The Impacts of International Migration on Remaining Household Members: Omnibus Results from a Migration Lottery Program[#]

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Abstract

The impacts of international migration on development in the sending countries, and especially the effects on remaining household members, are increasingly studied. However, comparisons of households in developing countries with and without migrants are complicated by a double-selectivity problem: households self-select into migration, and among households involved in migration, some send a subset of members with the rest remaining whilst other households migrate en masse. We address these selectivity issues using the randomization provided by an immigration ballot under the Pacific Access Category (PAC) of New Zealand's immigration policy. We survey applicants to the 2002-05 PAC ballots in Tonga and compare outcomes for the remaining household members of emigrants with those for similar households who were unsuccessful in the ballots. The immigration laws determine which household members can accompany the principal migrant, providing an instrument to address the second selectivity issue. Using this natural experiment we examine the myriad impacts that migration has on remaining household members, focussing on labor supply, income, durable assets, financial service usage, diet and physical and mental health.

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1. Introduction

The impacts of international migration on development in the sending countries, and especially the effects on remaining household members, are increasingly studied. Empirical measurement is needed because the effect of migration on development in source communities is *a priori* unclear. Migrant-sending households and their communities can benefit from remittance inflows, which now make up 30 percent of total financial flows to the developing world, but they lose the income and other household inputs that migrants would have generated locally had they not emigrated. Hence this is a growing area of the literature; for example, out of the 271 journal articles and working papers with remittances as a title or keyword, 74% were published since 2000.[1] Even more studies are likely in future as new survey data becomes available and since labor mobility is expected to increase in response to growing international wage gaps, the rising share of services in consumption, divergent trends in youth and elderly populations in developed and developing countries, and catch up from the previously "everything but labor" nature of globalisation in the post-World War II era (Pritchett, 2006).

However researchers face several difficulties in providing credible estimates of the impacts of migration on development. Migration may induce economy-wide effects on the labor market, the real exchange rate, and possibly the incentives for acquiring education, making it hard to evaluate overall impacts. Even restricting attention to impacts on poverty and inequality, net impacts are ambiguous since they depend on where migrants 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 migrants respond to changed factor endowments as labor leaves the home area. But perhaps the biggest difficulty in measuring impacts of migration on development is

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[1] Specifically, a search of EconPapers on RePEC (December 3, 2007) reveals that there were 17 papers in all of the 1980s, 47 in all of the 1990s, and 200 so far in the 2000s, with 67 in 2006 alone.

posed by selectivity issues. A common research strategy in this literature is to use household survey data to compare households who have sent a migrant with those who have not. Such comparisons are complicated by a double-selectivity problem: households self-select into migration, and among households involved in migration, some send a subset of members with the rest remaining whilst other households migrate en masse.

In this paper we address these selectivity issues using the randomization provided by an immigration ballot under New Zealand's immigration policy. We survey applicants to this random ballot and compare outcomes for the remaining household members of emigrants with those for similar households who were unsuccessful in the ballots. The immigration laws determine which household members can accompany the principal migrant, providing an instrument to address the second selectivity issue. Since this migration channel has only recently opened, we measure the short-term impact of migration, which may change over time. The short term may be when household challenges are greatest, as they adapt to the absence of household members and have yet to receive large quantities of remittances. Such effects may also serve as a guide to the impacts on source households of temporary worker migration, an increasing focus of migration policy discussions.[2]

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.[3] 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. We evaluate the impact of individuals migrating to New Zealand

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[2] New Zealand has introduced a Recognised Seasonal Employer (RSE) temporary work scheme in 2007, with 5000 workers recruited from the Pacific Islands to work for up to seven months per year.
[3] 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.

via the PAC on family members remaining in Tonga, focussing on labor supply, income, durable assets, financial service usage, diet and physical and mental health.

Our results suggest that at least in the short run there may be some adverse consequences for remaining family members from having a subset of their household migrate to New Zealand. Income falls by approximately 20-25 percent, whether measured per capita or per adult equivalent, with a rise in net remittances not offsetting a large fall in labor earnings. Ownership of livestock, durables, and access to financial services is also lower for the families of migrants than for the control group. Diets change, with less fruit, vegetables and fats consumed and more rice and root crops. Beneficial changes include falls in the body mass index and waist to hip ratio for working age adults.

