**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**

HĪKINA WHAKATUTUKI

# Exporting, innovation and the role of immigrants

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November 2014

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INNOVATION & EMPLOYMENT**
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November 2014

# Summary of findings

This research uses Statistics New Zealand's Integrated Data Infrastructure and data from the Business Operations Survey to investigate the correlations at the firm level between a) employee characteristics and firm international engagement, and b) firm international engagement and innovation.

The main findings on employee characteristics and international engagement are:
- Firms that employ a higher fraction of high-ability foreigners (and thus a lower fraction of high-ability natives) are more likely to export.
- Firms that employ a higher proportion of people who previously worked for an exporter are more likely to export.
- The proportions of foreign employees and employees with export experience are correlated with many other types of international engagement by firms.
- Employees from Australia and the Pacific and from Europe are positively correlated with firm exporting. The correlations are absent for foreign employees from Asia.
- The probability that a firm earns income in a given country is more correlated with its fraction of employees from that country than with its total fraction of foreign employees.
- A firm with a higher fraction of employees from a given country is more likely to earn income in that country only if the country is developed.


The main findings on international engagement and innovation are:
- Firms that export innovate more, even after controlling for size.
- Among exporters, the proportion of firm sales that comes from exports shows little correlation with innovation.
- Firms that export to more countries innovate more.
- Exports of raw goods have little correlation with innovation; exports of manufactured goods or services have a strong correlation.
- Firms that recently entered a new export market report especially high innovation, and firms that began earning overseas income in the previous two years report higher innovation than those that have earned overseas income for a longer period.
- Not all export destinations are correlated with higher innovation. Exports to the Americas are positively correlated with innovation, but there is no evidence that firms that export more to Asia are more likely to innovate.
- In addition to exporting, most other types of international engagement, such as inward and outward foreign direct investment, are positively correlated with innovation.
- Firms' sources of ideas for innovation vary with the types of international engagement in which they are involved. The patterns are consistent with exporters gaining ideas from their international customers, firms gaining ideas from their foreign owners, and importers gaining ideas from their foreign suppliers.


Although these relationships are correlations only and should not be interpreted as proof of causality, they do suggest that the experience and specialized knowledge of employees may be relevant to firms' decisions to engage internationally, and that such engagement may act as a conduit for foreign knowledge to enter the country.

## Disclaimer

The results in this paper are not official statistics, they have been created for research purposes from the Integrated Data Infrastructure (IDI) managed by Statistics New Zealand.

The opinions, findings, recommendations and conclusions expressed in this paper are those of the authors not Statistics NZ, the Ministry of Business, Innovation and Employment or Motu Economic and Public Policy Research.

Access to the anonymised 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 person, household, business or organisation and the results in this paper have been confidentialised to protect these groups 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.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes.

Any person who has had access to the unit-record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

# 1. Introduction

This research documents how various firm characteristics are correlated with international engagement among New Zealand firms. The first part of the report focuses on the relationship between employee characteristics, in particular nationality and prior experience working for an exporting firm, and firm international engagement. The second part focuses on the relationship between firm international engagement and innovation activities. The primary type of international engagement investigated is exporting, but alternative types including importing and inward and outward foreign direct investment are also considered.

The most important way most countries gain new knowledge and ideas, which are essential to long run economic growth, is by importing them from overseas.[1]  New Zealand's small size makes this doubly true. Exporting has been proposed by the literature as one means by which foreign ideas might enter a country.[2] It may expose firms to a diverse range of foreign knowledge that can be adapted for domestic use or used as an input into further innovation. Furthermore, the access to a larger market that exporting provides may increase a firm's optimal level of innovation.[3] If exporting were found to increase firms' innovation, this would provide an additional justification for lowering barriers to trade. Many case studies suggest a strong learning-from-exporting effect, but econometric studies have struggled to find evidence of such an effect.[4]

We find a substantial positive correlation between most measures of firms' international engagement and the different types of firm innovation. Innovation is particularly high for firms at around the time they enter a new export market. However, not all types of exporting are correlated with innovation. While exports of manufactured goods and services are strongly correlated with innovation, exports of raw goods show virtually no correlation. Furthermore, not all export destinations are correlated with innovation. The correlation is strong for exports to the Americas, but vanishes for exports to Asia. These results suggest that, even if some types of exporting encourage innovation, this relationship is not universal.

However, the positive correlation here between exporting and innovation should not be automatically interpreted as implying a causal effect of exporting on innovation, because innovation may also drive increases in exporting, the two could be determined simultaneously, or additional unobserved factors could affect them both. For example, firms may innovate in order to develop products for new export markets, or firms with less risk-averse senior managers could both export and innovate more. If exporting does have a causal effect on innovation, this could be either because of a genuine increase in international knowledge flows driven by the international engagement, or because the increased market size faced by the exporting firm makes innovation more worthwhile.

This research does not directly deal with the issue of identification, and so the correlations it finds should not be interpreted as causal relationships. Rather, it aims to document the correlation between exporting and innovation in detail, and identify the circumstances in which the relationship is strongest. It will also inform future research into the causal relationship between exporting and innovation.

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[1] See Keller (2004) and Klenow and Rodriguez-Clare (2005), among others.
[2] See for example MacGarvie (2006) and Salomon and Shaver (2005).
[3] Lileeva and Trefler (2010) find using Canadian data that this mechanism is important for low-productivity firms only.
[4] Keller (2004), Wagner (2005), Fabling and Sanderson (2013).

The current research does, however, allow some inferences to be made about the effect of exporting on innovation. In particular, because innovation is expected to increase exporting if anything, in the innovation regressions presented here the coefficients on exporting are likely to over-estimate the effect of exporting on innovation. They can thus be considered upper bounds on the causal effect of exporting on innovation. Differences in the strength of the exporting-innovation correlation reported here should be interpreted as only suggestive about when exporting has a stronger effect on innovation.

The question of what causes a firm to export is important whether we view exporting as a means to gain access to foreign knowledge or as an end in itself. This research therefore also investigates a potential driver of firm exporting, namely employees' specialist skills or knowledge gained from being born and living in another country, or from previously working for an exporter.[5]

We find that firms with a higher proportion of high-ability foreign employees (and thus a lower proportion of high-ability native employees) are more likely to export, as are firms with a higher proportion of employees who previously worked for an exporter. Similarly, these employee characteristics are correlated with many other types of firm international engagement. Not all foreign employees are equally correlated with exporting: while those from Australia and the Pacific and from Europe are positively correlated with exporting, the correlations vanish for employees from Asia. When examining income earned in New Zealand's major trading partners, we find that on average the probability that a firm earns income in a given country is more correlated with its fraction of employees from that country than with its total fraction of foreign employees. However, a firm with more employees from a given country is more likely to earn income in that country only if the country is developed. Firms with more employees from a developing country such as China, India or Malaysia are no more likely to earn income in that country.

As with the analysis of exporting and innovation, the correlations presented here between employee characteristics and firm international engagement should not be interpreted as causal relationships. For instance, employees are not hired randomly, and those with knowledge that will help a firm to successfully export may be hired because the firm plans to start exporting, generating a two-way relationship between employee characteristics and export performance. Alternatively, more dynamic or progressive firms may be both more likely to hire foreigners and more likely to export or be internationally engaged in other ways.

The remainder of this report is structured as follows. Section 2 describes the data used in this analysis. Section 3 documents the correlations between employee characteristics and firms' international engagement, and Section 4 documents the correlations between firms' international engagement and innovation. Section 5 concludes, drawing particular attention to the heterogeneity in the relationships found in this analysis.

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[5] Molina and Muendler (2013) find that firms preparing to export hire workers away from other exporting firms, and that this process leads to more successful export entry. This suggests that the knowledge held by such workers provides firms with an important advantage in exporting.

# 2. Data

This research combines firm-level data on international engagement and exporting activities from Statistics New Zealand's Business Operations Survey (BOS) with employee-level data from Statistics New Zealand's Integrated Data Infrastructure.

BOS data are from the years 2005, 2007, 2009 and 2011.[6] Each survey year, a sample of New Zealand firms with six or more employees is selected to be surveyed, with the sample probability increasing with firm size. All regression analysis conducted in this paper reweights firms included in the sample to make them representative of the population of New Zealand firms with six or more employees. The BOS surveys of 2007 and 2011 include comprehensive modules on both firm international engagement and innovation activities; the 2005 and 2009 surveys include comprehensive data on innovation activities, but only limited questions related to the firm's international engagement. Some of the variables relating to international engagement used in this analysis are therefore only available for the two years 2007 and 2011. Although all four BOS surveys allow us to identify exporting firms, only these two years have information on other types of international engagement such as making direct purchases from overseas, and regional breakdowns of the overseas countries in which firms earn income.

The primary indicators for innovation used in this analysis are for the four types of innovation included in the innovation module of BOS:

1. product innovation: did the business introduce onto the market any new or significantly improved goods or services in the past two years;
2. organisational innovation: did the business implement any new or significantly improved organisational or managerial processes (i.e. significant changes in the business' strategies, structures, or routines) in the past two years;
3. operational process innovation: did the business implement any new or significantly improved operational processes (i.e. methods of producing or distributing goods or services) in the past two years;
4. marketing innovations: did the business implement any new or significantly improved sales or marketing methods that were intended to increase the appeal of goods or services for specific market segments, or to gain entry to new markets in the past two years.

In addition to these primary measures of innovation, we briefly consider three alternative measures: an indicator for the firm introducing a product that was new to New Zealand, an indicator for the firm conducting R&D, and an indicator for the firm implementing a major change in its production technology.

The primary measure of exporting used in the analysis is an indicator for the firm being an exporter. A firm is classified as an exporter if, when asked the percentage of its sales that came from exports, it gave a positive value. For some of the analysis using the 2007 and 2011 International Engagement modules, a wider definition is used, based on firms reporting any form of overseas income, including fees and royalties received and significant income from overseas residents temporarily visiting New Zealand (e.g., tourism, export education).

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[6] BOS data are also available for the even numbered years over this period, but we ignore these years because detailed innovation information was not collected.

These data on firm behaviour are combined with data on the characteristics of firm employees from Statistics New Zealand's Integrated Data Infrastructure (IDI). The employee characteristics of interest are: whether the employees are foreign and, if so, also their country of origin; whether they have recent experience working for a different firm that reports in BOS that it is an exporter; and whether they are classified as being highly skilled, based on their observed earnings profile.

Foreign employees are identified based on the nationality of the passports they used when entering or leaving New Zealand over the period prior to their employment at the firm. Specifically, employees are considered foreign if their first border crossing in the seven-year period up to and including the financial year (April to March) referred to by the BOS survey was made on a foreign passport. Employees who made no border crossings during this seven-year period are considered to be New Zealanders. Employees who travelled on foreign passports initially during the seven-year window but later switched to New Zealand passports are considered foreign, because gaining New Zealand citizenship is a natural part of long-term migration to New Zealand. An employee's foreign country of origin is considered to be the country that issued the passport used on this first border crossing.

Given the short time frame over which we observe arrivals and the fact that long-term migrants are likely to take up New Zealand citizenship, we are likely to largely be capturing relatively recent migrants. However, there are a number of circumstances in which individuals may be misclassified. New Zealanders with dual citizenship may be misclassified as foreign, and long term migrants who may better be considered native may still be classified as foreign if they travel on foreign passports.[7]

Employee-level foreigner status variables are aggregated up to the firm level by calculating the fraction of employee-months paid for by the firm during the BOS financial year that were paid to foreigners.[8]

Based on their monthly wage and salary histories with New Zealand firms, individual employees are also classified as to whether they (a) have experience working for a firm other than their current employer (61 percent of employee-months), (b) have experience working for another firm that was surveyed in BOS (24 percent of employee-months), and (c) have experience working for a firm surveyed in BOS that declares that it made a non-zero fraction of its sales from exports (7.6 percent of employees).[9] Only employment spells of six months or longer that occurred in the five years prior to the BOS financial year or during the BOS year itself are considered. Employee experience working for other firms is aggregated to the firm level in three variables, these being the fraction of employee-months that fall into each of these categories.

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[7] One potential drawback of this method of identifying migrants is that it may differentially capture long-term migrants from different countries. In particular, migrants from countries that do not allow dual citizenship (which include much of Asia) are less likely to travel on New Zealand passports even after living in New Zealand for many years. They are thus more likely to be identified as migrants than are individuals who have lived in New Zealand for the same amount of time, but who come from countries that allow dual citizenship.

[8] Instead using the fraction of distinct employees who are foreign, or the proportion of the total wage bill paid to foreigners yields similar results.

[9] Former employers are categorised as BOS exporters, BOS non-exporters, or non-BOS firms based on their participation and responses in the BOS survey relating to the year the employee worked at his or current firm. This is primarily to overcome the issue of differential censoring of the data across BOS surveys that would arise if the past employer's export status at the time the employee worked for them were used.

Employees are also categorised by their level of ability, skill, or earnings potential.[10] This categorisation is based on a worker wage premium estimated from a two-way fixed effect model similar to Hyslop & Maré (2009), but constructed at the firm level (as in Maré et al., forthcoming). The model includes flexible controls for age and gender, so wage differences based on these factors are excluded from the wage premium. The measure of ability picks up whether a worker tends to be paid higher wages, relative to other workers, controlling for the fact that some firms pay more than others, regardless of who they employ. It thus captures a range of time-invariant and quasi-time invariant characteristics such as education, occupation, and innate ability.[11] Employees are considered high ability if their fixed effects fall on or above the 75th percentile of worker fixed effects.

