Export Performance, Invoice Currency, and Heterogeneous Exchange Rate Pass-Through

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Abstract

Using comprehensive, shipment-level merchandise trade data, we examine the extent to which New Zealand exporters maintain stable New Zealand dollar prices by passing on exchange rate changes to foreign customers. We find that the extent to which firms absorb exchange rate fluctuations in the short run is significantly related to both invoice currency choice and exporter characteristics when these are analysed separately. However, when jointly accounted for, the role of exporter characteristics largely disappears. That is, some firm types are more inclined to invoice in the New Zealand dollar, while others use either the importer or a third currency. In the short run, this translates into differences in exchange rate pass-through because of price rigidity in the invoice currency. Differences across invoice currencies diminish, but do not disappear, over time as prices adjust to reflect bilateral exchange rate movements.

JEL codes

D12, F14, F31

Keywords

Exchange rate pass-through; firm performance

1 Introduction

Using comprehensive, shipment-level trade data, we examine the extent to which New Zealand exporters maintain stable New Zealand dollar prices by passing on exchange rate changes to foreign customers. That is, we consider exchange rate pass-through (ERPT) from the perspective of the exporter. While it is more common to consider ERPT from the importer's perspective, our aim is to inform debate on the role of exchange rate fluctuations in New Zealand exporter performance.

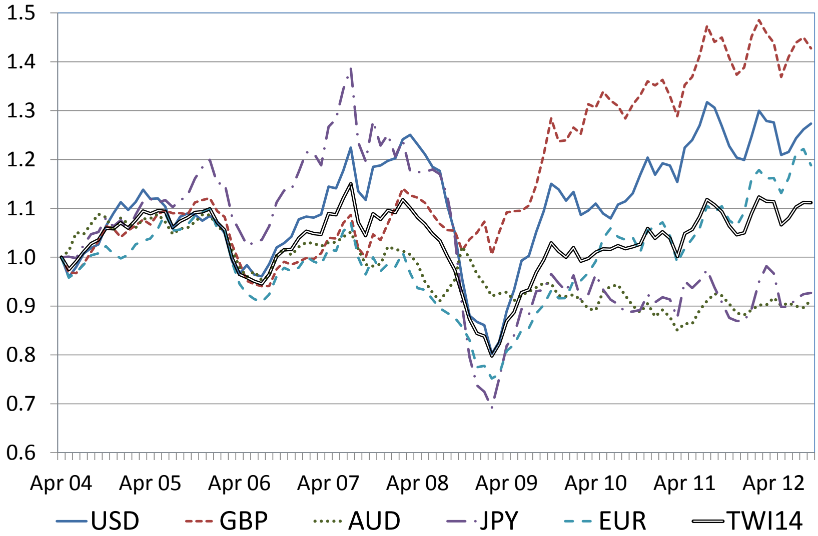
Over the period we consider, New Zealand experienced substantial fluctuations in bilateral exchange rates (figure 1). Bilateral currency swings of 20 to 30 percent were not unusual, motivating concerns about the sustainability of New Zealand-based export businesses at times of exchange rate appreciation. In large scale business surveys conducted in 2007 and 2011, exchange rate levels and volatility were the two most commonly cited challenges among firms with current overseas income (Statistics New Zealand 2012). Economic and political commentators have argued strongly for changes in the exchange rate regime to support export growth (Oram 2012; Tarrant 2012; NZMEA 2012). However, there is little New Zealand-based empirical evidence on the mechanisms through which exchange rate changes affect export (and exporter) performance. This paper takes a step towards filling this gap by estimating the extent to which exchange rate movements affect the New Zealand dollar (NZD) price received by exporters.[1]

Our approach builds directly on two recent microeconomic papers on ERPT. Using firm-level Customs and balance sheet data for French exporters, Berman et al. (2012) show that high-performing firms (those with relatively high productivity, export intensity, and with exports to a wide range of countries) tend to absorb exchange rate changes into their margins, while low-performing firms pass on a larger proportion of exchange rate fluctuations to their offshore customers which, in turn, impacts on sales volumes.

Meanwhile, Gopinath et al. (2010) consider the extent of ERPT to US import prices using longitudinal survey data. They examine differences in ERPT according to whether the currency of invoice is US dollars (USD) or not. They find that while both dollar and non-dollar invoiced goods show substantial nominal price stickiness in the short run, the degree of

[1] A complete picture of the impact of exchange rates on exporters would also need to address the impact of price changes on the extensive (entry/exit) and intensive (volume) margins of trade, market-switching, a theory of currency choice, and to take account of hedging mechanisms in place (including the costs of these).

Figure 1: Exchange rate index, April 2004 - December 2012



price adjustment in the long run differs across invoice currencies. Observed over the life of the good, goods priced in non-USD currencies continue to exhibit almost complete pass-through to USD prices – that is, the value received by the exporter remains almost entirely unaffected by exchange rate changes. In contrast, exporters invoicing in USD adjust their received value over time so that the change in the USD price reflects almost half the observed exchange rate movement. Gopinath et al. (2010) then use these findings to motivate a model of endogenous currency choice, in which exporters select their invoice currency in order to most closely reflect optimal prices during periods between price adjustments.

This paper draws a link between the two papers above by conditioning on both invoice currency and exporter performance, while extending the analysis of Gopinath et al. (2010) to distinguish between three invoicing options – producer currency (ie, NZD-denominated), local currency (denominated in the currency of the importing country), and vehicle currency (denominated in a third currency, predominantly the USD) – each of which is used by a substantial share of exporters. We first confirm that both short-run and long-run exchange rate pass-through differ by invoice currency. We then show that, within currency groups, there is little evidence for differential pass-through behaviour according to key firm or product characteristics. We relate this finding to the work of Berman et al. (2012) by showing that a negative relationship between pass-through and firms' export performance arises when invoice currencies are not controlled for. That is, the strong relationship found by Berman et al. (2012) may be driven by different invoicing strategies or opportunities across different types of firms, with lower value exporters being more likely to use producer currency pricing, which is in turn associated with greater pass-through to import prices.

The paper proceeds as follows. Section 2 reviews the relevant literature on ERPT. Section 3 outlines the specifics of our dataset, while sections 4 and 5 present descriptive and regression results respectively. Section 6 concludes.

2 Literature review

Goldberg and Knetter (1997) and Goldberg and Hellerstein (2008) review the micro-foundations of ERPT from the perspective of import prices. Exporters set prices in their domestic currency (the producer currency) and those prices depend on costs and the firms' mark-up (because firms are imperfectly competitive they are able to price above marginal cost). The exchange rate at time t enters the equation for the export price denominated in the local (importer's) currency. ERPT is defined as "the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries" (Goldberg and Knetter 1997, p.1248).

Complete ERPT occurs when the variation in the local currency price of the good mirrors the change in the exchange rate. Incomplete pass-through occurs when a change in a bilateral exchange rate is not completely transmitted into the local currency price of a traded good. Symmetrically, incomplete pass-through implies that some part of the exchange rate movement is absorbed by the exporter, through variation in the received unit price, while complete pass-through implies that the exporter does not absorb any of the exchange rate variation. Whether this has a positive or negative effect on exporters' returns will depend on the direction of the exchange rate change, as well as any impact on the volume of exports.

There are several theoretical explanations for incomplete pass-through, at least in the short run. Some of these reasons – pricing-to-market, menu costs, and implicit or explicit contracts with offshore customers – have direct implications for the profitability of the exporting firm. Others imply that the pressure to adjust prices in response to exchange rate fluctuations may be muted for some firms, for example through explicit exchange rate hedging or compensatory changes in the cost of imported inputs. A final set of factors suggest that traditional ERPT measures based on aggregate data may be biased due to an inability to identify changes in the composition or quality of the exported goods over time. In this section we briefly review the empirical literature on ERPT and pricing-to-market, with a focus on firm- and product-level studies.

2.1 Variable mark-ups – pricing-to-market and strategic interaction

One widely cited explanation for incomplete pass-through is the Krugman (1987) (and Dornbusch 1987) pricing-to-market (PTM) model of firms' price-setting behaviour in relation to changes in exchange rates. In a monopolistically competitive environment, firms adjust their mark-up depending on the elasticity of demand for their good in the destination market. For example, if firms are reluctant to lose market share, they will lower their mark-up when the exporter's exchange rate appreciates against the importing country.[2] In turn, empirical findings of PTM have been used to provide support for models of imperfect competition and market segmentation (Goldberg and Knetter 1997).

Knetter (1989) proposes a reduced form specification for estimating ERPT, distinguishing between changes in marginal costs and variable mark-ups by exploiting data on the shipments of goods to multiple destinations. If firms use imported goods that are affected by exchange rate movements as inputs, and inputs represent a constant cost increase or decrease across all destinations for a product, the component of a price change due to marginal cost will be the same across destinations, whereas mark-ups are destination-specific. Knetter (1993) applies this methodology to product-level export data finding that, in aggregate, exporters from the UK, Japan and Germany offset between 36 and 48 percent of exchange rate movements by adjusting their mark-ups, while US exporters pass the exchange rate change through to customers. However, Knetter (1993) notes that patterns of PTM are quite similar across source countries for a given industry, and thus that overall differences in PTM may be related to industry composition, rather than country-specific variation in pricing behaviour.