These results may have broader applicability since the Tongan migrants to New Zealand under the PAC have characteristics that are quite typical of developing country migrants to the U.S. (McKenzie, Gibson and Stillman, 2006). In particular, although a common stereotype is of a husband migrating alone and leaving a family behind in a developing country, a majority of married developing country immigrants in the U.S. actually have their spouse present.[4] Consequently, household structure and other impacts on the families of those migrants in the regions that supply labor to the U.S. may be quite similar to what we observe amongst the Tongan families left behind when migrants move to New Zealand.

The rest of this paper is structured as follows. Section 2 reviews relevant literature on the impact of emigration on source areas and discusses the channels through which emigration may affect the remaining family members. Section 3 describes the data from the Pacific Island-New Zealand Migration Study (PINZMS) and our estimation methods. The

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[4] Specifically, using the 5% public use sample of the 2000 U.S. Census, we find that 59% of married immigrants from developing countries who arrived in the U.S. in the last year had their spouses also present in the U.S. Even for Mexico, we find 46% of newly arrived married immigrants have migrated with their spouse.

impacts on household level outcomes are presented in Section 4 and on individual outcomes in Section 5. Section 6 concludes.

2. Previous Literature and the Channels through which Emigration Affects the Family Left Behind

2.1. Channels and Impacts

The most studied impact of migration on household members left behind has been the impact of remittances received. There are a variety of reasons that migrants send remittances, including altruism towards those left behind, exchange for a variety of services provided by the remaining family members (such as caring for property or other relatives), repayment of loans made to finance migration or education, and insurance and strategic motives (Rapoport and Docquier, 2006). These remittances directly contribute to household income, allowing households to purchase more assets[5], and buy more normal goods, including education and health inputs. They can also relax liquidity constraints, enabling greater household investment in businesses and children's education, and enable households to better mitigate the impact of domestic income shocks, which might otherwise lead to the household having to cut back on expenditures or move children out of school.

If migration purely resulted in an exogenous increase in income for the remaining household members, the sign of the expected impact on many outcomes of interest would be easily determined. However, migration can also have a number of other impacts on the sending household. The most obvious is that the migrant is no longer physically present in the household, causing foregone domestic income and time inputs that the migrant would supply if they had not migrated. These effects may counteract the effect of remittances received, so for example, households have less time to spend educating children, but perhaps more money

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[5] Remittances may also be received in the form of durable assets, directly increasing household asset stocks.

to spend on them. Migrants may also transfer knowledge and attitudes to their remaining family members. For example, Hildebrandt and McKenzie (2005) find contraceptive knowledge to increase with emigration of household members from Mexico to the U.S. Absence of decision-makers may also lead to changes in the bargaining power of remaining members in the household leading to a reallocation of household spending priorities (Chen, 2006). Separation from family members may impact on mental health. Finally, migration of some family members may make it more likely that others will migrate in the future, changing the incentives to acquire education.

The result of all of these different potential channels is that the overall impact of migration on various measures of the welfare of remaining family members is theoretically uncertain. The effects are also likely to vary with the amount of time the family member is away. For example, Lucas (1987) finds emigration from Botswana, Lesotho and other Southern African countries to South Africa decreases domestic crop productivity in the short run as labor is removed from the farm, but appears to enhance crop productivity and cattle accumulation in the long run through invested remittances. Many other empirical studies are unable to control for the length of time migrants have been away, resulting in an averaging of short run and long run effects.

2.2. Selection and Identification

The main challenge facing empirical analysis of the impacts of migration and remittances on sending households is a double-selectivity problem. The first form of selection is selection into migration. Households which send migrants are likely to differ along a number of observable and unobservable dimensions from households which do not send migrants, with some of these characteristics likely correlated with outcomes of interest. For example, an unobserved asset shock may make the sending household poorer and lead them to send out a migrant member. Households with aptitude and knowledge of foreign languages

may be more inclined to engage in migration, and also have children who do better in school. Secondly, amongst households which decide to engage in migration, some decide to move with their entire families, while in others only some members leave.[6]

We are not aware of any study of the impact of migration on sending households which explicitly deals with the second form of selection, since almost all developing country migrant datasets lack information on entire households that move. The literature has used a variety of approaches to address the first form of selection. Examples include assuming selection on observables (e.g. Adams, 1998; Cox-Edwards and Ureta, 2003), parametric selection correction models (e.g. Barham and Boucher, 1998; Acosta, Fajnzylber and Lopez, 2007), propensity-score matching (Esquivel and Huerta-Pineda, 2006), instrumental variables methods, predominantly using current migration networks (e.g. Mansuri, 2006, Brown and Leeves, 2007) or historic networks as instruments (e.g. Woodruff and Zenteno, 2007; McKenzie and Rapoport 2007)[7] and work by Yang (forthcoming) which uses a natural experiment provided by exchange rate shocks in destination countries to look at impacts within the group of households with migrants abroad.