Figure 2.1 plots kernel densities of worker fixed effects, distinguishing between native and migrant employees. Panel A presents the distribution for all employees, and shows that on average migrant employees have lower estimated fixed effects than natives, suggesting that they have lower average ability. Panel B presents the distributions of worker fixed effects for native and migrant workers who are classified as high ability. In contrast to the case for all workers, it shows that high-ability migrants have, on average, higher ability than high-ability natives.[12] The high density of very able migrants may reflect New Zealand's points system for immigrants, whereby foreigners with high earning potentials are disproportionately admitted.[13]

In both the regressions relating employee characteristics to firm international engagement and those relating international engagement to firm innovation, the preferred specifications include controls for the geographic locations of the firms, referred to as "regional council fixed effects". For firms that employ workers in more than one regional council, these are in fact the shares of employment in each regional council. These variables are included as controls in the regressions predicting international engagement to capture the possibility that particular areas (e.g. Auckland) might be disproportionately home to firms that engage internationally, and also home to large migrant populations.

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[10] Note the IDI does not include information on employees' occupations, thus precluding analysis based on workers' specific roles in their firms.

[11] Estimated worker fixed effects will also capture any other worker characteristics that are systematically rewarded by New Zealand employers, which may include local experience or English language proficiency.

[12] In particular, there is a lower density of migrants at the bottom end of the high-ability distribution, and a higher density to the right in the fixed effect range 0.3 to 0.7.

[13] These high-ability migrants are disproportionately likely to be long-term migrants. This may occur because temporary and short-term migrants are much more likely to work in low-skill occupations, or because longer term migrants have had more opportunity to gain New Zealand experience and to move into jobs that more closely reflect their ability.

**Figure 2.1. Foreign employees have lower average ability than natives**

**Panel A: Kernel density of ability of all workers**
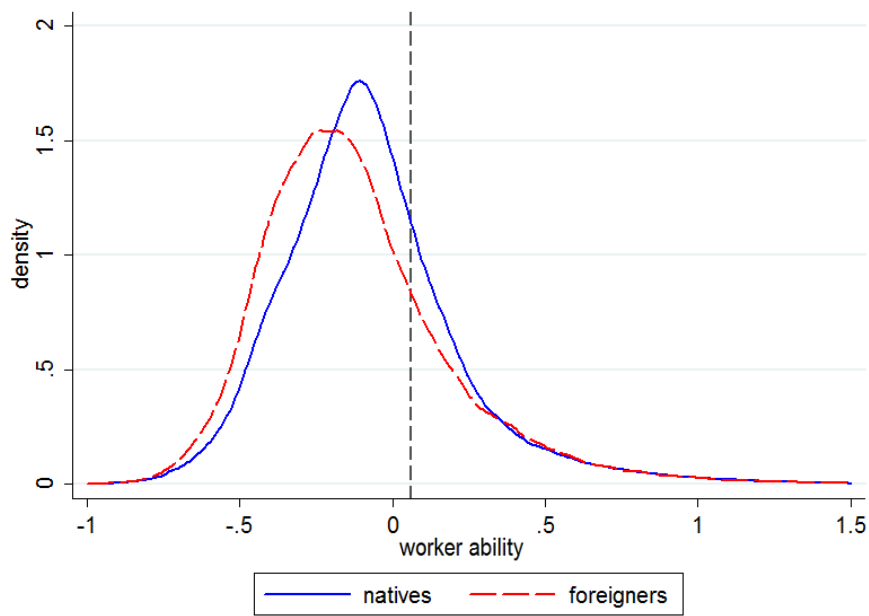


**Panel B: Kernel density of ability of high-ability workers**
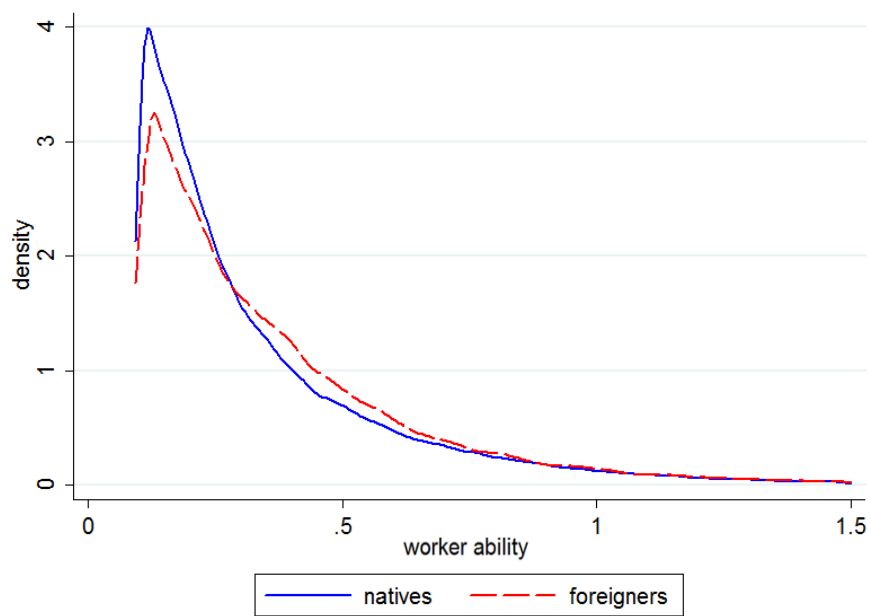


Notes: This figure plots the kernel density of worker fixed effects, as described in Section 2, for foreign and native employees. The vertical dashed line in Panel A represents the 75th percentile, which is the cut-off for "high-ability" workers. Panel B plots the distribution of high-ability workers only.

# 3. Results on employee characteristics and international engagement

## 3.1. Firms with more high-ability foreign employees are more likely to export

Firms that employ a higher fraction of foreign employees are slightly more likely to export. Column 1 of Table 3.1 reports the results of a linear probability regression of exporting on the fraction of the firm's employees who are foreign, while controlling for the (ln) number of employees and including survey year, industry, and regional council fixed effects.[14] The coefficient of 0.069 on fraction of foreign employees is relatively small, but statistically significant. It suggests that, relative to another firm of the same size in the same industry, a firm with 10 percentage points more foreign employees is 0.69 percentage points (4.0 percent[15]) more likely to export. The correlation increases slightly to 0.084 when controls that capture the previous experience of employees working for exporting firms are added (column 3).

Next, we show that this relationship between foreign employees and exporting is driven solely by high-ability employees. In addition to the controls in column 1, column 4 of Table 3.1 includes controls for the fraction of employees who have high ability, and the fraction who both are foreign and have high ability. Here the coefficient on the fraction of employees who are foreigners decreases in magnitude and becomes insignificant, but the coefficients on both types of high-ability employees are large and positive.

The coefficient of 0.119 on the fraction of high-ability employees suggests that changing 10 percent of a firm's employees from low-ability natives to high-ability natives is associated with a 1.2 percentage point (6.9 percent) increase in the probability the firm exports. It is unsurprising that firms with a higher proportion of high-ability employees are more likely to export. However, replacing the same low-ability natives with high-ability foreigners is associated with a much larger 4.4 percentage point (25.5 percent) increase in the probability the firm exports.[16] That is, among a firm's high-ability employees, the fraction of foreigners is strongly positively correlated with the firm exporting. Among its low-ability employees, in contrast, the fraction of foreigners shows little correlation with the firm exporting.

A number of possible mechanisms are consistent with these results. One possibility is that high-ability foreign employees have, on average, more specific knowledge that helps a firm to successfully export than do high-ability New Zealand-born employees. Such knowledge might include an understanding of the culture, business practices, or preferences prevalent in a foreign country. Foreign employees might also have personal contacts in their home country that could help their firm export to that country. This could lead to firms with more foreign employees being more likely to export, but also to firms preferentially hiring foreign employees because they export or plan to start exporting.

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[14] Versions of these regressions that included firm fixed effects were also run (results not presented). Here the coefficients of interest were identified solely from within-firm variation over time. The size of the data set and limited within-firm variation meant the standard errors on these estimates were large, and few of the coefficients were statistically significant.

[15] 17.3 percent of firms export, so 0.69 percentage points in percent is 0.69/17.3*100=4.0%.

[16] This value comes from adding the coefficients on fraction of high-ability employees (0.119) and fraction of foreign high-ability employees (0.322).

**Table 3.1: Firms with more high-ability foreign employees and more employees with exporting experience are more likely to export**

| Dependent variable: Firm exports | mean (sd) | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|
| **Fraction of employees who are/have:** | | | | | | | | |
| Foreigners | 0.165 | 0.069** | | 0.084** | 0.024 | | 0.018 | 0.010 |
| | (0.154) | (0.033) | | (0.033) | (0.035) | | (0.035) | (0.035) |
| High-ability foreigners | 0.042 | | | | 0.322*** | | 0.314*** | 0.281** |
| | (0.064) | | | | (0.114) | | (0.116) | (0.116) |
| Outside experience | 0.607 | | -0.046* | -0.036 | | -0.045 | -0.040 | -0.045 |
| | (0.192) | | (0.026) | (0.026) | | (0.034) | (0.035) | (0.035) |
| High-ability, with outside experience | 0.151 | | | | | -0.000 | 0.012 | 0.029 |
| | (0.137) | | | | | (0.073) | (0.074) | (0.073) |
| Experience at a BOS firm | 0.244 | | -0.049 | -0.049 | | -0.025 | -0.022 | -0.031 |
| | (0.140) | | (0.039) | (0.039) | | (0.048) | (0.048) | (0.048) |
| High-ability, with experience at a BOS firm | 0.059 | | | | | -0.093 | -0.103 | -0.087 |
| | (0.078) | | | | | (0.101) | (0.101) | (0.100) |
| Experience at a BOS exporter | 0.076 | | 0.333*** | 0.331*** | | 0.233*** | 0.227*** | 0.226*** |
| | (0.080) | | (0.068) | (0.068) | | (0.086) | (0.086) | (0.086) |
| High-ability, with experience at a BOS exporter | 0.020 | | | | | 0.363* | 0.353* | 0.250 |
| | (0.040) | | | | | (0.195) | (0.195) | (0.198) |
| High-ability | 0.277 | | 0.171*** | 0.173*** | 0.119*** | 0.167*** | 0.111** | 0.071 |
| | (0.187) | | (0.031) | (0.031) | (0.033) | (0.049) | (0.055) | (0.055) |
| Number of employees (ln) | 3.64 | 0.047*** | 0.045*** | 0.043*** | 0.045*** | 0.045*** | 0.043*** | 0.032*** |
| | (1.21) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Firm partly/wholly owned by foreign business | 0.158 | | | | | | | 0.088*** |
| | (0.365) | | | | | | | (0.020) |
| Firm has ownership interest in foreign business | 0.067 | | | | | | | 0.247*** |
| | (0.251) | | | | | | | (0.028) |
| Survey year fixed effects | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *R-Squared* | | *0.231* | *0.247* | *0.249* | *0.238* | *0.248* | *0.251* | *0.267* |
| *Observations* | | *22,272* | *21,339* | *21,339* | *22,272* | *21,339* | *21,339* | *21,150* |
| *Weighted fraction of successes* | | *0.173* | *0.182* | *0.182* | *0.173* | *0.182* | *0.182* | *0.182* |

Notes: Each numbered column presents the results of a linear probability regression of firm exporting on employee characteristics. See Section 2 for the definitions of the independent variables; their means and standard deviations are presented in the first column. Data are from 2005, 2007, 2009 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

An alternative that is consistent with the results is that high-ability foreigners are disproportionately attracted to, or able to get jobs with, firms that export or that have a high propensity to export. This could be true even if foreigners are no more helpful than New Zealand natives in aiding their firm to export successfully.[17]

Columns 1, 3 and 5 of Table 3.2 show how the relationship between foreign employees and exporting varies with the size of the firm. Small firms (6-20 employees) and large firms (50+ employees) both show similar patterns to firms overall. That is, foreign employees are essentially uncorrelated with exporting, but high-ability foreign employees are positively and significantly correlated with exporting. The magnitude of the latter correlation is larger for large firms than for small firms, but the standard errors on the coefficients are large enough that the true relationships could be equal. The regressions for medium-sized firms (20-50 employees) show a borderline-significant positive correlation between foreign employees overall and exporting, and an insignificant but imprecisely estimated correlation between high-ability foreign employees and exporting.

## 3.2. Firms with more employees with export experience are more likely to export

Firms that employ a higher proportion of people who previously worked for an exporter are more likely to export. This relationship holds both for high-ability and low-ability employees, but is stronger for high-ability ones. Column 2 of Table 3.1 presents results from a linear probability regression of exporting on several variables relating to the previous experience of the employees, and controls for the firm's fraction of high-ability employees, firm size, industry, survey year, and regional council. The first experience variable is the fraction of employees with experience outside the firm. This largely captures the proportion of relatively new employees in the firm, which we might expect to be negatively correlated with exporting if it indicates high employee turnover caused by underlying issues, or positively correlated if it indicates recent firm growth. In fact, the coefficient is negative and small.

The second experience variable is the fraction of employees with experience at a BOS firm. By definition, this fraction must be no greater than the fraction of employees with outside experience. The primary reason we distinguish BOS from non-BOS past employers is that we don't know the exporting status of non-BOS firms. Because the probability that a firm is sampled in BOS is increasing with firm size, non-BOS firms will be smaller than BOS firms on average and thus, because of the positive correlation between firm size and exporting, less likely to be exporters. Including this second experience control allows for this possibility, although the coefficient itself on the variable has no clear interpretation.

The third experience variable is the fraction of employees with experience at a BOS firm that exports. This fraction is by definition no greater than the fraction of employees with experience at a BOS firm. If employees who work for an exporter gain knowledge of exporting that helps their future employers to successfully export, then we would expect the coefficient on this variable to be positive. Indeed, we see a large positive coefficient of 0.333. This suggests that changing 10 percent of a firm's employees from workers who previously were employed by a BOS firm that *does not* export to workers who were previously employed by a BOS firm that *does* export is associated with a 3.3 percentage point (18.3 percent) increase in the probability that the firm exports. This correlation is unaffected by simultaneously controlling for foreign employees, as in column 3.