Fitzgerald and Haller (2012) apply a similar approach using microdata from

[2] Variable mark-ups in the face of changes in marginal costs or exchange rates have also been attributed to strategic interaction between producers. Firms may be unwilling to adjust their prices if they believe that other producers are unlikely to follow suit.

Irish export firms trading the same products domestically and in the UK, with some limited analysis of the role of invoice currency in observed pass-through. They find that when goods are invoiced in local currency (GBP), the relative mark-up across the two markets moves one-for-one with exchange rate fluctuations – that is, exporting firms absorb the full extent of exchange rate changes. In contrast, there is no evidence for mark-ups on goods invoiced in the producer currency (Irish pounds or Euros) being influenced by exchange rate changes. However, the structure of their data prevents robust analysis of producer currency-invoiced trades, as destination data are available only for a cross-section of observations, not the full panel.

Berman et al. (2012) explore the issue of heterogeneous PTM associated with differences in firm performance. They argue that more productive firms are likely to face lower elasticity of demand, leading them to react to exchange rate depreciations by increasing their mark-ups while lower productivity exporters instead pass exchange rate savings through to customers and increase the volume of their exports. Berman et al. (2012) discuss three alternative mechanisms through which this relationship may arise. In a Melitz and Ottaviano (2008) model with linear demand and horizontal product differentiation, the price elasticity of demand increases with the price faced by consumers. As high-productivity firms charge lower prices, these firms face a lower demand elasticity. A real depreciation leads to a fall in the prices faced by consumers, and exporters react by increasing their mark-up.

Atkeson and Burstein (2008) suggest an alternative model in which firms face Cournot competition with nested constant elasticity of substitution across several sectors. If the elasticity of substitution is lower across sectors than within sectors, then the elasticity of demand faced will depend on firms' market share, which is in turn determined by their productivity. In the extreme, a low productivity firm with a market share approaching zero faces a high elasticity of substitution within its own sector, while a high-productivity firm with a market share approaching one faces the lower cross-sectoral elasticity of substitution.

Finally, Berman et al. (2012) develop an extension to the Corsetti and Dedola (2005) model of distribution costs incurred in the local currency. If firms face a per-unit distribution cost payable in the importer currency, a depreciation implies that the production cost accounts for a lower proportion of the consumer price relative to the distribution cost. This reduces the elasticity perceived by the exporter in relation to the export price. High performance exporters again increase their export price more than others. Using detailed data on destination-specific export value and volume for French exporters, Berman et al. (2012) find evidence of heterogeneous PTM, including support for the hypothesis of local currency-denominated distribution costs. Specifically, they use Goldberg and Campa's (2010) estimates of distribution cost by sector and destination interacted with the real exchange rate to show that high distribution costs appear to increase the price elasticity, and decrease the volume elasticity, of exports to exchange rate changes.

In this paper we build on Berman et al.'s (2012) empirical findings, firstly by confirming that heterogeneous PTM is observed among New Zealand exporters, and then by relating this finding to observed invoicing patterns.[3]

2.2 Nominal price stickiness – menu costs and long term contracts

Menu costs of price adjustment and long-term contracts are another common explanation for incomplete ERPT. Menu costs include the administrative, technical and informational costs of deciding on and implementing a price change (see reviews by Ball and Mankiw 1994 and Andersen 1994). These costs prevent firms from immediately reacting to changes in demand or costs, particularly where there is some uncertainty about the magnitude or duration of the change. Explicit contracts, in turn, create rigidity in prices for a specified period of time, delaying firm-level price adjustments in response to exchange rate fluctuations.

If nominal prices are sticky in the currency of invoice then ERPT will be mechanically determined by the choice of currency in the short run. From the perspective of the foreign buyer, contract prices denominated in the producer currency (NZD) will exhibit complete pass-through, those denominated in local (importer) currency will show zero pass-through, and observed pass-through for goods invoiced in vehicle currencies will directly reflect the relative movement of the local and vehicle currencies.

Gopinath and Rigobon (2008) use product-level survey data from US importers to show that rather than pricing reflecting a desire to smooth prices in the buyer's currency, most price stickiness is observed in the currency of invoice. Hence, the ability to identify invoice currency is central to identifying the effect of exchange rates on prices, at least in the short-term (Goldberg

[3]Unlike Knetter (1989), we do not use within-firm destination market comparisons to identify differential mark-ups as the need to restrict to firms which export the same product to multiple markets in the same month would severely limit the representativeness of the analysis.

and Knetter 1997).

The literature on endogenous currency choice suggests a range of factors which may influence the decision to invoice in local, producer or vehicle currencies. For example, currency choices may be driven by a desire to limit transactions costs (eg, Krugman 1984), to minimise volatility (eg, Donnenfeld and Haug 2003), or to maintain stable prices relative to competitors, especially when demand is elastic (eg, Goldberg and Tille 2008).

While invoice currency has traditionally been treated as a choice for the exporting firm, Friberg and Wilander (2008) conclude that, for Swedish exporters, both the price and the currency of invoice are more commonly negotiated with the importer rather than set unilaterally. This process of negotiation implies that relative bargaining power will have an impact on both pricing and currency choice. For example, Goldberg and Tille (2009) find that while large shipments are more likely to be invoiced in local currency (which they argue reflects the larger opportunity cost to the exporter if the sale falls through), countries that provide a dominant share of imports in a particular industry are more likely to invoice in the producer currency. Similarly, Friberg and Wilander (2008) find that large orders, and export sales to large countries, are more likely to be invoiced in the importer's currency.

The choice of invoice currency is an important theme of this paper. We observe clear systematic relationships between invoice currency and firm characteristics, with large exporters and those exporting to multiple countries more likely to invoice in vehicle currencies. Taking currency choice as given, we then examine the impact of exchange rate fluctuations on export unit values within each invoice currency type, ie, producer (NZD), local, and vehicle. Together, this analysis allows us to demonstrate how invoice currency choice is related to ERPT for various firm types, without the need to explicitly model currency choice.

2.3 Explicit and implicit hedging

While some firms may be constrained from adjusting prices in the short run, others may be insulated from the effects of exchange rate fluctuations through explicit hedging, ie, through financial market instruments. Similarly, natural hedges may exist for firms which have substantial reliance on imported inputs, which export in a range of currencies, or which are under foreign ownership.

In this paper we examine whether the price setting behaviour of New Zealand exporters appears to be affected differentially according to the presence of both explicit and natural hedges: whether the firm has a history of hedging exchange rate risk, whether they maintain a portfolio of export currencies, and whether they are foreign owned or controlled.[4] We do not consider imported inputs, as we cannot identify the share of indirect imports in intermediates.

2.4 Product composition and quality

Many studies have estimated the relationship between exchange rate fluctuations and prices using export unit value data at the product-country level. However, this level of aggregation may be problematic for the analysis of ERPT if exchange rate fluctuations are systematically related to product composition. Lavoie and Liu (2007) show that the income effects for foreign consumers associated with an appreciation of the currency will lead them to demand a higher quality version of export goods. This reduces the degree of observed ERPT into local currency unit values, as the fall in the producer currency will be offset by an increase in the average quality, and hence average producer price, of the goods.

Alternatively, if appreciation of the local currency makes a market more attractive for domestic exporters, the heterogeneous quality model of Baldwin and Harrigan (2011) suggests that this will encourage entry among lower quality producers, reducing the average unit value (and hence overestimating the degree of ERPT). Empirical research using aggregate data – even that using highly detailed product classifications – is therefore likely to misrepresent the extent of pass-through in continuing exporters.

We reduce composition concerns as much as practicable given the available data by indexing over firm, good and destination. The next section demonstrates that a substantial proportion of unit value variation is explained by firm, good, and destination controls.[5]

[4] We do not produce estimates according to whether a particular relationship is hedged, as hedging status may change over time in response to exchange rate fluctuations. See Fabling and Grimes (2008) for evidence of this among New Zealand exporters to Australia.

[5] Theoretical work by Bernard et al. (2011) suggests that quality sorting may occur *within* as well as *across* firms. To the extent that New Zealand firms export varieties of differing quality within a product classification some bias may remain in our results.

3 Data

The data used in this paper are sourced from Statistics New Zealand's prototype Longitudinal Business Database (LBD), a firm-level database constructed from a range of administrative and survey sources linked to the Longitudinal Business Frame (see Fabling 2009). In particular, we draw on mandatory shipment-level filings of merchandise trade data provided by the New Zealand Customs Service. This data covers the period from April 2004 to December 2010.[6]

Our unit of observation is the firm-good-destination relationship. This detailed indexing minimises the extent to which results are affected by changes in the composition of traded goods, as we consider only price changes within a specified category of good by an individual seller. Goods are defined using the highly detailed ten-digit Harmonised System (HS10) classification[7] and unit values are calculated as the monthly free-on-board value in New Zealand dollars divided by the quantity exported:

$$P_{fcgt} = \frac{\text{value}_{fcgt}}{\text{volume}_{fcgt}} \tag{1}$$

where f,c,g,t index the firm, destination, good and month respectively. The reported invoice currency value is converted to New Zealand dollars using monthly exchange rate information from the International Monetary Fund's International Financial Statistics. Quantities are measured in standard units that are time-invariant and good-specific (eg, kilograms, litres, or counts).[8]

We observe almost 1.8 million price levels reported by 14,415 exporters.[9] These observations span 164 export destinations and 8,072 distinct goods,

[6]While earlier Customs data are available, April 2004 saw the introduction of mandatory electronic filing of Customs returns, including the comprehensive invoice currency information required for this analysis.

