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INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Hiring new ideas:
International migration and firm innovation in New Zealand

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Abstract

Poor productivity performance has been identified as a significant issue for New Zealand, and innovation is seen as a key mechanism for improving productivity growth. Understanding the drivers of firm innovation therefore represents an important step towards improving New Zealand's economic performance. In this paper, we combine firm-level innovation data with worker characteristics to examine links between innovation and the presence of new arrivals – both immigrants and returning New Zealanders – in the firm's workforce. Across a range of measures we find positive relationships between firm-level innovation and the share of new arrivals. These relationships weaken once we account for variation in firm characteristics (firm size, industry, R&D expenditure) and other worker characteristics (including the share of new and/or high skilled workers). Within new arrivals, innovation outcomes are most strongly associated with high skilled workers, though magnitudes vary depending on whether workers are returning New Zealanders or immigrants. Firms with a higher share of high skilled recent migrants were more likely to report introducing new marketing methods, new goods and services, or goods and services new to New Zealand. Firms with a higher share of high skilled returning New Zealanders were more likely to report introducing new organisational and managerial practices, and (as with migrants) goods and services new to New Zealand.

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.

EXECUTIVE SUMMARY

Poor productivity performance is an important issue for New Zealand. The OECD estimates that New Zealand's policy settings should generate GDP per capita 20% above the OECD average, while in reality the New Zealand figures are more than 20% lower than the average. These differences are attributed to weaknesses in international connections, and underinvestment in "knowledge-based capital". As such, innovation is seen as a key mechanism for improving New Zealand's economic performance.

In recent years a considerable body of international evidence has highlighted the positive effects of immigration on innovation. It has been suggested that migration impacts on innovation in a number of ways, including through: scale effects, whereby migrants increase the size of the economy, especially in large cities; skill composition effects, through migrants being more skilled than the general population; diversity effects, whereby culturally-diverse workplaces may generate new ideas and ways of doing things; and knowledge transfer effects, whereby migrants bring new ideas with them.

Only one study has looked at the link between migration and innovation in New Zealand. While the study found a positive relationship between innovation and the presence of migrants in the local workforce, the effect disappeared once firm characteristics were controlled for. New integrated administrative and survey data has become available in the last few years, and this enables us to now examine the share of migrants in the firms' workforce, extending the previous study.

There has been very little research on links between returning migrants (returnees) and innovation internationally, and none in New Zealand. New Zealand has not only one of the largest overseas-born populations in the OECD, it also has one of the largest expatriate populations. As such, returnees could be an important source of new ideas for New Zealand firms.

This study attempts to relate various firm-level measures of innovation, as reported in Statistics New Zealand's Business Operations survey, to characteristics of the firm and its workforce. We are particularly interested in identifying the effect of a firm hiring new migrants or returnee New Zealanders on its propensity to innovate. We first construct a model of the probability of a firm innovating against the share of recent migrant and returnee employment, before extending the model to control for other characteristics of the firm's workforce. We next control for a range of firm characteristics, before splitting the workforce employment shares (including for recent migrants and returnees) by the skill level of that employment, to account for the fact that high and low-to-medium skilled employees may not have the same relationship with the propensity to innovate.

We investigate a range of innovation measures, and find that firms that hire more recent migrants and firms that hire more recent returnee New Zealanders tend to innovate more than other firms. Firms with more recent migrants are more likely to introduce new goods and services, new processes, and new marketing methods, as well as being more likely to enter new export markets. Firms that hire more recent returnees are more likely to introduce new products that are new to New Zealand, new organisational or managerial practices, and new marketing methods.

These relationships are likely to result from a number of different factors. Migrants and returnees are often highly skilled, are new to the firms they work for, and they bring international perspectives with them. When we try to separate out these effects, we find that being new and high skilled seem to matter more, at least for some forms of innovation, and/or some types of firm. This conclusion is supported by results for the influence of new staff on innovation reported by firms. Recent migrants and returnees do not appear to raise the likelihood of this reporting, over and above their contribution to the new employee share. We cannot determine whether new employees, in general, play a substantial role in causing innovation outcomes or whether they are a consequence of such innovation.

We find a significant relationship between the share of high skilled immigrants working in a firm and the probability of that firm innovating, controlling for a range of characteristics of the firm and its workforce. High skilled immigrants may therefore have a positive impact on innovation, but this may not be different from the impact of similarly high skilled non-migrant new employees. As such, the main way in which immigration policy is likely to facilitate innovation is through any positive influence it exerts on the skills composition of the workforce. Through immigration policy settings that facilitate highly skilled migrants entering the New Zealand workforce, we may help to increase the chances of firms innovating, with associated positive benefits for New Zealand's economic performance.

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1 Introduction

1.1 Innovation and productivity growth

Poor productivity performance has been identified as a significant issue for New Zealand, with New Zealand lagging behind the Organisation for Economic Co-operation and Development (OECD) average in terms of both GDP per capita and labour productivity (Treasury, 2004). While New Zealand GDP per capita is more than 20% lower than the OECD average, recent OECD research (de Serres, Yashiro, & Boulhol, 2014) indicates that New Zealand's broad policy settings should generate GDP per capita 20% above the average. The report explains the difference between this expectation and reality as being derived from two key areas. The first relates to weaknesses in our international connections, with New Zealand firms unable to access large markets and having limited roles in global value chains. The second area of concern is underinvestment in "knowledge-based capital", with private sector Research and Development (R&D) investment being among the lowest in the OECD. These conclusions add impetus to the idea that innovation is a key mechanism for improving New Zealand's productivity growth. Understanding the drivers of firm innovation represents an important step towards improving New Zealand's economic performance.

While investment in R&D is one measure of firm innovation, other measures may be more relevant for many sectors of the economy, especially New Zealand's large service sector. de Serres, Yashiro, & Boulhol (2014) note that "although New Zealand can do better in R&D intensity, it is not clear that innovation-specific policies can do much to narrow the gap, especially given the sectoral composition of the economy". This finding is consistent with the work of Crawford et al (2007), who show that New Zealand's apparent underinvestment in R&D can be explained by structural features of the economy (specifically, industry composition, firm size distribution, and location relative to R&D-producing nations). de Serres et al go on to note that, given the industry composition, greater rewards might be gained from boosting innovation in the services sector.

1.2 Migration and innovation

The link between migration and a range of economic outcomes (both positive and negative) for the host country has been subject to wide-ranging research attention over recent decades. The evidence for New Zealand, a country with both high inward and outward migration flows on a per capita basis, has also received considerable attention, with the economic benefits generally considered likely to outweigh any negative effects (Hodgson & Poot, 2010). This is largely seen as being a result of the largely discretionary nature of New Zealand's inward flows of new migrants[1], and the relatively high skill level of New Zealand's permanent migrants. It has been suggested that migrants may influence innovation, and thereby economic growth, in various ways. For example:

- Scale – Immigration could result in greater innovation through increases in the size of the economy. Migrants arriving disproportionately in large urban centres could boost population density and growth, reinforcing agglomeration effects. In a recent paper, Fry (2014) notes the potential for large impacts whereby "greater scale and agglomeration, coupled with migrant diversity, could lead to increased innovation".
- Demographic and skill composition – In the New Zealand context, migrants are more likely to have higher skill levels than the general population. Selection criteria mean that permanent migrants have higher qualifications, higher overall employment rates, and higher earnings than the general population. Insofar as skills are a facilitator to innovation (Toner, 2011), highly skilled migrants may be more likely to drive innovation in the firms they work for.

[1] Flows of illegal migrants are small, and most legal migrants need to meet specific immigration criteria in order to be granted work or residence rights.

- Cultural diversity – Workforces that are 'cognitively diverse' may be better at generating new ideas and finding new ways of doing things. There is evidence that cultural diversity is linked to 'cognitive diversity', and that this in turn has an impact on rates of at least some types of innovation (Page, 2007). Clearly, immigration is strongly linked to cultural diversity, and given the size of the foreign-born population in New Zealand, this could be a strong driver of innovation.
- International knowledge transfer – Countries typically gain much of their new knowledge and ideas through bringing them in from overseas. One important potential mechanism for doing this is immigration. Ozgen (2013) notes that migrants are likely to bring unique ideas with them, "allowing host countries to learn from diverse knowledge bases".

There is a large body of literature examining the links between innovation and migration, particularly in the United States and Europe, commonly using patents or patent citations as an innovation outcome measure (Breschi, Lissoni, & Tarasconi, 2014; Foley & Kerr, 2011). Only a few studies have used data from surveys of businesses to identify innovation outcomes (Nathan & Lee, 2011; Lee, 2013), despite this being a common source for official statistical measurement of innovation.

Some research has focussed on the way cultural diversity may influence innovation, using various diversity measures as the predictor variable of interest (Nathan & Lee, 2011; Bosetti, Cattaneo, & Verdolini, 2012), while others focus on the relative size and/or skill level of the migrant stock or flow (Islam, Islam, & Nguyen, 2013). Other studies test a mix of measures with results showing diversity to have relatively strong effects (Ozgen C. , 2013; Ozgen, Nijkamp, & Poot, 2011a; Ozgen, Nijkamp, & Poot, 2011b). In a recent study, Ozgen, Peters, Niebuhr, Nijkamp, & Poot (2014) conclude from their own empirical analysis and an examination of the literature that "cultural diversity of employees can make a positive, but modest and context-dependent, contribution to innovation". The study showed statistically-significant effects of cultural diversity in Germany, but not in the Netherlands, after controlling for reverse causality.

Studies of the impact of innovation at the area level have been common over a number of years (Kerr & Lincoln, 2010; Hunt & Gauthier-Loiselle, 2010; Ozgen, Nijkamp, & Poot, 2012; Peri, 2007), but studies measuring both migration and innovation at the firm level are far less common. One important challenge is identifying the migration characteristics of workers and linking these to firm-level characteristics and outcomes. Studies have typically used characteristics of the local workforce to identify migrants, with innovation outcomes measured at the local area or firm level. More recently, partly due to developments in linked data, a number of studies have begun to measure both migration intensity and innovation outcomes at the firm level (Nathan & Lee, 2011; Ozgen, Nijkamp, & Poot, 2011b; Kerr, Kerr, & Lincoln, 2014; Ozgen & de Graaff, 2013; Ozgen, Peters, Niebuhr, Nijkamp, & Poot, 2014).

Kerr, Kerr & Lincoln (2014) refer to upcoming work using linked employer-employee data to extend previous work by Kerr & Lincoln (2010) that looked at indirect measures of a firm's immigration policy dependency. They state that a 10% increase of skilled migrant employment is associated with a 1-2% increase in firm patenting. This is an important development, with recent work highlighting firm migration effects as being larger than effects at the city level, and therefore an important unit of analysis in terms of migration and diversity (Lee, 2013). The study identified that a 10% increase in the share of migrant owners and partners was associated with an approximately 1% increase in the probability of a firm introducing a new product or process. However the study was not able to identify a city-level effect over and above the firm effect.

Only one study has estimated the relationship between immigration and innovation in New Zealand (Maré, Fabling, & Stillman, 2014). The study used firm-level innovation data from nationally representative surveys of firms, linked to area-level population census data, to examine the links between innovation and local workforce characteristics (including migration). Consistent with other research, the paper found a relationship between the share of migrants in an area and firm innovation when no firm-level controls were included. This relationship disappeared once controls were added to the model. While the research did not identify an independent relationship between the presence of migrants in the local workforce and firm innovation once other local workforce and firm-level control variables are accounted for, only limited firm-level workforce characteristics (collected through the survey questions) were available at the time the research was conducted. In the context of the evidence from Lee (2013), this limitation could be important.

1.3 Returnees and innovation

While the impacts of immigration on innovation are reasonably well researched, very little research has looked at the impact of returning migrants (returnees) on innovation. While many of the potential mechanisms for migration impacting on innovation outlined above are not relevant for returning migrants, knowledge effects may be particularly important. Returnees are exposed to new ideas while away from their country of origin, and may be in a better position than migrants to exploit that knowledge on their return to New Zealand.