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[17] While industry fixed effects (for the 53 NZSIOC categories) control for any predisposition to enter export-intensive industries, they do not fully capture the firm characteristics that may also attract foreign workers.

**Table 3.2: The foreign employee-exporting relationship by firm size**

| Dependent variable: | Firm size (number of employees) | | | | | |
|---|---|---|---|---|---|---|
| Firm exports | 6-20 | 6-20 | 20-50 | 20-50 | 50+ | 50+ |
| **Fraction of employees who are/have:** | | | | | | |
| Foreigners | 0.018 | | 0.078* | | 0.004 | |
| | (0.042) | | (0.041) | | (0.049) | |
| High-ability foreigners | 0.335*** | | 0.056 | | 0.538*** | |
| | (0.128) | | (0.202) | | (0.194) | |
| Outside experience | | -0.022 | | -0.140** | | -0.110** |
| | | (0.040) | | (0.055) | | (0.054) |
| High-ability, with outside experience | | 0.013 | | -0.017 | | -0.107 |
| | | (0.082) | | (0.144) | | (0.135) |
| Experience at a BOS firm | | -0.022 | | 0.049 | | -0.061 |
| | | (0.055) | | (0.082) | | (0.082) |
| High-ability, with experience at a BOS firm | | -0.031 | | -0.408* | | -0.640*** |
| | | (0.112) | | (0.217) | | (0.215) |
| Experience at a BOS exporter | | 0.179* | | 0.267* | | 0.352*** |
| | | (0.101) | | (0.153) | | (0.128) |
| High-ability, with experience at a BOS exporter | | 0.301 | | 0.591* | | 0.606** |
| | | (0.219) | | (0.352) | | (0.305) |
| High-ability | 0.089** | 0.120** | 0.239*** | 0.292*** | 0.155*** | 0.388*** |
| | (0.037) | (0.058) | (0.072) | (0.101) | (0.055) | (0.074) |
| Number of employees (ln) | 0.046*** | 0.049** | 0.056** | 0.052* | 0.017** | 0.016** |
| | (0.017) | (0.019) | (0.028) | (0.028) | (0.007) | (0.007) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| *R-Squared* | *0.208* | *0.217* | *0.298* | *0.304* | *0.395* | *0.402* |
| *Observations* | *7,617* | *6,735* | *5,406* | *5,358* | *9,249* | *9,249* |
| *Weighted fraction of successes* | *0.147* | *0.156* | *0.214* | *0.214* | *0.302* | *0.302* |

Notes: Each column presents the results of a linear probability regression of firm exporting on employee characteristics. Firms are stratified by size as given in the column headers. See Section 2 for the definitions of the independent variables. Data are from 2005, 2007, 2009 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

We might hypothesise that the experience of working for an exporter matters more for some employees than others. For instance, senior managers are more likely to transfer relevant knowledge between firms than are staff in production or customer service roles. We thus next explore how the correlations between worker experience and exporting differ for high-ability relative to low-ability employees.

In addition to the controls in column 2, column 5 of Table 3.1 controls for the fraction of employees who have both outside experience and high ability, the fraction who have experience with a BOS firm and high ability, and the fraction who have experience with a BOS exporter and high ability.

The results suggest that the only employee experience correlated with firm exporting is experience with a BOS exporter, and that this correlation is stronger for high-ability employees than for low-ability employees.[18] The point estimates suggest that changing 10 percent of a firm's employees from low-ability workers who previously were employed by a BOS firm that *does not* export to low-ability workers who were previously employed by a BOS firm that *does* export is associated with a 2.3 percentage point (12.8 percent) increase in the probability that the firm exports. A similar replacement among the firm's high-ability workers is associated with a 6.0 percentage point (32.7 percent) increase in the probability of exporting.

These correlations do not change substantially when we also control for the fractions of foreign and of high-ability foreign employees (column 6), and for whether the firm owns or is owned by a foreign business (column 7).

These results are consistent with employees who work for exporters gaining knowledge that they use to help their future employers export. However, an alternative explanation for the observed correlations is that employees tend to move between similar firms, and similar firms are likely to have similar exporting activity.

The second, fourth, and sixth columns of Table 3.2 replicate column 5 of Table 3.1, but stratify firms by size. These results suggest that the positive correlation between the exporting experience of employees and firm exporting is present across firm sizes. Although the correlations are imprecisely estimated, they appear stronger for larger firms, both for employees overall and for high-ability employees.

## 3.3. Employee characteristics are correlated with other types of international engagement

The proportions of foreign employees and employees with export experience are also positively correlated with many other types of international engagement by firms, particularly for high-ability employees. Table 3.3 presents results from regressions of a number of different types of international engagement on firm characteristics, including the proportions of foreign employees, high-ability foreign employees, employees with exporting experience, and high-ability employees with exporting experience. Regressions include industry and regional council fixed effects and firm size, so compare firms within the same industry, while allowing for size-related and location-related differences.

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[18] Some of the coefficients on the other experience variables are estimated imprecisely, and thus don't allow us to rule out sizeable correlations with exporting.

**Table 3.3: Foreign employees are positively correlated with most international engagement**

| Dependent variable: | (1) Fraction of sales from exports | (2) Fraction of sales from exports (exporters only) | (3) Number of countries where earning (ln) | (4) Entered a new export market | (5) Firm partly/wholly owned by foreign business | (6) Firm has ownership interest in foreign business | (7) Overseas production of good/service | (8) Direct purchases from overseas |
|---|---|---|---|---|---|---|---|---|
| **Fraction of employees who are/have:** | | | | | | | | |
| Foreigners | **0.083*** | **0.371*** | **0.299** | **0.071*** | **0.069** | 0.013 | 0.024 | 0.013 |
| | **(0.022)** | **(0.081)** | **(0.125)** | **(0.017)** | **(0.030)** | (0.016) | (0.025) | (0.052) |
| High-ability foreigners | **0.157** | 0.130 | 0.504* | 0.036 | 0.387*** | 0.022 | 0.188 | 0.504*** |
| | **(0.073)** | (0.222) | (0.296) | (0.056) | (0.089) | (0.047) | (0.118) | (0.152) |
| Outside experience | -0.026 | -0.043 | -0.170* | 0.013 | 0.028 | 0.011 | 0.023 | -0.002 |
| | (0.019) | (0.066) | (0.092) | (0.015) | (0.018) | (0.018) | (0.025) | (0.064) |
| High-ability, with outside experience | 0.008 | -0.047 | -0.001 | 0.008 | -0.136*** | -0.021 | -0.015 | 0.037 |
| | (0.042) | (0.140) | (0.190) | (0.034) | (0.042) | (0.043) | (0.063) | (0.131) |
| Experience at a BOS firm | -0.004 | 0.049 | -0.077 | 0.023 | 0.054** | 0.011 | -0.025 | -0.133 |
| | (0.020) | (0.101) | (0.149) | (0.019) | (0.026) | (0.017) | (0.033) | (0.085) |
| High-ability, with experience at a BOS firm | -0.036 | -0.098 | -0.005 | -0.012 | -0.002 | -0.053 | 0.024 | 0.351* |
| | (0.048) | (0.185) | (0.329) | (0.058) | (0.065) | (0.047) | (0.081) | (0.184) |
| Experience at a BOS exporter | **0.157*** | **0.151** | **0.179** | **0.006** | **0.070** | **-0.008** | **0.080** | **0.286** |
| | **(0.044)** | **(0.133)** | **(0.242)** | **(0.040)** | **(0.050)** | **(0.036)** | **(0.071)** | **(0.138)** |
| High-ability, with experience at a BOS exporter | **0.109** | **0.127** | **1.263*** | **0.216*** | **0.410*** | **0.266*** | **0.001** | **0.158** |
| | **(0.104)** | **(0.288)** | **(0.673)** | **(0.122)** | **(0.121)** | **(0.102)** | **(0.150)** | **(0.286)** |
| High-ability | 0.024 | 0.048 | 0.143 | 0.044* | 0.214*** | 0.074*** | 0.036 | 0.132 |
| | (0.035) | (0.126) | (0.128) | (0.023) | (0.031) | (0.026) | (0.033) | (0.086) |
| Number of employees (ln) | 0.008*** | -0.013* | 0.096*** | 0.011*** | 0.058*** | 0.025*** | 0.019*** | 0.080*** |
| | (0.002) | (0.008) | (0.012) | (0.002) | (0.003) | (0.002) | (0.003) | (0.006) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *R-Squared* | *0.202* | *0.330* | *0.178* | *0.109* | *0.164* | *0.055* | *0.101* | *0.245* |
| *Observations* | *21,339* | *5,628* | *10,683* | *21,054* | *21,273* | *21,300* | *10,500* | *10,503* |
| *Weighted fraction of successes* | | | | *0.044* | *0.074* | *0.035* | *0.055* | *0.304* |

Notes: Each column presents the results of an OLS regression of a different measure of firm international engagement on employee characteristics. See Section 2 for the definitions of the independent variables. In columns (1), (2), (4), (5), and (6) data are from 2005, 2007, 2009 and 2011. In the other columns, data are from 2007 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Changing 10 percent of a firm's employees from low-ability natives to low-ability foreigners is associated with a:

- 0.83 percentage point higher fraction of sales from exports among all firms (column 1);
- 3.7 percentage point higher fraction of sales from exports among exporters (column 2);
- 3.0 percent greater number of countries where the firm earns income (column 3);
- 0.71 percentage point (16 percent) higher probability of having entered a new export market in the last year (column 4); and a
- 0.69 percentage point (9.3 percent) higher probability of being partially foreign owned (column 5).

A similar employee substitution among high-ability workers is associated with much larger changes in the fraction of sales from exports, the number of countries where the firm earns income, and whether the firm is owned by a foreign business. It is also associated with a substantial 5.2 percentage point (17 percent) increase in the probability that the firm makes direct purchases from overseas (column 8).[19]

## 3.4. Does the duration of residence in New Zealand of foreign employees matter?

Table 3.4 presents the results of regressions of firm exporting on foreign employees where foreign employees are disaggregated by duration of residence in New Zealand. Long-term migrants are those who have spent at least two months in New Zealand every year for the previous 5 or more years. Medium-term migrants have done so for the previous 3 to 4 years, and short-term migrants for 2 or fewer years. Foreigners with more erratic patterns of residency over the preceding 6 years are classified as "other non-natives".

Theoretically, it is unclear which types of migrant are expected to be most correlated with firm exporting. Migrants' foreign connections and foreign knowledge may depreciate the longer they are in New Zealand, or they may gain insights into New Zealand that help them to better use their foreign knowledge for successful exporting. In addition, the types of people who migrate to New Zealand long term may be quite different on average to those who are only in New Zealand for a short period.

Column 1 shows that the fraction of long-term migrant employees is positively and significantly correlated with firm exporting, though the relationship decreases in magnitude and becomes statistically insignificant when fixed effects for industry and regional council are added, as in column 2. The sizes of the standard errors suggest there isn't enough statistical power in these regressions to draw firm conclusions about the type of migrants who are most correlated with firm exporting.

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[19] Being calculated from the sum of the coefficients on foreign employees (0.013) and high ability foreign employees (0.504).

**Table 3.4: Duration of migrants' residence and firm exporting**

| | mean (std dev) | Dependent variable: Firm exports | |
| --- | --- | --- | --- |
| | | (1) | (2) |
| Fraction of employees who are long-term migrants | 0.074 | 0.183*** | 0.077 |
| | (0.077) | (0.060) | (0.058) |
| Fraction of employees who are medium term migrants | 0.025 | 0.151 | 0.118 |
| | (0.043) | (0.098) | (0.102) |
| Fraction of employees who are short term migrants | 0.056 | -0.037 | 0.011 |
| | (0.088) | (0.045) | (0.040) |
| Fraction of employees who are other non-natives | 0.008 | 0.128 | 0.143 |
| | (0.020) | (0.190) | (0.170) |
| Number of employees (ln) | | 0.036*** | 0.034*** |
| | | (0.004) | (0.004) |
| Firm partly/wholly owned by foreign business | | 0.192*** | 0.108*** |
| | | (0.022) | (0.020) |
| Firm has ownership interest in foreign business | | 0.362*** | 0.273*** |
| | | (0.035) | (0.030) |
| Survey year fixed effects | | Yes | Yes |
| Industry fixed effects | | | Yes |
| Regional council fixed effects | | | Yes |
| *R-Squared* | | *0.074* | *0.255* |
| *Observations* | | *22,125* | *22,074* |
| *Weighted fraction of successes* | | *0.172* | *0.173* |

Notes: The numbered columns present the results of linear probability regressions of firm exporting on employee characteristics. The left hand column presents the means and standard deviations of the independent variables of interest. Data are from 2005, 2007, 2009 and 2011. Observations in the regressions are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

## 3.5. The original country of foreign employees matters for firm exporting

Employees from Europe are strongly correlated with firm exporting, whereas employees from Asia show almost no correlation with firm exporting.

There are reasons to hypothesise that employees from some regions have a larger effect on exporting than do employees from other regions. Employees from different origin countries are likely to have different skill sets on average because of the different distributions of skill sets in their countries of origin, and different forces that select who migrates to New Zealand from their countries of origin. For instance, Australians may legally work without restriction in New Zealand, so the Australians working in New Zealand are essentially those who wish to do so. Asian migrants may be more likely to be young and New Zealand-educated, or to face language barriers that limit their potential earnings. Employees from certain countries may be more likely to be refugees, and those from others may be more likely to have gained entry to New Zealand as high-skilled immigrants through the points system.