[7]HS10 classifications are concorded over time by grouping together codes which merge or split at any time over the sample period.

[8]For a small proportion of trade, quantity units are not defined by the classification system – primarily because the span of goods in the ten-digit code is not thought to be homogeneous enough to be covered by a single unit of measurement. In such cases we use the shipment weight to derive the volume measure or, where this is not possible, drop observations. Section 4.2 provides support for these product groups being sufficiently homogeneous *within firms* to be included in the analysis.

[9]All firm counts have been random rounded base three, and relationship counts have been graduated random rounded (base 100 for counts over 1,000) in accordance with Statistics New Zealand confidentiality requirements.

giving a comprehensive picture of New Zealand exporter behaviour.[10]

Changes in unit values are calculated across two time horizons. The short-run change is defined as the log difference of two consecutive unit values, adjusted for the number of months (M_t) between trades

$$\Delta_{SR} P_{fcgt} = \frac{1}{M_t} \left(\ln P_{fcg,t} - \ln P_{fcg,t-M_t} \right) . \tag{2}$$

The long-run change in unit value ($\Delta_{LR} P_{fcgt}$) is defined across the lifetime of the good by taking the log difference between the first and last observed unit value within the relationship, following Gopinath et al. (2010), and again adjusting for the number of months between the first and last trade.

Fabling and Sanderson (2010) show that many export relationships at the firm-good-destination level are short-lived. Conversely, some firms may export only intermittently, leading to large gaps between consecutive trades. To prevent long-run ERPT estimates from being affected by short-lived relationships and vice versa, we place restrictions on the gap between trades to be included in each calculation. In order to be included in short-run calculations, consecutive trades must be no more than 6 months apart (ie, $M_t \leq 5$). Symmetrically, to be included in long-run calculations a relationship must span at least six months, when measured between the first and last observed trades. These restrictions lead us to drop 16.7 percent of $\Delta_{SR} P_{fcgt}$ observations, and 21.9 percent of $\Delta_{LR} P_{fcgt}$ observations.[11]

Over the analysis period, the majority of firms (55%) trade in only a single currency. Where firms trade in multiple currencies within a relationship in a month, we allocate the monthly observation to a predominant currency according to the share of (NZD-converted) trade value associated with that currency in the month.[12] We then drop Δ_{SR} observations where consecutive unit values are in different predominant invoice currencies. Δ_{LR} observations are dropped if any Δ_{SR} in the relationship has been dropped. Having coded relationships to invoice currencies, we then distinguish between three

[10] Filing is mandatory for all shipments over NZD1,000 in value. We lose a small proportion of trade associated with destinations without published macroeconomic data.

[11] Including all longer-term trades in the short-run analysis or restricting the long run to relationship lifetimes of one year or longer has no significant effect on the main estimates.

[12] 96 percent of observed short-run price changes involve only a single currency of denomination, while the remaining four percent are allocated to a predominant currency. On average, the predominant currency accounts for 78 percent of the monthly trade value. Even at the 25th percentile, 65 percent of value is in the predominant currency, suggesting that this aggregation is unlikely to affect any results.

Table 1: Invoice currency and destination shares of aggregate trade

Shares by invoice currency			Shares by destination		
	Unweighted	Trade-weighted		Unweighted	Trade-weighted
AUD	0.122	0.091	Australia	0.296	0.218
EUR	0.039	0.069	Eurozone	0.084	0.091
GBP	0.016	0.036	United Kingdom	0.039	0.045
NZD	0.570	0.200			
USD	0.231	0.567	United States	0.074	0.121
Other	0.021	0.038	Other	0.507	0.525

Shares of $\Delta_{SR}P$ observations. Trade weights are the NZD-converted average value over t and $t - M$.

invoice currency groups in subsequent analysis: producer currency (NZD), local currency (the currency of the destination country), and vehicle currencies (primarily the USD).

Alongside information on unit values, we make use of a range of firm- and product-level characteristics to examine heterogeneity in exchange rate responses. The choice and definition of these is discussed in more detail in section 5.

4 Descriptive results

4.1 Heterogeneity in invoice currency

The prevalence of non-producer currency exports provides a point of difference between our study and that of Gopinath et al. (2010). Table 1 compares the share of total trade in each of New Zealand's top five invoice currencies (including the NZD) with the shares of exports going to the destinations most closely associated with those currencies. Table 2 lists a broader set of trade partners (the top 14 as used by the Reserve Bank of New Zealand in its Trade-Weighted Index, TWI14) plus all other countries pooled, showing the proportion of trade with that partner by each invoice currency grouping. Take Australia, New Zealand's largest trade partner, as an example. Australian trade accounts for 29.6 percent of observations and 21.8 percent of export value (table 1). However, the Australian dollar accounts for a much lower proportion of trade (12.2 percent of observations and 9.1 percent of value), due to heavy usage of the New Zealand dollar in trans-Tasman trade (table 2). In value terms, the Australian and New Zealand dollars each account for around 40 percent of trans-Tasman trade, with the remaining 20 percent being primarily invoiced in US dollars.

Table 2: Invoice currency share of trade by destination (TWI14)

	Unweighted				Trade-weighted			
	Producer	Local	Vehicle		Producer	Local	Vehicle	
			USD	Other			USD	Other
Australia	0.562	0.405	0.030	0.003	0.396	0.409	0.194	0.001
Canada	0.318	0.391	0.288	0.003	0.072	0.547	0.380	0.001
China	0.235	0.000	0.729	0.036	0.108	...	0.875	...
Eurozone	0.519	0.363	0.109	0.009	0.158	0.655	0.175	0.011
United Kingdom	0.536	0.400	0.043	0.021	0.198	0.709	0.076	0.018
Hong Kong	0.518	0.015	0.455	0.011	0.236	0.006	0.753	0.004
Indonesia	0.167	0.000	0.829	0.004	...	0.000	0.934	...
Japan	0.458	0.265	0.269	0.009	0.187	0.254	0.554	0.005
South Korea	0.331	0.000	0.665	0.004	...	...	0.862	0.001
Malaysia	0.415	0.000	0.578	0.007	0.118	0.000	0.879	0.003
Other (non-TWI14)	0.740	0.022	0.214	0.024	0.163	0.036	0.746	0.054
Singapore	0.542	0.096	0.353	0.009	0.190	...	0.747	...
Thailand	0.322	0.021	0.650	0.008	0.073	...	0.917	...
United States	0.370	0.624	N/A	0.005	0.107	0.892	N/A	0.001
Overall	0.570	0.238	0.179	0.013	0.200	0.332	0.453	0.015

Shares of ΔP_{SR} observations. Trade weights based on the NZD-converted average value over t and $t-M$. ... denotes values suppressed due to Statistics New Zealand confidentiality requirements. Taiwan excluded because necessary macroeconomic data are not available. Other (non-TWI14) countries are pooled.

In contrast, although the United States accounts for a mere 7.4 (12.1) percent of observations (value), the US dollar accounts for 23.1 (56.7) percent of observations (value), reflecting the role of the USD as an international currency of trade (Goldberg and Tille 2008; Krugman 1980). A substantial proportion of this gap is due to the heavy usage of the USD in trade with key Asian destinations, including China, Malaysia, Thailand, Indonesia, Hong Kong, Singapore and South Korea, which jointly account for 21.1 percent of aggregate exports, 86.1 percent of which are denominated in USD. In fact, the USD is essentially the only vehicle currency used by New Zealand exporters, with other vehicle currencies accounting for a mere 1.3 (1.5) percent of trades (value).[13] In all subsequent results, all vehicle currency trade is grouped together.

Overall, 57.0 percent of observations are invoiced in the producer currency (NZD), 23.8 percent are invoiced in the local (bilateral) currency, and the remaining 19.2 percent are invoiced in vehicle currencies (table 2). This contrasts starkly with Gopinath et al. (2010), who observe 90 percent of imports invoiced in USD (the local currency).[14] In part this difference may be driven by the much larger US market, which is intrinsically linked to the USD being the vehicle currency of choice. Whatever the reason, the greater diversity of invoice currencies used in New Zealand, coupled with substantial swings in bilateral exchange rates (figure 1), provides a valuable testing ground for differences in ERPT behaviour.

While a large proportion of observations across almost all destinations are denominated in New Zealand dollars, these trades tend to be of lower average value than foreign denominated trades (bottom row of table 2). This may in part be because smaller firms are less capable or willing to enter trade relationships that involve currency risk of various kinds. Alternatively, following Goldberg and Tille (2009), importers may have increased bargaining power in large trade relationships, where the exporter's default position is lower due to the value of the proposed trade. Finally, New Zealand's position as a commodity exporter may also be a factor, with Goldberg and Tille (2008) showing that undifferentiated products tend to be invoiced in vehicle currencies, allowing exporters to maintain price parity with their competitors.

