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Abstract: Does the emigration of highly-skilled workers deplete local human capital? The answer is not obvious if migration prospects induce human capital formation. We analyze a unique natural quasi-experiment in the Republic of the Fiji Islands, where political shocks have provoked one of the largest recorded exoduses of skilled workers from a developing country. Mass emigration began unexpectedly and has occurred only in a well-defined subset of the population, creating a treatment group that foresaw likely emigration and two different quasi-control groups that did not. We use rich census and administrative microdata to address a range of concerns about experimental validity. This allows plausible causal attribution of post-shock changes in human capital accumulation to changes in emigration patterns. We show that high rates of emigration by tertiary-educated Fiji Islanders not only raised investment in tertiary education in Fiji; they moreover raised the stock of tertiary educated people in Fiji—net of departures.

1   Introduction

The vanguard of legal international labor movement is often the high-skill worker, preferred by many countries of destination. This is likely to continue, as the United States and the European Union contemplate new policies to selectively attract skilled workers. How will measures to attract skilled workers to rich counties affect the stock of skilled workers in poor countries?

This question is sharp and urgent in academic and policy circles, as many of the origin countries face profound skill shortages. The United Nations (2007) states that "the emigration of qualified people" means "lost human capital", which "damages long-term growth and development prospects." Economists since Bhagwati and Hamada (1974) and before have argued that skilled-worker emigration tends to reduce human capital stocks and therefore productivity in developing countries. Today, Stanley Fischer (2003) and other leading economists warn that "brain drain" could be a powerful force for ill in the global economy.

A series of recent theoretical studies questions the core notion of "brain drain" (beginning with Stark et al. 1997 and Mountford 1997). They point out that human capital formation may not be exogenous to movement. In these models, higher returns to human capital abroad than at home cause skilled-workers to move, but also cause workers at home to invest in more human capital. If some portion of those who invest in more human capital cannot move, workers' option to move could either lower or raise human capital at home.

Testing these models empirically requires a strategy for causal identification. The incidence of skilled-worker emigration may well be endogenous—caused by local conditions that also affect human capital formation, or caused by human capital formation itself. Most previous literature attempts to identify the effect of emigration on human capital by using past local migration rates as an instrumental variable for current rates, either across countries or across households. But past

migration rates, too, can be caused by factors that affect human capital formation. These include unobserved cultural differences (across countries) and geographic clustering by people of unobservable types (across households).

It is difficult to find natural experiments to test the pure effect of labor movements on human capital stocks. Ideally, such an experiment requires two large groups of developing-country residents, similar in all relevant ways except that skilled workers from one group are much more likely to emigrate to a rich country. We need this difference to last long enough for young people to have time to change their decisions about higher education. We furthermore need rich pre-test data to rule out prior differences between the groups. These traits would allow plausible attribution of human capital patterns between the groups to emigration patterns. Designing such an experiment is difficult in the extreme.

This ideal experiment is approximated in key ways, however, by a series of events over the last two decades in the Republic of the Fiji Islands. In the mid-1980s, most of the population of this small, low-income country was roughly evenly divided between people of indigenous origin ("Fijians") and people of South Asian origin ("Indians"). [1] In 1987, Fijian military officers carried out two unexpected and largely bloodless coups d'état. The new government changed the constitution and enacted a series of economic measures that many Indians perceived to permanently harm their prospects in the country.

Indians, particularly the highly skilled, quickly began to emigrate en masse. This emigration has continued to the present day, spurred by additional coups by Fijian officers in 2000 and 2006. Today the Indian population is about 40% below its pre-1987 trend. A large majority of the emigrants have gone to other Commonwealth

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[1] To reflect standard practice in Fiji, including in official data sources, we herein frequently use the word "Fijian" to denote indigenous Fiji Islanders of the Fijian ethnicity (usually excluding Rotumans and other indigenous people not strictly Fijian) and the word "Indian" or "Indo-Fijian" to denote Fiji Islanders of South Asian descent (at the time that most of their ancestors arrived in Fiji, "India" included present-day Pakistan and Bangladesh). While a tiny portion of the population claims mixed ethnicity, intermarriage between the groups is extremely rare.

countries—Australia, New Zealand, and Canada—all of which apply skill-selective "points systems" to prospective Fijian migrants. Very large numbers of the emigrants have tertiary qualifications. This is one of the largest, fastest exoduses from any developing country in recent history, and it is highly skill-focused. If skilled-worker movement depletes domestic human capital, Fiji is precisely where we should observe the phenomenon.

One arresting fact about post-coup Fiji is the subject of the rest of this paper. Young Indians, at a time when many perceived a permanent negative shock to their economic prospects in the country, began quickly and massively to invest in higher education. This investment has risen so much that, while tertiary-educated Indians have been leaving in massive numbers, the stock of tertiary-educated Indians in Fiji has increased. Mass skilled-worker emigration has occurred alongside mass skill creation within Fiji. This simple correlation is factual and uncontroversial.

But we can go beyond this correlation to investigate the *effect* of skilled-worker emigration on domestic human capital investment and stocks, due to several features of Fiji. First, the coups create a natural quasi-experiment in which a treatment group foresaw large-scale skilled emigration, but two separate control groups did not. One quasi-control group is the Indians before 1987, since the coups were unexpected. Another quasi-control group is the Fijians, who are obviously not identical to the Indians but are similar in key relevant ways, such as average income. Comparison of treatment with controls allows plausible causal attribution. Second, the Fiji government collects and allows access to rich census and administrative data. These allow us to control extensively for differences between the treatment and control groups, ruling out several clear threats to internal validity of the experiment, and to carefully observe the timing of behavioral changes. Third, the principal destination countries are rich countries with highly skill-selective immigration policies. Fourth, the geographic isolation of Fiji means that illegal migration is extremely rare, thus the incentive effects of destination countries' migration policies are strong. Fifth, the emigration began over two decades ago,

3

allowing us to observe its long-term consequences. Finally, the coups were essentially bloodless and emigration was voluntary.

These traits allow us to show that the prospect of emigration to skill-selective destination countries greatly raised human capital investment in Fiji. Beyond that, the evidence shows that this increase in investment was large enough to raise the *stock* of human capital in Fiji, net of skilled-worker departures. These results are by no means universally applicable, but they do show that it is not economically meaningful to speak of skilled-worker movement as necessarily representing a "loss" to countries of origin (Docquier and Marfouk 2006). This throws into question the meaning of the term "brain drain". The results also reveal that international movement can substantially affect investment in higher education, building a literature on the determinants of tertiary schooling investment that began with Campbell and Siegel (1967), Radner and Miller (1970), Kohn et al. (1976), Bishop (1977), and Willis and Rosen (1979).

The rest of the paper is structured as follows. Section 2 unifies the relevant theory in a simple framework. Section 3 discusses the handful of identification strategies that have been used to test related models. Section 4 describes the natural experiment investigated here. Section 5 discusses the data used, and Section 6 presents core empirical results. The remaining sections discuss concerns of internal validity, construct validity, and external validity that arise in the interpretation of a quasi-experiment such as this, as well as what these results suggest for the broader consequences of skilled-worker movement.

2   Schooling investments and relative international returns to schooling

Following theoretical advances by Oded Stark and colleagues (1997, 1998, 2002) and by Mountford (1997), we develop a model of emigration and human capital investment in which successful emigration is uncertain. We expand somewhat on

earlier work by unifying in one simple framework a consideration of the effects of changes in both domestic and foreign human capital returns under migration, consideration of the effects of emigration on the distribution of unobserved ability, and the effects of skill-selective or skill-deterring immigration policies in destination countries.

2.1   *Without emigration*

We begin in a world with no international movement. A worker's net income is his or her expected net wage less the cost of human capital investment. In the home country this net income is $\pi(\tau, h, a) \equiv (1 - \tau)w(h) - c(a)h$, where τ is the tax rate, $w(h)$ is the present-value wage as a function of human capital investment h, and $c(a)$ is the present-value cost of one unit of human capital, which is a strictly decreasing function of ability a. The individuals' problem is to choose h to maximize π (net income). If w is continuous, differentiable, strictly increasing, and strictly concave in h, we have

> **Proposition 1:** In autarky, $dE[h^*]/d\tau < 0$. That is, without recourse to emigration, taxation at home decreases the average stock of human capital.

This and all other propositions are proved in the appendix. Intuitively, higher taxation reduces the gross benefit of schooling without affecting the cost, reducing the attractiveness of the investment. Campbell and Siegel (1967), Bishop (1977), and Willis and Rosen (1979), along with many successors, find that decreases in expected future income are associated with decreased investments in tertiary education.

2.2   *With emigration*

Suppose now that workers can attempt to emigrate to a foreign country, but success is uncertain. The worker's expected net income abroad is given by $\hat{\pi}(p, A, \hat{h}, a, m) \equiv$

$pAw(\hat{h}) - c(a)\hat{h} - m$, where $0 \leq p \leq 1$ is the probability of successfully moving abroad, $A > 1$ is the ratio of foreign wage to home wage, and $m > 0$ is the cost of leaving the country (broadly considered).

To permit a closed-form solution assume functional forms $w(h) \equiv \ln h$ and $c(a) \equiv \bar{c} - \zeta a$ (where $\bar{c} > 0$, $\zeta > 0$, and $c(a) > 0 \; \forall \; a$), and assume that ability a is uniformly distributed on the interval $[0, \bar{a}]$. An individual prefers to emigrate if $\hat{\pi}(\hat{h}^*) > \pi(h^*)$. If migration is possible ($p > 0$) and $\hat{h}^* > h^*$, then there exists some $\hat{a}$ such that $h = h^*$ if $a < \hat{a}$ and $h = \hat{h}^*$ if $a \geq \hat{a}$. That is, all individuals over some threshold ability level prefer to migrate if possible, so average ability and education among emigrants is higher than in the general population. Intuitively, this is because sufficiently low-ability people must incur such a large cost to acquire education that their consequently small net expected income is outweighed by the moving cost m.

We can now assess the net effect of emigration on average domestic human capital. The average stock of human capital is $[h] = \int_0^{\hat{a}} h^*(a) \frac{1}{\bar{a}} da + \int_{\hat{a}}^{\bar{a}} \hat{h}^*(a) \frac{1-p}{\bar{a}} da$, where the second term reflects the fact that a fraction $1 - p$ of those who acquire $\hat{h}^*$ cannot emigrate. The response of domestic h stock to a change in the tax rate is

$$\frac{dE[h]}{d\tau} = \theta \left[(1 - \tau) \left(\frac{\xi}{\hat{\varphi}} \frac{\partial \hat{a}}{\partial \tau} \right) - \ln \hat{\varphi} \right] + A\theta \left[p(1 - p) \left(-\frac{\xi}{\hat{\varphi}} \frac{\partial \hat{a}}{\partial \tau} \right) \right], \qquad (1)$$

where for simplicity $\theta \equiv -1/\bar{a} \zeta$, $\hat{\varphi} \equiv 1 - (\zeta \hat{a}/\bar{c})$, and $\xi \equiv -\zeta/\bar{c}$ (note $\theta < 0$, $0 < \hat{\varphi} < 1$, and $\xi < 0$). The first term on the right-hand side of (1) is always negative and shows the decrease in education investment due to strictly domestic forces analogous to Proposition 1. The second term is always positive and shows the increase in education investment that arises because the increase in taxation lowers the ability threshold at which migration is desired, so more people choose to invest in $\hat{h}^* > h^*$. Similarly,

$$\frac{dE[h]}{dp} = \theta \left[(1-\tau) \left(\frac{\xi}{\hat{\varphi}} \frac{\partial \hat{a}}{\partial p} \right) \right] + A\theta \left[(1-2p) \left(-\frac{\ln \bar{\varphi}}{\bar{\varphi}} \right) + p(1-p) \left(-\frac{\xi}{\hat{\varphi}} \frac{\partial \hat{a}}{\partial p} \right) \right], \quad (2)$$

Where $\bar{\varphi} \equiv 1 - (\zeta \bar{a}/\bar{c})$, and note that $0 < \bar{\varphi} < 1$. The first term on the right-hand side of (2) is always negative, and shows the decrease in the domestic stock of human capital due to emigration as the likelihood of successful emigration rises. Provided that $p < 1/2$, the second term is always positive and shows the increase in the domestic human capital stock as more and more people find it worthwhile to invest in $\hat{h}^* > h^*$, many of whom do not migrate. Equations (1) and (2) give us

> **Proposition 2:** $dE[h]/d\left(\frac{p}{1-\tau}\right)$ can be positive or negative. An increase in the probability of successful migration can raise or lower the domestic human capital stock, and an increase in the tax rate can raise or lower the domestic human capital stock.

Note that under these simplifying assumptions we can expect an individual reacting to a change in p to behave similarly to an individual reacting to a change in $1 - \tau$. One way to see this is to note that, if $\hat{h}^* > h^*$, the change in the incentive to acquire education for the marginal person brought just over the threshold of emigration desire $\hat{a}$ is

$$\left. \frac{d\hat{\pi}}{d\hat{h}} \right|_{\hat{h}=h^*} - \left. \frac{d\pi}{dh} \right|_{h=h^*} = c(a) \left[\left(\frac{p}{1-\tau} \right) A - 1 \right] > 0, \quad (3)$$

where the second term on the left-hand side is zero by definition of h^*. The incentive (3) increases to the same degree with any given proportional increase in p or decrease in $1 - \tau$. These two changes are two sides of the same coin. First, both of these policy changes raise emigration, and when there is positive skill-selection by the foreign country, both raise schooling of the emigrants. Second, both can either raise or lower average schooling in those who do *not* emigrate, since many of those who invest for the possibility of migrating cannot migrate.

2.3   *With emigration to a skill-selective destination*

Suppose now that the foreign country can select for or against emigrants with high levels of skill h. To explore this, we relax the assumption that $\hat{h}^* > h^*$. Let the cost of $\hat{h}$ be $\hat{c}(a) \equiv (1/\sigma)(\bar{c} - \zeta a)$ where σ is a skill-selectivity parameter: $\sigma > 1$ means that costs are lower for those with high education than for those with low education, and $\sigma < 1$ means that those with high education pay extra costs. This gives

> **Proposition 3:** As long as $\hat{h}^* > h^*$ and $\sigma \geq 1$ then $d\hat{a}/d\sigma > 0$ and $d\hat{h}^*/d\sigma > 0$. This means that it is possible that $dE[h]/d\sigma > 0$ for high σ. But sufficiently low skill-selectivity σ and sufficiently low migration cost m imply $\hat{h}^* < h^*$, and the emigration prospect can reduce domestic schooling.

That is, the more skill-selective the emigration, the higher the threshold ability $\hat{a}$; fewer people emigrate but the incentive to do so is stronger, and the net effect on $E[h]$ can be either positive or negative. Emigration that selects *against* skills, on the other hand, can make it preferable to migrate with low skill than to remain home with high skill, so that the emigration prospect can lower $E[h]$.

Figure 1 diagrams this simple framework. The upper-right quadrant shows the cost of education c for an individual of ability a. This person will acquire education h until the marginal wage increment $w'(h)$, shown in the upper-left quadrant, equals the cost c. At this level of education, the expected wage is shown in the lower-left quadrant: in home the expected wage is $(1 - \tau)w(h)$, and in foreign the expected wage net of migration cost is $pAw(\hat{h}) - m$. Several features of the model are clear in the picture: 1) Individuals with ability $a \leq \hat{a}$ prefer not to migrate and acquire education h^*, 2) Individuals with ability $a > \hat{a}$ prefer to migrate, and acquire education $\hat{h}^* > h^*$ whether or not they can migrate, and 3) greater skill-selectivity σ raises $\hat{h}^*$.