However, one may question the identification assumptions underlying these non-experimental approaches to constructing no-migration counterfactuals. There is evidence that migrants self-select both in terms of observables and unobservables (McKenzie, Gibson and Stillman, 2006, Akee, 2006), so methods which assume selection on observables (which include OLS and matching) are likely to be biased. Selection correction methods rely on parametric structure and dubious excludability assumptions. For example, Acosta et al.

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[6] A further issue faced by some of the literature are attempts to distinguish the impact of remittances from the overall impact of migration. See McKenzie (2005) for a critique of such attempts.

[7] Other instrumental variables have been also been used, but the exclusion restriction underlying these are perhaps less convincing than the historic network variables. For example, Amuedo-Dorantes and Pozo (2006a) assume that the number of Western Union branches in a state in Mexico affects labor supply only through current migration, when these branches are likely to have been established as the result of factors which have driven migration historically, including the level of development in a state, which likely also impact on labor supply.

(2007) and Barham and Boucher (1998) assume that household asset holdings predict selection into migration but do not directly affect earnings and labor force participation respectively, when these assets could be used to help finance own businesses, or could be the result of income earned. The use of current migration networks as an instrument is subject to concerns about other variables at the community level which also affect migration and outcomes of interest. For example, a recent community weather shock such as a drought may have led to increased migration and a reduction in agricultural income in the community. Historic networks are less subject to concerns about recent shocks, but still need to rely on a plausible story of why networks exogenously formed in one location and not another, such as the pattern of development of the railroad system in Mexico as used by Woodruff and Zenteno (2007). The natural experiment utilized by Yang (forthcoming) provides the cleanest identification of the impact of changes in remittance receipts amongst households receiving remittances, but is unable to address the impacts of other channels through which migration can affect households.

2.3. Which Household Outcomes does the literature focus on?

The growing literature on the impact of migration and remittances has examined a variety of outcomes, all intended to measure the extent to which migration can aid "development" in the sending countries. However, each study only focuses on the impact of migration on a small number (often one) of outcomes in the sending country, preventing analysis of the full range of impacts of migration on households in any one sending country. Common outcomes of interest include income and poverty levels, employment and business ownership, child health and education, and asset ownership. These outcomes are both of inherent interest, and also the most commonly available measures in household surveys.

Existing evidence paints a generally rosy picture of the impact of migration on the incomes, asset holdings, and poverty levels of household members left behind (Adams, 2007 provides a recent review).   There are fewer studies of the impact on child health outcomes, but the studies that do exist all show positive effects on outcomes, although more mixed results on inputs. For example, Hildebrandt and McKenzie (2005) find lower infant mortality rates and higher birth weights amongst Mexican migrant-sending families, but also that children in migrant households are less likely to be breastfed or be vaccinated. Acosta et al. (2007) find higher weight-for-age and height-for-age among children in migrant families in Nicaragua and Guatemala.

The existing literature has found ambiguous effects of migration on several other key outcomes of interest. In terms of the effect on child education, Cox-Edwards and Ureta (2003) find migration increases school attendance rates in El Salvador, and Yang (forthcoming) find that remittances lead to more child schooling in the Philippines, both consistent with higher income alleviating liquidity constraints, whereas McKenzie and Rapoport (2006) find migration lowers schooling attainment in Mexico, with boys in migrant households more likely to drop out of school to migrate, and girls to undertake more housework.

Evidence is also mixed in terms of the impact on adult employment. Funkhouser (1992) finds remittances to be associated with lower overall labor supply, but higher self-employment in Nicaragua. Acosta (2006) finds a negative impact on female labor supply in El Salvador, but no effect on male labor supply. Yang (forthcoming) finds higher remittances lead to households being more likely to engage in entrepreneurial activities and to spend more hours in self-employment, but to no significant effect on overall labor supply. Amuedo-Dorantes and Pozo (2006a) find remittance receipt lowers female labor supply in Mexico, and shifts male labor supply from formal to informal sector work. Woodruff and Zenteno (2007)

find remittance receipt to significantly increase the amount of capital invested in microenterprises in Mexico, whereas Amuedo-Dorantes and Pozo (2006b) find a significant negative impact of remittances on business ownership in the Dominican Republic.