[13] Non-USD vehicle currency usage is primarily Euro-denominated exports to non-Eurozone European countries, and Australian dollar-denominated exports to the Pacific Islands.

[14] 89.2 percent of New Zealand export value shipped to the United States is invoiced in USD, consistent with Gopinath et al. (2010).

Table 3: Share of variation in $ln(P)$ explained by fixed effects (R^2)

	All	10+ obs	Differentiated goods	NEC
	(1)	(2)	(3)	(4)
Good	0.731	0.787	0.666	0.651
Good-destination	0.795	0.844	0.740	0.727
Firm	0.622	0.680	0.601	0.682
Firm-good-destination	0.919	0.926	0.902	0.903
$N(P)$	1,774,100	1,207,600	1,096,600	433,600

Goods are defined at the 10-digit HS level. Relationships (firm-good-destination combinations) with only a single unit value observation are excluded. Column 2 restricts to relationships with at least 10 unit value observations. NEC stands for not elsewhere classified.

4.2 Heterogeneity in unit values

Using firm-level data minimises the extent to which ERPT estimates are affected by quality and compositional changes. While each product category may contain a range of varieties selling for different prices, restricting to goods supplied by a single New Zealand firm captures a large proportion of within-good variation, as the range of a single firm is more restricted than that of exporters in the country as a whole.

Table 3 demonstrates this by reporting R^2 from regressions where the log of the price level is regressed on fixed effects at increasingly detailed levels of resolution. Focussing first on column 1, which includes all export relationships, we see that good and good-destination fixed effects capture a substantial proportion of the overall variation in unit values across observations (R^2 of 0.731 and 0.795 respectively). This reflects the unit of observation available in most aggregate studies, which pool all exporters trading a certain good to the same destination.

Similarly, since firms trading multiple products to multiple destinations represent a large proportion of trades, firm-level controls alone (row 3) account for relatively little of the observed variation in unit values (R^2 of 0.622). In contrast, relationship (firm-good-destination) level controls add substantial explanatory power, soaking up a total of 92 percent of total variation. Residual variation is likely to include some degree of composition change, alongside exchange rate-induced price changes, other price shocks, and random variation due to, eg, measurement error. However, the use of detailed firm-level data on export relationships minimises the role of composition change as much as possible for comprehensive administrative data.

To check that the high R^2 at the firm-good-destination level is not driven by the prevalence of relationships which have only a few observations, column 2 repeats these regressions excluding all relationships with less than ten observations. This adjustment makes little difference to the final share of variation explained in the fully disaggregated specification, but leads to reasonably substantial increases in R^2 at other levels.

Columns 3 and 4 consider the same disaggregation strategy across two subsets of goods – differentiated goods as defined by Rauch (1999) (column 3) and those allocated to residual product groupings, as identified by product descriptions including the term "not elsewhere classified" or "n.e.c." (column 4).[15]

These breakdowns give further assurance that the disaggregated approach provides a good control for composition. In the case of both differentiated and NEC products, the good and good-destination controls provide substantially less explanatory power, as we would expect (because the products themselves are more highly differentiated, or because a range of products have been grouped under a single heading). Adding firm controls effectively closes this "explanatory power" gap, consistent with firms having limited product ranges within these categories, or market segmentation of their multiple varieties.[16]

4.3 Price stickiness

As noted above, perfect price stickiness generates a mechanical link between invoice currency and exchange rate pass through. To give an indication of the degree of price stickiness in the New Zealand data, table 4 reports the share of short-run unit value changes falling below an absolute value threshold of 0.1 percent.[17] This measure of stickiness is calculated in three currencies –

[15] For example, within the category of "vegetables, fruit, nuts, fruit-peel and other parts of plants, preserved by sugar (drained, glacé or chrystallised)" there are 11 separate categories plus a residual category of "Vegetables; n.e.c. in heading no. 2006".

[16] A parallel examination of unit value variation among importers suggests that, while importers tend to import a more diverse range of products from a more diverse range of countries, controlling for firm, product and source country leads to a similar level of explained variation in import unit values (R^2 of 0.89 for imports compared to 0.92 for exports). This suggests that a similar analysis could be carried out using import data – a possibility we leave for future research.

[17] To be consistent with other analyses of price stickiness, the observed changes in unit values are not normalised by M in this table. A threshold value approach is adopted because perfect unit value stickiness cannot be consistently observed across currencies due to rounding issues induced by currency conversion, and the division of value by volume.

Table 4: Proportion of sticky unit values by invoice and calculation currency

	Invoice currency		
Currency of calculation	Producer	Local	Vehicle
Producer	**0.075**	0.007	0.007
Local	0.017	**0.055**	0.021
Vehicle	N/A	N/A	**0.070**

Unit value changes are calculated in the "currency of calculation" and are unadjusted for the gap between observed trades (M). A threshold of 0.1 percent is used to define a sticky unit value.

producer, local, and vehicle (where applicable) – and is reported separately by invoice currency group. The key point to observe from the table is that price stickiness is a phenomenon observed primarily in the invoice currency (the bold values). From the first column, 7.5 percent of producer-currency priced unit values are unchanged across consecutive trades, when the change is measured in NZD, compared to 1.7 percent when measured in the currency of the importer. For trades invoiced in local currency, 5.5 percent of unit values are sticky when changes are measured in the local currency, but only 0.7 percent are sticky in NZD. Similarly, vehicle currency-invoiced unit values are sticky 7.0 percent of the time, when calculated in the vehicle currency, but two percent or less when measured in the producer or local currency.

Our subsequent approach to sticky prices differs from that observed in several recent papers (including Gopinath et al. 2010), in that we do not restrict analysis to pairs of unit values in which we observe a change in the unit value. This decision largely reflects the nature of the data we use – sticky unit values make up only a small proportion of observations, and exploratory estimates suggest little impact on estimated exchange rate impacts from including them. Meanwhile, identifying nominally sticky unit values is complicated by the use of aggregate monthly prices, as prices may differ across trades within, as well as across, months.

Price stickiness, in the form of "take it or leave it" offers by trading partners (perhaps driven by currency movements), could induce entry or exit by New Zealand exporters. Alternatively, fixed NZD price offers from New Zealand exporters could result in variable foreign demand. If a firm does not trade, we do not observe whether a product changes price. This analysis makes no adjustment for attrition and compares unit values across consecutive trading months. That is, we show that where firms continue to trade, the price set in

The patterns described in table 4 are maintained for other choices of threshold.

the invoice currency is an important anchor for short-run price changes, suggesting that it will be useful to control for invoice currency when considering estimates of ERPT.

5 Regression analysis

We now analyse the impact of exchange rate movements on the unit values. Our analysis follows the same steps for both short- and long-run estimates. First, we provide an estimate of the average elasticity of NZD-converted unit values to the bilateral exchange rate. We then allow this estimate to differ by invoice currency group. Having shown that the exchange rate elasticity differs dramatically according to invoice currency, we examine whether, within currency groups, there is any further role for firm or product characteristics in influencing observed ERPT. Finally, we compare these results to the case where differences in invoice currency are ignored, showing that this latter approach leads to a strong estimated relationship between firm characteristics and ERPT behaviour (at least in the short run).

5.1 Short-run exchange rate pass-through

We closely follow Gopinath et al. (2010), modifying their approach to account for the change in perspective from import to export pass-through. Specifically, our simplest regression is of the form

$$\Delta P_{fcgt} = \beta \Delta e_{ct} + \mathbf{Z}_{cgt}\gamma + \epsilon_{fcgt}, \Delta \in \{\Delta_{SR}, \Delta_{LR}\} \tag{3}$$

where the log change in NZD-converted unit values within a specific firm-country-good relationship (ΔP_{fcgt}) is regressed on the cumulative (normalised by M) log difference in the bilateral exchange rate with the destination country (Δe_{ct}) since the last observed trade, and a set of control variables $\mathbf{Z}_{cgt}$. Following Gopinath et al. (2010), $\mathbf{Z}$ includes destination×HS4-digit product dummies, and log changes in destination country GDP and CPI, and New Zealand CPI (all normalised by M).

β reflects the extent to which the NZD-converted unit value received by the exporter is influenced by the bilateral exchange rate. When $\beta = 0$, NZD-converted unit values are unaffected by the bilateral exchange rate. Conversely, when $\beta = 1$, unit prices in NZD respond one-for-one with the bilateral exchange rate so that the unit price in the importer's currency

Table 5: Sample size for ERPT regressions by invoice currency group

	Short run				Long run			
	All		Lagged trade		All		Lagged trade	
Producer	662,400	0.549	558,700	0.543	82,400	0.717	69,500	0.702
Local	303,800	0.252	262,100	0.255	15,300	0.133	13,800	0.139
Vehicle	240,900	0.200	208,300	0.202	17,300	0.150	15,700	0.159
Total	1,207,100	1.000	1,029,100	1.000	115,000	1.000	99,000	1.000

Reported sample size and invoice currency shares for columns labelled "All" relate to short-run (table 6) and long-run (table 11) regression samples. "Lagged trade" columns provide the same statistics for the population for which lagged export values are available (used in tables 8 and 12, respectively).

remains unchanged. More generally, $\beta = 1 - \beta'$ where β' is the estimate generated from the importer perspective following the same Gopinath et al. (2010) approach.

