Moving to Opportunity, Leaving Behind What? Evaluating the Initial Effects of a Migration Policy on Incomes and Poverty in Source Areas[*]

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Emigration to New Zealand and consequent remittance inflows are dominant features of many Pacific Island countries. Evaluating the effect of these people and money flows on incomes and poverty in the Pacific is potentially complicated by the non-random selection of emigrants. This paper uses the randomization provided by an immigration ballot under the Pacific Access Category (PAC) of New Zealand's immigration policy to address this problem. We survey applicants to the 2002-05 PAC ballots in Tonga and compare outcomes for the remaining family of emigrants with those for similar families who were unsuccessful in the ballots. We then contrast these estimates with more conventional ones that construct no-emigration counterfactuals by deducting remittance income from the remaining family of PAC emigrants and adding back the potential home earnings of emigrants. The results suggest that the economic welfare of remaining family may fall in the initial period after members of their household move to New Zealand. We also find that non-experimental

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methods of constructing counterfactual income are likely to work well only in rare situations where there is random selection of emigrants.

1. Introduction

Emigration to New Zealand and consequent remittance inflows are dominant features of many Pacific Island countries. The Pacific is arguably the only part of the world where New Zealand looms large, in the sense that choices made by New Zealand policy makers have an impact on other countries. Reflecting this, New Zealand's immigration policies are ostensibly designed to benefit both New Zealand and the Pacific Island countries. According to Stahl and Appleyard (2007, p. iv-v):

> "From the beginning, New Zealand's concessional policies have been designed to assist the participating Pacific Island countries in their economic development. In this regard, New Zealand's immigration policy towards the Pacific Island countries is unique. We cannot think of another developed country that admits migrants as part of its perceived duty to assist their economic development"

Migration from the Pacific Islands to New Zealand is likely to have many effects. Migrant-sending households can benefit from remittance inflows, which make up 40 percent of GDP in the case of Tonga, and knowledge transfers that occur when up-skilled migrants return home to visit or to permanently stay. However, they also lose the income migrants would have generated locally had they not emigrated. Migration may also induce economy-wide effects on the labour market, the real exchange rate, and possibly the incentives for acquiring education, making it hard to evaluate the overall impact of emigration. Therefore, in this paper, we study a single, recently introduced migration channel which is sufficiently small that there are unlikely to yet be economy-wide spillover effects. Consequently, the overall effect of the policy is just the observed impact on migrant-sending households as estimated with sample survey data. However, since this migration channel has only recently opened, we are only able to measure short-term effects which may change over time.

The particular policy we focus on is the Pacific Access Category (PAC), which was established in 2001 and allows an annual quota of 250

Tongans to immigrate as permanent residents to New Zealand without going through the usual channels used for groups such as skilled migrants and business investors.[1] Many more applications are received than the quota allows, so a ballot is used by the New Zealand Department of Labour (DoL) to randomly select from amongst the registrations. The probability of success in the ballot is approximately ten percent. The PAC is too small to make any meaningful contribution to New Zealand's labour needs, unlike the recently introduced Recognised Seasonal Employer scheme where up to 5000 workers will be recruited from the Pacific. However, the impact on sending countries was an important design factor. According to Phil Goff, the Minister of Foreign Affairs at the time of the PAC's introduction in 2001:

> "New Zealand has a special relationship with our Pacific neighbours and although limited, the scheme will assist these small nations".[2]

In this paper, we evaluate the impact of individuals migrating to New Zealand via the PAC on family members remaining in Tonga. The PAC allows the principal applicant, their spouse, and their dependent children to migrate, but other household members, such as parents and siblings of the principal applicant and spouse are not eligible. We examine the impact on total household income and income from different sources, and on poverty. These impacts are measured less than one year after eligible household members have migrated to New Zealand for most households, so represent the short-run effects of migration on the household members that remained in Tonga. In related work, we have shown that within this same period, the immigrants themselves experienced very large increases in incomes (McKenzie, Gibson and Stillman 2006) and improvements in mental health (Stillman, McKenzie and Gibson, 2007). Thus, we are now examining whether the PAC also benefits household members that remain in Tonga.

A large international literature studies the effect of emigration and remittances on poverty and inequality in source communities. Recent

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[1] The Pacific Access Category also provides annual quotas for 75 citizens from Kiribati, 75 citizens from Tuvalu, and, until recently suspended after the coup, 250 citizens from Fiji. The person who registers is a Principal Applicant. If they are successful, their immediate family (spouse and dependent children up to age 24) can also apply to migrate as Secondary Applicants. The quota of 250 applies to the total of Primary and Secondary Applicants, and corresponds to about 80 migrant households.

[2] http://www.beehive.govt.nz/ViewDocument.aspx?DocumentID=12740

studies construct no-emigration counterfactuals by deducting incoming remittance income from the remaining family of emigrants and adding back the potential earnings of the emigrants in the source country (Barham and Boucher, 1998). We carry out the same procedure using a sample of applicants to the 2002-05 PAC ballots in Tonga. Since the PAC ballot randomly allows some applicants to move to New Zealand, while similar, unsuccessful, applicants remain in Tonga, we can also construct an experimental measure of the no-emigration counterfactual, by comparing outcomes for the remaining family of emigrants with those for similar families that contain members who were unsuccessful in the ballots.

