The Impact of Immigration on the Labour Market Outcomes of New Zealanders

David C. Maré, Steven Stillman

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Author contact details
David C. Maré
Motu Economic and Public Policy Research
Email: dave.mare@motu.org.nz

Steven Stillman
Motu Economic and Public Policy Research
Email: stillman@motu.org.nz

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Motu Economic and Public Policy Research
PO Box 24390
Wellington
New Zealand

Email	info@motu.org.nz
Telephone	+64-4-939-4250
Website	www.motu.org.nz

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Abstract

This paper uses data from the 1996, 2001 and 2006 New Zealand Census to examine how the supply of immigrants in particular skill-groups affects the employment and wages of the New Zealand-born and of earlier migrants. We first estimate simple CES production functions that allow for substitutability between workers from different skill-groups, but assume that, within skill-groups, migrants are perfect substitutes for non-migrants. We next estimate hierarchical CES production functions that allow for substitutability between immigrant and non-immigrant workers within skillgroups, but constrain the patterns of wage impacts on different factors in response to changing factor shares, and that natives and migrants are not substitutable across skill-groups. Then, we extend the previous literature by estimating a Generalised Leontief production function that allows for a less restrictive relationship between changes in factors shares and changes in wages within a particular level of the production function and for substitution and complementarity between immigrant and nonimmigrant workers both between and across skill-groups. Regardless of the model being estimated, we find little evidence that immigrants negatively affect either the wages or employment opportunities of the average New Zealand-born worker. However, we find some evidence that increases in the number of high-skilled recent migrants have small negative impacts on the wages of high-skilled New Zealand-born workers, which are offset by small positive impacts on the wages of medium-skilled New Zealanders.

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J61, R23

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Immigration, Wage Impacts, New Zealand, Labour Market Areas

1 Introduction

Twenty-three percent of New Zealand's population is foreign-born and forty percent of migrants have arrived in the past ten years. Despite the magnitude of these immigrant flows, the impact of immigration on the labour market opportunities of New Zealanders has yet to be investigated using microeconometric techniques. Longhi et al. (2005; 2008) identify a number of published studies that examine the impact of immigration on the labour market outcomes of non-immigrants in a number of countries and perform meta-analysis to summarise the results found in these studies. They concluded that an increase in the supply of immigrants has a significantly negative, but very small, impact on the employment and wages of non-immigrants. This is consistent with the findings in earlier literature reviews undertaken in Borjas (1994) and Friedberg and Hunt (1995). However, a few papers, in particular Borjas (2003), have argued that methodological weaknesses in the majority of these studies have resulted in a general understatement of the impact of immigration on non-migrant wages.[1]

In this paper, we use data from the 1996, 2001 and 2006 New Zealand Census to examine how the supply of immigrants in particular skill-groups affects employment and wages for the New Zealand-born and earlier migrants. We begin by estimating a simple CES production function, as in Card (2001) and Borjas (2003). This approach allows for substitutability between workers from different skill-groups, but implicitly assumes that, within skill-groups, migrants are perfect substitutes for non-migrants.[2] However, as argued in recent papers by Ottaviano and Peri (2006), Manacorda et al. (2006) and Peri (2007), there are a number of reasons why migrants might actually be imperfect substitutes for non-migrants with the same skills. For example, if migrant networks are important for finding employment or if recent migrants do not have the language skills to be employed in the general labour market, migrants will likely work in different jobs than similarly skilled non-migrants.

[1] It is worth noting that other papers, such as Ottaviano and Peri (2006) and Raphael and Ronconi (2008), argue conversely that methodological weaknesses in Borjas (2003) result in this paper overstating the impact of immigration.

[2] Borjas (2003) allows for substitutability between workers with different amounts of education and work experience, while Card (2001) allows for substitutability between workers with different predicted occupations. We do both. Papers using this methodological approach estimate the impact of immigration on the labour market outcomes of non-migrants by using the estimated labour supply elasticity and elasticity of substitution

Thus, as is done in these papers, we next extend our empirical model to allow for substitutability between immigrant and non-immigrant workers within skill-groups in a hierarchical CES production function. While this modelling approach is more flexible than the simple CES approach, it still has two key restrictions. First, the CES model assumes that a single parameter can summarise the substitutability between factors at any particular level of the production function (eg. between different skill-groups or between migrants and non-migrants), an assumption that constrains the pattern of wage impacts in response to a change in factor shares. For example, if an increase in low-skilled workers is estimated to reduce the wages paid to low-skilled workers (as theory suggests it should) then, mechanically, this change will be estimated to increase the wages paid to medium- and high-skilled workers.[3] Second, the structure imposed by the CES production function does not allow for the substitutability of migrants and non-migrants across skill-groups, even though this may be important in reality.

Then, in our main contribution, we extend the previous literature by estimating a Generalised Leontief production function that allows: i) for a less restrictive relationship between changes in factors shares and changes in wages within a particular level of the production function; and ii) for substitution and complementarity between immigrant and non-immigrant workers both between and across skill-groups. This model combines the approach of Borjas (1987), which estimates within-area labour market competition among immigrants, minorities and the native population, with the approach taken in more recent papers, where individuals are assumed to compete within particular skill-groups.[4]

We identify the impact of immigration on labour market outcomes using the 'area-analysis' approach, which exploits the fact that immigration is spatially concentrated, and thus a change in the local supply of migrants should have an impact on the labour market outcomes of workers in that area. A number of papers have argued that this spatial approach may not properly identify the

between workers from different skill-groups to calculate how the addition of migrants, by changing the skill composition of the workforce, changes employment and wages for non-immigrants.

[3] Similarly, if an increase in share of immigrants is estimated to reduce the wages paid to immigrants, then, mechanically, this change will be estimated to increase the wages paid to non-immigrants.

[4] A recent paper by Islam (2009) also estimates a Generalised Leontief production function to examine national level competition between immigrants and the Candian-born, but does not stratify the labour market by skill.

economic impact of immigration, because immigration may affect all areas of the country, not just the ones that actually receive migrants (Borjas et al. 1996, 1997; Borjas 2003). This will occur if, over time, the supply of new migrants to local labour markets encourages outward migration of previously settled individuals, or causes a reallocation of resources across sectors and an associated adjustment of interregional trade (ie. a Heckscher-Ohlin effect). We address this concern both by examining, in a companion paper, Stillman and Maré (2007), the impact of immigration on the geographic mobility of the New Zealand-born and earlier migrants and by estimating labour market impacts at different levels of geographic aggregation. As discussed in Borjas (2003), if these endogenous processes are important for adjustment following an immigration shock, the impact of this shock will be larger in more closed labour markets (ie. larger geographical areas).

Besides the methodological contribution that this paper makes, it also extends the previous literature by examining the impact of immigration on labour market outcomes in a country that has a small open-economy, a large-scale and highly structured immigration system that focuses mainly on higher-skilled migrants, little low-skilled illegal immigration, and a highly mobile population both internally and internationally (Poot and Cochrane 2004; Maré and Choy 2001). Most international research focuses on countries, predominantly the US, that have large domestic economies and high levels of low-skilled and illegal immigration, and these institutional differences may be particularly important in determining the impact that immigration has on host country labour markets (Angrist and Kugler 2003; Borjas 1999). A number of European countries (such as the UK) are considering switching or have begun to switch to highly structured skill-based immigration systems, as is used in New Zealand, making our findings particularly relevant for policymakers in these countries, as well as for those in Canada, which is institutionally quite similar to New Zealand.

2 Data and Sample Characteristics

2.1 Data Sources and Variable Definitions

This paper uses unit record data for the entire usually resident New Zealand population from the 1996, 2001 and 2006 Census.[5] The Census collects information on each individual's country of birth and their year of first arrival in New Zealand. We restrict our analysis throughout to individuals aged 25-54 with non-missing year of first arrival, if foreign-born. We focus on this age group to exclude students and individuals nearing retirement. We classify individuals as being either New Zealand-born, a recent migrant or an earlier migrant, where recent migrants are all individuals who first arrived less than 5 years ago and earlier migrants are all other individuals born in a foreign country.

Information is also collected about the current usual residential location of each individual. This location information is coded to the census meshblock, allowing us to identify local labour market areas (LMAs), as well as other aggregated geographic areas. Our main estimates examine competition within 140 LMAs defined in Papps and Newell (2002) using an algorithm that ensures that most people who live in a LMA work in it, and most people who work in a LMA live in it.[6] Focusing on functional local labour market areas has major advantages over using administratively defined geographic areas, as migration between LMAs is typically related to employment mobility, whereas migration within a LMA more strongly reflects residential factors. We also estimate our regression models at more aggregated geographic levels, including 75 territorial authorities (TAs), 58 LMAs,

[5] We also have access to the 1986 and 1991 Census data, but we do not use this data for three reasons: first, New Zealand underwent a period of comprehensive market-oriented economic reform from 1984-93 which complicates interpretation of any results from the early time-period (Evans et al. 1996); second, the occupational classification system was changed between the 1991 and 1996 Census in a way that makes it impossible to create a consistent series over time even at an aggregated level; and third, the 1991 Census did not ask foreign-born individuals their year of first arrival in New Zealand making it impossible to separate recent from earlier migrants in this Census.

[6] Labour market areas (LMAs) are created using travel-to-work data at area unit level drawn from the 1991 census. Two sets of labour market areas are defined – one with 140 areas and one with 58. The main differences are that the 140-area set provides greater disaggregation of some relatively small areas. The 140 LMAs are defined by enforcing a minimum employed population of 2,000 and 75% self-containment of workers (allowing for some trade-off between the two). These LMAs have an average size of approximately 1900 square kilometres. In main urban areas, LMAs generally encompass the urban area and an extensive catchment area. In rural areas, LMAs tend to consist of numerous small areas, each centred on a minor service centre. We drop a small number of individuals (less than 1%) from all analyses for whom the address recorded on the census form is not sufficient for assigning an LMA to the current residence.

and 16 regional councils (RCs) to test the robustness of our results to the critique of the 'area-analysis' approach discussed above.[7]

2.2 Sample Characteristics

Table 1 presents the demographic characteristics of the three nativity groups (recent migrants, earlier migrants, NZ-born) in the 1996, 2001 and 2006 Census. Our analysis population is 1.45 million individuals in the 1996 Census of which 80% are NZ-born, 5% are recent migrants and 15% are earlier migrants. For the 2001 Census, our analysis population is 1.51 million of which 79% are NZ-born, 6% are recent migrants and 16% are earlier migrants and, for the 2006 Census, it is 1.59 million of which 74% are NZ-born, 9% are recent migrants and 17% are earlier migrants. As in most countries, recent migrants are younger than the non-immigrant population (for example, 45% are less than thirty-five versus 31% of the NZ-born in 2006). But, unlike the US where most immigrants are low-skilled, in New Zealand, recent migrants are much more qualified than the NZ-born, with 38% of recent migrants in 2006 (34% in 1996; 32% in 2001) having university degrees versus 17% of the NZ-born (9% in 1996; 12% in 2001). This is reflected throughout the qualification distribution, with few migrants having no qualifications compared to the NZ-born.[8] This occurs because New Zealand operates a structured immigration system that focuses mainly on higher-skilled migrants.

The source country distribution of recent immigrants is fairly stable over the fifteen-year period examined here, but there is evidence that immigrants from the British Isles, South and Central Asia, and Sub-Saharan Africa (mainly South Africa) are becoming more common and those from North-East Asia are becoming less common.[9] Comparing recent migrants to earlier migrants, we can see that

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[7] New Zealand geographically consists of two main islands separated by a three hour ferry ride or a plane flight, plus a third island that has a very minimal population (Stewart Island). Seventy-five percent of the working-age population lives on the North Island. Territorial authorities and regional councils are purely administrative areas.

[8] A large number of migrants have missing qualifications in 1996 because of the way that foreign qualifications were coded in this census. We generally drop these individuals from our econometric analyses, although we have also tested the robustness of our findings to treated them as a separate qualification group.

[9] The Pacific Islands include Melanesia, Micronesia, and Polynesia (excluding Hawaii); the British Isles include the United Kingdom and Ireland; Western Europe and North America includes all European countries not assigned to the British Isles or Eastern Europe, the US, Canada and Bermuda; the Former Soviet Union and Eastern Europe includes Greece, Cyprus, the countries of the former Yugoslavia, all former Eastern Bloc countries and all former republics of the Soviet Union (including those in the Baltics, Caucasus, and Central Asia); the Americas, Africa and Middle East includes all countries in Central and South America, the Caribbean, North Africa, Sub-Saharan Africa, and the Middle East (including Turkey); South-East Asia includes Myanmar, Cambodia, Laos, Thailand, Viet Nam, Brunei,

this reflects an ongoing evolution of migrant source countries. The relative strength of Asian immigration in the 1990s is reflected in a rising Asian share of earlier migrants, with less pronounced growth in the Asian share of recent migrants.

Table 2 presents the distribution of qualifications for recent migrants from different regions of birth in each year (as well as, the distribution for the NZ-born). The regions are ordered from the most to least common source areas of recent migrants. There is a large variation in the qualification distribution for recent migrants from different sources regions. For example, in 2006, 61% of recent migrants from the Pacific Islands have at most school qualifications and only 12% have university degrees, while only 22% of recent migrants from South and Central Asia have at most school qualifications and 63% have university degrees. These differences are largely related to the different immigration categories under which individuals from different countries enter NZ (mainly family versus skilled migration). Immigrants from different countries also are more or less likely to settle in different places in NZ. As will be discussed in more detail below, this variation allows us to create supply-pull instruments for where immigrants with different skills are most likely to settle.