To assess the potential importance of invoice currency to ERPT, we then allow β to differ according to the invoice currency

$$\Delta P_{fcgt} = [\beta_{producer}\delta^{p}_{fcgt} + \beta_{local}\delta^{l}_{fcgt} + \beta_{vehicle}\delta^{v}_{fcgt}]\Delta e_{ct} + \mathbf{Z}_{cgt}\gamma + \epsilon_{fcgt} \quad (4)$$

where δ^p, δ^l and δ^v are dummies indicating that the trade is invoiced in producer, local, or vehicle currencies respectively. Table 5 reports the sample size in each of these groups for both short-run and long-run populations. As discussed earlier, over half the $\Delta_{SR}P$ observations are producer-denominated, with 25 percent in local currency, and the remaining 20 percent in vehicle currencies (mainly USD).[18] In the long run, these ratios shift more towards producer-currency invoicing (71.7 percent of the sample), since less frequent traders tend to price in NZD. In both the short and long run, the restricted sample of firms with lagged trade data has very similar currency composition to the full sample.[19]

Table 6 shows the results of estimating equations 3 and 5 for short-run unit value changes. Column 1 reports the average β across all currency groups, showing that 47.5 percent of the average bilateral exchange rate movement is absorbed into the NZD-converted unit value. Column 2 then allows β to vary along the lines of Gopinath et al. (2010), into trades invoiced in the

[18]These numbers differ slightly from earlier counts because they impose the short-run regression population requirement of $M \leq 5$.

[19]Most of the sample loss comes from left-censoring of the trade data, rather than new firms entering exporting.

Table 6: Short-run ERPT by invoice currency group

	(1)	(2)	(3)	(4)
β	0.475**			
	[0.015]			
$\beta_{non\text{-}producer}$		0.804**		
		[0.021]		
$\beta_{producer}$		0.092**	0.092**	0.086**
		[0.022]	[0.022]	[0.022]
β_{local}			0.909**	0.901**
			[0.029]	[0.029]
$\beta_{vehicle}$			0.700**	
			[0.029]	
$\beta_{vehicle(p/v)}$				0.825**
				[0.030]
$\beta_{vehicle(v/l)}$				0.065
				[0.047]
$N(\Delta_{SR})$	1,207,100	1,207,100	1,207,100	1,207,100
Within R^2	0.013	0.013	0.013	0.013

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (** denotes significance at the 1% level). β coefficients all significantly different from each other at the one percent level with the exception of $\beta_{producer}$ and $\beta_{vehicle(v/l)}$ in column 4 (p-value 0.682).

producer currency and in other currencies. This specification represents an intermediate stage between equations 3 and 4, produced solely for comparison with Gopinath et al. (2010) (their table 2). Since that paper produces parameters from the importer's perspective, the comparable coefficients to our $\beta_{producer}$ (0.09) is one minus their coefficient for non-USD trades ($1-\beta_{ND}$, or 1-0.92=0.08). For trade invoiced in non-NZD, the coefficient (0.80) is comparable to Gopinath et al.'s coefficient on USD trade ($1-\beta_D$, or 1-0.24=0.76). In both cases, pass-through behaviour of New Zealand exporters to all countries is quite consistent with the previously estimated pass-through behaviour of exporters from all countries to the United States.

Column 3 represents our first step beyond Gopinath et al. (2010), where we now allow separate coefficients for each currency group (as in equation 4).[20]

[20] In unreported regressions, we also allowed for non-USD vehicle currency use to have a different coefficient from USD vehicle currency use. Point estimates for the two β's were 0.701 (USD) and 0.679 (non-USD), not significantly different from each other at the ten percent level. Other coefficients remained unchanged.

Allowing this distinction it is apparent that β is higher for contracts invoiced in the local currency than the vehicle currency – with coefficients of 0.909 and 0.700 respectively, significantly different at the one percent level. If, as table 4 implies, nominal prices are most sticky in the invoice currency, this would explain the relatively lower coefficient on $\beta_{vehicle}$ compared with β_{local}. To test this hypothesis, we note that, in the case of vehicle currency use, the bilateral exchange rate movement can be decomposed into two (log) additive parts

$$\Delta e_{ct} \equiv \Delta e_{(p/l)t} = \Delta e_{(p/v)t} + \Delta e_{(v/l)t}$$

where we replace the destination index c by the appropriate currency indexes. Given this decomposition we estimate

$$\begin{aligned} \Delta P_{fcgt} = [\beta_{producer}\delta^{p}_{fcgt} + \beta_{local}\delta^{l}_{fcgt}]\Delta e_{(p/l)t} + \\ \beta_{vehicle(p/v)}\delta^{v}_{fcgt}\Delta e_{(p/v)t} + \\ \beta_{vehicle(v/l)}\delta^{v}_{fcgt}\Delta e_{(v/l)t} + \mathbf{Z}_{cgt}\gamma + \epsilon_{fcgt} \end{aligned} \qquad (5)$$

so that pass-through for vehicle currency users has two components: one related to the bilateral exchange rate between the producer and vehicle currencies $\beta_{vehicle(p/v)}$, and one related to the exchange rate between the vehicle and local currencies $\beta_{vehicle(v/l)}$. If stickiness in the invoice currency is an important factor, and these exchange rates have a degree of independent movement, then we would expect $\beta_{vehicle(p/v)}$ to be the higher of the two coefficients. Table 7 shows the correlation between observed exchange rate movements, conditional on the use of a vehicle currency.[21] $\Delta e_{(p/l)t}$ and $\Delta e_{(p/v)t}$ are positively correlated (coefficient of 0.774), but not perfectly so. Thus, when we estimate equation 5 (column 4 of table 6), we see a stronger ERPT coefficient on the bilateral exchange rate between the producer and vehicle currencies – implying a consistent story across all currency groups, that the main driver of short-run unit value fluctuations is nominal stickiness in the contract currency.

Having established the importance of controlling for invoice currency, we now turn our attention to the question of whether ERPT differs systematically with characteristics of the firm or the exported product. Berman et al. (2012) find consistent and significant differences in pass-through behaviour between high- and low-productivity firms, with high-productivity exporters absorbing a greater share of exchange rate changes into their margins than less productive firms.

[21] These correlations relate to the short-run sample but are almost identical in the long-run sample.

Table 7: Exchange rate correlations, conditional on vehicle currency usage

	$\Delta e_{(p/l)t}$	$\Delta e_{(p/v)t}$	$\Delta e_{(v/l)t}$
$\Delta e_{(p/l)t}$	1.000		
$\Delta e_{(p/v)t}$	0.774	1.000	
$\Delta e_{(v/l)t}$	0.244	-0.426	1.000

$\Delta e_{(x/y)t}$ is the change in the exchange rate between currency groups x and y. Currency groups are producer (p), local (l) and vehicle (v).

We revisit the Berman et al. (2012) findings by generating binary indicators for high export performance or other characteristics δ^1 which we then interact with the currency dummies, giving a total of six distinct exchange rate coefficients (two performance groups by three invoice currency groups)

$$\begin{aligned}\Delta P_{fcgt} = [(1-\delta^1_{fcgt})(\beta^0_{producer}\delta^p_{fcgt} + \beta^0_{local}\delta^l_{fcgt} + \beta^0_{vehicle}\delta^v_{fcgt}) + \\ \delta^1_{fcgt}(\beta^1_{producer}\delta^p_{fcgt} + \beta^1_{local}\delta^l_{fcgt} + \beta^1_{vehicle}\delta^v_{fcgt})]\Delta e_{ct} \\ + \mathbf{Z}_{cgt}\gamma + \epsilon_{fcgt}. \end{aligned} \tag{6}$$

Firm characteristics are mainly based on lagged firm-level export data,[22] and reflect various elements of export performance, diversity, and/or potential hedges. Firstly, on the basis that total export value is correlated with firm performance (Eaton et al. 2011), we compare relationships according to whether the firm has relatively high or low export revenue. Additional measures of export performance includes lags of the number of destinations, discrete goods exported, and currencies in which exports have been invoiced. We also consider the degree of diversity in lagged export receipts, as measured by the reciprocal of the Herfindahl-Hirschman index of concentration for destinations, goods and currencies (ie, "high" group firms have more diverse trade). As well as being correlated with export performance, use of a diverse mix of currencies may also provide firms with a form of natural hedge if exchange rate fluctuations are imperfectly correlated across currencies. For each measure we generate a binary indicator of whether the firm is above or below the currency group-specific median of the performance metric.[23]

[22] The lag period covers the 12 months prior to the first trade observation in the ΔP_{fcgt} pair.

[23] While a small subset of performance measures have tetrachoric correlations above 0.50 (eg, total export receipts, number of destinations, and number of currencies used), it is not generally true that the various dichotomous performance measures pick up the same subsets of firms.

Heterogeneity in ERPT is also considered for three further characteristics: whether the firm has ever explicitly hedged their export exchange rate risk, whether the export is a differentiated good according to Rauch (1999),[24] and whether the firm is under foreign ownership (FDI). If firms use hedging to insulate themselves from exchange rate shocks, we might expect to see less price adjustment in the foreign contract currency (ie, higher βs) among firms with hedging experience. Alternatively, explicit hedging may indicate a firm is particularly sensitive to NZD-denominated price fluctuations, leading it to adjust prices more quickly than other firms (yielding lower βs).