We will consider these outcomes, along with other welfare outcomes such as diet, anthropometric health measures, and mental health, which are measured less often in household surveys and for which we have not been able to identify existing literature. For example, a recent submission to the Global Commission on International Migration states (Carballo and Mboup, 2005, p. 5) that "for close family and relatives left behind, the departure of migrants to seek a living elsewhere is also fraught with psychosocial difficulties", but provides no evidence for this assertion.

In addition, Aggarwal et al. (2006) have recently used cross-country panel data to show an association between remittances and financial development, with the argument being that the receipt of remittances paves the way for recipients to demand and gain access to other financial services, even if the funds themselves are not received through banks. However, they note that remittances may instead substitute for use of credit and other demands for bank accounts, so that the empirical direction is unclear. Furthermore, it is possible that it is the household members who use the banking system who migrate, reducing household use of bank accounts when they leave. We will therefore also consider measures of access to bank accounts as another outcome measure.

3. Data and Methods

3.1. Data

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.[8] This survey includes questions on household demographics, education, labor supply, income, asset ownership and diet, and pays special attention to health issues, relying on both self-reported information (general health status), smoking and alcohol use, and anthropometric measurements (height and weight for all individuals, and waist and hip circumference and blood pressure for individuals aged 20 and older). It also measures mental health for individuals aged 15 and older using the Mental Health Inventory 5 (MHI-5) of Veit and Ware (1983).

The unique feature of the PINZMS survey is that it has a mechanism that allows selection biases to be overcome, by surveying applicants in the first four years of the Pacific Access Category (PAC). 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,[9] 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 the odds of success turning out to be around ten percent during the period we examine. 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.

The person who registers for the PAC 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 represents about 80 migrant households. Successful applicants can not take other members of their household to New Zealand, so anyone living with parents, siblings, or other relatives will leave household members behind when they migrate.

These two features of the PAC, random selection amongst applicants and a rule

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

[9] 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.

specifying which family members can and can not accompany the successful migrant, allow us to address the double-selectivity issues involved in assessing the impact of migration on the remaining household. In particular, we can compare the group of households with a PAC emigrant to the group of unsuccessful ballots who would not be eligible to move their entire household to New Zealand had their principal applicant been chosen in the ballot.

In a perfect randomised experiment, the impact of the treatment (here, having some household members emigrate) could then be obtained via a simple comparison of means in these two groups. However, mean comparisons may be biased if control group members substitute for the treatment with a similar program or if treatment group members 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 suggests that substitution bias is not of serious concern; the low odds of winning the ballot and the limits on eligibility for other migration channels available to Tongans mean that those with the ability to migrate via other arrangements would likely 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, with 283 individuals, in Tonga who have some previous members that are now PAC migrants in New Zealand; these are the "treatment" group, (ii) 26 households, with 115 individuals, containing successful participants from the same PAC ballots who were still in Tonga; these are the "non-complier" group, who had not moved when surveyed 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) 124 households, with 654 individuals, containing unsuccessful participants from the same ballots

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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 37.9 are needed to weight each sample up to the relevant population) and all of the analyses take this into account.

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. The use of a homogeneous period of time abroad allows us to avoid averaging short and long run effects which may differ in sign (as found in Lucas, 1987), and is over a period of time which will be informative for policymakers concerned about the effects of temporary migration.

We use the age and relationship rules governing which Secondary Applicants can move with the Principal Applicant to identify household members that would have moved to New Zealand if the Principal Applicant had been successful and compliant with the treatment. These rules appear to be the binding constraint since the remaining family of PAC emigrants are almost all outside the age and relationship eligibility for moving to New Zealand (see Appendix Table 1).[10] We therefore drop 75 unsuccessful households and 18 non-complier households in which their age and relationship structure would have allowed all members to move to New Zealand, making them an invalid counterfactual group for comparing with households where some people did not move to New Zealand. Individuals in these households, those who would have moved in the control group and non-complier

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[10] Specifically, just 11 (of the 283 residents of treatment group households) eligible family members stayed in Tonga rather than immediately move to New Zealand with their principal applicant. Those that did were mainly very young children and their mothers and the primary reason given for staying was either to look after these children, or to look after the parents or parents-in-law of the migrant.

households and the few eligible ones who did not move to New Zealand, are all dropped for the individual level analyses, so that only like individuals in the treatment, non-complier and control group are compared to each other. We define "stayers" to be the individuals who the legal rules would require to stay behind if their principal applicant had been successful in the PAC ballot.

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,[11] and so as original household members their welfare is likely to have been impacted by the departure of the PAC emigrants.