2.3 Defining Skill-Groups

Throughout this paper, we classify individuals into particular skill-groups and allow for substitutability both across and within these groups by nativity. One important question that we need to address is then how to define skill-groups. As in Cohen-Goldner and Paserman (2006), we consider multiple definitions. Our first definition follows the human capital approach taken in Borjas (2003) and creates 24 age/qualification skill-groups, using the six age categories shown in Table 1, and the four non-missing qualification groups.[10] This approach is appropriate if the productivity of different individuals is determined solely by their measured human capital. One potential problem with using

Indonesia, Malaysia, Philippines, Singapore, and East Timor; North-East Asia includes China, Hong Kong, Macau, Mongolia, Taiwan, Japan and the Koreas; and South Asia includes Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

[10] Borjas (2003) uses education and potential experience to define human capital groups. Because our data only identifies qualifications and not years of education, our groups will be the same whether we use age or potential experience to classify individuals.

age and qualifications to create skill-groups is that human capital acquired in foreign countries may not translate to similar skill levels in New Zealand.

Thus, our second definition follows the methodology first used in Card (2001) and creates five predicted occupation skill-groups defined as each individual's predicted probability of working in each of the following aggregated occupation groups: 1) Legislators, Administrators, and Managers; 2) Professionals; 3) Technicians, Associate Professionals; 4) Clerks, Agriculture, Fishery and Forestry Workers, Trades Workers, and Plant and Machine Operators; and 5) Service and Sales Workers and Elementary Occupations.[11] These predicted probabilities are calculated from a multinomial logit occupational choice model estimated at the national level for each census year separately by gender for the NZ-born and immigrants as a function of observed characteristics, such as education, age, ethnicity, years in NZ and region of birth.[12]

Predicted occupations are used to group individuals rather than actual occupations for two reasons. First, an individual's actual occupation is partially determined by the demand for different occupations in particular locations and the goal is to produce skill-groups that are exogenous to local demand patterns. Second, it would not be possible to assign a skill-group to individuals who are not currently employed without strong assumptions, such as that the unemployed complete directly with other unemployed regardless to other measures of their skill. The main downside in using predicted occupations is that they add noise to our estimates in the sense that some individuals are assigned to the wrong skill-group. The distribution of nativity groups across these five predicted occupational groups is summarised in the following section, together with the actual occupational distribution.

[11] This particular aggregation was chosen by using cluster analysis to group occupations according to the similarity of the individuals employed in them across a wide variety of characteristics.

[12] Specifically, separate models are estimated for the NZ-born and migrants by gender for all individuals employed and reporting a non-missing occupation in each census year. The following covariates are included for the NZ-born models: qualifications, a quadratic in age, ethnicity, qualifications interacted with a quadratic in age, marital status, and household type (couple with or without children, single parent, or non-couple). For immigrants, the following additional covariates are included: a quadratic for years in NZ, indicators for whether the individuals moved to NZ earlier than at age 18 or at age 25, indicators for their region of birth and a quadratic for years in NZ interacted with qualifications and with region of birth. Predicted probabilities of working in each of the five occupations are then generated using the relevant model and each individual's characteristics. These predicted probabilities are then totalled over each LMA and year to generate counts of the number of individuals predicted to be in occupation skill-group i in LMA j in year t.

2.4 Labour Market Outcomes

Table 3 presents employment rates, and the industry and occupation mix for the three nativity groups in the 1996, 2001 and 2006 Census. Employment rates are much lower among recent migrants compared to both earlier migrants and the NZ-born, confirming earlier findings by Winkelmann and Winkelmann (1998) and Boyd (2006). Only 55% of recent migrants were employed in 1996 compared with 76% of earlier migrants and 78% of the NZ-born. This gap narrowed by 2006, with 73% of recent migrants employed versus 79% of earlier migrants and 82% of the NZ-born. Employed migrants and non-migrants work in similar occupations and industries (at a highly aggregated level). The only meaningful differences are that migrants are more likely to be in the Professional occupation and the Business and Property Services and the Accommodation, Cafes and Restaurants industries and are less likely to be in Agriculture, Fishery, or Forestry (occupation or industry) and other blue-collar professions (eg. Trades and Plant and Machine Operators) and industries (eg. Construction).

Table 3 also summarises the distribution of predicted occupations for each of the nativity groups, as defined in the previous section. These occupation-related skill groups are defined for all individuals, not only those who are employed at the time of the census. As expected from the different age, qualification, and other characteristics of the groups, the nativity groups have differing predicted occupation profiles. Recent and earlier migrants are much more likely to be in the Professional and Technicians/Associated Professional predicted occupational groups and less likely to be in the Clerks/Agricultural/Trades/Operator predicted occupational groups than the NZ-born. This is true in all three census years even though relatively more NZ-born individuals are in the Professional predicted occupational group in 2001 and 2006. Little differences in found in the proportion of each nativity group predicted to be employed in the three other occupational groupings.

Unfortunately, the Census does not directly collect wage data. However, it does collect (bracketed) total annual income on an individual basis. Since one of the goals of this paper is to estimate the impact of immigration on wages for different nativity-groups, we use a secondary dataset to impute wages for all employed individuals in the Census. The Income Survey (IS) has been run annually since 1997 as a supplemental questionnaire to the Household Labour Force Survey (HLFS) and directly collects wage data, as well as comprehensive demographic characteristics and total annual income using a question identical to the one in the Census (including having the exact same brackets). We run separate regressions stratified by gender and country of birth (NZ-born vs immigrant) using the 1997, 2001 and 2006 IS, where the dependent variable is each employed individual's log real hourly wage and the independent variables include indicator variables for each individual's total annual income bracket, their age, age-squared, ethnicity, marital status, qualifications, hours worked in the past week, occupation and geographic location (one of twelve local government regions), and, in addition, for migrants, a quadratic in years in NZ and indicator variables for whether they were born in Australia, the UK, Asia, the Pacific Islands or elsewhere (this is the finest coding available in the IS).[13] We then use the resulting coefficients from these regressions to predict the log real hourly wage for all employed individuals in each Census. This imputed wage rate is then used in the analyses throughout the remainder of this paper.[14]

Information on the average wages of individuals in each nativity-group and skill-group are summarised in Table 4.[15] Average real hourly wages are remarkably similar across the three nativity groups, varying by no more than 5% in any year. This lack of an overall difference in wage rates reflects the fact that immigrants are more likely to be in highly paid qualification groups but are paid somewhat less within qualification groups, possibly reflecting their younger age structure, lower New Zealand-specific human capital, or lower transferability of international qualifications. For example, recent migrants with either no qualifications or only school qualifications have wage rates that are about 90% of comparable non-migrant in 1996 and only 80% of comparable non-migrant in 2006. While the average wage rate for migrants with post-school qualified migrants is quite similar to that for similarly qualified non-migrants in 1996, it is only 86% of the comparable non-migrant rate in

[13] The IS sample is fairly large with 800-1,100 immigrants of each gender and 3,400-4,000 NZ-born of each gender in the sample in each year. The R-squared for the imputation regressions range from 0.47 for NZ-born women in 1997 to 0.79 for male immigrants in 2001. Besides annual income (strongly positively related to wage rates) and hours worked (strongly negatively related to wage rates controling for annual income), few of the other control variables are significant or have large impacts on the predicted wage rates.
[14] We also estimate the regression models in the paper using average incomes for full-time wage and salary workers to instead proxy for the wages of particular migrant/skill-groups and get qualitatively similar results.
[15] For each predicted occupation skill-group, this is calculated by taking a weighted average of each employed individual's wage where the weight is the predicted probability of a particular individual being assigned to a particular predicted occupation.

2006. Wage rates for degree qualified recent migrants are 87% of that for comparable non-migrants rate in 1996 and 95% in 2001.

In contrast to the wage differences by qualification group, migrants and non-migrants in the same predicted occupation group have quite similar wage rates, with wages for recent migrants 94-107% of the comparable non-migrant rate. This is true even though there is a large variation in the average wages for workers across the predicted occupation groups. For example, the average wage for NZ-born in the Professional predicted occupation is 26-32% more than the average wage for NZ-born in the Service and Sales/Elementary predicted occupation. This wage gradient across predicted occupation groups is even greater for migrants, with the highest paid predicted occupation group receiving, on average, 36-42% more than those in the lowest paid group. This compares to the wage gradient between individuals with no qualifications and those with university qualifications of 38-46%, which generally is the similar across nativity groups.[16]

3 Descriptive Evidence

We now turn to analysing the impact of immigration on labour market outcomes. We begin by examining the relationship between inflows of recent migrants to different geographic areas and labour market outcomes for different nativity groups in those areas. Before turning to regression analysis, we first examine whether there is a descriptive relationship between the concentrations of recent immigrants in different skill-groups in particular LMAs and the employment rates and average wages for each nativity group in these same skill-groups and LMAs. Economic theory suggests that the entry of immigrants should lower the wages of competing workers and increase the wages of workers whose skills become more valuable because of immigration (Borjas 1999). This increased supply of workers will also lead to reduced employment opportunities for competing workers if wages adjust slowly or institutions, such as minimum wages, make wage adjustment impossible.

Figure 1 graphs the five-yearly change in the employment rate for the NZ-born (left), earlier migrants (middle) and recent migrants (right) in each skill-group in each of 140 LMAs between each census versus the five-yearly change in the proportion of recent migrants in the overall population in the same skill-group and LMA between each census, with the two sets of comparisons superimposed in the same figure . In the top row, we present the results for age/qualification skill-groups and, in the bottom row, we present the results for predicted occupation skill-groups. By examining changes between each census, we control for fixed differences across local skill-groups that are related to both the share of recent migrants in a particular skill-group/LMA and the employment rate for individuals in that local skill-group. The size of the plot circles are proportional to the average population of each local nativity/skill-group across the two census periods being compared and the solid line in each graph is the best linear fit of the data, with each point weighted by the average population of each local nativity/skill-group.[17]

Changes in employment rates for the NZ-born are weakly related to changes in the recent migrant share of the population in a particular local age/qualification group or in a particular local predicted occupation-group; a 10% increase in the recent migrant share (from the mean recent migrant share of 7% to 7.7%) in a particular local age/qualification group is associated with a 0.04 percentage point decline in the employment rate for the NZ-born in that local skill-group while the same change in a particular local predicted occupation-group is associated with a 0.05 percentage point increase in the employment rate for the NZ-born in that local skill-group. Similar to the results for the NZ-born, a 10% increase in the recent migrant share in a particular local age/qualification group is associated with a 0.05 percentage point decline in the employment rate for earlier migrants and a 0.32 percentage point decline for recent migrants. On the other hand, a 10% increase in the recent migrant share in a particular local predicted occupation group is associated with a 0.35 percentage point increase in the employment rate for earlier migrants and a 0.64 percentage point increase for recent migrants.

[16] Average wage rates for the missing qualifications group suggest that this group is mainly composed of low skilled workers. As noted previously, we exclude these individuals from our main estimates for human capital skill-groups, but also test whether our results are robust to including them as their own skill-group.

[17] All summary statistics and regressions are variance weighted because the number of individuals in each LMA ranges from less than 500 in eight LMAs to over 100,000 in four LMAs and there is a large variation in the relative size of different nativity/skill-groups within LMA/years. If the variances of the estimated employment and wage rates are inversely proportional to the sample sizes for each nativity/skill-group/LMA group cell, then weighted estimates are more efficient.

Overall, a weak correlation is found between changes in the share of recent migrants in particular local skill-groups and changes in employment rates for each nativity group using both skill-group definitions.

Figure 2 graphs the five-yearly change in the mean log wage for the NZ-born, earlier migrants and recent migrants in each skill-group in each LMA between each census against the five-yearly change in the proportion of recent migrants in the overall population in the same skill-group and LMA between each census and presents the results in the same format as Figure 1. In local skill groups where the recent migrant share grew most, NZ-born workers had larger wage increases. For example, a 10% increase in the recent migrant share was associated with 0.21% higher NZ-born wages in the same local age/qualification groups, and 0.03% higher NZ-born wages in the same local predicted occupation groups. In contrast, wage growth for earlier migrants was lower in local skill-groups with greater increases in recent migrants – by 0.11% in local age/qualification groups and by 0.71% in local predicted occupation groups.

The results differ by skill-group when we examine the relationship between recent migrant inflows and wage changes for recent migrants themselves. Within local age/qualification groups, a 10% higher recent migrant inflow rate is associated with recent migrant wages that are 0.30% lower, whereas within local predicted occupation groups, they are 0.21% higher. As with employment rates, a weak overall correlation is found between changes in the share of recent migrants in particular local skill-groups and changes in wage rates for each nativity group using both skill-group definitions.