Alongside differences in migrant composition, source country characteristics themselves may directly affect the strength of the links between migration and export outcomes. In principle, we might expect migrants from countries that are more different from New Zealand in terms of their linguistic, cultural or legal environment to have a greater marginal impact on export performance than those from more similar source countries. Employees with first-hand

knowledge of the destination country may provide an efficient means of addressing the challenges associated with working in a different linguistic or economic system.

However, if barriers to exporting to countries that are most different from New Zealand remain high, or these countries are less attractive export destinations for reasons such as geographic distance or a lack of demand for products from New Zealand, employing workers from these countries may not be sufficient to push firms over the threshold required to export.

Columns 1 and 2 of Table 3.5 present the results from regressions of firm exporting on foreign employees disaggregated by continent of origin. Employees from Australia and the Pacific, and employees from Europe are positively and significantly correlated with exporting in comparisons of firms across industries and regional councils (column 1). When fixed effects for industry and regional council are added in column 2, only the correlation between exporting and employees from Europe remains large and significant. The magnitude of the coefficient suggests that, within industries and regional councils, having a 10 percentage point higher fraction of European employees is associated with a 1.8 percentage point (10 percent) higher probability of exporting.

In contrast, the coefficient on the fraction of employees from Asia is small and sufficiently precisely estimated that we can with reasonable confidence rule out a large positive correlation between Asian employees and firm exporting. This suggests that average Asian employees are unlikely to have large causal impacts on exporting. However, for the reasons suggested previously, the average Asian migrant may have very different characteristics from the average migrant from regions such as Europe, and the lack of a relationship with exporting may reflect the types of Asian migrants currently attracted to New Zealand. The coefficients on employees from the Americas and from the Middle East and Africa are too imprecisely estimated to be able to draw any solid conclusions.

## Table 3.5: Foreign employees by continent and firm exporting

| Fraction of employees who are: | mean (std dev) | Dependent variable: Firm exports | | | |
|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) |
| From Australia/Pacific | 0.038 | 0.329*** | 0.097 | 0.397*** | 0.125* |
| | (0.063) | (0.082) | (0.067) | (0.092) | (0.072) |
| High-ability from Australia/Pacific | 0.007 | | | -0.408 | -0.072 |
| | (0.019) | | | (0.266) | (0.227) |
| From Asia | 0.048 | -0.003 | -0.004 | 0.004 | -0.002 |
| | (0.110) | (0.042) | (0.045) | (0.045) | (0.049) |
| High-ability from Asia | 0.006 | | | 0.200 | 0.225 |
| | (0.024) | | | (0.274) | (0.257) |
| From the Americas | 0.009 | 0.001 | 0.096 | 0.061 | 0.067 |
| | (0.027) | (0.135) | (0.112) | (0.143) | (0.120) |
| High-ability from the Americas | 0.002 | | | -0.058 | 0.251 |
| | (0.011) | | | (0.434) | (0.405) |
| From Europe | 0.056 | 0.171** | 0.184*** | 0.013 | 0.044 |
| | (0.069) | (0.069) | (0.059) | (0.073) | (0.062) |
| High-ability from Europe | 0.020 | | | 0.376* | 0.392** |
| | (0.039) | | | (0.202) | (0.176) |
| From Middle East/Africa | 0.015 | -0.037 | -0.096 | -0.272*** | -0.221** |
| | (0.033) | (0.095) | (0.086) | (0.104) | (0.099) |
| High-ability from Middle East/Africa | 0.005 | | | 0.635* | 0.351 |
| | (0.017) | | | (0.346) | (0.339) |
| High-ability | 0.266 | | | 0.128*** | 0.092*** |
| | (0.192) | | | (0.034) | (0.033) |
| Number of employees (ln) | | 0.035*** | 0.034*** | 0.034*** | 0.034*** |
| | | (0.004) | (0.004) | (0.004) | (0.004) |
| Firm partly/wholly owned by foreign business | | 0.194*** | 0.107*** | 0.171*** | 0.091*** |
| | | (0.022) | (0.020) | (0.022) | (0.020) |
| Firm has ownership interest in foreign business | | 0.365*** | 0.274*** | 0.353*** | 0.269*** |
| | | (0.035) | (0.030) | (0.034) | (0.030) |
| Survey year fixed effects | | Yes | Yes | Yes | Yes |
| Industry fixed effects | | | Yes | | Yes |
| Regional council fixed effects | | | Yes | | Yes |
| | | | | | |
| *R-Squared* | | *0.075* | *0.256* | *0.083* | *0.261* |
| *Observations* | | *22,125* | *22,074* | *22,125* | *22,074* |
| *Weighted fraction of successes* | | *0.172* | *0.173* | *0.172* | *0.173* |

Notes: The columns numbered (1) to (4) present the results of linear probability regressions of firm exporting on employee characteristics. See Section 2 for the definitions of the independent variables; their means and standard deviations are presented in the first column. Data are from 2005, 2007, 2009 and 2011. Observations in the regressions are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Figure 3.1 supports the hypothesis that workers from different continents have different average skills (or have skills that are not equally valued by New Zealand employers). It shows the distribution of worker fixed effects by continent of origin; this distribution lies further left for migrants from Asia, Australia and the Pacific, and the Americas than for migrants from Europe and the Middle East and Africa. This is consistent with some of the variation in the relationship between exporting and migrant employees from different countries being driven by the different skill distributions of the migrants.

**Figure 3.1: Kernel density of worker ability by continent of origin**
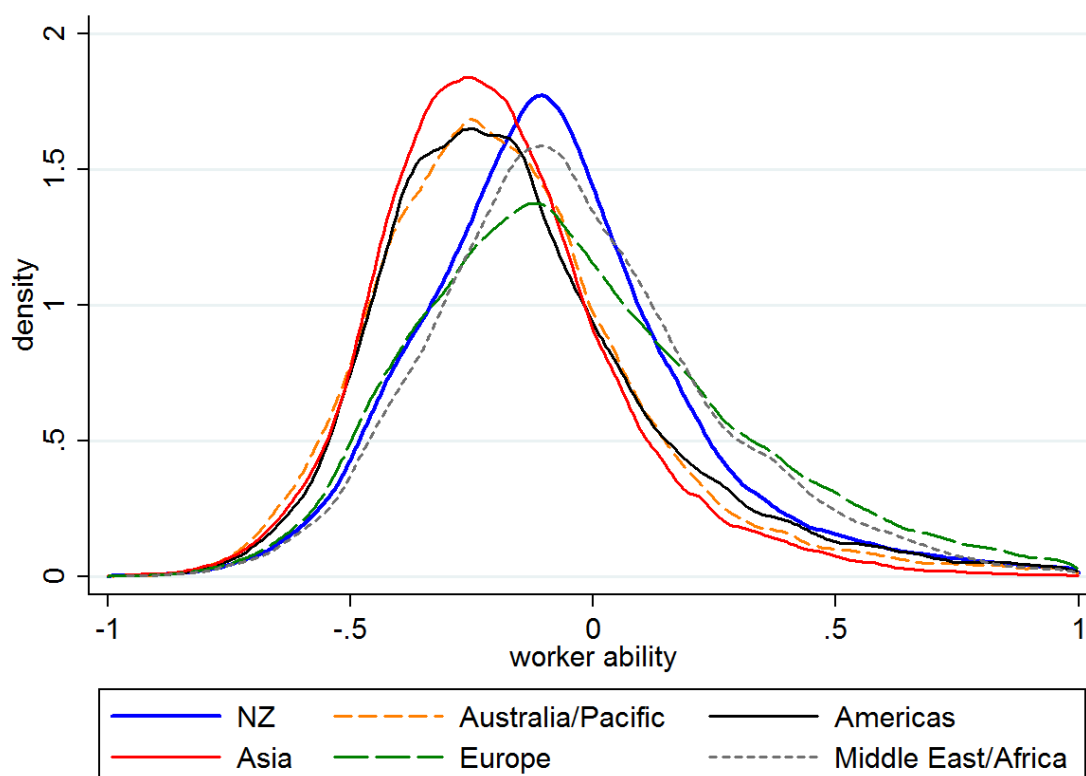


Notes: This figure plots the kernel density of worker fixed effects, as described in Section 2, for native employees and migrant employees from different continents. 3.6. Foreign employees from developed countries are particularly correlated with exporting to their country of origin.

Columns 3 and 4 of Table 3.5 investigate the correlations between employees from the different continents and firm exporting, allowing these relationships to differ for high-ability and low-ability employees. The results suggest that, relative to native low-ability employees, low-ability employees from Australia and the Pacific are associated with a higher probability of exporting. Relative to high-ability natives, high-ability employees from Europe are associated with a higher probability of exporting. High-ability employees from Asia may be positively correlated with exporting, but they are a low proportion of total Asian employees and estimates of these coefficients are too imprecise to say with any degree of certainty.[20]

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[20] We might hypothesise that employees from developed countries have a different effect on exporting to employees from developing countries, but a greater degree of geographical disaggregation is not feasible here because of a lack of statistical power.

On average, the probability that a firm earns income in a given country is more correlated with its fraction of employees from that country than with its total fraction of foreign employees. However, the positive correlation between foreign employees and their firm earning income in their country of origin is entirely driven by employees from *developed* countries. Employees from *developing* countries are not associated with a higher probability of their firms earning income in their countries of origin.

Column 1 of Table 3.6 presents the results from a probit regression of whether a firm earns income[21] in a specific country on its fraction of employees from that country and fraction of foreign employees from any country, plus additional controls.[22] An observation is thus a BOS respondent firm in a survey year coupled with a foreign country. The countries included are those in which a sizeable fraction of New Zealand firms earn income, namely, Australia, India, Japan, China, the USA, Great Britain, Malaysia, the Republic of Korea, Canada, and Germany. The developing countries among these are India, China, and Malaysia; the others are developed countries.

The marginal effects of interest are those on the fraction of employees who are from the specific country, and on the fraction of employees who are foreign overall. These regressions include fixed effects for foreign country, survey year, industry, and regional council, so the comparisons captured in the marginal effects relate to firms in the same industry, allowing for common changes over time and common variation by region of the country, and controlling for the overall propensity to export to certain countries.

The marginal effect of 0.014 on fraction of foreign employees overall suggests that changing 10 percent of the employees of a firm from natives to foreigners is associated with a negligible 0.14 percentage point (2.6 percent) increase in the probability of the firm earning income in each of New Zealand's major trading partners. It is also associated with a much larger 0.47 percentage point (8.7 percent) increase in the probability of the firm earning income in the home country of the foreign employees.[23] This shows that foreign employees are mainly associated with their firm having foreign earnings in their countries of origin, rather than foreign earnings in general. This is what we would expect if foreign employees have particular knowledge about or connections in their home countries that provide a benefit for exporting. It is less consistent with the situation where foreign employees are merely attracted to the types of firms that are more likely to export.

Column 2 of Table 3.6 investigates the same relationship, but allows it to differ for high-ability and low-ability employees. We find that both high- and low-ability foreign employees are positively correlated with their firm earning income in their country of origin, but only high-ability foreign employees are associated with their firm earning foreign income more generally. This is consistent with a situation where all foreign employees have some useful knowledge about their home country, but high-ability foreign employees have additional knowledge that gives their employer an advantage in earning foreign income more generally.

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[21] BOS does not ask which specific destination countries firms export to, which is why this analysis uses the dependent variable "firm earns income in the foreign country" rather than "firm exports to the foreign country". Note however, that a high proportion of foreign income does come from exporting.

[22] Probit regressions are used here instead of OLS (linear probability) because the fraction of successes is small. If OLS is used instead, the results are qualitatively unchanged, though the estimated magnitudes of the relationships tend to be larger.

[23] This 0.47 percentage points comes from adding the coefficients on foreigners in general and foreigners from the specific country.

**Table 3.6: Foreign employees are more correlated with firms earning income in their home countries**

| Dependent variable: Firm earns income in specific country | mean (sd) | (1) | (2) | (3) |
|---|---|---|---|---|
| **Fraction of employees who are:** | | | | |
| From specific country | 0.010 | 0.033*** | 0.030*** | -0.020 |
| | (0.038) | (0.009) | (0.010) | (0.018) |
| High-ability from specific country | 0.003 | | 0.011 | |
| | (0.015) | | (0.025) | |
| Foreign | 0.169 | 0.014* | 0.008 | 0.022** |
| | (0.162) | (0.008) | (0.010) | (0.009) |
| High-ability foreign | 0.040 | | 0.042* | |
| | (0.062) | | (0.024) | |
| High-ability | 0.263 | | 0.010 | |
| | (0.188) | | (0.010) | |
| **Specific country is developed * fraction of employees who are:** | | | | |
| From specific country | 0.007 | | | 0.095*** |
| | (0.028) | | | (0.026) |
| High-ability from specific country | 0.003 | | | |
| | (0.014) | | | |
| Foreign | 0.117 | | | -0.011** |
| | (0.156) | | | (0.005) |
| High-ability foreign | 0.028 | | | |
| | (0.055) | | | |
| High-ability | 0.183 | | | |
| | (0.198) | | | |
| Number of employees (ln) | | 0.006*** | 0.006*** | 0.006*** |
| | | (0.001) | (0.001) | (0.001) |
| Firm partly/wholly owned by foreign business | | 0.013*** | 0.009*** | 0.012*** |
| | | (0.004) | (0.003) | (0.004) |
| Firm has ownership interest in foreign business | | 0.039*** | 0.037*** | 0.039*** |
| | | (0.011) | (0.010) | (0.010) |
| Foreign country fixed effects | | Yes | Yes | Yes |
| Survey year fixed effects | | Yes | Yes | Yes |
| Industry fixed effects | | Yes | Yes | Yes |
| Regional council fixed effects | | Yes | Yes | Yes |
| | | | | |
| *Pseudo R-Squared* | | *0.213* | *0.217* | *0.215* |
| *Observations* | | *104,271* | *104,271* | *104,271* |
| *Weighted fraction of successes* | | *0.054* | *0.054* | *0.054* |

Notes: Each numbered column presents the marginal effects from a probit regression at the firm-foreign country level of the firm earning overseas income in that country on employee characteristics. The foreign countries included are Australia, India*, Japan, China*, USA, Great Britain, Malaysia*, the Republic of Korea, Canada, and Germany. *s denote developing countries; other countries are developed. Data are from 2007 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Column 3 allows the relationship between foreign employees and overseas income to vary by whether the foreign employees are from a developed or a developing country. These results show that the correlation between foreign employees and firm income earned in their home country is entirely driven by foreign employees from developed countries. Changing 10 percent of a firm's employees from natives to foreigners from developed country X is associated with a 0.75 percentage point (13.9 percent) higher probability of the firm earning

income in country X, but only a small increase in the probability of the firm earning income in other overseas countries. An increase in employees from a developing country, in contrast, is associated with a small and insignificant decrease in the probability of their firm earning income in their country of origin.