A number of case studies outline the benefits of return migration, especially in the context of developing countries such as India and China, however there is limited empirical evidence of the impact of returnees on innovation. This has been noted as a significant gap in the migration research literature (Kerr W. R., 2013). Breschi, Lissoni, & Tarasconi (2014) outline the issues in measuring the impact of returnees on patenting, and attempt to derive some estimates of the extent of returnee patenting, but do not estimate the relationship between return migration and patenting, while Choudhury (2014) estimates a positive impact of returnee managers on patenting rates of their staff within multi-national enterprises.

New Zealand has one of the largest migrant populations in the OECD, but also one of the largest expatriate communities, particularly residing in the UK and Australia (Dumont & Lemaître, 2005).[2] Returning expatriates make up a sizeable group within New Zealand's migration flows, and this is therefore an important potential source of idea and knowledge transmission, and of innovation.

[2] Dumont & Lemaître estimated that 16% of the New Zealand born population, and almost a quarter of the highly skilled New Zealand born population were residing outside of New Zealand.

2 Data and approach

2.1 Data Source – The Integrated Data Infrastructure

This study uses data derived from Statistics New Zealand's Integrated Data Infrastructure (IDI). The IDI brings together both survey and administrative data sources from across a number of government agencies (Statistics New Zealand, 2013). Individuals' unit record data is linked across multiple data sources, covering a broad range of domains. Individual taxation-based employment records in the IDI are further linked with firm-level data in the Longitudinal Business Database (LBD). The IDI includes the following information relevant to our research:

- data from the Ministry of Business, Innovation and Employment (MBIE) on international arrivals and departures from New Zealand, and on migrants, including their source countries, certain demographic characteristics, and their migration status
- tax data from the Inland Revenue Department on the earnings of employees in New Zealand
- data from the Statistics New Zealand's Longitudinal Business Frame that identifies characteristics of firms that employees are working for
- firm-level unit record data from Statistics New Zealand's Business Operations Survey (BOS), contained in the LBD.

From the IDI and LBD we identify when someone arrives in, or returns to, New Zealand following a period of time spent overseas, characteristics related to their migrant status, which firms they work for following their arrival, and the innovation activity reported by those firms. In addition we can derive information on characteristics of the employee, such as their skill level, and characteristics of the firms, such as firm size, industry, and geographic location(s).

Administrative tax and migration data in the IDI provide a complete enumeration of the population of workers and migrants, while the Business Operations Survey is a nationally representative sample of firms. Over 6,000 firms respond each year,[3] and we combine data from across four survey years (2005, 2007, 2009 and 2011). The population is restricted to private sector businesses with six or more employees, comprising approximately 35,000 firms.

2.2 Research questions

We address the following questions: Are firms that employ more recent migrants and/or returnee New Zealanders also more likely to innovate? Is the skill level of migrants and returnees an important factor for innovation? In which types of firm are the relationships most evident? Which types of innovation are migrants and returnees associated with? Are the associations still evident once differences in firm and workforce characteristics are controlled for?

[3] The survey has an 80% or higher response rate in each year

2.3 Defining and measuring innovation

Official statistics on firm innovation in New Zealand are collected through the innovation module of the Business Operations Survey, in accordance with the Oslo Manual (OECD and Eurostat, 2005). The module is included in the survey every second year, and asks firms to report whether they have implemented any of four types of innovation during the last two financial years:

- **Product Innovation:** Did this business introduce onto the market any new or significantly improved goods or services?
- **Process Innovation:** Did this business implement any new or significantly improved operational processes (ie methods of producing or distributing goods or services)?
- **Organisational Innovation:** Did this business implement any new or significantly improved organisational / managerial processes (ie significant changes in this business's strategies, structures or routines)?
- **Marketing Innovation:** Did this business implement any new or significantly improved sales or marketing methods which were intended:
  - to increase the appeal of goods or services for specific market segments
  - to gain entry to new markets?

Product innovations are further delineated as being "new to New Zealand" or "new to the world", and we also include measures related to each of these in our analysis.

Our sample selection and measures of innovation outcomes differ from those used in official reports. We measure outcomes as indicators of whether a firm stated that a particular outcome occurred. Therefore, non-responses are treated as negative responses. An exception is that if an enterprise failed to respond to any of the four main innovation outcome questions (new goods and services, new operational processes, new organisational or managerial processes, and new marketing method) in any year, the observation is dropped. We also repaired responses which were inconsistent with the questionnaire routing. We include in our analysis additional firms that were included in the panel top-up to the survey, but not included in the official cross-sectional statistics.[4]

In addition to the four categories of innovation identified above, we also examine two other questions that capture aspects of innovation. Businesses were asked whether they entered any new export markets in the last year, and innovating businesses were asked whether new staff were important as a source of ideas or information for innovation in the past two financial years. Entering a new export market may be the result of the influence of migrants or returnees on a firm, or migrants or returnees could be hired to help the firm successfully expand into a new market. The fact that a firm identifies new staff as being important to innovation could provide assurance that there is a causal link from migration to innovation.

Alternative measures

As discussed above, the number of patents or patent citations is commonly used in the research literature as an indicator of innovation activity, however this is more likely to capture information about product innovation than the other three categories identified above, and may not adequately capture innovations occurring in the service sector. In addition, many product innovations may not result in a patent being acquired, meaning that they may undercount actual levels of product innovation (Breschi, Lissoni, & Tarasconi, 2014). As with patenting, R&D is an important part of innovation activity (Toner, 2011), however R&D investment is neither a guarantee of successful innovation, nor necessary for innovation to occur (OECD, 2010). R&D investment is also most likely to relate to product innovation. Given that R&D investment may be independently associated with innovation outcomes, we include it as a control variable in our analysis together with other firm-level correlates of innovation (discussed further below).

[4] Additional firms are included in the relevant survey stratum, and then stratum weights are recalculated to enable replication of official population counts. Extra units were sampled in 2005, and these are also included in the same manner.

2.4 Defining and measuring new employees, migrants, and returnees

Our analysis focusses on innovation through the generation and transmission of new ideas by new staff, and looks at the evidence of whether migrants and returnees are associated with greater levels of reported innovation than other new employees. As such, we focus on the initial two-year period following the arrival of a migrant or returnee in New Zealand.

Returnees are identified through arriving on a New Zealand passport, or returning resident visa. As such, they are either a permanent migrant who has lived in New Zealand in the past, or they are a New Zealand citizen, either by birth or naturalisation. To be considered as a recent returnee or migrant for the purposes of this study a new arrival must also meet the condition that they were out of New Zealand for at least the two year period prior to their arrival. The intent of this additional requirement is to ensure that the person was outside New Zealand for long enough to be exposed to new ideas, knowledge, and ways of doing things, and to reduce the chance they were outside New Zealand for purposes other than employment.

New employees are defined in a similar way to recent migrants and returnees. A worker is considered to be a new employee for up to two years following a period of at least two years not working for the employer. As a result of this definition, recent returnees and migrants are mutually exclusive subsets of the larger population of new employees.

2.5 Defining and measuring skills

Skills are strongly connected to innovation activities. Skilled workers have been shown to adopt innovations earlier and implement and adapt them sooner and the presence of skilled workers is often associated with greater employer investment in workforce education and knowledge creation (Toner, 2011). Toner notes that "a vicious circle is evident whereby low initial educational attainment constrains further acquisition of knowledge and capacity to engage in innovation". Further, improvement in skill levels is associated with an increase in the capital-labour ratio over the long term, which in turn enables the introduction of new and improved products, services, and production processes.

We control for overall levels of skilled employment in firms, as well as levels of skilled employment of new employees, and finally levels of skilled employment of recent migrants and returnees. The IDI does not include detailed individual data on occupation or educational attainment, and as a result, we are reliant on information that can be inferred from individuals' earnings.[5] Skill level is therefore defined using a fixed-effects model based on that outlined by Maré & Hyslop (2006). The model uses full-time equivalent annual earnings and constructs fixed effects that reflect an individual worker's earnings premium, regardless of who they are working for. Maré & Hyslop directly control for observable worker characteristics – age and gender – that determine earnings. We also directly control for these observables in the innovation regressions in this paper.

We calculate the worker fixed effects for all employees working for firms in the BOS sample in the years of interest, and consider those with an earnings premium above a certain threshold as being "high skilled", with the remaining workers classified as "low-to-medium skilled". The threshold was set such that, on average, firms would have a quarter of the months worked by their workforce being defined as high skilled.[6] While differences in individual earnings premia are likely to largely reflect differences in levels of innate ability or skills, they may also capture other differences between individuals, such as different career choices. For recent migrants, the premia may also capture the effects of discrimination, or differences in the returns to particular skills for migrants and non-migrants, perhaps because of complementarity between skills (eg English language ability).

[5] Educational attainment data is present in the IDI, but it not suitable for our purposes because it covers only recent graduates, and qualifications gained in NZ.

[6] Since larger firms tend to have a somewhat higher skilled workforce than smaller firms, in total around 28% of months worked across BOS firms are considered to be high skilled under this definition.

2.6 Other firm characteristics

We also control for a number of other firm characteristics related to innovation: firm size (log employment), R&D expenditure, the industry in which they operate (see Appendix A for details), whether they are a new firm (established in the past two years), and the region in which they operate. Given that firms may operate across a number of regions, location is expressed as a share the of employment in each region.[7]

As well as analysis of innovation and migration at an economy-wide level, we undertake specific analyses for subsets of firms that we consider may have different characteristics with respect to innovation. We classify firm subsets in the following ways:

- **Small/Medium/Large firms** – Firms with 6-19, 20-49 and 50+ employees respectively.
- **R&D firms** – Firms with positive R&D spending.
- **Firms in R&D industries** – Firms in industries with average firm R&D across the industry of $1,000 or more per worker.
- **High-skilled firms** – Firms with at least a 50% high skilled employment share.
- **Firms in high-skilled industries** – Firms in industries where at least 25% of firms have at least a 50% high skilled employment share.
- **Export firms** – Firms which export goods and/or services.
- **Firms in export industries** – Firms in industries where more than 25% of firms export.

A list of R&D, high skilled, and export industries is included in Appendix A.

2.7 Model approach

Our modelling approach follows that of Maré, Fabling, & Stillman (2014), replacing local workforce characteristics with firm-level worker characteristics. The earlier work identified a significant relationship between workforce characteristics in a local area and innovation by firms in that area, but this effect disappeared once firm-level controls were added to the model. We further extend the earlier paper by allowing for differential impacts on innovation by workers of different skill levels. Workforce characteristics are expressed as shares of total firm employment, where employment is measured in terms of months worked for wages and salaries over the two-year reference period contemporaneous to measured innovation.

We define innovation outcomes as binary variables that are equal to 1 if a firm reports innovating, and 0 otherwise. We first construct a logit model of the probability of a firm innovating against the share of recent migrant and returnee employment, controlling for survey year. We then extend the model to control for other characteristics of the firm's workforce, including the share of high skilled employment, the share of new employment, and the average workforce age and gender composition, weighted by those characteristics' estimated relationship with worker wages, following Maré & Hyslop (2006). The third specification of our model includes controls for firm characteristics such as total employment, an indicator of whether the firm is new, indicators they had invested in R&D and the extent of that investment, industry dummy variables, and the share of the firm's employment in each region. Finally, we split the new employee, recent migrant and returnee employment shares by the skill level of that employment, to account for the fact that high and low-to-medium skilled employees in each of these categories may not have the same relationship with the propensity to innovate.

[7] Region is defined at the Regional Council level, giving 18 areas. See: *http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/regional-council/definition.aspx.*

The model is specified as follows:

$$logit(p_{ft}) = W_{ft}\gamma + X_{ft}\beta + \Gamma_{frt}\delta r + \eta_i + \tau_t + \epsilon_{ft}$$

Where:

p_{ft} =The probability of firm f reporting innovation outcome p at time t.