3.2. 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). 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 higher education levels and that there are more children amongst the stayer group in successful ballot households. We present all regression results

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[11] 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.

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.

3.3. Calculating Experimental Estimates

Throughout the remainder of the paper, we present experimental estimates of the impact on households and individuals 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. The PAC ballot outcome can be used as an excluded instrument because randomization ensures that success in the ballot is uncorrelated with unobserved individual attributes which might also affect outcomes among the stayer household members and success in the ballot is strongly correlated with migration.

4. Impacts on Household Level Outcomes

4.1. Household Size and Composition

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". The impact of having some household members migrate to New Zealand on household size and composition is shown in Table 2. Emigration leads to a significant reduction in household size. The mean household has 6.7 people, and emigration is estimated to reduce this by 2.2-3.3 people. Emigration leads to households having, on average, 1.5-1.6 fewer prime-age adults and

0.8-1.6 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.

4.2. Household Income

We next examine the impact on total household income, which can be disaggregated into four sources, i) household earnings (annualised from individual reports for the previous week), ii) net returns from sales of fish, crops, livestock, tapa cloth and mats (annualised from household reports on an average month), iii) the imputed value of own-produced or own-captured food consumed by the household (annualised from household reports for the previous week), and iv) net remittances of money and goods.

Since households in Tonga who have had some members move to New Zealand under the PAC have fewer members, we examine the impact on per capita incomes and alternatively on adult equivalent incomes.[12] The results in Table 3 for log total income suggest that the families of migrants have 22-23% lower incomes than the families of non-migrants, when no control variables are included regardless to whether income is per capita or per adult equivalent.[13] The estimated impact is a 20-21% decline in income when control variables are added, but the per capita estimate is no longer statistically significant. If we instead estimate a linear model, which is more sensitive to outliers, we find that income declines by \$1,000 per capita or \$1,250 per adult equivalent (19-20% of the mean for treatment group households) for families of migrants when there are no controls and by \$635 per capita or \$910 per adult equivalent (12-14%) when controls are included; in neither case are the estimates significantly different from zero.

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[12] 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. As households in Tonga who have had some members move to New Zealand under the PAC have fewer children, 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.

[13] These are calculated as 100×[exp (-0.259) – 1] and 100×[exp (-0.253) – 1].

Examining the four components of household income, we find that having household members migrate to New Zealand under the PAC leads to significant reductions in household labour income per capita ($1,030-$1,280) or per adult equivalent ($1,260-$1,560), depending on whether control variables are included in the regression. These falls are partially offset by significant increases in remittances received of $465-$500 per capita or $560-$590 per adult equivalent. There is no significant change in either agricultural or subsistence income per person.[14] Thus, while households with PAC migrants receive more remittances and have fewer mouths to feed, this does not compensate for the large reduction in labor earnings faced by these households.

4.3. Durable Assets and Financial Access

We next examine changes in other measures of household resources, including three types of durable assets; i) the dwelling, ii) durable goods, and iii) livestock. We also examine the impact on the financial access of each household, in particular, whether any household members have bank accounts or ATM cards.

Among our survey questions, we ask whether the dwelling the family lives in is at least partially owned by anyone in the household and whether, in the last 12 months, any improvements have been made to the dwelling. Our survey also asks whether household members own any of 24 durable assets, including household appliances, entertainment equipment and motor vehicles. We aggregate these responses into a single index using the prices of durable goods we collected from stores in Tonga.[15] A separate question is asked on the number of automobiles that household members have available for their regular use. The final asset questions concern holdings of domestic livestock (pigs, chicken, cattle, goats and

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[14] It is worth nothing that both overall agriculture and subsistence income decline significantly for households with PAC migrants, but the decline in the number of individuals in these households offsets these declines at least using per capita and per adult equivalent measures of household income.
[15] We also used principal component analysis, to create a single dimensional index of wealth based on the first principal component following the approach of Filmer and Pritchett (2001), and the results are the same.

horses). We examine the impact of having families members emigrate to New Zealand via the PAC on the wealth index, the number of cars available to household members, and the holdings of the main livestock; pigs, chickens and cattle.

Table 4 reports the estimated impact of having family members migrate to New Zealand on each of these outcomes. Again, impacts are estimated both without any control variables and with controls to deal with small sample differences between treatment and control groups. Although some outcomes are discrete, we continue to present estimates from linear instrumental variable regression models (eg 2SLS). We also estimated treatment effects for the discrete outcomes using the equivalent simultaneous equations probit models and found nearly identical marginal effects as those presented for the models with no covariates, but had difficulty getting the models with control variables to converge (a small number of covariates perfectly predict whether households are in the non-complier group).