To summarize, within this simple framework 1) home taxation decreases education investment in the absence of migration. Provided that migration is possible but not guaranteed, 2) either an increase in the probability of successful migration or an increase in home taxation can raise the domestic human capital stock, and 3) emigration that selects on high levels of schooling can increase the home stock of schooling, while emigration that selects against schooling can decrease it. An increase in the probability of successful emigration and an increase in domestic taxation both have the effect of raising the opportunity cost of investing in schooling for the home labor market (h^*) rather than investing in schooling for the possibility of attaining the foreign market ($\hat{h}^*$).

3   Testing the model: A shortage of experiments

A rise in the relative foreign-home expected returns to schooling can, then, either raise or lower the current domestic human capital stock. Whether this effect is positive or negative depends on the parameters and becomes an empirical question. Often in the empirical literature on migration, cross-country correlations of high relative foreign-home expected returns to schooling and low domestic stocks of schooling are interpreted as evidence that the former causes the latter. Since innumerable country characteristics can affect both emigration rates and schooling rates, such correlations are unsatisfactory evidence of a causal relationship.

This is the case, for example, with Docquier and Marfouk's (2006) useful counts of highly-educated emigrants, where high numbers suggest a high probability of successful emigration and therefore higher expected returns to human capital. The authors interpret these numbers *prima facie* as a measure of "brain drain"—that is, the "loss of skilled workers", described with normative qualifiers such as "severe".

This embodies the assumption of a causal, negative relationship between skilled worker movements and domestic stocks of skilled workers.[2]

A small, recent literature seeks to test the causal relationship between emigration and human capital stocks. This work falls into three categories, according to the strategy for causal identification.

In the first group, identification is primarily sought using past emigration rates as an instrument for current emigration. Beine, Docquier, and Rapoport (2008) use cross-country data and find that larger stocks of educated people abroad cause higher stocks at home in some developing countries, but lower stocks in most. They use two instrumental variables for country-level skilled-worker emigration: the initial size of each country's diaspora—which is to say cumulative past emigration—and the initial size of each country's domestic population. The validity of these instruments requires a set of jointly untestable exclusion restrictions.[3]

Household-level studies have used a related identification strategy. McKenzie and Rapoport (2006) use household-level data from Mexico to find that living in a migrant household decreases the chance that a child will complete high school. Here the instrumental variable is past state-level emigration rates as shaped by early 20th-century railroad networks. A related method is used by Batista, Lacuesta, and Vicente (2007) in Cape Verde and by Görlich, Mahmoud, and Trebesch (2007) in Moldova. Both of these use household-level data with emigration propensity instrumented directly by local past emigration rates, but find that living in a household whose members are likely to migrate increases human capital investment, particularly at the tertiary level. Again, the validity of this instrument is

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[2] The word "loss" inherently represents the net effects of worker movement, not just the gross flow in one direction. The gross flow of money from a checking account to a mutual fund, for example, is not meaningfully described as a "loss".

[3] Population growth cannot affect both population and tertiary schooling directly (through an effect on the distribution of income) for example, and past expansions/contractions of schooling cannot simultaneously cause both current expansions/contractions in schooling and the diaspora size (since schooling levels can influence the ability and desire to emigrate).

difficult to firmly establish, theoretically or empirically: If people who are both prone to migrate and to go to school are also prone to choose to live near each other, or if past emigration rates shape omitted variables such as income inequality, the excludability of the instrument is in question.

The second category relies on instruments unrelated to past emigration rates. DeBrauw and Giles (2008) find that a higher propensity for members of rural Chinese households to migrate to a city lowers educational attainment for children in that household. They instrument for migration propensity by taking advantage of the advent of national identity cards that made it easier to find city work legally, cards that arrived at different and plausibly exogenous times in different provinces. A key trait of this and the work of McKenzie and Rapoport is that they investigate settings in which the labor market structure and migrant networks mean that job opportunities at the destination are largely for low-skill work.

A third category relies on panel data to argue for causal identification without a natural experiment. Boucher, Stark, and Taylor (2007) find that internal migration from Mexican villages is associated with greater schooling investment in the sending households, controlling for several observed and all time-invariant unobserved household traits. They also find that households with a higher propensity to emigrate to the United States also exhibit greater human capital investment, though the authors attribute this primarily to the alleviation of credit constraints on schooling investment by remittances.

The present study builds this literature by describing a unique natural quasi-experiment with traits desirable for identification of a causal relationship between emigration propensity and both flows and stocks of domestic human capital. The experiment does not rely on possibly endogenous past emigration rates, with their attendant issues of experimental validity, and it occurs in a setting where most foreign job opportunities are restricted by policy to require a high level of skill.

4   A quasi-experiment in the Pacific

The ideal experiment to test the above theoretical propositions would require two groups of developing-country residents, identical in every respect except that one group experienced a large exogenous change in the relative returns to human capital at home versus abroad. The response of the treatment group in subsequent international movement and domestic human capital investment could be assessed and attributed reliably to the change in relative return, and the competing effects on domestic human capital stock determined with scientific rigor. We neither know of any such ideal experiment nor know how it could be feasibly designed.

4.1   *Coups and changes in policy*

A series of events similar in some key ways to the ideal experiment did occur in one developing country, Fiji, following a major shock in 1987. When that year began, the population of Fiji was split roughly evenly between Fijians and Indians. At odds with the experience of the Indian diaspora in many African countries, Indo-Fijians had levels of average income, health, and basic education that were similar to those of their indigenous Fijian counterparts. Most Indo-Fijians are descended directly from penniless, and mostly illiterate, indentured laborers who arrived between 1879 and 1917 and have never been richer on average than ethnic Fijians.[4]

In 1987 began a series of essentially bloodless military coups d'état by the Fijian-dominated army. In April of that year, an election ousted the administration of indigenous chief Ratu Sir Kamisese Mara, whose Alliance Party had ruled since independence. Timoci Bavadra's Fiji Labor Party, which held widespread support among Indians, took power. On May 14th, Lieutenant Colonel Sitiveni Rabuka of the Fiji army escorted Bavadra out of Parliament and seized control of the government. This coup d'état was not widely expected and came as a shock to most of the

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[4] Recruitment of Indian indentured laborers stopped in 1917 and the indenture system was abolished in 1920 (Gillion, 1962: 188).

population (Lal 2008). A second coup by Rabuka followed in September, consolidating the power of the new government and returning Ratu Mara to the post of prime minister.

The post-coup government profoundly changed the landscape of public policy in Fiji. It enacted a range of new affirmative action policies for ethnic Fijians, modeled directly on similar policies enacted years earlier in Malaysia. Many Indians perceived Fiji's new rules to permanently disadvantage them relative to their indigenous counterparts. These policy changes included the following:

- *Politics.* A new constitution in 1990 guaranteed a permanent Fijian majority in the parliament and limited Indians to hold at most 27 out of 70 seats (Robertson 2006). A minimum of half the positions in the public service were reserved for indigenous Fijians, as were the positions of prime minister and president. The armed forces remained predominantly Fijian, as they had been since independence. At several ministries and in the police force, the years after 1987 saw large increases in the fraction of staff who were Fijian, resulting in large Fijian majorities (Sharma 1997: 88-91).
- *Business.* In 1992, F$20 million in public funds were granted to Fijian-owned businesses through Fijian Holdings Limited. The annual number of publicly-subsidized loans to Fijian-owned firms through the Fiji Development Bank roughly tripled after 1988, and their terms were made more concessional (Ratuva 2002; Gounder and Prasad 2005). In 1990, the Fiji National Provident Fund created the Small Business Equity Scheme, which over the next decade paid out over F$17 million to business owners—roughly 90% of whom were Fijian (Ratuva 2002).[5]
- *Housing.* In 1987, the Fiji National Provident Fund set up the Village Housing Scheme to provide grants for housing in rural villages. This was part of the post-coup affirmative action package and the large majority of beneficiaries

[5] After a further pro-Fijian coup in 2000, the government set a target "for 50% of all economic activities to be undertaken and/or owned by indigenous Fijians by the year 2020" (Ministry of Finance and National Planning, 2002: 1).

have been Fijians (Ratuva 2002; Fiji Human Rights Commission 2006: 88). As of 2005 the scheme had granted over F$100 million (Parliament of Fiji 2005).

- *Labor*. A series of new laws in 1991 sought to liberalize the labor market by weakening labor unions and other trade associations. These affected Fijian workers as well, but many unions were Indian-dominated, and "unions with a predominantly Indo-Fijian membership base—like the National Farmers Union—were specifically targeted" (G. Chand 2000: 173).

- *Land*. Upon independence from Great Britain in 1970, Fiji retained colonial laws reserving all but eight percent of land for Fijian or government ownership (Ward 1995). For several years thereafter Indians lobbied to relax this restriction, without success (Kunabuli 1990). The coups in 1987 convinced many Indians that limitations on their land ownership were unlikely to change (Prasad 2008).

- *Higher education*. Shortly before the coups, in 1984, the government created a F$3.5 million fund for Fijian education. A large portion of this was directed to the Fiji Affairs Scholarship Scheme—higher education scholarships available only to Fijians (Sharma 1997: 111). The post-coup government raised this fund to F$4.5 million in 1987, then to F$5 million in 2001, and to F$8 million by 2006 (Sutherland 2000: 207; Puamau 2001; Fiji Human Rights Commission 2006: 88). In the years after 1987, funding for public tertiary scholarships available to Indians declined (Kumar 1997: 85). In 1989, the government overturned its longstanding rule of splitting tertiary scholarships evenly between Indians and Fijians, and allotted scholarships in a manner "heavily weighted" toward Fijians (Tavola 1991: 55). Today Indians are restricted to hold a maximum of 50% of government scholarship awards regardless of qualifications, and scholarships available to Indians are means-tested whereas those available to Fijians are not (Puamau 2001; Fiji Human Rights Commission 2006: 88; Vallance 1996: 100).

While some of these measures were eased by a new constitution in 1997, another coup followed in 2000. The 1997 constitution was suspended, and feelings of insecurity among Indians intensified again. The new coup had much in common with the events of 1987. In both years, "coups had occurred in the wake of election victories by predominantly Indian-backed political parties. … Each time, takeovers had been carried out in the name of upholding 'indigenous paramountcy'" (Fraenkel 2007: 422). A fourth coup, in 2006, differed in fundamental respects from the others, but occurred outside the period analyzed here.

4.2   *Large differences in emigration between Indians and Fijians*

The policy changes after 1987 led many Indians to believe their economic prospects in the country had declined relative to their prospects elsewhere, and they began to depart the country en masse. By 2007, relative to a simple extrapolation of the pre-1987 trend, the Indian population had declined roughly 40%, while the Fijian population was largely unaffected (Figure 2). This is one of the largest and fastest departures of a developing country's population in recent history.

Although birth rates among Indians did decline, most of the decline in the Indo-Fijian population was due to emigration. Departures from Fiji after 1987 were roughly triple their pre-1987 levels among Indians, with little notable change for Fijians (Figure 3). This mass movement can be readily tracked in destination countries since the large majority of the emigrants went to Australia and New Zealand (Figure 4). Almost all of the rest went to Canada and the United States.

4.3   *Skill-selection at the destination*

The exodus has also been concentrated among highly-educated workers. In 1979, Australia followed Canada in creating a "points" system to reward higher education and certain skills in visa allocations. At the time that mass Indian emigration from Fiji began, three countries that were the destinations of roughly 70% of the

15

emigrants—Australia, New Zealand, and Canada—had such points systems. Here we discuss the system of Australia, by far the principal destination country for emigrants from Fiji.

Though it has changed over time, the Australian system has always heavily rewarded tertiary education and youth—both for independent migrants and for family-linked "concessional" migrants. The beginning of mass Indian emigration from Fiji happened to coincide with an Australian shift to an even stronger focus on skills in 1988.[6] In that system, the level of higher education and age were the two largest determinants of total points. The points threshold was such that, even for very young workers, qualification for an "independent" worker visa was almost impossible without tertiary education (Masri 1990; Hitchcock 1992: 80; Angley and Barber 1988).[7]

By 1990, skill-linked visas were the chief route of entry for new settlers in Australia (Jupp 2002: 146-150). The 1988 points system continued, with minor adjustments, throughout the early 1990s. There was little focus on particular skilled occupations during this period.[8] But more points were awarded to applicants whose skills were judged to offer them a high probability of quickly finding employment.

A revision of the points system in 1996 brought even greater skill-focus to Australian admissions (Miller 1999). By 1999 Australia had a "Skilled Occupations List" (SOL). In order to even be considered by the points system, skilled-worker visa applicants now needed postsecondary qualifications to perform an occupation on the SOL, and needed to be less than 45 years old (Crock and Lyon 2000: 37). Past that hurdle, the points system again heavily rewarded occupation-specific higher

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[6] In 1988, the Australian government announced a decrease of 10,000 immigration slots for family reunification but an increase of 17,000 slots for economic migrants (Masri 1990).
[7] The alternative was to go under a "preferential" family visa, which required immediate family to already be established in Australia.
[8] There was a provision for applicants in the early 1990s to earn a small number of extra points for an occupation included on the official "Priority Occupation List" (POL), but this appears to have been rarely used. In 1992, for example, the POL did not list any occupations.

education as well as low age. In 2000, this list included several professions including accountant, various forms of engineer, and teacher. Some of these occupations, those included on a separate "Migration Occupations in Demand List" (MODL) brought extra points to those past the SOL hurdle. MODL occupations in 2000 included accountant and information technology professional. The exigencies of the SOL and MODL remain similar today.

Figure 5 shows that most of the increase in Fiji-born settler arrivals in Australia following 1987 occurred through skilled-worker admission categories. Whether due to self-selection or to destination-country immigration laws easing movement of the highly-skilled, educated Fiji Islanders have been greatly overrepresented in the emigrant population versus the non-emigrant population. Higher education attainment among Fiji-born residents of Australia is above that of the native-born (AGDIC 2006).

4.3   *Fears of "brain drain"*

As in many academic analyses of large-scale skilled worker movements, research on Fiji has tended to assume that these massive, skill-focused departures have greatly and obviously depleted Fiji's human capital stock. Kunabuli (1990: 189) considers the "loss" of skilled workers from Fiji "quite ominous" and compares the effects of emigration to those of a large increase in the death rate. The World Bank (1995: 23) warns that emigration imposes "huge costs" on Fiji's economy from "lost investment in human capital." Lal (2001: 7) laments that "the best and brightest are leaving for other shores, taking with them the skills … the country can ill-afford to lose." Walsh (2006: 57) writes, "The coup trauma resulted in significant increases in emigration, particularly by Indo-Fijians, and large, crippling losses to Fiji's skilled labor force. … Fiji may have lost up to half its highly skilled labor force. … The numbers involved, and the loss of skills and experience in key occupations, can only be described as horrific."

But there are reasons to question simple assertions of "brain drain". For decades, the principal destination countries for emigration from Fiji have enforced strongly skill-selective immigration policies. Fiji Islanders wishing to leave the country had an incentive to acquire higher education in order to meet visa requirements. Propositions 2 and 3 suggest reasons why the post-coup policy shifts and consequent mass emigration might have induced more human capital investment by Indo-Fijians than if the exodus had never happened. Because emigration from Fiji is difficult and uncertain, it is even possible that this departure caused a net increase in Fiji's domestic stock of human capital. The following sections present data that allow a quasi-experimental test of the propositions.