Our results suggest that family members remaining in Tonga may initially be made worse off after some of their household members migrate to New Zealand. Although remittance receipts rise, there is a larger offsetting loss from the foregone earnings of emigrants and the foregone informal sector sales and own food production. This decline in income occurs whether we examine total household income, per capita income, or adult-equivalent income and is associated with higher poverty rates (although the change is statistically insignificant for some poverty lines and poverty measures). The standard non-experimental method of constructing no-migration counterfactuals gives similar results when applied to an appropriate comparison group (the ballot losers) but quite different results when applied to a sample of non-applicants. This suggests that non-experimental methods of constructing no-migration counterfactuals may work well only in rare situations where there is random selection of emigrants.

The rest of this paper is structured as follows. Section 2 reviews the relevant literature on the impact of emigration and remittances on poverty and inequality. Section 3 describes the data from the Pacific Island-New Zealand Migration Study (PINZMS) and our estimation methods. Experimental results are reported in Section 4. Section 5 compares these estimates with alternative methods of constructing counterfactual no-emigration estimates and Section 6 concludes.

2. Previous Literature

The effect of emigration on income levels, inequality and poverty in source communities is *a priori* unclear. The net effect depends on where emigrants are drawn from in the initial income distribution, whether new remittances are large enough to offset possible reductions in local earnings and own-production, and also on how other households who do not send emigrants

respond to changed factor endowments as labour leaves the home area. Perhaps because of these complex effects, a major review by a key development agency – the U.K.'s Department for International Development (DFID) – finds both positive and negative effects of emigration and remittances (DFID, 2007). However, this review concludes that on balance emigration does not lead to higher inequality.

Uncertainty about the net effects of emigration and remittances may also reflect the maturation of the empirical literature, since early studies did not cover all likely pathways for impacts and ignored some possible sources of bias. For example, Stark, Taylor and Yitzhaki (1986) treat remittance income in two villages in Michoacán, Mexico as an exogenous transfer and compare Gini coefficients with and without these remittances, finding that remittances reduce inequality. Following a similar approach, Milanovic (1987) finds that remittances increase inequality among agricultural households in Yugoslavia.

One drawback of focusing only on remittances is that this ignores that emigrant workers would otherwise be working and earning income at home. Adams (1989) controls for this effect for a sample of three villages in Egypt and finds that emigration worsens inequality. Similarly, Barham and Boucher (1998) use data from three neighbourhoods in Bluefields, Nicaragua to estimate a double-selection model which allows the counterfactual of no migration and no remittances to affect the participation decisions and earning outcomes of other household members. When remittances are treated as exogenous they find that remittances reduce income inequality, whereas when they are treated as a substitute for home earnings they are found to increase the Gini coefficient by between 12 and 15 percent.[3]

Other recent studies that attempt to control for selectivity problems tend to find that emigration and remittances reduce poverty. For example, Adams (2006) uses a two-stage Heckman procedure to impute counterfactual incomes for Guatemalan emigrants had they stayed and worked at home and finds that international remittances reduce a distributionally sensitive poverty measure (the squared poverty gap) by 21 percent. Esquivel and Huerta-Pineda (2006) use propensity score matching

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[3] Recently McKenzie and Rapoport (2007) pursued an alternative strategy for measuring the effect of migration on inequality, using instrumental variables to exploit differences in migration rates across, rather than within, communities. They suggest that the impact of migration on inequality follows an inverse-U shape: increasing inequality at first when migration networks are low, and then reducing inequality over time as more households become involved in migration.

methods to compare Mexican households receiving remittances with those that do not, and find that the receipt of international remittances reduces food-based poverty by about 36 percent. Yang (2006) uses shocks to the Philippines exchange rate during the 1997 Asian crisis as a form of natural experiment (since the shocks are exogenous to decisions that households make) and finds that a 10 percent improvement in the exchange rate, corresponding to higher remittance receipts in domestic currency, reduces the poverty rate by about 0.6 percent.

One of the more ambitious recent studies uses a two-step Heckman approach to control for emigrant selectivity in 11 Latin American countries (Acosta, Fajnzylber and Lopez, 2007). After adjusting for self-selection these authors find a lower but still positive effect of remittances on reducing poverty, compared with a situation where exogenous migration is assumed. However, the exclusion restrictions used in this paper to identify the selection model include a household asset index and the percentage of remittance recipients in the county or province where the sending household lives, which arguably affect incomes and poverty rather than just emigration decisions.

Most relevant for our work, Brown and Leeves (2007) use a two-step approach to predict the number of emigrants and calculate the effect of remittances on household incomes in Fiji and Tonga. The maximum length of time overseas of any return migrant in their sample (which they argue is a proxy for community-level network effects) is used as the exclusion restriction. There are two potential problems with this approach. First, it is unclear how the experience of return migrants can identify current network effects. Second, emigrant's decisions to return are likely affected by and also may affect incomes in the source area. Thus, while this paper finds that emigration and remittances reduced poverty in Fiji and Tonga, there may be doubts about the robustness of this non-experimental approach to constructing no-migration counterfactuals.

In section 5, we carefully compare our experimental results to the results calculated using similar non-experimental approaches as used in the above papers. We also consider a number of alternative assumptions about generating the counterfactual outcomes. The results from this comparison may help to inform this literature on whether and how best to apply non-experimental methods when (quasi-)experimental data are unavailable.