The associations displayed in Figure 1 and 2 will only indicate the causal relationship between inflows of recent migrants and labour market outcomes if different LMAs are equal attractive to different skill-groups, to different nativity-groups with the same skills, and their relative attractiveness does not change over time. Thus, we next extend on this graphical evidence by controlling for a range of other possible changes that may be correlated with local labour market outcomes and recent migrant inflows. In particular, we estimate reduced-form regressions models of the following form:

$$Y_{jkt} = \gamma R_{jkt} + \alpha_{jk} + \alpha_{jt} + \alpha_{kt} + e_{jkt} \tag{1}$$

where j indexes age/qualification or predicted occupation skill-groups, k indexes the 140 LMAs, and t indexes time, Y_{jkl} is the employment rate or mean log wage for the NZ-born, earlier migrants or recent migrants in a particular local skill-group in a particular census year, R_{jkl} is the proportion of recent migrants in the overall population in a particular local skill-group, and α_{jk}, α_{jt} and α_{kt} are two-way interactions between skill-group fixed effects (α_j), LMA fixed effects (α_k) and time fixed effects (α_t). The coefficient of interest in this model is γ, which measures the average impact of a change in the share of recent migrants on employment rates and wages of the NZ-born, earlier migrants and recent migrants, controlling for unobservable fixed differences in local labour markets, skill-groups and time-periods, unobservable time-varying differences in local labour markets and skill-groups, and unobservable spatially varying differences in skill-groups.[18]

Table 5 presents the results from estimating this regression model for employment rates (left panel) and log real wages (right panel) using both age/qualification (top panel) and predicted occupation (bottom panel) skill-groups. Each regression is variance-weighted by the population of each nativity/skill-group/LMA in a particular year and standard errors are clustered by local skill-group to adjust for possible serial correlation or error components within cells. The number of potential observations here is the number of skill groups (5 predicted occupations or 24 age/qualification skill-groups) multiplied by the number of LMAs (140) for each census; ie. 12,600 for age/qualification skill-groups and 2,100 for predicted occupations skill-groups. However, a number of skill-group/LMA/year observations are dropped because there are no individuals (for employment rates) or workers (for wages) in a particular nativity in that cell.

First, examining the results for age/qualification skill-groups, we find two statistically significant relationships. The first is between the recent migrant share and the employment rate for recent migrants, with a 10% increase in the recent migrant share (from the mean recent migrant share of 7%, to 7.7%) in a particular age/qualification-group/LMA associated with a 0.40 percentage point

[18] LMA fixed effects control for differences in local labour market opportunities and are allowed to vary over time and skill-groups, but not both dimensions simultaneously. Skill-group fixed effects control for different returns to human capital in the labour market and are allowed to vary over time and across LMAs, but not both

decrease in the employment rate for recent migrants in that age/qualification-group/LMA. The second is that a 10% increase in the recent migrant share is associated with 0.20% higher wages for NZ-born workers. Examining the results for predicted occupation skill-groups, we again find that a higher recent migrant share is associated with lower employment for recent migrants and higher wages for NZ-born workers. In addition, a higher recent migrant share in a local predicted occupation skill-group is associated with a lower employment rate for NZ-born workers. Converting the coefficients in this table to elasticities, a 10% increase in the recent migrant share is associated with 0.14 and 0.36 percentage points lower employment rates for the NZ-born and for recent migrants, respectively, and with 0.89% higher wages for the NZ-born.

Overall, these reduced-form models indicate that higher immigration has at most a weak negative impact on employment rates for the NZ-born along with a slightly stronger positive impact on their wages. In contrast, higher recent migrant inflows reduce the employment rates of recent migrants themselves, with negative but statistically insignificant impacts on wages for these individuals. However, this reduced-form approach is only appropriate if competition only occurs between recent migrants, earlier migrants and the NZ-born within skill-groups and does not allow us to examine whether immigration affects the wages for earlier migrants and the NZ-born in different skill-groups through production interactions. Thus, we next extend upon these reduced-form models by specifying the technology of the local production function. Imposing more structure on our estimates allows us to consider more complicated mechanisms through which inflows of recent migrants impact the labour market and for there to be imperfect substitutability between workers with different skills and from different nativity groups.

4 Production Function Estimates

4.1 Nativity-Groups Are Perfect Substitutes Within Skill-Groups – CES Estimates

We begin by estimating a simple CES production function, as in Card (2001) and Borjas (2003), that allows for substitutability between workers from different skill-groups, but assumes that, within skill-

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dimensions simultaneously, and year fixed effects control for aggregate changes in employment and wages and groups, recent migrants, earlier migrants and the NZ-born are perfect substitutes. We assume that output in LMA k at time t (Y_{kt}) is produced by a competitive industry with a production function

$$Y_{kt} = F(K_{kt}, L_{kt}), \tag{2}$$

where K_{kt} is a vector of non-labour inputs (capital, land, etc.) and L_{kt} is a CES-type aggregate of labour units L_{jkt} from different skill-groups (j):

$$L_{kt} = \left[\sum_j ((\theta_{jk} + \theta_{jt} + \theta_{kt}) L_{jkt})^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)}. \tag{3}$$

The variable θ_{jk} represents time-invariant skill-group/LMA-specific productivity differences, θ_{jt} represents time-varying skill-group-specific productivity shocks for the aggregate economy and θ_{kt} represents time-varying LMA-specific productivity shocks that affect all skill-groups equally, while the parameter σ is the (common) elasticity of substitution between skill-groups.

Solving this model yields factor demand equations of the form:

$$\ln w_{jkt} = \alpha_{jk} + \alpha_{jt} + \alpha_{kt} + \gamma \ln \left(L_{jkt} \middle/ L_{kt} \right) \tag{4}$$

where L_{jkt}/L_{kt} is skill-group j's share of employment at time t in LMA k, α_{jk} is an intercept that is specific to each skill-group/LMA combination and controls for heterogeneity in wage levels across skill-groups in different LMAs, α_{jt} is a time fixed effect for each skill-group that controls for aggregate skill-group-specific wage changes between census years, and α_{kt} is a time fixed effect for each LMA that controls for skill-group invariant wage changes between census years in each LMA.[19] The parameter γ is the wage elasticity of demand for skill-group j, indicating the percentage change in wage in response to a percentage change in that skill-group's share of employment and is equal to the negative inverse of the elasticity of substitution between skill-groups (eg. $\gamma = -1/\sigma$). The lower the elasticity of substitution, the more an increase in the employment share for a particular skill-group will reduce the wages for that skill-group. If skill-groups are infinitely substitutable, wages are

are allowed to vary across skill groups and LMAs, but not both dimensions simultaneously.

[19] An alternative approach would be to assume a common production function across all LMAs, and restrict α_{jk} to be $\alpha_j + \alpha_k$. Given the lack of information on non-labour inputs in our data, we choose to identify γ solely from changes over time in local skill-group shares, rather than using cross-unit variation in shares.

unaffected by how much of total employment is accounted for by any skill-group, and the wage impact of a change in employment share will be zero.

Following Card (2001), we allow for a log-linear labour supply function for each skill-group/LMA:

$$\ln\left(L_{jkt} \big/ P_{jkt} \right) = \varepsilon \ln w_{jkt} \tag{5}$$

where L_{jkt}/P_{jkt} is the employment rate for skill-group j at time t in LMA k. Combining equations (4) and (5), we obtain expressions for the log wage, $\ln w_{jkt}$, and log employment rate, $\ln(L_{jkt}/P_{jkt})$, for each skill-group/LMA/time-period, in terms of skill-group population shares, $\ln(P_{jkt}/P_{kt})$, in that LMA/time-period:

$$\begin{aligned} \ln w_{jkt} &= \left[\frac{1}{\sigma+\varepsilon} \left((\alpha_{jk} + \alpha_{jt} + \alpha_{kt})\sigma + \ln \frac{L_{kt}}{P_{kt}} \right) \right] - \left(\frac{1}{\sigma+\varepsilon} \right) \ln \frac{P_{jkt}}{P_{kt}} \\ \ln\left(L_{jkt} \big/ P_{jkt} \right) &= \left[\frac{\varepsilon}{\sigma+\varepsilon} \left((\alpha_{jk} + \alpha_{jt} + \alpha_{kt})\sigma + \ln \frac{L_{kt}}{P_{kt}} \right) \right] - \left(\frac{\varepsilon}{\sigma+\varepsilon} \right) \ln \frac{P_{jkt}}{P_{kt}} \end{aligned} \tag{6}$$

These two equations form the basis of our empirical model, with the coefficients on the skill-group population shares jointly identifying the elasticity of substitution σ and the labour supply elasticity ε. The inclusion of skill-group/LMA fixed effects, skill-group/time fixed effects and LMA/time fixed effects means that these parameters are identified solely from changes over time in local skill-group population shares and changes in relative employment rates and wages for these skill-groups.

Adding white-noise error terms, subsuming all constant terms into the appropriate fixed effects and substituting for the coefficients on the skill-group population shares in each equation, our regression equations can be written as:

$$\begin{aligned} \ln w_{jkt} &= \beta_1 \ln\left(P_{jkt} \big/ P_{kt} \right) + \lambda_{jk} + \lambda_{jt} + \lambda_{kt} + e_{jkt} \\ \ln \frac{L_{jkt}}{P_{jkt}} &= \beta_2 \ln\left(P_{jkt} \big/ P_{kt} \right) + \delta_{jk} + \delta_{jt} + \delta_{kt} + u_{jkt} \end{aligned} \tag{7}$$

where e_{jkt} and u_{jkt} are standard white-noise error terms. In the first equation, w_{jkt} is calculated as the mean (imputed) log wage in each skill-group/LMA/year and, in the second equation, L_{jkt}/P_{jkt} is calculated as the ratio of FTE employment to population, where FTE employment is calculated as the number of full-time workers plus one-half the number of part-time workers in each skill-group/LMA/year.[20] The labour supply elasticity ε can be calculated from the coefficients on the skill-group population share as β_2/β_1 and the elasticity of substitution σ equals $-1/\beta_1 - \varepsilon$.

Table 6 presents estimates of the wage (β_1) and employment rate (β_2) elasticities for age/qualification (left panel) and predicted occupation skill-groups (right panel). We also report the implied substitution (σ) and labour supply (ε) elasticities. All regressions are variance weighted by the employed population in each skill-group/LMA in a particular year and skill-group/LMAs are dropped from a regression when there are no employed individuals in that cell in any census year. The bottom panel of the table shows the maximum number of observations that could be used in a particular regression, the actual number of observations used (ie. the cells containing workers in all three census years) and the percentage of total employment covered by these observations. In each specification, even though a number of cells are dropped, the data used captures at least 99.95% of all employment.

The first row of the first panel of Table 6 presents the employment rate elasticities (β_2) derived from estimating equation (7) for 140 LMAs. As an age/qualification skill-group increases its share of the population in one of 140 LMAs by 10%, the group's employment rate is estimated to decrease by 0.34%. The employment effect is also negative within local predicted occupation groups. As a predicted occupation skill-group increases its share of the population in one of 140 LMAs by 10%, the group's employment rate is estimated to decrease by 1.52%. The larger effect obtained when using the predicted occupation skill-definition is consistent with occupation being a more appropriate skill definition, with workers competing more strongly within rather than between occupation groups.

The second panel presents wage elasticities – showing the proportional change in a skill-group's wage in response to a proportional increase in the skill-group's local population share. The first row presents the results for 140 LMAs. Examining the first column, OLS estimates of β_1 indicate that that a 10% increase in an age/qualification skill-group's population share in a LMA is associated with that

[20] Full-time workers are employed for at least 30 hours in the week prior to the census.

group having insignificantly higher wages (0.05%) – essentially unchanged.[21] This very small own-wage effect suggests a relatively high degree of substitutability between local age/qualification skill-groups. Similarly for predicted occupation skill-groups, the own-wage effect is essentially zero, suggesting that workers in different predicted occupations are highly substitutable for each other.

These estimates are, however, biased if there are skill-group-specific demand shocks in particular local labour markets in particular time-periods, eg. if individuals in particular skill-groups are attracted to local labour markets with the strongest employment or wage growth for their group in a particular time-period. Maré et al. (2007) show that region of birth migrant networks are the most important factor in the settlement decisions of recent migrants to New Zealand. Thus, following the approach taken in Card (2001), we instrument the supply of both recent and earlier migrants in a local labour market area with the concentration of past immigrants from the same region of birth in that area.[22] We use a similar approach to instrument for the supply of the NZ-born in each labour market, using the concentration of NZ-born with the same ethnicity to create the instrument. If social networks are (weakly) stratified by ethnicity, then the ethnic concentration in a particular area should act as a pull-factor that is independent from local demand shocks. If each of these pull-factors is independent from the local demand for individuals with particular skill-levels, instrumental variables (IV) will produce consistent estimates even if there are skill-group specific local demand shocks.

The IV estimates, shown in the first row and second and fourth column of Table 6, are more strongly negative than the OLS estimates, although the estimates for predicted occupation skill-groups

[21] Statistical significance here refers to whether the wage elasticity is significantly different from zero. A zero wage elasticity is commensurate with infinite substitutability of factors.

[22] Formally, let RM_{gt} represent the number of recent migrants from source region g in census t, and let λ_{gkt} represent the fraction of earlier migrants from region g that is observed living in LMA k five-years prior to the current census. Finally, let τ_{gst} represent the fraction of recent migrants from source region g that is in skill-group s in census t. In the absence of demand factors, the number of recent migrants from region g in skill-group s who would be expected to live in LMA k in census t is $\tau_{gst} * \lambda_{gkt} * RM_{gt}$. Summing over all regions, we can calculate the component of the supply of recent migrants in each skill-group and LMA that occurs because of an individual's desire to live near other migrants from their home region. The same formula is used to determine the supply of earlier migrants in a LMA, except that τ_{gst} is calculated for earlier migrants and that RM_{gt} is replace by EM_{gt}, the number of earlier migrants from source region g in census t. In practice, we group individuals into the nine regions tabulated in Table 1 for calculating this instrument.

are insignificantly different from the OLS estimate (and from zero).[23] This suggests that OLS estimates are biased upward by endogenous location choice of individuals in different skill-groups.[24] The IV estimates imply that a 10% increase in a skill-group's local population share lower that group's employment rate by 2.1%. The group's wages also decline, although the magnitudes of the estimated decline differs across the two skill-group definitions. For age/qualification skill-groups, wages are 0.56% lower, whereas for predicted occupation skill-groups, the decline is estimated to be 16.7%. The smaller wage impact for the age/qualification groups implies that these groups are relatively highly substitutable. The implied elasticity of substitution of 14.1 is shown in the third panel. Occupation groups are less substitutable, with an estimated elasticity of substitution of only 0.5. The declining wage is accompanied by a drop in the employment rate, implying a positive labour supply elasticity, of 3.58 for the age/qualification groups and of 0.13 for the occupation groups.

