# THE PENNSYLVANIA STATE UNIVERSITY SCHREYER HONORS COLLEGE

#### DEPARTMENT OF ECONOMICS

## EDUCATION, REMITTANCES, AND RETURN MIGRATION

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A thesis submitted in partial fulfillment of the requirements for baccalaureate degrees in Economics and Political Science with honors in Economics

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#### ABSTRACT

The neoclassical "brain drain" hypothesis contended higher returns to skill in the developed world would lead to skilled emigration from the developing world, depleting the poorest countries of their skilled individuals and "trapping" them at low levels of human capital. However, descriptive and qualitative evidence suggest skilled emigration also has the potential to generate "brain gains" for developing countries by directly increasing or indirectly promoting human capital investment in the sending country. Does the likelihood of brain gains depend on migrants' skill level? Drawing on cross-sectional data from the World Bank's Migration and Remittances Surveys, I consider the relationship between migrant educational attainment and two specific channels of brain gain: remittances and return migration. I build on empirical work by Collier, Piracha, and Randazzo (2011) and others, using a probit model to estimate the effect of migrants' education on their propensity to remit and further analyzing the characteristics of return migrants. I find no systematic impact of migrant education on propensity to remit and significant heterogeneity among return migrants by sending country, demonstrating the contextdependent nature of brain gains and the challenges of linking migration to human capital accumulation and development.

# TABLE OF CONTENTS

LIST OF TABLES I	Π
LIST OF FIGURES I	V
ACKNOWLEDGEMENTS	V
. INTRODUCTION	1
I. THEORIES OF MIGRATION	4
II. CASE STUDY: INDIA	5
V. EMPIRICAL ANALYSIS	8
V. DISCUSSION	13
VI. CONCLUSION	16
APPENDIX A: DERIVATION OF PARTIAL EFFECTS	19
APPENDIX B: CODESHEET FOR CATEGORICAL VARIABLES	50
APPENDIX C: STATA CODE FOR REPLICATION	51
REFERENCES	50

# LIST OF TABLES

Table 1: Levels and changes in international migrant stock, 1990-2013.	l
Table 2: Expected signs of probit control variable coefficients, with reference groups shaded 24	1
Table 3: Sampling design for Migration and Remittances Household Surveys in Kenya, Nigeria, and Senegal, 2009-2010.	5
Table 4: Selected development indicators for Kenya, Nigeria, and Senegal, 2000-2010	5
Table 5: Summary statistics.   27	7
Table 6: Probit regression results with dependent variable Remit.    30	)
Table 7: Probit regression results with new independent variable, ln(HouseholdSize)	3
Table 8: Frequency of school attendance in last migration location by highest level of         educational attainment before migration.         37	7
Table 9: Work situation in last migration location by highest level of educational attainment before migration.    39	)
Table 10: Migration-related activities by highest level of educational attainment before         migration.       42	2

# LIST OF FIGURES

Figure 1: Migration and remittances by origin and destination.	. 2
Figure 2: Worldwide external financial flows to developing countries over time	. 2
Figure 3: Growth of remittance flows in the world and in selected countries, 1970-2015	14
Figure 4: Distribution of return migrants' level of educational attainment before migration	37
Figure 5: Reasons for return by highest level of educational attainment before migration	40
Figure 6: Remittance behavior by highest level of educational attainment before migration	41

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	International migrant stock			Refugees as percentage of				Annual rate of change of			
Destination	at	mid-yea	r (millio	ns)	intern	national	migrant	stock	migrant stock		
Destination	1000	2000	2010	2012	1000	2000	2010	2012	1990-	2000-	2010-
	1990	2000	2010	2015	1990	2000	2010	2015	2000	2010	2013
World	154	173	221	232	12.1	9.0	7.0	6.8	1.2	2.3	1.6
More developed	87	103	130	136	2.4	3.0	16	15	23	23	15
regions	62	105	130	130	2.4	5.0	1.0	1.5	2.5	2.5	1.5
Less developed	72	70	01	06	22.1	17.6	147	14.2	1	2.5	1 8
regions	12	70	71	90	23.1	17.0	14./	14.2	1	2.3	1.0
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Table 1: Levels and changes in international migrant stock, 1990-2013.

Source: United Nations Population Division.

A closer look at Table 1 reveals over two-thirds of the new migrants since 1990 have moved to more developed regions, or the global North. Again, the fact that refugees have constituted at most 3 percent of migrants in the North since 1990 suggests the majority were economic migrants. In 2015, although South-North migration was slightly less common than South-South migration, it drove North-South remittances, which account for 37 percent of all remittances and contribute to their rapid growth as a source of external finance, seen in Figure 1.



Figure 1: Migration and remittances by origin and destination.

Source: World Bank Migration and Remittances Factbook, 2016.





Source: World Bank Migration and Remittances Factbook, 2016.

Scholars and policymakers are interested in whether economic migrants' transnational activities can be leveraged for the development of the sending country, or if, on the other hand, their relocation leads to underdevelopment of the sending country. This thesis will examine the relationship between international migration and sending country development from a human capital perspective, taking remittances and return migration to be dimensions of the impact migrants have on their "home" economies. It will be guided by the following questions: *To what* 

extent can migration from developing countries to developed countries generate "brain gains" for the home economies? Can sending countries predict which migrants will be most likely to increase home human capital levels? Can this knowledge aid in the formation of migration policy and sending country development? In particular, it will investigate the effect of skill on migrants' probability of sending remittances and returning to their home economies.

The remainder of this thesis is structured as follows. Section II will describe the evolution of conceptions of migration as an economic process and its implications for development, focusing on studies of the "brain drain" and "brain gains." It will briefly review two existing models of remittances, featuring different migrant motives, to provide theoretical priors for the empirical analysis. Section III will present the migration experience of India to build a practical case for studying the impact of remittances and return migrants. Section IV will introduce an approach to empirically predicting migrants' propensity to remit, the household survey data, and the results of the analyses. Section V will discuss the limitations of the model. The last section, Section VI, will summarize the findings, formulate recommendations for migration policy in developing countries, and enumerate directions for future research.

#### II. THEORIES OF MIGRATION

Migration has long been understood as a response to wage differentials, or disparate returns to labor supply and quality across regions stemming from "spatial disequilibrium" in labor markets (Bodvarsson, Simpson, & Sparber, 2010). Accordingly, one of the earliest and simplest conceptualizations of migration as an economic process was pioneered by Sjaastad (1962), who analyzed migration as an investment in human capital. Migration is an investment because it incurs immediate costs with later benefits, and specifically is the result of individuals' choices to move where returns to their human capital are highest, in order to maximize wages and lifetime utility (Bodvarsson et al., 2010). More explicitly, an individual will migrate if the benefits exceed the costs of relocation.

Relocation has both monetary and non-monetary costs. The former are straightforward, depending only on the distance between the origin and destination; examples of the latter include the opportunity costs of time spent moving, acquiring information about the destination, and searching for employment in the destination, as well as the psychic costs associated with leaving behind family, friends, and one's place of origin. In the case that relocation occurs alongside other skill-increasing activities, such as attending a better school or new on-the-job-training, these human capital investments can also factor into the costs of migration.

Likewise, migration has both monetary and non-monetary returns. Monetary returns are realized through a higher wages or a lower cost of living (De Haas, 2010), and differ according to individuals' age, experience, and occupation. Non-monetary returns may reflect preferences for the destination. Ultimately, the migration decision balances monetary and non-monetary returns against monetary and non-monetary costs, implying migrants are positively selected: that is, they will exceed a minimum threshold of wealth that allows them to cover the initial costs of relocation, or a human capital level that ensures returns to migration are greater than costs.<sup>1</sup>

The "neoclassical" framework put forth by Sjaastad was an intuitive economic model that provided insight on individuals' motives for relocation and subsequent gains to migrants. Its premise of utility-maximizing behavior and pivotal notion of positive selection among migrants were carried forward in subsequent theories and empirically supported. However, it was limited in that it viewed migration decisions as static, one-period optimization problems, and largely dismissed the social context within which migration occurs, reasoning the private costs and private benefits of migration do not significantly differ from its social costs or social benefits.<sup>2</sup>

Bhagwati and Hamada (1974) made a critical contribution to the migration literature by a introducing a general equilibrium model that relaxed this assumption and explicitly connected the causes of skilled international migration to its aggregate impacts on the sending country, beyond household income and geographic labor reallocation. The model is based on an economy with skilled labor, unskilled labor, and a fixed cost of education. Domestic wages are dynamic, responding to both foreign wages and the probability of migration. In developing countries

<sup>&</sup>lt;sup>1</sup> More explicitly, it is easy to imagine that those who have high human capital levels initially are more likely to undertake further conscious investments in education, training, or other skill-increasing activities, which in turn create opportunities to earn higher returns on human capital abroad and make migration more appealing. They migrate to take advantage of natural ability and investments which produce differentials in human capital returns.

<sup>&</sup>lt;sup>2</sup> Extensions to the Sjaastad model recognized the migration decision depended upon location-specific costs and consumption possibilities, not simply individual characteristics and preferences. Consumption possibilities vary widely from area to area, whether they entail public goods like infrastructure and community facilities or cultural environments. For example, a number of studies have documented that existing social networks in a destination, either of family members or past migrants, can especially reduce psychic costs associated with relocation there (Bodvarsson et al., 2010). Consequently, these extensions allowed for the consideration of multiple alternative locations, with individuals searching for and evaluating information about the costs and benefits of each new location. They also acknowledged the close relationship between the life-cycle stage of the individual and their migration behavior, explaining why younger individuals are more likely to migrate, as well as migrate more frequently, than older individuals. Multiple episodes of migration in individual lifetimes may occur due to age-related changes in preferences and location-specific changes, including economic aspects like unemployment rates and public expenditures on education.

where capital-to-labor ratios, and hence productivity, are low, skilled wages are low; the opposite is true for developed countries with high capital-to-labor ratios. Skilled workers in developing countries thus have an incentive to migrate to developed countries. As they leave the home economy, the expected wages of skilled workers rise and cause the demand for education in the sending country to increase.