5 Data

For much of the analysis we use full-universe census microdata generously provided by the Fiji Bureau of Statistics. Charts and tables using these data do not present standard errors because they are not samples; the only source of substantial error would be measurement error in the census, which we approximate as zero. We have one observation of every person in Fiji the year before the first coup, 1986, and a second observation (unlinked) of every person in Fiji in 1996. We supplement these data with a household sample-survey, the Household Income and Expenditure Survey of 2002-2003, which affords greater detail but only a single time-point.

Further data on school enrollments come from the Fiji Ministry of Education and constitute full-universe data. Aside from errors in enrollment reporting, which we take to be very small, the only source of substantial error in this estimate lies in the age-specific estimates of the population size in the denominator of the enrollment estimates. Since demographic data for Fiji are quite complete, we take this source of error to be minor as well.

Finally, we compiled unique historical data on graduates from the University of the South Pacific (USP), the largest and historically the most important institution of higher education in the country. These are disaggregated by ethnicity via the list of names circulated at each graduation ceremony. A potential source of error could be from misallocation of individuals into their ethnic groups through perusal of their names. This is unlikely as names are quite distinct in the two ethnic groups.

6   Results: Effects of skilled emigration on human capital stocks and flows

Figure 6 presents the arresting fact about post-coup education investment in Fiji, and is the starting point of all further analysis. Recall that roughly one fifth of the Indian population departed the country during the intercensal period 1986-1996, this departure was heavily weighted toward the highly educated, and the entire Indian population was in rapid decline. But despite all of this, Figure 6 shows that the number of Indians with tertiary schooling in Fiji did not decline or even remain constant. It increased enormously—by almost exactly as much as did the number of Fijians with tertiary schooling.

We can assert based on Figure 6 alone that even very large, sudden departures of the highly educated from a developing country to rich countries need not correlate with a decline in the stock of highly educated workers in the country of origin. Figure 6 is broadly consistent with the theoretical propositions above. For the group that did not emigrate, a sharp rise in economic prospects (modeled as a negative tax) in the form of markedly increased formal-sector job prospects, tertiary scholarships, and credit access was associated with an increase in the human capital stock. For the group that did migrate, a sharp decline in economic prospects in the presence of skill-selected emigration is associated with such a large increase in human capital investment that human capital stocks rise, even net of large departures of skilled workers.

6.1   *Census data*

Figure 7 disaggregates the above data by age. It shows the fraction of persons at each age who had attained Form 4 (equivalent to 10th grade in the US), Form 6 (12th grade), and tertiary schooling (which includes Form 7 and all other postsecondary education), in 1986 and 1996. Among young people, the schooling attainment gap between the two ethnic groups closed markedly during this period at the secondary level. At the tertiary level, it expanded greatly. These "stock" data show the educated population net of departures.

These data suggest that formation of Indian human capital rose more than formation of Fijian human capital after 1987, and that this occurred exclusively at the tertiary level. Because secondary qualifications by themselves are worth little in the immigration points systems of Australia, New Zealand, and Canada, this accords with emigration as the motive for the change in Indian behavior. Furthermore, these stock data show the result of human capital investment net of all departures, suggesting that the change in Indian investment behavior was large enough to fully offset massive departures of tertiary-educated Indians at the time.

6.2   *School enrollment data*

Figure 8 supplements the census "stock" data with school enrollment "flow" data. While the Ministry of Education does not collect historical ethnicity-specific enrollment figures for the higher education system,[9] it does collect figures on enrollment in Form 7—a postsecondary gateway year to higher education that since the early 1990s has been the principal route to all higher education in the country. While Form 7 enrollment does not capture all tertiary enrollment, it captures the large majority of it, as can be seen in the close correspondence between census-based tertiary attainment measures for 18 year-olds and Form 7 enrollment rates

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[9] We also attempted without success to obtain historical ethnicity-specific enrollment statistics directly from the University of the South Pacific and the Fiji Institute of Technology.

for 18 year-olds. Figure 8 shows a large divergence in Form 7 enrollment between the ethnic groups after the coup. The absolute difference-in-difference is much larger in Form 7 than in Forms 4 or 6 in the early 1990s, and the proportional difference-in-difference is larger in Form 7 then in Forms 4 or 6 throughout the post-1987 period.

A remarkable feature of Figure 8 is the extremely high tertiary enrollment rate for Indian 18 year-olds, even by global standards. In the United States, for example, only 29% of 18-19 year olds in the 2005 Current Population Survey had attained tertiary education (Bureau of the Census 2005). Indo-Fijian children, despite growing up in a far poorer country, now attain tertiary education at higher rates than American children. This accords well with the explanation that they are acquiring tertiary training for a global labor market rather than a local one. This holds despite the fact that secondary attainment rates for Indians in the same figure are well below those seen in the United States. Again this accords well with predicted behavior in response to destination-country immigration policy that selects strongly on tertiary education but only weakly on secondary education per se.

6.3   *Graduation data*

Furthermore, the number of bachelor's degree graduates from the University of the South Pacific rose rapidly not long after mass emigration began, and rose much more for Indians than for Fijians (Figure 9). The country returned to stability around 1989-1991 (World Bank 1995: 5-14), and the earliest bachelor's degree graduates responding to this new environment and the new constitution thus would have emerged around 1993-5. It is at this time that graduation numbers for Indians and Fijians sharply diverge, in three of the University's four faculties.

The fact that graduations showed no ethnic divergence in the Faculty of Islands and Oceans corroborates the inference that Indian students were strongly motivated by the migration prospect. Students in that faculty acquire qualifications in tourism and

hospitality, environmental science, agricultural science, land management, and related disciplines. None of these have appeared on Australia's aforementioned Skilled Occupation List (SOL), which affords extra visa qualification points for training in certain fields. The lack of ethnic differences in graduation numbers from this faculty is therefore an important falsification test for the validity of the quasi-experiment.

In contrast, the other three faculties—in which Indian graduations massively increased relative to Fijian graduations—grant degrees in fields that figure prominently in Australia's SOL. The Faculty of Science and Technology provides qualifications in Computing Science and Information Technology; the Faculty of Business and Economics provides qualifications in accounting and financial management; and the Faculty of Arts and Law provides qualifications in primary/secondary school teaching. All of these occupations receive maximum skill points (60) on the SOL when combined with postsecondary qualifications.

7 Internal validity

The experience of Fiji, like any quasi-experiment, presents important limitations of experimental validity. These must be carefully assessed before we can attribute the increase in domestic human capital to effects of the post-coup change in relative foreign-home returns to schooling. Below we discuss in detail several potential concerns of internal validity (does correlation constitute causation?), construct validity (does causation act through the mechanism suggested by the model?), and external validity (would the result differ in other circumstances?). We begin with three concerns about internal validity.

7.1   *Selection*

The first and most important threat to internal validity is that the treatment group in this case is not randomly selected and may differ both observably and unobservably from the control group in ways that may affect educational attainment. Indian migrants could have been richer, for example, and thus faced fewer credit constraints. Alternatively, unobserved differences in social and cultural norms might cause Indians to invest more in human capital than Fijians.

Pre-treatment comparison on observables does not suggest major differences of this kind. In 1912, 53 percent of Fijians could read and write, while only 9 percent of Indians could (Gillion, 1962: footnote 68). For much of the early 20th century, Indians were unequivocally seen as behind the Fijians on education performance and investment (Gaunder 1999, 62; Parliament of Fiji 1968). This suggests little purely cultural predisposition toward schooling investment brought from the subcontinent. Just prior to the coups, however, Indian secondary and tertiary attainment was somewhat higher than Fijian enrollment, suggesting that it is important in this analysis to control for pre-experimental differences.[10]

Development indicators from the early to mid-1980s (Table 1) show that fertility, female life expectancy, unemployment, and average weekly earnings were very similar between the two ethnic groups. Female age at marriage was lower and infant mortality rates were slightly higher among Indians. The Indian population was about nine percentage points more urbanized than the Fijian population. The distribution of income between the two groups differed more than the means: The poorest Indians were poorer than the poorest Fijians, seen in higher poverty rates for Indians and lower per-capita household incomes for the bottom quintile of

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[10] Notably, White's (2003) historical analysis attributes much of the pre-1987 disparity in education between Fijians and Indians to colonial-era restrictions on movement—in this case, internal movement by Fijians. The 1948 Fijian Affairs Regulations under the colonial government and Fijian chief Ratu Sir Lala Sukuna attempted to preserve Fijian traditions by severely restricting Fijian migration into urban areas, consequently preventing Fijian access to jobs requiring higher schooling, and to schools geared to prepare students for those jobs.

Indians than the bottom quintile of Fijians. Household income per capita in the top quintile of Indians, however, was about fifty percent higher than the same figure for Fijians.

It is plausible that this difference in the top quintile—or other differences both observable and unobservable between the two groups—could influence schooling decisions. A differences-in-differences analysis can help to control for observable and unobservable differences prior to the experiment, with close attention to assumptions about functional form of the treatment-effect expansion path. The data in Figure 7 show such an analysis. The first thing to notice is the large widening of the tertiary-attainment gap between younger Indians and younger Fijians after the 1987 coup—despite the fact that many educated younger Indians departed during precisely this period.

In Form 4 and Form 6, the simple difference between the two groups' attainment declined. Notably, secondary school attainment per se does not substantially affect one's chances of successful emigration to any of the major destination countries. This represents, then, an important falsification exercise. If some unobserved cultural difference between Indians and Fijians regarding education investments in general affected not just the prior level of attainment but also the rates of expansion in attainment, we would expect this to hold for secondary education as well.

The "flow" measures of enrollment and graduation in Figures 8 and 9 also allow differences-in-differences analysis, controlling for all time-invariant observable and unobservable differences between the groups. In Figure 8, the enrollment gaps between Indians and Fijians in Form 4 and Form 6 were similar in the years just before and just after the coups. The enrollment gap at the postsecondary level— Form 7—soared after the coups. In Figure 9, the graduation gap balloons right around the time of graduation for the first bachelor's degree classes following the post-coup return of stability.

Differences-in-differences analysis controls for time-invariant pre-experimental differences between treatment and control. But some Indians' traits that might have affected schooling behavior, such as wealth, could have been changing during the post-coup years. Table 2 explores whether or not controlling for a variety of observable development indicators in the census microdata can explain the gap between Indian and Fijian tertiary attainment. The dependent variable is a dummy for the tertiary attainment of each 18 year old in the census who is either Indian or Fijian. The first two columns reveal that the gap increased about tenfold between the censuses. The next two columns show that the gap is undiminished when controlling for a variety of covariates such as household infrastructure, parental occupation, household-specific child mortality, and province dummies. Differences on none of these observed dimensions, then, can explain the gap.

So far we have assumed that simple differences are the appropriate functional form, but differences-in-differences estimates are notoriously sensitive to this assumption. The final two columns of Table 2 adopt a logit specification and display odds ratios, pointing out that not only the partial difference between Indian and Fijian tertiary attainment rose between the censuses; the ratio of attainment rates rose as well. The differences-in-differences result is robust, then, to alternate functional forms in the expansion path as well as controlling for a variety of plausibly relevant observable traits.

We supplement these results with analysis of the Fiji Household Income and Expenditure Survey (HIES) conducted in 2002-2003. Its advantage is that, unlike the census, it contains a direct measure of household income. Its disadvantage is that there is no pre-experimental observation,[11] so it constitutes a post-test only. Figure 10 shows average per-capita household expenditure on secondary and tertiary schooling, by ethnic group and income quintile, in the 2002-2003 HIES sample.

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[11] An HIES was conducted in 1990-1991, but we choose not to use it, for two reasons. First, it does not afford a pre-coup observation. Second, problems with sampling in the 1990-1991 HIES have caused some researchers to question its representativeness (Kami 1997).

There is no systematic difference between ethnic groups in expenditure on secondary education. But there are large and statistically significant differences in mean expenditure on tertiary education between ethnic groups, at all levels of household income. This suggests that differences between the ethnic groups' expenditures do not arise from income differences in any part of the income distribution.

Table 3 conducts OLS regressions on the same HIES data. The dependent variable is total household expenditure (not per-capita) on primary, secondary, and tertiary schooling. Regressors include the size and age composition of the household, as well as income. Indian and Fijian households are included in the sample, so the coefficient on the Indian dummy shows the difference in spending between the groups. There are no large differences between primary and secondary education expenditures in the two ethnic groups. At the tertiary level, however, there is a large and statistically significant difference (column 5) that only rises when income, household size, and other covariates are controlled for (column 6). Again, this suggests that the large differences in Indian investment in tertiary education do not arise from difference in income (or else the Indian dummy would be insignificant in column 6), or from differences in cultural predisposition toward education (or else the Indian dummy would have been positive and significant in columns 2 and 4).

7.2   *Crossover*

A further concern for internal validity is the existence of "crossovers", people in the quasi-control groups who received some form of treatment. Figures 3 through 5 show, for example, that Indian emigration was already rising before 1987, for example—although nowhere near to post-1987 levels. A plausible cause of this emigration is the minor economic crisis of the early 1980s, when Fiji was hit by a drought, tropical cyclone Oscar, a spike in oil prices, and turbulence in international prices of sugar, Fiji's major commodity export (Sepehri and Akram-Lodhi 2000: 76).

Another important form of crossover is the large increase in incentives for tertiary school completion for Fijians after 1987. In this period it became an explicit goal of the ruling government to get more Fijians relative to Indians into the tertiary schooling system. Tertiary scholarships for Fijians rose substantially, both in number and size. Seventh Form subsidies in the 1990s were given to equal numbers of Indians and Fijians, even though far more Indians were enrolling in Seventh Form (Ministry of Education 1993). Cutoff scores on Form 6 and Form 7 leavers' examinations for admission to tertiary education were raised for Indians relative to Fijians, more government jobs for tertiary leavers were reserved for Fijians, and their promotions in the public service were accelerated. Today, means testing is largely absent for Fijian applicants for tertiary scholarships from the Fijian Affairs Board, but has been retained for Indian applicants for similar scholarships from the Department of Multi-Ethnic Affairs. Many publicly funded tertiary training institutions, such as the Fiji College of Advanced Education, are legally required to admit a substantial Fijian majority in each entering class. These interventions were seen as broadly successful and their results can be observed in the large post-coup increases in Fijian tertiary attainment.

Both of these forms of crossover, however, tend to produce underestimates of the parameter of interest rather than overestimates. If the 1986 census occurred at a time when Indian's estimates of future migration probability and home economic prospects had already shifted somewhat, then the measured effect of the large shift following 1987 would likely have been larger without this form of crossover. Likewise, since tertiary attainment and enrollment went up for Indians relative to Fijians both in difference and in ratio, the effect can reasonably be expected to have been even larger if the supply of tertiary education had not been shifted toward Fijians. These threats to internal validity result in conservative estimates of the human capital investment reaction.

A similar nuance arises from this quasi-experiment's violation of the stable unit treatment value assumption (SUTVA; Angrist, Imbens and Rubin 1996) that each

person's outcomes are influenced only by the treatment of that individual rather than through general equilibrium or spillover effects. It is plausible, for example, that part of the reason for rises in tertiary attainment among Fijians post-1987 was an unmet demand for skilled labor produced by Indian emigration. This would again tend to make the estimates of this investigation conservatively low. It is more difficult to conjure reasons why the emigration of Indians would cause a decline in Fijian tertiary attainment, which would make the estimates here exaggerate the true effects on Indians. Another SUTVA violation could arise if the Fiji government restricted public scholarships to Indians precisely because it knew they were likely to later emigrate; this appears to be the case, as Fiji government scholarships for overseas study by Fiji Islanders are available to Fijians, but not to Indians. In any case, questions of general equilibrium effect are of greater policy interest than those relating only to partial equilibrium. The effects measured here should therefore be considered more of a total derivative than a partial derivative (Duflo, Glennerster, and Kremer 2008).