As emphasised by Borjas (2003), the area variations approach may fail to pick up negative wage effects of immigration if competition occurs between rather than within areas or if immigration to particular locations causes reallocations of resources across sectors and adjustments in interregional trade (ie. a Heckscher-Ohlin effect), thus leading to diffuse impacts on all areas of the country. To gauge the strength of between-area competition, the remaining rows in each panel present results for increasingly aggregated definitions of local labour markets, 75 TAs, 58 LMAs, and 16 RCs. In contrast to the findings in Borjas (2003), our results show no evidence of increased competition within skill-groups as we examine more aggregated labour markets. Overall, the estimated wage and employment rate elasticities are qualitatively similar for both skill-group definitions across each definition of local labour markets. In a companion paper, Stillman and Maré (2007), we examine the

[23] For age/qualification skill-groups, predicted population shares are strongly related to actual population shares, with the partial R-squared from the unreported first-stage regression 0.154 and the F-stat on the significance of the instrument 1158, where a F-stat of less than 17 indicates potential problems with weak instruments in our model (Stock and Yogo 2002). However, the instrument is much weaker when focusing on predicted occupation groups, with a partial R-squared of 0.006 and a F-stat of 6.9. This is a likely explanation for the lack of precision on the IV estimates that uses this skill-group definition and perhaps calls into question the large estimates wage elasticity. As is noted later on, the instruments are strong for both skill-group definitions when we allow for substitutability between nativity groups, eg. our preferred estimates.

[24] This differs from the finding in Maré et al. (2007) that the settlement decisions of recent migrants are not significantly related to skill-specific local labour market conditions. However, both sets of results are consistent

impact of recent migrants on the geographic mobility of other individuals and find no evidence that inflows of recent migrants displace either the NZ-born or earlier migrants with similar skills. Combined, these results suggest that, in New Zealand, competition occurs mainly within local labour market areas and thus the area variation approach should produce unbiased estimates of the impact of immigration on labour market outcomes for the NZ-born and earlier migrants.

4.2 Nativity-Groups Are Imperfect Substitutes Within Skill-Groups – CES Estimates

The estimates in the previous subsection assume that migrants are perfect substitutes within skill-groups. However, as discussed above, there are a number of reasons why migrants might actually be imperfect substitutes for non-migrants with the same skills. Thus, as in Ottaviano and Peri (2006), Manacorda et al. (2006) and Peri (2007), we next extend the CES model to allow for substitutability between workers from different nativity-groups within skill-groups in a hierarchical CES production function. L_{jkt} is now further defined as a CES-type aggregate of labour units L_{jknt} from the three different nativity-groups n (eg. equation (8) is nested in equation (3)):

$$L_{jkt} = \left[\sum\nolimits_n ((\theta_{njk} + \theta_{njt} + \theta_{nkt}) L_{njkt})^{(\rho-1)/\rho} \right]^{\rho/(\rho-1)}. \tag{8}$$

The variables θ_{njk} represent time-invariant nativity-, LMA- and skill-group-specific productivity differences, θ_{njt} represents time-varying nativity/skill-group-specific productivity shocks that affect all LMAs and θ_{nkt} represents time-varying productivity shocks that affect all nativity-skill-groups in a LMA, while the parameter ρ is the (common) elasticity of substitution between nativity-groups within skill-groups.

With this addition, our regression equations can now be written as:

$$\begin{aligned} \ln w_{njkt} &= \beta_1 \ln \left(P_{njkt} \middle/ P_{jkt} \right) + \lambda_{njk} + \lambda_{jkt} + \lambda_{nkt} + \lambda_{njt} + e_{njkt} \\ \ln \frac{L_{nkjt}}{P_{nkjt}} &= \beta_2 \ln \left(P_{njkt} \middle/ P_{jkt} \right) + \delta_{njk} + \delta_{jkt} + \delta_{nkt} + \delta_{njt} + u_{njkt} \end{aligned} \tag{9}$$

with earlier migrants and/or the NZ-born being attracted to areas with skill-specific demand shocks, while recent migrants are not responsive to these differences.

The inclusion of nativity/skill-group/LMA-specific fixed effects (*njk*) means that the β parameters are identified solely from changes over time in local population shares of each nativity-group within each skill-group. Furthermore, the other fixed effects control for changes over time in the demand for local skill groups (*jkt*) and nativity groups (*njt)* and for national level changes in outcomes for different nativity-skill groups (*nkt*). Again, the labour supply elasticity ε can be calculated from the coefficients on the nativity-group population share as β_2/β_1 and the elasticity of substitution between nativity-groups within skill-groups ρ equals $-1/\beta_1 - \varepsilon$.

Table 7 presents estimates of the wage (β_1) and employment rate (β_2) elasticities across nativity groups disregarding skill-groups (left panel), for nativity groups within age/qualification skill-groups (center panel) and for nativity groups within predicted occupation skill-groups (right panel). Again, we also report the implied substitution (ρ) and labour supply (ε) elasticities for each set of estimates, all regressions are variance weighted by the employed population in each nativity/skill-group/LMA in a particular year, and nativity/skill-group/LMAs are dropped from a regression when there are no employed individuals in that combination in any census year.[25]

We first examine the overall substitutability of nativity groups disregarding skill-groups to judge, in general, the degree to which migrants compete with the NZ-born and with earlier migrants. If skill-group stratification is important in the economy, as we are suggesting, then we should expect to find that nativity groups are only moderately substitutable, as Tables 1 and 3 show that recent migrants are concentrated in different skill-groups than the NZ-born and earlier migrants. Our results show a moderate-to-strong degree of substitutability between nativity groups. The elasticity of substitution implied by the IV estimates range from 5.4 to 7.3, with lower substitutability in larger areas. The substitutability of nativity groups is thus less than for age-qualification groups, but considerably stronger than the substitutability of predicted occupation skill groups.

[25] For nativity groups, the partial R-squared from the unreported first-stage regression is 0.314 and the F-stat on the significance of the instrument is 251. For nativity groups within age/qualification skill-groups, the partial R-squared is 0.054 and the F-stat is 770. For predicted occupation groups, the partial R-squared is 0.050 and the F-stat is 117. Thus, none of the IV estimates is this section appear to suffer from weak instrument problems.

We next turn to the within skill-group results. First, examining the results for nativity-groups within age/qualification-groups, the IV estimates indicate that a 10% change in a nativity-group's share of population within an age/qualification-group in a local area has a significant negative impact on that nativity group's employment rates (-1.42% to –2.14%), and a smaller negative effect (-0.58% to -0.68%) on their wages. The wage results indicate that there is a very high degree of substitutability between nativity-groups within age/qualification-skill-groups, with the implied substitution elasticity being between 12 and 25. The results for predicted occupation skill groups are similar, although with somewhat stronger wage and employment effects. A 10% increase in a nativity group with a local predicted occupation skill group lowers their employment rate by between 2.2% and 2.9%, and their wages by between 1.7% and 3.0%.

These estimates of the substitutability of nativity-groups within skill-groups can be used to calculate the impact that inflows of recent migrants, as well as changes in the population of earlier migrants and the NZ-born, have on the wages and employment rate of similarly skilled NZ-born, earlier migrants and recent migrants. Differentiating equation (9) with respect to the population of a particular nativity-group in the overall population reveals that cross-elasticities (ie. $\partial \ln w_i \big/ \partial \ln P_j$ and $\partial \ln\left(L/P\right)_i \big/ \partial \ln P_j$) are calculated by multiplying the appropriate coefficient from Table 7 (eg. either β_1 for the impact on wages or β_2 for the impact on employment rates) by -(P_j/P), while own-elasticities (eg. $\partial \ln w_j \big/ \partial \ln P_j$ and $\partial \ln\left(L/P\right)_j \big/ \partial \ln P_j$) are calculated by multiplying the appropriate coefficient from Table 7 by 1-(P_j/P).

Table 8 summarises the implied own- and cross- elasticities using the IV estimates from Table 7 for the 140 LMAs. In all cases, the largest impact is the effect inflows of recent migrants have on their own labour market outcomes. For example, the results for age/education skill-groups indicate that a 10% increase in the population of recent migrants in a local labour market decreases wages by 0.7% and employment rates by 1.6% for recent migrants in that area. The results for predicted occupation skill-groups indicate that a 10% increase in the population of recent migrants in a local labour market decreases wages by 2.1% and employment rates by 2.1% percent for recent migrants in that area. Changes in the population of earlier migrants have similar, but smaller, impacts on their own wages and employment rates, whereas the impact of population changes of NZ-born on their own outcomes are only one-fifth as large, in the range of –0.1 to 0.4. We find no evidence that inflows of recent migrants negatively impact labour market outcomes for the NZ-born; looking across both skill-group definitions, a 10% increase in the population of recent migrants in a local labour market is estimated to increase employment rates by 0.08-0.11% and wages by 0.03-0.11% for the NZ-born.

As discussed earlier, the CES model assumes that a single parameter can summarise the substitutability between factors at a particular level of the production function, here nativity-groups within skill-groups. The wage and employment effects then depend only on the factor share of each labour input. One implication of this restriction is that own-wage and own-employment rate elasticities must have the opposite sign to the corresponding cross-elasticities. Thus, as an increase in the recent migrant share of the population causes a decrease in the shares of other population groups and we estimate negative own-wage and own-employment rate elasticities, this increase must, by the assumptions of the CES model, lead to increased employment rates and wages for the NZ-born and for earlier migrants.[26] We next extend our analysis to estimate models that relax this assumption and allow there to be a less constrained relationship between changes in factors shares and changes in wages within a particular level of the production function.

4.3 Nativity-Groups Are Imperfect Substitutes Within Skill-Groups - Generalised Leontief Estimates

In this section, we relax the implicit CES restriction that own-group and cross-group elasticities are of opposite sign, and are both derived from the same estimated parameter. Specifically, we utilise a generalized Leontief (GL) production function (Diewert 1971), which is a second order approximation to an arbitrary twice-differentiable production function:[27]

[26] The same point applies when interpreting the results in Ottaviano and Peri (2006), Manacorda et al. (2006) and Peri (2007), each which uses this modelling approach.

[27] There are two downsides to this approach relative to the nested CES model. First, there is not a straightforward way to incorporate labour supply into this model and thus we now assume that labour supply is inelastic and employment is not affected by changing factor shares. Second, this approach is more demanding of the data (for example, for the model examining the impact on nativity groups within age/qualification skill-groups, the CES model estimates 7,270 parameters using 21,847 observations, while the GL model estimates 3,426 parameters using 8,271 effective observations – this is the actually number of observations times three simultaneous equations) and thus the estimates are generally less precise.

$$Y_{kt} = \sum_j \sum_n \sum_m \gamma_{nm} \left(L_{njkt} L_{mjkt} \right)^{1/2} \tag{10}$$

where n and m index each of the nativity-groups within skill-groups and the parameters γ_{nm} describe the production technology. Under the assumptions of profit maximisation and constant prices, the factor demand equations implied by this technology take the following convenient form:

$$w_{njkt} = \gamma_{nn} + \sum_{m \neq n} \gamma_{nm} \left(L_{mjkt} / L_{njkt} \right)^{1/2} \tag{11}$$

The coefficients from this model can also be used to derive estimates of the Hicks (Hicks 1970) partial elasticity of complementarity between any two nativity-groups c_{nm}:[28]

$$c_{nm} = \frac{\gamma_{nm}}{2\left(s_n s_m w_n w_m \right)^{1/2}} \tag{12}$$

where s_n is nativity-group n's share of the overall wage-bill (e.g. $s_n = w_n L_n / \sum_n w_n L_n$). A positive value of c_{nm} indicates that nativity-groups n and m are complements, whereas a negative value indicates substitutability. For example, a finding that $c_{NZ,RM} < 0$ would imply that an increase in the number of recent migrants lead to a lowering of wages for the New Zealand-born. Own- and cross-wage elasticity estimates are conveniently obtained as

$$\eta_{nm} = \frac{d \ln w_n}{d \ln L_m} = s_m c_{nm} . \tag{13}$$

Adding error components to (11), results in the following regression model which we estimate:

$$w_{njkt} = \sum_{m \neq n} \gamma_{nm} \left(L_{mjkt} / L_{njkt} \right)^{1/2} + \alpha_{njk} + \alpha_{njt} + \alpha_{nkt} + e_{njkt} \tag{14}$$

where w_{njkt} and L_{njkt} are defined as above, α_{njk} is a nativity/skill-group/LMA fixed effect, α_{njt} is a time-varying nativity/skill-group-specific fixed effect and α_{nkt} is a time-varying nativity/LMA-specific fixed effect. The inclusion of these fixed effects controls for unobservable time-invariant differences in the wages paid to different nativity-groups in different skill-groups and local labour markets and for

[28] The Hicks-Allen elasticity of substitution as estimated by the CES approach measures the change in relative quantities in response to a change in relative marginal productivities, holding other factor prices constant. The elasticity of complementarity provides an alternative view of the same relationship, and is estimated holding other factor quantities constant.

unobservable differences in the wages paid over time to different nativity/skill-groups and to different nativity-groups in different LMAs.