W_{ft} =Matrix of workforce shares of employment in firm f at time t – new employees in the firm, recent migrant employees, recent returnee employees, high skilled employees – and average employee observable characteristics

γ =Vector of workforce share and characteristic coefficients.

X_{ft} =Matrix of firm level control variables – log total employment, new firm status, R&D spend indicator and level of R&D spend per employee.

β =Vector of firm-level control coefficients.

Γ_{frt} =Matrix of region shares of employment for firm f in region r at time t.

δr =Region fixed effects (r=18-1 regional council areas).

η_i =Industry fixed effects (i=52-1 NZSIOC classification level 3 industries. See Appendix A for details).

τ_t =Time fixed effects.

We use contemporaneous worker employment shares. Our definitions of migrants and returnees identify workers who arrived in New Zealand within two years of the survey date – the same window over which innovation outcomes are measured. This choice has the benefit of picking up relatively short-term impacts of new ideas on firm innovation, and relating innovations to the workforce characteristics present when the innovation was introduced. It may also capture endogenous workforce selection, arising from reverse causation. Recent migrant, recent returnee and new worker employment shares are unlikely to be exogenous with respect to innovation. Firms that are more open to change may be more likely to look further afield for the skills they require. In addition, firms that are growing may be more likely to both innovate and recruit more intensively and/or more widely. The firm-level controls included in the regressions do not address these potential sources of endogeneity. Unsuccessful attempts to implement an Instrumental Variable (IV) approach are discussed in Appendix B.[8]

As already noted, we also report results based on managers' views of whether the causality runs from new staff to innovation. By estimating whether such reporting is more correlated with particular types of new staff, we seek to provide additional support for our central hypothesis that foreign work experience improves the potential of workers to contribute to innovation in New Zealand firms. Even in this case, however, we cannot completely preclude the possibility that being a recent returnee New Zealander or migrant is correlated with some uncontrolled-for worker characteristic that is related to skills or experience. For example, university students who undertake OEs may have relatively low estimated worker-fixed effects because they work while studying prior to departing New Zealand, but have high "skill" as measured by formal qualifications.

[8] We also estimated a series of models with firm-fixed effects which would, at least, restrict identification to changes in firm behaviour. Coefficients in these models were seldom significantly different from zero, consistent with firm innovation and employment patterns being quite stable over time and, therefore, the estimated logit coefficients largely relying on cross-firm variation for identification.

3 Descriptive analysis

3.1 Innovation and firm characteristics

Table 3.1 describes the characteristics of the firms in the population. Almost a quarter of firms operate in the retail trade and accommodation sector, with 15% operating in manufacturing. These firms have a 20% and 22% share of employment respectively. Almost three quarters of firms were small, having between 6-19 employees, but these made up only 22% of employment. While only 7% of firms reported investing in R&D and 17% exported, these firms tended to be larger and made up larger proportions of total employment (19% and 29% respectively).

Table 3.1 Firm characteristics, pooled years

Firm characteristics	Average number of firms[1]	Share of firms	Share of employment[2]
All Firms	34,906	100.0%	100.0%
Industry			
Agriculture, Forestry and Fishing (AA)	3,032	8.7%	3.8%
Mining (BB)	93	0.3%	0.4%
Manufacturing (CC)	5,381	15.4%	22.3%
Electricity, Gas, Water and Waste Services (DD)	74	0.2%	0.6%
Construction (EE)	3,513	10.1%	7.4%
Wholesale Trade (FF)	2,857	8.2%	7.9%
Retail Trade and Accommodation (GH)	7,931	22.7%	20.1%
Transport, Postal and Warehousing (II)	1,343	3.8%	6.6%
Information Media and Telecommunications (JJ)	373	1.1%	2.8%
Financial and Insurance Services (KK)	541	1.5%	4.6%
Rental, Hiring and Real Estate Services (LL)	807	2.3%	1.4%
Professional, Scientific, Technical, Admin & Support Services (MN)	4,481	12.8%	13.0%
Public Administration and Safety (OO)3	65	0.2%	0.4%
Education and Training (PP)	679	1.9%	1.5%
Health Care and Social Assistance (QQ)	2,012	5.8%	4.9%
Arts, Recreation and Other Services (RS)	1,727	4.9%	2.3%
Firm Size			
6-19 employees	25,658	73.5%	21.8%
20-49 employees	6,076	17.4%	15.9%
50+ employees	3,173	9.1%	62.4%
Firm Subsets			
R&D industries	4,685	13.4%	17.1%
R&D firms	2,499	7.2%	18.6%
High skilled industries	3,728	10.7%	14.4%
High skilled firms	4,100	11.7%	12.5%
Export industries	8,957	25.7%	29.0%
Export firms	5,870	16.8%	28.8%

[1] Firm counts are averages across the four survey years (2005, 2007, 2009, and 2011).

[2] Calculated using firm level employment (months worked) from IDI wage and salary data multiplied by survey weights.

[3] Firms in the Public Administration and Safety industry or with fewer than 6 employees are out of scope for BOS.

Innovation is associated with a number of firm characteristics, including the industry in which the firm operates, the size of the firm, and whether it invests in research and development. Overall, 46% of firms innovated, in that they reported at least one of the four core categories of innovation defined from the Business Operations Survey (ie a product, process, organisational, or marketing innovation). Figure 3.1 breaks this down by industry and other firm characteristics. More than half of all firms in the Information Media and Telecommunications (58%), Wholesale Trade (58%), Electricity, Gas, Water and Waste Services (57%), Manufacturing (56%), Financial and Insurance Services (55%) and Education and Training (54%) industries reported some form of innovation in the past two years.

Large firms were more likely to innovate, with 60% of those with more than 50 employees innovating. Eighty-three percent of firms who invested in R&D and 58% of exporting firms reported innovating. High skilled firms and firms in high skilled, export, and R&D industries all have rates of innovation above the average for all firms.

Figure 3.1 Percentage of innovating firms according to firm characteristics, pooled years

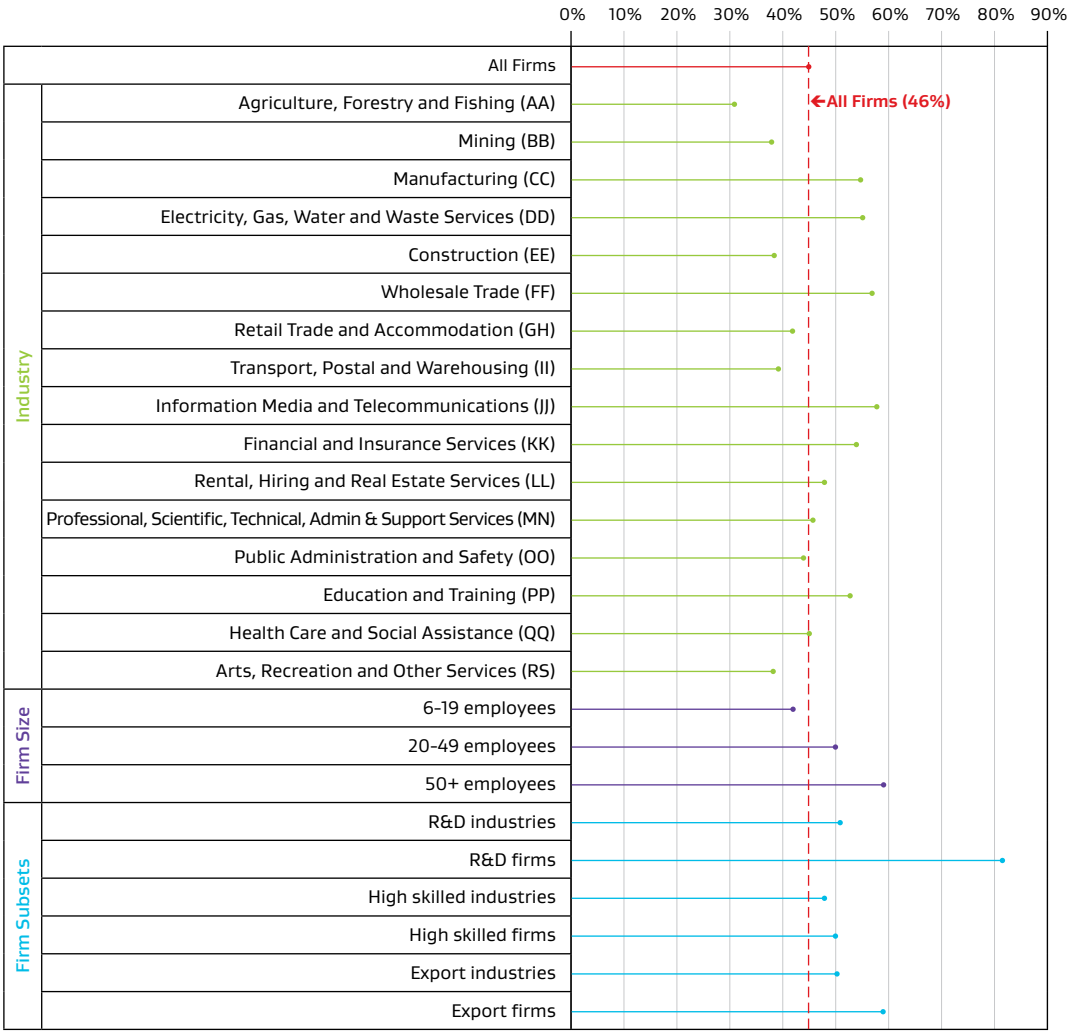


Table 3.2 expands on Figure 3.1, showing average innovation rates for each detailed measure by each firm characteristic.[9] As discussed above, 46% of firms innovated overall, with between a fifth and a quarter implementing process innovations, organisational innovations, marketing innovations, or product innovations (new goods or services). Product innovations were new to New Zealand and/or new to the world for 9% and 3% of firms, respectively. Firms in the Manufacturing, Wholesale Trade, and Information and Media Telecommunications industries were most likely to be product innovators, and 8% of firms in the former two industries indicated they had introduced a product that was new to the world. Process, marketing, and organisational innovators were more evenly distributed across industries. A third or more of firms in the Financial and Insurance Services, Public Administration and Safety and Education and Training industries were organisational innovators, while roughly the same proportion of firms in Rental, Hiring and Real Estate Services had introduced new marketing methods. Firms that invested in R&D were not only more likely than other firms to have introduced a product innovation, they were also more likely to report other types of innovation.