7.3   *Attrition*

If the research goal is to establish the effect of migration on educational investment behavior, census data exhibit high rates of attrition, since a large fraction of educated Indians departed the country between censuses and were not present for the post-test. Here one should rely primarily on "flow" data about enrollments and graduations. Since roughly one quarter of the college-age Indian population departed Fiji between the 1986 and 1996 censuses, for example, it is not surprising that the stocks in Figure 4 show smaller ethnic gaps than the flows in Figures 8 and 9, both in differences and ratios.

On the other hand, if the research goal is to establish the effect of skilled emigration on the net stock of human capital, census "stock" data are more appropriate than "flow" data. For this purpose, to the extent that census counts were performed accurately, attrition in the census data is near zero. The census data show that, net

of departures from the country, Indian tertiary attainment rose by more than Fijian tertiary attainment. Since emigration rates are highest among young Indians with tertiary attainment, this suggests that even the large relative expansion in Indian attainment in the stock data understate the relative expansion in investment behavior. This is borne out by the flow data on enrollments and graduations.

8   Construct validity

Construct validity refers to the ability of the experiment to separate one theoretical model of the treatment effect from another.[12] Here we discuss competing theoretical models that are also consistent with some features of the data.

8.1   *Supply versus demand*

Propositions 2 and 3 do not constitute the only theoretical model capable of producing a large increase in Indian investment in human capital relative to Fijian investment. One alternative model is one in which the post-coup governments greatly expanded the supply of tertiary education available to both ethnicities, in the hope that more Fijians would take up the new spots, but found demand among Fijians to be low and fixed. In this case, tertiary attainment among Indians could rise relative to Fijian attainment even though demand among Indians did not change after mass emigration began.

There is no evidence that the Fiji government produced a large expansion in tertiary schooling supply but was unable to fill the requisite spots with Fijians. One new institution of higher education, the Fiji College of Advanced Education (FCAE), did open in 1992, coincident with the explosion of Indian tertiary attainment. But Fijians or Rotumans have constituted at least half of intakes to every class in FCAE

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[12] A famous example of construct invalidity is the "Hawthorne" effect, in which treatment effects arise from scientists' observation of the subjects rather than from the designed intervention.

history.[13] Thus there was only a modest increase in supply of tertiary schooling, and Fijian demand for the new spots was not rationed.

Outside of the establishment of the FCAE, there is no evidence of a substantial government effort to expand the general supply of tertiary schooling at the time that Indian tertiary attainment soared. Figure 11 shows the evolution of the central government subsidy to the University of the South Pacific and the Fiji Institute of Technology, in real Fiji dollars. At the time that Indians poured into USP in the mid- and late- 1990s, these subsidies were flat or declining. Further subsidies beyond these were distributed to individuals as scholarships, but tertiary scholarships available to Indians did not increase after the coups relative to those available to Fijians; the tendency was in fact the opposite. This strongly suggests that the large majority of these students were paying their own way, and that the rise in attainment was driven primarily by demand.

8.2   *Remittances and credit constraints*

Propositions 1 to 3 assume away credit constraints to schooling investment. It is theoretically possible that Indians did not experience any change in the foreign-domestic differential in returns to tertiary education, but simply were better able to finance tertiary education investments at existing returns because relatives had gone abroad for other reasons and sent home remittances.

The regressions in Table 3 test this directly. First, the difference between Indian and Fijian investment in tertiary education only rises when household income is held constant. Second, the regressors include a separate term for the portion of household income that is "gifts received", and this has no partial positive association with tertiary spending, controlling for total household income.[14] If an important

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[13] Data provided by the Students Management System, Fiji College of Advanced Education.

[14] It is possible that some survey respondents placed remittances in "other income" rather than "gifts received". For this reason we include "other income" in the regression. It has a positive partial

reason for the difference in Indian tertiary schooling behavior were the remittance-financed relaxation of credit constraints, controlling for "gifts received" and total income would substantially reduce the coefficient on the Indian dummy in these regressions. Instead, including these covariates raises the coefficient on the Indian dummy.

A less direct but still informative test is provided by the tertiary attainment regressions in Table 2. These show that controlling for various measures of household comfort on which remittances could be spent (extra rooms, improved sanitation, better construction materials, electric wiring, and even child survival) does not narrow the gap in educational investment between Indians and Fijians, but rather widens it. If remittances are the primary reason for the gap, then, it would have to be the case that remittances are spent with enormously greater priority on tertiary schooling than on child survival or improved material living conditions. We consider this unlikely.

8.3   *Human capital versus signaling*

Another important concern about construct validity arises because Indians did not receive exclusively the treatment of an increase in the relative foreign-domestic return to human capital. After 1987, more jobs in the public sector were reserved for Fijians and it is possible that some portion of the increased Indian investment in tertiary schooling is unproductive signaling in competition for a reduced pool of domestic jobs.

While this could influence the estimates to some degree, we note that unemployment of educated Indians barely rose between 1986 and 1996, while

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association with tertiary expenditures. But the mean fraction of household income received as "other income" is higher among Fijian households (10.6%) than Indian households (10.5%).

unemployment of educated Fijians rose by more.[15] Thus if there was increased competition for domestic high-skill jobs among Indians relative to Fijians, emigration provided an effective safety valve, and it is implausible that mass emigration came as a surprise for any large share of Indians who had acquired tertiary education exclusively for reasons of domestic signaling. Furthermore, the patterns of USP graduation seen in Figure 9 give evidence that emigration is the express purpose of many Indians' tertiary education investments. In that figure, as discussed above, there is close correspondence between occupations in demand in Australia and the subjects that Indian students choose.

Beyond this, standard Australian and New Zealand skilled worker visas have made it much easier for younger people to acquire skilled worker visas (with a cap at age 45, and higher points for much lower ages). It is thus noteworthy that the rises in Indian tertiary attainment are concentrated among youths while increases for Fijians display much greater variance in age. Figure 12 uses a cohort analysis of the 1986 and 1996 census data to establish the age range of departures. The horizontal axis shows an individual's age in 1986. The vertical axis shows the change in the size of that cohort by 1996, either in absolute (upper pane) or percentage (lower pane) terms. In each pane, the bottom half shows changes in the total number of people, and the upper half shows changes in the number of people with tertiary schooling attainment.[16]

In other words, Figure 12 shows where the schooling expansions in Figure 6 occurred in the age distribution. The integral between the Indian and Fijian tertiary education curves in the upper pane of Figure 12 is roughly +4,000 up until those

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[15] In the 1986 census data person records, 2.6% of Indians with postsecondary educational attainment are unemployed ("economic activity" = "looking for work"), and in 1996, 3.0% of Indians with postsecondary attainment are unemployed ("days of work" = "unemployed"). The same figures for Fijians are 1.4% in 1986 and 3.4% in 1996.

[16] For example, the upper pane shows that the number of Indians who appear in the 1996 census at age 31 was about 1,800 fewer than the number of Indians who appear in the 1986 census at age 21, while the corresponding decline for Fijians was only about 700. The lower pane shows that this decrease represents about 25% of the cohort for Indians, and 10% for Fijians. Since death rates are low in this age range, we can attribute the large majority of these differences to emigration.

who were age 18 in 1986, and for those who were over 18 in 1986 the integral between the curves is roughly –4,000. This balance produces the parallel growth in absolute numbers of those with tertiary attainment seen in Figure 6, but the increase for Indians occurred among the relatively young while the increase for Fijians was more widely distributed across ages. All of this evidence suggests that even if Indians acquiring tertiary schooling are doing so for signaling rather than human capital acquisition, they are signaling for the international labor market rather than the domestic one.

8.4   *Relative return to human capital investment versus other investments*

Given the multiplicity of new interventions in the economy after 1987, it is theoretically possible that investment in human capital sharply increased because Indians' returns to investment in other assets declined by more than their returns to human capital investment did. This could conceivably generate an increase in demand for human capital unrelated to migration.

There is no evidence of a large, sudden decline in the returns to capital investment by Indians after the coups began. There were no major expropriations of Indian-owned businesses. Between 1987 and 1997, there was no rise in the fraction of companies listed by the Fiji Registrar of Companies that were owned by ethnic Fijians; rather, this fraction slightly declined (Ratuva 2000: 232). There was no wave of Indian bankruptcies after 1987. Fijian-owned firms saw expanded access to subsidized capital through Fijian Holdings Limited and the Commercial Loans to Fijians Scheme, but the terms of credit available to Indians did not deteriorate in absolute terms. There was no special tax on Indian-owned businesses, nor any lasting campaign of violence against them.

New entry of Indians into a few business sectors was regulated—notably the government ceased issuing new taxi licenses to Indians in 1993—but this was the exception rather than the rule (Ratuva 2002). And import licenses for a limited

33

number of products were reserved for ethnic Fijians, but this phenomenon was relatively minor. One of the most famous examples was the government's 1989 decision to reserve a portion of rice importation licenses for Fijians, but this only covered 3,000 of the 17,000 tons of rice imported that year (Sutherland 2000: 212). In short, there is little reason to suspect that Indians were investing heavily in tertiary education because they suddenly lost access to other profitable capital investments.

Nor were there major changes in Indians' returns to investment in land after the coups. 92 percent of land in Fiji is legally reserved for Fijian and public ownership, as it was in the colonial period (Ward 1995: 199). There was little material change in this policy before or since 1987. There were short-lived declines in land prices during the economic instability that followed the 1987 coups and the 2000 coup, but these would have affected the investment returns of Fijian landowners at least as much as Indian tenants. In the late 1990s a number of long-term leases held by Indians began to expire and some were not renewed. But as of 2000, of the 134 long-term leases that had expired, 102 had been renewed for another 30 years. And even prior to expiry, Indian tenants had no property right in the land itself and very weak property rights to improvements on it (Prasad and Kumar 2000: 131). There is thus little reason to suspect that increases in Indians' human capital investment were sparked by sharp declines in their returns to investing in any land-related assets.

8.5   *Treatment and response incidence*

Another threat to validity is that the Indians who are emigrating could somehow differ in an unobserved way from those who are making the schooling investments. It could be, for example, that departures were occurring only or primarily among older Indians whose prospects were of questionable relevance to younger Indians making educational investments, which would render the evidence irrelevant to the theoretical model above.

Figure 12, discussed above, also reveals that there is a good match between treatment and response incidence across ages. Departures were largest in fractional terms for those who were in their twenties during 1986-1996, departures for Indians were triple those of Fijians in this age range, and young Indians coming up behind them invested much more in tertiary schooling than their Fijian counterparts. This pattern of timing accords well with a model in which investments in tertiary schooling are made for the prospect of migration.

9   External validity

Here we discuss three concerns regarding the applicability of these results to other circumstances.

9.1   *More opportunity abroad versus less at home*

The most noteworthy threat to the external validity of this investigation, and one of the traits that distinguishes it from all others in the literature, is that the shock to relative foreign-home returns to schooling arises not from an increase in the expected return to human capital abroad, but from a decrease in the expected return to human capital at home. We have presented theoretical reasons to consider these two shocks as symmetric; they both reflect an increase in the opportunity cost of making human capital investment decisions based on the home labor market rather than on the world labor market. It is nevertheless possible that Indo-Fijians would have reacted differently to an increase in this opportunity cost arising from an increase in economic prospects abroad (such as a substantial relaxation in immigration restrictions in the destination countries) than from a decrease in economic prospects at home.

This hypothesis cannot be definitively tested with the present experiment. Note, however, that the decrease in home prospects was immediately followed by one of the largest and fastest emigrations on record—for the treatment group only. There can be little doubt that the behavior of Indo-Fijians in the aftermath of the coups was strongly affected by information at their disposal about their *relative* prospects abroad versus at home. If this were not the case, and instead it was exclusively the absolute decline in home prospects that somehow induced the flood of Indians into university, the subsequent emigration of so many of those same people would have to have been—implausibly—a surprise.

Contemporary observers within the education system reported the opposite: Indian students at the time felt "that they must become as well qualified as possible … with a long-term view to emigrating" (Tavola 1991: 53). Migration was quite foreseeable for large numbers of Indo-Fijians, many of whom spent years working to bring it about. It is not immediately clear why one source of change in the probability of foreseeable future migration would affect schooling investment decisions greatly differently than another source.

Such differences could nonetheless exist; research on "endowment effects" (Hanemann 1991) suggests, for example, that Indo-Fijians' reaction to a decrease in future income believed to be their due (decreased prospects in Fiji) could differ from their reaction to an increase in future income not seen as an entitlement (increased prospects in Australia). On this subject we make two observations. First, recent experimental evidence suggests that past evidence of large endowment effects in laboratory settings may have been an artifact of experimental method (Plott and Zeiler 2005). Second, if Indo-Fijians entering tertiary education were reacting primarily to the loss of a perceived entitlement rather than to an international gap, one might expect the schooling reaction of Indo-Fijians to diminish over time: Many of those just attaining tertiary schooling now were not even born at the time of the first coup, and thus have never known a Fiji in which their economic future there was broadly considered a secure entitlement by large

numbers of Indians. Tertiary schooling rates among Indians, however, are higher than ever today as the emigration continues.

9.2   *Unique traits of the sending country*

Another important concern bearing on the applicability of these results to other contexts is that Fiji was not randomly selected for this study. It was chosen because a natural experiment of scientific interest occurred there. It is possible that Fiji is somehow different from all other developing countries. It could be, for example, that Indo-Fijians are in some sense less "rooted" than other populations and therefore more responsive to international differentials in opportunity.

Few Indo-Fijians, however, retain family ties to the Indian subcontinent, and a large number of other developing countries contain large ethnically-distinct groups with little access to land ownership, so it is unclear that Indo-Fijians are unique in this regard. Data from a detailed household level survey showed that Indo-Fijians with post-secondary qualifications remitted US$641 compared to the corresponding figure for ethnic Fijians of US$695 (World Bank, 2006; Table 3.11).[17] This suggests that even after migrating, Indo-Fijians do not exhibit markedly weak ties to their homeland.

9.3   *Unique traits of the destinations*

A major determinant of external validity for these results is that three of the four principal destination countries for Fiji Islanders exhibit highly skill-selective immigration policies. As McKenzie and Rappoport (2006) observe for Mexico-US movements and DeBrauw and Giles (2008) observe for rural-to-urban migration in China, in contexts with substantially less skill selection or even skill-deterrence

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[17] The difference in remittances between the two groups was the greatest for those with a maximum of secondary education. This, as noted by the World Bank, is due to the large number of Indigenous Fijians employed in the Middle East on temporary basis and mostly within the security industry.

there is little reason to expect similar effects. This pattern accords well with theory (Proposition 3). Skill-selective migration corridors are globally important, however, and are likely to get much more important as both the United States and the European Union are currently considering legislation shifting their immigrant admissions toward the highly-skilled—the US in the stalled "Comprehensive Immigration Reform Acts" of 2006 and 2007, and the EU with the planned establishment of a "blue card" visa.

Note also that Australia entered recession in 1990-1991. Thus the pull from this major destination country would have been subsiding exactly when large numbers of Indo-Fijians were emigrating. In another setting with a similar large decline in home returns to human capital but no small decline in foreign returns, the impact of the home decline on investment behavior might have been larger.