For this model, there is one factor demand equation for each nativity-group and the three equations are estimated simultaneously using Seemingly Unrelated Regression (SUR or Zellner's regression) with cross-equation symmetry of technology parameters imposed. As in the CES case, if individuals in particular nativity-skill-groups are attracted to local labour markets with the strongest wage growth for their group in a particular time-period, OLS estimates will be biased. We again use the supply-pull instruments (properly transformed as square roots of ratios) to estimate models that are consistent even if there are nativity-skill-group-specific demand shocks in particular local labour markets in particular time-periods. These IV regressions are estimated using three-stage least squares. Elasticities of complementarity (c_{ij}) and wage elasticities (η_{ij}) are derived by scaling the estimated parameters (γ), as in equations (12) and (13), where s and w are evaluated at sample means.

As employment rate elasticities cannot be conveniently incorporated in the GL formulation, we restrict our attention in this section to wage elasticities. Table 9 presents SUR (top panel) and IV-3SLS (bottom panel) estimates of GL wage elasticities between nativity groups within age/qualification (left panel) and predicted occupation (right panel) skill-groups for 140 LMAs.[29] Each row reports the (transformed) estimates from one equation of a three-equation system of factor demands. Each equation has as many observations as there are skill-group/area/year combinations and all regressions are variance weighted by the employed population in each skill-group/LMA in a particular year. Because of the cross-equation symmetry restrictions, skill-group/areas need to be dropped when data for any nativity-groups in that cell are missing in any year. The loss of observations is more severe than for the CES estimates, but we still capture 89% of employment for age/qualification skill groups, and close to 100% for predicted occupation skill-groups.

The results for the wage elasticities of nativity groups within age-qualification skill groups are puzzling. The SUR results show own-wage elasticities that are generally positive, and often statistically insignificant. The first entry in the table shows that a 10% increase in the employment of the NZ-born raises their own wages by 0.03%. This suggests a lack of identification, as may arise due to local demand shocks. The analogous entry in the IV-3SLS estimates should control for the endogeneity of local employment, but unexpectedly, show a slightly larger positive impact of 0.08%. Although we present these results for completeness, we do not believe that they provide robust inference.[30]

Turning to the results for predicted occupation skill-groups, which still provide coverage for the entire population, the SUR results show no significant own-wage or cross-wage elasticities. Using three-stage least squares to adjust for the potential endogeneity of local employment composition yields generally negative, although insignificant own-wage elasticities. Based on the point estimates, a 10% increase in the number of recent migrants in a local predicted occupation group has the strongest impact on the wages of recent migrants in that group – lowering their wages by 0.73%. We do estimate a number of significant cross-elasticities. For example, a 10% increase in the number of recent migrants in an occupation group increases the wages of earlier migrants in the local skill-group by 0.25%, suggesting some degree of complementarity. Similarly, there is a very small (0.01%) negative impact of recent migrants on the wages of NZ-born workers in the same local skill-group. We also estimate that an increase in the number of earlier migrants raises the wages of similarly-skilled local recent migrants by 0.79%, while an increase in the number of NZ-born lowers the wages of similar-skilled local recent migrants by 0.21%.

4.4 Nativity-Groups Are Imperfect Substitutes Between and Within Skill-Groups – GL Estimates

Our final specification extends the previous subsection's GL model to allow for substitution and complementarity between different nativity-groups both between and across skill-groups. This is done

[29] Results from when the model is estimated at other geographies are available from the authors. In general, the finding are sensitive to the chosen aggregation, but given that we found qualitatively similarly results at different aggregations when estimating the CES models, we feel that 140 LMAs is the preferred geography.

[30] One undesirable consequence of the GL specification is that observations need to be dropped if employment is zero in any of the local skill-nativity groups. This restriction is often binding because many of the smaller local age/qualification groups have no recent migrants. Of the 10,080 potential observations, only 2,757 are used in this regression. We examined whether using more aggregated age-qualification skill-groups led to more 'sensible' results, but generally this has little impact.

by re-estimating equations (14) with each nativity/skill-group as a separate factor of production, each included in a simultaneous equations model. Increasing the number of factors within the GL framework makes econometric identification increasingly challenging as the number of parameters to be estimated rises with the square of the number of factors, and the number of observations is reduced due to having to drop areas containing any empty nativity-group/skill-group cells. In the light of the estimation issues outlined in the previous section, we confine our analysis to using the predicted-occupation definition of skill with only three skill-groups defined as i) Legislators, Administrators, and Managers; and Professionals; ii) Technicians and Associate Professionals; and Trade Workers; and iii) the remaining five one-digit occupations.[31]

Table 10 presents IV-3SLS estimates of wage elasticities for 140 LMAs. At this level of aggregation only 6 of 420 possible observations are dropped from due to zero employment for one or more factor. Own-wage elasticities are consistently negative, and close to –1 for recent migrants and earlier migrants. Wage elasticities are also more strongly negative for low-skilled than for higher skilled workers within each nativity group. The CES restriction of positive cross-wage elasticities within skill groups does not appear to hold. For instance, within the high-skilled Professional/ Managerial group, all cross-elasticities between nativity groups are negative. In particular, there is a negative impact of high-skilled recent migrants on the wages of high-skilled NZ-born workers, with a 10% increase in high skilled recent migrants lowering the wages of similarly skilled NZ-born workers by 0.18%. There are also significant interactions across both skill and nativity cells, such as the estimated positive impacts of low skilled recent migrants on earlier migrants in the Associate Professionals and Trade Workers group, or of high-skilled migrants on New Zealand-born Associate Professionals and Trade Workers. Such interactions were constrained in the CES specification to operate only through changes in the overall skill composition.

[31] Like the five predicted occupation grouping, this particular aggregation was also chosen by using cluster analysis to group occupations according to the similarity of the individuals employed in them across a wide variety of characteristics, but with a lower threshold of similarity.

4.5 Simulated Impacts of Alternative Immigration Flows

The regression results presented so far summarise the strength of relationships in terms of elasticities. With some further manipulation, they can provide more readily interpretable measures of the impacts of different immigration patterns. In this section, we consider four possible scenarios, as a means of gauging the economic significance of the estimated results. Each of the four scenarios takes as its baseline the observed 2006 population structure, and asks what the impact would have been of receiving a different number or composition of recent migrants in the preceding 5 years.

The first scenario (A) entails halving the number of recent migrants that arrived between 2001 and 2006, keeping the composition of recent migrants that same as was observed for the actual flow. This resulting smaller inflow is similar in magnitude and composition to the actual inflow that was observed between 1991 and 1996. The second scenario (B) is similar to scenario (A) but assumes a doubling rather than a halving of the 2001-2006 recent migrant inflow. Scenarios (C) and (D) both maintain the same number of recent migrants as were observed between 2001 and 2006, but change the skill composition. Scenario (C) examines the implications of raising the proportion of high-skilled recent migrants to 75%. For the age-qualification definition of skills, this is captured as an increase in the number of recent migrants with post-school or degree qualifications, from the actual level of 64% to 75%. For predicted-occupation skill groups, we examine an increase in the proportion of recent migrants in the three most skilled predicted occupations (Legislators, Administrators and Managers; Professionals, and Technicians & Associate Professionals) from an actual level of 49%, to 75%.

For each of these scenarios, we calculate the change in factor shares, and examine wage and employment effects along two margins. First, we calculate the implied change in skill-group shares that would result from the assumed scenario, and use the estimates from Table 6 to calculate the implied wage and employment rate change for each nativity group. We refer to this as a ‘between-skill-group’ change. The second source of wage and employment rate change is a result of the changing nativity group mix within skill groups. For this, we use the estimates in Table 7 to calculate the implied change for each nativity group, which we refer to as the ‘within skill-group’ contribution.

Table 11 summarises the employment and wage rate impacts of each scenario on the NZ-born, on earlier migrants, and on the recent migrants themselves, using the CES estimates. Scenarios A and

B show impacts that are similar in magnitude but opposite in sign. The reduced recent migrant flows in scenario A lower the population shares of skill groups in which recent migrants are prevalent. Combined with the negative share elasticities for own-skill outcomes as shown in Table 6, this 'between' effect implies increases in recent migrants' employment rates (0.4% for age-qualification groups, and 0.02% for occupation groups) and wages (0.13% for age-qualification groups, and 0.2% for occupation groups). The skill composition of earlier migrants is similar to that of recent migrants, so the impact of the changing skill composition is also positive, and similar to that for the recent migrants. The 'between skill' impacts on the New Zealand born are smaller because the decline in recent migrants raises shares for skill groups where the NZ-born are relatively more prevalent, leading to less positive or more negative impacts overall.

The 'within skill' impacts resulting from the imperfect substitutability of nativity groups within skill groups for these scenarios are much larger. The negative own elasticities in Table 7 imply that the decline in the number of recent migrants in scenario A will have a positive impact on recent migrant employment and wage rates within skill groups. Table 11 shows that employment rates for recent migrants increase by 10% to 15%, and wage rates rise by 4% to 14% when the inflow of recent migrants is halved. The drop in recent migrant shares within skill groups necessarily raises the shares of the NZ-born and earlier migrants, with a consequent decline in their employment rates (-0.7% to –1.0%) and wage rates (-0.3% to –1.0%). The impacts on these groups are lower in part because of their initially larger population shares.[32]

The impacts under scenario B are roughly the negative of those under Scenarios A. The doubling of recent migrant flows increases the population shares of skill groups where recent migrants are most prevalent, leading to declines in their wages and employment rates, and small or positive between-skill effects on outcomes for the NZ-born. Numerically larger effects are observed for within-skill effects, for which the increase in recent migrant shares within skill groups lowers their

[32] For example, in scenario A, the roughly 69,000 decline in the recent migrant population lowers the recent migrant share by about 50% (from 8.7% to 4.5%), but raises the non-recent migrant population by only about 5% for NZ-born (from 74% to 77%) and earlier migrants (from 17.4% to 18.2%).

wages and employment rates, and increases the wages and employment rates of earlier migrants and the NZ-born.

Scenario C maintains the same number of migrants but changes the skill composition towards more highly skilled migrants. This has the impact of increasing inflows most strongly for skill-groups where recent migrants are relatively prevalent. As a result, the between-skill impacts on recent migrants are negative. Within skill-groups, recent migrant population shares are raised for high-skilled groups, lowering their wages and employment rates and lowered for low-skill groups, raising their wages and employment rates. Weighting these impacts by initial wage-bill shares, the overall within-skill impact is to raise the employment rates of recent migrants, Wage rates of recent migrants are raised when examining predicted-occupation skill-groups (1.85%), but lowered when examining age/qualification groups (-0.13%). The employment rates impacts on earlier migrants and the NZ-born are minimal, with small between-skill and within-skill contributions roughly balancing each other. Estimated wage impacts on other nativity groups are close to zero using the age/qualification skill definition, and are negative using predicted occupations. The more-skilled recent migrant inflow in this scenario leads to lower wages for earlier migrants (-1.4%) and for the NZ-born (-0.35%), primarily as a result of changing the ('between-skill') skill composition of the workforce.

Finally, a lower-skilled recent migrant inflow in scenario D leads to generally positive wage and employment impacts across the board because the implied recent migrant inflow is sufficiently different from the existing workforce that skill shares are reduced for the majority of workers, raising outcomes. The within-group wage effects are the opposite sign to those seen in scenario C. Overall, average wages are raised for recent migrants, and either raised (using predicted occupations) or reduced only slightly (age/qualification groups) for earlier migrants and the NZ-born.

To gauge whether the less constrained GL specification shows patterns that are substantially different from those found in the more parsimonious CES model, we next examine whether the implied CES changes differ from those calculated using the fully unrestricted GL estimates reported in Table 10. The results are summarised in Table 12. For each scenario, there are nine separate impact estimates – for each combination of 3 nativity-groups and 3 skill-groups, defined as in Table 10. Table 12 also shows a weighted average of impacts for each nativity group, using 2006 labour cost shares as weights. This weighted average is comparable to the restricted CES estimate, which is presented in the first column of the table.

Halving the number of recent migrants under scenario A has a large positive impact on the wages of recent migrants, and negative impacts on both earlier migrants and the NZ-born. The estimated impacts do, however, vary across skill groups within the NZ-born and earlier migrant groups. Negative impacts only occur for medium-skilled NZ- born and medium- and high-skilled earlier migrants. Overall, the weighted average of GL impacts for scenario A is qualitatively similar to the estimates obtained from the CES model, although with much larger positive impact on recent migrants (62%) and a somewhat weaker negative impact on the NZ-born (-0.23%). In order to capture both of these effects with a single parameter, it appears that the CES estimates understate the impact on recent migrants and overstate the impact on NZ-born. Based on the GL estimates, the impacts of scenarios A and B are exactly equal in magnitude but opposite in sign.

Scenario C reflects an increase in the skill-content of recent migration flows. There is a negative impact on high-skilled workers of each nativity group, although the magnitudes of the resulting wage change are quite different: -36% for high-skilled recent migrants; -0.82% for high-skilled earlier migrants; and -1.77% for high-skilled NZ-born. Medium-skilled earlier migrants also experience a wage decline, of -0.99%. Averaged over all skill groups, the more highly-skilled recent migrant flow lowers average wages for earlier migrants, and raises them for recent migrants and the NZ-born. This is in contrast to the negative implied CES impact of -0.39% for the NZ-born.