We find that having family members migrate to New Zealand via the PAC leads to remaining members of the household having fewer cars and livestock and being less likely to have a bank account or ATM card. Even when control variables are added these effects persist for chickens and the financial access variables. The impacts are large, with the remaining family of emigrants having half as many chickens as non-migrant households and being 17% less likely to have a bank account and 31-34% less likely to have an ATM card. We also find negative, albeit insignificant, impacts on home ownership, the likelihood of having made improvements to ones home, and the value of durable goods.[16]

It is worth emphasising that all of these results merely reflect changes in household level assets and/or financial access. These changes may be occurring for a number of reasons: i) households may have sold-off assets so the proceeds could used by the individuals moving to New Zealand; ii) the lower incomes caused by having these family members move to New

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[16] Although the results for having made a home improvement is insignificant, it is particularly striking that 6.1% of unsuccessful stayer households made improvements to their homes in the previous 12 months while not a single household with PAC migrants did.

Zealand may have caused a reduction in assets and financial access relative to unsuccessful stayer households; iii) the individual in the household who used a bank account may have been the person who migrated, or iv) the change in household composition (eg the moving away of working-age household members) reduces needs for particular assets (such as cars and computers) or financial access. Only 10 percent of migrant households in New Zealand with family members remaining in Tonga report selling livestock, vehicles or other assets before moving to New Zealand, suggesting the first explanation can not be the main channel.

4.4 Diet

We next examine the impact of having family members emigrate to New Zealand via the PAC on the diet of the remaining household members. Specifically, we collect information from households on whether any of thirty different foods were eaten by any member of the family during the day prior to the interview. For twenty-seven of these foods, we also asked during how many meals were these foods eaten. To focus our analysis, we examine the cumulative number of meals in which seven foods are consumed, six of which are composites. These foods are: rice, roots, fruits and non-root vegetables, fish, fats, meats and milk.

The results presented in Table 5 indicate that having family members emigrate leads to a significant increase in the consumption of rice and roots and a significant decrease in the consumption of fruits and vegetables. These changes in diet are large; consumption of rice triples, consumption of roots goes up by 20-25%, and consumption of fruits and vegetables declines by 38-40%.

The question on diet asks which foods anyone in the household ate yesterday. We would thus expect larger households to be more likely to have someone in them eating any given food group. Since this question is asked of the entire household, and not just of the members who would stay if the household had a PAC ballot winner, the smaller size of

migrant households should lead to a tendency to find lower likelihoods of consuming any particular food group. The significant negative result for fruits and vegetables may therefore just reflect that migrant households do not have as many prime age adults who are likely to eat these foods. However, this mechanical effect of household size can not explain the increase in rice and root consumption amongst migrant households.

5. Impacts on Individuals

Comparison of household level outcomes for migrant and non-migrant families is complicated by the issue of how to account for differences in household size. Furthermore, assuming a unitary household model in a large household with siblings or parents living with the potential migrant may not be satisfactory. For example, while we find non-migrant households to be more likely to have a car, it is possible that the car is used only by the potential migrant, and that stayer members of this non-migrant household do not have use of the car. We therefore turn to comparing individual level outcomes, which don't require assumptions about distribution of resources within the household.

5.1. Working-Age Adults

Table 6 examines the impact of migration on the labor supply, employment activity, and health of 18 to 45 year old stayer adults – the age range eligible to apply for the PAC. Since the literature has found that the impact of migration on labor supply varies by gender we split the employment results by gender. The point estimates suggest a negative effect for females and positive impact on males, but neither is significant. There is also no significant impact on business ownership/self-employment or on whether the adult is currently studying. However, we do find that individuals are less likely to be working in agriculture, significant at the 10 percent level.

Self-assessed general health status does not change with migration of other household members. We do see significant impacts on some health behaviours and anthropometric measures. Individuals in migrant households do not change smoking behaviour, but do have significantly more alcoholic drinks per month, although the significance disappears when we add controls. The Tongan population is notable for having one of the highest levels of obesity in the world, with 60 percent of the population classified as obese (Colagiuri et al., 2002). Migration is found to reduce BMI, significant at the 10 percent level, and to reduce the waist-to-hip ratio, significant at the 5 percent level. The waist-to-hip ratio is a marker of central obesity that has been found to be more strongly associated with the risk of myocardial infarction among many ethnic groups than BMI (Yusuf et al, 2005). Reductions in BMI and waist-to-hip ratios thus represent health improvements for the remaining individuals in migrant households.[17] The point estimates also suggest migration lowered blood pressure, but this effect is insignificant.

