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ABSTRACT

The Effect of Social Networks on the Economic Outcomes of a Disadvantaged Group: Evidence from Tribal Affiliations*

Minority groups in many countries, particularly indigenous populations, live in very segregated environments. Many social scientists believe that social networks create poverty traps in these types of segregated environments, with a lack of positive role models reinforcing a lack of good job opportunities. In this paper, we use data from the New Zealand Census to examine the relationship between the strength of an individual's local social network and their labor market outcomes. We focus on outcomes for Māori, which allows us to use tribes as exogenously formed networks, and traditional tribal ties to specific geographical regions as an exogenous shock to the locations of social networks. We thus avoid the typical problem of endogenously formed networks and network locations. We find that Māori who locate in areas with strong networks have modestly worse labour market outcomes than Māori from other tribes in the same areas. However, when we account for the endogenous selection of Māori into high networks areas, we find that they are negatively selected on both observables and unobservables and that social networks have a positive causal impact on employment and total income for women and wage rates for men. These results are consistent with those found in the literature on immigrant enclaves and allude to role that social networks play in improving job match quality.

JEL Classification: J61, J15, R23

Keywords: social networks, mobility, labour market outcomes, New Zealand, Māori

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1 Introduction

Minority groups in many countries live in very segregated environments (Logan 2013). This is particular true among indigenous populations (Iceland and Weinberg 2002). Many social scientists believe that social networks create poverty traps in these types of segregated environments, with a lack of positive role models reinforcing a lack of good job opportunities.[2] While a number of papers model how social networks affect individual labour market outcomes (for example, Montgomery 1991; Calvo-Armengol and Jackson 2004), as first discussed in Manski (1993), identifying the impact of social networks is fraught with difficulty both because of endogeneity of the choice of where to live and with whom to associate and because of the 'reflection' problem where network systems create feedback loops where it is difficult to separate cause from effect.

For this reason, the majority of papers seeking to identify the causal impact of social networks on labour market outcomes have focused on immigrant groups (for example, Edin et al. 2003; Damm 2009; Munshi 2003; Beaman 2012; Bertrand et al. 2000). This has the advantage that both country of origin and language spoken provide natural exogenous networks and that, in the case of Edin et al. (2003), Damm (2009) and Beaman (2012), the location of the immigrants being examined is initially randomly assigned. Interestingly, these three papers, along with Munshi (2003), find that while there is strong negative selection into living in a co-ethnic enclave, living in an enclave leads to better labour market outcomes for immigrants.[3] These authors speculate that this occurs because ethnic networks disseminate information that leads to better job-worker match quality. This result is strongly consistent

[2] Wilson (1987) is one of the original papers to make this argument.

[3] Bertrand et al. (2000) focuses on welfare usage and finds that women whose local co-ethnics are more likely to use welfare are also more likely to use welfare themselves. The paper also argues that this occurs because of shared information. It is not possible to tell from their analysis whether this increased welfare usage occurs because these groups have worse labour market outcomes or if, conditional on not being employed, they have higher take-up of welfare.

with recent work by Dustmann et al. (2016) who, using linked employer-employee data from a labour market in Germany, find that job search networks help to reduce information gaps in the labour market and lead to better outcomes for both workers and firms.

In this paper, we extend on this previous literature by examining the impact of social networks on labour market outcomes for the Māori ethnic group in New Zealand.[4] Māori are the indigenous people of New Zealand. Unlike indigenous groups in other Anglo countries, Māori are a large proportion of the New Zealand population, with nearly one in five New Zealand-born individuals reporting Māori ethnicity. That said, like other indigenous populations, Māori have lower average levels of educational attainment than New Zealand Europeans, as well as lower levels of income and a much higher likelihood of living in poverty (Perry 2015; Chapple 1999).

The vast majority of Māori belong to an iwi, which can loosely be translated as a tribe.[5] The iwi is traditionally the largest socio-political organisation in Māori society and is generally a territorial entity. Hence, an iwi can be thought of as an exogenous social network similar to a grouping based on country of origin or language spoken. Iwi members retain strong ties to the rohe, or traditional region, of their iwi (Walker 1990; Statistics New Zealand 2014). As can be seen in Sin and Stillman (2005), this attachment to traditional lands has led to a large amount of geographic clustering among Māori. Rohe, therefore, provide exogenous variation in the location decisions of Māori of different iwi.

We use unit record data from the entire Māori population in the 1996, 2001, and 2006 New Zealand Censuses to examine the impact of social networks as measured either by

[4] In the most related paper to ours, Skoufias et al. (2010) examine the effects of social networks for Indigenous people in Mexico, focusing on language networks and using the same identification strategy as Bertrand et al. (2000). This differs from the approach taken in our paper which is more similar to those used in Edin et al. (2003), Damm (2009) and Beaman (2012).