These patterns are consistent with foreign employees from developed countries providing their firms with some kind of specialist knowledge or connections that help the firms to earn income in the employees' home countries. However, the regressions find no evidence of such a mechanism operating for employees from developing countries such as China, India, and Malaysia.

One possible explanation may lie in the types of employees attracted from developing relative to developed countries. For instance, if migrants from developing countries tend to be young former international students, they may lack both business contacts back home and business experience in their country of origin, which limits their effect on exporting.[24]

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[24] This result is consistent with the ability to speak Mandarin, for instance, being very useful for firm exporting, but only when it occurs in combination with another characteristic that Asian immigrants may tend to lack, such as proficiency in English, or business networks back home.

# 4. Results on international engagement and firms' innovation

## 4.1. Firms that export innovate more

Firms that export are more likely to innovate. The magnitude of the correlation decreases, but only slightly, when firm size is controlled for, suggesting larger firms both export and innovate more, but size doesn't explain the majority of the relationship.

Table 4.1 presents the results of linear probability regressions of having introduced various types of innovation in the past two years on being an exporter and other firm characteristics.[25] The first column regresses product innovation on exporting, survey year fixed effects, industry fixed effects, and regional council fixed effects.  It shows that an exporter is 16.4 percentage points (83 percent) more likely to have introduced a product innovation than a non-exporter in the same region, year and industry. Adding a control for firm size (column 2) decreases this value slightly to 15.6 percentage points; also controlling for whether a foreign business has any ownership of the firm and whether the firm has an ownership interest in any foreign business reduces it further to 14.4. However, this correlation is still economically and statistically significant.

The last three columns of Table 4.1 examine the same relationship for three other types of innovation: organisational, operational process, and marketing. In each case, exporters are significantly more likely to innovate than are similar non-exporters, though the magnitudes are all considerably smaller than in the case of product innovation. An exporter is 6.0 percentage points (26 percent) more likely to introduce an organizational innovation, 7.8 percentage points (45 percent) an operational process innovation, and 6.1 percentage points (28 percent) a marketing innovation.

These regressions are consistent with a positive effect of exporting on all four types of innovation. Such effects could arise because exporting exposes firms to new knowledge and ways of operating, or because facing a larger market makes innovation more worthwhile. The results could alternatively arise from innovation causing exporting by making firms more competitive in overseas markets, or because certain types of managers have stronger preferences for both exporting and innovation.

Table 4.2 shows that the positive correlation between firm exporting and innovation is present across firm sizes. The magnitude of the correlation is similar for medium (20-50 employees) and large firms (50+ employees), and somewhat stronger for small firms (6-20 employees), despite small firms having a lower innovation rate on average.

## 4.2. Whether a firm exports is what matters for innovation, not how much it exports

Exporters are more likely to introduce product innovations than are non-exporters, but among firms that do export the fraction of their sales that come from exports bears little correlation with product innovation. However, firms that export to a higher number of countries are more likely to innovate than are those that serve fewer foreign markets.

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[25] We also ran these regressions including firm fixed effects, and thus identifying solely off within-firm variation (results not presented). However, these regressions had low statistical power and few coefficients were ever significant.

**Table 4.1: Firms that export are more likely to innovate**

| Dependent variable:<br>Introduced an innovation of type: | Product | Product | Product | Organisational | Operational process | Marketing |
|---|---|---|---|---|---|---|
| Exporter | 0.164*** | 0.156*** | 0.144*** | 0.060*** | 0.078*** | 0.061*** |
| | (0.016) | (0.016) | (0.016) | (0.015) | (0.013) | (0.015) |
| Number of employees (ln) | | 0.026*** | 0.020*** | 0.049*** | 0.034*** | 0.016*** |
| | | (0.004) | (0.004) | (0.005) | (0.004) | (0.005) |
| Firm partly/wholly owned by foreign business | | | 0.071*** | 0.018 | 0.009 | 0.017 |
| | | | (0.019) | (0.017) | (0.016) | (0.019) |
| Firm has ownership interest in foreign business | | | 0.106*** | 0.040 | 0.057** | 0.117*** |
| | | | (0.028) | (0.028) | (0.026) | (0.029) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| | | | | | | |
| *R-Squared* | *0.086* | *0.089* | *0.093* | *0.033* | *0.041* | *0.043* |
| *Observations* | *22,446* | *22,446* | *22,269* | *22,233* | *22,254* | *22,233* |
| *Weighted fraction of successes* | *0.197* | *0.197* | *0.197* | *0.229* | *0.174* | *0.220* |

Notes: Each column presents the results of a firm-level linear probability regression of the type of firm innovation given in the column header on firm exporting and other characteristics. Data are from 2005, 2007, 2009 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

**Table 4.2: The exporting-innovation relationship by firm size**

| Dependent variable: Introduced a product innovation | Firm size (number of employees) | | | | | |
|---|---|---|---|---|---|---|
| | 6-20 | 6-20 | 20-50 | 20-50 | 50+ | 50+ |
| Exporter | 0.169*** | 0.159*** | 0.110*** | 0.101*** | 0.117*** | 0.100*** |
| | (0.022) | (0.022) | (0.021) | (0.021) | (0.015) | (0.016) |
| Number of employees (ln) | 0.026 | 0.025 | -0.001 | -0.005 | 0.034*** | 0.026*** |
| | (0.020) | (0.020) | (0.028) | (0.028) | (0.007) | (0.007) |
| Firm partly/wholly owned by foreign business | | 0.104*** | | 0.059** | | 0.014 |
| | | (0.034) | | (0.028) | | (0.015) |
| Firm has ownership interest in foreign business | | 0.112** | | 0.057 | | 0.126*** |
| | | (0.047) | | (0.036) | | (0.021) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| | | | | | | |
| *R-Squared* | *0.088* | *0.093* | *0.082* | *0.084* | *0.116* | *0.121* |
| *Observations* | *7,587* | *7,536* | *5,415* | *5,382* | *9,444* | *9,354* |
| *Weighted fraction of successes* | *0.178* | *0.179* | *0.226* | *0.227* | *0.291* | *0.291* |

Notes: Each column presents the results of a firm-level linear probability regression of an indicator for product innovation on firm exporting and other characteristics. Firms are stratified by size as given in the column headers. Data are from 2005, 2007, 2009 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Exporting, innovation and the role of immigrants

The first column of Table 4.3 regresses product innovation on whether a firm exports at all, the fraction of its sales from exports, and other controls. It shows that whether a firm exports at all drives the entire correlation between exporting and innovation. The coefficient on the exporting indicator is 0.142, suggesting a firm that exports is 14 percentage points more likely to introduce a product innovation than a firm that does not export. The coefficient on fraction of sales from exports, on the other hand, has the economically small value of 0.005 and is statistically insignificant.

The second column of Table 4.3 examines the relationship between the number of overseas countries where the firm earned income and product innovation.[26] The coefficients on the numbers of export markets show how the innovation of firms that earn income from many markets compares with the innovation of firms that do not earn income overseas. All these coefficients are positive, economically sizeable, and statistically significant, suggesting earning foreign income from any number of countries is correlated with higher innovation. In addition, the coefficients tend to be larger for larger numbers of countries. For instance, a firm that earns income from just one foreign market is 9.1 percentage points more likely to innovate, whereas a firm that serves 51 or more foreign markets is 37 percentage points more likely to innovate.

Caution should be taken in interpreting these regressions not only because the relationship is not necessarily causal, but also because the fixed costs involved in exporting to a particular market suggest that most firms are unlikely to export in very small quantities to any one market. However, one explanation that is consistent with these findings is that each additional market that a firm serves provides a certain impetus to its innovation, potentially through exposing it to an additional set of new ideas.

## 4.3. Exporting is correlated with most alternative measures of innovation

Exporting is also positively correlated with alternative measures of innovation activity: introducing a product that is new to NZ, conducting R&D, and implementing a major change in production technology.

Most of this analysis focuses on firm innovation as measured by the introduction of a new product, new organizational or management strategy, new operational process, or sales or marketing innovation. However, exporting is positively correlated with most potential measures of innovation that can be derived from the BOS data.[27] The final three columns of Table 4.3 show the relationship between exporting and three alternative measures of innovation. The coefficients suggest that, relative to a non-exporter, an exporter is 8.6 percentage points (99 percent) more likely to introduce a product that is new to New Zealand, 12 percentage points (149 percent) more likely to conduct R&D, and 1.3 percentage points (20 percent) more likely to implement a major change in its production technology.[28] The probability of conducting R&D also rises significantly as imports as a fraction of the firm's sales rise.

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[26] The number of export markets is not specifically asked in BOS, but the most common means of earning overseas income is exporting. We refer to the number of overseas markets where the firm earned income somewhat loosely as the number of export markets.

[27] For the sake of conciseness, most of these regressions are not presented.

[28] The coefficient on being an exporter is not statistically significant in the regression for introducing a major technology change when fraction of sales from exports is also included as a control. When fraction of sales from exports is dropped, the coefficient on exporting increases in magnitude and becomes significant.

## Table 4.3: The robustness of the exporting-innovation correlation

| Dependent variable: | Product innovation | Product innovation | Product innovation | Product innovation | New NZ product | R&D | Major technology change |
|---|---|---|---|---|---|---|---|
| Exporter | 0.142*** | | 0.100*** | | 0.086*** | 0.115*** | 0.013 |
| | (0.021) | | (0.018) | | (0.017) | (0.016) | (0.012) |
| Fraction of sales from exports | 0.005 | | | | 0.020 | 0.072** | 0.020 |
| | (0.034) | | | | (0.028) | (0.028) | (0.017) |
| Number of overseas countries where enterprise earned income (omitted category 0) | | | | | | | |
| 1 | | 0.091*** | | | | | |
| | | (0.029) | | | | | |
| 2-5 | | 0.116*** | | | | | |
| | | (0.026) | | | | | |
| 6-10 | | 0.091** | | | | | |
| | | (0.040) | | | | | |
| 11-20 | | 0.166*** | | | | | |
| | | (0.059) | | | | | |
| 21-50 | | 0.216** | | | | | |
| | | (0.086) | | | | | |
| 51+ | | 0.374*** | | | | | |
| | | (0.143) | | | | | |
| Entered a new export market | | | 0.287*** | | | | |
| | | | (0.033) | | | | |
| Sold manufactured goods to overseas business | | | | 0.113*** | | | |
| | | | | (0.030) | | | |
| Sold manufactured goods to overseas households | | | | 0.144*** | | | |
| | | | | (0.044) | | | |
| Sold raw goods to overseas | | | | -0.036 | | | |
| | | | | (0.039) | | | |
| Sold services to overseas | | | | 0.088*** | | | |
| | | | | (0.030) | | | |
| Number of employees (ln) | 0.020*** | 0.019*** | 0.019*** | 0.020*** | 0.014*** | 0.022*** | 0.010*** |
| | (0.004) | (0.006) | (0.004) | (0.006) | (0.003) | (0.003) | (0.003) |
| Firm partly/wholly owned by foreign business | 0.071*** | 0.065*** | 0.076*** | 0.071*** | 0.071*** | 0.017 | -0.005 |
| | (0.019) | (0.024) | (0.019) | (0.024) | (0.016) | (0.013) | (0.010) |
| Firm has ownership interest in foreign business | 0.106*** | 0.117** | 0.062** | 0.118*** | 0.083*** | 0.136*** | 0.002 |
| | (0.027) | (0.046) | (0.028) | (0.046) | (0.022) | (0.024) | (0.013) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *R-Squared* | *0.093* | *0.099* | *0.109* | *0.095* | *0.100* | *0.125* | *0.024* |
| *Observations* | *22,269* | *10,737* | *22,014* | *11,064* | *21,822* | *22,056* | *21,987* |
| *Weighted fraction of successes* | *0.197* | *0.185* | *0.198* | *0.186* | *0.087* | *0.077* | *0.064* |

Notes: Each column presents the results of a firm-level OLS regression of the measure of firm innovation given in the column header on firm exporting behaviour and other characteristics. Data are from 2005, 2007, 2009 and 2011, except in the second and fourth columns where they are from 2007 and 2011 only. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

## 4.4. Exports of raw goods do not cause innovation

Not all types of exporting are equally correlated with innovation. Exports of manufactured goods to consumers or businesses and exports of services seem positively correlated with most types of innovation, but there is little evidence that exports of raw goods are correlated with any type of innovation.

The fourth column of Table 4.3 presents results from a regression of product innovation on indicators for whether the firm derived overseas income from sales of manufactured goods primarily for business use, sales of manufactured goods primarily for personal or household use, sales of raw or unprocessed goods, and provision of services.[29] The coefficients on the two types of manufactured goods and on services are positive, economically sizeable and statistically significant. In contrast, the coefficient on raw goods is small and insignificant, while being estimated with a moderate degree of precision. Similar regressions for the other three types of innovation give qualitatively the same results.