3. Data and Methods

The data used here are from the Tongan component of the first wave of the Pacific Islands-New Zealand Migration Survey (PINZMS), which measures multiple aspects of the migration process.[4] The components of household income included are earnings, formal and informal business revenue, consumption of own-production, and remittances from both incoming and outgoing transfers of cash and goods in kind. The unique feature of the PINZMS survey is that it has a mechanism that allows selection biases to be overcome. Since any Tongan citizen aged between 18 and 45, who meets certain English, health and character requirements can register under the PAC to immigrate to New Zealand,[5] many more applications are received than the quota allows. A random ballot is therefore used by the New Zealand Department of Labour (DoL) to select from amongst the registrations, with just ten percent odds of success. Once their ballot is selected, applicants must obtain a valid job offer in New Zealand within six months in order to have their application to migrate approved.

In a perfect randomised experiment, the impact of the treatment (here, having some household members emigrate) can be obtained via a simple comparison of means in the control group (unsuccessful ballots) to the treatment group (households containing a PAC emigrant). There are two complications for this study. First, some emigrants move their entire household to New Zealand so a method is needed to identify (and remove from the sample) those control group households who would also move their entire household, if they were in the treatment group. Second, this simple mean comparison may be biased if control group members substitute for the treatment with a similar program or if members of the treatment group drop out (Heckman, et al, 2000). For example, *substitution* bias will occur if PAC applicants who are not drawn in the ballot migrate through alternative means and *dropout* bias will occur if PAC applicants whose name are drawn in the ballot fail to migrate to New Zealand. Previous research on the PAC ballots in Tonga suggests that substitution bias is not of serious concern; the low odds of winning the PAC ballot and the limits on eligibility for other migration channels available to Tongans suggests that those with the ability to migrate via other arrangements would likely

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[4] Further details about this survey and related papers produced from these data can be found at www.pacificmigration.ac.nz.

[5] Data supplied by the DoL for residence decisions between November 2002 and October 2004 show only 1 person was rejected for failing the English requirement, and 3 others for failing other requirements of the policy.

have done so previously (McKenzie et al, 2006). However, dropout bias is a more relevant concern because approximately 15 percent of ballot winners do not ultimately move to New Zealand.

To adjust experimental estimates for possible dropout bias we use three subsets of the PINZMS sample: (i) 61 households in Tonga who have some previous members that are now PAC migrants in New Zealand; these are the "treatment" group, (ii) 26 households containing successful participants from the same PAC ballots who were still in Tonga; these are the "non-complier" group, who have not moved either because their application for New Zealand residence was not approved (typically because of lack of a suitable job offer) or was still being processed, and (iii) 120 households containing unsuccessful participants from the same ballots who were still in Tonga; these are the "control" group and were typically selected from the same villages that the sampled PAC migrants had lived in prior to moving. The two samples of successful ballots have a much higher sampling rate than the sample of unsuccessful ballots (expansion factors of approximately 3.4, 2.5 and 39.1 are needed to weight each sample up to the relevant population) and all of the analyses take this into account.[6] A further sample of non-applicants to the PAC ballot (n=90 households) drawn from the same villages as the applicants are used to construct no-migration counterfactuals that are similar to those that would be typically available to researchers who did not have access to random ballot data.

At the time of our survey, the sampled Tongan households with PAC emigrants in New Zealand had a mean (median) time abroad for their former household members of 10 months (8 months). Just over three-quarters (77 percent) of migrant-sending households were interviewed less than one year after eligible household members had emigrated to New Zealand. Thus, our analysis is examining the initial impact of sending emigrants.

We use the age and relationship rules governing which Secondary Applicants can move with the Principal Applicant to identify control group households where all members would have moved to New Zealand if they had a successful ballot. These household are dropped since comparing them with the remaining family of PAC emigrants, who are almost all outside the age and relationship eligibility for moving to New Zealand, involves comparisons across different types of household and individuals and so is unlikely to be valid. The results from this procedure suggest that about

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[6] Since poverty and inequality comparisons are made across individuals, rather than households, we follow standard practice in multiplying these expansion factors by household size to construct weights for our analysis.

60 percent of unsuccessful ballots would move their entire household to New Zealand.

The remaining household members of PAC emigrants typically contain working age adults who are either the parent and/or the siblings of the Principal Applicant, along with children who are often their nephews and nieces. Specifically, 46 percent of migrant households contain a parent of the Principal Applicant, and 52 percent have a sibling. Just over one-half (57 percent) of other relatives are under 18, and are mostly nephews and nieces of the Principal Applicant. Very few of these extended family members appear to have joined the household since the emigrants left,[7] and so as original household members their welfare is likely to have been impacted by the departure of the PAC emigrants. The remainder of the paper examines the impact of the Principal Applicant and their nuclear family emigrating on the income levels and poverty status of the remaining household members.

3.1. Verifying Randomization

We first test whether the PAC ballot correctly randomises "stayer" households into a treatment and a control group by examining whether the stayer group within the households containing ballot losers are statistically different than the stayer group in households containing ballot winners (both the migrant families and the non-compliers). As discussed above, these stayer groups are created after using the age and relationship rules to predict which Secondary Applicants would have accompanied the Principal Applicant if they had a successful ballot and moved to New Zealand. The results in Table 1 show that most ex-ante pre-migration characteristics are the same for ballot winners and losers (at 95 percent confidence level). The only exceptions are that stayer adults in successful ballot households have slightly higher education levels and that there are more children amongst the stayer group in successful ballot households. We present regression results with and without controls for the characteristics of these stayer members to examine the robustness of our findings to small sample differences in the treatment and control group.