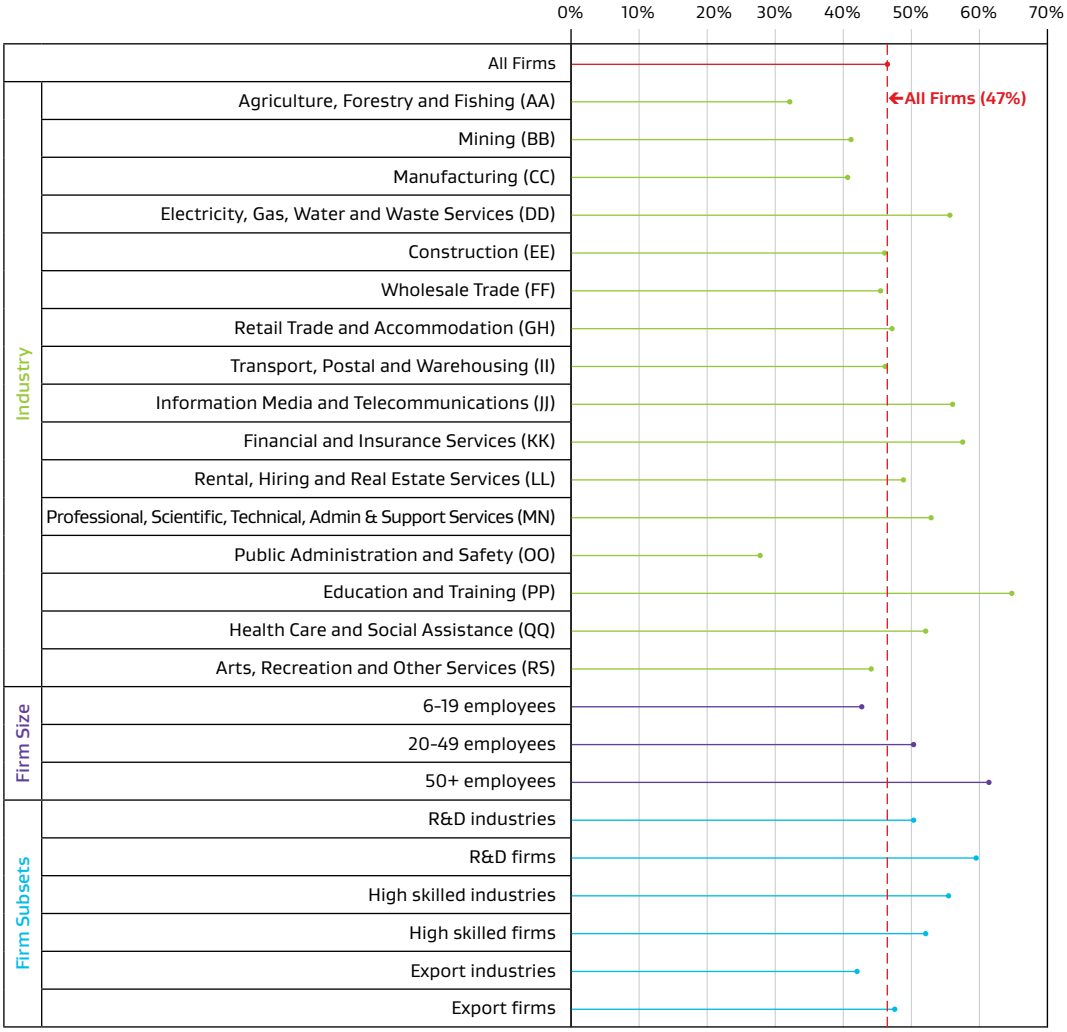
Table 3.2 Innovation rates by firm characteristics and type of innovation activity, all years pooled

Firm characteristics	Product Innovation			Process Innovation	Organisational Innovation	Marketing Innovation	Any Innovation
	Any	New to NZ	New to world				
All Firms	22.0%	8.6%	3.3%	18.9%	24.0%	24.2%	45.8%
Industry							
Agriculture, Forestry and Fishing (AA)	10.9%	3.8%	1.8%	13.7%	16.5%	11.1%	31.6%
Mining (BB)	17.7%	4.8%	0.8%	21.0%	16.9%	12.1%	38.7%
Manufacturing (CC)	34.1%	16.8%	8.1%	25.4%	26.0%	25.8%	55.7%
Electricity, Gas, Water and Waste Services (DD)	21.4%	7.1%	1.0%	27.6%	28.6%	25.5%	56.1%
Construction (EE)	12.4%	4.1%	0.8%	14.9%	24.8%	20.3%	39.2%
Wholesale Trade (FF)	34.8%	20.8%	8.0%	20.1%	25.8%	31.3%	57.9%
Retail Trade and Accommodation (GH)	19.2%	4.2%	1.5%	15.6%	21.7%	28.9%	42.7%
Transport, Postal and Warehousing (II)	17.6%	5.6%	1.8%	19.9%	22.3%	18.3%	40.0%
Information Media and Telecommunications (JJ)	35.6%	15.9%	4.4%	26.6%	30.8%	29.0%	58.8%
Financial and Insurance Services (KK)	26.1%	9.3%	1.4%	29.1%	32.9%	27.7%	54.9%
Rental, Hiring and Real Estate Services (LL)	15.1%	4.6%	0.7%	19.9%	26.5%	34.3%	48.8%
Professional, Scientific, Technical, Admin & Support Services (MN)	22.6%	9.9%	4.2%	21.1%	25.3%	22.7%	46.6%
Public Administration and Safety (OO)	26.4%	2.3%	0.0%	24.1%	37.9%	25.3%	44.8%
Education and Training (PP)	28.8%	9.0%	2.7%	23.2%	33.5%	30.7%	53.7%
Health Care and Social Assistance (QQ)	19.6%	4.3%	0.5%	19.7%	28.5%	17.3%	45.9%
Arts, Recreation and Other Services (RS)	16.1%	4.3%	0.8%	14.3%	20.0%	23.5%	39.0%
Firm Size							
6-19 employees	20.3%	7.3%	2.8%	17.1%	21.8%	23.3%	42.8%
20-49 employees	24.7%	10.6%	4.1%	21.1%	27.5%	24.8%	50.9%
50+ employees	30.9%	15.3%	5.4%	29.8%	35.1%	30.0%	60.1%
Firm Subsets							
R&D industries	30.7%	16.0%	8.0%	23.5%	26.1%	23.6%	51.8%
R&D firms	61.7%	36.7%	18.9%	42.0%	47.4%	44.1%	82.8%
High skilled industries	25.1%	11.5%	4.8%	22.9%	26.2%	22.4%	48.8%
High skilled firms	28.1%	14.8%	6.5%	21.8%	26.7%	26.1%	50.9%
Export industries	29.5%	15.6%	6.9%	21.0%	23.8%	24.6%	51.2%
Export firms	37.1%	20.6%	10.6%	26.5%	28.7%	29.8%	60.0%

[9] We pool all years throughout, since aggregate innovation rates are very stable across years.

In addition to the four innovation indicators collected in the Business Operations Survey, innovating firms were asked whether new staff were an important source of new ideas. This provides an alternative innovation measure that is directly linked to the influence of new staff, some of whom will be recent migrants and returning New Zealanders. Overall, 47% of innovating firms reported new staff being an important source of new ideas for innovation (Figure 3.2). Innovating firms in the Education and Training (66%), Financial and Insurance Services (58%), Information Media and Telecommunications (57%), and Electricity, Gas, Water and Waste Services (56%) industries were most likely to report new staff being a source of new ideas. Large firms with 50 or more employees (62%), and firms investing in research and development (60%) were also particularly likely to report new staff being a source of new ideas.

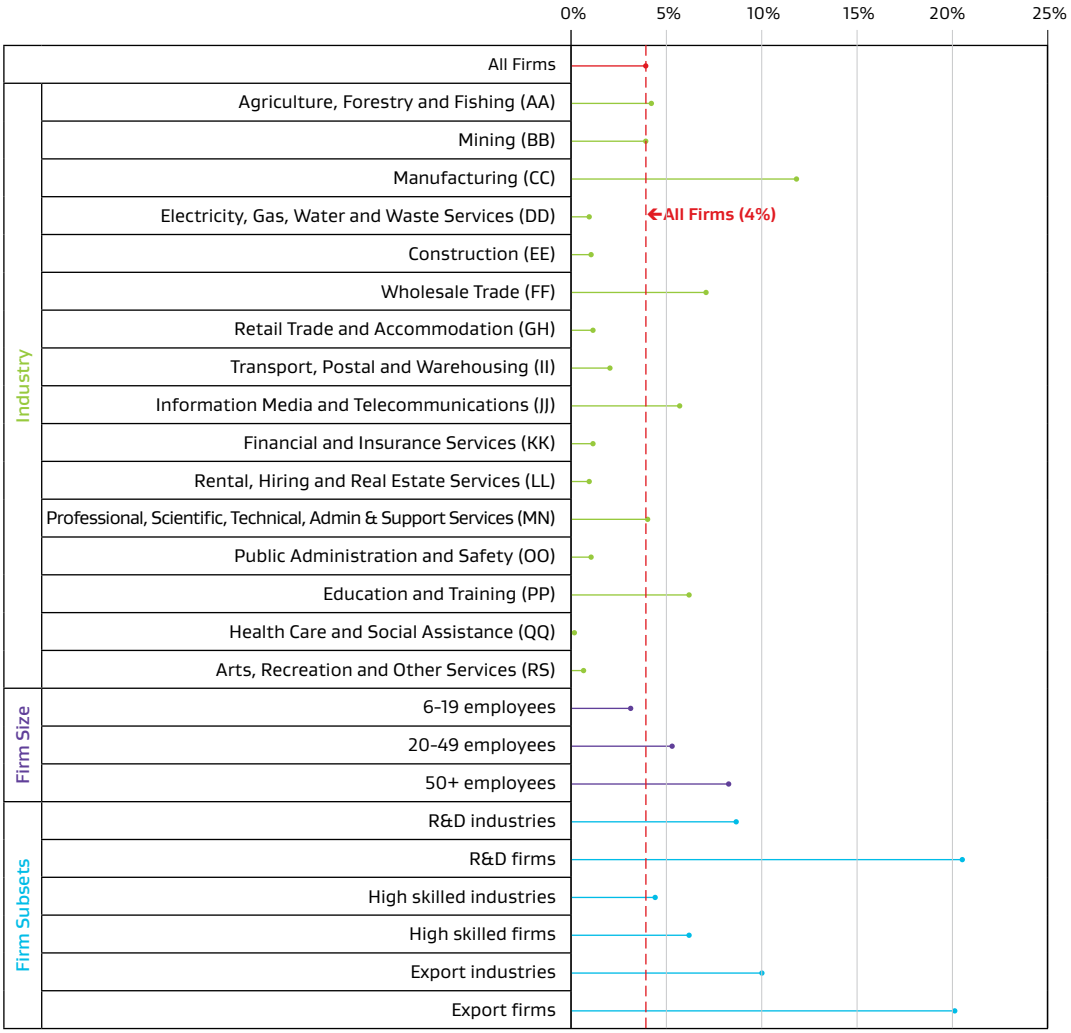
Figure 3.2 Percentage of innovating firms indicating new staff are an important source of new ideas for innovation, pooled years



Finally, we looked at whether firms had entered a new export market in the past year

Figure 3.3). Not surprisingly, given exporting is restricted to a subset of firms located in specific industries, only a small percentage of firms (4%) had entered a new export market in the past year. Firms in the Manufacturing (12%) and Wholesale Trade (7%) industries were most likely to have done so, as were firms that had invested in R&D (21%) and, as we would expect, exporting firms (20%).

Figure 3.3 Percentage of firms indicating they had entered a new export market in the last year, pooled years



3.2 Innovation and workforce characteristics

While this paper examines the link between migration (of both recent migrants and returnees) and innovation, we expect other workforce characteristics to also be related to innovation. In particular, new employees more generally could be a source of new ideas for a firm, even if those new employees did not come from overseas. Similarly, an expanding firm may be both more likely to innovate and to have a greater number of new employees. Finally, firms with more high skilled workers may also be more likely to innovate than those with lower skilled workers.

Table 3.3 shows employment shares for innovating and non-innovating firms by skill level, firstly of all employees, and secondly of new employees. Overall, innovating firms tend to have a higher share of high skilled employees (26% vs 23%), and a higher share of new employees generally (57% vs 52%), with this higher share being evident at both skill levels (all differences significant at the 1% level). Given our focus on the first two years after arrival in New Zealand, migrant employment makes up a small percentage of overall employment, with returnee employment smaller again (around 3% and 0.5% respectively). There is a small difference between the share of recent migrants and returnees in innovating and non-innovating firms, with innovating firms having higher shares (not different from zero at the 10% level for migrant share). As with new employees overall, innovating firms were particularly likely to employ high skilled recent migrants and returnees (differences significant at the 5% or better level).