10   Discussion

While these results suggest that emigration raised stocks of human capital in Fiji, they do not imply that emigration raised stocks of natural talent, raised worker productivity, or improved public finances. These separate issues we discuss below.

10.1   *Ability level in the sending-country workforce*

Propositions 1 to 3 imply that those with the highest unobserved natural ability are more likely to migrate than those who do not. Thus emigration can cause the level of natural ability in the domestic populace can decline by some amount. The earlier propositions yield

> **Proposition 4:** $d\hat{a}/d\tau < 0$, and if $p < 1/A$, then also $d\hat{a}/dp < 0$. The ability threshold at which people prefer to migrate decreases with the tax rate and with the probability of successful migration.

38

That is, unless the probability of emigration is extremely high, both increases in domestic taxation and increases in the chance of successful migration tend to lower the ability level above which workers prefer to emigrate. These changes raise the relative return to working abroad versus at home, making emigration attractive to a person previously just below the ability threshold $\hat{a}$. This has an immediate consequence:

Proposition 5: $\frac{dE[a]}{d\tau} = p\frac{\hat{a}}{\bar{a}}\frac{d\hat{a}}{d\tau} < 0$. The average ability level in the home population tends to decrease with the tax rate, as increased taxation places more workers above the ability threshold at which migration is desirable. This effect is smaller, the smaller is the probability of successful migration, and the lower is the ability threshold already. By related reasoning, $\frac{dE[a]}{dp} < 0$, an effect whose size decreases with the probability of successful migration and with the ability threshold.

Testing natural ability is difficult. Two observations, however, suggest that any such decline in natural ability among Indians is minor. First, if the departure of Indians is substantially depleting reserves of natural ability in the Indian population, and if natural ability is heritable, then we would expect to observe poorer performance on standardized tests by the children of Indians who have not emigrated. But Indian performance on standardized tests at all levels of schooling has not declined (either in absolute terms or relative to Fijians), even for children born well after mass emigration began. For example, Indian performance relative to Fijians on the standardized Fiji Junior Certificate exam—administered after 10 years of schooling—has increased relative to Fijians since Indian mass emigration began.[18]

Second, if Indian emigration is substantially decreasing the stock of natural ability in those remaining behind, and if people of lower ability tend to show lower demand for higher education, then we might expect demand for higher education among

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[18] In 1986, just before mass Indian emigration began, 78.4% of Fijian children passed the standardized Fiji Junior Certificate exam while 79.5% of Indian children did so. In 2006, after two decades of heavy emigration by skilled Indians, 82.0% of Fijian children passed, while 87.3% of Indian children passed (from the 1986 and 2006 *Annual Reports* of the Ministry of Education).

Indians to decline as the emigration proceeds. As we have discussed, the observed tendency is that Indian demand for higher education has sharply increased along with the emigration.

10.2 *Productivity of the sending-country workforce*

Furthermore, even if emigration has raised stocks of acquired human capital in Fiji, it is possible that emigration has so depleted stocks of inborn talent that worker productivity has declined. The net result depends on which effect dominates. Mountford (1997) presents a model in which skilled-worker emigration can raise worker productivity by inducing domestic human capital formation. The same phenomenon can be seen more simply in the present theoretical framework. Although Proposition 4 suggests that high-skill emigration can deplete stocks of natural talent, increased human capital investment can offset this loss. Propositions 2 and 4, with equation (3), imply

> **Proposition 6:** $dE[\pi]/d\left(\frac{p}{1-\tau}\right)$ can be positive or negative. That is, although an increase in the chance of migration or a decrease in the tax rate causes a decrease in average domestic ability, the resulting rise in human capital investment for people of given ability means that the net effect on worker productivity is ambiguous.

This proposition is difficult to test in Fiji with the available data. One approach would be to conduct Mincerian wage regressions at different points in time to investigate dynamics in the wage-schooling relationship for Indians. The census does not contain earnings data, however, and as mentioned above, the Household Income and Expenditure Survey from 1990-1991 experienced problems in sampling that have rendered its data suspect. One fact is suggestive: Neither the level of, nor growth in, Fiji's real GDP has been markedly different during the period of mass Indian emigration than prior to it.

10.3 *Public finance*

Finally, even if migration raises domestic human capital, it could deplete public coffers if incremental investment in human capital is publicly subsidized. Some portion of Indians' higher education has been publicly financed. As we have shown, however, the large majority of the surge in post-coup Indian tertiary education has been privately financed. Furthermore, the net effects of emigration on public coffers could only be determined with an extensive analysis of factors we do not consider. These include the Keynesian multiplier effects and public revenue effects of domestic expenditures from remittances—of which Fiji now receives approximately US$130 million per year, or about 5% of GDP (Mohanty 2006: 115).

11 Conclusion

We raise several questions regarding conventional concerns about "brain drain", interpreted here to mean a loss of human capital necessitated by the emigration of skilled workers. We have two main findings. First, in a context of constrained and skill-selected migration, a shift in the relative foreign-domestic return to tertiary education can directly increase investment in tertiary education in a migrant-sending country. Second, this increase can be large enough to fully offset the decline in home-country stocks of human capital due to the departure of highly educated workers. By no means does this imply that what has happened in Fiji can or must happen everywhere. But it does suggest that this can happen in a setting where many observers have considered the loss of skilled workers to be too obvious to question. The experience of Fiji gives reason to doubt the very notion that skilled-worker emigration causes, by definition, a loss of skilled workers to the country of origin.

The belief that a worker who departs must be a worker "lost" shares much with the 18th-century mercantilist belief that an ounce of gold flowing abroad is necessarily

lost wealth. David Hume dismembered this fallacy in his 1752 *Political Discourses*. When gold is traded for imports and "lost", Hume pointed out, this tends to lower domestic prices and raise the incentive to buy the source country's exports. The net effect on production and wealth can be positive in general equilibrium, because the movement of gold changes the incentives of market participants.

Flows of skilled workers abroad likewise change the incentives faced by everyone in the domestic economy, and the net effect on domestic skilled worker stocks need not decline. As counterintuitive as these conclusions may seem, they are a direct consequence of the fact that human capital is not a static resource in fixed quantity. It forms and dissipates in response to incentives—incentives to which physical movement is inextricably bound, as many labor markets are spatially delimited. The practice of defining skilled worker movements as the mechanical "loss" or "drain" of those workers should join mercantilism in the litter bin of economic thought.

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Table 1: Comparison of groups near beginning of emigration

	Fijians	Indians
Health and urbanization		
Fertility, 1980	3.3	3.3
Female life expectancy, 1986	65.3	65.1
Median female age at marriage, 1985	23.5	20.4
Infant mortality, 1986	19.2	21.0
Percent of population urban, 1986	32.7	41.4
Employment and income		
Unemployment, 1986	4.3%	4.0%
Percent in poverty, 1990	31.3	34.5
Avg. weekly earnings, 1986	F$136.9	F$144.7
Household weekly income/cap., bottom quintile 1990	F$10.9	F$10.4
Household weekly income/cap., top quintile 1990	F$95.6	F$151.2

Fertility, age at marriage, life expectancy, urban population, infant mortality, and earnings data from Bureau of Statistics (1990: 5, 7, 11, 13, 14, 73). Poverty figures based on household income from UNDP (1998: 32, Table 14), where poverty is defined as a household income less than 50% of the national average. Household income per capita figures by quintile is in weekly current Fiji dollars and is based on UNDP (1998: 25, Table 10). Unemployment data and corroboration of other statistics in this table from Bureau of Statistics (1989: *passim*).

Table 2: Correlates of tertiary attainment among youth, 1986 and 1996

Dependent variable: Tertiary attainment dummy
Sample: 18 year-old Fijians and Indians only

	OLS		OLS		Logit, OR	
	1986	1996	1986	1996	1986	1996
Indian	**0.012**	**0.119**	**0.015**	**0.123**	**1.639**	**2.438**
Male			−0.001	−0.010	0.939	0.913
Toilet (flush)			0.021	0.087	1.886	1.914
Toilet (water-sealed)			0.005	0.024	1.268	1.102
HH child mortality			−0.008	0.003	0.681	1.018
People/Room			−0.001	−0.002	0.873	0.912
HH head professional			0.040	0.117	2.194	1.997
Electricity			0.003	0.012	1.282	1.334
Constant	0.021	0.093	0.016	0.051		
14 Province dummies	N	N	Y	Y	Y	Y
6 HH construction dummies	N	N	Y	Y	Y	Y
Observations	13559	14796	12957	13597	12767	13596

No standard errors are reported, as the data comprise the entire population. "Logit, OR" signifies that logit odds ratios are reported rather than raw coefficients. The household construction dummies are concrete/brick/cement, wood, permanent tin/iron, makeshift/improvised, and other. The toilet base group includes "latrine" and "none". "HH head professional" is a dummy variable that takes the value of 1 if the head of household gives an occupation categorized by the census bureau as "professional, technical, administrative, and managerial". "HH child mortality" is the number of children ever born to women in the household in which each individual lives who died prior to the census date, divided by total children ever born to women in the household. "People per room" in the household in which each individual resides is the total number of people in the household divided by the number of rooms in the house. "Electricity" is a dummy variable indicating that the household in which the individual resides has electricity.

Table 3: Correlates of schooling expenditure in the Household Income and Expenditure Survey 2002-2003

Dependent variable	Schooling expenditure, F$					
	Primary		*Secondary*		*Tertiary*	
Indian HH	−29.7	−13.5	−22.0	−4.71	109	123
	(6.83)	(2.66)	(2.64)	(0.576)	(4.09)	(4.77)
Total income, F$		$2.41×10^{-3}$		$5.34×10^{-3}$		$1.42×10^{-2}$
		(6.27)		(4.49)		(4.93)
Total income squared		$-9.10×10^{-9}$		$-1.55×10^{-8}$		$-3.06×10^{-8}$
		(3.12)		(3.03)		(1.27)
'Other' income, F$		$1.11×10^{-3}$		$-3.62×10^{-4}$		$1.48×10^{-2}$
		(0.546)		(0.200)		(2.26)
Gifts received, F$		$4.08×10^{-3}$		$4.38×10^{-3}$		$-1.85×10^{-2}$
		(0.66)		(0.529)		(2.57)
No. HH members, total		20.6		4.11		−32.5
		(12.4)		(1.24)		(2.91)
No. HH members age 15-34		−24.7		0.809		40.8
		(14.3)		(0.209)		(3.38)
No. HH members female		3.41		17.6		33.5
		(1.06)		(3.62)		(1.87)
Head of HH female		−4.56		−6.89		68.7
		(1.04)		(0.722)		(1.72)
Constant	70.6	−28.9	107	−30.4	97.7	−117
	(24.8)	(2.71)	(20.7)	(2.62)	(8.51)	(3.70)
N	5245	5245	5245	5245	5245	5245
Adj. R²	0.008	0.087	0.001	0.047	0.003	0.043

OLS regressions weighted by household sampling weight. Absolute value of t-statistics in parentheses. "HH" = household. Sample includes Indian households and Fijian households, thus base group is Fijian households.

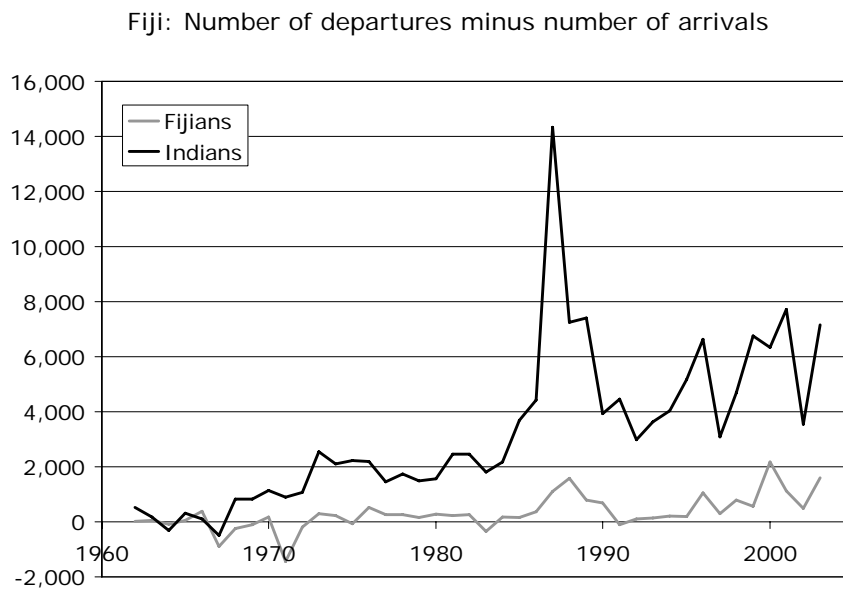**Figure 1: Schooling investment and the foreign-home relative return to schooling**

$$w', c$$

$$(1 - \tau)w'(h)$$

$$pAw'(\hat{h})$$

$$c(a)|_{\sigma=1}$$

$$c(a)|_{\sigma>1}$$

h

$\hat{h}^*$ h^*

$\hat{a}$ $\bar{a}$

a

$$(1 - \tau)w(h)$$

$$pAw(\hat{h}) - m$$

$$pAw(\hat{h})$$

$$w$$
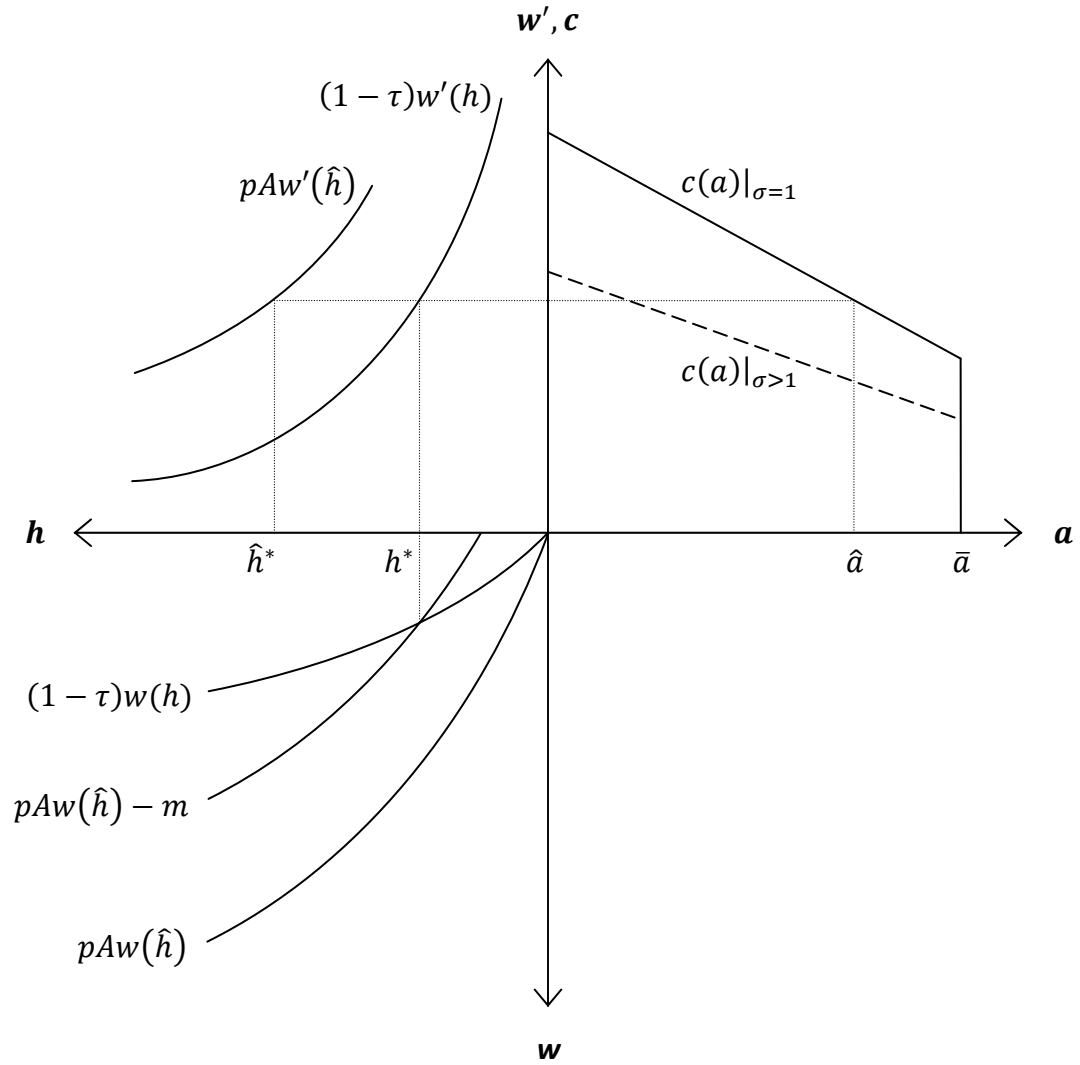
Figure 2: Population of Fiji by ethnicity, 1880-2007