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[7] We ask about how many of the previous 12 months each person was attached to the household. The number of recent members who had been attached for less than 12 months was slightly lower (0.48 versus 0.63) for migrant families than for those with unsuccessful ballots.

Table 1: Tests of Randomization

Stayer Household Characteristics	Successful Ballot	Unsuccessful Ballot	T-test p-value
Size of the Stayer Household	4.0	3.3	0.149
Number of Adults 18 to 45 among stayers	1.4	1.5	0.792
Number of Children <18 among stayers	1.5	0.8	0.016
Number of Adults 46 and over	1.1	1.0	0.726
Proportion of Adults who are Female	0.5	0.5	0.887
Mean education level of adults	10.2	9.0	0.022
Highest education level of adults	11.4	10.6	0.080
Mean height of male adults	172.3	170.7	0.572
Mean height of female adults	164.4	164.0	0.910
Annual Labor Earnings of Stayers in 2004	3,838	5,337	0.320

Note: median annual labor earnings of stayers in 2004 is zero for both groups.

3.2. Measuring Poverty

We use poverty standards that are based on existing poverty lines set for Tonga from the 2001 Household Income and Expenditure Survey (HIES). The higher "basic needs" poverty line had a value of 1,466 Pa'anga per person per year in 2001, and 22.7 percent of the population had consumption expenditures below this level. Other research has suggested that this threshold corresponds to 'hardship' rather than poverty, since there is reasonable access to land and food in Tonga (ADB, 2004). But in a society like Tonga, an inability to participate in community and church life due to lack of economic resources could also be considered as being in poverty. The food poverty line, which is the required expenditure just for a minimum diet, is less debateable and was calculated as 703 Pa'anga per person per year in 2001 (with 5.2 percent of the population below this line). These poverty lines did not vary between the main island of Tongatapu and the outer islands, so we use the CPI gathered in Tongatapu to update them to June 2005 values of 2,040 and 980 Pa'anga. In New Zealand dollar terms, these poverty lines are $1,520 and $730 per person per year.[8]

Besides considering two different poverty lines, we also construct two different income measures. Both have in common the following

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[8] This is calculated at market exchange rates, but our comparison of prices in Nuku'alofa and Auckland for a bundle of goods from the Tongan CPI suggests that the market rate is very close to purchasing power parity (McKenzie, Gibson and Stillman, 2006).

components: household earnings (annualised from individual reports for the previous week); net returns from sales of fish, crops, livestock, tapa cloth and mats (annualised from household reports on an average month); income from investments, pensions, rentals, etc. (annualised from household reports for the previous fortnight); and the imputed value of own-produced or own-captured food consumed by the household (annualised from household reports for the previous week). But, they differ in their treatment of remittances. Approximately one-third of remittance transactions are at least partially earmarked for the major church fund raising activity, the *Misinale*. The *broad income* measure counts these as part of household income, since these remittances enable households to participate in the life of the community. The *narrow income* measure excludes remittance transactions made for *Misinale*, since the household could be seen as simply a conduit, with the receipt of these remittances having no effect on their ability to purchase more narrowly defined goods and services.

4. Experimental Estimates of the Impacts on Income and Poverty

In this section, we present experimental estimates of the impact on income and poverty of having family members move to New Zealand under the PAC. We do not directly compare means of the treatment and control groups due to concerns about dropout bias from non-compliers. Instead, instrumental variables regression models are used to estimate local average treatment effects (IV-LATE), where ballot success is used as an instrument for having family members emigrate. Angrist (2004) demonstrates that in situations where no individuals assigned to the control group receive the treatment (i.e., there is no substitution) the IV-LATE is the same as the average treatment effect on the treated.

We begin by examining the impact of emigration on household size and composition, since one immediate effect is that there are "fewer mouths to feed". Thus, if total household resources remain the same, migration can lower poverty by allowing the same resources to be divided amongst fewer people. We then examine the impact on total household resources, and per person income and poverty rates.

4.1. How Does PAC Migration Change Household Size and Composition?
The impact of having some household members migrate to New Zealand on household size and composition is illustrated in Table 2. Emigration leads to a significant reduction in household size. The mean individual in the comparison group lives in a household of size 8.1 people, and emigration is

estimated to reduce this by 3.5 people. Emigration leads to households having, on average, 1.6 fewer prime-age adults and 2.0 fewer children. There is no change in the number of older adults (>45 years), which is unsurprising since they are not eligible to move as Secondary Applicants.

Table 2: Impact of Migration on Household Composition

	Total Household Size	Adults Aged 18 to 45	Children Aged under 18	Adults Aged over 45
Panel A: Without Controls				
Migration	-2.178**	-1.674***	-0.766	0.168
	(0.832)	(0.413)	(0.601)	(0.246)
Panel B: With Controls				
Migration	-3.534***	-1.634***	-1.993***	-0.000
	(0.574)	(0.198)	(0.476)	(0.000)
Sample Size	118	118	118	118
Mean for Unsuccessful Stayer Households	8.14	3.64	3.45	1.05

Note: Estimates are 2SLS estimates where migration is instrumented with the PAC ballot outcome. Controls are labor earnings of stayers in 2004, the proportion of adult stayers who are female, highest education level of stayer adults, and the number of stayers who are children, adults 18 to 45, and adults 46 and over.