In response, the sending country increases public expenditures on and investment in education. But if public funds are used to provide education under the rationale that the social returns to education are greater than the private returns to education, skilled migration deprives the sending country of the full social returns. When skilled individuals educated at home leave the economy, non-migrants who remain experience a welfare loss, or negative externality. Migration eventually results in a "brain drain" of skilled workers from developing countries where skilled wages are low to developed countries where skilled wages are high and widens inequality across countries. Pessimism surrounding the brain drain dominated migration literature for several years (van Naerssen, 2008).

A departure from the neoclassical perspective that treated migration not as an individual undertaking, but rather a joint household decision identified a source of development gains: remittances. In Stark and Bloom's theory, the "New Economics of Labor Migration" (1985), the household aims not only to maximize utility, but also to minimize risk. Migration constitutes a means of portfolio diversification for the household: it is one of several different types of activities they may engage in to overcome the constraints of imperfect markets, especially credit markets (De Haas, 2010). In developing countries, poor households may not have access to credit markets as a consumption safety net, so in the absence of other social welfare policies, they designate one or more members of the family who can take their skills abroad and earn

higher incomes, or at least incomes immune to local economic distress. Then, migrant remittances, the central element of this hypothesis, serve as income insurance and periodically help finance household expenses. In return, the household assumes responsibility for some of the initial costs of migration and also insures the migrant when necessary. The New Economics of Labor Migration essentially regards migration as an outcome of a cooperative game played by household members, and remittances as the facilitating mechanism.

But while Stark and Bloom's insight on migrant remittances as a form of portfolio diversification introduced the idea that migration could benefit development of the home economy by smoothing consumption, it did not necessarily counter Bhagwati and Hamada's argument concerning human capital depletion. It was only later that theoretical models and realworld evidence began to reveal how migration, apart from leading to "brain drain," could help raise the sending country's human capital in the long run and generate "brain gains." Mayr and Peri (2008) outline three specific channels of brain gain: incentive effects, remittances, and return migration. I consider each in turn.

First, Beine, Docquier, and Rapoport (2001) assert that ex ante, skilled emigration can produce two growth effects acting in different directions: a classical brain drain, hindering growth, and an "incentive effect" in which the prospect of migration increases education incentives in the sending country, promoting growth. In order for the incentive effect to dominate and for a net brain gain to occur, it must be the case that among the individuals who are incentivized by higher returns to education abroad to acquire more education, only a fraction eventually leave the home economy. That is, the probability of migration must be high enough to induce education investments, but not so high that all who seek the higher returns can migrate.<sup>3</sup> As long as some proportion of the newly-educated population stays, there is a possibility for the sending country's human capital stock to increase, rather than decrease.<sup>4</sup>

The sending country's human capital stock may also benefit from remittances. As direct transfers that ease household liquidity constraints, remittances not only expand present-period consumption possibilities, but also free income for human capital investments with future-period payoffs (Page & Plaza, 2006). Reports and surveys have repeatedly found that, when not financing basic needs and health expenses, families spend a major portion of remittances on education, increasing school enrollment and educational attainment (Ratha, 2011). Salas (2014) shows the amount of household remittances received has a positive and statistically significant effect on the likelihood that children attend private schools, which presumably offer higher-quality education. Abroad, sending country diasporas sometimes direct remittances towards education-related development projects, like constructing or investing in schools at home.<sup>5</sup> By supporting both demand and supply of education at home, remittances may positively alter norms of educational attainment, which tend to be weak in developing countries. They could help to break "vicious cycles" of underinvestment in human capital and promote "virtuous circles" of higher productivity if average education levels of sending country populations rise.

<sup>&</sup>lt;sup>3</sup> Such a situation is not unrealistic, as would-be migrants often face restrictive immigration policies abroad; for example, it can be quite difficult to obtain a visa or permit to work in the United States, given quotas favoring the most skilled or migrants from particular countries.

<sup>&</sup>lt;sup>4</sup> Beine, Docquier, and Rapoport (2008) concluded this brain gain tends to offset the brain drain in the aggregate.

<sup>&</sup>lt;sup>5</sup> See the following for dedicated discussions of diasporas' investments:

Johnson, B., & Sedaca, S. (2004). Diasporas, Émigrés and Development: A Special Study of the United States Agency for International Development (USAID) Trade Enhancement for the Services Sector Project.

Kuznetsov, Y. (Ed.). (2006). Diaspora networks and the international migration of skills: how countries can draw on their talent abroad (Part II). World Bank Publications.

Interest in the potential for remittances to generate brain gains has been spurred by the high and almost monotonically-increasing volume of worldwide remittance flows. Figure 1 approximates official remittances, likely a gross underestimate of total remittances, at nearly three times the amount of official development assistance in 2014. Moreover, remittances are less variable than both official development assistance and foreign direct investment, which tend to follow developed-world business cycles. With the steady growth of this source of finance reflected across countries, remittances may surpass foreign direct investment in the future, raising questions about their microeconomic determinants and the extent to which they can contribute to brain gains. To answer these questions, a theoretical model of migrants' decisions to remit is useful. First, I present a simplified version of Bouhga-Hagbe's (2004) model of the altruistic motive for remittances, in which the migrant derives utility from his or her own consumption as well as household members' consumption.

Suppose an altruistic migrant living abroad has utility function U. In each period t, he or she can allocate current labor income to his or her own consumption,  $c_{it}$ , or the consumption of household members in the home economy,  $c_{ht}$ , through remittances  $r_t$ .<sup>6</sup> Then, over the lifetime, the migrant would like to solve the problem

$$max U = \sum_{t=1}^{\infty} \beta^{t-1} (\ln(c_{it}) + \gamma_t \ln(c_{ht}))$$
(1)

subject to the budget constraints for each period:

$$p_{it}c_{it} + r_t = w_{it} \tag{2}$$

$$p_{ht}c_{ht} = w_{ht} + r_t \tag{3}$$

<sup>&</sup>lt;sup>6</sup> The model places no restrictions on the sign of  $r_t$ ;  $r_t > 0$  simply denotes transfers from the migrant to the household, while  $r_t < 0$  denotes transfers from the household to the migrant.

 $\beta^{t-1}$  represents the migrant's discount factor for each period,  $\gamma_t \in [0, \infty)$  is a measure of his or her altruism towards household members in that period, and  $w_{it}$  and  $w_{ht}$  are the earnings of the migrant and household in that period, respectively. The budget constraints thus specify that total expenditures cannot exceed total income for either the migrant or the household members.<sup>7</sup>

Consider the case when the migrant is choosing his or her level of remittances in a single period. Rearranging the budget constraints, (1) can be rewritten as

$$\begin{split} max_{r_{t}} \left\{ \beta^{t-1} \left[ \ln \left( \frac{w_{it} - r_{t}}{p_{it}} \right) + \gamma_{t} \ln \left( \frac{w_{ht} + r_{t}}{p_{ht}} \right) \right] \right\} \\ &= max_{r_{t}} \{ \beta^{t-1} [\ln(w_{it} - r_{t}) - \ln(p_{it}) + \gamma_{t} \ln(w_{ht} + r_{t}) - \gamma_{t} \ln(p_{ht})] \}. \end{split}$$

The first-order condition is therefore  $-\frac{\beta^{t-1}}{w_{it}-r_t} + \frac{\beta^{t-1}\gamma_t}{w_{ht}+r_t} = 0$ . Then, solving for the optimal  $r_t$ 

yields the explicit solution

$$r_t^* = \frac{\gamma_t w_{it} - w_{ht}}{1 + \gamma_t}$$

from which I derive the partial effects of  $\gamma_t$ ,  $w_{it}$ , and  $w_{ht}$ :

$$\frac{\partial r_t^*}{\partial \gamma_t} = \frac{w_{it}(1+\gamma_t) - (\gamma_t w_{it} - w_{ht})}{(1+\gamma_t)^2} = \frac{w_{it} + w_{ht}}{(1+\gamma_t)^2} \ge 0$$
$$\frac{\partial r_t^*}{\partial w_{it}} = \frac{\gamma_t}{1+\gamma_t} > 0$$
$$\frac{\partial r_t^*}{\partial w_{ht}} = -\frac{1}{1+\gamma_t} < 0$$

Concordant with intuition, the model indicates that as the migrant's degree of altruism increases,

remittances should increase, holding constant the migrant's earnings and the household's

<sup>&</sup>lt;sup>7</sup> Bouhga-Hagbe's original model allows for saving, in addition to consumption and remittances, in both the home economy and abroad. In particular, it contains variables representing financial assets held abroad, financial assets held in the home economy, and non-financial assets held in the home economy by the migrant that can earn a return equal to the interest rates abroad or the interest rates in the home economy each period. In this setting, the utility derived from the assets held in the home economy is weighted by a measure of attachment to the home economy, and the budget constraints include income earned from interest.

earnings. Likewise, for a given degree of altruism, remittances are increasing in the migrant's earnings, but decreasing in the household's earnings. If more educated migrants are as altruistic as less-educated migrants, their increased probability of securing employment and ability to earn higher wages abroad implies they will be more likely to remit.