Table 3.3 Employment shares for innovating and non-innovating firms by skill level shares, for new employees, and for migrants and returnees

	Non-Innovators	Innovators	Difference	F Value	Pr > F
High Skilled Share	23.3%	25.8%	2.5%	37.98	<.0001
New Employee Share	51.8%	56.5%	4.6%	67.05	<.0001
New High Skilled Employee Share	9.7%	12.0%	2.4%	82.79	<.0001
Recent Migrant Share	3.00%	3.25%	0.25%	2.54	0.1111
Recent Returnee Share	0.44%	0.51%	0.07%	4.96	0.0259
High Skilled Recent Migrant Share	0.40%	0.65%	0.26%	32.46	<.0001
High Skilled Recent Returnee Share	0.12%	0.17%	0.06%	5.86	0.0155

3.3 Migrant and returnee employment

The skill level of migrants and returnees

Table 3.4 shows the high skilled share of months worked by new employees, and by those new employees classified as being recent migrants or returnees. As discussed in Section 2.5, skill level was set by assigning employees with the highest worker fixed effects as being high skilled, such that the average firm high skilled employment share was 25%. This results in a little over 28% of all months worked being classified as high skilled, as shown in Table 3.4. Overall, new employees are less likely to be high skilled than the total workforce (22.7% of months worked), while recent migrants had a similar share of high skilled employment to other new employees (22.2%). Recent returnees were more likely to be high skilled than any of the other groups (31.6%).

Table 3.4 Skill level of employment for different employee groups

Employee group	High skilled share of months worked	Total years worked[1]
All employees	28.3%	6,815,728
New employees	22.7%	3,109,922
Recent migrants	22.2%	210,613
Recent returnees	31.6%	32,567

[1] Calculated as the number of months worked from April 2003 to March 2011 divided by 12.

Recent migrants are highly heterogeneous, and skill level differs markedly according to the policy category under which migrants enter New Zealand, as we might expect given the intent of these policies and the associated criteria. Table 3.5 summarises both high skilled and low-to-medium skilled recent migrant employment according to the relevant policy at the time the migrant was first employed in New Zealand. In most cases (71% of high skilled recent migrants and 73% of low-to-medium skilled recent migrants) this was through a temporary work visa. The final two columns indicate the share of employment that is high skilled in each category and the size of each category in terms of years worked, as in Table 3.4.

The migrants that are most likely to be defined as high skilled are Work to Residence visa holders (73.0%), those granted residence as Skilled Migrant Category principal applicants (37.5%), Australians (36.5%), and Essential Skills Visa holders (31.4%). Groups with the lowest share of high skilled employment include: those with a visa under the Recognised Seasonal Employer scheme, which provides seasonal workers to the horticulture and viticulture industry (2.9%); international students, who may have the right to work for up to 20 hours per week during term time, and longer during holiday breaks (7.5%); and Study to Work visa holders, who are seeking to make the transition from study to residence in New Zealand (6.2%).

Most migrants to New Zealand arrive with temporary status, and this is reflected in the final column of the table. The largest categories of recent migrant employment are for Essential Skills visa holders and working holidaymakers. The former are more likely to be high skilled than the average employee, and many take up residence and stay in New Zealand long term, while the latter tend to do lower skilled work, and generally only stay in the country for up to a year.

Table 3.5 Skill level of recent migrant employment arriving under different categories

	Share of high skilled recent migrants	Share of low-to-medium skilled recent migrants	High skilled share of months worked	Total years worked[1]
Australians	**11.8%**	**5.8%**	**36.5%**	**15,094**
Resident				
Skilled Migrant Category (P) 2	8.2%	3.9%	37.5%	10,282
Skilled Migrant Category (S) 2	3.2%	4.9%	15.9%	9,475
Other residence categories	2.8%	7.1%	10.1%	12,884
Total residents	**14.2%**	**15.9%**	**20.4%**	**32,641**
Temporary - Work				
Essential Skills	24.0%	15.0%	31.4%	35,785
Working holidaymakers	13.5%	21.7%	15.1%	41,927
Recognised Seasonal Employer	0.3%	3.0%	2.9%	5,096
Family	7.3%	15.6%	11.8%	29,003
Study to Work	1.1%	4.6%	6.2%	8,010
Work to Residence	14.0%	1.5%	73.0%	8,970
Other temporary	10.9%	12.0%	20.6%	24,684
Total temporary work	**71.1%**	**73.4%**	**21.7%**	**153,475**
International students	**1.0%**	**3.5%**	**7.5%**	**6,231**
TOTAL MIGRANTS	**100.0%**	**100.0%**	**22.2%**	**210,613**

[1] Calculated as the number of months worked from April 2003 to March 2011 divided by 12.

[2] Principal migrants (P) are the main applicant, with points awarded based on the extent to which they meet various policy criteria. Secondary migrants (S) are family members included on the application of a principal applicant.

Recent migrant and returnee employment by firm characteristic

Table 3.6 describes employment shares according to different firm characteristics. Firms in the Information Media and Telecommunications Industry had the highest average high skilled employment share and the highest new high skilled employment share (46% and 17% respectively). Larger firms tended to have a higher high skilled share than smaller firms, but similar proportions of new high skilled staff due to having a lower share of new staff overall.

Table 3.6 Employment shares by firm characteristics

Firm characteristics	High skilled employment share	New employment share	High skilled new employment share
All Firms	28.3%	45.6%	10.3%
Industry			
Agriculture, Forestry and Fishing (AA)	19.5%	52.9%	9.1%
Mining (BB)	40.1%	46.7%	16.4%
Manufacturing (CC)	25.6%	36.8%	7.7%
Electricity, Gas, Water and Waste Services (DD)	40.1%	47.3%	13.6%
Construction (EE)	27.5%	46.5%	10.9%
Wholesale Trade (FF)	35.3%	41.3%	11.9%
Retail Trade and Accommodation (GH)	18.3%	52.4%	7.8%
Transport, Postal and Warehousing (II)	26.3%	38.5%	7.1%
Information Media and Telecommunications (JJ)	46.2%	46.2%	17.5%
Financial and Insurance Services (KK)	43.7%	36.3%	13.3%
Rental, Hiring and Real Estate Services (LL)	32.5%	49.3%	12.9%
Professional, Scientific, Technical, Administrative & Support Services (MN)	39.3%	53.6%	16.1%
Public Administration and Safety (OO)	19.1%	47.8%	5.6%
Education and Training (PP)	28.2%	55.8%	13.3%
Health Care and Social Assistance (QQ)	25.1%	48.6%	10.6%
Arts, Recreation and Other Services (RS)	25.1%	48.9%	9.7%
Firm Size			
6-19 employees	25.6%	49.7%	10.6%
20-49 employees	28.0%	47.3%	10.6%
50+ employees	29.3%	43.8%	10.2%
Firm subsets			
High R&D industries	43.3%	39.8%	14.8%
High R&D firms	32.4%	37.0%	10.1%
High skilled industries	49.2%	40.7%	17.0%
High skilled firms	62.9%	41.5%	22.8%
Export industries	27.5%	39.0%	8.9%
Export firms	31.7%	38.0%	9.9%

Table 3.7 shows the distribution of recent migrants and returnees across firm types. Industries with a particularly high share of high skilled migrants include Mining (1.9%), Professional, Scientific, Technical, Administrative & Support Services (1.5%), and Information Media and Telecommunications (1.1%). These industries also have generally high skilled employment (Table 3.7), and high shares of high skilled returnees. Agriculture, Forestry and Fishing (5.5%) and Retail Trade and Accommodation (4.1%) have the highest share of low-to-medium skilled migrant employment, while low-to-medium skilled returnees show no strong industry pattern.

Table 3.7 Migrant and returnee share of employment by firm characteristics

Firm characteristics	High skilled recent migrant employment share	Low-to-medium skilled recent migrant employment share	High skilled recent returnee employment share	Low-to-medium skilled recent returnee employment share
All Firms	0.69%	2.40%	0.15%	0.33%
Industry				
Agriculture, Forestry and Fishing (AA)	0.60%	5.50%	0.07%	0.31%
Mining (BB)	1.89%	0.92%	0.26%	0.32%
Manufacturing (CC)	0.42%	1.59%	0.09%	0.26%
Electricity, Gas, Water and Waste Services (DD)	0.66%	0.70%	0.18%	0.22%
Construction (EE)	0.81%	1.54%	0.17%	0.39%
Wholesale Trade (FF)	0.69%	1.31%	0.16%	0.26%
Retail Trade and Accommodation (GH)	0.42%	4.05%	0.09%	0.37%
Transport, Postal and Warehousing (II)	0.32%	1.03%	0.14%	0.33%
Information Media and Telecommunications (JJ)	1.12%	1.24%	0.30%	0.28%
Financial and Insurance Services (KK)	0.75%	1.13%	0.24%	0.29%
Rental, Hiring and Real Estate Services (LL)	0.49%	1.68%	0.15%	0.32%
Professional, Scientific, Technical, Administrative & Support Services (MN)	1.50%	3.08%	0.32%	0.43%
Public Administration and Safety (OO)	0.42%	2.50%	0.06%	0.49%
Education and Training (PP)	0.68%	2.17%	0.19%	0.43%
Health Care and Social Assistance (QQ)	0.94%	2.08%	0.10%	0.22%
Arts, Recreation and Other Services (RS)	0.64%	3.33%	0.10%	0.37%
Firm Size				
6-19 employees	0.53%	2.30%	0.15%	0.34%
20-49 employees	0.64%	2.56%	0.15%	0.35%
50+ employees	0.76%	2.40%	0.15%	0.32%
Firm subsets				
High R&D industries	1.31%	1.36%	0.27%	0.23%
High R&D firms	0.75%	1.54%	0.15%	0.25%
High skilled industries	1.48%	1.20%	0.34%	0.26%
High skilled firms	2.04%	0.99%	0.44%	0.22%
Export industries	0.50%	1.83%	0.11%	0.26%
Export firms	0.77%	1.81%	0.16%	0.27%

4 Estimation results

4.1 Any innovation

Table 4.1 summarises the results from logit models using the specification outlined in Section 2.7, where the dependent variable is "any innovation." In the first specification, neither the presence of recent migrants nor returnees is significantly associated with innovation, although the latter measure has a large positive coefficient.

Table 4.1 Logit models controlling for firm and workforce characteristics – Any innovation

Specification	Any innovation (mean = 0.458)			
	(1)	(2)	(3)	(4)
Recent migrant employment share	0.131 [0.090]	-0.045 [0.099]	-0.112 [0.100]	
High skilled recent migrant employment share				0.656* [0.265]
Low-to-medium skilled recent migrant employment share				-0.157 [0.113]
Recent returnee employment share	0.756 [0.438]	0.210 [0.437]	0.100 [0.436]	
High skilled recent returnee employment share				0.738 [0.634]
Low-to-medium skilled recent returnee employment share				-0.293 [0.459]
High skilled employment share		0.125** [0.031]	0.080* [0.032]	0.033 [0.047]
New employee employment share		0.285** [0.026]	0.290** [0.028]	
New high skilled employee employment share				0.320** [0.064]
New low-to-medium skilled employee employment share				0.265** [0.036]
Average employee observable characteristics		0.274** [0.064]	0.166* [0.066]	0.154* [0.065]
Log total employment			0.054** [0.005]	0.057** [0.005]
New firm indicator			-0.016 [0.028]	-0.017 [0.028]
Positive R&D spend			0.200* [0.082]	0.205* [0.083]
Log R&D spend per employee			0.032* [0.013]	0.031* [0.013]
Survey year dummies	Y	Y	Y	Y
Industry dummies	N	N	Y	Y
Region shares	N	N	Y	Y
Observations	26,415	26,415	26,415	26,415
Goodness of fit p-value	0.002	0.100	0.913	0.859

Notes: Reported coefficients are marginal effects from logistic regressions, evaluated at means.
All estimates take account of the stratified survey sample design and weighting. Numbers in brackets are standard errors.
** = significant at 1%; * = significant at 5%. Goodness of fit statistics calculated as in Archer & Lemeshow (2006).
Reference worker groups in columns are non-migrant, non-returnees (1), and low-to-medium-skilled existing employees (2), (3), and (4)

The coefficient for migrant and returnee share reduces in magnitude when we directly control for workforce and firm characteristics (specifications (2) and (3) respectively[10]). These estimated coefficients now capture the relationship with innovation over and above the fact that recent migrants/returnees must, by construction, be new employees. The share of high skilled employees and the share of new employees in the firm both show a positive significant relationship with innovation, as do firm size and R&D expenditure.