[5] There are 111 iwi recognised by Te Puni Kōkiri (Ministry of Māori Affairs). Statistics New Zealand (2014) reports that 89 percent of Māori adults know their iwi.

whether a person lives in the traditional region of his tribe (i.e. the rohe of his iwi) or by the proportion of co-tribal members living in the same local labour market, on employment, wages and incomes. While we focus on exogenously defined networks, we still need to account for the fact that Māori are not randomly assigned to different parts of New Zealand and hence can decide whether to live in a strong network area, and that this decision is likely closely related to their expected labour market outcomes. Our identification strategy has three components. First, we control for a limited set of observable characteristics that are related to both labour market returns (e.g. age and education) and the potential value of local amenities (marital and family status). Second, we include location fixed effects in all of our estimates and hence control for differences in the quality of local labour markets that are not iwi-specific. Third, we use information available in our otherwise cross-sectional census data on where individuals lived five years previously to estimate the degree of selection on unobservables by comparing labor market outcomes for individuals who have moved away from their social networks with outcomes of those who have moved from other areas.

For this last component of our identification strategy, it is easier to illustrate what we do by describing the process when the focus is on the impact of living in one's rohe, but the approach is nearly identical when examining the impact of strong social networks. Specifically, we examine how outcomes differ for two types of Māori who currently live outside their rohe: those who have migrated out of their rohe in the past five years; and those who have migrated out non-rohe areas in the same period. We assume the selection of migrants out of rohe areas mirrors the selection of migrants out of non-rohe areas.[6] Under this assumption, the difference between the current labour market outcomes of these two types provides an estimate of the selection effect of choosing to live in one's rohe.

[6] We examine selection on observables for these two migrant groups and show that this is likely to be a reasonable approximation.

We hypothesize several interactions between networks, location decisions and labour market outcomes. The location decisions that individuals make will depend on both the economic (e.g. employment opportunities) and non-economic (e.g. local amenities) benefits of living in a particular area, as well as the economic (e.g. the cost of local housing) and non-economic (e.g. missing friends and family who do not live nearby) costs. Social networks potentially impact both economic and non-economic benefits and costs. For example, networks can help individuals find employment and lower the costs of going to work, say by providing childcare. However, they may also change people's preferences for leisure, because social networks and leisure time are complements.

Overall, we find that Māori, particularly men, who locate in their rohe or areas with a strong network have modestly worse labour market outcomes than other Māori in the same local labour market. However, our additional results suggest that these individuals are negatively selected on unobservables and, once we account for this selection, we find social networks have a positive causal impact on employment and total incomes for women and wage rates for men. These findings are qualitatively similar as those in Edin et al. (2003), Damm (2009), Munshi (2003) and Beaman (2012) when examining the impact of social networks for immigrants and similar to those in Skoufias et al. (2010) in terms of impact on employment but not on wages, when examining the effects of social networks for indigenous people in Mexico. We join Skoufias et al. (2010) and Dustmann et al. (2016) in showing that social networks matter not only for immigrants but also for other well-established social and ethnic groups. This may occur because tribal networks disseminate information, which leads to better job-worker match quality, and also, perhaps especially for women, help to expand childcare knowledge and options.

2 Background

'Māori' are defined in this paper, and generally in New Zealand research, as individuals who identify themselves with the Māori ethnicity, which is a measure of cultural affiliation, as opposed to race, ancestry, nationality, or citizenship. Iwi, roughly, "tribe", is part of the hierarchy, based on kinship and descent, of waka (founding canoe), iwi (tribe), hapu (sub-tribe) and whanau (family) by which Māori traditionally defined their position in society (Consedine 2007). Importantly, the sociology literature suggests that identity in terms of iwi affiliation remains a relevant construct in today's world (Nikora et al. 2004) and this is supported by recent evidence from the Survey of Māori Well-Being (Statistics New Zealand 2014). Iwi are a fixed construct and a person can only join an iwi if they have strong ancestral or family ties with that tribe.

Iwi are heterogeneous in both population and geographic size. At the time of the 2001 census, Statistics NZ recognised 95 individual iwi. Of these, 13 had more than ten thousand members, 14 had between five and ten thousand, 32 had between one and five thousand and 36 had fewer than one thousand members. While iwi may speak different dialects of Māori, these are easily mutually comprehensible. Hence, iwi is a much narrower definition of a social network than the definitions based on country of origin, language or ethnicity examined in the previous literature. Iwi are also likely more homogenous than these previously examined groups.

As discussed above, land-based ties are extremely important for Māori. Each iwi has traditional ties to a specific geographical region called a rohe, which were generally established when New Zealand formally became an English colony. Rohe may be disproportionately attractive place for iwi members to live: the land is "home", the marae (traditional meeting house) is there, many other members of the iwi live there, and it is the usual location for iwi-specific social and cultural events. While the proportion has decreased

over 20th century, a high concentration of iwi members (roughly one-quarter) still live in their rohe. Importantly for our paper, rohe cover all inhabited parts of New Zealand including both rural and urban areas. Hence, rohe provide natural variation in the location of Māori from different iwi that is exogenous to their labour market opportunities today.

3 Data

This paper uses a 100% sample of unit record data for the New Zealand population from the 1996, 2001 and 2006 censuses.[7] Individuals can record up to three self-defined ethnicities on a census form. We differentiate between two groups of Māori in our analysis: sole Māori, being individuals who report Māori as their only ethnicity; and mixed Māori, being individuals who report Māori ethnicity and at least one other ethnicity.[8] We restrict our analysis to the New Zealand-born Māori population aged 30–59.[9] We focus on this age group because, in some of our models, we condition on an individual's location five years prior to the current census. At this point, individuals in our sample were as young as 25, so their locations were likely to be primarily determined by labour market rather than education considerations.