As mentioned earlier, another function of remittances is portfolio diversification: they serve as an informally-enforced insurance mechanism among household members. The income uncertainty household members face in their home economies and the income uncertainty migrants face when relocating lends itself to the expected utility representation in Agarwal and Horowitz (2002). In this model, there are two periods (1 and 2), both of which are after migration. There is only one state in the first period, but in the second period, there are two states: good (2a), which occurs with probability 1- $\pi$ , and bad (2b), which occurs with probability  $\pi$ . Denote the migrant's utility function by *V*, income by *Y*, remittances from the migrant to the household by *r*, and an insurance payment from the household members to the migrant by *s* if the bad state is realized in the second period. Suppose the migrant is risk-averse, or V'(Y) > 0 and V''(Y) < 0, and the insurance is actuarially fair: that is,  $r = \pi s$ . Then the migrant's expected utility is straightforward:

$$E[V] = V_1(Y_1 - r) + (1 - \pi)V_{2a}(Y_{2a}) + \pi V_{2b}(Y_{2b} + s)$$
$$= V_1(Y_1 - r) + (1 - \pi)V_{2a}(Y_{2a}) + \pi V_{2b}\left(Y_{2b} + \frac{r}{\pi}\right)$$

Taking the first-order condition with respect to r,

$$\frac{dE[V]}{dr} = -V_1'(Y_1 - r) + V_{2b}'(Y_{2b} + \frac{r}{\pi}) = 0$$
(4)

or equivalently,  $V'_1(Y_1 - r) = V_{2b}'(Y_{2b} + \frac{r}{\pi})$ . This equation intuitively implies a utilitymaximizing migrant chooses to remit in such a way that the marginal utility of his or her net income in the first period will be equal to the marginal utility of his or her net income if the bad state is realized in the second period.

Applying the implicit function theorem to (4), the partials are given by<sup>8</sup>

$$\frac{dr^{*}}{dY_{1}} = \frac{\pi V_{1}^{\prime\prime}(Y_{1} - r)}{\pi V_{1}^{\prime\prime}(Y_{1} - r) + V_{2b}^{\prime\prime}\left(Y_{2b} + \frac{r}{\pi}\right)} > 0$$
$$\frac{dr^{*}}{dY_{2b}} = -\frac{\pi V_{2b}^{\prime\prime}\left(Y_{2b} + \frac{r}{\pi}\right)}{V_{2b}^{\prime\prime}\left(Y_{2b} + \frac{r}{\pi}\right) + \pi V_{1}^{\prime\prime}(Y_{1} - r)} < 0$$
$$\frac{dr^{*}}{d\pi} = \frac{rV_{2b}^{\prime\prime}\left(Y_{2b} + \frac{r}{\pi}\right)}{\pi V_{2b}^{\prime\prime}\left(Y_{2b} + \frac{r}{\pi}\right) + \pi^{2}V_{1}^{\prime\prime}(Y_{1} - r)} > 0$$

Thus, in this model, the higher the migrant's income in the first period and the higher the probability that the bad state is realized, the more the migrant will remit. However, remittances are decreasing in the migrant's income in the bad state. Interestingly, this suggests that to the extent migrants with higher levels of education are better able to lower the probability of the bad state or retain higher incomes in the bad state, they may indeed be less likely to remit than less-educated migrants. Thus, the two models yield different predictions regarding the sign of the relationship between migrant education and propensity to remit.

In contrast to the abundant theoretical frameworks and empirical literature on traditional migration and remittances, there are few formal models to explain the third hypothesized channel of brain gains: return migration. Return migration from a developed country to a developing country is particularly puzzling to economists, as such movements are typically characterized by a negative wage differential, which appears to contradict the original assumption about traditional migration (Dumont & Spielvogel, 2008). Four possible reasons for return migration

<sup>&</sup>lt;sup>8</sup> See Appendix A for the fully-expanded second derivatives.

have been identified: preferences for the sending country and attachment to family members there,<sup>9</sup> achievement of a savings target set at initial migration, failure to integrate successfully into the destination labor market, and improved employment opportunities at home after gaining human capital abroad.

There is some descriptive evidence to support each of these motives, both from direct surveys of return migrants on why they returned and data on their outcomes after they returned. However, the latter two have interesting implications for development from a human capital perspective. The third reason, failure to integrate into the destination labor market, highlights the uncertainty inherent in many migration decisions: the individual may not have complete information about the conditions of the destination labor market and how he or she well will perform in it.<sup>10</sup> He or she may overestimate the returns to migration or underestimate the costs, only to discover after the move that relocation has made him or her worse off. Thus, whereas traditional migrants are thought to be positively selected from the sending country population, return migrants may be negatively selected from the total migrant stock leaving the sending country. If it is true that the migrants who return are the ones who cannot earn returns abroad, return migration may not be a source of brain gains for developing countries. The fourth reason implies just the opposite: because the migration experience increases human capital, the individual's prospects in the home economy labor market are enhanced from his or her prospects

<sup>&</sup>lt;sup>9</sup> Preferences for or family-related attachment to the sending country can be viewed from the perspective of the Sjaastad model, entering into the non-monetary costs of initial migration and the non-monetary benefits of return migration made in a second period of the life cycle.

<sup>&</sup>lt;sup>10</sup> In constructing a model to explain rural-urban migration, Harris and Todaro (1970) incorporate the uncertainty inherent in the process of seeking employment. When urban or "modern sector" wages are higher than rural wages, workers have an incentive to move from the rural area to the urban area and seek employment in the modern sector, which hires with some small probability. Although the likelihood of securing modern sector employment may be low in any given period, as long as the wage differential is sufficiently large, they will migrate to the urban area given the increasing cumulative probability of modern sector employment and the expectation of high payoffs when they finally enter the modern sector.

at initial migration. Return migration provides direct brain gains to developing countries, a repatriation of his or her skill and "repayment" of public investment in his or ehr education.

The development consequences of remittance flows and return migration have been enumerated anecdotally, typically within case studies synthesizing sources of brain drain and brain gain to countries that send large numbers of migrants. In the next section, I explore the human capital experiences of one country often cited in the developmental context: India.





Source: World Bank Migration and Remittances Data.

#### III. CASE STUDY: INDIA

India's experience with skilled emigration is perhaps the most salient example of brain gain. Indian migrants constituted nearly 5 percent of migrants to the OECD in 2011, and were the largest group of tertiary-educated migrants to the OECD (Tejada et al., 2014). In absolute amounts, India has been the world's top recipient of remittances since 2001, receiving \$72.2 billion in 2015. At the same time, remittances have grown as a share of India's GDP, from less than .5 percent in 1975 to more than 3 percent in 2015.

As elsewhere, remittances to Indian households are often spent on consumption goods and services. However, they also enable investments in housing, health, and children's education, thereby mitigating the tradeoffs poor families face between short-term well-being and long-term productivity. In a survey conducted across major bank branches in India in 2012, 49 percent of remittances were used for "family maintenance" expenses such as food, health, and education; 20 percent deposited in banks; and 7 percent invested in financial or physical assets (Reserve Bank of India, 2013). Additionally, migrants have been known to invest in the expansion or founding of secondary schools and higher education institutions in India, underscoring the potential for remittances to support human capital acquisition in the home economy. Accordingly, the government's stance has shifted from seeing the departure of its scientists, doctors, and researchers as a loss to the country to treating its non-resident population as a resource for development, actively building infrastructure and lowering transaction costs for sending remittances (van Naerssen, 2008). Many Indian banks now provide electronic wire or online instruments that allow migrants to transfer money from foreign accounts to their families easily and relatively quickly (Reserve Bank of India, 2013).

The country's highly-skilled diaspora of engineers, scholars, and other experts has contributed indirectly to the development of specific industries in India through various professional associations and formal programs. Members of these organizations have acted as linkages between their origins and destinations, engaged in a variety of positive-externality activities such as exchange of specialized, technical information<sup>11</sup>; cross-border collaboration on projects; "diplomacy" on behalf of India in business and research and development communities; and mentoring students from India studying abroad near them. But skilled migrants have served equally important roles as returnees, bringing with them acquired human capital, social capital, financial capital, and even attitudes and norms that enhance productivity in the home economy (Naujoks, 2013). For instance, return migrants can draw on networks they cultivated abroad "for business leads and financing," a practice "associated with better performing firms," or exchange information with previous partners abroad on investments and innovations, putting them in a position to give strategic advice to venture capitalists (Tejada et al., 2014). Their experience abroad becomes a valuable asset when deployed in the home economy.

The Indian information technology sector in particular has been cited as a beneficiary of return migration. Since the 1990s, migrants returning from the United States have founded and managed their own companies in India (Naujoks, 2013), transferring both technical and business knowledge to their employees and creating knowledge-intensive jobs. In this way, return migrants repatriated their human capital, "repaying" the country's early investment in their education, and generated human capital spillovers to their workers. They also aided in lowering barriers to trade between the United States and India, as their tenure as professionals abroad and

<sup>&</sup>lt;sup>11</sup> Agrawal, Kapur, and McHale (2008) study a "knowledge flow production function" in which the value of inventions depends on innovators' co-location as well as access to knowledge. They find that the importance of access to knowledge increases with the patent's number of citations, whereas the co-location effect disappears for patents at the 93<sup>rd</sup> percentile and above in citations.

subsequent return migration built confidence in and a positive reputation for India's capabilities in information technology (Naujoks, 2013).

It is worth emphasizing that the information technology sector presented a large, entrepreneurial subgroup of India's skilled migrants with especially profitable opportunities and allowed productive integration of return migrants, but such conditions might not be satisfied in other industries, time periods, or countries. The employment or entrepreneurship prospects for return migrants may not be competitive with those available to them abroad, or there may not be enough return migrants concentrated in any one sector to take advantage of complementarities among their acquired human capital, social capital, and financial capital. Home economy and local market conditions determine in part whether return migrants are positively or negatively selected from the diaspora, and consequently, the likelihood of brain gains from return migration is highly context-dependent.