In specification (4), we further distinguish new staff, recent migrant and returnee employment shares by skill level. At this stage, we see that the high skilled migrant employment share is significantly associated with innovation. The coefficient of 0.656 for the high skilled migrant employment share variable indicates that if a firm hires a number of high skilled migrants equivalent to 1 percent of its workforce, we expect the firm to be 0.656 percentage points more likely to innovate than if they had hired an equivalent number of non-migrant, non-returnee high skilled workers. While the coefficient for high skilled returnees is even larger (0.738), it is insignificantly different from zero (at the 5% level). Both low-to-medium skilled migrants and returnees have a negative, albeit non-significant, association with innovation overall.

While the share of new high skilled employment is significantly associated with innovation, so too is the share of new low-to-medium skilled employment. Unlike for migrants and returnees, for new employees more generally it seems to be their newness, rather than their skill level, that is linked with a firm's propensity to innovate.[11] This is consistent with reverse causality – innovating firms expanding – influencing the relationship.

Once we control for the skill level of new employee employment shares, the share of high skilled employees overall is no longer significantly associated with innovation. This could be due to the presence of multi-collinearity, with the high skilled employment share and new high skilled employment share being highly correlated.[12] As a result, it is difficult to say whether high skilled staff generally, or new high skilled staff in particular, are driving the relationship with innovation.

4.2 Other innovation measures

Results of models following specifications (1) and (4) above are presented in Table 4.2 and Table 4.3 respectively for the remaining innovation measures. This section looks at whether different workforce characteristics are related to different types of innovation.

While there were no significant relationships between recent migrant or returnee employment shares and overall innovation identified in Section 4.1 (without any other workforce of firm controls), some positive associations are evident in Table 4.2. Specifically, we see a positive relationship between the recent migrant employment share and product innovation, process innovation, and marketing innovation, as well as the propensity for a firm to enter new export markets. Returnee New Zealanders on the other hand are associated with product innovations where those products are new to New Zealand, with organisational innovation, and with marketing innovation. They are also positively associated with innovating firms reporting that staff are an important source of new ideas for innovation.

Positive associations are still evident once we control for other workforce and firm characteristics, and add a skill dimension to the workforce characteristics (Table 4.2). Positive associations are particularly evident for high skilled recent migrants and returnees, as shown for the earlier models looking at innovation more broadly. These relationships are over and above that due to newness to the firm per se, which itself is significantly correlated with almost all innovation measures. As noted earlier, high skilled is correlated with new high skilled so that the significance of the latter may partly reflect the general skills composition of the firm. However, the consistent significance of the new low-medium skilled share supports the hypothesis that newness itself is directly related to innovation, potentially via reverse causation.[13]

[10] While firm level controls and industry/region dummies are added to the model in specification (3), it is the former set of variables that explain most of the change in the coefficients and improvement in the model goodness-of-fit between specifications (2) and (3).

[11] The coefficients are not significantly different at the 5% level.

[12] To test this conclusion further we ran models with each of these variables included separately. Each variable was strongly positively significant with the other variable excluded, models had similar goodness of fit, and the exclusion of either variable had little effect on other coefficients in the model.

[13] As in Table 4.1, the coefficients for the new high skilled employment share and the new low-to-medium skilled employment share were not significantly different in any of the models presented in this section.

High skilled recent migrants are associated with a firm being more likely to have introduced new products (as well as specifically those that are new to New Zealand), and with the introduction of new marketing methods. Hiring a number of high skilled recent migrants equivalent to 1 percent of its workforce is associated with a firm being 0.53 percentage points more likely to introduce a new product, 0.18 percentage points more likely to introduce a product new to New Zealand, and 0.44 percentage points more likely to introduce new marketing methods, than if they had hired an equivalent number of non-migrant, non-returnee high skilled workers.

High skilled returnees are associated with product innovation where that product is new to New Zealand, and with new organisational or managerial practices. Hiring a number of high skilled returnee New Zealanders equivalent to 1 percent of its workforce is associated with a firm being 0.34 percentage points more likely to introduce a new product that is new to New Zealand, and 1.09 percentage points more likely to introduce new organisational or managerial practices than if they had hired an equivalent number of non-migrant, non-returnee high skilled workers.

Lower skilled recent migrants and returnees are associated with small positive associations with firms entering new export markets and introducing products that are new to the world respectively. Neither of these outcomes measures is associated with new high skilled recent migrants or returnees, or with new high skilled employees more generally. Both measures show a small but significant relationship with the share of new low-to-medium skilled employees.

While the presence of new employees more generally (regardless of skill level) is associated with innovating firms reporting that new staff are an important source of new ideas for innovation, the presence of recent migrants or returnees is not associated with any additional effect. Firms that report new staff as being important for innovation are not disproportionately more likely to have hired recent migrants or returnees over and above any relationship that arises from skill or general newness to the firm.

Table 4.2 Logit models without firm or workforce controls – All innovation measures

Specification	Product Innovation			Process Innovation	Organisational Innovation	Marketing Innovation	New staff as a source of ideas	Entered new export market
	Any	New to NZ	New to World					
Recent migrant employment share	**0.184****	0.031	0.007	**0.168****	0.111	**0.149***	0.143	**0.084****
	[0.066]	[0.041]	[0.020]	**[0.062]**	[0.068]	**[0.070]**	[0.136]	**[0.018]**
Recent returnee employment share	0.527	**0.444***	0.188	-0.075	**1.038****	**0.724***	**2.383****	-0.020
	[0.312]	**[0.187]**	[0.105]	[0.301]	**[0.340]**	**[0.341]**	**[0.690]**	[0.135]
Survey year dummies	Y	Y	Y	Y	Y	Y	Y	Y
Industry dummies	N	N	N	N	N	N	N	N
Region shares	N	N	N	N	N	N	N	N
Mean dependent variable	0.220	0.086	0.033	0.189	0.240	0.242	0.470	0.041
Observations	26,415	26,415	26,415	26,415	26,415	26,415	14,124	26,415
Goodness of fit p-value	0.001	0.000	0.005	0.052	0.000	0.023	0.076	0.000

Notes: Reported coefficients are marginal effects from logistic regressions, evaluated at means.
All estimates take account of the stratified survey sample design and weighting.
Numbers in brackets are standard errors. ** = significant at 1%; * = significant at 5%.
Goodness of fit statistics are calculated as in Archer & Lemeshow (2006).
The 'New staff as a source of ideas' model is restricted to "any innovation" firms only.

Table 4.3 Logit models with firm or workforce controls – All innovation measures

Specification	Product Innovation			Process Innovation	Organisational Innovation	Marketing Innovation	New staff as a source of ideas	Entered new export market
	Any	New to NZ	New to World					
High skilled recent migrant employment share	**0.534****	**0.180***	-0.007	0.163	0.108	**0.444***	-0.066	-0.011
	[0.169]	**[0.0786]**	[0.0259]	[0.202]	[0.215]	**[0.181]**	[0.424]	[0.029]
Low-to-medium skilled recent migrant employment share	0.036	0.022	0.011	0.057	-0.114	-0.108	-0.192	**0.040****
	[0.084]	[0.040]	[0.016]	[0.075]	[0.085]	[0.087]	[0.173]	**[0.014]**
High skilled recent returnee employment share	0.159	**0.336***	0.033	-0.501	**1.089****	0.549	1.272	-0.006
	[0.376]	**[0.148]**	[0.046]	[0.410]	**[0.420]**	[0.455]	[0.828]	[0.068]
Low-to-medium skilled recent returnee employment share	-0.034	0.097	**0.131***	-0.224	-0.011	0.0051	0.746	-0.032
	[0.316]	[0.156]	**[0.053]**	[0.341]	[0.370]	[0.356]	[0.763]	[0.058]
High skilled employment share	0.002	0.027	0.014*	-0.027	0.019	0.036	0.102	0.018**
	[0.033]	[0.014]	[0.006]	[0.035]	[0.039]	[0.039]	[0.069]	[0.006]
New high skilled employee employment share	0.194**	0.057**	0.011	0.178**	0.298**	0.171**	0.393**	0.009
	[0.044]	[0.019]	[0.007]	[0.043]	[0.049]	[0.049]	[0.089]	[0.008]
New low-to-medium skilled employee employment share	0.081**	0.018	0.013*	0.136**	0.272**	0.168**	0.341**	0.010*
	[0.027]	[0.012]	[0.005]	[0.026]	[0.029]	[0.029]	[0.053]	[0.004]
Average employee observable characteristics	-0.032	0.000	-0.008	0.028	0.170**	0.030	0.245*	0.023**
	[0.049]	[0.023]	[0.010]	[0.046]	[0.053]	[0.051]	[0.098]	[0.008]
Log total employment	0.019**	0.010**	0.001**	0.033**	0.046**	0.015**	0.088**	0.003**
	[0.003]	[0.001]	[0.001]	[0.003]	[0.003]	[0.004]	[0.007]	[0.000]
New firm indicator	0.008	-0.004	-0.001	-0.011	-0.027	-0.013	0.002	-0.000
	[0.021]	[0.009]	[0.004]	[0.018]	[0.019]	[0.021]	[0.041]	[0.003]
Positive R&D spend	0.110	0.006	0.003	0.134**	0.230**	0.202**	0.110	0.001
	[0.056]	[0.016]	[0.006]	[0.051]	[0.063]	[0.062]	[0.071]	[0.005]
Log R&D spend per employee	0.026**	0.012**	0.003**	0.007	-0.000	0.001	0.006	0.003**
	[0.006]	[0.002]	[0.001]	[0.005]	[0.006]	[0.006]	[0.009]	[0.001]
Mean dependent variable	0.220	0.086	0.033	0.189	0.240	0.242	0.470	0.041
Observations	26,415	26,193	26,394	26,415	26,415	26,415	14,124	26,244
Goodness of fit p-value	0.275	0.014	0.097	0.912	0.615	0.832	0.730	0.004

Notes: All models include time and industry dummies, as well as region employment shares.
Reported coefficients are marginal effects from logistic regressions, evaluated at means.
All estimates take account of the stratified survey sample design and weighting.
Numbers in brackets are standard errors. ** = significant at 1%; * = significant at 5%.
Goodness of fit statistics are calculated as in Archer & Lemeshow (2006).
Numbers of observations vary due to subgroups with no variation in innovation outcomes.
The 'Staff as a source of new ideas' model is restricted to "any innovation" firms only.

4.3 Firm subsets

The presence of recent migrants or returnees may be an important contributor to firm innovation for only some subgroups of firms. In firms for which the potential for innovation is generally low, workforce characteristics may not be associated with innovation, meaning that the models above may underestimate the effect of these characteristics for innovative firms. In order to understand whether migration has a particular relationship with innovation for specific groups of firms we estimated separate regressions for firms with different characteristics, as outlined in Section 2. Firm subgroups were identified according to whether the firms (or the industries in which they operate) were more likely to have a high skilled workforce, to export, or to invest in R&D. Subgroups were also defined according to firms of different sizes.

The results of these firm subset models for any innovation, and for whether new staff were identified as being an important source of ideas for innovation, are presented in Table 4.4 and

Table 4.5 respectively.[14] One concern with the models presented here is that the goodness of fit tests are poor for each of the subset models, with the exception of the 'any innovation' measure for small firms. This could indicate that the relationships are more complex than is captured by our model. Given these concerns, we focus on results that are generally consistent across firm subsets.