Finally, a less skilled recent migrant inflow in scenario D raises the wages of high-skilled workers in each nativity group, again by quite different magnitudes, with the largest impact on recent migrants. The overall impacts are positive for recent and earlier migrants, as in the CES estimates, but the average impact on the NZ-born of a less-skilled migrant inflow is negative, in contrast to the positive impact implied by the CES estimates. While both high-skilled and low-skilled NZ-born benefit from the less-skilled migrant inflow, the average effect reflects the strength of the negative impact on medium-skilled NZ-born.

5 Conclusions

This paper examines how the supply of immigrants in particular skill-groups affects the wages of the New Zealand-born and older immigrants. Migrants in New Zealand have different skill characteristics than the NZ-born and we would therefore expect any negative wage impact of migration to be greatest within skill–groups. In particular, both recent and earlier migrants, on average, have higher levels of qualification than NZ-born workers, and are more likely to be in more highly-paid occupations. Thus, we would expect migrants to be substitutes for NZ-born workers with the same skill attributes, but potentially to be complements with NZ-born workers with different skills sets.

We identify the impact of recent immigration on the labour market using the 'area-analysis' approach, which exploits the fact that immigration is spatially concentrated, and thus a change in the local supply of immigrants in a particular skill group should have an impact on the labour market outcomes of similarly skilled non-immigrants in that local labour market. We estimate both CES and Generalised Leontief (GL) production functions using local inputs, thus allowing for different degrees of substitutability between various skill-migrant status groups, and use an instrumental variables estimation strategy to reduce the bias due to groups locating in areas where wage growth is expected to be high for that group.

We examine two factors contributing to the wage and employment impacts of immigration. First, immigrants may change the skill mix of the population, with the consequent impacts on wages and employment reflecting the degree of substitutability between different skill groups. Second, if nativity groups are imperfect substitutes within skill groups, the changing nativity-mix of skill groups will affect relative wages and employment rates. We use two different characterisations of skill – one based on age and qualification, and one based on predicted occupation. We find that there is greater substitutability between age/qualification groups than between predicted occupation groups, implying that changes to the wage and employment impacts of immigration flows will be stronger where they change the occupational mix. Within skill groups, we find greater substitutability between nativity groups when defining skills in terms of age and qualifications than we do when defining it in terms of predicted occupation. Any wage or employment impacts of immigration will be more strongly felt by other workers with predicted occupations similar to those of immigrants, and less strongly felt by other workers with the same age and qualification characteristics.

Simulations of the impact of different potential immigration scenarios show that the impact of immigrants' changing the skill distribution are small relative to the impact that arises from the changing nativity mix within occupations. The strongest wage and employment impact of a change in the number of recent migrants falls on recent migrants themselves. Our CES estimates imply that doubling the size of recent migrant inflows lowers the wages of recent migrants by 4% to 14% and lowers their employment rates by 10% to 13%. Less restrictive GL estimates show a much larger negative wage impact on recent migrants of around 60%. The impact on New Zealand-born workers of a doubling of recent migrant inflows is positive, but small – raising employment rates by between 1.4-1.8% and wage rates by 0.2-1.9% depending on the model assumptions. The only evidence we find of negative impacts of recent migrants on wages for New Zealand-born workers is when we increase the relative skill-composition of the recent migrant inflows; this has a small negative impact on the wages of high-skilled New Zealand-born workers which is offset by a small positive impact on the wages of medium-skilled New Zealand-born workers.

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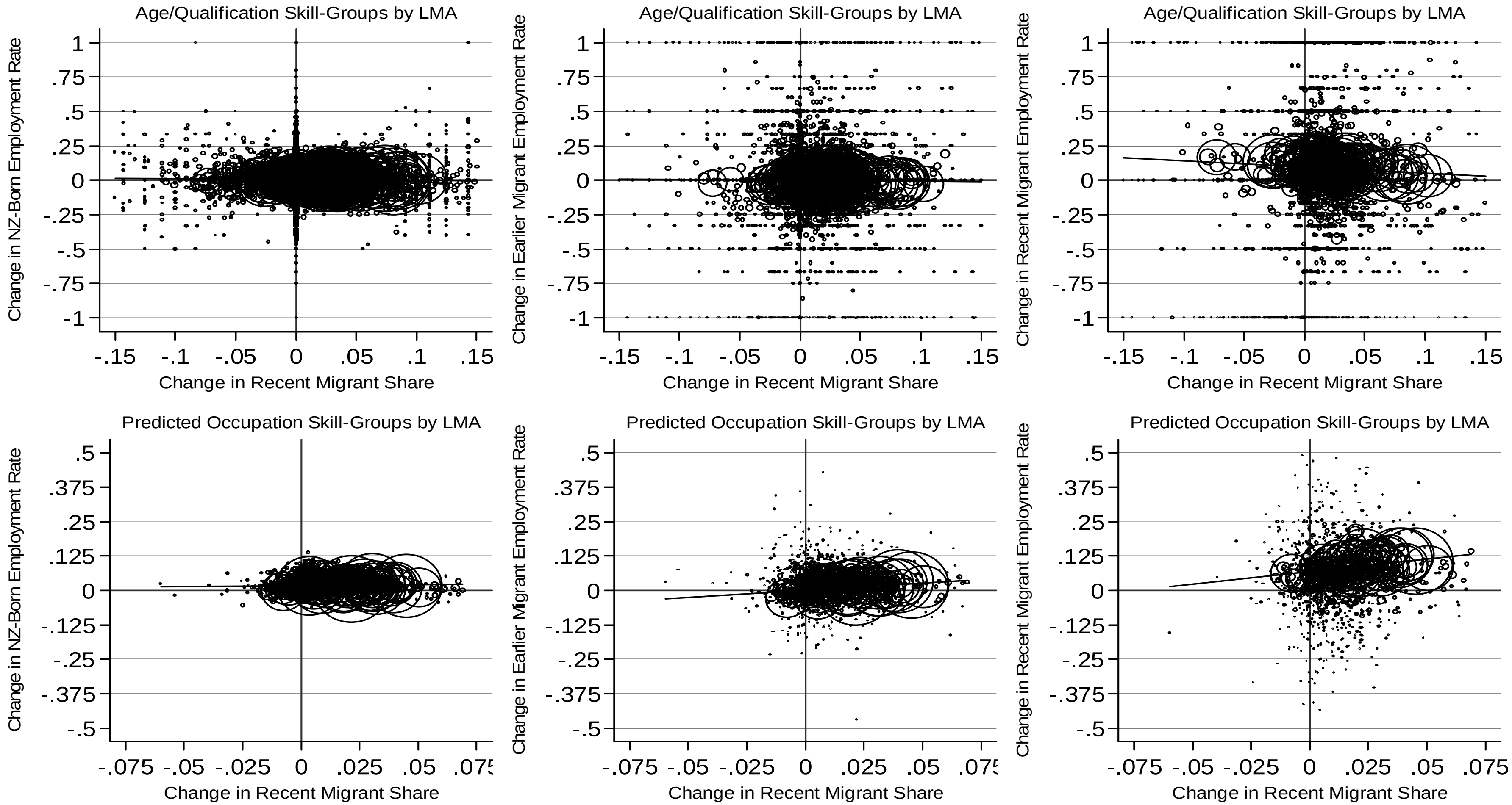
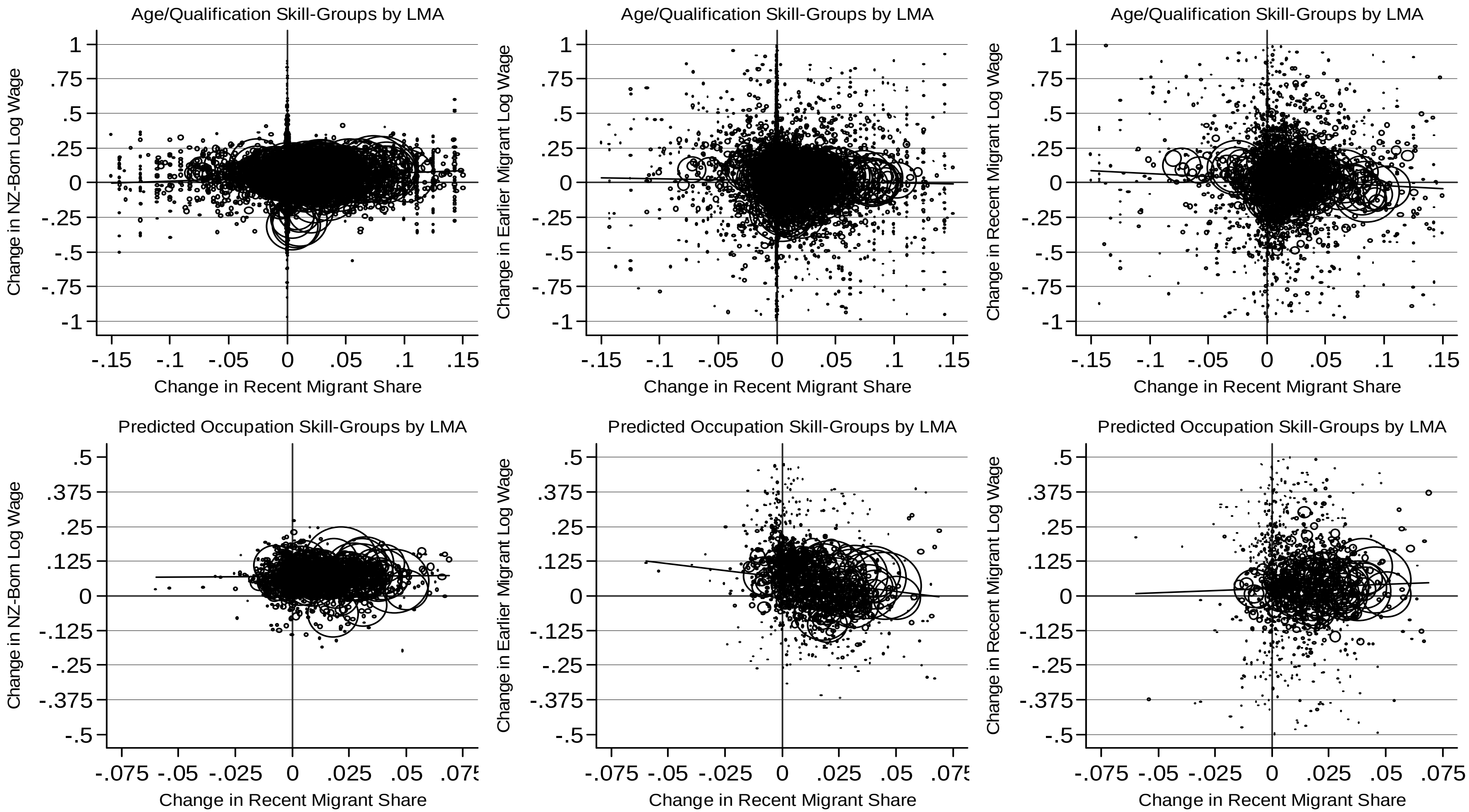


The size of the circles are proportional to the average population of each skill-group and nativity in each LMA
The solid line is the best linear fit

Figure 1: Relationship between Changes in Recent Migrant Share and Changes in Employment Rates for each Nativity Group between each Five-Yearly Census



The size of the circles are proportional to the average population of each skill-group and nativity in each LMA
The solid line is the best linear fit

Figure 2: Relationship between Changes in Recent Migrant Share and Changes in Log Wages for each Nativity Group between each Five-Yearly Census

Table 1: Demographic Characteristics of Migrants and the New Zealand Born in 1996, 2001 and 2006

	1996			2001			2006		
	NZ Born	Earlier Migrants	Recent Migrants	NZ Born	Earlier Migrants	Recent Migrants	NZ Born	Earlier Migrants	Recent Migrants
Age									
25-29	18%	12%	22%	16%	9%	21%	14%	10%	22%
30-34	19%	16%	26%	18%	14%	24%	17%	13%	23%
35-39	19%	17%	20%	18%	19%	22%	18%	18%	20%
40-44	17%	18%	16%	18%	19%	16%	18%	21%	17%
45-49	15%	20%	11%	16%	19%	10%	18%	20%	11%
50-54	12%	17%	5%	14%	20%	6%	15%	18%	6%
Qualifications									
Missing Qualifications	9%	15%	21%	7%	7%	8%	4%	5%	4%
No Qualifications	31%	25%	12%	23%	15%	6%	20%	13%	5%
School Qualifications	27%	23%	17%	34%	39%	37%	31%	32%	30%
Post-school Qualifications	23%	22%	16%	24%	20%	17%	28%	23%	23%
Degree Qualifications	9%	15%	34%	12%	20%	32%	17%	28%	38%
Region of Birth									
Australia		7%	7%		7%	5%		6%	4%
Pacific Islands		22%	6%		22%	12%		21%	9%
British Isles		41%	18%		34%	17%		27%	21%
Western and Northern Europe		6%	5%		6%	4%		5%	4%
Southern and Eastern Europe		1%	5%		2%	4%		2%	3%
North Africa and the Middle East		1%	3%		1%	3%		2%	2%
South-East Asia		6%	7%		7%	9%		8%	7%
North-East Asia		4%	28%		9%	21%		13%	20%
South and Central Asia		3%	7%		4%	9%		5%	13%
North America		3%	5%		3%	4%		3%	4%
Central and South America		1%	1%		1%	1%		1%	2%
Sub-Saharan Africa (incl South Africa)		2%	6%		3%	12%		6%	10%
Percent of Population	80%	15%	5%	78%	16%	6%	74%	17%	9%
Individuals	1,161,048	221,835	67,002	1,189,629	238,341	87,780	1,173,768	276,573	138,465

Note: Recent migrants first arrived in New Zealand in the five years prior to the census. All other migrants are classified as earlier migrants. See the text for more information on how the regions of birth are defined.