#### IV. EMPIRICAL ANALYSIS

The extent to which remittances and return migration can increase sending country human capital depends on the prevailing characteristics of the migrants who remit and return. This section will describe and analyze data from the World Bank's Migration and Remittances Household Surveys, aggregated for five developing countries in sub-Saharan Africa, to study the empirical determinants of migrants' choices to remit and return. The first part will specify a binary probit model to understand the effect of education, as indicated by the highest level of attainment or years of schooling completed by an individual before migration, and several individual-level controls on international migrants' propensity to remit. The second part will examine the profiles of return migrants using descriptive statistics and cross-tabulations.

Theoretical models of migrant remittances have been followed by numerous empirical models which predict the decision to remit and the amount of remittances sent based on various household and personal characteristics. Hagen-Zanker and Siegel (2007) review papers on the determinants of remittances and summarize variables used in the literature. In their survey, remittance amounts are usually positively associated with migrant income, age, marriage, household dependency ratio, age of the household head, and negative shocks to the household, but negatively associated with household income, the number of migrants in the household, and presence of a spouse abroad. Durand et al. (1996) find evidence age and marriage are positively related to the probability of remitting, while education level is negatively related. Emmanuel et al. (2012) write, "the duration of the migrant in the country of residence, household assets, household size, living in OECD, highest education attainment prior to migration, being male, being a son, daughter or father to the head of the household, and type of employment have statistically significant positive impact" on the probability of remitting.

Of note are the mixed empirical findings of Durand et al. (1996) and Emmanuel et al. (2012) regarding the relationship between migrant education and probability of remitting, and the general lack of significance of education across the ten microeconomic papers reviewed by Hagen-Zanker and Siegel (2007) that include it as a regressor. This ambiguity echoes the different motives for remitting laid out in the earlier theoretical models. As shown by Bouhga-Hagbe (2004), if remittances are largely altruistic, and altruism does not differ by education level, migrants with higher education levels who enjoy higher income abroad should be more likely to remit given their increased earnings. Yet, since migrants tend to come from households above a wealth threshold that can afford the same investments, they may lack the financial imperative to send money to their family and instead exhibit lower propensity to remit. If remittances are primarily a form of insurance, migrants with higher education levels may be less inclined to send remittances, reflecting the employment security benefits of their schooling or training. Furthermore, skilled migrants who integrate well into the host economy may have weaker ties with the home economy than less-skilled migrants, again decreasing the probability of remitting. Ozden, Rapoport, and Schiff (2011) identify the relationship between migrant education and probability of remitting as a fundamental microeconomic question, which, if resolved, could clarify the causal pathways linking migration to brain gains and development.

The purpose of this analysis, then, is to determine the marginal effect of an additional level of educational attainment or additional year of schooling prior to migration on a migrant's propensity to remit. Following Collier, Piracha, and Randazzo (2011), I employ a probit model with the binary dependent variable *Remit*, an independent education variable, and several controls. The model takes the basic form

$$Pr(Remit = 1|X_i) = \Phi(\alpha + \beta_i X_i + \gamma Education_i)$$

where  $\Phi(Z)$  is the Normal cumulative distribution function,  $\alpha$  is the constant term,  $\beta_i$  is a vector of coefficients corresponding to the vector of control variables  $X_i$  for individual *i*, and  $\gamma$  is the parameter of interest. *Remit* equals 1 if the migrant has ever sent money to the household since migrating, and equals 0 if the migrant has not sent money to the household since migrating. The independent variable of interest is education prior to migration, measured in two ways. The first set of specifications will measure education by classifying the migrant's highest level of attainment before leaving the sending country, treating "None" as the reference group. The second set of specifications will measure education by the years of schooling the migrant completed before leaving the sending country. Results from the latter set will serve as a robustness check for results from the former set, ensuring heterogeneity within broadly-defined levels of attainment does not conceal a more subtle relationship between education and propensity to remit.

The control variables are the migrant's gender, age, age squared, marital status, whether the migrant is living with his or her spouse or children abroad, work situation before migration, work situation after migration, and country of origin. The five countries are pooled into one sample and distinguished by dummy variables in order to take advantage of greater degrees of freedom in estimation, while still allowing for country-specific effects. Aside from the migrant's age, all control variables are categorical; a codesheet is included as an appendix.

The expanded form of the model follows:

 $Pr(Remit = 1|X_i)$ 

 $= \Phi(\alpha + \beta_{1}Female_{i} + \beta_{2}Age_{i} + \beta_{3}Age_{i}^{2} + \beta_{4}MaritalStatus_{i}$  $+ \beta_{5}SpouseChildren_{i} + \beta_{6}Urban_{i} + \beta_{7}AssetIndex_{i} + \beta_{8}WorkBefore_{i}$  $+ \beta_{9}WorkCurrent_{i} + \beta_{10}Country_{i} + \gamma Education_{i})$ 

The control variables included in the model are those which could systematically affect a migrant's probability of remitting *a priori*, his or her education level notwithstanding. The first control variable is gender. Given a gender wage gap of 30 percent in sub-Saharan Africa (U.N. Women, 2015), female migrants can be expected to earn less than males on average and, by extension, be less likely to remit less than males on average. Accordingly, the sign on the dummy variable *Female* should be negative. The second control variable is age. As migrants grow older and gain more work experience, their earnings and income available for sending remittances should increase up to a point when their human capital begins to depreciate and their earnings begin to decline, suggesting an inverse quadratic relationship. Thus, the coefficient on  $Age^2$  is predicted to be negative, and the coefficient on Age is predicted to be positive.

The third control variable is marital status. Compared to single migrants, migrants who are married, engaged, or cohabiting should be more likely to send remittances, since their spouses and children may depend on them as a principal source of household income, whereas single migrants may only send remittances to supplement their parents' household's income. Separated, divorced, or widowed migrants may have weaker ties to their sending country households or fewer dependents on average than single migrants and be less inclined to remit, resulting in a negative coefficient on the factor variable *Separated*.

The fourth control variable is whether the migrant lives alone, or has a spouse or children who accompany them abroad. If a migrant's spouse or children relocate with them, there should be less motivation to remit to the sending country household, as his or her primary dependents live with him or her in the destination. Therefore, a negative coefficient is expected for *SpouseChildren*.

The next two control variables are whether the migrant's household is in an urban area, and how wealthy his or her household is according to an "asset index." Urban households tend to have better earnings and employment opportunities and therefore be less dependent on remittances, so a negative coefficient is expected for *Urban*. *AssetIndex* is a proxy for household wealth constructed from a series of questions common to all five countries' surveys that inquires about the household's ownership of various mobile and immobile assets.<sup>12</sup> It is an unweighted sum of a series of dummy variables coding whether or not they own particular types of property, appliances, consumer electronics, and vehicles. <sup>13</sup> Higher indices indicate the household's ownership of more assets, and possibly fewer financial constraints in the home economy; therefore, *AssetIndex* is expected to be negatively related to probability of remitting.

The seventh and eighth control variables are migrants' work situation before migration and current work situation, after migration. If work situation before migration is accepted as a rough indicator of how well-off the migrant is in his or her home economy, it can control for the financial resources he or she has to pay the costs of relocation and investment in skill-increasing activities, which ultimately affect the probability of remitting. Theoretically, individuals who are paid employed and self-employed before migration have some personal income at their disposal to cover migration-related expenses, and will be more likely to have earnings available to remit relative to those who were not in the labor force, explaining the expected positive coefficients on

<sup>&</sup>lt;sup>12</sup> In developing countries, data that directly measure income, expenditure, and consumption are often unavailable, as in this survey. Thus, it is not uncommon to construct wealth indices from ownership of durable goods and other variables such as housing status to proxy for welfare or poverty. See Johnston and Abreu (2013) and the World Bank's *Quantitative Techniques for Health Equity Analysis*, Technical Note #4 for a detailed discussion of the advantages, variations on, and limitations of this approach.

<sup>&</sup>lt;sup>13</sup> The nineteen assets are agricultural land, non-agricultural land, a house, other buildings, a bed, a radio, a television, a refrigerator, air conditioning, a sound system, a VCR/DVD player, a computer, a cell phone, a landline, a bicycle, an animal-drawn cart, a car, a motorcycle, and a tractor or harvester. Although there are nineteen assets, in the sample, *AssetIndex* ranges from 0 to 17.

being paid employed or self-employed before migration. The coefficient on student status before migration is also expected to be positive, as individuals who are pursuing education prior to relocation presumably increase their human capital in a way that raises their earnings abroad and makes it financially possible for them to send a portion of their eventual income to their families. An individual who is unemployed before migration may not have much more work experience or savings to invest in migration than an individual not in the labor force, suggesting a decreased propensity to remit and a negative coefficient on being unemployed before migration.

Work situation after migration signals how well the migrant has integrated into the host economy, which directly impacts his or her income abroad and thus his or her ability to remit. Clearly, migrants who are paid employed or self-employed in the destination should be more likely to remit than the reference group that is not active in the destination labor force, as they have access to earnings streams. This logic accounts for the expected positive coefficients on being paid employed or self-employed after migration. On the contrary, migrants who are students in the destination are likely not earning income and even continuing to spend on their education. They are potentially in worse position to send remittances than those not in the destination labor force, implying the negative coefficient on student status after migration. Similarly, migrants who are unemployed in the host economy may not have resources to remit, leading to a negative coefficient on being unemployed after migration.

The last control variable is country of origin, a dummy variable intended to capture all ways in which the sending country affects propensity to remit relative to the reference country, Burkina Faso. Since this variable reflects a multitude of known and unknown circumstances that may be shared by the particular migrants in a country's subsample, its signs are not predicted and are instead left treated as empirically-determined parameters of the analysis.