If differentiated goods face a lower elasticity of demand than commodities, we might expect to see higher βs among "commodity" exporters as they attempt to stabilise prices with respect to their competition. Finally, if some part of the exports of foreign-owned firms are destined for their foreign parent and the firms are able to take advantage of transfer pricing, or alternatively if membership of multinational organisations provides a degree of implicit hedging, we might expect to see higher βs among foreign-owned firms.

Table 8 shows the results of this analysis, including tests of whether the invoice currency coefficients differ by characteristics. In contrast to Berman et al. (2012), we see almost no evidence of differences in ERPT associated with firm performance. Only three pairs of coefficients differ at the five percent level, all among trades denominated in the producer currency (NZD), where the high group shows no response to the currency change ($\beta^1_{producer}$ insignificantly different from zero) and the low group displays a positive response ($\beta^0_{producer}$).

To relate these results to those of Berman et al. (2012), we re-estimate equation 6 constraining β coefficients to be the same across invoice currencies

$$\Delta P_{fcgt} = [(1 - \delta^1_{fcgt})\beta^0 + \delta^1_{fcgt}\beta^1]\Delta e_{ct} + \mathbf{Z}_{cgt}\gamma + \epsilon_{fcgt}. \tag{7}$$

These estimates (table 9) follow the pattern observed by Berman et al. (2012). High-performance firms show a significantly higher degree of exchange rate absorption (ie, lower ERPT from the importer's perspective) across most binary measures.

[24] Using the liberal definition and mapping from SITC to HS classifications.

Table 8: Short-run ERPT by invoice currency group and firm characteristics

	Total exports	Number of countries	fx rates	goods	Herfindahl^{-1} countries	fx rates	goods	Prior hedging	Differentiated goods	FDI
$\beta^0_{producer}$	0.137**†	0.105**	0.106**	0.099**	0.106**	0.145**†	0.074*	0.157**‡	0.113**	0.109**
	[0.034]	[0.033]	[0.031]	[0.031]	[0.034]	[0.033]	[0.031]	[0.036]	[0.036]	[0.028]
$\beta^1_{producer}$	0.045†	0.070*	0.065	0.073*	0.072*	0.034†	0.104**	0.037‡	0.069*	0.039
	[0.032]	[0.033]	[0.035]	[0.035]	[0.032]	[0.032]	[0.035]	[0.030]	[0.030]	[0.042]
β^0_{local}	0.885**	0.938**	0.856**	0.888**	0.890**	0.863**	0.896**	0.867**	0.901**	0.935**
	[0.046]	[0.046]	[0.046]	[0.042]	[0.046]	[0.045]	[0.042]	[0.078]	[0.045]	[0.035]
β^1_{local}	0.913**	0.871**	0.934**	0.913**	0.908**	0.930**	0.905**	0.906**	0.899**	0.804**
	[0.040]	[0.041]	[0.040]	[0.043]	[0.040]	[0.041]	[0.044]	[0.033]	[0.041]	[0.059]
$\beta^0_{vehicle}$	0.688**	0.720**	0.677**	0.709**	0.724**	0.694**	0.695**	0.836**	0.698**	0.743**
	[0.044]	[0.043]	[0.040]	[0.042]	[0.044]	[0.043]	[0.043]	[0.110]	[0.038]	[0.036]
$\beta^1_{vehicle}$	0.723**	0.694**	0.745**	0.704**	0.691**	0.719**	0.718**	0.696**	0.721**	0.620**
	[0.041]	[0.042]	[0.046]	[0.043]	[0.042]	[0.042]	[0.043]	[0.031]	[0.049]	[0.056]
$N(\Delta_{SR})$	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100
Within R^2	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (** ; * denotes significance at the 1%; 5% level respectively). ‡; † signify that low-high coefficient pairs are significantly different from each other at the 1%; 5% level respectively.

Table 9: Short-run ERPT by firm characteristics only

	Total exports	Number of countries	fx rates	goods	Herfindahl^{-1} countries	fx rates	goods	Prior hedging	Differentiated goods	FDI
β^0	0.379**‡	0.377**‡	0.307**‡	0.468**	0.400**‡	0.307**‡	0.452**	0.324**‡	0.516**‡	0.512**‡
	[0.024]	[0.023]	[0.023]	[0.022]	[0.024]	[0.023]	[0.022]	[0.031]	[0.023]	[0.019]
β^1	0.540**‡	0.555**‡	0.630**‡	0.480**	0.529**‡	0.612**‡	0.498**	0.525**‡	0.433**‡	0.382**‡
	[0.021]	[0.021]	[0.022]	[0.023]	[0.021]	[0.021]	[0.023]	[0.018]	[0.022]	[0.029]
$N(\Delta_{SR})$	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100	1,029,100
Within R^2	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (** denotes significance at the 1% level). ‡ signifies that low-high coefficient pairs are significantly different from each other at the 1% level.

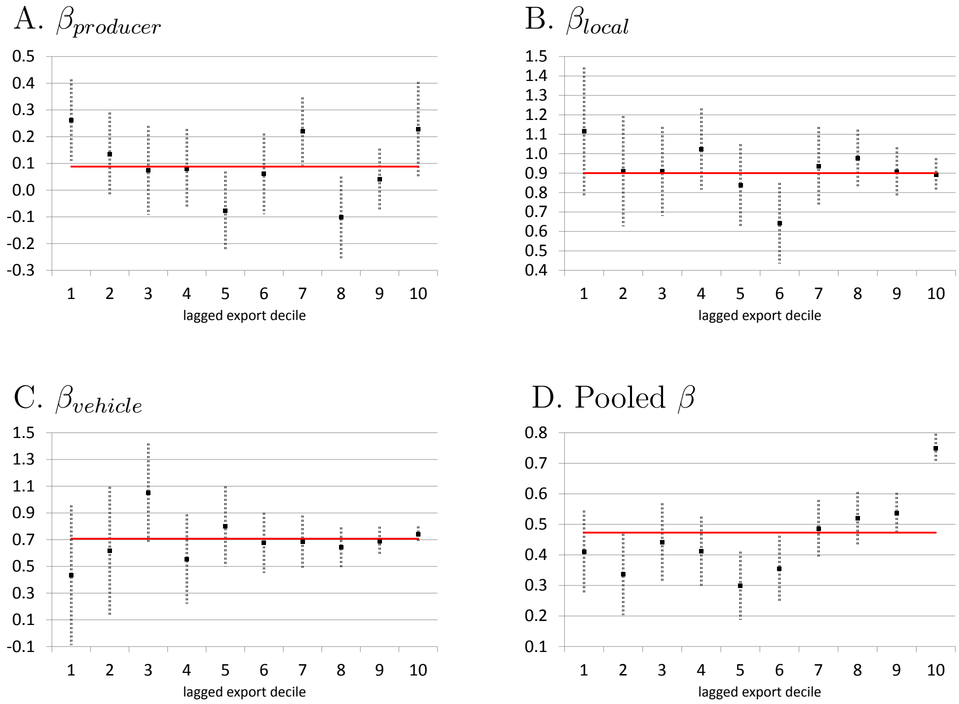
Table 10: Short-run invoice currency shares for "high" characteristic groups

	Producer	Local	Vehicle
Total exports	0.402	0.276	0.322
Number of: countries	0.410	0.274	0.315
fx rates	0.293	0.377	0.330
goods	0.560	0.246	0.194
Herfindahl^{-1}: countries	0.444	0.248	0.308
fx rates	0.343	0.394	0.263
goods	0.546	0.244	0.211
Prior hedging	0.436	0.299	0.265
Differentiated goods	0.587	0.263	0.150
FDI	0.592	0.215	0.193
Overall	0.543	0.255	0.202

Table 10 provides the bridge between tables 8 and 9, comparing the distribution of invoice currency for each "high" performance group with the full population distribution (bottom row). Firms with high export receipts, exporting to multiple countries, exporting in a range of different currencies and with experience of exchange rate hedging – the same characteristics which are associated with high βs in table 9 – tend to be over-represented in vehicle and local currency use, and under-represented in producer currency use. In contrast, where the "high" group includes an above average share of producer currency invoicing – foreign-owned firms and those trading in differentiated goods – the relationship is reversed, with β^0 higher than β^1. That is, "good" exporters tend to absorb a greater proportion of exchange rate movements in the short run, and this difference is related to their greater tendency to trade in foreign currencies, rather than because of within-currency group differences in ERPT.

While binary performance indicators provide a blunt test of the relationship between firm characteristics and ERPT, figure 2 provides an indication of the extent to which this relationship differs across the performance distribution, plotting βs estimated separately for each decile of lagged export value. These coefficients show the same basic patterns reported for the binary groups in tables 8 and 9. When invoice currency is ignored (panel D), we see mild evidence of a positive relationship between exporter size and the degree of ERPT, driven in part by significantly higher β in the top decile of export receipts. However, within currencies, this relationship disappears, with no clear correlation between export value and βs.

Figure 2: Short-run ERPT by export decile



β coefficients estimated separately for each decile of lagged export value, via expanded versions of equations 6 (panels A-C) and 7 (panel D). Deciles are calculated across the full sample, rather than within currency groups. Vertical lines represent 95 percent confidence intervals centered on point estimates. The solid horizontal line shows average β estimates from table 6 (column 3 for panels A-C and column 1 for panel D).