Given that, if anything, we expect these coefficients to over-estimate the positive effect of exports on innovation, it seems very likely that exports of raw goods do not cause innovation. In the context of the importance to New Zealand of exports of raw goods, this finding could have important implications.

One possible explanation for the lack of relationship between exporting raw goods and innovation is that raw goods by nature tend to have little innovation embedded in them. This could mean that the possibilities for innovation by producers of raw goods are limited, and such innovations are not required for the firm to be competitive internationally, so even if exporting exposes a raw good producer to new ideas, these are unlikely to be converted into innovations. This line of argument is strongest in the case of product innovations; it is possible but less obvious that the nature of raw good producers makes them less reliant on organisational and other types of innovation.

## 4.5. The timing of exporting and innovation

Although the timing of innovation relative to exporting is insufficient to provide definitive evidence on the direction of causality between the two, it can help to provide suggestive evidence.[30] This section uses several different approaches to investigate the temporal relationship between increases in exporting and innovation.

### 4.5.1. Entering a new export market is strongly correlated with innovation

A firm that has just entered a new export market is substantially more likely to have also introduced a product innovation recently.

This result is shown in the third column of Table 4.3, which regresses product innovation on entering a new export market, being an exporter, and other controls. The large positive coefficient on entering a new export market, in addition to the positive coefficient on exporting, suggests it is entering a new export market in particular, not just being involved in a foreign market, that is correlated with high innovation. An exporter is 10 percentage points more likely than a non-exporter to have recently innovated, but this difference increases to 39 percentage points for exporters who have recently entered a new market.

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[29] In 2007, BOS asks firms whether they earn income from each of these sources; in 2011, it asks the percentage of overseas income earned from each. For consistency between years, we consider only indicators for whether the firm earned any income from each of these sources.

[30] See Fabling and Sanderson (2013) for a discussion of investment (or innovation) and exporting might occur in either order as a result of joint decision-making.

This result is consistent with at least two stories. It could be that entering the new market exposes the firm to new ideas, thus causing innovation. Alternatively, the innovation could have come first and made expansion into the new market desirable, or it could have been developed to take into the new market.

### 4.5.2. Innovation is highest when a firm begins earning overseas income

In 2007 and 2011, BOS also asked firms that currently earned overseas income when they first earned overseas income. This enables the construction of a measure of how long since such firms first began earning overseas income, and thus we can examine how the probability of innovation evolves with a firm's export experience.[31]

We regress each different type of innovation in turn on an indicator for the firm having earned overseas income in the past but not currently, and indicator variables for currently earning overseas income and having earned it for different numbers of years. We include the standard controls, as well as a quadratic in firm age to capture the possibility that innovation probability varies over the firm lifecycle.[32] The five panels of Figure 4.1 present the coefficients on the indicators for time earning overseas income in the regressions for the different types of innovation. Although these regressions have limited power, they do seem to suggest that firms that first earned overseas income one or two years ago are most likely to report innovating in the past two years. Long-term earners of overseas income settle in to a lower rate of ongoing innovation than new earners, but a higher rate than that of firms that do not earn overseas income.
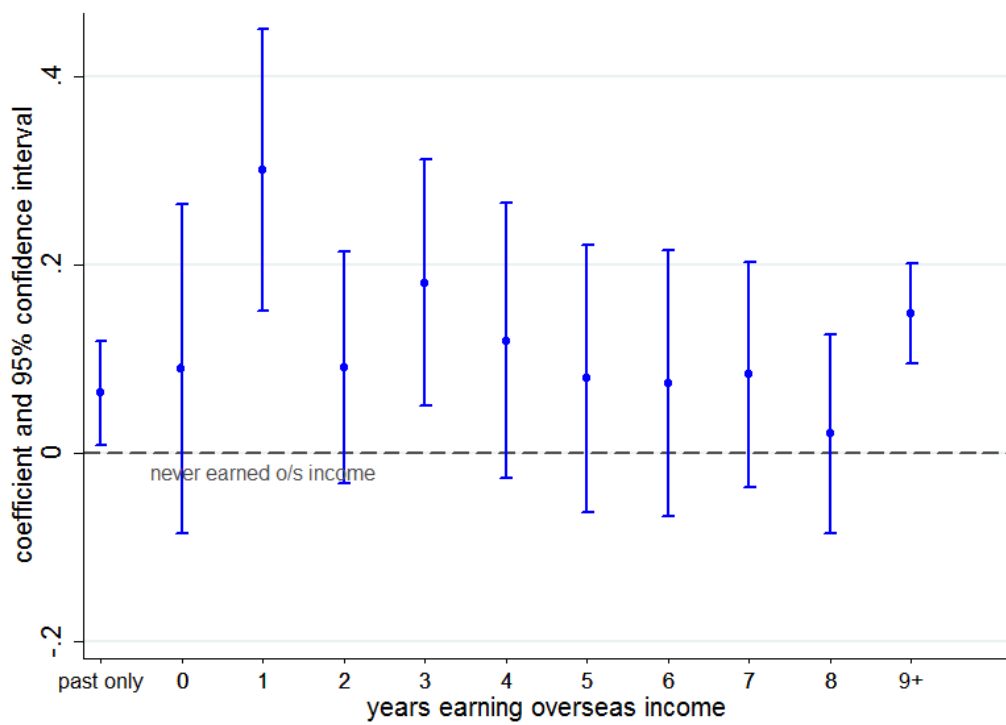
### Figure 4.1. Innovation of firms with different durations earning overseas income
**Panel A: Firm introduced any innovation in the past 2 years**



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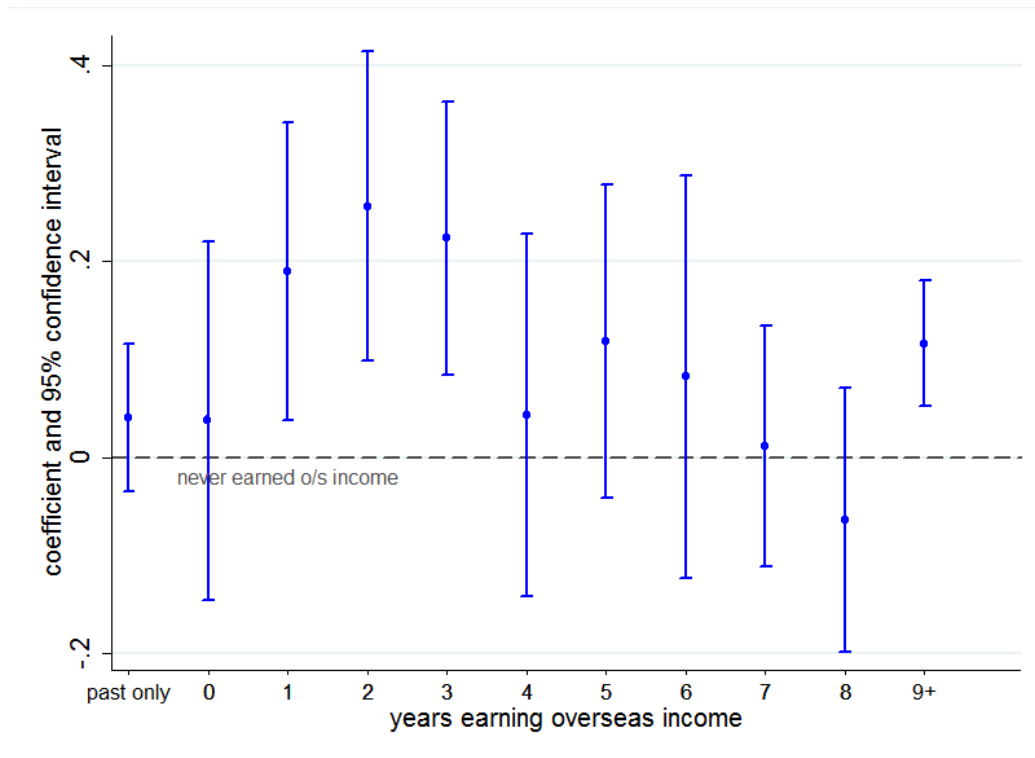
[31] Some firms might have stopped earning overseas income during this period and then restarted.
[32] Replacing the quadratic in firm age with a set of age dummies for <=5 years, 6-10 years, and over 10 years makes little difference to the results.

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## Panel B: Firm introduced a product innovation the past two years



## Panel C: Firm introduced an organisational innovation in the past two years
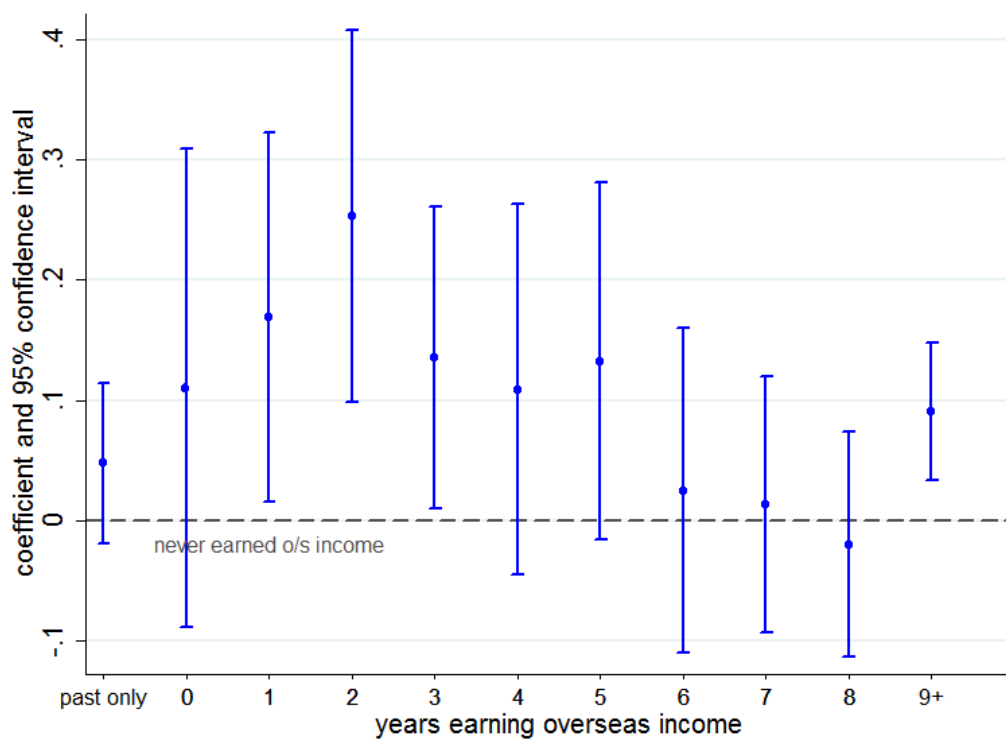
**Panel D: Firm introduced an operational process innovation in the past two years**



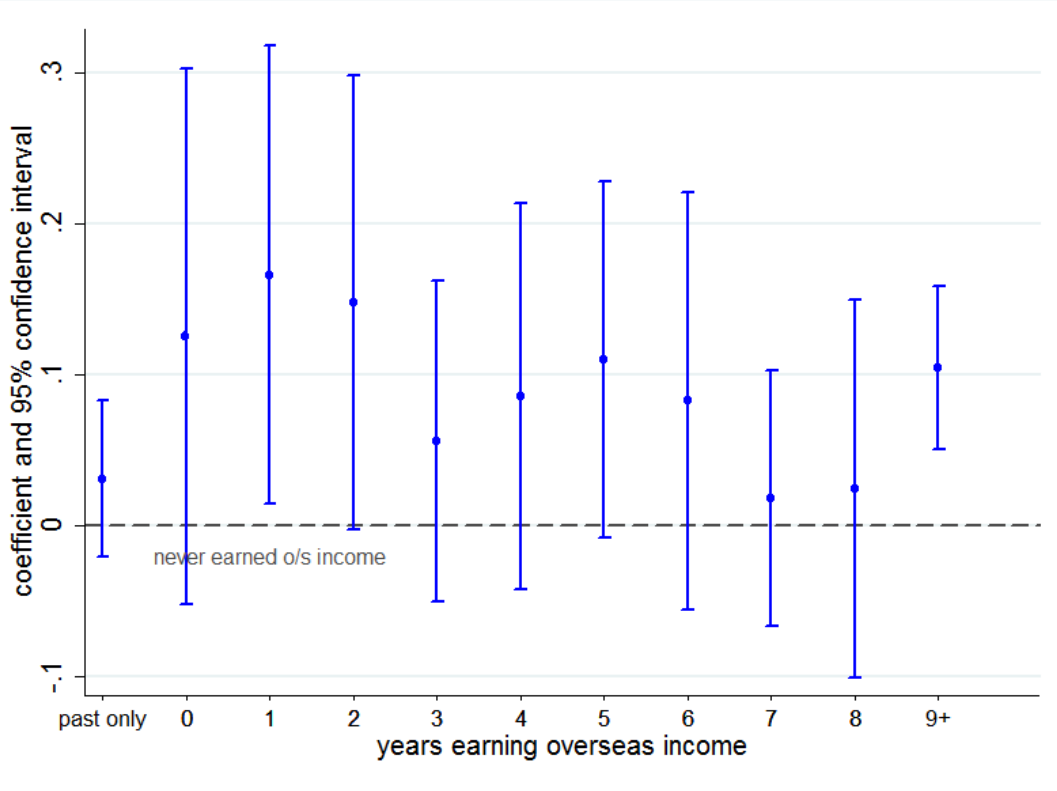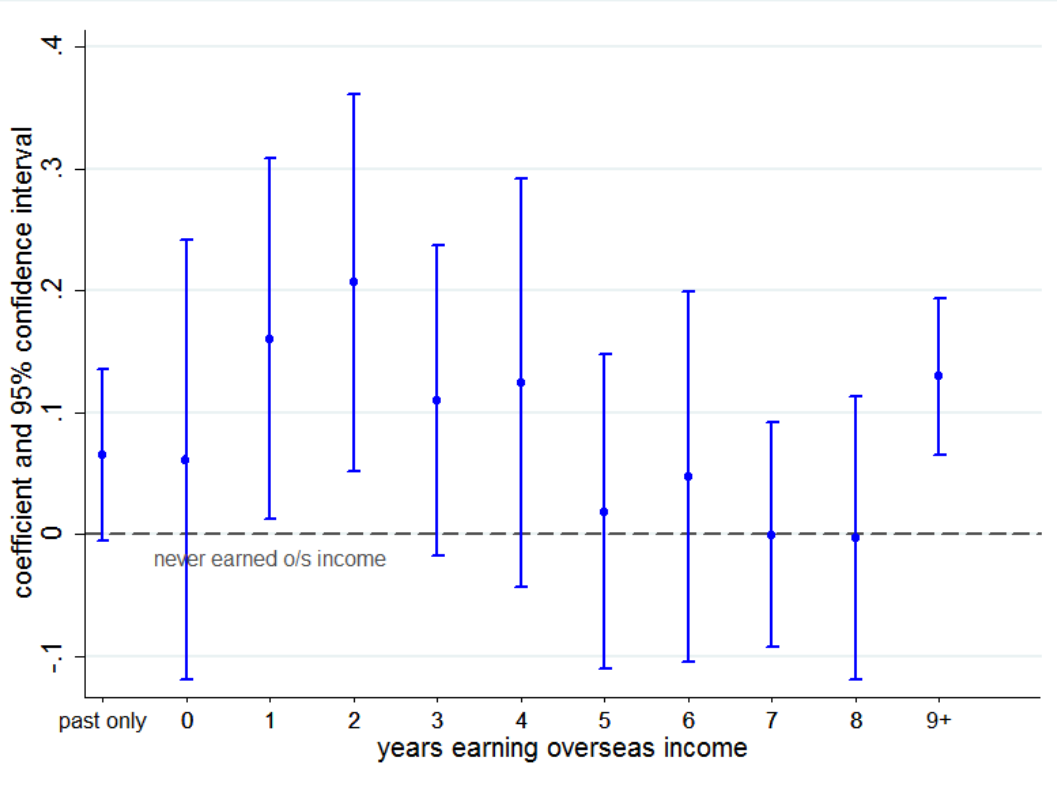**Panel E: Firm introduced a marketing innovation in the past two years**