Population of Fiji

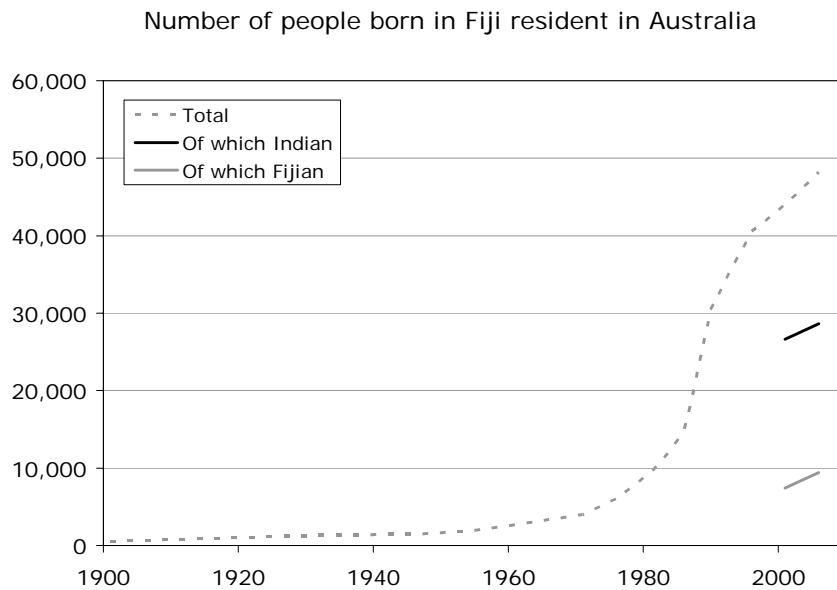**Figure 3: Net air and sea departures from Fiji by ethnicity**

Fiji: Number of departures minus number of arrivals

Figure 4: Evolution of the Fiji-born resident population of New Zealand and Australia

Number of people born in Fiji resident in New Zealand
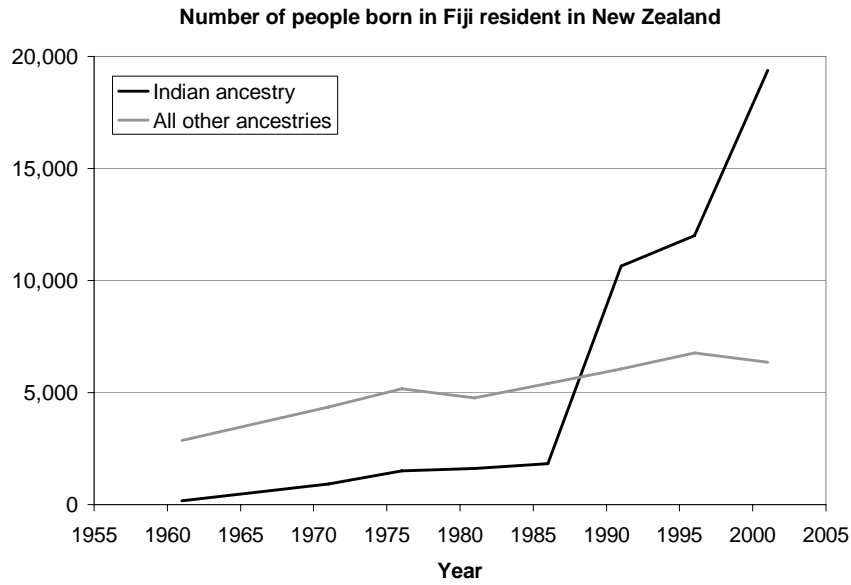
Source: Statistics New Zealand (see Appendix).

Number of people born in Fiji resident in Australia

Source: Australian Bureau of Statistics (see Appendix).

Figure 5: Fiji-born settler arrivals in Australia by broad category

Settler arrivals in Australia, born in Fiji
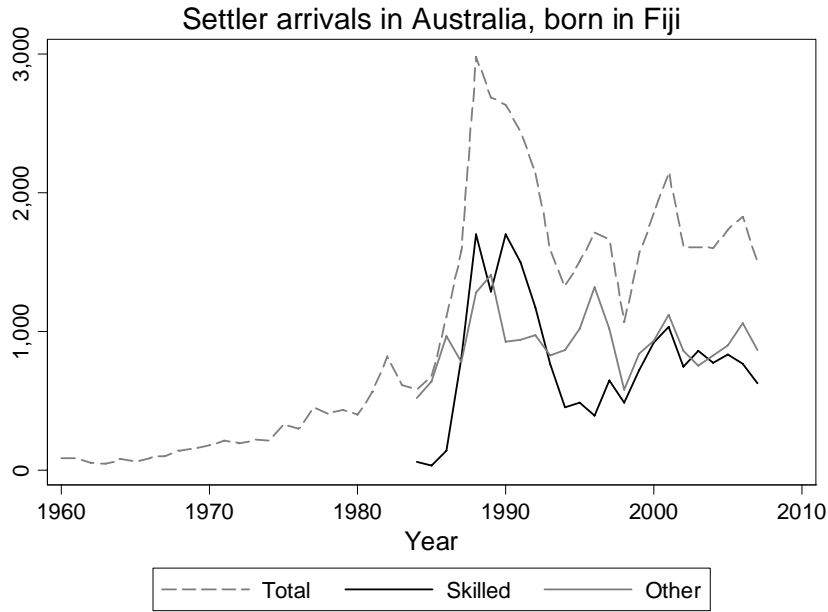
Source: Australian Bureau of Statistics. "Skilled" includes both "skill" visa group (business, special talents, independent, and ENS) and family-linked visas with a high skill requirement (called at various points in history "family concessional", "Australia-linked skilled", and "Australia-sponsored skilled"). "Other" includes family and family preferential, humanitarian, and "non-program".
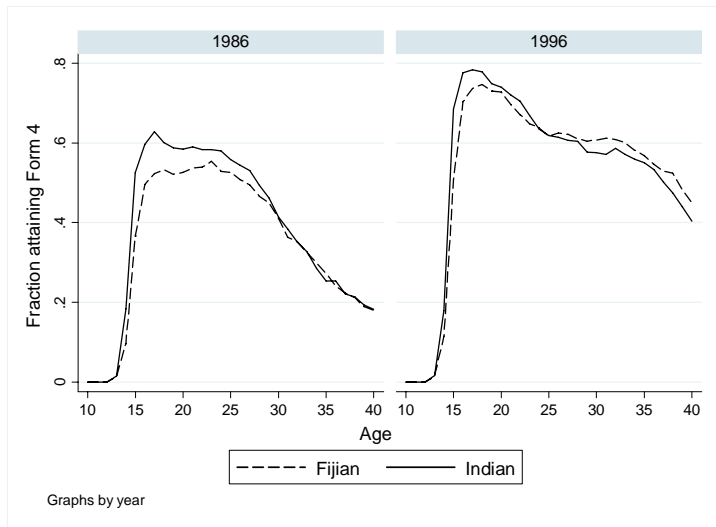
Figure 6: Increases in the absolute number of people attaining tertiary education, by ethnicity

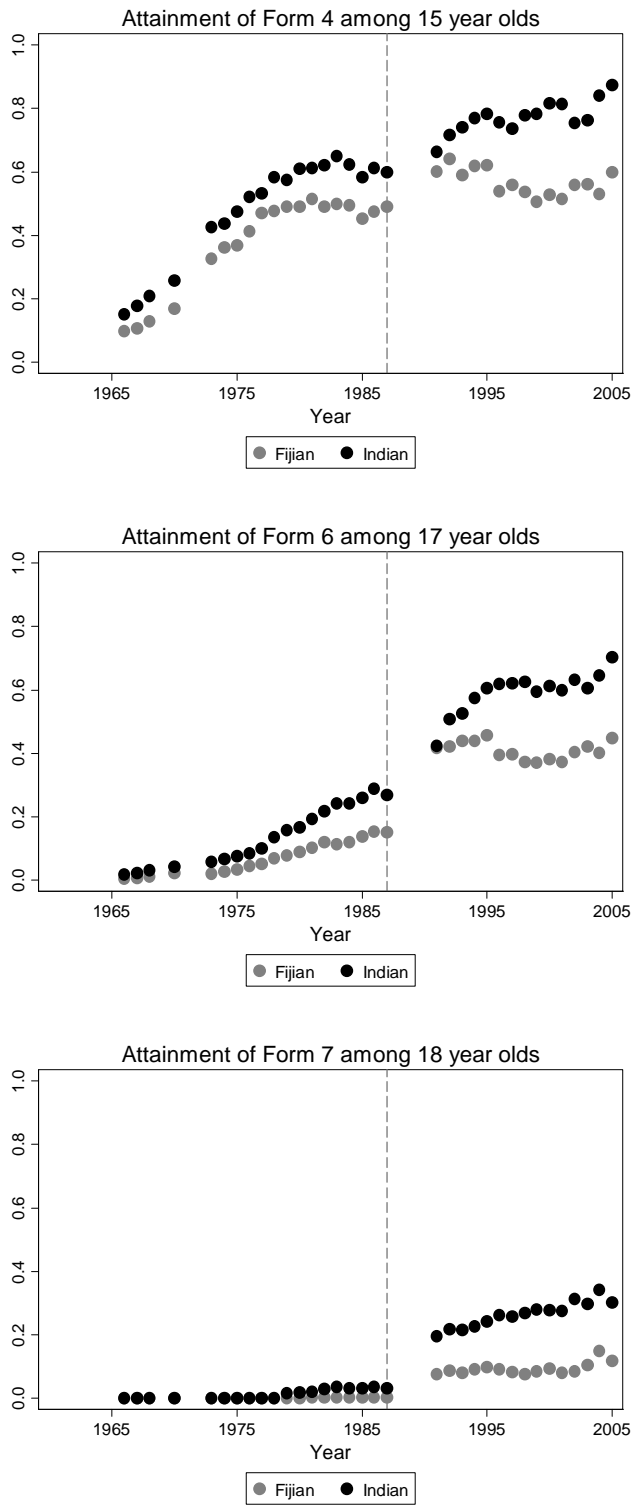Number of people with tertiary attainment
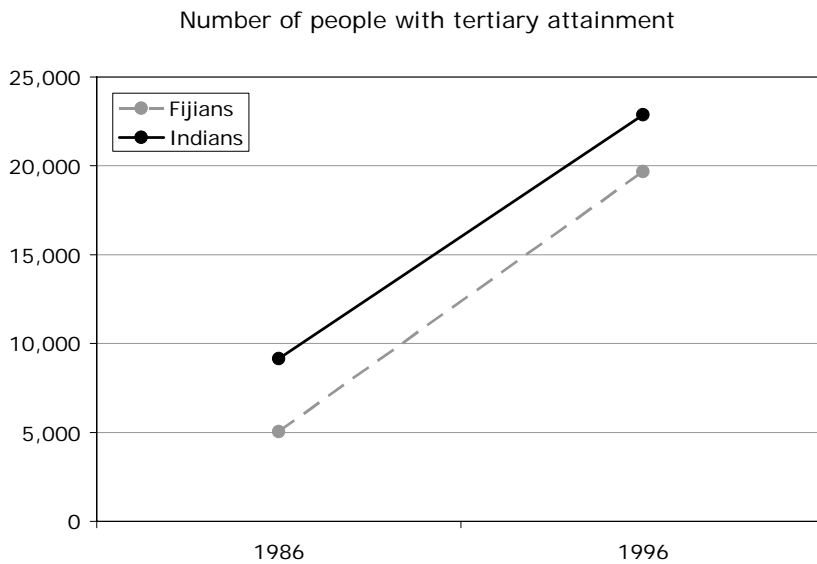
Source: Fiji Bureau of Statistics

**Figure 7: Secondary and tertiary school attainment by age, 1986 and 1996**
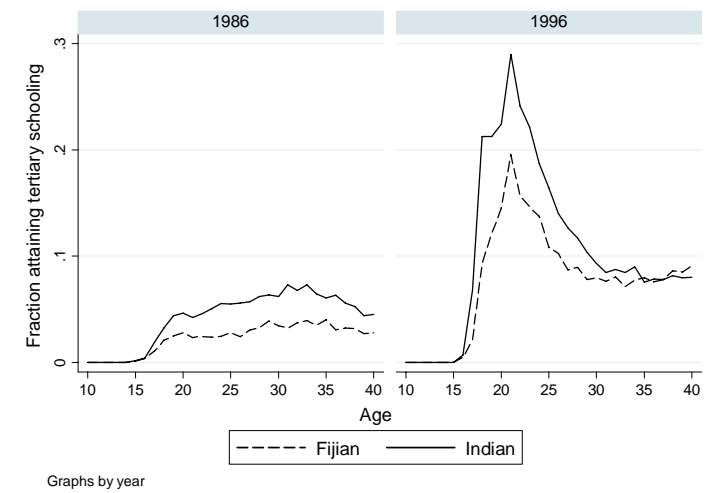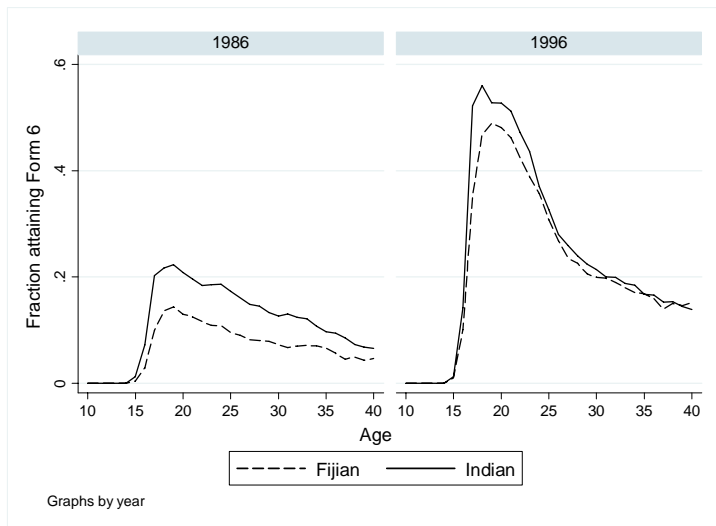
Figure 8: Secondary and tertiary school enrollment by ethnicity

Attainment of Form 4 among 15 year olds

Attainment of Form 6 among 17 year olds

Attainment of Form 7 among 18 year olds

Source: Ministry of education *Annual Report*, various years; see Appendix B.