*, **, and *** indicate significance at the 10%, 5% and 1% levels.

4.2. The Impact on Total Household Resources

The impact of having some household members migrate to New Zealand on the level and composition of household income is illustrated in Table 3. The families of migrants have lower total household income, lower earnings, lower agricultural and business incomes and lower imputed income from the consumption of food that they have produced, harvested or captured. These households receive more remittances, but this does not compensate for the reductions in other sources of income. Overall, having some household members migrate to New Zealand causes total household income

Table 3: Impact of Migration on Total and Components of Household Income of Household Members Remaining

	Total Income Broad Definition	Log Total Income	Total Income Narrow Definition	Household Labor Earnings	Agricultural Income	Subsistence Income	Net Remittances
Panel A: Without Controls							
Migration	-18,560***	-0.697***	-18,081***	-11,932***	-1,903**	-6,386***	1,661**
	(4,187)	(0.139)	(4,134)	(3,433)	(953)	(1,981)	(695)
Panel B: With Controls							
Migration	-18,215***	-0.753***	-16,902***	-9,737***	-953*	-8,335***	809
	(3,302)	(0.123)	(3,186)	(3,370)	(566)	(2,413)	(681)
Sample Size	118	118	118	118	118	118	118
Mean for Unsuccessful Stayer Households	34,607	10.24	33,657	19,008	1,989	12,792	818

Note: Estimates are 2SLS estimates where migration is instrumented with the PAC ballot outcome. Controls are labor earnings of stayers in 2004, the proportion of adult stayers who are female, highest education level of stayer adults, and the number of stayers who are children, adults 18 to 45, and adults 46 and over.

*, **, and *** indicate significance at the 10%, 5% and 1% levels.

to decline by approximately 50 percent, even after controlling for pre-migration labour incomes and other household characteristics.

4.3. The Impact on Per Person Resources

Households in Tonga who have had some members move to New Zealand under the PAC have fewer members (Table 2) and lower total income (Table 3) than households in the control group. We now examine how these two effects translate into changes in per capita incomes. The estimated treatment effects for total per capita income, under both the broad and narrow definitions of income, are reported in Table 4. We also show results for the log of broad income, which is less sensitive to outliers. When no control variables are used, we estimate that emigration reduces the per capita annual income of the remaining family by approximately 1,200 Pa'anga. This is a sizeable reduction, equivalent to 26 percent of the mean income per capita for the control group. This gap becomes even larger if we convert total incomes to per person measures using either an adult equivalence scale[9] or on a per adult basis. Households in Tonga who have had some members move to New Zealand under the PAC have fewer children, so equivalence scales which are based on children needing less food and other resources than adults will raise per-person resources more for the control group than for the migrant group.

The results for log income indicate the emigration leads to declines in per capita income of over 30 percent among household members who remain in Tonga. Once control variables are added, the treatment effects become somewhat smaller. Nevertheless, the log specification still indicates that emigration leads to a 22 percent decline in per capita broad income, significant at the 10 percent level, and a 27 percent decline in per adult broad income, significant at the 5 percent level.[10]

4.4. The Impact on Inequality

To assess the impact of emigration and subsequent remittance receipts on income inequality it is necessary to measure inequality in a counterfactual, no-migration, setting. One way to do this is to consider the income inequality amongst those households with unsuccessful ballots as the counterfactual. For this group, the Gini coefficient on the narrow definition of per capita income is 0.357, with a bootstrapped standard error of 0.032.

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[9] Nutrition-based equivalence scales are not available for Tonga. We therefore follow Deaton and Paxson (1994) and define the number of adult equivalents as the number of adults 18 and over, plus 0.5 times the number of children 17 and under.

[10] These are calculated as $100 \times [\exp(-0.245) - 1]$ and $100 \times [\exp(-0.316) - 1]$.

Table 4: Impact of Migration on Income per Member of Remaining Household Members

	Broad Income			Log Broad Income			Narrow Income		
	Per Capita	Per Adult Equivalent	Per Adult	Per Capita	Per Adult Equivalent	Per Adult	Per Capita	Per Adult Equivalent	Per Adult
Panel A: Without Controls									
Migration	-1,217*	-1,564**	-2,345**	-0.352**	-0.327**	-0.297*	-1,250**	-1,584**	-2,310**
	(614)	(744)	(1,147)	(0.163)	(0.157)	(0.166)	(598)	(725)	(1,106)
Panel B: With Controls									
Migration	-603	-949	-2,123**	-0.245*	-0.260*	-0.316**	-584	-875	-1,818**
	(524)	(608)	(929)	(0.141)	(0.134)	(0.133)	(509)	(592)	(852)
Sample Size	118	118	118	118	118	118	118	118	118
Mean for Unsuccessful Stayer Households	4,706	5,845	8,427	8.23	8.45	8.79	4,590	5,693	8,167

Note: Estimates are 2SLS estimates where migration is instrumented with the PAC ballot outcome. Adult equivalents give weight 0.5 to children 17 and under. Controls are labor earnings of stayers in 2004, the proportion of adult stayers who are female, highest education level of stayer adults, and the number of stayers who are children, adults 18 to 45, and adults 46 and over.

*, **, and *** indicate significance at the 10%, 5% and 1% levels.