Information is collected in each census about the current usual residential location of each individual and their usual residential location (including overseas) five years before the census date (i.e. at the time of the previous census). The location information is coded to the relatively fine census 'area unit' level.[10] Newell and Papps (2001) estimate the geographical boundaries of local labour market areas (LMAs) using an algorithm that ensures that most people who live in a particular LMA work in it and most people who work in a particular

[7] Individuals cannot be linked in the data to which we have access.
[8] Chapple (1999) shows that this can be an important distinction when examining labour market outcomes for Māori.
[9] Excluding Māori born outside New Zealand drops very few individuals and we suspect that these people may have very different networks and outcomes to New Zealand-born Māori.
[10] There are nearly 2,000 area units in New Zealand, with an average of 2,000 individuals living in each. In urban areas these more or less correspond to suburbs.

LMA live in it.[11] This procedure creates 140 LMAs; this is the level of geographical aggregation that we focus on when comparing people living in the same location.

The census asks individuals with Māori ancestry to list up to five iwi affiliations. Intermarriage among Māori of different iwis was fairly common historically and remains common today and hence individuals who list multiple iwi affiliations are most likely those who have parents or grandparents that belong to different iwis. That said, 74% of Māori men and 69% of Māori women who provide an affiliation only provide one. We drop from our analysis sample Māori who do not report an iwi affiliation. Māori without an iwi affiliation are a heterogeneous group including individuals reporting Māori ethnicity but not Māori ancestry, Māori who report an iwi affiliation that cannot be classified by Statistics NZ, Māori who do not answer the iwi affiliation question, and Māori who truly do not have an iwi affiliation. Most importantly for our analysis, we cannot calculate social networks for these individuals. Overall, they make up about 20% of the Māori population and generally have better labor market outcomes than other Māori. For the remaining individuals, we focus on the rohe of their first affiliation.[12] We also drop individuals who are affiliated with an iwi based on the South Island since the rohe for the largest South Island iwi, Ngāi Tahu, covers almost the entire South Island and crosses multiple labor markets. This drops around a further 24% of the sample of men and 23% of women and 49 of the 140 LMAs in New Zealand.

We use data collected by Te Puni Kōkiri (the New Zealand Ministry of Māori Affairs) from each iwi on what they consider to be their territorial area (i.e. rohe). This information can be matched using geocoding software to an individual's usual location as measured in the

[11] The addresses recorded on the census form are not always sufficient for assigning an LMA to either the current or previous residence. We drop individuals with incomplete addresses from our analysis.

[12] The census form does not ask people to list affiliations in any particular order but we suspect that people put their most relevant affiliation first in the list. 74% of Māori men and 69% of Māori women who provide an affiliation only provide one, hence this assumption is unlikely to substantially alter our results.

census.[13] This allows us to code whether an individual currently lives in his rohe. Similarly, we can determine whether an individual lived in his rohe five years earlier. We also use the locations of iwi members to create measures of the strength of an individual's iwi network in his current LMA. Our primary measure of network strength is calculated as the number of iwi members as a fraction of the total population of the LMA (ln), where the total population includes people of all ethnicities. This is intended to capture the probability that a random person encountered in the LMA belongs to the same iwi. The individual himself always lives in the LMA, so this variable is always defined.

Table 1 presents descriptive statistics for our analysis. We stratify all analysis by gender as there are a number of reasons why social networks might have different impacts on the labour market outcomes of men and women. In total, our analysis sample consists of 143,499 men and 169,488 women. We examine the impact on three labour market outcomes: whether an individual is employed; his/her (log) hourly wage conditional on being employed; and his/her total income.[14] The employment rates, wages and incomes of Māori men and women are all considerably below the averages for other New Zealanders. Nearly a quarter of both men and women live in the rohe of their iwi and just over one in five has moved labour market areas since the previous census. The census collects fairly limited information that is either predetermined or exogenous to current labour market outcomes. In our analysis, we control for age, qualifications, whether Māori is a person's only ethnicity, marital status, household composition and census year, as well as the number of iwi affiliations an

[13] Of the 111 iwi that Te Puni Kōkiri recognises, geographical information is currently unavailable for 9. We drop individuals who are affiliated with these iwi. We also drop individuals who are affiliated with iwi based on the South Island and TPK iwi that cannot be mapped to iwi in the census, leaving us with 80 iwi for our analysis.

[14] Income data in the census are provided in bands, and the bands covered vary somewhat by year. For each band, we assign the median income within that band, calculated by Statistics NZ using the Household Economic Survey. We then convert to thousands of real 2006 dollars using the CPI. Real hourly wages are calculated as (real earnings/(48*weekly hours worked)) for those who earn wages/salaries and the self-employed.

individual reports and iwi fixed effects.[15] The Māori population as a whole is young, with low levels of education, and more than one in five women are single mothers.

4 Empirical Strategy and Results

4.1 Locational choice and labour market outcomes for Māori

We begin by examining the relationship between locational choice and labour market outcomes for Māori without attempting to disentangle the mechanism of the relationship. In particular, we estimate the following regression model using OLS:[16]

$$Y_{it} = \delta Network_{it} + X_{it}\beta + \varepsilon_{it} \quad (1.1)$$

where i denotes individual and t denotes census. Y_{it} is one of our three labour market outcomes: employment, log wages, or total income; $Network_{it}$ is either an indicator variable for whether an individual lives in the rohe of their iwi or the log relative population of their iwi in their current LMA; X_{it} are controls for individual characteristics discussed above and census year; and ε_{it} is standard uncorrelated error term that is allowed to have a flexible correlation structure for individuals in the same iwi.[17] All regressions are run separately for males and females. The coefficient δ, which indicates the relationship between networks and labour market outcomes, is our main coefficient of interest.