Figure 9: Bachelor's degrees awarded to Fiji Islanders by the University of the South Pacific (typically 4 years after enrollment)
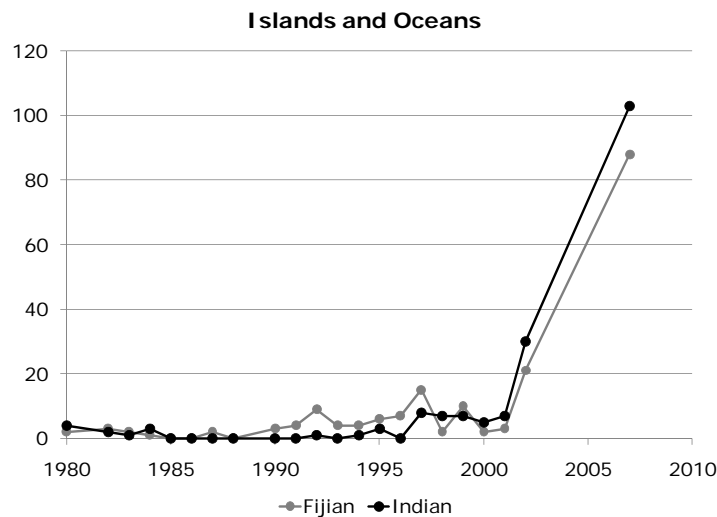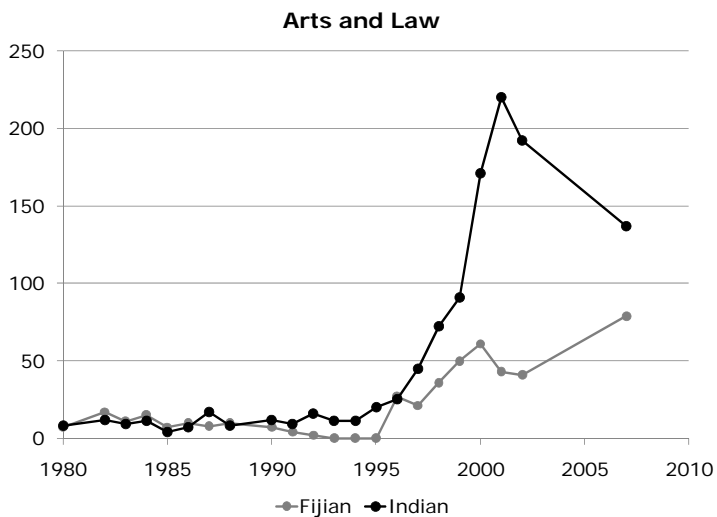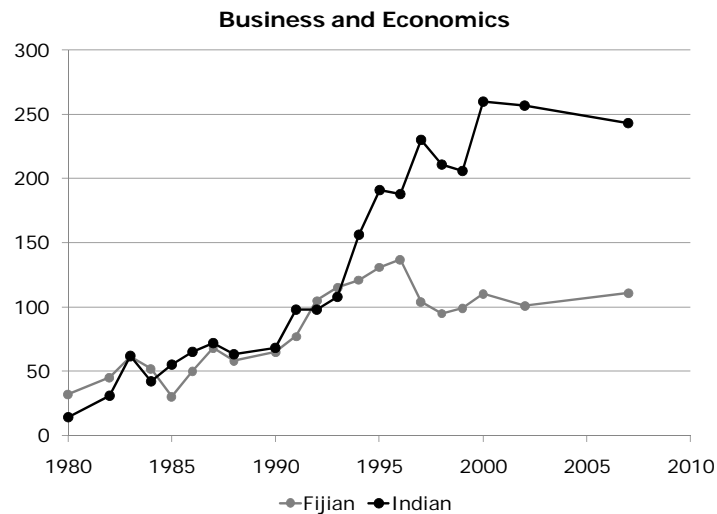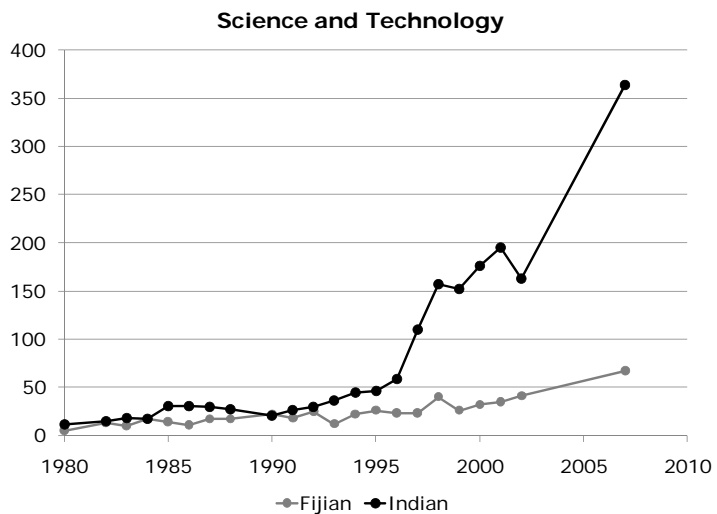
Figure 10: Differences in schooling expenditures per household member, by ethnic group and income quintile, 2002-2003

Secondary schooling expenditure
by household income/capita quintile

Tertiary schooling expenditure
by household income/capita quintile
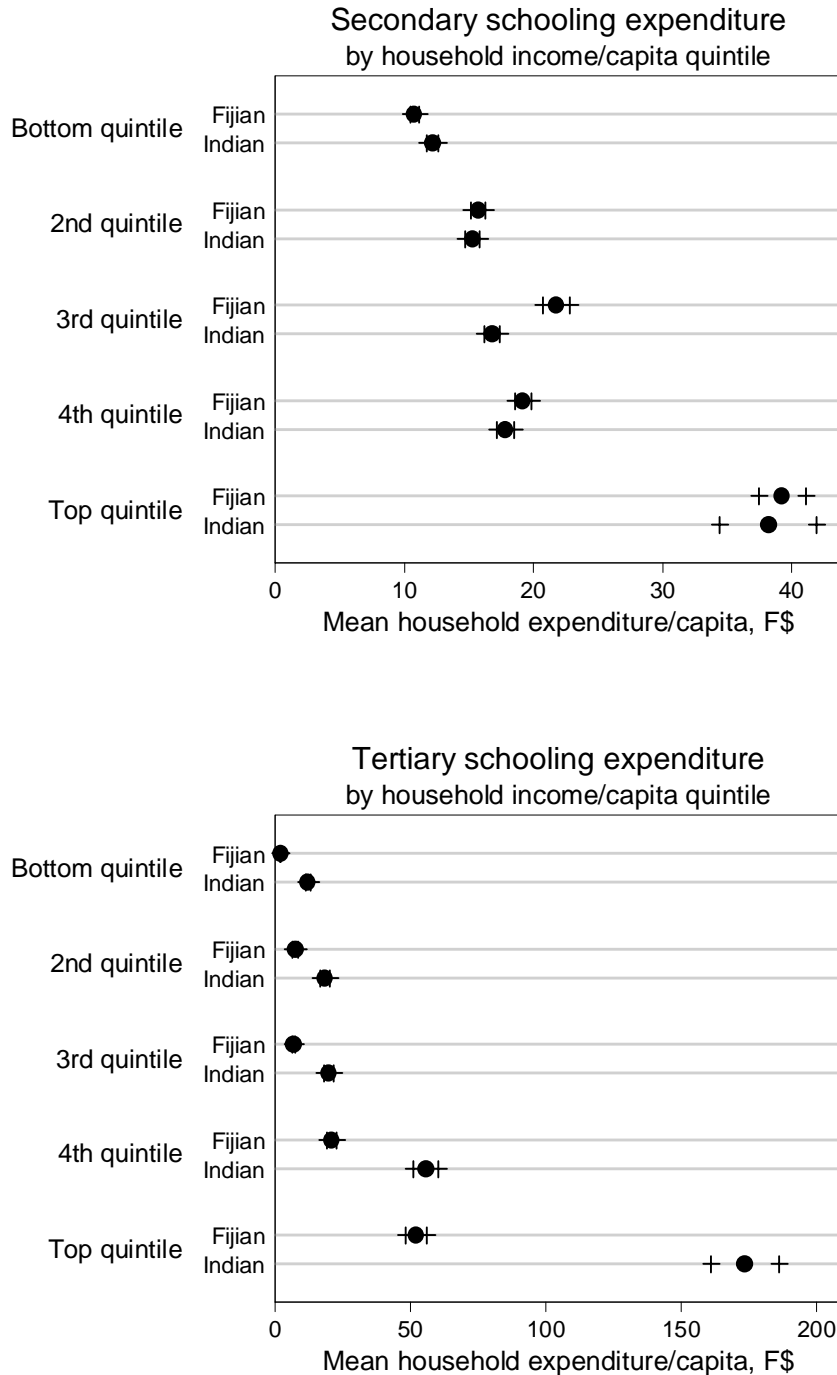
The horizontal axis is total household expenditure on each type of schooling divided by the number of people in the household. Circles show mean and plus-signs show 95% confidence interval, both of which are weighted by the household-level survey sampling weight. Horizontal axis shows monthly expenditure divided by number of people living in household. Data from the Fiji Bureau of Statistics, 2002-2003 Household Income and Expenditure Survey.

Figure 11: Fiji government real transfers to the University of the South Pacific (USP) and the Fiji Institute of Technology (FIT), 1991-2004
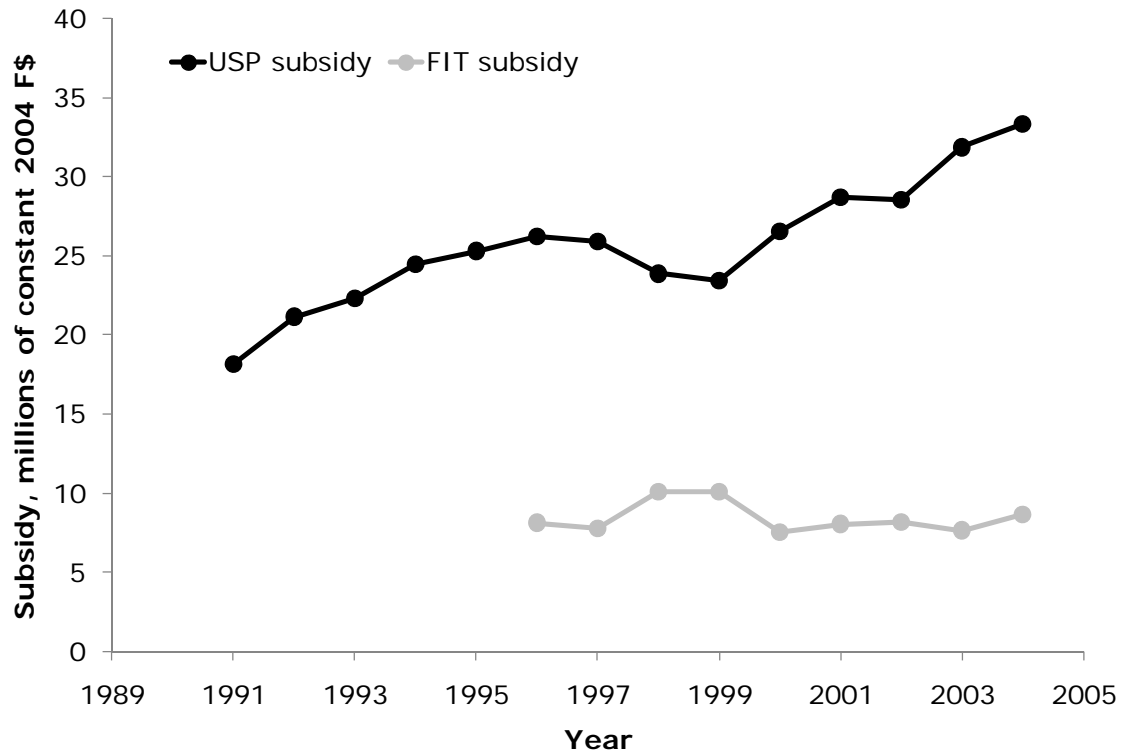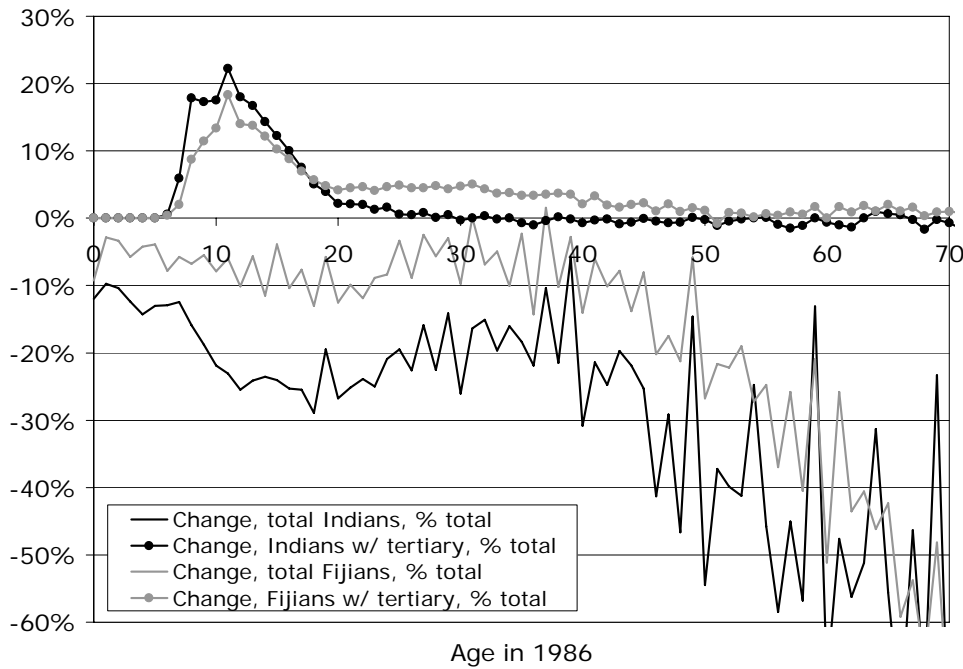

1991-1993 data from *Fiji Budget Estimates*, 1993 (p. 150) and 199 (p. 148). 1994-2004 data from Ministry of Education *Annual Report*, 1995-2004.