Notes: Each panel presents coefficients from a firm-level regression of a particular type of innovation on the firm's duration earning overseas income, as described in Section 4.5.2. Each panel has an indicator variable for a different type of innovation as the dependent variable. The grey dashed line represents the level of innovation of firms that have never earned overseas income, which is normalised to zero. The regressions also control for (ln) firm size, a quadratic in firm age, indicators for the firm having any overseas ownership and for the firm having an ownership interest in any overseas business, survey year fixed effects, industry fixed effects, and regional council fixed effects.

### 4.5.3. Innovation is higher for firms that are planning to increase exporting

The difference in innovation between exporters and non-exporters can largely be explained by differences in intentions to expand overseas earnings. Among firms that state they are not interested in increasing their overseas income, there is no evidence that firms that currently earn overseas income innovate more than firms that do not. However, firms that state an interest in expanding their overseas income claim higher innovation rates than those with no interest, regardless of whether they currently earn overseas income. Because firms that currently earn overseas income are more likely to state an interest in expanding this income, average innovation rates are higher for firms that earn overseas income.

Table 4.4 presents the results of OLS regressions of various types of innovation on firm type, where firms are classified by whether they currently earn overseas income and, if not, if they ever have, and by their stated interest in expanding their overseas income. Firm type is captured by a set of indicator variables, the coefficients on which give the innovation propensity of that type relative to the omitted category of firms that have never earned overseas income, and have no interest in doing so. Perhaps surprisingly, the coefficients on firms that earned overseas income in the past, and have no intentions to earn overseas income again, and those that currently earns overseas income, and have no intentions to expand overseas income are economically small and statistically insignificant for most types of innovation. That is, among firms with no intentions to increase their overseas earnings, those that currently earn overseas income (largely exporters) are no more innovative than those that do not.

Firms with an interest in expanding their overseas income or concrete plans to do so have higher rates of most types of innovation, regardless of whether they currently earn overseas income. In fact, in many cases innovation rates are similar for firms with the same intentions regarding overseas income, though different current overseas earning status. These similar innovation rates for groups with similar intentions aggregate into higher innovation rates for firms that currently earn overseas income, as shown in previous sections, because firms that currently earn overseas income are more likely to report interest in expanding their overseas income. Just 9.7 percent of firms that do not earn overseas income state any interest in overseas income, whereas among those currently earning overseas income, 70 percent are at least interested in expanding it, and 31 percent have solid plans that should result in increased overseas income within 12 months.

The finding that earning overseas income is uncorrelated with innovation among firms with no interest in expanding their overseas income could suggest that exporting has no effect on innovation. However, this ignores the potential endogeneity of interest in expanding overseas income. If overseas income drives innovation, which in turn drives an expansion of overseas income, this could cause the patterns observed in the data.

Alternatively, it may be that exporting per se does not drive the innovation rate. Rather, innovation may be the result of firms' exporting strategies, as they develop new products or processes in order to extend their reach into export markets. Finally, as both exporting and innovation are risky activities with potentially high but uncertain payoffs, it may be that less risk-averse managers are more active on both the innovation and exporting fronts, rather than there being a direct connection between the two activities.

**Table 4.4: Innovation is unrelated to having overseas earnings after controlling for intentions to expand overseas earnings**

| | weighted % of firms | Dependent variable: Introduced an innovation of type: | | | | |
|---|---|---|---|---|---|---|
| | | Any | Product | Organisational | Op. process | Marketing |
| **Omitted category: Never earned overseas income, no intentions** | 70.35 | | | | | |
| *Never earned overseas income and:* | | | | | | |
| Interested in overseas income, but no action | 5.27 | 0.258*** | 0.167*** | 0.214*** | 0.141*** | 0.179*** |
| | | (0.044) | (0.044) | (0.044) | (0.039) | (0.043) |
| Exploring options for overseas income | 1.44 | 0.293*** | 0.208*** | 0.169*** | 0.152*** | 0.147*** |
| | | (0.054) | (0.055) | (0.049) | (0.048) | (0.048) |
| Overseas income expected within 12 months | 0.87 | 0.266*** | 0.108* | 0.332*** | 0.322*** | 0.299*** |
| | | (0.096) | (0.056) | (0.090) | (0.095) | (0.087) |
| *Earned overseas income in the past and:* | | | | | | |
| No intentions to earn overseas income | 1.35 | 0.025 | 0.038 | -0.003 | -0.020 | 0.061 |
| | | (0.066) | (0.041) | (0.042) | (0.030) | (0.059) |
| Interested in overseas income, but no action | 0.79 | 0.089 | 0.151** | 0.096 | 0.110 | 0.157** |
| | | (0.082) | (0.071) | (0.070) | (0.070) | (0.069) |
| Exploring options for overseas income | 0.37 | 0.276** | 0.169 | 0.371*** | 0.145 | 0.270** |
| | | (0.124) | (0.107) | (0.120) | (0.102) | (0.124) |
| Overseas income expected within 12 months | 0.34 | 0.321*** | 0.178 | 0.072 | 0.047 | 0.090 |
| | | (0.092) | (0.122) | (0.106) | (0.070) | (0.119) |
| *Currently earn overseas income and:* | | | | | | |
| No intentions to expand overseas income | 5.80 | 0.003 | 0.023 | 0.002 | 0.005 | 0.011 |
| | | (0.033) | (0.022) | (0.023) | (0.022) | (0.026) |
| Interested in expanding overseas income, but no action | 3.44 | 0.069* | 0.115*** | 0.037 | 0.041 | 0.100*** |
| | | (0.039) | (0.032) | (0.027) | (0.025) | (0.037) |
| Exploring optons to expand overseas income | 4.00 | 0.205*** | 0.197*** | 0.141*** | 0.134*** | 0.112*** |
| | | (0.041) | (0.038) | (0.032) | (0.036) | (0.032) |
| Overseas income expected to increase within 12 months | 6.00 | 0.354*** | 0.342*** | 0.285*** | 0.270*** | 0.339*** |
| | | (0.035) | (0.035) | (0.039) | (0.033) | (0.037) |
| Number of employees (ln) | | 0.031*** | 0.024*** | 0.044*** | 0.032*** | 0.013** |
| | | (0.007) | (0.005) | (0.006) | (0.005) | (0.006) |
| Survey year fixed effects | | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | | Yes | Yes | Yes | Yes | Yes |
| *R-Squared* | | *0.082* | *0.127* | *0.080* | *0.077* | *0.089* |
| *Observations* | | *10,638* | *10,968* | *10,944* | *10,959* | *10,962* |
| *Weighted fraction of successes* | | *0.374* | *0.188* | *0.215* | *0.167* | *0.219* |

Notes: Each column after the first presents the results of a firm-level linear probability regression of the type of firm innovation given in the column header on a set of dummy variables that capture the firm's overseas income status and intentions. The first column presents the fraction of firms with each overseas income status. Data are from 2007 and 2011. Observations in the regressions are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

It is also noteworthy that, among firms that state an interest in expanding their overseas income but no current action to do so, the highest innovation rates are among firms that have never earned overseas income, followed by firms that earned overseas income in the past only, and those that currently earn overseas income have the lowest innovation rates. The magnitudes of these differences are smaller for product and marketing innovations, and larger for organisational and operational process innovations. These patterns are consistent with some minimum level of innovation being necessary for international competitiveness; firms that have never earned overseas income but would like to need to undertake this innovation, whereas firms that have earned or currently earn overseas income have already done it.

## 4.6. Export destination may matter

Only exports to certain destinations are correlated with innovation. Firms in the same industry that earn a higher proportion of their income in the Americas are substantially more likely to innovate; those that export to Australia or the Pacific are slightly more likely to innovate than those that do not. Earnings in Asia, on the other hand, show no positive correlation with innovation; in fact, firms that earn higher proportions of their incomes in Asia appear less likely to make operational process or marketing innovations. These relationships are likely to reflect the types of firms that choose to earn income in these regions as well as any effect of foreign earnings on innovation.

Table 4.5 presents the results of linear probability regressions of different types of innovation on indicators for earning income in five different regions of the world, and the fraction of income earned in each, the share earned domestically being the omitted category.[33] The regressions also control for firm size, and whether the firm owns or is owned by any foreign business, and include survey year, industry, and regional council fixed effects. Although innovation probability doesn't jump discretely when a firm starts earning in the Americas, the coefficients on fraction of income earned in the Americas suggest that a 10 percentage point increase in the share of income earned in this region is associated with a 1.9 to 3.0 percentage point (5 to 15 percent) increase in the probability of introducing different types of innovations. All but one of these correlations are statistically significant at the 10 percent level or better.

Most innovation probabilities, in contrast, jump discretely if the firm earns income in Australia or the Pacific. Earning any income in this region is associated with a 2.3 to 8.9 percentage point higher probability of introducing the various types of innovation.

There is no evidence of a discrete increase in innovation for firms that export to Asia; firms that earn 10 percentage points more of their income in Asia rather than New Zealand actually appear 1.3 percentage points (7.5 percent) *less* likely to introduce an operational process innovation, and 1.5 percentage points (6.7 percent) less likely to introduce a marketing innovation. Exporting to Europe or the Middle East and Africa may be associated with higher probabilities of introducing some types of innovation, but many of the coefficients for these regions are too imprecisely estimated to draw conclusions.

These results may indicate that only exports to certain regions of the world facilitate international knowledge flows, or the results may be driven by several alternative mechanisms. For example, some foreign markets may only be serviceable by more innovative, higher productivity firms (e.g., because of greater competition, or greater consumer demand for quality or variety). This could cause higher rates of innovation in firms that serve those markets, or drive already innovative firms to self-select into serving those markets. Either

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[33] The number of observations is insufficient for overseas earnings regions to be disaggregated any more finely without losing too much statistical power.

would generate a positive correlation between innovation and exporting to those markets. Regardless of this sequencing, since the coefficients on overseas earnings are likely to represent upper bounds, this suggests that earning income in Asia is unlikely to have any substantial positive causal effect on firms' innovation.