5.2 Long-run exchange rate pass-through

While short-run ERPT appears closely related to nominal price stickiness, firms may have more opportunity in the long run to adjust prices to reflect exchange rate movements. Gopinath et al. (2010) find that over the observed lifetime of US imported products, the gap between ERPT rates for USD and non-USD denominated contracts narrows, with pass-through to USD-denominated goods approximately doubling in the long run, to an average of 49 percent, while non-USD denominated goods maintain the very high rates of pass-through observed in the short run.[25]

Table 11 compares directly with the short-run calculation in table 6. In the long run, the average β across all currencies (0.256, column 1) is substantially lower than that observed in the short run (0.475), consistent with more

[25] The maximum possible duration in Gopinath et al. (2010) is 11 years, with the median relationship observed over 35 months. Our data provides for relationship lifetimes up to 7 years. In practice, the median lifetime is slightly over two years, with a quarter of relationships spanning four years or more.

Table 11: Long-run ERPT by invoice currency

	(1)	(2)	(3)	(4)
β	0.256**			
	[0.043]			
$\beta_{non\text{-}producer}$		0.423**		
		[0.071]		
$\beta_{producer}$		0.168**	0.171**	0.171**
		[0.052]	[0.052]	[0.052]
β_{local}			0.672**	0.672**
			[0.107]	[0.107]
$\beta_{vehicle}$			0.230*	
			[0.094]	
$\beta_{vehicle(p/v)}$				0.234*
				[0.095]
$\beta_{vehicle(v/l)}$				0.194
				[0.156]
$N(\Delta_{LR})$	115,000	115,000	115,000	115,000
Within R^2	0.151	0.151	0.151	0.151

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (**; * denotes significance at the 1%; 5% level respectively). β coefficients all significantly different from each other at the one percent level with the exception of $\beta_{producer}$ and $\beta_{vehicle}$ in column 3; and each of the $\beta_{vehicle}$ coefficients with each other, and with $\beta_{producer}$ with in column 4.

flexibility in the long run to adjust prices to maintain constant NZD returns.

Allowing β to vary by invoice currency we see that the lower aggregate rate in the long run is driven by the same phenomena observed by Gopinath et al. (2010) – lower long-run βs (higher pass-through to import prices) in non-producer currency transactions (column 2). β for local currency pricers falls from 90.9 percent in the short run to 67.2 percent, while for vehicle currency pricers the drop is more dramatic, from 70.0 to 23.0 percent (column 3 of tables 6 and 11 respectively).

Table 12 compares directly with the short-run calculation in table 8. In the long run, when posted prices have more time to adjust, firm characteristics are somewhat more likely to have a distinguishable effect on ERPT, with six pairs of coefficients significantly different from each other at the five percent level or below. However, the extent to which characteristics matter for ERPT differs by invoice currency. Despite some sizeable differences in point estimates (β ranges from 0.385 to 0.755), there is no evidence that pass-through rates among local currency-invoiced trades differ significantly by firm characteristics. In contrast, for trades denominated in either the producer or vehicle currency, in many cases we cannot rule out the possibility of complete pass-through ($\beta = 0$) for high-performing firms. Although long-run βs are higher than the short-run βs among producer currency-invoiced trades overall, this effect is largely limited to firms with relatively low export performance. This may suggest selection at the extensive margin for smaller exporters, or a degree of market power among small, niche exporters, such that they are able to maintain their NZD returns in the face of exchange rate fluctuations. A similar pattern is observed among vehicle currency-invoiced trades. This may also be related to market power, or alternatively may suggest that some of the larger, vehicle currency exporters are in commodity sectors where currency movements are correlated with price movements (Chen and Rogoff 2003).

Finally, table 13 returns to the Berman et al. (2012) style specification by holding β constant across invoice currency groups (as in table 9, the short-run equivalent), showing that many of the apparent differentials between firms with different characteristics wash out in the long run, as average βs across high and low groups converge. At the same time, estimated βs are lower across the board, due to the higher share of producer-currency pricing in the long-run sample (table 14).

5.3 Robustness

Potentially, the estimated convergence of βs in the long run could be driven by either (firm- or relationship-level) selection or implicit re-weighting. For example, some relationships which are included in the short-run calculation do not continue beyond the six month threshold required to be included in the long-run analysis. Similarly, some sporadic or seasonal relationships may be observed in the long run, but not be included in the short-run analysis. Additionally, the short-run analysis includes every pair of consecutive trades, such that relationships in which goods are traded monthly will implicitly receive a higher weight in the analysis than those in which trade occurs less regularly.

Table 12: Long-run ERPT by invoice currency group and firm characteristics

	Total exports	Number of countries	fx rates	goods	Herfindahl^{-1} countries	fx rates	goods	Prior hedging	Differentiated goods	FDI
$\beta^0_{producer}$	0.214**†	0.256**‡	0.141*	0.181*	0.243**‡	0.003	0.092	0.100	0.267*	0.083
	[0.075]	[0.072]	[0.067]	[0.072]	[0.075]	[0.078]	[0.072]	[0.072]	[0.105]	[0.065]
$\beta^1_{producer}$	-0.034†	-0.116‡	0.010	-0.016	-0.067‡	0.181*	0.099	0.089	0.033	0.123
	[0.079]	[0.082]	[0.092]	[0.082]	[0.079]	[0.075]	[0.082]	[0.082]	[0.065]	[0.099]
β^0_{local}	0.409**	0.444**	0.686**	0.584**	0.598**	0.433**	0.704**	0.689**	0.608**	0.534**
	[0.156]	[0.154]	[0.144]	[0.144]	[0.165]	[0.155]	[0.143]	[0.202]	[0.189]	[0.130]
β^1_{local}	0.755**	0.729**	0.416*	0.569**	0.567**	0.728**	0.385*	0.530**	0.558**	0.697**
	[0.157]	[0.160]	[0.175]	[0.174]	[0.149]	[0.158]	[0.175]	[0.132]	[0.138]	[0.213]
$\beta^0_{vehicle}$	0.614**‡	0.269*	0.350**	0.367**	0.373**	0.038‡	0.444**	0.300	-0.093‡	0.283*
	[0.137]	[0.135]	[0.129]	[0.134]	[0.139]	[0.129]	[0.133]	[0.254]	[0.146]	[0.120]
$\beta^1_{vehicle}$	-0.054‡	0.329*	0.223	0.215	0.220	0.660**‡	0.120	0.296**	0.631**‡	0.325
	[0.144]	[0.145]	[0.152]	[0.146]	[0.140]	[0.153]	[0.146]	[0.108]	[0.135]	[0.172]
$N(\Delta_{LR})$	99,000	99,000	99,000	99,000	99,000	99,000	99,000	99,000	99,000	99,000
Within R^2	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (** ; * denotes significance at the 1%; 5% level respectively). ‡; † signify that low-high coefficient pairs are significantly different from each other at the 1%; 5% level respectively.

Table 13: Long-run ERPT by firm characteristics only

	Total exports	Number of countries	fx rates	goods	Herfindahl^{-1} countries	fx rates	goods	Prior hedging	Differentiated goods	FDI
β^0	0.250**	0.310**†	0.179**	0.276**	0.316**†	0.093†	0.247**	0.174**	0.222**	0.192**
	[0.063]	[0.062]	[0.063]	[0.059]	[0.064]	[0.065]	[0.059]	[0.066]	[0.079]	[0.053]
β^1	0.168**	0.102†	0.237**	0.122	0.108†	0.303**†	0.157*	0.234**	0.201**	0.246**
	[0.062]	[0.063]	[0.062]	[0.066]	[0.062]	[0.060]	[0.067]	[0.059]	[0.055]	[0.080]
$N(\Delta_{LR})$	99,000	99,000	99,000	99,000	99,000	99,000	99,000	99,000	99,000	99,000
Within R^2	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (** ; * denotes significance at the 1%; 5% level respectively). ‡; † signify that low-high coefficient pairs are significantly different from each other at the 1%; 5% level respectively.

Table 14: Long-run invoice currency shares for “high” characteristic groups

	Producer	Local	Vehicle
Total exports	0.573	0.170	0.257
Number of: countries	0.596	0.151	0.254
fx rates	0.493	0.223	0.284
goods	0.694	0.136	0.170
Herfindahl^{-1}: countries	0.618	0.139	0.242
fx rates	0.502	0.232	0.266
goods	0.713	0.130	0.158
Prior hedging	0.574	0.180	0.247
Differentiated goods	0.737	0.134	0.129
FDI	0.726	0.115	0.159
Overall	0.702	0.139	0.159

Table 15: Methodological impacts of move from short run to long run

Dependent variable	$\Delta_{SR}P$ Full sample (1)	$\Delta_{SR}P$ LR sample (2)	$\Delta_{SR}P$ Re-weighted (3)	$\Delta_{LR}P$ Full sample (4)
$\beta_{producer}$	0.092**	0.108**	0.167**	0.171**
	[0.022]	[0.025]	[0.031]	[0.052]
β_{local}	0.909**	0.977**	0.967**	0.672**
	[0.029]	[0.038]	[0.057]	[0.107]
$\beta_{vehicle}$	0.700**	0.744**	0.698**	0.230*
	[0.029]	[0.031]	[0.048]	[0.094]
N	1,207,100	620,100	620,100	115,000
R^2	0.013	0.021	0.083	0.151

Regressions include unreported HS4-destination fixed effects and macroeconomic variables as outlined in the main text. Standard errors in brackets (** ; * denotes significance at the 1%; 5% level respectively).