Figure 12: Cohort analysis of the 1986 and 1996 censuses

a) Absolute size of change in cohort

Age in 1986
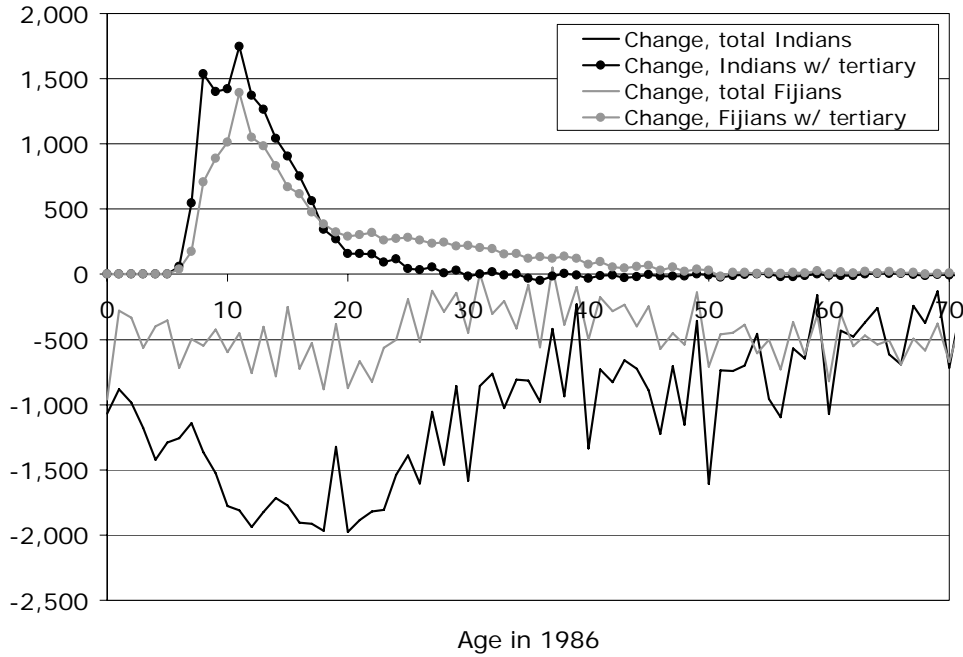
b) Percent change in cohort

Age in 1986

Appendix A: Proofs of propositions

<u>Proposition 1</u>

Given $\pi(\tau, h, a) \equiv (1 - \tau)w(h) - c(a)h$, the first-order condition for each individual of ability a to maximize π is $\frac{dw}{dh^*} \equiv w'(h^*) = \frac{c(a)}{1-\tau}$. Average human capital is then $E[h^*] = E\left[w'^{-1}\left(\frac{c(a)}{1-\tau}\right)\right]$. If $w(h)$ is everywhere continuous and differentiable and is strictly concave ($w'' < 0$) then w'^{-1} has finite, negative slope and $dh^*/d\tau < 0 \; \forall \; a \; \Rightarrow \; dE[h^*]/d\tau$. ∎

<u>Proposition 2</u>

From the above first-order condition, with $w(h) \equiv \ln h$, we have $h^* = (1 - \tau)/(\bar{c} - \zeta a)$. The corresponding first-order condition for $\hat{\pi}(p, A, \hat{h}, a, m) \equiv pAw(\hat{h}) - c(a)\hat{h} - m$ gives $\hat{h}^* = pA/(\bar{c} - \zeta a)$. Then $\pi^* \equiv \pi(h^*) = (1 - \tau)(\ln((1 - \tau)/(\bar{c} - \zeta a)) - 1)$ and $\hat{\pi}^* \equiv \pi(\hat{h}^*) = pA(\ln(pA/(\bar{c} - \zeta a)) - 1) - m$. An individual of ability a desires to emigrate if $\hat{\pi}^* > \pi^*$. Solving for a, assuming $\hat{h}^* > h^*$, an individual desires to emigrate if

$$a > \hat{a} \equiv (1/\zeta)\left(\bar{c} - e^{\frac{(1-\tau)(\ln(1-\tau)-1)-pA(\ln pA-1)+m}{(1-\tau)-pA}}\right) \tag{A1}$$

If there is no migration, average domestic h is $E[h] = \int_0^{\bar{a}} h^*(a)\frac{1}{\bar{a}}da = \frac{1}{\bar{a}}\int_0^{\bar{a}} \frac{1-\tau}{\bar{c}-\zeta a}da$. Integration by substitution ($u \equiv \bar{c} - \zeta a$) proceeds as $E[h] = -\frac{1-\tau}{\zeta\bar{a}}\int_{\bar{c}}^{\bar{c}-\zeta\bar{a}} \frac{1}{u}du = -\frac{1-\tau}{\zeta\bar{a}}\ln\left(1 - \frac{\zeta\bar{a}}{\bar{c}}\right)$. Thus $dE[h]/d\tau < 0$, as shown more generally above. With migration, now $E[h] = \int_0^{\hat{a}} h^*(a)\frac{1}{\bar{a}}da + \int_{\hat{a}}^{\bar{a}} \hat{h}^*(a)\frac{1-p}{\bar{a}}da$ where the second term reflects the fact that a fraction $1 - p$ of those who acquire $\hat{h}^*$ do not emigrate. From this,

$E[h] = \left(\frac{1-\tau}{\bar{a}} - \frac{p(1-p)A}{\bar{a}}\right)\int_0^{\hat{a}} \frac{1}{\bar{c}-\zeta a}da + \left(\frac{p(1-p)A}{\bar{a}}\right)\int_0^{\bar{a}} \frac{1}{\bar{c}-\zeta a}da$

$= (1 - \tau)\left(\frac{-(1/\zeta)\ln(1-\zeta\hat{a}/\bar{c})}{\bar{a}}\right) + (p(1-p)A)\left(\frac{-(1/\zeta)\ln(1-\zeta\bar{a}/\bar{c})+(1/\zeta)\ln(1-\zeta\hat{a}/\bar{c})}{\bar{a}}\right)$,

and differentiation of this expression gives

$\frac{dE[h]}{d\tau} = \underbrace{\left(\frac{-(1-\tau)}{\zeta\bar{a}}\right)\left(\frac{1}{1-\zeta\hat{a}/\bar{c}}\right)\left(-\frac{\zeta}{\bar{c}}\frac{\partial\hat{a}}{\partial\tau}\right) + \left(\frac{1}{\zeta\bar{a}}\ln(1-\zeta\hat{a}/\bar{c})\right)}_{<0} + \underbrace{\left(\frac{p(1-p)A}{\zeta\bar{a}}\right)\left(\frac{1}{1-\zeta\hat{a}/\bar{c}}\right)\left(-\frac{\zeta}{\bar{c}}\frac{\partial\hat{a}}{\partial\tau}\right)}_{>0}$.

$\frac{dE[h]}{dp} = \underbrace{\left(\frac{-(1-\tau)}{\zeta\bar{a}}\right)\left(\frac{1}{1-\zeta\hat{a}/\bar{c}}\right)\left(-\frac{\zeta}{\bar{c}}\frac{\partial\hat{a}}{\partial p}\right)}_{<0 \text{ since } c-\zeta a>0} + \underbrace{+\left(\frac{A(1-2p)}{\zeta\bar{a}}\ln\left(\frac{1-\zeta\hat{a}/\bar{c}}{1-\zeta\bar{a}/\bar{c}}\right)\right)}_{>0 \text{ iff } p<0.5} + \underbrace{\left(\frac{p(1-p)A}{\zeta\bar{a}}\right)\left(\frac{1}{1-\zeta\hat{a}/\bar{c}}\right)\left(-\frac{\zeta}{\bar{c}}\frac{\partial\hat{a}}{\partial p}\right)}_{>0}$.

which gives Proposition 2. Note also that $\left.\frac{d\hat{\pi}}{d\hat{h}}\right|_{\hat{h}=h^*} - \left.\frac{d\pi}{dh}\right|_{h=h^*} = \left(\frac{pA}{h^*} - c(a)\right) - (0) = c(a)\left[\left(\frac{p}{1-\tau}\right)A - 1\right] > 0$. ∎

Proposition 3

In this case, $\hat{h}^* = \sigma pA/(\bar{c} - \zeta a)$ and equation (A1) becomes

$$\hat{a} = (1/\zeta)\left(\bar{c} - e^{\frac{(1-\tau)(\ln(1-\tau)-1)-pA(\ln pA-1)+(m-pA\ln\sigma)}{(1-\tau)-pA}}\right) \qquad (A2)$$

Note that for σ sufficiently low, $\hat{h}^* < h^*$ so that now anyone with $a < \hat{a}$ prefers to emigrate as long as m is sufficiently low that $\hat{\pi}(\hat{h}^*) > 0$. This reverses Proposition 2 so that the emigration prospect can lower $[h]$, as can an increase in either τ or p. ∎

Proposition 4

Return to equation (A1) and consider the exponentiated ratio. The numerator of this ratio increases with τ, since $\frac{d}{d\tau}\big((1-\tau)(\ln(1-\tau)-1)-pA(\ln pA-1)+m\big) = \frac{d}{d\tau}\big((1-\tau)(\ln(1-\tau)-1)\big) = -\ln(1-\tau) > 0$. The denominator decreases with τ, since $\frac{d}{d\tau}\big((1-\tau)-pA\big) < 0$. Therefore the entire ratio strictly increases with τ, and since $\zeta > 0$, $d\hat{a}/d\tau < 0$. Similar reasoning leads to $d\hat{a}/dp < 0$, assuming $p < 1/A$. ∎

Proposition 5

$E[a] = \int_0^{\hat{a}} a\frac{1}{\bar{a}}da + \int_{\hat{a}}^{\bar{a}} a\frac{1-p}{\bar{a}}da = \left(\frac{p}{2\bar{a}}\right)\hat{a}^2 + \left(\frac{1-p}{2}\right)\bar{a}$. This implies

1) $\frac{dE[a]}{d\tau} = p\frac{\hat{a}}{\bar{a}}\frac{d\hat{a}}{d\tau} < 0$.
2) $\frac{dE[a]}{dp} = p\frac{\hat{a}}{\bar{a}}\frac{d\hat{a}}{dp} + \left(\frac{\hat{a}^2}{2\bar{a}} - \frac{\bar{a}}{2}\right)$. The first term is negative by Proposition 4. The second term is negative if, without loss of generality, $\bar{a} \equiv 1$. Thus $\frac{dE[a]}{dp} < 0$. ∎

Proposition 6

This follows immediately from Propositions 2 and 5. By Proposition 5, an increase in τ or p lowers the average ability in the population. But by Proposition 2, either change can increase the stock of acquired human capital h^* in the home country. These countervailing forces can, on balance, either raise or lower π^*. ∎

Appendix B: Data sources

Microdata from the Census of Fiji 1986 & 1996, and the Household Income and Expenditure Survey 2002-2003: Graciously provided by Toga Raikoti and Epeli Waqavonovono of the Fiji Islands Bureau of Statistics.

Stocks of the Fiji-born in New Zealand are calculated from data on stocks of all Fiji-born and percentages ethnically Indian found in: Statistics New Zealand website, "Birthplace for the Census Usually Resident Population Count,

2006", accessed Oct 28, 2007 [http://www.stats.govt.nz/NR/rdonlyres/BC29ACAC-12C9-4A5A-A71B-C7AD3A4335B8/0/06birthplace.xls]; Statistics New Zealand (2002), *People Born Overseas, New Zealand Census of Population and Dwellings* 2001, Table 2, p. 22; Statistics New Zealand (2002), *People Born Overseas, New Zealand Census of Population and Dwellings 2001*, Table 7, p. 87; Statistics New Zealand (1997), *People Born Overseas, New Zealand Census of Population and Dwellings 1996*, Table 2, p. 27; Statistics New Zealand (1997), *People Born Overseas, New Zealand Census of Population and Dwellings 1996*, Table 4, p. 39-40; Statistics New Zealand (1992), *Population Overview, 1991 Census of Population and Dwellings*, Figure 2.7, page 35; Statistics New Zealand (1992), *New Zealand's Multicultural Society, 1991 Census of Population and Dwellings*, Table 1, p. 17; Statistics New Zealand (1987), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1986*, Table 12, p. 51; Statistics New Zealand (1987), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1986*, Table 3, p. 19; Statistics New Zealand (1982), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1981*, Table 28, p. 91; Statistics New Zealand (1982), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1981*, Table 4, p. 11; Statistics New Zealand (1977), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1976*, Table 4, p. 18; Statistics New Zealand (1977), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1976*, Table 20, p. 57; Statistics New Zealand (1972), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1971*, Table 4, p. 18; Statistics New Zealand (1972), *Birthplaces and Ethnic Origin, New Zealand Census of Population and Dwellings 1971*, Table 20, p. 80; Department of Statistics (1963), *Vol. 7: Race, New Zealand Population Census 1961*, Wellington, Table 9, p. 36.

Stocks of the Fiji-born in Australia come from Australian Bureau of Statistics (1991) *Australian Immigration, Consolidated Statistics 1989-90*, No. 16 (Canberra: Australian Government Publishing Service), Table 2, p. 7; Australian Bureau of Statistics (1995) *Australian Immigration, Consolidated Statistics 1993-94*, No. 18 (Canberra: Bureau of Immigration, Multicultural and Population Research), Table 1.2, p. 3; Australian Bureau of Statistics (1998), *Australian Demographic Statistics*, December Quarter 1997, 3101.0. Table 9, p. 22. Ethnicity-specific figures come from Australian Government Dept. of Immigration and Citizenship (2001), *Community Information Summary, Fiji Born*, Jointly produced by Multicultural Affairs Branch and the Programme Statistics and Monitoring Section of DIAC; Australian Government Dept. of Immigration and Citizenship (2006), *Community Information Summary, Fiji Born*, Jointly produced by Multicultural Affairs Branch and the Programme Statistics and Monitoring Section of DIAC.

Annual enrollment by grade level and age: In each case the numerator is the number of children of each ethnicity enrolled in the given grade level who have the given age or lower. These numbers are taken from the *Annual Report* of the Ministry of Education, in each year. The Ministry of Education did not produce an annual report covering the years 1988, 1989, and 1990. The denominator is the number of people of each ethnicity who have the given age, in each year. The raw data for these estimates come from the age pyramids in the reports on the census of the population (1966, 1976, 1986, and 1996), plus an additional timepoint from the intercensal population pyramid estimates for 2003 published by the Fiji Bureau of Statistics (Fiji Islands Bureau of Statistics, *Key Statistics*, June 2008, "Population: Table 2.5, Estimated Population by Ethnic Origin, Sex and Age as at 31st December 2003", http://www.statsfiji.gov.fj/Key%20Stats/Population/2.5estimated%20population.pdf, accessed August 7, 2008). Populations at each age level for the intervening years are interpolated geometrically.

Number of graduates from USP by program of study and ethnicity: compiled using name-list for graduating students for each year kept at the University of the South Pacific. We estimate that fewer than two percent of students have names that leave ambiguity about their ethnic groups.

USP and FIT subsidies: These are taken from the following Fiji government publications: *Fiji Budget Estimates 1993, as approved by Parliament*, page 150; *Fiji Budget Estimates 1995, as approved by Parliament*, page 148; Ministry of Education, Women, Culture, Science and Technology, *Annual Report for the Year 1995* (Suva: Parliament of Fiji), p. 2; Ministry of Education, Women, and Culture, *Annual Report for the Year 1996* (Suva: Parliament of Fiji), p. 4; Ministry of Education and Technology, *Annual Report for the Year 1997* (Suva: Parliament of Fiji), p. 4; Ministry of Education and Technology, *Annual Report for the Year 1998* (Suva: Parliament of Fiji), p. 6; Ministry of Education, *Annual Report for the Year 1999* (Suva: Parliament of Fiji), p. 6; Ministry of Education, *Annual Report for the Year 2000* (Suva: Parliament of Fiji), p. 6; Ministry of Education, *Annual Report for the Year 2001* (Suva: Parliament of Fiji), p. 8; Ministry of Education, *Annual Report for the Year 2003* (Suva: Parliament of Fiji), p. 9; Ministry of Education, *Annual Report for the Year 2004* (Suva: Parliament of Fiji), p. 8. They are deflated to 2004 real Fiji dollars using the Consumer Price Index in Fiji Islands Bureau of Statistics, *Key Statistics*, December 2007, p. 75 ("All Items").