Table 2 summarizes the expected signs of the coefficients on the control variables other than country of origin, where the dependent variable is *Remit*.

Variable	Expected Sign	Variable	Expected Sign
Female	-	Asset Index	-
Age	+	Work Situation Before Migration	
Age <sup>2</sup>	-	Not in Labor Force	
Marital Status		Paid Employed, Full-Time	+
Single		Paid Employed, Part-Time	+
Married, Monogamous	+	Self-Employed	+
Engaged	+	Student	+
In Union or Cohabiting	+	Unemployed	-
Separated	-	Current Work Situation Abroad	
Divorced	-	Not in Labor Force	
Widowed	-	Paid Employed, Full-Time	+
Married, Polygamous	-	Paid Employed, Part-Time	+
With Spouse or Children		Self-Employed	+
No		Student	-
Yes	-	Unemployed	-
Urban	-	Country	?

Table 2: Expected signs of probit control variable coefficients, with reference groups shaded.

#### Data

The data in this analysis come from the World Bank's Migration and Remittances Household Surveys collection, available via the Central Microdata Catalog. These crosssectional surveys were conducted as part of the Africa Migration Project in six countries in sub-Saharan Africa in 2009 and 2010: Burkina Faso, Kenya, Nigeria, Senegal, South Africa, and Uganda. Since South Africa is by far the wealthiest and the single predominantly migrantreceiving country of the six, I remove it from my dataset and limit my analysis to Burkina Faso, Kenya, Nigeria, Senegal, and Uganda.

Information about the sampling designs in each of the five countries is provided in Table 3. "Migrants" were defined as those who formerly lived in a household in the country in which the interview was conducted, but left before the interview to live elsewhere for at least six months. Due to the rarity of migrant households, the surveys disproportionately selected regional

clusters in which migrant households were more prevalent, and drew samples of households from within the regional clusters after classifying them as non-migrant, internal migrant, or international migrant.

Table 3: Sampling design	o for Migration and Remitta	ances Household Surv	veys in Kenya, Nigeria,
and Senegal, 2009-2010.			

	Sampling Frame	Strata	Representation Level
Burkina	(Not Available)	Province	10 provinces with highest
Faso			incidence of migration
Kenya	Kenya National Bureau of	Urban and rural by district	17 districts with highest
	Statistics National Sample Survey		concentration of migrant
	and Evaluation Programme 1999,		households
	Kenya Integrated Household		
	Budget Survey 2005, Financial		
	Services Deepening Survey 2006		
Nigeria	Population Census 2006	Urban high migration, urban low	National
		migration, rural high migration,	
		rural low migration	
Senegal	General Census of Population and	Dakar (capital) high migration,	National
	Housing 2002	Dakar (capital) low migration,	
		other urban high migration, other	
		urban low migration, rural high	
		migration, rural low migration	
Uganda	Population and Housing Census	Central urban, Central rural,	National
	2002	Eastern urban, Eastern rural,	
		Northern urban, Northern rural,	
		Western urban, Western rural	

Source: Plaza, S., Navarrete, M., & Ratha, D. (2011). Migration and remittances household surveys in sub-Saharan Africa: methodological aspects and main findings. *World Bank, Washington, D.C.* 

Kenya and Nigeria are classified by the World Bank as lower-middle income economies;

the remaining countries are classified as low-income economies. Relevant development

indicators for each are given in Table 4 below.

	Burkina Faso	Kenya	Nigeria	Senegal	Uganda
Income	2010	2010	2010	2010	2010
Adjusted net national income	496.59	888.36	1,865.93	880.72	505.55
per capita (constant 2010 US \$)					
Personal remittances, received					
(% of GDP)	1.34	1.71	5.35	11.44	3.82
Demographics	2000	2000	2000	2000	2000
Population	11,607,944	31,065,820	122,876,723	9,860,578	23,757,636
OECD Migrants	8,275	198,104	261,046	133,246	82,119

Table 4: Selected development indicators for Kenya, Nigeria, and Senegal, 2000-2010.

OECD Migrants (% of					
population)	.0713	.6377	.2124	1.3513	.3457
Education	2008	2008	2008	2008	2008
School enrollment, secondary,	16.07	56.80	32.12	26.25	23.98
female (% gross)					
School enrollment, secondary,	21.67	62.00	37.94	33.20	28.21
male (% gross)					

Sources: World Bank World Development Indicators, Database on Immigrants in OECD Countries.

As shown, the five countries exhibit some variation in home economy conditions. Nigeria's per capita income is distinctly highest at nearly \$1,900 in 2010 dollars, more than double the levels of Kenya and Senegal. Burkina Faso and Uganda have similar per capita incomes of around \$500 in 2010 dollars. Senegal receives more than a tenth of its national income from remittances; Kenya receives a moderate share of five percent from remittances; and, at the minimum, Burkina Faso receives just over one percent from remittances. Senegal and Kenya send the largest proportions of migrants to Organization for Economic Cooperation and Development (OECD) countries, in relative terms, but Nigeria sends the most migrants to OECD countries in absolute terms. In terms of education, Kenya leads in secondary school enrollment, followed by Nigeria and Senegal. Burkina Faso trails substantially in secondary school enrollment, an outcome that is likely linked to its low per capita income. Evidently, per capita income and average educational attainment for all five countries is far below the OECD averages of over \$27,000 and over 70 percent for both genders, respectively.

Taken together, these development indicators suggest increased returns to human capital in OECD countries are a strong incentive for skilled individuals to migrate, and moreover, any remittances spent on education or repatriation of skill by return migrants would indeed be valuable brain gains, in light of their low human capital stock. Specifically, individuals with the highest human capital levels from developing countries should have the greatest incentive to migrate to the OECD, where presumably the differentials between home economy and host economy returns to human capital are largest. This high-skilled population has the greatest potential to generate brain gains for the sending countries. As such, the analysis excludes internal migrants and "South-South" migrants, using only international migrants whose destinations were OECD countries.

Summary Statistics	Burkina	Kenya	Nigeria	Senegal	Uganda
	Faso				
Percent Remitting	70.59	58.53	72.35	80.00	49.11
Highest Level of Attainment Before Migration					
None	11.11	1.10	.36	33.34	.91
Less Than Primary	16.67	_	.18	3.75	3.64
Primary	11.11	7.86	1.78	13.02	7.27
Secondary	44.44	47.48	34.99	25.68	27.27
Post-Secondary Technical/Vocational	_	15.88	4.09	5.11	9.09
University	11.11	18.24	46.54	10.51	31.82
Graduate or Tertiary Technical/Vocational	5.56	9.43	12.08	6.46	20.00
Mean Years of Schooling Before Migration	12.67	12.53	14.27	11.72	16.03
Female	33.33	46.25	28.55	20.69	44.64
Mean Age	36.11	33.82	33.39	38.46	31.03
Median Age	34.5	32	32	37	30
Marital Status					
Single	44.44	38.24	34.26	18.70	48.21
Married, Monogamous	50.00	54.49	56.06	64.78	42.86
Engaged		2.63	7.96	.43	2.68
In Union or Cohabiting	_	.62	.17	_	2.68
Separated	_	1.08	.17	_	1.70
Divorced	_	1.08	.87	1.88	.89
Widowed	_	1.86	.52	.29	.89
Married, Polygamous	5.56	_	_	13.91	_
Living With Spouse or Children	50.00	41.31	50.27	29.81	44.55
Percent Urban	61.11	51.61	52.25	77.71	88.39
Median Asset Index	8	7	10	8	9
Work Situation Before Migration					
Not in Labor Force	11.11	1.70	1.56	6.10	.92
Paid Employed, Full-Time	22.22	27.86	23.78	12.65	24.77
Paid-Employed, Part-Time	_	5.57	5.38	3.96	10.09
Self-Employed	33.33	5.73	9.55	43.75	6.42
Student	33.33	34.98	37.15	22.10	40.37
Unemployed	_	24.15	22.57	11.43	17.43
Current Work Situation Abroad					
Not in Labor Force	11.76	3.25	2.91	5.23	.91
Paid Employed, Full-Time	23.53	56.01	58.00	40.81	53.64
Paid Employed, Part-Time	_	14.61	13.64	4.55	18.18
Self-Employed	35.29	2.76	8.55	35.75	6.36
Student	23.53	19.97	15.27	8.43	16.36
Unemployed	5.88	3.41	1.64	5.23	4.55
Number of Observations	17	646	578	690	112

Table 5: Summary statistics.

Variation among the five countries is again present in the summary statistics in Table 5, in both the dependent variable and the independent variable of interest. Around three-fourths of OECD migrants from Burkina Faso, Nigeria, and Senegal send remittances, whereas less than 60 percent of Kenyan OECD migrants send remittances and less than half of Ugandan OECD migrants send remittances. Meanwhile, an overwhelming majority of Kenyan, Nigerian, and Ugandan OECD migrants are secondary or tertiary-educated, at over 91 percent, 97 percent, and 88 percent, respectively. By contrast, the secondary and tertiary-educated constitute less than half of Senegal's OECD migrants and less than two-thirds of Burkina Faso's OECD migrants. This is not unexpected, considering secondary school enrollment in Burkina Faso and Senegal are relatively low. Nonetheless, noting that the tertiary-educated typically also enrolled in and completed secondary school, positive selection remains apparent: the share of those who have at least some secondary education is substantially higher among OECD migrants than among the overall population from all five countries. Again, it is clear why the brain drain continues to be a concern for these countries, as well as why there could be substantial brain gains per remitting migrant or return migrant.