Table 2: Qualifications for Recent Migrants by Region of Birth in 1996, 2001 and 2006

	None	School	Post-School	Degree	% of RMs
1996 (# Recent Migrants = 67,002, # NZ Born = 1,161,048)					
North-East Asia	18%	26%	13%	43%	28%
British Isles	8%	22%	34%	36%	18%
South-East Asia	29%	19%	14%	38%	7%
Australia	14%	26%	28%	31%	7%
South and Central Asia	7%	13%	9%	70%	7%
Sub-Saharan Africa (incl South Africa)	7%	15%	28%	50%	6%
Pacific Islands	44%	31%	16%	9%	6%
Southern and Eastern Europe	4%	20%	19%	57%	5%
Western and Northern Europe	6%	20%	36%	37%	5%
North America	5%	18%	10%	66%	5%
North Africa and the Middle East	17%	15%	10%	58%	3%
Central and South America	8%	22%	23%	47%	1%
New Zealand-born	34%	30%	26%	10%	
2001 (# Recent Migrants = 87,780, # NZ Born = 1,189,629)					
North-East Asia	5%	52%	11%	31%	21%
British Isles	3%	32%	27%	39%	17%
Sub-Saharan Africa (incl South Africa)	3%	33%	33%	31%	12%
Pacific Islands	21%	51%	20%	8%	12%
South and Central Asia	5%	27%	12%	57%	9%
South-East Asia	14%	38%	10%	38%	9%
Australia	4%	42%	21%	33%	5%
Western and Northern Europe	1%	44%	21%	34%	4%
Southern and Eastern Europe	2%	45%	16%	37%	4%
North America	1%	32%	9%	58%	4%
North Africa and the Middle East	9%	39%	10%	41%	3%
Central and South America	4%	42%	13%	41%	1%
New Zealand-born	25%	37%	25%	13%	
2006 (# Recent Migrants = 138,465, # NZ Born = 1,173,768)					
British Isles	2%	25%	31%	42%	21%
North-East Asia	7%	43%	16%	34%	20%
South and Central Asia	4%	18%	15%	63%	13%
Sub-Saharan Africa (incl South Africa)	2%	32%	40%	26%	10%
Pacific Islands	16%	45%	27%	12%	9%
South-East Asia	9%	26%	17%	47%	7%
Australia	3%	32%	26%	39%	4%
Western and Northern Europe	1%	25%	31%	43%	4%
North America	1%	25%	12%	61%	4%
Southern and Eastern Europe	1%	30%	27%	42%	3%
North Africa and the Middle East	16%	32%	16%	36%	2%
Central and South America	3%	32%	24%	40%	2%
New Zealand-born	21%	33%	29%	18%	

Note: See the note to Table 1 for more information. These figures are the shares out of the total of non-missing qualifications.

Table 3: Employment Characteristics of Migrants and the New Zealand Born in 1996, 2001 and 2006

	1996			2001			2006		
	NZ	EM	RM	NZ	EM	RM	NZ	EM	RM
Percent Employed	78%	76%	55%	80%	77%	62%	82%	79%	73%
Industry Distribution									
Agriculture, Fishery and Forestry	10%	4%	4%	9%	4%	3%	8%	3%	3%
Manufacturing, Mining, and Utilities	15%	19%	15%	14%	16%	13%	13%	14%	12%
Construction	7%	5%	4%	7%	5%	4%	8%	5%	6%
Wholesale Trade	6%	6%	7%	6%	6%	6%	6%	6%	5%
Retail Trade	10%	10%	10%	10%	10%	10%	10%	11%	12%
Accommodation, Cafes and Restaurants	3%	4%	6%	3%	4%	6%	3%	5%	7%
Transport, Storage, and Communication	6%	5%	4%	6%	5%	4%	5%	5%	5%
Finance and Insurance	4%	3%	3%	3%	4%	4%	4%	4%	4%
Property and Business Services	10%	11%	14%	12%	13%	14%	13%	15%	16%
Government Administration and Defense	5%	5%	3%	4%	4%	3%	4%	3%	3%
Education	7%	8%	8%	8%	9%	10%	8%	8%	7%
Health and Community Services	7%	8%	9%	9%	10%	11%	8%	10%	10%
Cultural and Recreational Services	2%	2%	2%	2%	2%	2%	3%	2%	2%
Personal and Other Services	4%	4%	3%	4%	4%	3%	4%	4%	3%
Missing Industry	4%	5%	8%	3%	4%	7%	4%	5%	5%
Occupation Distribution									
Legislators, Administrators and Managers	14%	15%	14%	14%	15%	12%	17%	17%	14%
Professionals	13%	16%	21%	15%	19%	24%	16%	21%	21%
Technicians and Associate Professionals	12%	13%	15%	12%	12%	12%	13%	13%	14%
Clerks	13%	13%	10%	13%	12%	10%	11%	10%	11%
Service and Sales Workers	11%	11%	12%	12%	12%	12%	11%	11%	13%
Agriculture, Fishery and Forestry Workers	10%	4%	4%	8%	4%	3%	7%	3%	3%
Trades Workers	9%	9%	7%	9%	8%	7%	9%	7%	8%
Plant and Machine Operators	9%	9%	5%	9%	8%	6%	8%	7%	5%
Elementary Occupations	6%	6%	5%	5%	5%	5%	5%	5%	5%
Missing Occupation	3%	4%	7%	4%	5%	8%	4%	5%	6%
Predicted Occupation Distribution (All individuals)									
Legislators, Administrators, and Managers	13%	13%	13%	14%	15%	12%	16%	17%	14%
Professionals	12%	16%	19%	14%	18%	22%	16%	20%	20%
Technicians and Associate Professionals	12%	12%	15%	12%	12%	11%	13%	13%	14%
Clerks, Agriculture, Trades, and Operators	43%	39%	30%	40%	35%	30%	37%	30%	30%
Service and Sales, and Elementary	20%	20%	23%	19%	20%	24%	19%	20%	22%
Percent of Employed Individuals	82%	15%	3%	80%	15%	5%	75%	17%	8%
Employed Individuals	906,663	169,221	36,519	948,906	182,613	54,246	964,821	218,145	100,464
Individuals	1,161,048	221,835	67,002	1,189,629	238,341	87,780	1,173,768	276,573	138,465

Note: See the note to Table 1 for more information and the text for a description of how predicted occupations are created. NZ = New Zealand-born, EM = earlier migrants and RM = recent migrants.

Table 4: Wages for Migrants and the New Zealand Born in Different Skill-Groups in 1996, 2001 and 2006

	1996			2001			2006		
	NZ Born	Earlier Migrants	Recent Migrants	NZ Born	Earlier Migrants	Recent Migrants	NZ Born	Earlier Migrants	Recent Migrants
Avg. Real Hourly Wage for All Employed	$17.37	$18.23	$17.73	$18.88	$18.69	$19.76	$21.00	$19.88	$20.90
Avg. Real Hourly Wage by Qualifications									
Missing Qualifications	$15.11	$15.80	$16.13	$16.69	$15.89	$15.60	$18.35	$16.23	$16.53
No Qualifications	$14.57	$14.01	$13.02	$15.33	$15.00	$12.65	$16.41	$15.12	$13.16
School Qualifications	$17.40	$17.07	$16.66	$18.32	$17.98	$16.21	$20.23	$18.42	$16.67
Post-school Qualifications	$18.72	$19.62	$18.59	$19.87	$20.78	$18.77	$22.09	$22.67	$21.02
Degree Qualifications	$25.18	$24.47	$21.91	$26.71	$27.13	$23.36	$26.66	$25.65	$22.93
Avg. Real Hourly Wage by Predicted Occupation									
Service and Sales, and Elementary	$15.96	$15.54	$15.57	$17.09	$16.28	$17.09	$19.08	$17.00	$17.89
Clerks, Agriculture, Trades, and Operators	$16.81	$17.10	$16.78	$18.23	$17.56	$18.43	$20.51	$19.30	$19.91
Technicians and Associate Professionals	$18.34	$19.67	$19.44	$19.49	$20.21	$21.00	$21.46	$21.14	$22.16
Legislators, Administrators, and Managers	$19.05	$19.41	$19.39	$20.63	$20.25	$21.42	$22.27	$21.41	$22.37
Professionals	$20.92	$21.40	$21.63	$22.53	$22.11	$24.24	$24.09	$23.03	$24.49
Percent of Employed Individuals	82%	15%	3%	80%	15%	5%	75%	17%	8%
Employed Individuals	906,663	169,221	36,519	948,906	182,613	54,246	964,821	218,145	100,464
Individuals	1,161,048	221,835	67,002	1,189,629	238,341	87,780	1,173,768	276,573	138,465

Note: Wages are in June 2006 dollars. See the note to Table 1 for more information and the text for a description of how predicted occupations are created.

Table 5: Reduced-Form Regression of Impact of Recent Migrant Share on Employment and Wage in Local LMAs

	Employment Rate			Mean Log Hourly Wage		
	New Zealand Born	Earlier Migrants	Recent Migrants	New Zealand Born	Earlier Migrants	Recent Migrants
	Age-Qualification Skill Groups - 140 LMAs w/ Age/Qual/LMA, Age/Qual/Year, LMA/Year and Year Fixed Effects					
Recent Migrant Share	-0.005	-0.147	-0.573**	0.284**	0.157	-0.168
	(0.036)	(0.100)	(0.180)	(0.089)	(0.120)	(0.160)
Observations	9,985	7,712	4,710	9,982	7,583	4,469
R-squared	0.95	0.77	0.82	0.98	0.95	0.93
	Predicted Occupation Skill Groups - 140 LMAs w/ Occ/LMA, Occ/Year, LMA/Year, and Year Fixed Effects					
Recent Migrant Share	-0.193**	-0.077	-0.509**	1.266**	0.504	-0.289
	(0.047)	(0.140)	(0.140)	(0.400)	(0.360)	(0.250)
Observations	2,100	2,100	2,100	2,100	2,100	2,090
R-squared	1.00	0.99	0.99	1.00	1.00	0.99

Note: Each cell of the table is from a separate regression with the form of equation (1). All regressions are variance weighted by the skill-group population in each LMA for the examined sub-group in a particular year. Standard errors that account for skill-group/LMA clustering are in parentheses. See the note to Table 1 for more information and the text for a description of how predicted occupations are created.

** 5% Significance, * 10% Significance

Table 6: CES Employment and Wage Elasticities for Skill-Groups

	24 Age*Qualification Skill-Groups		5 Predicted Occupation Skill-Groups	
	OLS	IV	OLS	IV
	Employment Rate Elasticity (se)			
140 LMA	-0.034 **	-0.202 **	-0.152 **	-0.209
	(0.01)	(0.02)	(0.02)	(0.24)
75 TA	-0.030 **	-0.227 **	-0.160 **	-0.230 **
	(0.01)	(0.02)	(0.03)	(0.10)
58 LMA	-0.029 **	-0.214 **	-0.157 **	-0.523 *
	(0.01)	(0.02)	(0.03)	(0.30)
16 RC	-0.040 *	-0.246 **	-0.114 **	-0.094
	(0.02)	(0.03)	(0.03)	(0.26)
	Wage Elasticity (se)			
140 LMA	0.005	-0.056 **	-0.007	-1.670 *
	(0.01)	(0.02)	(0.07)	(0.91)
75 TA	0.006	-0.040 **	0.150	-0.818 *
	(0.01)	(0.02)	(0.10)	(0.30)
58 LMA	-0.005	-0.053 **	-0.016	-1.798
	(0.01)	(0.02)	(0.09)	(1.12)
16 RC	-0.003	-0.060 **	0.094	-5.269
	(0.02)	(0.02)	(0.17)	(5.55)
	Elasticity of Substitution			
140 LMA	-177.2	14.1	115.7	0.5
75 TA	-159.5	19.2	-5.6	0.9
58 LMA	200.8	14.9	52.9	0.3
16 RC	311.4	12.5	-9.4	0.2
	Labour Supply Elasticity			
140 LMA	-6.19	3.58	20.66	0.13
75 TA	-4.88	5.63	-1.06	0.28
58 LMA	5.90	4.06	9.86	0.29
16 RC	12.96	4.07	-1.22	0.02
	Number of Observations (Potential Obs/ Percent of Employment covered)			
140 LMA	10,029 (10,080 / 100%)		2,100 (2,100 / 100%)	
75 TA	5,256 (5,400 / 100%)		1,095 (1,125 / 100%)	
58 LMA	4,176 (4,176 / 100%)		870 (870 / 100%)	
16 RC	1,152 (1,152 / 100%)		240 (240 / 100%)	

Note: Each cell of the table is from a separate regression with the form of equation (7). All regressions are variance weighted by the skill-group population in each LMA in a particular year. See the note to Table 1 for more information and the text for a description of how predicted occupations are created.
** 5% Significance, * 10% Significance