The PAC leads to there being three groups of households: 1) the remaining family of emigrants; 2) households of ballot winners who stay in Tonga; and 3) households of unsuccessful ballots. Inequality amongst this combined group, when compared with the counterfactual inequality, can be considered as the treatment effect. The Gini coefficient for the combined group is 0.363 (standard error of 0.032), which is higher but not by a statistically significant amount, than the counterfactual inequality.

One reason that the overall effect on inequality is relatively small, even though the impact on household resources is large amongst emigrant PAC households, is that these households only constitute about six percent of the overall population of ballot entrants, reflecting that the chances of winning the ballot in any given year are less than one in ten. As a result, negative impacts are only found for a relatively small number of PAC applicant households, reducing the extent to which this can affect overall inequality in this population.

4.5 The Impact on Poverty

Table 5 reports on the treatment effects for poverty, using the broad and narrow income definitions, the basic needs and food poverty lines, and two poverty measures. We examine the impact of emigration on poverty amongst migrant-sending households. As discussed above, since PAC ballot winners are a small fraction of overall ballot entrants, and constitute an even smaller share of all Tongan households, the impacts on poverty among either of these larger groups is very small.[11]

The two poverty measures we examine are the headcount index, which is the proportion of the population below the poverty line, and the poverty gap index, which measures the proportionate shortfall from the poverty line, averaged over the whole population. There is no evidence to suggest that having some household members emigrate via the PAC leads to a lower poverty rate amongst the remaining family members in Tonga. In fact, the headcount poverty rates in emigrant households are between 15 and 23 percentage points higher (compared with a rate of 22 percent in the control group) when using the basic needs poverty line, with or without control variables and with either income definition. However, only the impacts measured using the narrow income definition are statistically significant. The impacts measured using the food poverty line and the poverty gap

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[11] For example, the headcount poverty rate for narrow income using a basic needs line is 22.4 percent for the group of ballot losers (the counterfactual), and 23.8 percent for the overall group of ballot entrants. The resulting increase in poverty is not statistically significant.

Table 5: Impact of Migration on Headcount and Poverty Gap Index

Income Measure	Headcount: Basic Needs Line		Headcount: Food Poverty Line		Poverty Gap: Basic Needs Line		Poverty Gap: Food Poverty Line	
	Broad	Narrow	Broad	Narrow	Broad	Narrow	Broad	Narrow
Panel A: Without Controls								
Migration	0.150	0.202*	0.051	0.054	0.049	0.055	0.011	0.012
	(0.108)	(0.108)	(0.065)	(0.065)	(0.047)	(0.048)	(0.011)	(0.011)
Panel B: With Controls								
Migration	0.172	0.227**	0.049	0.053	0.046	0.052	0.011	0.012
	(0.106)	(0.106)	(0.047)	(0.047)	(0.043)	(0.044)	(0.011)	(0.011)
Sample Size	118	118	118	118	118	118	118	118
Mean for Unsuccessful Stayer Households	0.224	0.224	0.028	0.028	0.077	0.080	0.0007	0.0007

Note: Estimates are 2SLS estimates where migration is instrumented with the PAC ballot outcome. Controls are labor earnings of stayers in 2004, the proportion of adult stayers who are female, highest education level of stayer adults, and the number of stayers who are children, adults 18 to 45, and adults 46 and over.

*, **, and *** indicate significance at the 10%, 5% and 1% levels.

index are also positive, but statistically insignificant. In all cases, the point estimates indicate that emigration lead to large increases in poverty for the remaining family members in PAC households relative to the means for the control group, which is consistent with the large fall in per capita income previously estimated.

5. Comparisons with Alternative Methods of Measuring Poverty Impacts

The natural experiment provided by the use of a random ballot to allow Tongans to apply to immigrate to New Zealand under the PAC provides a rare opportunity to estimate the effect of emigration and remittances on poverty and inequality in source communities. Other studies typically use non-experimental methods to deal with the problems posed by the non-random selection of emigrants (Barham and Boucher, 1998). These studies usually construct no-emigration counterfactuals by deducting incoming remittance income and adding back the potential home earnings of the emigrants. In this section, we examine whether this approach gives similar results to those obtained using the experiment. We also report some sensitivity analyses of the experimental estimators of the treatment effects on poverty, to examine how modelling choices affect our results.

5.1. Sensitivity of the Experimental Estimates to Different Modelling Choices

Table 6 reports the experimental impact of emigration on basic needs poverty rates, using four different modelling choices; ignoring goods remittances, using only gross remittances, ignoring the non-compliers, and using all households with unsuccessful ballots as the control group rather than just those whose age and relationship structure would have meant that they had some stayers. The general pattern of results for these four sensitivity analyses is that the impact on poverty among the remaining family is larger and more statistically significant than previously reported (the relevant comparison is with columns 1 and 2 of Table 5). The modelling choices that make the biggest difference are using only cash remittances and including all households with unsuccessful ballots in the control group. Using either of these modelling approaches causes the estimated impact on poverty rates to rise to 0.19-0.23 for the broad income definition and 0.24-0.29 for the narrow definition. Moreover, all of these treatment effects are statistically significant even when control variables are included in the models.