The results from these regressions without LMA fixed effects are presented in columns 1, 3 and 5 of Table 2, with results for men in Panel A and results for women in Panel B. Each row shows the coefficient on *Network* from a different specification. Examining the first specification, we find that Māori men who live in the rohe of their iwi have 8.8 percentage

[15] We recognize that marital status and household composition could be related to both labour market outcomes and location decisions. When these controls are omitted, results (not presented) are essentially unchanged.
[16] We estimate an OLS model when examining employment even though it is a binary dependent variable because, as discussed in Angrist and Pischke (2009), if one's goal is to estimate marginal effects then this model is robust to misspecification of the conditional distribution of the error term, whereas discrete choice models are not. Interpretation of the results is also more straightforward. Our results are qualitatively unchanged when we use a probit model instead.
[17] In other words, we estimate standard errors that are clustered at the iwi level and hence allow for arbitrary correlation in outcomes for individuals in the same iwi.

point lower employment rates (relative to a mean of 71 percent), 6.9 percent lower wages and earn $4,438 less than Māori men with similar observable characteristics who do not live in the rohe of their iwi (relative to a mean of $31,990). Similar results are found for women, who have 4.9 percentage point lower employment rates (relative to a mean of 58 percent), 5.5 percent lower wages and earn $2,325 less if they live in the rohe of their iwi (relative to a mean of $21,570).

In columns 2, 4 and 6 of the same table, we run the same regressions adding LMA fixed effects as controls. This matters if selection into living in a rohe is related to local labour market opportunities in the area of that rohe. These regressions compare outcomes of Māori from different iwi who currently live in the same LMA (and thus face the same labour market opportunities) but only some of whom are in their rohe. A comparison of the results with and without LMA fixed effects indicates that rohe tend to be in areas with poor economic opportunities, and that this explains a large amount of the differences in outcomes between Māori who live inside versus outside their rohe. Men who live in their rohe are now found to have 2.4 percentage point lower employment rates, 1.3 percent lower wages, and to earn $1,342 less each year. For women, there are no significant differences in employment or wages, and earnings are only slightly lower for women in their rohe.

In the second specification, we look at local iwi network strength more generally rather than just focusing on whether individuals live in the rohe of their iwi. These results tell qualitatively the same story. Relative to Māori men living in the same areas but without strong local iwi networks, Māori men who live in areas with strong local networks are less likely to be employed, have lower wages, and have lower total income. For women, the only significant relationship between network strength and labour market outcomes is found for total income, and the magnitude of this relationship is fairly small.

Unlike rohe, which reflect historical settlement patterns only, one might worry that the location of individuals of a particular iwi and hence the location of the current iwi networks are partially driven by local economic opportunities and hence are endogenous to individual outcomes (i.e. we are observing correlated effects in Manski's terminology). We address this concern by reestimating the previous model instrumenting for local network strength with whether an individual is living in his rohe and, if not, the (log) distance from his rohe. These are valid instruments as long as living in one's rohe or the distance one lives from one's rohe only impact labor market outcomes via their impact on network strength.

The instruments from this regression are extremely strong (with joint-F statistics ranging from 123 to 219), indicating that geography is a central determinant of the location of Māori from particular iwi.[18] Furthermore, the results from this IV specification are nearly identical to those from the OLS model. This is strong evidence that the locations of iwi networks are exogenously determined by the location of the rohe of the iwi and are not related to local labour market opportunities.[19] However, it is important to emphasize that the location of networks being exogenous is not the same as location of individuals being exogenously determined. Our finding here just implies that, in general, rohe location is a strong determinant of where individuals from a particular iwi live but not which individuals live in 'concentrated' areas.

4.2 The role of selection on unobservables

In the previous section, we examine the overall relationship between co-tribal networks and labour market outcomes for Māori. Outcomes for Māori currently living in a strong network area may differ from Māori of other iwi in the same LMA either because social

[18] See Appendix Table 1 for the full first-stage results.
[19] It is possible that the IV and OLS estimates are the same by coincidence in the sense that IV estimates the local average treatment effect only for the group of compliers, which in this case means the iwis whose networks are sensitive to rohe location.

networks have a causal effect on labour market outcomes or because Māori who choose to live in a strong network area are unobservably different from Māori belonging to other iwi who choose to live in the same area. For example, one can imagine that Māori with weak attachment to the labour market might choose to live in an area with strong social networks in order to take advantage of support provided by their fellow iwi members. This type of negative selection on unobservables would lead our previous estimates to understate the positive effect of social networks.

In this section, we take advantage of the census question that asks where an individual lived five years ago to attempt to disentangle the selection and treatment effects of co-tribal networks on labour market outcomes. Our identification strategy is most straightforward to understand in the case when we estimate the effect of living in one's rohe rather than the effect of living in a strong network area. We first take our results from the previous section as estimates of the sum of the selection and treatment effects of living in one's rohe. We then infer the degree of selection as the difference in outcomes between observably similar individuals who recently left their rohe and those who left non-rohe areas. Our estimate of the treatment effect is the difference between the previous two estimates. Later, we attempt to sign the bias in our estimate of the treatment effect caused by leavers from different areas being differentially non-representative of the overall populations living in those areas.