Table 7: CES Employment and Wage Elasticities for Nativity Groups

	Nativity Groups		Nativity Groups within 24 Age*Qual Groups		Nativity Groups within 5 Predicted Occ Groups	
	OLS	IV	OLS	IV	OLS	IV
Employment Rate Elasticity (se)						
140 LMA	-0.005	0.089 *	-0.074 **	-0.165 **	-0.052 **	-0.217 **
	(0.07)	(0.05)	(0.01)	(0.05)	(0.02)	(0.07)
75 TA	0.070	0.176 **	-0.064 **	-0.142 **	-0.089 **	-0.241 **
	(0.07)	(0.07)	(0.01)	(0.04)	(0.02)	(0.05)
58 LMA	0.087	0.159 **	-0.079 **	-0.176 **	-0.070 **	-0.253 **
	(0.06)	(0.05)	(0.01)	(0.04)	(0.02)	(0.06)
16 RC	0.187 **	0.182 **	-0.076 **	-0.214 **	-0.098 **	-0.285 **
	(0.03)	(0.02)	(0.02)	(0.05)	(0.03)	(0.09)
Wage Elasticity (se)						
140 LMA	-0.018	-0.150 **	0.003	-0.068 **	-0.005	-0.216 **
	(0.06)	(0.07)	(0.01)	(0.03)	(0.01)	(0.06)
75 TA	-0.037	-0.186 *	0.001	-0.034	-0.028 *	-0.169 **
	(0.07)	(0.10)	(0.01)	(0.02)	(0.02)	(0.05)
58 LMA	-0.073	-0.192 **	0.002	-0.065 **	-0.023	-0.221 **
	(0.07)	(0.08)	(0.01)	(0.03)	(0.02)	(0.06)
16 RC	-0.114	-0.219 **	0.005	-0.058 **	-0.057 *	-0.296 **
	(0.13)	(0.10)	(0.01)	(0.03)	(0.03)	(0.11)
Elasticity of Substitution						
140 LMA	56.3	7.3	-292.3	12.3	184.7	3.6
75 TA	28.6	6.3	-871.9	25.2	32.4	4.5
58 LMA	14.8	6.0	-510.0	12.8	40.8	3.4
16 RC	10.4	5.4	-183.8	13.6	15.9	2.4
Labour Supply Elasticity						
140 LMA	0.31	-0.59	-23.33	2.42	10.15	1.00
75 TA	-1.87	-0.95	-59.40	4.17	3.15	1.43
58 LMA	-1.19	-0.83	-43.90	2.72	3.06	1.14
16 RC	-1.64	-0.83	-15.14	3.72	1.73	0.96
Number of Observations (Potential Observations / Percent of Employment Covered)						
140 LMA	1,254 (1,260 / 100.0%)		21,847 (30,240 / 99.7%)		6,270 (6,300 / 100.0%)	
75 TA	657 (675 / 100%)		14,019 (16,200 / 99.0%)		3,285 (3,375 / 100.0%)	
58 LMA	522 (522 / 100%)		11,108 (12,528 / 99.9%)		2,610 (2,610 / 100%)	
16 RC	144 (144 / 100%)		3,344 (3,456 / 100.0%)		720 (720 / 100%)	

Note: Each cell of the table is from a separate regression with the form of equation (9). All regressions are variance weighted by the nativity-skill-group population in each LMA in a particular year. See the note to Table 1 for more information and the text for a description of how predicted occupations are created.

** 5% Significance, * 10% Significance

Table 8: CES Cross Wage Elasticities between Nativity Groups in 140 LMAs (IV)

	Impact of a Change in Nativity Group within . . .					
	24 Age*Qual Skill-Groups			5 Predicted Occ Skill-Groups		
	NZ	EM	RM	NZ	EM	RM
on Employment of						
NZ	-0.033	0.025	0.008	-0.043	0.033	0.011
EM	0.132	-0.140	0.008	0.174	-0.184	0.011
RM	0.132	0.025	-0.156	0.174	0.033	-0.206
	NZ	EM	RM	NZ	EM	RM
on Wages of						
NZ	-0.014	0.010	0.003	-0.043	0.032	0.011
EM	0.054	-0.058	0.003	0.173	-0.184	0.011
RM	0.054	0.010	-0.065	0.173	0.032	-0.205

Note: Elasticities are dervied from the results presented in Table 7 for 140 LMAs using instrumental variables.
NZ = New Zealand-born, EM = earlier migrants and RM = recent migrants

Table 9: GL Cross Wage Elasticities between Nativity Groups in 140 LMAs

	Impact of a Change in Nativity Group within . . .					
	24 Age*Qual Skill-Groups			5 Predicted Occ Skill-Groups		
	NZ	EM	RM	NZ	EM	RM
on Wages of	using SUR estimation					
NZ	0.003 **	-0.002	-0.001 **	0.001	-0.001	0.000
EM	-0.008	0.005	0.008 **	-0.005	0.005	0.002
RM	-0.017 **	0.024 **	-0.002	-0.001	0.005	0.002
on Wages of	using IV-3SLS estimation					
NZ	0.008	-0.005	-0.003	0.003	-0.002	-0.001 *
EM	-0.024	0.016	0.020	-0.008	-0.013	0.025 **
RM	-0.038	0.061	-0.006	-0.021 *	0.079 **	-0.073
Obs (Potn Obs/% Emp)	2,757 (10,080 / 89.1%)			2,070 (2,100 / 99.9%)		

Note: Each row reports the (transformed) estimates from one equation of the three-equation system of factor demands described in equation (14). NZ = New Zealand-born, EM = earlier migrants and RM = recent migrants.

** 5% Significance, * 10% Significance

Table 10: GL Wage Elasticities between Nativity-Skill-Groups across 140 LMAs (IV-3SLS)

		Impact of a Change in . . .								
		New Zealand Born			Earlier Migrants			Recent Migrants		
on wages of . . .		LegProfMgr	Tech/Trade	Serv&Plant	LegProfMgr	Tech/Trade	Serv&Plant	LegProfMgr	Tech/Trade	Serv&Plant
New Zealand-Born	LegProfMgr	-0.298 **	0.074 **	0.265 **	-0.027 **	-0.028 **	0.014	-0.018 **	0.004	0.013 **
	Tech/Trade	0.108 **	-0.413 **	-0.015	0.010	0.027 **	-0.049 **	0.029 **	-0.009	-0.012 *
	Serv&Plant	0.203 **	-0.008	-0.693 **	0.024 **	0.006	0.016 *	-0.004	0.001	-0.002
Earlier Migrants	LegProfMgr	-0.113 **	0.028	0.132 **	-0.640 **	-0.016	0.002	-0.002	0.021 **	0.004
	Tech/Trade	-0.205 **	0.137 **	0.057	-0.029	-0.843 **	0.165 **	0.020	-0.027 *	0.033 **
	Serv&Plant	0.061	-0.150 **	0.093 *	0.002	0.100 **	-1.052 **	-0.010	-0.009	-0.023 **
Recent Migrants	LegProfMgr	-0.223 **	0.254 **	-0.059	-0.005	0.034	-0.029	-0.837 **	0.029	-0.017
	Tech/Trade	0.092	-0.128	0.035	0.111 **	-0.080 *	-0.042	0.050	-0.923 **	-0.019
	Serv&Plant	0.185 **	-0.121 *	-0.041	0.016	0.066 **	-0.074 **	-0.020	-0.013	-1.075 **

Notes: Each row reports the (transformed) estimates from one equation of a nine-equation system of factor demands of the form described in equation (14). LegProfMgr aggregates Legislators, Administrators, and Managers; and Professionals, Tech/Trade aggregates Technicians, Associate Professionals; and Trade Workers, and Serv&Plant aggregates the remaining occupation groups. 414 observations out of a total of 420 potential observations were used in the estimates, accounting for 99.9% of employment.

** 5% Significance, * 10% Significance

Table 11: Simulated Impacts of Different Immigration Scenarios (CES Estimates)

		Impact on Employment Rates		Impact on Wage Rates	
Scenario	Component	Age-Qual	Occ	Age-Qual	Occ
		Impact on New Zealand-Born			
A: Halve RM flows	Between	-0.04%	0.00%	0.01%	-0.03%
(from 138,475 to 69,238)	Within	-0.70%	-0.96%	-0.31%	-0.96%
	Total	-0.74%	-0.97%	-0.30%	-0.99%
B: Double RM flows	Between	0.11%	0.01%	-0.01%	0.08%
(from 138,475 to 276,950)	Within	1.28%	1.80%	0.58%	1.80%
	Total	1.39%	1.81%	0.57%	1.87%
C: RM flows are 75% high-skilled	Between	0.03%	0.05%	-0.01%	-0.41%
(AQ: 64% in 2006)	Within	-0.02%	-0.05%	0.01%	0.05%
(Occ: 48% in 2006)	Total	0.01%	0.00%	0.00%	-0.35%
D: RM flows are 25% high-skilled	Between	-0.03%	0.00%	0.06%	0.66%
(AQ: 64% in 2006)	Within	0.02%	0.00%	-0.07%	-0.09%
(Occ: 48% in 2006)	Total	-0.01%	0.00%	-0.01%	0.57%
		Impact on Earlier Migrants			
A: Halve RM flows	Between	0.04%	0.01%	0.03%	0.14%
(from 138,475 to 69,238)	Within	-0.76%	-0.98%	-0.34%	-0.98%
	Total	-0.73%	-0.97%	-0.31%	-0.84%
B: Double RM flows	Between	-0.03%	-0.02%	-0.05%	-0.23%
(from 138,475 to 276,950)	Within	1.39%	1.83%	0.62%	1.84%
	Total	1.37%	1.81%	0.58%	1.60%
C: RM flows are 75% high-skilled	Between	-0.03%	-0.05%	-0.03%	-1.64%
(AQ: 64% in 2006)	Within	0.03%	0.05%	0.04%	0.21%
(Occ: 48% in 2006)	Total	-0.01%	0.00%	0.01%	-1.43%
D: RM flows are 25% high-skilled	Between	0.19%	0.08%	0.14%	1.75%
(AQ: 64% in 2006)	Within	-0.16%	-0.09%	-0.17%	-0.23%
(Occ: 48% in 2006)	Total	0.04%	0.00%	-0.03%	1.52%
		Impact on Recent Migrants			
A: Halve RM flows	Between	0.37%	0.02%	0.13%	0.20%
(from 138,475 to 69,238)	Within	10.38%	14.05%	4.26%	13.99%
	Total	10.75%	14.07%	4.39%	14.19%
B: Double RM flows	Between	-0.59%	-0.04%	-0.20%	-0.33%
(from 138,475 to 276,950)	Within	-9.56%	-13.19%	-3.90%	-13.13%
	Total	-10.15%	-13.23%	-4.11%	-13.46%
C: RM flows are 75% high-skilled	Between	-0.12%	-0.02%	-0.07%	-1.46%
(AQ: 64% in 2006)	Within	0.60%	3.57%	-0.13%	1.85%
(Occ: 48% in 2006)	Total	0.47%	3.55%	-0.19%	0.40%
D: RM flows are 25% high-skilled	Between	0.56%	0.06%	0.27%	1.59%
(AQ: 64% in 2006)	Within	5.26%	2.66%	3.40%	4.15%
(Occ: 48% in 2006)	Total	5.82%	2.72%	3.67%	5.74%

Note: Estimated impacts in this table are derived from coefficients in Tables 6 and 7 for 140 LMAs using instrumental variables, using formulae presented in the text. For the purposes of these siimulations, 'high skilled' refers to education groups with post-school or degree qualifications, or predicted occupation groups of Legislators/Administrators/Managers; Professionals; and Technicians/Associate Professionals.

Table 12: Simulated Wage Impacts of Different Immigration Scenarios (GL Estimates)

		CES Total Estimate	Unrestricted GL Estimate	Impact on Low-Skilled	Impact on Medium-Skilled	Impact on High-Skilled
				Impact on New Zealand-born		
Scenario A	Halve RM	-0.99%	-0.23%	0.30%	-0.61%	0.06%
Scenario B	Double RM	1.87%	0.23%	-0.30%	0.61%	-0.06%
Scenario C	RM 75% High-skilled	-0.39%	0.48%	-0.03%	2.33%	-1.77%
Scenario D	RM 25% High-skilled	0.73%	-0.58%	0.17%	-2.49%	1.68%
				Impact on Earlier Migrants		
Scenario A	Halve RM	-0.84%	-1.04%	2.88%	-1.77%	-1.67%
Scenario B	Double RM	1.60%	1.04%	-2.88%	1.77%	1.67%
Scenario C	RM 75% High-skilled	-1.66%	-0.57%	1.35%	-0.99%	-0.82%
Scenario D	RM 25% High-skilled	1.88%	0.01%	-0.28%	-0.47%	0.59%
				Impact on Recent Migrants		
Scenario A	Halve RM	14.19%	62.29%	76.81%	61.83%	57.17%
Scenario B	Double RM	-13.46%	-62.29%	-76.81%	-61.83%	-57.17%
Scenario C	RM 75% High-skilled	1.56%	7.02%	77.53%	21.83%	-36.21%
Scenario D	RM 25% High-skilled	8.14%	8.57%	-38.81%	-17.40%	54.86%

Note: Estimated impacts in this table are derived from coefficients in Tables 6, 7, and 10 for 140 LMAs using instrumental variables, using formulae presented in the text. For the purposes of these siimulations, Here 'high-skilled' refers to predicted occupation groups of Legislators/Administrators/Managers and Professionals, 'medium-skilled to predicted occupation-groups of Technicians/Associate Professionals and Trades Workers, and 'low-skilled' to the remaining predicted occupation groups.

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