Natural experiment evidence on whether selection bias overstates the gains from migration

John Gibson[1] University of Waikato

David McKenzie World Bank

Halahingano Rohorua University of Waikato

Steven Stillman Motu Research

Introduction

Migration from developing to developed countries and the resulting remittance flows are emerging as key development policies. Restrictions on international migration may have larger welfare costs than the more widely studied restrictions on international trade (World Bank, 2005).

Measuring the gains from migration requires estimating what workers in developing countries could earn in rich countries. These estimates may be affected by selection bias, with differences in earnings for migrants and non-migrants reflecting unobserved differences in ability, skills, and motivation, rather than the act of moving itself.

We use a unique random selection mechanism to overcome this selection problem. This mechanism is based on the Pacific Access Category (PAC) under New Zealand's immigration policy. The PAC allows a quota of about 70 Tongan families to immigrate each year, with a ballot used to choose amongst the excess number of applicants. Comparing ballot winners and losers provides the only known experimental measure of the income gains from migration.

A sample of non-applicants is then compared to the migrant sample to assess whether typically used non-experimental methods provide reliable estimates of the income gains from migration.

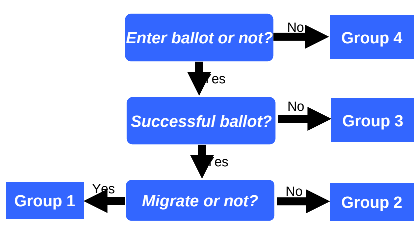
Methods

Detailed surveys of four random samples of Tongan households were conducted by the authors in 2005:

1) 65 migrant households who came to New Zealand through the 2002/03 and 2003/04 PAC ballots (a 70% sampling rate)
2) 55 households whose members had successful ballots but who had not yet migrated to New Zealand – these are non-compliers to the migration "treatment" (a 30% sampling rate)
3) 78 households with unsuccessful ballots who were still in Tonga (a 3% sampling rate), and
4) 60 households in Tonga who had never entered the migration ballot and who were living in the same villages as the successful and unsuccessful PAC applicants (a 1% sampling rate).

Figure 1 shows the relationship between these four samples and the PAC immigration program.

Figure 1: The immigration ballot and the four household samples



If ballot winners randomly choose to migrate, the income gain from migration could be estimated by comparing the mean earnings, *Y* of successful ballots who migrate and unsuccessful ballots (Group 1 vs 3):

$$SEE - TT = \overline{Y}_{Group\ 1} - \overline{Y}_{Group\ 3} \quad (1)$$

This simple estimate ignores the "dropout bias" from successful ballots who were yet to migrate. But the "intent-to-treat" (ITT) effect, which is the earnings difference between all ballot winners (regardless of whether migrated) and unsuccessful ballots,

$$ITT = \overline{Y}_{(Group\ 1+Group\ 2)} - \overline{Y}_{Group\ 3} \quad (2)$$

when divided by the proportion of non-dropouts (53% here) gives an unbiased estimate of the average treatment effect on the treated.

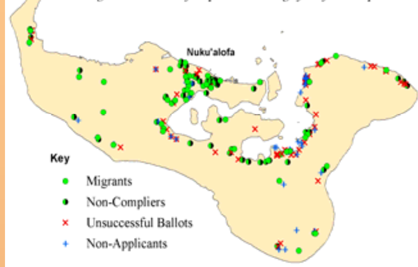
Instrumental variables (IV) provide another unbiased method for estimating average treatment effects (Angrist, et. al, 1996). The ballot outcome is strongly correlated with migration and is a valid instrument because randomization (see Table 1) ensures that ballot success is uncorrelated with unobserved attributes that might also affect earnings.

Table 1: Evidence for Randomization

	Sample Means APPLICANTS Successful Ballots	Sample Means APPLICANTS Unsuccessful Ballots	T-test of equality of means p-value
Age	33.6	33.7	0.91
Years of schooling	11.9	11.5	0.37
Proportion male	0.55	0.51	0.52
Proportion born on Tongatapu	0.75	0.79	0.54
Proportion who are married	0.60	0.62	0.77
Height	171.6	169.3	0.16
Income in 2003 / before moving	103.7	88.0	0.32
Total Sample Size	**120**	**78**	

Five non-experimental methods of estimating the income gain from migration are also used. These mainly compare the migrants to the pseudo-controls in Tonga (Group 4). To ensure the validity of this comparison we selected non-applicants from the same villages as either the migrants or the unsuccessful ballot entrants. Figure 2 shows how this worked for the main island of Tongatapu.

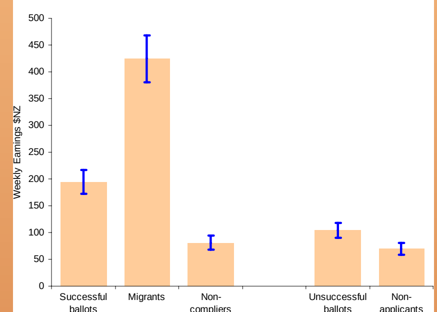
Figure 2: Evidence for spatial matching of the four samples



Experimental results

Figure 3 shows mean weekly earnings for the different groups. Earnings in Tonga are converted to New Zealand Dollars at the market exchange rate of 1 Pa'anga=0.73 NZD (= 0.53 USD). Results are similar using PPP exchange rates calculated from prices we gathered in Nuku'alofa and Auckland. The mean earnings for migrants are $424, compared to $104 for unsuccessful entrants in the PAC ballot. So the simple experimental estimator (equation 1) suggests that migration raised earnings by $320 per week. But this estimator does not take account of the non-compliers (Group 2).