Specifically, we estimate

$$Y_{it} = Network_{it-5} + X_{it}\beta + LMA_{it} + LMA_{it-5} + \varepsilon_{it} \tag{1.2}$$

for the subsample of individuals who moved in the previous five years and currently live outside of their rohe (or outside a strong network area).[20] This regression compares labour market outcomes for rohe versus non-rohe leavers (or strong versus weak network leavers)

[20] We define a labour market as having a strong network for a particular iwi if the population of that iwi is 2% or more of the total population of the labour market.

among Māori who moved in the previous five years and do not currently live in their rohe (or in a strong network area). We compare recent rohe-leavers with recent movers from other areas rather than with non-movers because movers may differ from non-movers.[21]

Furthermore, we include current and previous LMA fixed effects as well as individual characteristics, meaning we compare observably similar individuals who made the same move in terms of labour market areas and face the same labour market opportunities. Since neither rohe-leavers nor other movers are now subject to the treatment effect of a strong local network, under the assumption that selection into moving is the same for both groups, any differences in current labour market outcomes are driven by differences in unobservable characteristics.

Table 3 presents the results from this analysis, where the dependent variable is a dummy for being employed, log wages conditional on being employed, or total income, and the main control of interest is a measure of network strength five years ago. The setup mirrors Table 2, with three different types of specification. The first is an OLS specification that measures social network five years ago by whether the individual at that time lived in his rohe. The second is an OLS specification that measures network strength by the proportion of the local labour market population that is from the same iwi. This specification controls for both current and previous network strength; previous network strength is the main coefficient of interest. The third is an IV specification that similarly controls for current and previous iwi concentration, and accounts for potential endogeneity in both by instrumenting for these two variables using dummies for living in one's rohe now and five years ago and distance from one's rohe now and five years ago. All regressions also control for the observable

[21] For example, if many people move to start new jobs, recent movers might have higher employment rates than non-movers. Alternatively, movers might have weaker labour market outcomes for a period while they settle into their new locations.

characteristics used in the previous regressions. Again, standard errors are clustered at the iwi level.

Consider the first specification. For men, we find strong negative selection into living in one's rohe in terms of hourly wages and total income and, for women, in terms of employment and total income. Overall, men who previously lived in their rohe and now do not have 6% lower wages and $1,937 lower annual incomes than men with the same observable characteristics living in the same area and who made exactly the same move but not from their rohe. Similarly, women who previously lived in their rohe have 3 percentage point lower employment rates and $1,335 lower annual incomes.

Examining instead the continuous measure of local network strength gives qualitatively similar results, especially once we allow for the potential endogeneity of local networks. The difference between the OLS and IV results is larger here than in the earlier specification. This could be because this specification restricts the sample to those currently living in weak network areas, and those who move away from their rohe do tend to locate in areas with good labour market prospects. That said, the instrumental variable estimates are only slightly larger than the OLS ones, giving some confidence in their validity. Comparing the IV and OLS results indicates that individuals with worse unobservables move towards places with stronger networks, which is consistent with the overall finding that people with worse unobservables locate in places with stronger networks.

Consistent with our findings in this section, we also find that individuals are negatively selected on observables in terms of living in one's rohe and in strong network areas, with less educated and older individuals, as well single parents, more likely to live in these locations (results not reported). A number of mechanisms may contribute to this: the need to leave the rohe to pursue higher education; more geographic mobility among those with higher earning potential; lower-skilled individuals placing a higher value on networks as an economic safety

net; and higher-skilled individuals having to contribute more (in terms of helping others) to belong to a network. In general, it appears that people are making trade-offs between investing in themselves and living in strong network areas, which may reflect different values individuals place on work and career achievements relative to other aspects of life.

4.3 Selection among different movers

The previous analysis only reveals the degree of selection on unobservables into living in strong network labour markets if the selection of migrants out of strong network areas mirrors the selection of migrants out of weak network areas. We test this assumption by examining whether selection into moving for these two groups differs in terms of *observable* characteristics. While we cannot test selection on unobservables, in almost all models, selection on observables and unobservables operate in the same direction (Altonji et al. 2005).

We examine selection on observables by first regressing total income in the full Māori sample on all predetermined individual characteristics, including LMA and whether a person lives in his/her rohe or a strong network area, and generating a "predicted income" (*PRInc*) for all individuals based on assuming they do not live in their rohe or a strong network area. We then estimate the following regression equation

$$Move_{it,t-5} = \delta PRInc_{it} * Network_{it-5} + \gamma Network_{it-5} + X_{it}\beta + LMA_{it-5} + \varepsilon_{it} \qquad (1.3)$$

for the sample of individuals who did not move to their rohe (or a strong network area). This regression examines the relationship between an individual's observable characteristics and their likelihood of being a mover and whether this varies depending on whether they were living in their rohe (or a strong network area) five years previously. This regression also includes all demographic characteristics included in previous regressions (which include all the variables used to predict income). This approach allows us to conveniently summarise in

dollar terms the extent to which movers from both types of area are more likely to be those whom we would expect to have higher incomes.