Table 6: Impact of Different Modelling Choices on Poverty Headcount Effect

Income Measure	Only cash remittances		Only gross remittances		Ignoring Non-compliers		Including whole households which move	
	Broad	Narrow	Broad	Narrow	Broad	Narrow	Broad	Narrow
Panel A: Without Controls								
Migration	0.222**	0.285***	0.173	0.225**	0.168	0.220**	0.187*	0.240**
	(0.106)	(0.105)	(0.106)	(0.106)	(0.104)	(0.103)	(0.099)	(0.099)
Panel B: With Controls								
Migration	0.211**	0.276***	0.161	0.216**	0.193*	0.249**	0.230**	0.286***
	(0.105)	(0.105)	(0.105)	(0.105)	(0.103)	(0.103)	(0.110)	(0.110)
Sample Size	118	118	118	118	110	110	211	211

Note: Estimates are 2SLS estimates where migration is instrumented with the PAC ballot outcome. The Basic Needs Line is used for constructing Headcount Poverty. Controls are labor earnings of stayers in 2004, the proportion of adult stayers who are female, highest education level of stayer adults, and the number of stayers who are children, adults 18 to 45, and adults 46 and over.

*, **, and *** indicate significance at the 10%, 5% and 1% levels.

These results may have implications for studies in other settings, since some surveys only capture cash remittances, and many only capture gross receipts of remittances rather than the net effect of incoming and outgoing transactions. Our results indicate that not capturing either goods flows or reverse remittances may lead to overstated poverty impacts. Similarly, it is not always possible to establish which households in a no-migration counterfactual are the relevant comparison group for the emigrant families, whereas the explicit rules on age and relationship eligibility for PAC immigration allowed such households to be identified in this example. The estimated treatment effects appear to be sensitive to assumptions about these stayer households.

5.2 Comparison to Non-Experimental Approaches
Instead of using our experimental control group, we now construct no-emigration counterfactuals by deducting incoming remittance income and adding back the potential home earnings of the emigrants. Following Adams (1989), we calculate no-migration counterfactual household income by estimating a household-level earnings equation and using the characteristics of emigrant households to predict what their labour incomes would have been had they not emigrated. Similar equations are also estimated to predict each emigrant household's income from agricultural and informal sector sales and for the value of their consumption from own production. These three sources of imputed earnings are then added to a remittance total that excludes remittance transactions (both incoming and outgoing) with the PAC emigrants.[12]

The appropriate sample to use for estimating these earnings equations is the sample of households with unsuccessful ballots since these have similar characteristics to the migrant households. However, for the methodological purpose of examining how well these non-experimental methods deal with problems of sample selectivity we also estimate these equations using the sample of non-applicant households. This sample is more typical of what researchers would be able to gather, in settings unlike ours, where there is not a random ballot available to create a more natural comparison group.

Using the coefficients estimated for the unsuccessful ballot sample, the counterfactual estimate of the average per capita income of emigrant

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[12] We also examine whether our results are robust to using an alternative approach which uses individual-level equations for employment and earnings to build up to a household-level total of expected earnings, with the other components of household income estimated in the same way as for the first approach.

households is about 40 percent higher than the actual income of these households (e.g. this is the estimated income for these households had their PAC emigrants not moved to New Zealand). Specifically, we estimate that the average emigrant household would have earned 4,691 Pa'anga per capita had individuals not emigrated.[13] This estimate is, in fact, very close to and not significantly different from the mean per capita income of the stayer households among the unsuccessful ballots (4,706 Pa'anga), which serves as our experimental counterfactual. Since the actual average per capita income of the remaining family members of PAC immigrants is only 3,337 Pa'anga, both the experimental treatment effects approach and the non-experimental approach indicate that the per capita incomes for the remaining family of PAC emigrants are considerably lower than they otherwise would have been, at least in the initial period after the emigrants have left Tonga.

Since the imputed counterfactual incomes are derived from multiple regression models, it is not appropriate to directly use these estimates in poverty calculations. The problem is that the predictions from the regression models only include the systematic components of income and not the random components, so calculating poverty and inequality measures based on these predictions leads to much lower inequality and poverty than would actually occur. We therefore follow the bootstrapping approach implemented in McKenzie (2005). The residuals from estimating the household-level earnings equation for the sample of unsuccessful ballots are sampled with replacement and used to calculate estimates of imputed income which contain both the systematic and random components.[14] Poverty measures are then calculated using these predictions of income. This process is repeated 1,000 times, providing estimates of the mean, standard deviation, and confidence interval of the poverty statistics.

Table 7 shows the resulting estimates of the headcount and poverty gap using broad income and the basic needs poverty line. The headcount poverty rate for families with PAC migrants abroad is 39.2 percent, compared to 22.4 percent in the experimental comparison group. The non-experimental estimate predicts that the headcount poverty rate would be 19.5 percent for the migrant households in the absence of migration. It thus is very close to the experimental estimate, and both show considerably higher poverty as a result of family members migrating. Similar results are

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[13] The alternative approach using individual level earnings and employment equations gives a similar estimate of 4,455 Pa'anga.

[14] The bootstrapping process samples with replacement a vector of errors, so that any correlation in the errors across income components is preserved.