In related work (Stillman et al. 2007) we have found migration to improve the mental health of the Tongans who move to New Zealand under the PAC. The last column of Table 6 shows that their remaining family members do not receive the same improvement. The MHI-5 ranges from 5 to 25, with higher scores indicating better mental health. The point estimates thus suggest that, if anything, migration lowered the mental health of remaining family members, although this effect is insignificant.

5.2. Children

Table 7 examines the impacts of migration of other family members on the education and health of children aged 17 and under. Recall that the migrants here are typically aunts

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[17] These health improvements have occurred with a decline in household economic resources, suggesting that one pathway is that less food leads to less over-nutrition but behavioural change could also be a factor (e.g. more walking if migrants sold the family car). Evidence from developed countries suggests that people adopt healthier lifestyles when income declines, such as during recessions (Ruhm, 2005).

and uncles of these children[18], and their parents are not the ones migrating. For this reason we might expect less of the potential negative effects of parental absence on education and health, and that the main channel through which migration would affect these children is through income effects. Tonga has good basic education and health services, and is ranked by the UN as high in terms of human development, with an adult literacy rate of 98.2 percent.[19] As such, liquidity constraints appear unlikely to be of large importance in determining access to schooling and health, so that changes in income may have relatively small impacts on health or education outcomes.

The results in Table 7 are consistent with this hypothesis. Migration is not found to have a significant effect on the likelihood of currently studying, on years of education attained, on Tongan literacy, and on both parental-assessed and anthropometric health measures. The only marginally significant effect is greater English literacy among children in migrant households. One can imagine these children receiving more information about the returns to English abroad, and having more incentive to study English if they are now more likely to apply to migrate in the future. However, given that we are looking only at effects within one year of the household members leaving, it seems more plausible that this effect is purely the result of chance.

5.3. Older Adults

Finally in Table 8 we report the results of migration of household members on adults aged 46 and older. The majority of these older household members are parents of the migrant, with a mean (median) age of 60 (59) years. The point estimates suggest that both older males and females are less likely to be employed when their children migrate. The magnitudes are sizeable relative to the mean, corresponding to a halving of the employment rate. However,

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[18] 72% are classified as "other relative" in terms of their relation to the principal applicant, and 23 percent are a sibling of the principal applicant.
[19] http://palaceoffice.gov.to/content/view/124/95/ [accessed December 18, 2007].

the results are not significant when we examine men and women separately, and are only significant at the 10 percent level when we combine males and females and do not include additional controls in the regression. The point estimates also show large negative effects of the likelihood of being a business owner, but again these are statistically insignificant.

As with younger adults, there is a tendency for older adults to be less involved in agriculture when they are in migrant households, although this difference is insignificant. Older adults are marginally less likely to view themselves as being in very good health when other household members have migrated, but we see no significant impacts on health behaviour, BMI, waist-to-hip ratios, blood pressure, or mental health.

6. Omnibus Effects and Multiple Hypothesis Testing

Our analysis so far has followed the existing literature and tested for the impact of migration on particular outcomes one-by-one. This allows comparability with existing studies, since we can compare, for example, our results for the impact of migration on business ownership to other studies examining the same outcome. However, in total over Tables 2 through 8, we are examining the impacts of migration on 62 different outcomes, and for each outcome, we consider the result with and without controls. This raises questions about multiple hypothesis testing. In this section we examine which of our results are robust to different corrections for multiple testing.

Consider then testing the impact of migration on a family of n outcomes. For example, we could consider all outcomes related to diet as a family. The familywise error rate is then defined as the probability of at least one type I error in the family (Shaffer, 1995). Then we can maintain the familywise error rate at some designated level α, such as 0.05 or 0.10, by adjusting the p-values used to test each individual null hypothesis in the family. The simplest such method is the Bonferroni method, which uses as critical values α/n. Thus with

10 outcomes in a family, we would need to use a cutoff of a p-value less than 0.01 when testing each individual outcome to maintain the familywise error rate at 10 percent.