The age distribution of migrants is slightly skewed towards the right in all five countries, with younger individuals migrating more frequently. This is consistent with life-cycle extensions to the Sjaastad model, which pointed out younger migrants have longer future periods in which to recoup the costs of relocation and any associated human capital investments, both in monetary terms and in terms of consumption possibilities. With respect to gender, in Kenya and Uganda, just under half of migrants are women; in Burkina Faso, Nigeria, and Senegal, the proportion of women is one-third or less. Approximately 80 percent of migrants in Senegal, 65 percent in Nigeria, and half in Burkina Faso, Kenya, and Uganda are married, engaged, or cohabiting; most

remaining migrants are single. Additionally, migrants tend to be fairly evenly split between living alone or with a spouse or children abroad, save for Senegal, where the majority of migrants live alone.

Finally, an informative comparison of migrants' work situations before migration and after migration serves as an indirect means of assessing gains from migration and human capital acquisition in the migration process. Kenya and Nigeria display remarkably similar patterns of work situation before migration and current work situation. Before migration, just over one-third of migrants in both countries were students, approximately another third were paid employed, and close to one-fourth were unemployed. Senegal, where nearly 44 percent of migrants were self-employed, had much lower proportions who were paid employed, students, or unemployed. Nonetheless, on the whole, work situations were fairly balanced among paid employment or self-employment, student status, and unemployment in all five countries before migration.

After migration, paid employment is overwhelmingly most common, with nearly threefourths of migrants from Kenya, Nigeria, and Uganda and half from Senegal falling in this category, while student status and unemployment decrease sharply. Interestingly, changes in the "self-employed" and "not in labor force" categories are relatively smaller. This implies many migrants who were previously students or unemployed were able to secure paid employment in the OECD, and highlights the positively selective nature of human capital acquisition and migration. Individuals chose to migrate or invest in their own human capital because they expected some threshold increase in utility or income, realized in part by changes in work situation from unemployment to paid employment or from student status to paid employment. Table 6 displays initial regression results, estimated using heteroskedasticity-robust standard errors. Specifications (1) and (3) measure education by levels of attainment, while (2) and (4) measure education by years of schooling. In (3) and (4), I test whether the natural logarithm of age and its square provide an improvement of fit over age and its square.

Table 6: Probit regression results with dependent variable *Remit*.

Variables	(1)	(2)	(3)	(4)
Female	153	106	142	0957
	(.0827)	(.0840)	(.0824)	(.0836)
Age	.0911***	.0914***	_	—
	(.0199)	(.0210)		
$Age^2$	000944***	000971***	-	—
	(.000234)	(.000251)		
InAge	_	_	1.394	1.365
			(1.509)	(1.418)
$(lnAge)^2$	_	_	116	120
			(.221)	(.210)
SpouseChildren	192	165	180	153
	(.103)	(.108)	(.103)	(.108)
MaritalStatus				
Married, Monogamous	.282*	.281*	.317**	.315*
	(.118)	(.125)	(.117)	(.124)
Engaged	0360	0199	0111	.00581
	(.172)	(.170)	(.173)	(.172)
Cohabiting	.232	.300	.285	.350
	(.591)	(.594)	(.580)	(.584)
Separated	.453	.212	.520	.258
	(.497)	(.491)	(.497)	(.487)
Divorced	.00748	.236	.0700	.304
****	(.308)	(.351)	(.307)	(.350)
Widowed	.224	.109	.133	00653
	(.421)	(.434)	(.419) 7.co.w.t	(.434)
Married, Polygamous	.749**	.682	.769**	.769*
	(.266)	(.376)	(.262)	(.373)
<b>T</b> T 1	0101	00000	0.450	0205
Urban	0191	00233	0452	0305
A	(.0820)	(.0807)	(.0815)	(.0862)
Assennaex	.0193	.00970	.0173	.00917
	(.0150)	(.0155)	(.0150)	(.0155)
WorkPatone				
<i>workbejore</i>				
Paid Employed Full-Time	- 205	_ 35/	- 137	_ 231
	205	(262)	( 222)	(257)
Paid Employed Part-Time	- 0458	(.202) - 161	(.232) 0248	- 0339
r are Employed, r are rine	(277)	(305)	(276)	(301)
Self-Employed	- 0550	- 255	00723	- 128
Sen Employed	.0550	.200	.00725	.120

Stadaut	(.242)	(.278)	(.241)	(.272)
Student	207	3/0	142	255
Unomployed	(.229)	(.201)	(.228)	(.230)
Onemployed	(234)	(269)	(233)	(262)
	(.234)	(.209)	(.233)	(.202)
WorkCurrent				
Paid Employed, Full-Time	.746***	.893***	.811***	.964***
	(.217)	(.230)	(.215)	(.226)
Paid Employed, Part-Time	.576*	.760**	.627**	.815***
	(.233)	(.247)	(.231)	(.243)
Self-Employed	.606**	.695**	.658**	./55**
Student	(.235)	(.257)	(.233)	(.253)
Student	$794^{+++}$	$034^{+}$	$778^{++}$	(252)
Unomployed	(.244)	(.230)	(.243)	(.233)
Unempioyed	104	.0708	13/	.124
	(.238)	(.275)	(.230)	(.209)
Kenya	409	568	479	611
	(.384)	(.389)	(.384)	(.392)
Nigeria	0496	191	0993	215
	(.383)	(.387)	(.383)	(.390)
Senegal	0925	270	119	274
	(.380)	(.389)	(.380)	(.392)
Uganda	774	941*	828*	975*
	(.399)	(.404)	(.399)	(.407)
LevelSchooling				
Less Than Primary	.128	_	.0685	_
5	(.351)		(.361)	
Primary	433*	_	427*	_
	(.189)		(.188)	
Secondary	173	_	162	_
	(.183)		(.182)	
Post-Secondary Technical or Vocational	134	_	131	_
	(.216)		(.216)	
College or University	330	_	303	_
	(.195)		(.194)	
Graduate or Tertiary Technical or Vocational	.00997	_	.0257	_
	(.214)		(.214)	
YearsSchooling	_	.00347	_	.00478
		(.0106)		(.0104)
Constant	-1.427*	-1.442*	-3.025	-3.020
	(.592)	(.623)	(2.631)	(2.447)
Observations	1 745	1 522	1 745	1 522
Disou da Di Sauarad	1,743 277	1,525	1,745	1,525 251
r seudo K-squared	.211	.230	.212	.231

Robust standard errors in parentheses \*\*\* p<.001, \*\* p<.01, \* p<.05

On the whole, estimates are robust to the two different measures of migrant education. In (1) and (3), primary education has a significant negative effect on propensity to remit. However, in line with much of the previous literature which pointed to an ambiguous or indeterminate relationship between education and probability of remitting, no other levels of attainment generate statistically significant effects. An F-test of the *LevelSchooling* coefficients reveals that they are not jointly statistically significant; in other words, the effect of a migrant's education level on his or her propensity to remit cannot be claimed different from zero. The almost negligible magnitude and lack of significance of the coefficient on *YearsSchooling* corroborate this ambiguous result.

For the control variables, in comparing (1) with Table 2, most coefficients conform to the expected signs.  $Age, Age^2$ , and marital status are all significant, where age seems to share a negative quadratic relationship with propensity to remit and being in either a monogamous marriage or a polygamous marriage increases propensity to remit. Interestingly, whether the migrant lives with his or her spouse or children abroad and his or her work situation before migration appear not to matter in these specifications. On the other hand, work situation after migration is a highly significant predictor. Relative to those who are not in the destination labor force, those who are full-time employed are much more likely to remit, as shown by the positive coefficients significant at the .1 percent level. The same is true for part-time employed and self-employed migrants, though at the 1 percent level. Unsurprisingly, those who are students in the destination are less likely to remit, significant at the 1 percent level, and the propensity to remit of the unemployed does not differ significantly from the propensity to remit of those not in the labor force. Lastly, (2), (3), and (4) indicate migrants' sending countries may impact their probability of remitting, at least in the case of Uganda: relative to migrants from Burkina Faso,

Ugandan migrants are much less likely to remit, significant at the 5 percent level. The reason for this is unclear, but could be related to systematic differences in their migrants' destinations within the OECD or interactions between migrants' education levels and their destinations within the OECD, given that migrants from Uganda are significantly more educated than migrants from Burkina Faso in the sample.

Given their collective lack of significance, the dummy variables coding work situation before migration are dropped from subsequent specifications. I replace these variables with an interval-scale variable that should possess greater explanatory power, household size. To allow for nonlinear effects of household size on propensity to remit, or for the magnitude of the marginal effect of household size to decrease with each additional family member, I take a logarithmic transformation. I also drop specifications (3) and (4), as using the logarithmic transformation of age did not yield any improvement in fit over simply using age. The revised model is as follows:

$$\Pr(Remit = 1|X_i)$$

 $= \Phi(\alpha + \beta_{1}Female_{i} + \beta_{2}Age_{i} + \beta_{3}Age_{i}^{2} + \beta_{4}SpouseChildren_{i}$  $+ \beta_{5}MaritalStatus_{i} + \beta_{6}Urban_{i} + \beta_{7}\ln(HouseholdSize_{i}) + \beta_{8}AssetIndex_{i}$  $+ \beta_{9}WorkCurrent_{i} + \beta_{10}Country_{i} + \gamma Education_{i})$ 

Table 7 presents results from the revised model, where (5) measures education by level of attainment and (6) and (7) measure education by years of schooling. In (7), I test for possible interactions between sending country and years of schooling on propensity to remit.

$\theta$		···· · · · · · · · · · · · · · · · · ·	
Variables	(5)	(6)	(7)
Female	140	0957	0956
	(.0817)	(.0834)	(.0838)
Age	.0907***	.0904***	.0908***

Table 7: Probit regression results with new independent variable, ln(*HouseholdSize*).