Table 4 presents the results from this regression. Turning to the key interaction, we do not find any statistically significant evidence that individuals who move away from their rohe or a strong network area are more *negatively* selected on observables than those who move from weak network areas. For women, selection into mobility appears similar for the two groups; for men, there is some evidence that Māori who move away from their rohe or a strong network area are more positively selected than those who move from other areas, but the scale of the impact is small, with individuals with a 1 SD higher predicted income (25,000 NZD) roughly 1.4 percentage points more likely to be a mover. Under the assumption that selection on unobservables is in the same direction as what we find here, then our findings in the previous section at worst understate the degree of negative selection on unobservables among men living in their rohe or a high network area, while they are likely to be relatively unbiased for women.[22]

4.4 The causal impact of social networks

Given the findings in the previous section, we argue that the causal impact of social networks on labour market outcomes for Māori can be estimated by subtracting the estimated selection effects in Table 3 from the corresponding estimates of the total difference in labour market outcomes for individuals living in strong vs weak network areas found in Table 2. For women, this is likely to give an unbiased estimate of the true impact of social networks while, for men, this is expected to give a lower bound on the true causal impact.

We present the results from this exercise in Table 5 for the two OLS specifications of the model and the IV approach. Standard errors are calculated and inference is done in this

[22] The fact that we find fairly weak selection on observables suggests that this understatement is likely to be small, however this is only true if the selection on unobservables is of a comparative size, which is impossible to know.

table by bootstrapping the system of estimators.[23] Examining first the results focusing on the causal impact of living in one's rohe, we find this causes men to have 4.8% higher wages while women have 2.5 percentage point higher employment rates (a 4.3% increase relative to the mean) and $1,018 higher income (a 4.7% increase). Qualitatively similar results are found when looking at the overall role of social networks, especially when focusing on the instrumental variables estimates which account for any endogeneity in the location of strong social networks. For men, these results indicate that an individual who moves from an average location outside their rohe in terms of network strength to inside their rohe (a change in log network strength of 2.27) will have 5.1% higher wages, which is nearly identical to the previous results. For women, the implied impacts of moving into one's rohe from an average location are about 1/3rd smaller than those found in the first specification.

We also estimated versions of these regressions that exclude all control variables besides LMA fixed effects. Our identification strategy, if correct, should yield similar results if selection on observables is not controlled for in either set of regressions. Our main results estimate the treatment effect as the difference between treatment plus selection on unobservables and selection on unobservables; this alternative estimates the treatment effect as the difference between treatment plus selection on all characteristics and selection on all characteristics. Our estimates from this exercise are extremely similar to our main estimates, which adds credence to our identification strategy.

5 Conclusions

In this paper, we examine how social networks affect labor market outcomes of the indigenous population of New Zealand. In general, the effects of social networks are challenging to estimate because it is difficult to distinguish the effects of having a large peer

[23] 200 bootstrap replications are done with clustering at the first iwi level.

group in one location from the factors that caused the peer group to congregate at that location in the first place. We focus on outcomes for Māori, using their tribes as social networks and their traditional tribal ties to specific geographical regions as an exogenous shock to the locations of their networks, and thus are able to examine exogenously determined and located social networks. While previous work has done this looking at country of birth and language networks, we are the first paper to our knowledge to use tribal affiliations in a similar way to look at the importance of social networks for an indigenous population.

Overall, we find that Māori who locate in areas with a strong network have modestly worse labour market outcomes than other Māori in the same local labor market. However, our additional results suggest that these individuals are negatively selected on unobservables and hence social networks have a positive causal impact on employment and total income for women and wage rates for men. These findings are qualitatively the same as those in Edin et al. (2003), Damm (2009), Munshi (2003) and Beaman (2012) when examining the impact of social networks for immigrants and similar to those in Skoufias et al. (2010) in terms of impact on employment but not on wages, when examining the effects of social networks for Indigenous people in Mexico. These effects may occur because tribal networks disseminate information that leads to better job-worker match quality and, perhaps especially for women, help to expand childcare knowledge and options.

6 References

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Table 1: Descriptive statistics

	Males	Females
Employed	0.709	0.581
Hourly income (ln)	2.87	2.79
	(0.660)	(0.756)
Total income ($000s)	31.99	21.57
	(25.64)	(19.28)
Lives in rohe	0.247	0.246
Distance from rohe for those living outside rohe (km	4.97	4.92
	(1.23)	(1.23)
Network strength (ln)	-4.68	-4.65
	(1.86)	(1.82)
Network strength for those living in rohe (ln)	-2.97	-3.00
	(1.53)	(1.51)
Network strength for those living outside rohe (ln)	-5.24	-5.19
	(1.60)	(1.58)
Moved between LMAs in past 5 years	0.203	0.206
Age 30-39	0.433	0.453
Age 40-49	0.349	0.344
Age 50-59	0.217	0.203
No qualifications	0.432	0.389
School qualifications	0.213	0.257
Post-school qualifications	0.190	0.182
Degree	0.050	0.066
Missing qualifications	0.115	0.105
Sole Maori	0.712	0.657
One iwi only	0.741	0.686
Never Married	0.204	0.215
Married	0.455	0.412
De facto	0.214	0.186
Divorced or separated	0.103	0.139
Widowed	0.010	0.034
Missing marital status	0.015	0.013
Couple without dependent children	0.216	0.200
Couple with dependent children	0.406	0.347
Single with dependent children	0.062	0.221
Single without dependent children	0.309	0.221
Unknown dependent children status	0.008	0.011
1996 census	0.274	0.262
2001 census	0.332	0.331
2006 census	0.394	0.406
Individuals	143,790	169,833

Notes: This table presents the means and standard deviations of the continuous variables of interest. Note for dummy variables the successes and observations used to calculate the means have both been randomly rounded to base 3 for confidentiality reasons.

