for determining prices are exchange rate movements, the level of competition in the market and transport costs (table 8). These three factors rank highest across sectors and firm sizes. Tax system of destination market was the factor least recognised as being 'very important' for determining price. Customer characteristics and cyclical fluctuations in demand are important for primary firms, but less so for firms in other sectors.

5 Conclusion

This paper studies how exporters set prices, focusing in particular on the decisions over which currency to use for invoicing and whether to price to

Table 8
What determines prices across countries?

	1	2	3	4	5	6	7	8
Firm size								
Small	71	55	45	41	39	37	36	15
Medium	67	60	54	35	37	37	33	20
Large	64	62	51	36	32	37	32	16
Sector								
Primary	79	74	55	59	61	66	66	23
Manufacturing	70	58	51	33	32	29	23	13
Distribution	63	48	53	35	31	27	28	36
Business services	59	43	24	24	20	16	17	17
Overall	69	57	48	39	37	37	35	17
Employment weight	63	61	50	39	35	42	35	17

Note: Share of firms that differentiate across markets citing factor as 'very important'.

1: Exchange rate movement
2: Level of competition in the market
3: Transport costs
4: Regulations
5: Tariff
6: Customer characteristics
7: Cyclical fluctuation in demand
8: Tax system of destination market

market. It uses the responses to a large behavioural survey of New Zealand exporters, an alternative, complementary approach to the widespread use of unit-record customs data in the literature. The survey asks firms to consider prices in both the domestic and all foreign markets, allowing for a more accurate study of pricing to market than the straight use of customs data, which does not consider the domestic market.

The analysis here demonstrates that firm characteristics play a statistically significant role in the decision to differentiate prices. Larger firms are more likely to price to market, as are more productive ones. Conversely, once other characteristics are taken into account, the sector that the firm operates in has no significant impact on the likelihood that a firm differentiates prices between countries, with the exception of firms in the primary sector. That primary sector firms price to market (let alone are *more* likely to do so than firms in other sectors) contrasts sharply with the widely held assumption that these products are priced in international markets.

Since customs data relies on the physical shipment of goods, the literature is silent on the export pricing behaviour of service sector firms, who represent a large share of exports of developed economies. We demonstrate that these firms do price to market, although their behaviour is not significantly different from those of manufacturers.

Finally, the survey responses enable a better understanding of the factors that influence firms' decisions on pricing in foreign markets. Exchange rate movements are the most cited factor as being very important for determining the price within market. The level of competition in the market and transport costs are also widely recognised. Cyclical fluctuations in demand and the tax system of the destination market are less widely recognised as being very important for setting the price within market.

References

Amiti, M., O. Itskhoki, and J. Konings (2014, July). Importers, Exporters, and Exchange Rate Disconnect. *American Economic Review 104*(7), 1942–78.

Atkeson, A. and A. Burstein (2008, December). Pricing-to-Market, Trade Costs, and International Relative Prices. *American Economic Review 98*(5), 1998–2031.

Auer, R. and T. Chaney (2009, 02). Exchange Rate Pass-Through in a Competitive Model of Pricing-to-Market. *Journal of Money, Credit and Banking 41*(s1), 151–175.

Berman, N., P. Martin, and T. Mayer (2012). How do Different Exporters React to Exchange Rate Changes? *The Quarterly Journal of Economics 127*(1), 437–492.

Betts, C. and M. B. Devereux (1996, April). The exchange rate in a model of pricing-to-market. *European Economic Review 40*(3-5), 1007–1021.

Blinder, A. S., E. Canetti, D. Lebow, and J. Rudd (1998). *Asking About Prices: a New Approach to Understanding Price Stickiness*. New York: Russell Sage Foundation.

Burstein, A. and G. Gopinath (2013, February). International Prices and Exchange Rates. NBER Working Papers 18829, National Bureau of Economic Research, Inc.

Chatterjee, A., R. Dix-Carneiro, and J. Vichyanond (2013, May). Multi-product Firms and Exchange Rate Fluctuations. *American Economic Journal: Economic Policy 5*(2), 77–110.

Clemens, R. and B. A. Babcock (2004, November). Country of Origin as a Brand: The Case of New Zealand Lamb. Midwest Agribusiness Trade

Research and Information Center (MATRIC) Publications 04-mbp9, Midwest Agribusiness Trade Research and Information Center (MATRIC) at Iowa State University.

Corsetti, G. and L. Dedola (2005, September). A macroeconomic model of international price discrimination. *Journal of International Economics 67*(1), 129–155.

Devereux, M. B., C. Engel, and P. E. Storgaard (2004, July). Endogenous exchange rate pass-through when nominal prices are set in advance. *Journal of International Economics 63*(2), 263–291.