Across all firm subsets, the share of new workers (at both skill levels) is positive, and is generally statistically significant. Similarly, for all but small firms, there is a relationship between the size of the firm and its R&D expenditure on the one hand, and its likelihood of innovating on the other.

High skilled recent migrants were identified as having a positive association with innovation in small firms, firms in high skilled industries, and firms in R&D industries (coefficients of 0.628, 1.624 and 1.562 respectively), but not amongst larger firms, high skilled firms, exporting firms, or R&D firms. All but the last of these firm subsets have positive estimated coefficients however, and the lack of significance may be at least partly related to the smaller samples resulting in larger standard errors.

Setting aside this possibility, the fact that we have a positive significant relationship between high skilled recent migrant share and innovation in firms in skilled and R&D industries, but not in skilled or R&D firms is difficult to interpret. One possibility is that high skilled migrants are particularly important for innovation for those firms that operate in high skilled or R&D industries, but that do not themselves have a particularly high skilled workforce or investment in R&D respectively.[15] This could indicate that skilled migrants are substitutes rather than complements for a high skilled workforce or R&D investment in these industries with respect to innovation.

As with the earlier models across all firms, models for firm subsets fail to show a relationship between recent migrants or returnees and the firm identifying new staff as being an important source of ideas for innovation.

[14] Models were also estimated for other innovation measures and are available from the author on request.

[15] This suggestion is supported by additional analysis. For both skills and R&D, we additionally ran four models defined according to both firm-level skills/R&D and whether they were in a high skilled/R&D industry. The only model for which the new high skilled migrant share was significantly correlated with innovation was for those firms not themselves high skilled or engaging in R&D, but who were operating in a high skilled/R&D industry.

Table 4.4 Firm subset logit models controlling for firm and workforce characteristics – Any innovation

Specification	Small Firms	Medium Firms	Large Firms	Skilled Industries	Skilled Firms	R&D Industries	R&D Firms	Export Industries	Export Firms
High skilled recent migrant employment share	**0.628***	0.310	0.954	**1.624***	0.675	**1.562***	-0.262	0.152	1.081
	[0.315]	[0.537]	[0.499]	**[0.692]**	[0.366]	**[0.608]**	[0.539]	[0.572]	[0.716]
Low-to-medium skilled recent migrant employment share	-0.164	-0.191	0.043	-0.032	0.217	0.035	-0.203	0.269	-0.112
	[0.164]	[0.224]	[0.124]	[0.474]	[0.587]	[0.395]	[0.241]	[0.236]	[0.278]
High skilled recent returnee employment share	0.557	-1.818	**-3.677***	1.733	0.521	2.233	0.522	1.491	-0.093
	[0.771]	[1.279]	**[1.585]**	[1.827]	[1.269]	[2.020]	[1.419]	[1.232]	[1.144]
Low-to-medium skilled recent returnee employment share	-0.626	1.178	0.558	-1.276	2.337	-0.872	-0.134	-0.180	-0.005
	[0.554]	[1.004]	[1.123]	[1.011]	[1.611]	[1.098]	[0.954]	[0.998]	[1.028]
High skilled employment share	-0.005	0.183*	0.080	-0.121	0.301	-0.109	-0.029	0.036	-0.134
	[0.056]	[0.088]	[0.078]	[0.126]	[0.190]	[0.105]	[0.088]	[0.075]	[0.088]
New high skilled employee employment share	0.392**	0.452**	0.233	0.447**	0.302**	0.383**	0.135	0.244	0.351**
	[0.082]	[0.135]	[0.121]	[0.145]	[0.111]	[0.143]	[0.152]	[0.129]	[0.135]
New low-to-medium skilled employee employment share	0.269**	0.373**	0.037	0.260	0.714**	0.239*	0.128	0.194**	0.245**
	[0.046]	[0.074]	[0.058]	[0.136]	[0.203]	[0.105]	[0.078]	[0.064]	[0.082]
Average employee observable characteristics	0.203*	0.093	0.019	0.176	0.186	0.156	-0.370*	-0.134	-0.097
	[0.082]	[0.119]	[0.092]	[0.213]	[0.184]	[0.177]	[0.160]	[0.118]	[0.151]
Log total employment	0.042	0.102**	0.040**	0.083**	0.071**	0.060**	0.020*	0.065**	0.051**
	[0.023]	[0.033]	[0.007]	[0.013]	[0.013]	[0.012]	[0.008]	[0.009]	[0.009]
New firm indicator	0.070	0.012	0.003	0.035	0.152	0.043	-0.003	-0.022	-0.035
	[0.052]	[0.081]	[0.054]	[0.141]	[0.156]	[0.124]	[0.085]	[0.088]	[0.091]
Positive R&D spend	0.113	0.291**	0.148**	0.559**	0.352*	0.411**		0.121	0.257**
	[0.167]	[0.105]	[0.057]	[0.066]	[0.151]	[0.090]		[0.119]	[0.073]
Log R&D spend per employee	0.044	0.009	0.027**	-0.037	0.005	-0.000	0.023**	0.038*	0.011
	[0.023]	[0.019]	[0.010]	[0.029]	[0.027]	[0.019]	[0.006]	[0.018]	[0.013]
Mean dependent variable	0.428	0.509	0.601	0.488	0.509	0.518	0.828	0.512	0.600
Observations	9,384	6,279	9,156	4,035	3,735	4,767	2,871	7,470	6,246
Goodness of fit p-value	0.640	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000

Notes: All counts have been rounded to protect confidentiality.
All models include time and industry dummies, as well as region employment shares.
Reported coefficients are marginal effects from logistic regressions, evaluated at means.
All estimates take account of the stratified survey sample design and weighting.
Numbers in brackets are standard errors. ** = significant at 1%; * = significant at 5%.
Goodness of fit statistics are calculated as in Archer & Lemeshow (2006).

Table 4.5 Firm subset logit models controlling for firm and workforce characteristics – New staff as a source of ideas for innovation

Specification	Small Firms	Medium Firms	Large Firms	Skilled Industries	Skilled Firms	R&D Industries	R&D Firms	Export Industries	Export Firms
High skilled recent migrant employment share	-0.352	0.877	0.553	-0.612	-0.293	-0.201	1.467	0.537	0.242
	[0.453]	[0.782]	[0.606]	[0.594]	[0.476]	[0.557]	[1.056]	[0.666]	[0.684]
Low-to-medium skilled recent migrant employment share	-0.228	-0.459	0.034	-0.908	-0.668	-0.440	-0.796	-0.097	-0.255
	[0.268]	[0.292]	[0.187]	[0.534]	[0.883]	[0.430]	[0.552]	[0.301]	[0.315]
High skilled recent returnee employment share	0.990	2.469	-0.103	0.868	1.263	-0.091	0.053	-1.959	-1.086
	[0.972]	[1.816]	[2.240]	[1.573]	[1.732]	[1.486]	[2.058]	[1.377]	[1.170]
Low-to-medium skilled recent returnee employment share	0.595	1.910	0.975	-0.581	0.088	0.145	1.475	0.908	-2.620
	[0.934]	[1.417]	[1.506]	[1.786]	[1.800]	[1.961]	[2.253]	[1.388]	[1.377]
High skilled employment share	0.087	0.004	0.070	-0.230	-0.512*	-0.124	0.081	0.009	0.018
	[0.086]	[0.126]	[0.100]	[0.187]	[0.250]	[0.155]	[0.171]	[0.113]	[0.127]
New high skilled employee employment share	0.473**	0.601**	0.316	0.932**	0.817**	0.955**	0.623*	0.667**	0.766**
	[0.118]	[0.179]	[0.162]	[0.199]	[0.166]	[0.201]	[0.263]	[0.179]	[0.225]
New low-to-medium skilled employee employment share	0.334**	0.379**	0.225**	0.215	0.097	0.222	0.424**	0.352**	0.341**
	[0.070]	[0.104]	[0.078]	[0.193]	[0.277]	[0.146]	[0.155]	[0.094]	[0.111]
Average employee observable characteristics	0.224	0.275	0.298*	0.302	0.445	-0.010	-0.174	0.034	0.137
	[0.130]	[0.165]	[0.122]	[0.309]	[0.302]	[0.260]	[0.270]	[0.164]	[0.199]
Log total employment	0.132**	0.128**	0.042**	0.144**	0.132**	0.144**	0.107**	0.093**	0.116**
	[0.033]	[0.044]	[0.009]	[0.019]	[0.018]	[0.017]	[0.016]	[0.010]	[0.011]
New firm indicator	0.039	-0.096	0.006	-0.365**	-0.118	-0.255*	0.155	-0.039	0.113
	[0.080]	[0.107]	[0.071]	[0.120]	[0.194]	[0.126]	[0.119]	[0.107]	[0.127]
Positive R&D spend	0.185	-0.027	-0.023	0.019	-0.272	0.050		-0.042	-0.029
	[0.132]	[0.107]	[0.063]	[0.221]	[0.212]	[0.141]		[0.102]	[0.097]
Log R&D spend per employee	-0.003	0.019	0.023*	0.011	0.047	0.010	0.023*	0.024	0.020
	[0.017]	[0.014]	[0.009]	[0.025]	[0.027]	[0.016]	[0.011]	[0.014]	[0.012]
Mean dependent variable	0.433	0.509	0.622	0.562	0.530	0.510	0.603	0.426	0.482
Observations	4,266	3,369	5,571	2,310	2,145	2,802	2,427	4,410	4,107
Goodness of fit p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: All counts have been rounded to protect confidentiality.
All models include time and industry dummies, as well as region employment shares.
Reported coefficients are marginal effects from logistic regressions, evaluated at means.
All estimates take account of the stratified survey sample design and weighting.
Numbers in brackets are standard errors. ** = significant at 1%; * = significant at 5%.
Goodness of fit statistics are calculated as in Archer & Lemeshow (2006).

5 Conclusions

Firms that hire more recent migrants and firms that hire more recent returnee New Zealanders tend to innovate more than other firms. Firms with more recent migrants are more likely to introduce new goods and services, new processes, and new marketing methods, as well as being more likely to enter new export markets. Firms that hire more recent returnees are more likely to introduce products that are new to New Zealand, new organisational or managerial practices, and new marketing methods.

These relationships result from a number of different factors. Migrants and returnees are often highly skilled, are new to the firms they work for, and they bring 'outside' (ie international) perspectives with them. When we try to separate out the effects of migrants and returnees on innovation from them being new, high skilled, and having an 'outside' perspective, we find that the former two factors seem to matter more, at least for some forms of innovation, and/or some types of firm. This conclusion is supported by results for the self-reported influence of new staff on innovation, where recent migrants and returnees do not appear to raise the likelihood of this reporting, over and above their contribution to the new employee share. We cannot determine whether new employees, in general, play a substantial role in causing innovation outcomes or whether they are a consequence of such innovation.

We find a significant relationship between the share of high skilled immigrants working in a firm and the probability of that firm innovating, controlling for a range of characteristics of the firm and its workforce. High skilled immigrants may therefore have a positive impact on innovation, but this does not seem to be different from the impact of similarly high skilled non-migrant new employees. As such, the main way in which immigration policy is likely to facilitate innovation is through any positive influence it exerts on the skills composition of the workforce.

Recent returnees were more likely to be high skilled than the average worker, and considerably more likely than the average new employee. Migrants on the other hand were less likely to be high skilled than the average worker, but somewhat more likely than the average new employee. The average skill level of recent migrants is dragged down somewhat by categories that tend to attract low skilled workers, many on a short-term basis (for example working holidaymakers, and seasonal horticulture workers from the Pacific). Nevertheless, those temporary and permanent policies with a skills focus do tend to attract high skilled workers, and Australian migrants also tend to be high skilled. Focussing policy attention on reinforcing these categories could have flow-on innovation and productivity benefits for New Zealand firms and the New Zealand economy.