Table 2: Locational Choice and Labour Market Outcomes for Maori

Dependent variable:	Employed		Ln(hourly income)		Total income ($000s)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Males						
OLS 1: coefficient on lives in rohe	-0.088***	-0.024***	-0.072***	-0.013*	-4.438***	-1.342***
	(0.016)	(0.004)	(0.019)	(0.007)	(0.793)	(0.208)
Observations	143,790	143,790	94,545	94,545	143,790	14,3790
OLS 2: coefficient on network strength (ln)	-0.027***	-0.005***	-0.023***	-0.006**	-1.431***	-0.502***
	(0.004)	(0.002)	(0.005)	(0.002)	(0.156)	(0.079)
IV: Second stage coefficient on network strength (ln)	-0.030***	-0.008***	-0.024***	-0.006**	-1.451***	-0.529***
	(0.005)	(0.002)	(0.006)	(0.003)	(0.226)	(0.088)
Observations	143,499	143,499	94,320	94,320	143,499	143,499
Panel B: Females						
OLS 1: coefficient on lives in rohe	-0.049***	-0.005	-0.057***	-0.009	-2.325***	-0.318**
	(0.010)	(0.005)	(0.014)	(0.006)	(0.409)	(0.140)
Observations	169,833	169,833	91,068	91,068	169,833	169,833
OLS 2: coefficient on network strength (ln)	-0.016***	0.002	-0.021***	-0.003	-0.858***	-0.168***
	(0.003)	(0.001)	(0.002)	(0.002)	(0.042)	(0.042)
IV: Second stage coefficient on network strength (ln)	-0.017***	0.002	-0.018***	-0.002	-0.821***	-0.141***
	(0.003)	(0.002)	(0.004)	(0.003)	(0.105)	(0.054)
Observations	169,488	169,488	90,852	90,852	169,488	169,488
Includes Labour Market Area Fixed Effects	No	Yes	No	Yes	No	Yes

Notes: Asterisks denote significance at: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the first iwi level. This table presents the main coefficients of interest and their standard errors estimated from OLS and IV regressions where the dependent variables are labour market outcomes as given in the column headings. The sample for hourly income includes employed individuals only. The IV specification instruments for network strength using a rohe dummy and (ln) distance from one's rohe. All regressions also include controls for an individual's age, qualifications, legal marital status and number of iwi affiliations, whether Māori is a person's only ethnicity, household composition, first iwi fixed effects and census year. The number of observations have been randomly rounded to base 3 for confidentiality reasons.

Table 3: Selection among Movers in Non-Networked Areas

Dependent variable:		Employed	Ln(hourly income)	Total income ($000s)
Regression and sample	Independent variable of interest			
Panel A: Males				
OLS 1: Movers who currently live outside rohe	Lived in rohe 5 years ago	-0.013	-0.062***	-1.937***
		(0.009)	(0.021)	(0.461)
Observations		18,690	12,081	18,690
OLS 2: Movers who currently live in weak network area	Network strength 5 years ago (ln)	-0.003	-0.021***	-0.537***
		(0.003)	(0.006)	(0.163)
IV: Movers who currently live in weak network area	Network strength 5 years ago (ln)	-0.004	-0.029***	-0.779***
		(0.004)	(0.007)	(0.187)
Observations		16,314	10,692	16,314
Panel B: Females				
OLS 1: Movers who currently live outside rohe	Lived in rohe 5 years ago	-0.030***	0.008	-1.335***
		(0.008)	(0.019)	(0.416)
Observations		22,944	11,220	22,944
OLS 2: Movers who currently live in weak network area	Network strength 5 years ago (ln)	-0.002	-0.010	-0.180
		(0.003)	(0.007)	(0.119)
IV: Movers who currently live in weak network area	Network strength 5 years ago (ln)	-0.005*	-0.010	-0.403***
		(0.003)	(0.008)	(0.135)
Observations		19,923	9,876	19,923

Notes: Asterisks denote significance at: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the first iwi level. This table presents the main coefficients of interest and their standard errors estimated from OLS and IV regressions where the dependent variables are labour market outcomes as given in the column headings. The IV instruments for current network strength and network strength 5 years ago using the current and 5-years-ago rohe dummies and current and 5-years-ago (ln) distance from one's rohe. A strong network area is where an iwi is >2% of the total population of the labour market. All regressions also include controls for an individual's age, qualifications, legal marital status and number of iwi affiliations, whether Māori is a person's only ethnicity, household composition, first iwi fixed effects, census year and current and previous LMA fixed effects. The OLS 2 and IV specifications also control for network strength in current LMA. Number of observations have been randomly rounded to base 3 for confidentiality reasons.