Devereux, M. B. and S. Shi (2013, 02). Vehicle Currency. *International Economic Review 54*(1), 97–133.

Donnenfeld, S. and A. A. Haug (2008). Currency invoicing of US imports. *International Journal of Finance & Economics 13*(2), 184–198.

Dornbusch, R. (1987, March). Exchange Rates and Prices. *American Economic Review 77*(1), 93–106.

Fabiani, S., M. Druant, I. Hernando, C. Kwapil, B. Landau, C. Loupias, F. Martins, T. Math, R. Sabbatini, H. Stahl, and A. Stokman (2006, September). What Firms' Surveys Tell Us about Price-Setting Behavior in the Euro Area. *International Journal of Central Banking 2*(3), 3–47.

Fabling, R. and A. Grimes (2015, 04). Over the Hedge: Do Exporters Practice Selective Hedging? *Journal of Futures Markets 35*(4), 321–338.

Fabling, R., A. Grimes, and P. Stevens (2012, May). The relatives are fine: use of qualitative firm data in economic analysis. *Applied Economics Letters 19*(7), 615–618.

Fabling, R. and L. Sanderson (2015, 02). Export Performance, Invoice Currency and Heterogeneous Exchange Rate Pass-through. *The World Economy 38*(2), 315–339.

Fitzgerald, D. and S. Haller (2014). Pricing-to-Market: Evidence From Plant-Level Prices. *Review of Economic Studies 81*(2), 761–786.

Friberg, R. and F. Wilander (2008, May). The currency denomination of exports – A questionnaire study. *Journal of International Economics 75*(1), 54–69.

Galtry, J. A. (2013, November). Improving the New Zealand dairy industrys contribution to local and global wellbeing: the case of infant formula exports . *New Zealand Medical Journal 126*(1386), 82–89.

Goldberg, L. S. and C. Tille (2008, December). Vehicle currency use in international trade. *Journal of International Economics 76*(2), 177–192.

Goldberg, L. S. and C. Tille (2009). Micro, macro, and strategic forces in international trade invoicing. Technical report.

Goldberg, L. S. and C. Tille (2013, April). A Bargaining Theory of Trade Invoicing and Pricing. NBER Working Papers 18985, National Bureau of Economic Research, Inc.

Gopinath, G., O. Itskhoki, and R. Rigobon (2010, March). Currency Choice and Exchange Rate Pass-Through. *American Economic Review 100*(1), 304–36.

Greene, W. H. (2012). *Econometric analysis /* (7th ed. ed.). Boston :: Prentice Hall,.

Greenslade, J. and M. Parker (2010, July). New insights into price-setting behaviour in the United Kingdom. Bank of England working papers 395, Bank of England.

Ito, T., S. Koibuchi, K. Sato, and J. Shimizu (2012). The choice of an invoicing currency by globally operating firms: A firm-level analysis of Japanese exporters' invoicing behavior. *International Journal of Finance and Economics 17*(4), 305–320.

Krugman, P. (1987). Pricing to market when the exchange rate changes. In S. Arndt and J. Richardson (Eds.), *Real-financial linkages among open economies*, pp. 49–70. Cambridge, MA: The MIT Press.

Li, H., H. Ma, and Y. Xu (2015). How do exchange rate movements affect Chinese exports? – A firm-level investigation. *Journal of International Economics*, forthcoming.

Martin, J. and I. Méjean (2012, October). Invoicing Currency, Firm Size, and Hedging. Working Papers 2012-28, CEPII research center.

Parker, M. (2014, July). Price-setting behaviour in New Zealand. Reserve Bank of New Zealand Discussion Paper Series DP2014/04, Reserve Bank of New Zealand.

Statistics New Zealand (2011). *Global New Zealand: year ended December 2010*. Wellington, NZ: Statistics New Zealand.

USDA (2014, December). Dairy: World Markets and Trade. Technical report, United States Department of Agriculture.

White, H. (1980, May). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica 48*(4), 817–38.

Zespri (2010). *Annual Review 2009/10*. Zespri International Limited.