Several refinements to the Bonferroni method offer greater power.[20] Rank the n outcomes in increasing order of their p-values for testing a null effect, so that $p_1 \leq p_2 \leq ... \leq p_n$. Then the Holm's (1979) sequentially-rejective bonferroni method is applied as follows. In the first step, a null effect for outcome 1 is rejected if $p_1 \leq \alpha / n$. If we can not reject this outcome, we can not reject null effects for all other outcomes. Otherwise, reject a null effect for outcome 2 if $p_2 \leq \alpha /(n-1)$, and at step j, reject a null effect for outcome j if and only if null effects have been rejected for all outcomes $i<j$, and $p_j \leq \alpha /(n-j+1)$. Hochberg (1988) provides a "step-up" modification of this procedure, which rejects null effects for all outcomes $i \leq j$ if $p_j \leq \alpha /(n-j+1)$ for any $j=1,2,...n$.

The disadvantages of these approaches are that the larger the number of outcomes in the family, the smaller the average power for testing each individual outcome. Furthermore, these tests are conservative, in that they are based on the assumption of independence between outcomes. This is certainly not the case in our application, where some outcomes are very closely related to one another. In future versions of this paper, we will experiment with the use of testing procedures which take account of the correlation between outcomes. However, at present we can examine which effects stand up to conservative corrections for multiple testing.

Table 9 shows the smallest p-values for each set of outcomes. Given the loss of power involved in multiple testing and our small sample sizes, we fix the family-wise error rate at 10 percent. If we consider all 62 outcomes as a family, the Bonferroni p-value is thus 0.0016. The only outcomes that are significant at this level are total household size, the number of adults aged 18 to 45, whether the household has an ATM card (without controls), and the

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[20] The description of methods here is based on Shaffer (1995).

number of children in the household (with controls). The Holm and Hochberg adjustments do not reveal any other outcomes to be significant. That is we can be very confident that migration lowers the size of the sending household, a none too startling result.

A slightly less conservative approach is to consider the outcomes in each table as a family of outcomes. Doing this again reveals that the changes in total household size, adults 18 to 45, and children (with controls) are all significant. In Table 3, the net increase in remittances per capita and per adult are significant, and the fall in household labor earnings per adult and per capita are significant when we do not include controls. In Table 4, the fall in the likelihood the household has an ATM card is significant, as is the fall in the number of chickens (without controls). In Table 5, the increase in rice and roots are significant without controls, and the fall in vegetables and fruits is significant with and without controls. None of the individual level outcomes in Tables 6, 7 and 8 are significant when we adjust for multiple hypothesis testing using these conservative approaches.

6. Conclusions

In this paper we have made two innovations to advance the literature that attempts to estimate the impact of migration on development. First, we addressed the double-selectivity problem whereby households self-select into migration, and among households involved in migration, some send a subset of members with the rest remaining whilst other households migrate en masse. Our solution was to study a migration program where a random ballot is used to select from the large number of applications, dealing with the self-selection problem, and to use the rules which state who can and can not accompany the principal migrant, to deal with the problem of identifying and removing all-mover households from comparison groups. Second, in contrast to most studies, which examine the impact of migration on one or a few outcomes, we examined the impact on a comprehensive set of household and individual level

development indicators, including income, asset ownership, labor supply, business ownership, physical and mental health, and child education.

Our results suggest that family members remaining in Tonga may initially be made worse off in several respects after some of their household members immigrate to New Zealand. Households sending migrants are smaller in size, and receive more remittances per capita. However, the amount received in remittances and the reduction in household size is not enough to compensate for the lost labor earnings of the migrants, leading to sizeable reductions in household income per person. Migrant sending households also appear to have less durable assets and livestock, and are less likely to have access to banking services such as ATM cards. The impacts on individual level outcomes are imprecise, with sizeable point estimates accompanied by large standard errors in many cases. Adults in migrant-sending households are less likely to be obese, although the significance of this result is not robust to corrections for multiple hypothesis testing.

Our results give a less rosy picture of the (immediate) impact of migration on the incomes, asset holdings, and poverty levels of household members left behind than is provided by much of the existing literature. Since we have attempted to deal with selectivity problems in a more credible way than some strategies employed in the literature, a natural question is whether our different results are due to these methodological differences. We have some evidence in a related paper to suggest that they are. Specifically, McKenzie, Gibson and Stillman (2007) use the same data to 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 not some members emigrated. Similar equations are 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 with the PAC emigrants. When these earnings equations are estimated on the sample of households with unsuccessful ballots the results are very similar to the experimental estimates of the impact on income, reported in Table 3 above. But when these earnings equations are estimated on a sample of non-applicant households the estimated counterfactual income is much lower than that for the experimental comparison group and is closer to that of the actual income for the remaining family of emigrants, wrongly implying that there is no impact. 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.

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 assist economic development in the source areas 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).

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