6 References

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APPENDIX A: INDUSTRY CLASSIFICATION

We classify firms according to the New Zealand Standard Industry Output Classification (NZSIOC), a standard classification used to categorise industries according to economic output.[16] The descriptive analysis in Section 2 uses Level 1 of the NZSIOC classification (consisting of 16 categories), while the econometric modelling and classification of industries according to skills, R&D activity and exporting uses Level 3 (53 categories, once out of scope industries are excluded – 0011 and 0021).

Table A.1 NZSIOC classification (Level 1) descriptions

Code	Description
AA	Agriculture, Forestry and Fishing
BB	Mining
CC	Manufacturing
DD	Electricity, Gas, Water and Waste Services
EE	Construction
FF	Wholesale Trade
GH	Retail Trade and Accommodation
II	Transport, Postal and Warehousing
JJ	Information Media and Telecommunications
KK	Financial and Insurance Services
LL	Rental, Hiring and Real Estate Services
MN	Professional, Scientific, Technical, Administrative and Support Services
OO	Public Administration and Safety
PP	Education and Training
QQ	Health Care and Social Assistance
RS	Arts, Recreation and Other Services

Table A.2 NZSIOC classification (Level 3) descriptions with industry subgroup indicators

Code	Description	High Skilled Industry	R&D Industry	Export Industry
AA11	Horticulture and Fruit Growing			Y
AA12	Sheep, Beef Cattle and Grain Farming			Y
AA13	Dairy Cattle Farming			Y
AA14	Poultry, Deer and Other Livestock Farming			Y
AA21	Forestry and Logging			
AA31	Fishing and Aquaculture		Y	Y
AA32	Agriculture, Forestry and Fishing Support Services and Hunting			
BB11	Mining		Y	
CC11	Meat and Meat Product Manufacturing			Y
CC12	Seafood Processing			Y

[16] See http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/industrial-classification.aspx for more detail.

Code	Description	High Skilled Industry	R&D Industry	Export Industry
CC13	Dairy Product Manufacturing		Y	Y
CC14	Fruit, Oil, Cereal and Other Food Product Manufacturing			Y
CC15	Beverage and Tobacco Product Manufacturing			Y
CC21	Textile, Leather, Clothing and Footwear Manufacturing			Y
CC31	Wood Product Manufacturing			Y
CC32	Pulp, Paper and Converted Paper Product Manufacturing		Y	Y
CC41	Printing			
CC51	Petroleum and Coal Product Manufacturing	Y		Y
CC52	Basic Chemical and Chemical Product Manufacturing		Y	Y
CC53	Polymer Product and Rubber Product Manufacturing		Y	Y
CC61	Non-Metallic Mineral Product Manufacturing			
CC71	Primary Metal and Metal Product Manufacturing		Y	Y
CC72	Fabricated Metal Product Manufacturing			
CC81	Transport Equipment Manufacturing			Y
CC82	Machinery and Other Equipment Manufacturing		Y	Y
CC91	Furniture and Other Manufacturing			Y
DD11	Electricity and Gas Supply	Y	Y	
DD12	Water, Sewerage, Drainage and Waste Services			
EE11	Building Construction			
EE12	Heavy and Civil Engineering Construction			
EE13	Construction Services			
FF11	Wholesale Trade			Y
GH11	Motor Vehicle and Motor Vehicle Parts and Fuel Retailing			
GH12	Supermarket, Grocery Stores and Specialised Food Retailing			
GH13	Other Store-Based Retailing and Non Store Retailing			
GH21	Accommodation and Food Services			
II11	Road Transport			
II12	Rail, Water, Air and Other Transport			
II13	Postal, Courier Transport Support, and Warehousing Services			
JJ11	Information Media Services			
JJ12	Telecommunications, Internet and Library Services	Y	Y	
KK11	Finance	Y		
KK12	Insurance and Superannuation Funds			
KK13	Auxiliary Finance and Insurance Services	Y		
LL11	Rental and Hiring Services (except Real Estate)			
LL12	Property Operators and Real Estate Services			
LL21	Owner-Occupied Property Operation			
MN11	Professional, Scientific and Technical Services	Y	Y	
MN21	Administrative and Support Services			
OO11	Local Government Administration	N/A*	N/A	N/A
OO21	Central Government Administration, Defence and Public Safety	N/A*	N/A	N/A
PP11	Education and Training			
QQ11	Health Care and Social Assistance			
RS11	Arts and Recreation Services			
RS21	Other Services			

* Industries OO11 and OO21 are out of scope for the Business Operations Survey.

APPENDIX B: INSTRUMENTING FOR MIGRANT AND RETURNEE EMPLOYMENT SHARES

We want to assess the impact of new employees working in a firm on the chances of that firm innovating. Our measurement of innovation outcomes is based on two-yearly survey responses, and firms are asked to report innovations that have occurred over the previous two years. Given our interest in the flow of new ideas into a firm, we expect any impact on innovation to occur within a relatively short period of time. As such, we wish to relate worker composition to innovation during the same two-year time period.

A concern we have using contemporaneous measures is that the relationship between the measures could be due to reverse causality (ie innovation could result in a firm changing its workforce). As such, we want to instrument for the workforce composition variables of interest (recent returnee and migrant employment shares). Other studies of this type have typically used lagged workforce measures as instruments, although some have used more creative approaches (for example, Ozgen, Nijkamp, & Poot, 2011b use the number of foreign restaurants in a muncipality as one of their two instruments).

We considered a range of instruments as outlined below:

1. Lagged (2 year) migrant or returnee New Zealander shares by industry and firm-size, adjusted according to the region's share of total employment.
2. As in (1) above, but based on region by industry only (to test whether local industry was more predictive of migrant/returnee employment than the industry by firm-size dimension).
3. As in (1) above, but trying to introduce firm-level variation in the high skilled vs. low skilled employment mix, by adjusting the lagged industry by firm-size share according to the lagged firm-level high skilled/low-to-medium skilled share of total employment.
4. Lagged (two year) firm migrant/returnee share of employment.

The first three instruments use a combination of a time lag and aggregations across similar firms to construct an instrument which is arguably uninfluenced by firm innovation but still highly correlated with migrant/returnee shares. Instrument 4 attempts to overcome concerns around the weakness of the first three instruments by focussing specifically on firm-level lagged shares. While there may be some concerns that this is less clearly exogenous, as there could be persistent firm characteristics that are both associated with hiring of migrants/returnees and innovation, it should deal adequately with reverse causality concerns.

In fact, all four instruments produced materially similar results:

- Instruments for high skilled migrant share and (especially) high skilled returnee share were not highly correlated with the firm's migrant/returnee share in the current period. As a result, coefficients from the IV regressions were inflated, and standard errors were even more inflated.
- Instruments for low-to-medium skilled migrant share and (to a lesser degree) low-to-medium skilled returnee share were highly correlated with low-to-medium skilled migrant/returnee shares.

All of the instruments tested failed under-identification tests, with p-values well in excess of 0.05.

For returnees specifically, we also tested an instrument based on the distribution of lagged new non-migrant, non-returnee employees in the previous two-year period by industry, firm size, region and skill share aggregations. The justification for this is that returning New Zealanders may be more likely to take jobs in the same types of firm that hire New Zealanders more generally.

Another consideration, given the particular difficulties in constructing a sufficiently strong instrument for returning New Zealanders, was to take advantage of information on where the returning New Zealanders were working prior to departing the country, for those returning New Zealanders who had left New Zealand two to five years earlier. We tried two approaches:

- Allocating the current total flow of high/low-to-medium skilled returnees according to the last recorded industry/firm size/region of employment of the subset of returnees who had left 2-5 years earlier.
- Using the firm-level share of employment of high/low-to-medium skilled returnee New Zealanders who had left 2-5 years earlier as an instrument.

While significantly associated with the returnee share, the instruments resulting from these approaches were no stronger than the other instruments tried.

In general, employment shares of returnee New Zealanders seem to be harder to predict than shares of recent migrants, while high skilled employment shares seem to be more difficult to predict than lower skilled shares. Given our expectation that it is high skilled workers that might plausibly facilitate or drive firm innovation, this latter result is particularly concerning.

APPENDIX C: MEANS AND STANDARD ERRORS OF KEY VARIABLES

Table C.1 Means and standard errors of key variables by survey year and pooled years

	2004-2005 mean	2006-2007 mean	2008-2009 mean	2010-2011 mean	Pooled mean
Innovation outcomes					
Product innovation	25.53%	21.96%	20.73%	19.98%	22.01%
	(0.85%)	(0.78%)	(0.82%)	(0.84%)	(0.41%)
Product innovation - New to NZ	10.31%	8.20%	7.74%	8.18%	8.59%
	(0.54%)	(0.43%)	(0.46%)	(0.49%)	(0.24%)
Product innovation - New to world	4.50%	3.13%	2.71%	2.82%	3.28%
	(0.37%)	(0.30%)	(0.25%)	(0.29%)	(0.15%)
Process Innovation	21.93%	17.85%	18.09%	17.87%	18.91%
	(0.78%)	(0.73%)	(0.77%)	(0.81%)	(0.39%)
Organisational Innovation	27.46%	22.68%	23.71%	22.23%	24.00%
	(0.87%)	(0.82%)	(0.89%)	(0.90%)	(0.44%)
Marketing innovation	26.78%	22.51%	23.33%	24.16%	24.18%
	(0.90%)	(0.86%)	(0.90%)	(0.97%)	(0.45%)
Any innovation	51.08%	44.36%	44.43%	43.43%	45.78%
	(1.01%)	(1.01%)	(1.04%)	(1.09%)	(0.52%)
Entered new export market	4.82%	4.24%	3.53%	3.75%	4.07%
	(0.34%)	(0.30%)	(0.28%)	(0.31%)	(0.15%)
New staff are a source of new ideas	49.85%	45.63%	47.93%	44.22%	47.02%
	(1.36%)	(1.44%)	(1.54%)	(1.61%)	(0.74%)
Employment shares					
High skilled employment share	25.29%	23.69%	23.83%	25.00%	24.45%
	(0.38%)	(0.37%)	(0.36%)	(0.39%)	(0.19%)
New employee employment share	58.73%	56.59%	54.10%	46.66%	53.96%
	(0.50%)	(0.50%)	(0.51%)	(0.55%)	(0.26%)
New high skilled share	11.93%	10.61%	10.51%	10.01%	10.75%
	(0.26%)	(0.23%)	(0.24%)	(0.28%)	(0.13%)
Recent migrant employment share	3.01%	2.80%	3.28%	3.36%	3.11%
	(0.14%)	(0.12%)	(0.15%)	(0.19%)	(0.08%)
Recent returnee employment share	0.60%	0.52%	0.39%	0.38%	0.47%
	(0.03%)	(0.04%)	(0.03%)	(0.03%)	(0.02%)
High skilled recent migrant employment share	0.58%	0.52%	0.51%	0.44%	0.52%
	(0.04%)	(0.03%)	(0.03%)	(0.06%)	(0.02%)
High skilled recent returnee employment Share	0.18%	0.13%	0.17%	0.10%	0.14%
	(0.03%)	(0.02%)	(0.03%)	(0.01%)	(0.01%)

	2004-2005 mean	2006-2007 mean	2008-2009 mean	2010-2011 mean	Pooled mean
Firm controls					
Log firm employment	2.706	2.728	2.720	2.727	2.720
	(0.007)	(0.007)	(0.008)	(0.008)	(0.004)
Positive R&D spend	6.42%	6.06%	7.81%	8.28%	7.16%
	(0.41%)	(0.36%)	(0.44%)	(0.49%)	(0.22%)
Log R&D spend per employee	0.448	0.437	0.570	0.603	0.516
	(0.030)	(0.026)	(0.033)	(0.035)	(0.016)
Mean observable worker characteristics	10.579	10.580	10.581	10.592	10.583
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
New firm	6.92%	7.47%	5.23%	5.38%	6.23%
	(0.56%)	(0.61%)	(0.51%)	(0.63%)	(0.29%)