$Age^2$	(.0199)	(.0209)	(.0208)
	000926***	000934***	000938***
0	(.000234)	(.000247)	(.000247)
SpouseChildren	189	165	182
	(.101)	(.106)	(.107)
MaritalStatus			
Married, Monogamous	.257*	.262*	.285*
Engaged	(.115)	(.122)	(.122)
	0152	.000208	.00696
Cohabiting	(.174)	(.174)	(.174)
	.223	.291	.330
Separated	(.575)	(.573)	(.574)
	.411	.162	.177
Divorced	(.535)	(.511)	(.511)
	00320	.238	.232
Widowed	(.305)	(.345)	(.347)
	.204	.131	.125
Married, Polygamous	(.417)	(.434)	(.433)
	.762**	.564	.669
	(.272)	(.387)	(.401)
Urban	0239	.0164	.0279
	(.0822)	(.0877)	(.0893)
lnHouseholdSize	.233***	.252***	.259***
	(.0600)	(.0636)	(.0638)
AssetIndex	.0134	.00402	.00359
	(.0131)	(.0136)	(.0138)
WorkCurrent			
Paid Employed, Full-Time	.680***	.783***	.768***
Paid Employed, Part-Time	(.190) .546** (.210)	(.210) .684** (.220)	(.209) .673**
Self-Employed	(.210) .625** (222)	.603*	(.229) .633**
Student	(.203)	(.235)	(.235)
	898***	806***	842***
Unemployed	223	0248	(.235) 0326
	(.239)	(.257)	(.256)
Kenya	348	462	172
	(.390)	(.398)	(1.192)
Nigeria	0726	171	183
	(.387)	(.395)	(1.225)
Senegal	188	322	583
	(.384)	(.397)	(1.189)
Uganda	710	856*	-1.284
	(.403)	(.412)	(1.272)
LevelSchooling		. ,	. /
Less Than Primary	- 118	_	_
Less man i man y	(.351)	_	

322	_	_
(.189)		
0432	—	-
(.181)		
0149	—	-
(.211)		
177	-	_
(.193)		
.112	-	-
(.208)		
_	.00639	.00976
	(.0104)	(.0833)
_	_	0220
		(.0845)
_	-	.00100
		(.0866)
—	—	.0211
		(.0847)
_	-	.0253
		(.0878)
-1.950**	-2.084***	-2.147
(.607)	(.629)	(1.273)
1,774	1,536	1,536
.276	.260	.262
	322 (.189) 0432 (.181) 0149 (.211) 177 (.193) .112 (.208) - - - - - - - - - - - - - - - - - - -	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

Robust standard errors in parentheses \*\*\* p<.001, \*\* p<.01, \* p<.05

Comparing Table 7 to Table 6, the revised model yields results rather similar to those from the original model, with the exception of the new variable, ln(*HouseholdSize*), which is predictably positively related to probability of remitting and significant at the .1 percent level across specifications (5), (6), and (7). The coefficients on age, monogamous and polygamous marriage remain significant at the .1 percent and 5 percent level, respectively, with the effect of age on propensity to remit decreasing and eventually becoming negative in slope while the effects of monogamous and polygamous marriage are again positive and large in magnitude. Also, work situation after migration seems to be the most directly relevant determinant of migrants' probability of remitting. As before, for both measures of migrant education, being paid employed abroad is associated with an increase in propensity to remit, significant at the .1

percent level for full-time and at the 1 percent level for part-time; being self-employed is associated with an increase in propensity to remit, significant at the 1 percent level; and being a student is associated with a greater decrease in propensity to remit, significant at the .1 percent level. On the other hand, whether the household is urban or rural and its asset ownership do not significantly affect propensity to remit, and the country-specific effect present for Uganda in specifications (2), (3), and (4) now only surface in specification (6). Nevertheless, the sign and magnitude of this effect are the same: migrants from Uganda are much less likely to remit than migrants from Burkina Faso, all else equal.

Most notably, neither the coefficients on the migrant's level of attainment nor the coefficient on their years of schooling are significant in specifications (5), (6), or (7). Even interacting years of schooling with sending country shows no statistically significant effect, so there is no evidence of a systematic direct or indirect effect of education on probability of remitting. Altogether, these results suggest the aspects of increased skill which tend to promote remitting, such as the ability to earn higher income in Bouhga-Hagbe's (2004), balance against those aspects which discourage remitting, such as the ability to lower the risk of poor outcomes abroad in Agarwal and Horowitz (2002). In other words, multiple models of the motives behind remittances may apply to any one migrant and their effects may negate one another, even controlling for household and individual characteristics.

Having failed to detect a significant effect of migrant education on the probability of remitting, which can facilitate brain gains by enabling increased spending on human capital acquisition in the sending country, I now turn to analyzing the characteristics of 24 return migrants in Kenya and 36 return migrants in Senegal to gauge whether those who return to their countries of origin might contribute substantively to skill repatriation. The following tables and figures display the distributions of return migrants' education, school attendance abroad, work situations abroad, reasons for return, and migration-related activities separately for each country.



Figure 4: Distribution of return migrants' level of educational attainment before migration.

Table 8: Frequency of school attendance in last migration location by highest level of educational attainment before migration.

Attended School in Last	None	Primary	Secondary	Secondary	Post-	University	Graduate
Migration Location				Technical/	Secondary		School
				Vocational	Technical/		
					Vocational		
Kenya							
Yes	0	0	3	1	1	2	4
No	2	1	4	0	4	1	1
Senegal							
Yes	3	2	2	1	1	1	1
No	15	3	4	1	0	0	0

The heterogeneity in the educational distributions between Kenya and Senegal in this small sample of OECD return migrants is dramatic. Around one-third of Kenyan return migrants had completed university or graduate school before they migrated, whereas two-thirds of the Senegalese return migrants had completed no education or primary education before they migrated. Although Senegal's educational distribution was centered at a mean below Kenya's even for the traditional migrants, the fact that the Senegalese return migrants are drawn heavily from the low end of the educational distribution and did not report proportional increases in school attendance while abroad seems to raise the concern of negative selection from its OECD migrants. Meanwhile, Kenyan return migrants are much more representative of the traditional migrants in the proportion who had completed secondary or tertiary education at the time of migration. Moreover, the groups of Kenyan return migrants who most frequently reported attending school were exactly those who had completed university or graduate school before they migrated, implying they successfully made additional human capital investments while abroad, and would likely be more productive workers and experience improved employment prospects upon returning to Kenya.

Table 9, which displays the work situation of the return migrants while they were abroad by educational attainment, and Figure 5, which documents their reasons for return, also reveal divergent trends. Kenyan return migrants who had higher levels of educational attainment before migration were more likely to be paid employed, self-employed, or students while abroad, but a large fraction of the Senegalese return migrants who had not had any education before migration were still able to become paid employed, self-employed, or students. Further, while those out of the destination labor force among Kenyan return migrants were evenly distributed across levels of educational attainment, none of those out of the destination labor force among Senegalese return migrants had had any education before migration. Combined with the concentration of relatively poorly-educated Senegalese return migrants who were students abroad, it might be inferred that they found they needed additional schooling in order to gainfully participate in OECD labor markets. Those who could not may have exited the destination labor force, and, on a larger scale, those who were able to undertake additional schooling would tend to depress remittances, but could add to the human capital stock in Senegal upon their return. Nonetheless, this positive impact, if it existed, would likely be small compared to the positive impact of return migrants on human capital in Kenya, since a plurality of Kenyans at the high end of the educational distribution returned because they simply had "no intention to stay," after reaching their human capital goals in the OECD. In contrast, among the Senegalese, the predominant factor among was "family reasons" for migrants across the educational distribution, which may have forced them to interrupt educational or work experiences in the OECD.

Table 9: Work situation in last migration location by highest level of educational attainment before migration.

Work Situation in Last Migration Location	None	Primary	Secondary	Secondary Technical/ Vocational	Post- Secondary Technical/ Vocational	University	Graduate School
Kenya							
Paid Employment, Full-Time or Part- Time	0	_	3	0	2	2	1
Self-Employed	0	-	0	0	2	0	0
Unemployed	0	_	2	0	0	0	0
Student	0	_	0	1	0	0	2
Not in Labor Force	1	_	1	0	1	0	1
Senegal							
Paid Employment, Full-Time or Part- Time	8	0	3	1	1	0	1
Self-Employed	6	3	1	0	0	0	0
Unemployed	0	1	1	0	0	0	0
Student	2	1	1	1	0	1	0
Not in Labor Force	4	0	0	0	0	0	0



Figure 5: Reasons for return by highest level of educational attainment before migration.

In Figure 6 and Table 10, I consider the return migrants' engagement with the home economy before and after their return. Figure 6 breaks down return migrants from both countries into those who sent remittances, and those who did not. It is not encouraging from a brain gains standpoint, as particularly at the very high end of the Kenyan return migrants' educational distribution, the number of return migrants who did not send remittances was greater than the number who sent remittances. Among Senegalese return migrants, the opposite is true: slightly more sent remittances, but almost all of those who did had had secondary education or less at the time of migration. This is consistent with the empirical model estimated earlier on traditional migrants, where higher levels of educational attainment or years of schooling did not correspond to a higher propensity to remit.

Finally, I analyze activities by the return migrants that are not well-studied but may still positively impact human capital acquisition in Table 10: in-kind remittances, investment from migration income, and helping another family member migrate. Much like traditional remittances, the former two activities may ease home economy budget constraints, and clearly the latter may allow another family member to make human capital investments in the OECD before themselves remitting or returning. Similar to the pattern of sending remittances, for the most part, better-educated Kenyan return migrants are not more likely to bring goods into the home economy when they return. For the Senegalese return migrants, again, somewhat counterintuitively, only return migrants with secondary education or less invested in the home economy with their migration income and helped other family members migrate. Here, Kenya and Senegal have more in common: a minority of return migrants is involved in these activities.