Appendices

A Appendix - Probit estimation

This appendix briefly outlines the estimation of probit models.[7] The basic probit model is used in situations where the variable in question has two possible outcomes (typically denoted 0 and 1). For example, in section 4.2 we model the firm's choice between charging the same price to all markets, or differentiating prices. The model assumes that the choice, Y is a function of a number of explanatory factors, X specifically:

$$\Pr(Y = 1 \mid X) = \Phi(X'\beta) \tag{1}$$

where Pr is the probability and Φ is the cumulative normal distribution. An alternative way of expressing (1) is to assume there is some unobserved, latent variable, Y^*, such that

$$Y^* = X'\beta + \epsilon \tag{2}$$

where $\epsilon \sim N(0, 1)$. Then Y is an indicator of whether the latent variable Y^* is positive:

$$Y = \begin{cases} 1 & \text{if } Y^* > 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

The log likelihood function for a sample of n observations, $\{y_i, x_i\}_{i=1}^n$, is given by:

$$\ln L = \sum_{i=1}^{n} \Big(y_i \ln \Phi(x_i'\beta) + (1 - y_i) \ln \big(1 - \Phi(x_i'\beta)\big) \Big) \tag{4}$$

Maximum likelihood estimation is used to derive an estimate for β. The coefficients from these estimations follow in this appendix. However, since the coefficients from these estimations refer to the effect of the explanatory variables on the latent variable, their interpretation is not straightforward. Instead we prefer to present the average marginal effect (see tables 4, 5 and 7), which is to say the effect that changing the explanatory has on the probability of choosing outcome 1, averaged across all observations. These marginal effects are expressed as the change in probability associated with a one unit change in the explanatory variable.

[7] See Greene (2012, ch. 17) for a more detailed description.

Table 9
Invoice currency mulitnomial probit – currency of destination coefficients

	(1)	(2)	(3)	(4)
Primary	−0.184	−0.220	−0.228	−0.219
	(0.229)	(0.228)	(0.231)	(0.228)
Other industry	−0.773	−0.713	−0.786	−0.717
	(0.478)	(0.479)	(0.472)	(0.476)
Distribution	−0.507**	−0.406*	−0.378*	−0.409*
	(0.163)	(0.165)	(0.166)	(0.166)
Business services	−0.376**	−0.339*	−0.361*	−0.346*
	(0.144)	(0.146)	(0.153)	(0.146)
Personal services	−1.529**	−1.521**	−1.369**	−1.515**
	(0.334)	(0.343)	(0.351)	(0.342)
Medium	0.304*	0.391**	0.349*	0.387**
	(0.139)	(0.141)	(0.142)	(0.141)
Large	0.167	0.337*	0.297	0.338*
	(0.157)	(0.162)	(0.165)	(0.162)
Export share	0.014**	0.015**	0.016**	0.015**
	(0.002)	(0.002)	(0.002)	(0.002)
Foreign owned		−0.605**	−0.603**	−0.603**
		(0.138)	(0.138)	(0.138)
Foreign parent sets prices		−0.048	−0.008	−0.044
		(0.384)	(0.385)	(0.383)
Households			−0.555*	
			(0.219)	
Business within group			−0.221	
			(0.188)	
Retailer / wholesaler			−0.018	
			(0.120)	
Government			0.302	
			(0.277)	
Lower productivity				0.164
				(0.229)
Higher productivity				0.117
				(0.123)
Constant	−0.663**	−0.641**	−0.577**	−0.681**
	(0.144)	(0.145)	(0.157)	(0.149)
Observations	1281	1281	1281	1281
Log likelihood	-1260	-1246	-1237	-1245

*, ** significant at 5 percent and 1 percent level respectively.
White (1980) robust standard errors in parentheses.

Table 10
Invoice currency multinomial probit – vehicle currency coefficients

	(1)	(2)	(3)	(4)
Primary	0.552*	0.545*	0.545*	0.549*
	(0.218)	(0.218)	(0.221)	(0.219)
Other industry	0.209	0.202	0.116	0.206
	(0.380)	(0.380)	(0.408)	(0.382)
Distribution	−0.416*	−0.382*	−0.358*	−0.388*
	(0.179)	(0.181)	(0.181)	(0.181)
Business services	−0.159	−0.185	−0.270	−0.192
	(0.151)	(0.153)	(0.159)	(0.153)
Personal services	−0.604	−0.627	−0.587	−0.610
	(0.324)	(0.320)	(0.325)	(0.320)
Medium	0.228	0.254	0.251	0.244
	(0.147)	(0.148)	(0.150)	(0.149)
Large	0.400*	0.485**	0.513**	0.487**
	(0.162)	(0.167)	(0.171)	(0.167)
Export share	0.020**	0.0208**	0.020**	0.020**
	(0.002)	(0.002)	(0.002)	(0.002)
Foreign owned		−0.299*	−0.305*	−0.297*
		(0.141)	(0.142)	(0.141)
Foreign parent sets price		0.634	0.619	0.654*
		(0.333)	(0.336)	(0.333)
Households			−0.450*	
			(0.223)	
Business within group			−0.120	
			(0.190)	
Retailer / wholesaler			−0.328*	
			(0.131)	
Government			0.012	
			(0.297)	
Lower productivity				0.349
				(0.230)
Higher productivity				0.171
				(0.128)
Constant	−1.216**	−1.179**	−1.007**	−1.241**
	(0.154)	(0.154)	(0.167)	(0.159)
Observations	1281	1281	1281	1281
Log likelihood	-1260	-1246	-1237	-1245

*, ** significant at 5 percent and 1 percent level respectively.
White (1980) robust standard errors in parentheses.