Table 7: Non-Experimental Estimates of Counterfactuals for Stayer Households

	Broad per capita income	Headcount Poverty	Poverty Gap
Actual Levels			
Migrant households	3,337	0.392	0.133
	(341)	(0.076)	(0.035)
95% Confidence Interval	[2656, 4019]	[0.239, 0.544]	[0.062, 0.203]
Unsuccessful Ballot	4,706	0.224	0.077
	(460)	(0.071)	(0.028)
95% Confidence Interval	[3781, 5631]	[0.082, 0.366]	[0.020, 0.134]
Counterfactual Predictions for Migrant households			
Using Unsuccessful ballots to predict	4,691	0.195	0.084
	(307)	(0.053)	(0.028)
95% Confidence Interval	[4077, 5305]	[0.107, 0.283]	[0.040, 0.131]
Using non-applicants to predict	3,408	0.320	0.118
	(260)	(0.053)	(0.027)
95% Confidence Interval	[2887, 3928]	[0.229, 0.404]	[0.072, 0.165]

Note: Counterfactual income level and poverty rates are calculated using income predicted from a household-level model of total income. See the text for more details. The broad income definition and Basic Needs Line is used for constructing poverty rates.

found for the poverty gap measure, with the non-experimental estimate not statistically different from the experimental estimate.

Note that here we are using the sample of unsuccessful ballots with similar characteristics as the migrants to carry out these calculations. This shows that with the right comparison group subtracting remittances and adding back imputed income can give results very close to that implied by our experiment. However, in practice, other studies face the double-selection issue of identifying which households have potential migrants and whether or not the entire household will potentially emigrate.

In the last rows of Table 7, we report the results when non-applicant households are used instead to estimate the earnings equations needed to construct counterfactual income for migrant households. These results are indicative of the bias which may occur in studies that are either unable to identify a counterfactual population with similar characteristics to migrants or unable to successfully control for selection bias using other methods, such as instrumental variables. In contrast to both the experimental results and the non-experimental results based on the sample of unsuccessful ballots, the estimated counterfactual income is now considerably lower and is not significantly different from the actual income of the migrant households. Likewise, using non-applicants leads one to predict counterfactual poverty rates and poverty gaps which are much higher than those calculated for the experimental control group. The inaccuracy of these estimates illustrates the importance of using a comparison group which is similar to the migrants to generate counterfactual calculations.

6. Conclusions

New Zealand's immigration policy with respect to the Pacific Islands is unusual in the weight that it places on attempting to assist participating countries in their economic development (Stahl and Appleyard, 2007). In this paper, we have reported evidence from one of the more recent immigration streams – the Pacific Access Category – on the impact that having some household members immigrate to New Zealand has on the economic welfare of family members remaining in Tonga. We focus on the impact on income levels, sources and poverty. Our analysis uses both experimental estimates, which are made possible by the use of a random ballot to select from the large number of applications to the PAC, and non-experimental estimates that construct no-emigration counterfactuals by deducting remittance income from the remaining family of PAC emigrants and adding back the potential home earnings of emigrants.

The results suggest that family members remaining in Tonga may initially be made worse off after some of their household members immigrate to New Zealand. Although remittance receipts rise, there is a larger offsetting loss from the foregone earnings of emigrants. The value of agricultural sales and consumption from own food production is also lower for the remaining family members. This decline in income occurs whether we examine total household income, per capita income or adult-equivalent income. These reductions in per capita income are associated with higher poverty rates (although the change is statistically insignificant for some poverty lines and poverty measures) and higher inequality (for which the change is also imprecisely measured).

It must be emphasised that these results are based on a survey that captures the experiences of households not long after their family members have left for New Zealand. There are a number of significant costs that emigrants face in moving to New Zealand, so it is possible that their remaining family in Tonga will receive greater remittances in the future, once the migrants have repaid their moving costs. However, there is no guarantee of this occurring, and, in fact, expectations questions that we ask of both migrants and their remaining family members suggest that remittances will decline over time; 78-80 percent of these individuals expect to be remitting or receiving remittances one year in the future, declining to 64-68 percent five years out and 32-37 percent ten years out. It will therefore be important to continue monitoring the economic situation of the remaining family members of PAC immigrants to see whether the initial declines in their income are ultimately reversed.

In terms of policy implications, it would be incorrect to infer from the results reported here that the PAC scheme is in some sense a failure. First, and foremost, the policy clearly benefits the migrants themselves – in other work, we show that they experience large gains in income and improvements in mental health. The PAC is clearly very popular in Tonga (and Fiji, until it was suspended) with many more people applying to enter this immigration channel than the quota allows. What the results do show is that it would be wrong to assume that the PAC (and other immigration policies) designed to help economic development in the Pacific will automatically achieve that aim, without complementary interventions. For example, these same data show that there are high transactions costs of sending money from New Zealand to Tonga (and more generally throughout the Pacific) and that if the costs fell to levels prevailing in other regions, net remittances received in Tonga might rise by almost 30 percent (Gibson, McKenzie and Rohorua, 2006). With the renewed emphasis on labour mobility in the Pacific, any reductions in unnecessary frictions so as

to enhance the ability of immigrants to support their households in both New Zealand and their home country may be valuable.

In terms of methodological implications, we find that non-experimental methods of constructing counterfactual income are unlikely to work well if there is non-random selectivity of emigrants. When we use a sample of unsuccessful ballots with similar characteristics to those of the migrants to construct no-emigration counterfactuals the results are very close to those from the experimental approach and imply that the remaining family of emigrants experience a fall in economic welfare. But, when non-applicant households are used, who tend to have less favourable observable and unobservable characteristics (McKenzie, et al, 2006), the estimated counterfactual income is much lower than that for the experimental comparison group and is closer to that of the remaining family of emigrants. It is therefore important to have the right comparison group when creating non-experimental counterfactuals, which is often difficult to achieve in migration studies since migrants are self-selected.

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