Figure 3: Mean weekly earnings (± 1 standard error)



Comparing ballot winners (Groups 1 and 2) and ballot losers gives the intent to treat effect (equation 2): ITT=$(194-104)=$90. A successful ballot raises expected earnings by $90 per week. Column (1) of Table 2 reports the same result from a simple OLS regression model using a dummy variable for success in the ballot.

Adjusting this ITT for non-compliance, migration is estimated to have raised the weekly earnings of Tongans by $274. The same estimate comes from using the lottery outcome as an instrument for migration, shown in column (3) of Table 2.

Columns (2) and (4) add controls for pre-existing characteristics to the regression models. Adding age, sex, marital status, school years, height (as a measure of health), being born on the main island of Tongatapu (a proxy for having more urban skills), and past income only marginally changes the estimated intent-to-treat effect, from $91 to $87, and does not change the treatment effect on the treated. This invariance of the estimated program effects is consistent with Table 1, which shows the randomization across the successful and unsuccessful ballots.

Table 2: OLS and IV Regression Equations for Weekly Earnings (NZD)

	(1) OLS	(2) OLS	(3) IV	(4) IV
Ballot Success Dummy	90.634	87.390		
	(3.68)**	(3.89)**		
Male Dummy		-23.855		-27.772
		(1.08)		(1.33)
Married Dummy		24.535		18.376
		(1.05)		(0.82)
Age Dummy		-0.886		-0.462
		(0.71)		(0.41)
Years of Education		4.605		3.274
		(1.18)		(0.91)
Born on Tongatapu Dummy		27.600		28.005
		(1.87)		(2.04)*
Height		0.381		0.353
		(0.92)		(0.93)
Past income		0.662		0.660
		(6.98)**		(7.31)**
Migration Dummy			273.996	273.736
			(4.46)**	(4.99)**
Constant	104.051	-60.422	104.051	-48.595
	(8.85)**	(0.74)	(8.90)**	(0.66)
First stage F-statistic on instrument			66.53	61.51
Observations	197	190	197	190
R-squared	0.04	0.27		

Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

Given that mean income of applicants with unsuccessful ballots is $104, these results indicate that Tongans experience a 263% increase in weekly labour income from migrating to New Zealand.

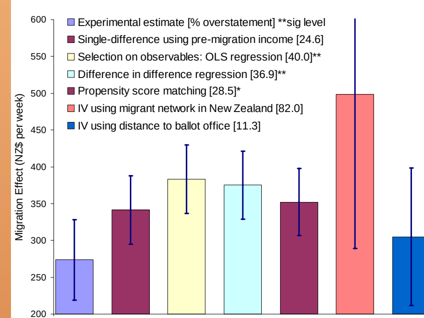
Non-experimental results

The natural experiment provided by the use of a ballot to admit Tongans to New Zealand provides a unique chance to estimate the gain in income from migration. Other studies attempt to deal with selectivity issues by using non-experimental methods to compare the income of migrants to those of non-migrants with similar observable characteristics. To see how well such methods work in practice, the experimental results are compared with those from five non-experimental methods:

- a single difference estimator which compares migrants' post-migration income to their pre-migration income;
- OLS regression, which assumes selection on observables;
- difference-in-differences regression estimation;
- propensity-score matching; and
- instrumental variables, using as instruments for migration either the pre-existing family network in New Zealand or the pre-migration distance from place of residence to the office in Tonga where ballot registrations are deposited.

Figure 4 summarizes the non-experimental estimates. Each non-experimental method overstates the gains in income from migration compared to the experimental estimate. Instrumental variables using a good instrument for migration (the distance from the pre-migration residence to the office in Tonga where ballots are deposited) performs best, only overstating the gains by 11%. But using a poor instrument (the size of the family network in New Zealand, which fails the exclusion restrictions because the network is also a source of job offers and so directly affects the dependent variable) overstates the gains by 82%.

Figure 4: Non-Experimental Estimates Overstate the Earnings Gain (± 1 standard error)



The single-difference estimator, which relies on migrants' retrospectively recalling their pre-migration earnings, overstates the gains by 25%. The difference-in-differences estimator compares this change in migrants' earnings with the similarly calculated change in non-applicants' earnings and overstates the gains by 37%. Propensity-score matching, which uses the characteristics listed in Table 2 to match migrants to 'similar' non-migrants, overstates the gains by 29%. OLS using the same characteristics overstates the gains by 40%.

Conclusion

Measuring the gains from increased international migration requires estimating what workers in developing countries could earn in rich countries. Immigrants are likely to have different abilities, skills and motivations than non-migrants in their home countries making their earnings a poor measure of what a randomly selected worker would earn if they emigrate. Our results show that popular approaches for dealing with this selection problem in non-experimental data overstate the gains from migration, at least compared with the benchmark of an experimental estimate. Thus, assessments of global gains from increased international migration are likely to be sensitive to the modelling of selectivity bias.

Acknowledgements

We are grateful to the Government of the Kingdom of Tonga and the New Zealand Department of Labour Immigration Services for the sampling frame and permission to conduct the survey, and most especially to the interviewers and participants. Financial support from the World Bank, Stanford University, the Waikato Management School and Marsden Fund grant UOC0504 is gratefully acknowledged. The views expressed here are those of the authors alone and do not necessarily reflect the opinions of the World Bank, the New Zealand Department of Labour, or the Government of Tonga.

Notes

Angrist, J.D., G.W. Imbens and D.B. Rubin (1996) "Identification of Causal Effects Using Instrumental Variables", *Journal of the American Statistical Association* 91(434): 444-455.

World Bank (2005) *Global Economic Prospects: Economic Implications of Remittances and Migration* World Bank Group, Washington DC.

[1]Corresponding author: jkgibson@waikato.ac.nz