Table 11
Differentiation across markets probit coefficients

	(1)	(2)	(3)	(4)
Primary	0.346*	0.353*	0.351*	0.337*
	(0.146)	(0.148)	(0.147)	(0.154)
Other industry	−0.551*	−0.404	−0.423	−0.388
	(0.273)	(0.281)	(0.280)	(0.278)
Distribution	−0.162	−0.158	−0.166	−0.066
	(0.109)	(0.110)	(0.110)	(0.115)
Business services	−0.174	−0.098	−0.110	−0.045
	(0.094)	(0.098)	(0.098)	(0.100)
Personal services	−0.381*	−0.290	−0.296	−0.108
	(0.188)	(0.193)	(0.191)	(0.192)
Medium	0.277**	0.267**	0.267**	0.230∗
	(0.091)	(0.092)	(0.092)	(0.093)
Large	0.531**	0.512**	0.513**	0.489**
	(0.103)	(0.105)	(0.105)	(0.107)
Export share	0.006**	0.006**	0.006**	0.003∗
	(0.001)	(0.001)	(0.001)	(0.001)
Households		−0.124	−0.126	−0.0243
		(0.132)	(0.131)	(0.137)
Businesses within group		−0.031	−0.022	0.024
		(0.117)	(0.117)	(0.120)
Retailers and wholesalers		0.189*	0.196*	0.238**
		(0.079)	(0.079)	(0.082)
Government		−0.189	−0.188	−0.241
		(0.185)	(0.184)	(0.185)
Lower productivity			−0.012	−0.053
			(0.155)	(0.163)
Higher productivity			0.185*	0.168*
			(0.0802)	(0.0818)
Destination currency				0.801**
				(0.091)
Vehicle currency				0.772**
				(0.097)
Constant	−0.355**	−0.421**	−0.474**	−0.839**
	(0.095)	(0.103)	(0.106)	(0.115)
Observations	1281	1281	1281	1281
Log likelihood	-837	-833	-830	-780
Pseudo R^2	0.05	0.06	0.06	0.12
Pearson Chi^2	560 (0.14)	869 (0.14)	1020 (0.21)	1140 (0.27)

*, ** significant at 5 percent and 1 percent level respectively.
White (1980) robust standard errors in parentheses.

B Appendix - survey questionnaire

Section C: Price and Wage Setting

1 Section C should be completed by the General Manager

Definition

2 The following section asks about factors that are important when this business reviews and sets prices. To answer these questions, apply the following definition.

Main product: The product (good or service) or product group from which this business gets its largest share of revenue.

If this business does not have a main product (eg in the case of large-format retail stores), provide answers that are most representative of this business's price-setting process.

Exporting

25 **During the last financial year, did this business have any sales of goods or services that came from exports?**

- o yes → go to **26**
- o no → go to **32**

26 For the following questions, the **New Zealand dollar price** refers to the price of the product when converted to New Zealand dollars.

27 **Is the New Zealand dollar price of this business's main product the same across different countries?**
Include sales in New Zealand and all export markets

- o yes → go to **29**
- o no → go to **28**

28 **Mark one oval for each item listed. How important are the following factors in determining differences in the New Zealand dollar price across countries?**

	not important	moderately important	very important	don't know
exchange rate movements	o	o	o	o
tariffs	o	o	o	o
tax system of the destination market	o	o	o	o
customer characteristics (eg consumer tastes, standards of living)	o	o	o	o
cyclical fluctuations in demand (eg markets are at different points in the business cycle)	o	o	o	o
level of competition in the market	o	o	o	o
regulations	o	o	o	o
transport costs	o	o	o	o

29 **Mark one oval. What is the predominant currency of invoice for this business's export market contracts?**

- o currency of the destination market (eg Australian dollars when exporting to Australia)
- o New Zealand dollar
- o United States dollar
- o other

30 **How high would the New Zealand dollar have to appreciate before this business would raise prices?**

percent appreciation in the New Zealand dollar ___%

or
- o appreciations are always passed on to export prices because the New Zealand dollar price is held fixed → go to **32**
- o there is no scope to raise export prices → go to **32**

31 **Would the resulting rise in export prices <u>match</u> the exchange rate appreciation recorded in question 30?**

- o yes
- o no, the rise in export prices would be smaller
- o no, the rise in export prices would be larger