**Table 4.5: Export destination matters**

| Dependent variable: Introduced an innovation of type: | Any | Product | Organisational | Operational process | Marketing |
|---|---|---|---|---|---|
| **Australia and Pacific (excl NZ)** | | | | | |
| Firm earned income indicator | 0.074** | 0.089*** | 0.045* | 0.054** | 0.023 |
| | (0.029) | (0.026) | (0.023) | (0.022) | (0.025) |
| Fraction of total income | 0.007 | -0.031 | 0.041 | -0.051 | 0.073 |
| | (0.082) | (0.083) | (0.069) | (0.059) | (0.071) |
| **Asia** | | | | | |
| Firm earned income indicator | -0.032 | -0.044 | 0.004 | 0.011 | 0.005 |
| | (0.043) | (0.046) | (0.039) | (0.045) | (0.039) |
| Fraction of total income | -0.043 | -0.101 | -0.087 | -0.125* | -0.146* |
| | (0.095) | (0.091) | (0.062) | (0.067) | (0.085) |
| **Americas** | | | | | |
| Firm earned income indicator | -0.000 | -0.004 | -0.007 | -0.036 | 0.043 |
| | (0.049) | (0.038) | (0.040) | (0.039) | (0.041) |
| Fraction of total income | 0.195 | 0.214* | 0.299** | 0.241* | 0.254* |
| | (0.143) | (0.130) | (0.123) | (0.139) | (0.136) |
| **Europe** | | | | | |
| Firm earned income indicator | 0.019 | 0.093** | 0.048 | 0.077* | 0.031 |
| | (0.053) | (0.044) | (0.047) | (0.043) | (0.042) |
| Fraction of total income | -0.027 | -0.065 | -0.083 | 0.014 | 0.006 |
| | (0.123) | (0.106) | (0.101) | (0.103) | (0.107) |
| **Middle East and Africa** | | | | | |
| Firm earned income indicator | 0.133** | 0.138** | 0.012 | 0.091 | 0.119* |
| | (0.067) | (0.066) | (0.064) | (0.061) | (0.071) |
| Fraction of total income | -0.410 | -0.269 | 0.106 | -0.087 | -0.351 |
| | (0.365) | (0.319) | (0.332) | (0.308) | (0.326) |
| Number of employees (ln) | 0.030*** | 0.020*** | 0.047*** | 0.032*** | 0.012* |
| | (0.007) | (0.006) | (0.006) | (0.005) | (0.006) |
| Firm partly/wholly owned by foreign business | 0.056** | 0.073*** | 0.019 | 0.029 | 0.021 |
| | (0.027) | (0.023) | (0.023) | (0.023) | (0.025) |
| Firm has ownership interest in foreign business | 0.120*** | 0.116** | 0.021 | 0.032 | 0.081** |
| | (0.044) | (0.047) | (0.032) | (0.029) | (0.036) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes |
| | | | | | |
| *R-Squared* | *0.046* | *0.102* | *0.045* | *0.052* | *0.060* |
| *Observations* | *10,545* | *10,848* | *10,824* | *10,836* | *10,842* |
| *Weighted fraction of successes* | *0.370* | *0.186* | *0.213* | *0.166* | *0.217* |

Notes: Each column presents the results of a firm-level linear probability regression of the type of firm innovation given in the column header on indicator variables for the firm earning income on each continent, and the fraction of income earned on each continent. The omitted category is New Zealand. Data are from 2007 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

This lack of effect on innovation of exporting to Asia may at least partially relate to the types of exports that New Zealand firms send to this region. We showed earlier that exports of raw goods do not seem to drive innovation; if exports to Asia are largely of raw goods, this could explain the lack of correlation that we find here. BOS data do not enable identification of which type of goods (raw, manufactured etc) firms that serve more than one international market export to which country. However, in regressions that use export type (raw goods, manufactured goods sold to businesses, manufactured goods sold to households, services) to predict exporting to each continent, raw goods predict exporting to Asia more strongly than they predict exporting to any other continent, and the strongest predictor of exporting to Asia is exporting raw goods.

A plausible additional hypothesis is that the effects on innovation of exporting to (or earning income in) a foreign country depend on the foreign country, in particular on the ideas in circulation and their applicability at home. More useful ideas are likely to be available in more advanced economies and more culturally similar ones. The data used in this project have insufficient power to test these hypotheses.

## 4.7. Most types of international engagement are correlated with innovation

There are a number of different ways in which a firm can be internationally engaged, and most are correlated with a higher probability of innovating.

Table 4.6 presents the results from regressions of product innovation on various types of international engagement, alone and in combination. When included individually along with firm size, survey year fixed effects, industry fixed effects, and regional council fixed effects, all five types of international engagement considered are positively correlated with product innovation. The correlation is largest for the overseas production of a good or service; a firm that produces a good or service overseas is 24.6 percentage points (132 percent) more likely to introduce a product innovation. Being an exporter, having an ownership interest in a foreign business, or making direct purchases from overseas are associated with probabilities of product innovation that are 15.6 to 18.9 percentage points (79 to 101 percent) higher; being partially or wholly owned by a foreign business is associated with 10.2 percentage point (52 percent) higher probability of product innovation. The magnitudes of these correlations decrease when all five measures of international engagement are included in the same regression, but three of the five remain positive and statistically significant.

## 4.8. Different types of international engagement are related to different sources of ideas for innovation

Firms that are internationally engaged in various ways may be more likely to innovate because international engagement is a mechanism through which they are exposed to new ideas that feed into innovation, or for various other reasons. Although the analysis in this paper cannot provide direct evidence on whether international engagement causes innovation, it can explore some of the implications for knowledge flows of such a relationship.

**Table 4.6: Most types of international engagement are correlated with higher innovation**

| Dependent variable: Introduced a product innovation | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Exporter | 0.156*** | | | | | 0.144*** | 0.078*** |
| | (0.016) | | | | | (0.016) | (0.019) |
| Firm has ownership interest in foreign business | | 0.156*** | | | | 0.020*** | 0.072 |
| | | (0.028) | | | | (0.004) | (0.044) |
| Firm partly/wholly owned by foreign business | | | 0.102*** | | | 0.071*** | 0.020 |
| | | | (0.020) | | | (0.019) | (0.023) |
| Overseas production of good/service | | | | 0.246*** | | | 0.155*** |
| | | | | (0.033) | | | (0.036) |
| Direct purchases from overseas | | | | | 0.188*** | | 0.158*** |
| | | | | | (0.017) | | (0.018) |
| Number of employees (ln) | 0.026*** | 0.030*** | 0.028*** | 0.029*** | 0.019*** | 0.106*** | 0.011** |
| | (0.004) | (0.004) | (0.004) | (0.005) | (0.005) | (0.028) | (0.006) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | | | | | | | |
| R-Squared | 0.089 | 0.077 | 0.076 | 0.093 | 0.112 | 0.093 | 0.128 |
| Observations | 22,446 | 22,401 | 22,368 | 11,055 | 11,064 | 22,269 | 10,938 |
| Weighted fraction of successes | 0.197 | 0.197 | 0.197 | 0.187 | 0.187 | 0.197 | 0.188 |

Notes: Each column presents the results of a firm-level linear probability regression of product innovation by the firm on measures of the firm's international engagement. Data are from 2005, 2007, 2009 and 2011, except in columns 4, 5, and 7, where they are from 2007 and 2011 only. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

BOS asks firms whether various groups such as employees, customers, and suppliers were sources of ideas for innovation. If, for instance, firms that export are more likely to innovate because they learn from their overseas customers, then in a regression with dependent variable an indicator for customers being a source of ideas for innovation, we would expect to see a positive coefficient on the control for the firm being an exporter. Table 4.7 presents the results of a number of such regressions, with the five dependent variables: employees, other businesses in the business group, customers, suppliers, and competitors were a source of ideas for innovation. For each dependent variable, the regression is run both using all firms, and using only firms that reported innovation. Each regression controls for whether the firm is an exporter, whether it has any ownership interest in a foreign business, whether the firm is partly or wholly owed by a foreign business, whether it makes direct purchases from overseas, and the fraction of its employees who are foreign, as well as firm size, survey year fixed effects, and industry fixed effects. The bolded coefficients are those that we might expect to be positive if the type of international engagement in question facilitates an international transfer of knowledge to the firm.

As we would expect if exporters learn from their foreign customers, being an exporter is correlated with a higher probability of stating customers were a source of ideas for innovation, both in the full sample and the sample of innovators. Being an exporter is also associated with a slightly higher probability of stating that employees were a source of ideas for innovation.

The results are also consistent with foreign owners being an important source of ideas for innovation: a firm that is partly or wholly owned by a foreign business is 22 to 28 percentage points more likely to state other businesses in the business group were a source of ideas.[34] Being owned by a foreign business is also associated with a lower likelihood of stating suppliers or competitors were sources of ideas.

In contrast, there is no evidence that having an ownership interest in a foreign business affects where firms gain ideas for innovation: the coefficients on ownership interest in foreign business in the regressions predicting whether other businesses in the business group were a source of ideas for innovation are small and insignificant.

It is not immediately obvious which groups to look to for ideas when a firm has overseas production of a good or service. In fact, in the full sample regressions overseas production is associated with a higher probability of every group being a source of ideas for innovation. Direct purchases from overseas are also associated with a higher probability of every group being a source of ideas, including the expected suppliers.

A higher fraction of foreign employees is associated as predicted with a higher probability of employees being a source of ideas, but also with higher probabilities of customers and suppliers being sources of ideas.

These results are consistent with the various forms of international engagement bringing firms into contact with groups that provide ideas for innovation, but also with the firms that conduct each type of international engagement differing in unobserved ways that affect their sources of ideas for innovation.

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[34] This could be partly driven by such firms being more likely to be part of a business group.

**Table 4.7: Different types of international engagement are correlated with different sources of ideas for innovation**

| Dependent variable: This group was a source of ideas for innovation | Employees | | Other businesses in business group | | Customers | | Suppliers | | Competitors | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample: | All firms | Innovators | All firms | Innovators | All firms | Innovators | All firms | Innovators | All firms | Innovators |
| Exporter | 0.071*** | 0.052* | -0.009 | 0.009 | **0.089***** | **0.096*** | 0.031 | 0.001 | **0.025** | **0.011** |
| | (0.024) | (0.029) | (0.017) | (0.032) | **(0.024)** | **(0.034)** | (0.022) | (0.037) | **(0.021)** | **(0.035)** |
| Firm has ownership interest in foreign business | 0.097** | 0.010 | **0.031** | **-0.012** | 0.058 | 0.006 | 0.072 | 0.032 | -0.008 | -0.086 |
| | (0.045) | (0.045) | **(0.033)** | **(0.047)** | (0.045) | (0.050) | (0.049) | (0.061) | (0.037) | (0.053) |
| Firm partly/wholly owned by foreign business | -0.023 | -0.017 | **0.216*** | **0.283*** | -0.002 | -0.033 | -0.095*** | -0.119*** | -0.050** | -0.078** |
| | (0.028) | (0.035) | **(0.026)** | **(0.036)** | (0.026) | (0.037) | (0.024) | (0.039) | (0.022) | (0.039) |
| Overseas production of good/service | 0.130*** | 0.048 | 0.117*** | 0.076** | 0.166*** | 0.113*** | 0.079** | 0.057 | 0.105** | 0.035 |
| | (0.041) | (0.038) | (0.035) | (0.038) | (0.040) | (0.041) | (0.040) | (0.047) | (0.041) | (0.047) |
| Direct purchases from overseas | 0.144*** | 0.058* | 0.052*** | 0.043 | 0.122*** | 0.058* | **0.087*** | **0.070** | 0.062*** | 0.022 |
| | (0.023) | (0.032) | (0.017) | (0.030) | (0.022) | (0.034) | **(0.021)** | **(0.032)** | (0.019) | (0.032) |
| Fraction of employees who are foreign | **0.136** | **0.144** | 0.012 | -0.076 | 0.140** | 0.255** | 0.133** | 0.090 | 0.057 | 0.044 |
| | **(0.067)** | **(0.090)** | (0.043) | (0.077) | (0.064) | (0.101) | (0.061) | (0.103) | (0.057) | (0.101) |
| Number of employees (ln) | 0.054*** | 0.032*** | 0.044*** | 0.046*** | 0.032*** | 0.015 | 0.043*** | 0.031*** | 0.037*** | 0.029*** |
| | (0.008) | (0.010) | (0.006) | (0.010) | (0.007) | (0.011) | (0.007) | (0.011) | (0.007) | (0.011) |
| Survey year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Regional council fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *R-Squared* | *0.090* | *0.075* | *0.089* | *0.116* | *0.079* | *0.083* | *0.054* | *0.071* | *0.040* | *0.044* |
| *Observations* | *10,143* | *4,413* | *10,002* | *4,320* | *10,014* | *4,332* | *9,957* | *4,296* | *9,918* | *4,281* |
| *Weighted fraction of successes* | *0.428* | *0.706* | *0.166* | *0.292* | *0.310* | *0.540* | *0.262* | *0.448* | *0.242* | *0.421* |

Notes: Each column presents the results of a firm-level linear probability regression of the group given in the column header being a source of ideas for innovation for the firm on measures of the firm's international engagement. Each regression is run on two samples: all firms, and those who innovated only. Data are from 2007 and 2011. Observations are weighted to match the population of New Zealand firms with six or more employees. Observations and number of successes have been randomly rounded to base 3 for confidentiality reasons. Standard errors, in parentheses, are clustered at the firm level. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

# 5. Conclusions

This analysis shows that, in general, firms that have a higher share of high-ability foreign employees (and a lower share of high-ability native employees) are more likely to export and to be internationally engaged in other ways, as are firms with more employees with experience working for an exporter. On the innovation side, exporting and other types of foreign engagement are associated with a higher probability of innovating. In particular, innovation is more likely around the time a firm enters a new export market.

However, these relationships are not universal, and several aspects of their heterogeneity could have implications for New Zealand policy. On the employee side, only employees from certain countries seem to be positively correlated with exporting. For instance, we find no evidence that employees from Asia are correlated with exporting. Results suggest that employees from developed countries are highly positively correlated with earning income in their home countries, but firms with more employees from China, India or Malaysia are no more likely to earn income in these countries, despite the fact that many New Zealand firms do earn income in these countries.

On the exporting-innovation side, export destination seems to matter, with a positive correlation between exporting to Australia and the Pacific or to the Americas and innovation, but no correlation between exporting to Asia and innovation. The type of good or service exported also seems to matter: exports of manufactured goods and of services are positively correlated with innovation, but exports of raw goods are not.

Although these correlations cannot be interpreted as causal relationships, they do suggest that, if the causal relationships of interest are present, they may be heterogeneous along similar lines. Furthermore, because the positive correlations between exporting and innovation are likely to overstate the positive causal effect of exporting on innovation, where the two are uncorrelated, such as for exports of raw goods, it is likely that such exports do not have a causal effect on innovation.

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