Table 4: Selection on Observables for Different Types of Movers

Dependent variable: Moved between LMAs in last 5 years	**Males**		**Females**	
Predicted income ($00,000s) * rohe 5 yrs ago	0.057**		-0.035	
	(0.026)		(0.043)	
Predicted income ($00,000s) * strength of network 5 yrs ago		0.026***		0.003
		(0.005)		(0.009)
Lived in rohe 5 years ago	-0.092***		-0.058***	
	(0.010)		(0.011)	
Strength of network 5 years ago		-0.043***		-0.033***
		(0.002)		(0.003)
Other controls and fixed effects	Yes	Yes	Yes	Yes
R-Squared	0.052	0.056	0.047	0.050
Observations	120,978	118,512	146,574	143,445

Notes: Asterisks denote significance at: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the first iwi level. Either individuals who have moved to their rohe or have moved to a strong network labour market are dropped from the regression depending on the specification. A strong network area is where an iwi is >2% of the total population of the labour market. Income is predicted using the full sample of Maori and controlling for all variables used in previous regressions, see the text for more details. All regressions also include controls for an individual's legal marital status and number of iwi affiliations, whether Māori is a person's only ethnicity, household composition, first iwi fixed effects, census year and previous LMA fixed effects. Observations have been randomly rounded to base 3 for confidentiality reasons.

Table 5: Impact of Locational Choice on Labour Market Outcomes Controling for Endogenous Selection

Dependent variable:	Employed	Ln(hourly income)	Total income ($000s)
Panel A: Males			
OLS 1: Effect of living in rohe	-0.011	0.049*	0.595
	(0.012)	(0.026)	(0.564)
OLS 2: Effect of network strength (ln)	-0.002	0.015**	0.035
	(0.004)	(0.007)	(0.201)
IV: Effect of network strength (ln)	-0.004	0.023***	0.250
	(0.005)	(0.008)	(0.241)
Panel B: Females			
OLS 1: Effect of living in rohe	0.025**	-0.017	1.018**
	(0.010)	(0.027)	(0.453)
OLS 2: Effect of network strength (ln)	0.004	0.007	0.012
	(0.003)	(0.009)	(0.124)
IV: Effect of network strength (ln)	0.007**	0.007	0.262*
	(0.003)	(0.011)	(0.155)

Notes: Asterisks denote significance at: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are bootstrapped and clustered at the first iwi level. This table presents the difference between the coefficients in Table 2 and those in Table 3 which can be interpreted as the treatment effect of living in one's rohe or a strong network area.

Appendix Table 1: First Stage for IV Model of Impact of Networks

Dependent variable:	Men		Women	
	(1)	(2)	(3)	(4)
Lives in rohe of first iwi affiliation	-0.535***	-0.551***	-0.525***	-0.550***
	(0.160)	(0.164)	(0.160)	(0.168)
Distance from rohe of first iwi affiliation (ln)	-0.654***	-0.591***	-0.642***	-0.587***
	(0.042)	(0.043)	(0.042)	(0.044)
Age 40-49	0.013**	-0.009**	-0.002	-0.004
	(0.006)	(0.004)	(0.004)	(0.003)
Age 50-59	0.043***	-0.012**	0.022***	-0.006
	(0.008)	(0.006)	(0.007)	(0.004)
School qualifications (4-category)	-0.097***	-0.032***	-0.051***	-0.014***
	(0.010)	(0.005)	(0.009)	(0.004)
Post-school qualifications (4-category)	-0.097***	-0.032***	-0.060***	-0.027***
	(0.007)	(0.006)	(0.011)	(0.007)
Degree (4-category)	-0.219***	-0.076***	-0.168***	-0.053***
	(0.027)	(0.013)	(0.017)	(0.012)
Specify Maori ethnicity only	0.146***	0.056***	0.174***	0.065***
	(0.014)	(0.012)	(0.020)	(0.015)
Whether legally married	-0.034**	-0.026***	-0.009	-0.027***
	(0.013)	(0.008)	(0.013)	(0.008)
Defacto	-0.019**	-0.030***	0.024**	-0.013*
	(0.009)	(0.010)	(0.012)	(0.008)
Divorced or separated	-0.043***	-0.011*	-0.056***	-0.022***
	(0.007)	(0.006)	(0.009)	(0.007)
Widowed	0.032	0.006	0.021	-0.009
	(0.020)	(0.015)	(0.020)	(0.010)
Couple with dependent children	0.059***	0.013***	0.057***	0.021***
	(0.010)	(0.003)	(0.009)	(0.006)
Single parent with dependent children	0.106***	0.012	0.078***	0.022**
	(0.022)	(0.008)	(0.014)	(0.009)
Single without dependent children or missing family t	-0.001	-0.020***	0.019**	0.001
	(0.012)	(0.006)	(0.008)	(0.006)
R-Squared	0.829	0.911	0.824	0.907
F-Test of Joint Significance of Excluded Instruments	126	220	123	208
Observations	143,499	143,499	169,488	169,488
Includes Labour Market Area Fixed Effects	No	Yes	No	Yes

Notes: Asterisks denote significance at: * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at the first iwi level. This table presents the first stage regressions from the IV models im Table 2. All regressions also include controls for whether qualificatiosn, maritial status or household composition is missing, for the number of iwi affiliations, first iwi fixed effects and census year. The number of observations have been randomly rounded to base 3 for confidentiality reasons. The first stage is similar for the subsample of individuals who are used for the wage regressions.