Table 15 uses short-run data to consider the impact of selection and weighting on estimated ERPT parameters.[26] Column 1 repeats the main short-run specification (column 3 of table 6). Column 2 reestimates this regression restricting the sample to those short-run relationships which (in total) extend beyond the threshold to be included in the long-run analysis. Column 3 then takes this reduced sample and re-weights each observation by $1/N(\Delta_{SR}P_{fcgt})$, the reciprocal of the number of observed price changes, to give each relation-

[26] This test considers only the impact of excluding short-run relationships from the long-run analysis, not that of excluding sporadic relationships from the short-run analysis.

ship a total weight of one. Finally, column 4 repeats coefficients from the comparable long-run calculation (column 3 of table 11)

Focussing on column 3, the combined effect of selection and re-weighting is to increase estimates of β for both producer and local currency-denominated trades, but leave the coefficient on vehicle currency trade unchanged. While the implicit reweighting between the short-run and long-run calculation largely accounts for the estimated increase in the producer currency coefficient (comparing columns 3 and 4), these factors do not explain any of the apparent change in ERPT for local and vehicle currency groups. Rather, changes in these parameters seem more likely associated with exporters having a greater ability to escape rigidities associated with, eg, explicit contracts in the long run.

6 Conclusion

This paper explores the degree to which exchange rate fluctuations are absorbed into the New Zealand dollar-converted unit values received by exporters.

In the short run, estimated ERPT appears to be intrinsically related to the invoice currency. Firms invoicing in producer currency on average adjust the New Zealand dollar prices of their goods to reflect only 9 percent of the exchange rate fluctuation, with the remaining 91 percent being passed through to the importer. In contrast, when firms invoice in local or vehicle currencies, price rigidities in the invoice currency mean that the exporter absorbs a much greater share of the exchange rate fluctuation into their NZD-converted return – 90 percent for local currency invoicers and 70 percent for vehicle currency invoicers (or 83 percent of the variation in the NZD/vehicle currency exchange rate). These results are closely comparable to those of Gopinath et al. (2010), implying that the ERPT behaviour of New Zealand exporters to all countries is almost identical (on average) to that of exporters from all countries to the US.

Invoicing behaviour differs substantially across firms. In particular, firms with relatively high past exports, those that export to more countries, and those that utilise a greater number of currencies are more likely to invoice in either local- or vehicle-currencies. As a consequence of stickiness in the invoice currency, changes in their received unit values are therefore more closely related to changes in bilateral exchange rates. Conversely, producer-currency invoicing is more common among foreign-owned firms and exporters of differentiated products, leading to a milder average impact of exchange rate changes on received unit values for these groups. When currency choice is directly controlled for, firm characteristics cease to show any relationship with pass-through. These findings provide evidence as to the mechanism through which "high-performing" firms give effect to the lower rates of pass-through to importers (higher βs) observed by Berman et al. (2012) – lower short-run pass-through is directly associated with higher usage of foreign currencies.

In the long run, the role of stickiness in the invoice currency weakens and NZD-denominated returns absorb a lower overall proportion of the exchange rate change. While received unit values of local-currency pricers still respond quite strongly to the bilateral exchange rate ($\beta = 0.672$), vehicle-currency pricers become indistinguishable from producer-currency pricers with long-run changes in received unit values reflecting only 23 and 17 percent of the exchange rate change, respectively. Increasing pass-through to foreign prices, combined with a higher share of producer-currency invoiced observations leads to a substantial reduction in the average impact of exchange rates on received unit values in the long run. However, despite these adjustments, pass-through remains low among some groups of firms (particularly those invoicing in the local currency) suggesting that in the absence of offsetting effects (eg, changes in costs) long-run exchange rate movements will impact upon exporter profitability. The implied variability in export returns increases the risks associated with exporting, which may in turn reduce firms' incentives to enter and develop export markets.

References

Andersen, T. (1994). *Price Rigidity: Causes and Macroeconomic Implications*. Oxford: Oxford University Press.

Atkeson, A. and A. Burstein (2008). Pricing-to-market, trade costs, and international relative prices. *American Economic Review 98*(5), 1998–2031.

Baldwin, R. and J. Harrigan (2011). Zeros, quality, and space: Trade theory and trade evidence. *American Economic Journal: Microeconomics 3*(2), 60–88.

Ball, L. and G. Mankiw (1994). A sticky-price manifesto. *Carnegie-Rochester Conference Series on Public Policy 41*(1), 127–151.

Berman, N., P. Martin, and T. Mayer (2012). How do different firms react to exchange rate variations? *Quarterly Journal of Economics 127*(1), 437–492.

Bernard, A., S. Redding, and P. Schott (2011). Multi-product firms and trade liberalization. *Quarterly Journal of Economics 126*(3), 1271–1318.

Chen, Y. and K. Rogoff (2003). Commodity currencies. *Journal of International Economics 60*(1), 133–160.

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

Donnenfeld, S. and A. Haug (2003). Currency invoicing in international trade: An empirical investigation. *Review of International Economics 11*(2), 332–345.

Dornbusch, R. (1987). Exchange rates and prices. *American Economic Review 77*(1), 93–106.

Eaton, J., S. Kortum, and F. Kramarz (2011). An anatomy of international trade: Evidence from French firms. *Econometrica 79*(5), 1453–1498.

Fabling, R. (2009). A rough guide to New Zealand's Longitudinal Business Database. Global COE Hi-Stat Discussion Papers No. 103, Institute of Economic Research, Hitotsubashi University.

Fabling, R. and A. Grimes (2008). Over the hedge? Exporters' optimal and selective hedging choices. Discussion Papers DP2008/14, Reserve Bank of New Zealand.

Fabling, R. and L. Sanderson (2010). Entrepreneurship and aggregate merchandise trade growth in New Zealand. *Journal of International Entrepreneurship 8*(2), 182–199.

Fitzgerald, D. and S. Haller (2012). Pricing-to-market: Evidence from plant-level prices. Unpublished working paper.

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

Goldberg, L. and J. Campa (2010). The sensitivity of the CPI to exchange rates: Distribution margins, imported inputs, and trade exposure. *The Review of Economics and Statistics 92*(2), 392–407.

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

Goldberg, L. and C. Tille (2009). Micro, macro, and strategic forces in international trade invoicing. Working Papers 15470, National Bureau of Economic Research.

Goldberg, P. and R. Hellerstein (2008). A structural approach to explaining incomplete exchange-rate pass-through and pricing-to-market. *American Economic Review 98*(2), 423–29.

Goldberg, P. and M. Knetter (1997). Goods prices and exchange rates: What have we learned? *Journal of Economic Literature 35*(3), 1243–1272.

Gopinath, G., O. Itskhoki, and R. Rigobon (2010). Currency choice and exchange rate pass-through. *American Economic Review 100*(1), 304–36.

Gopinath, G. and R. Rigobon (2008). Sticky borders. *The Quarterly Journal of Economics 123*(2), 531–575.

Knetter, M. (1989). Price discrimination by U.S. and German exporters. *American Economic Review 79*(1), 198–210.

Knetter, M. (1993). International comparisons of pricing-to-market behaviour. *American Economic Review 83*(3), 473–486.

Krugman, P. (1980). Vehicle currencies and the structure of international exchange. *Journal of Money, Credit and Banking 12*(3), 513–526.

Krugman, P. (1984). The international role of the dollar: Theory and prospect. In J. Bilson and R. Marston (Eds.), *Exchange Rate Theory and Practice*, Chapter 8. Chicago, Illinois: University of Chicago Press.

Krugman, P. (1987). Pricing to market when the exchange rate changes. In S. Arndt and J. D. Richardson (Eds.), *Real-Financial Linkages among Open Economies*, pp. 49–70. The MIT Press.

Lavoie, N. and Q. Liu (2007). Pricing-to-market: Price discrimination or product differentiation? *American Journal of Agricultural Economics 89*(3), 571–581.

Melitz, M. and G. Ottaviano (2008). Market size, trade, and productivity. *Review of Economic Studies 75*(1), 295–316.

NZMEA (2012). Parties should support RBNZ Amendment Bill to select committee. Press Release: New Zealand Manufacturers and Exporters

Association (NZMEA), 23 August 2012.

Oram, R. (2012). Monetary policy hurting NZ. Sunday Star Times, 23 September 2012, Edition 1, p. 24.

Rauch, J. (1999). Networks versus markets in international trade. *Journal of International Economics 48*(1), 7–35.

Statistics New Zealand (2012). Business Operations Survey: 2011 – detailed tables. Technical report, Statistics New Zealand: Wellington.

Tarrant, A. (2012). Government and Reserve Bank should intervene more in economy as others break the rules, JBWere economist says. www.interest.co.nz, posted in Currencies, 18 September 2012.

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