Figure 6: Remittance behavior by highest level of educational attainment before migration.

	None	Primary	Secondary	Secondary	Post-	University	<i>Graduate</i>
				Vocational	Technical/		School
				vocuitonui	Vocational		
17					vocuitonai		
Kenya							
Brought goods to home							
economy							
Yes	0	0	1	0	0	3	0
No	2	1	4	1	3	1	4
Senegal							
Invested in home							
economy from migration							
income							
Yes	7	1	1	0	0	0	0
No	7	1	3	2	1	1	0
Helped family member							
migrate							
Yes	9	0	1	0	0	0	0
No	4	3	3	2	1	1	0

Table 10: Migration-related activities by highest level of educational attainment before migration.

Ideally, the causal impact of migrants' education on probability of remitting would be estimated by an experiment in which migrants were randomly assigned to different levels of education and years of schooling, and comparing the remittance behavior of these "treatment groups" to a control group assigned to receive no education. However, such an experiment is not feasible for obvious reasons, and in the absence of data from a "natural" experiment that closely approximates a randomized experiment, the above model identifies the causal impact only by controlling on observables in the Migration and Remittances Household Survey dataset. This approach is subject to several limitations.

First, despite the attempt to control for relevant factors that are correlated with education, and in particular migrants' individual and household characteristics, many observed and unobserved factors remain in the residual, creating omitted variable bias. At the individual level, the migrant's occupation and duration of residence in the OECD could systematically depend on his or her education, and at the same time affect his or her propensity to remit. For example, educated migrants may be selected into more stable occupations, which by nature increase the likelihood of remitting, or educated migrants may tend to stay longer in the host economy, which decreases the likelihood of remitting as their ties to their home economies weaken. In both cases, failing to include occupation or duration of residence in the OECD in the model will bias the estimate of the impact of education on probability of remitting upwards.

Additionally, there are a number of aggregate-level omitted variables that seriously compromise the estimate. For instance, the model does not control for any characteristics of the migrants' localities in the host economy, such as economic conditions, employment opportunities, and existence of migrant networks in the surrounding region, which could easily be correlated with both education and probability of remitting. In fact, whereas the model treats all OECD migrants from each sub-Saharan African country as one group, an important source of heterogeneity could be the specific OECD country to which they migrated. OECD countries may differ in their remittance infrastructure, and if more educated migrants tend to locate in places with better or worse remittance infrastructure than less-educated migrants, estimates of the causal impact of education on probability of remitting would again be biased.

A second limitation of the model is the potential for simultaneity bias. In particular, using asset ownership and household size as explanatory variables ignores the possibility that they are endogenous to probability of remitting. Early in the empirical analysis, I posit an inverse relationship between asset ownership and propensity to remit, but as the indeterminate coefficient on *AssetIndex* suggests, the relationship could be direct as well. The direct relationship reveals that causality may run in both directions: while households with fewer assets might lack access to bank accounts and thus cause their migrants to be less likely to remit, it could also be that migrants who are independently less likely to remit cause their households to own fewer assets. Since the Migration and Remittances Household Surveys are cross-sectional, data on past asset ownership is not available, and these two situations would be observationally equivalent.<sup>14</sup> A similar issue exists for household size: the positive coefficient on *HouseholdSize* may reflect that larger households need more money and cause migrants to be more likely to remit, or it may reflect that migrants who are more likely to remit provide resources that enable households to have more children or otherwise grow in number.

The third limitation of the model is measurement error in the explanatory variables. The head of the household responded to the Migration and Remittances Household Surveys, and he

<sup>&</sup>lt;sup>14</sup> One way to mitigate this problem would be to use the average asset index of the migrant's village, district, or region, which arguably their own remittances could not determine, instead of his or her household's asset index.

or she may not have reported correct or complete information on the migrant's education, work situation before and after migration, marital status, or household asset ownership. If measurement error is systematic in the sense that it is larger for particular groups of migrants, such as older migrants or migrants from poorer households, estimates of the causal impact of education on probability of remitting from a pooled sample will not be accurate.

In summary, it is critical to recognize that the near impossibility of ensuring "all else equal" in a model which only controls on observables warrants a cautious interpretation of the regression results. A combination of omitted variables bias, simultaneity bias, and measurement error may have rendered the estimates of the coefficient of interest and coefficients on several other explanatory variables imprecise. Since Bhagwati and Hamada's (1984) seminal paper, a far-reaching concern of migration theory and policy has been the phenomenon of "brain drain," or human capital depletion in developing countries when skilled migrants leave for developed countries, where returns to education are higher. More recent literature has called this pessimism into question and raised the possibility of "brain gains," or human capital increases stemming from the interactions of educated migrants with their home economies. Two channels through which such human capital increases might occur are remittances, which may ease sending country household budget constraints and allow for additional investments in education, and return migration, which may repatriate migrants' skills and human capital gained abroad. Anecdotally, India presents an excellent case for the development contribution of remittances and return migration, but it is unclear to what extent their success generalizes. Empirical evidence on how exactly these two channels translate into brain gains, and what conditions must first be satisfied, is sparse. Indeed, if highly-educated migrants are less likely to remit or return than less-educated migrants, brain gains may be small or economically negligible relative to the brain drain.

This thesis has considered the relationship between education and propensity to remit for OECD migrants from Burkina Faso, Kenya, Nigeria, Senegal, and Uganda and examined the characteristics of return migrants to Kenya and Senegal. The primary result is that migrant skill, as measured by highest level of attainment as well as years of schooling, is neither positively nor negatively related to propensity to remit; education does not have a statistically significant effect on propensity to remit, which suggests both altruistic motives and insurance motives are at play and on average exert equal influence across individuals. The second result is that, even in a small sample of OECD return migrants to Kenya and Senegal, there is significant heterogeneity in

return migrants' education levels, work situations abroad, and reasons for return, including a contrast between neutral selection of return migrants to Kenya and seemingly negative selection of return migrants to Senegal. Nonetheless, neither countries' return migrants displayed strong or consistent patterns of engagement with their home economies; the secondary-educated and tertiary-educated return migrants largely did not send remittances, bring goods to the home economy, invest in the home economy with their migration income, or help family members migrate. These findings casts doubt on whether any meaningful increase in human capital in these countries can be traced to remittances or return migration by the most educated migrants.

In order for remittances and return migration to have any chance of positive development impact, migrants who successfully integrate into destination labor markets would have to engage with their home economies on a much larger scale. If altruism towards their households and places of origins and the desire for insurance do not constitute sufficient incentives to do so, developing country governments may be justified in actively attempting to correct the negative externality skilled emigration imposes on the home economy labor market by maximizing benefits received from migrant experiences in the host economy. This leads naturally to a few short-run policy recommendations:

- i. Promote continuing ties to the home economy among diasporas by maintaining contact with hometown associations and establishing overseas citizenship benefits.
- ii. Cooperate with international financial institutions, host economy banks, and mobile banking service providers in order to reduce financial transaction costs and thereby facilitate remittances.
- iii. Target remittance initiatives and return migration incentives towards educated migrants, potentially sponsoring a portion of the costs of their human capital acquisition abroad in exchange for a commitment to remit or return.

Of course, perhaps the most effective strategy for developing countries to increase diaspora engagement and positive selection of return migrants in the long run is to pursue broader economic growth, as the investment opportunities and employment prospects accompanying a credible dedication to equitable, sustainable development would make remitting and returning more profitable for skilled individuals.

Future research on the importance of education for remitting and returning could study shocks that produced quasi-experimental variation in migrant educational attainment to better estimate its effect on engagement with the home economy. In general, the brain gains literature should continue to explore the motivations and characteristics driving remittances and return migration across sending country and destination contexts. Open empirical questions on both the extensive and intensive margins have yet to be answered: *Do the positive impacts of remittances on human capital investment persist? What factors determine the proportion of remittances spent on education? Can negative selection of return migrants still be beneficial for sending country human capital? To what extent do intentions to return affect skill repatriation?* Answers to these questions will contribute to a deeper understanding of the decisions made by educated migrants and their households, enhancing the capacity for migration policy to serve as a development tool.

#### APPENDIX A: DERIVATION OF PARTIAL EFFECTS

Below I expand the second derivatives of expected utility as in Agarwal and Horowitz's (2002) model, in order to derive the partial effects on remittances with respect to migrant's income in the first period ( $Y_1$ ), migrant's income if the bad state is realized in the second period ( $Y_{2b}$ ), and the probability that the bad state is realized in the second period ( $\pi$ ).

$$\begin{aligned} \frac{d^2 E[V]}{dr^2} &= -V_1''(Y_1 - r) * \left(1 - \frac{dr}{dY_1}\right) + \frac{V_{2b}''}{\pi} \left(Y_{2b} + \frac{r}{\pi}\right) * \frac{dr}{dY_1} \\ &= -V_1''(Y_1 - r) + \left[V_1''(Y_1 - r) + \frac{V_{2b}''}{\pi} \left(Y_{2b} + \frac{r}{\pi}\right)\right] \frac{dr}{dY_1} = 0 \\ \frac{d^2 E[V]}{dr^2} &= -V_1''(Y_1 - r) * \left(-\frac{dr}{dY_{2b}}\right) + V_{2b}'' \left(Y_{2b} + \frac{r}{\pi}\right) * \left(1 + \frac{dr}{\pi dY_{2b}}\right) \\ &= V_{2b}'' \left(Y_{2b} + \frac{r}{\pi}\right) + \left[\frac{V_{2b}''}{\pi} \left(Y_{2b} + \frac{r}{\pi}\right) + V_1''(Y_1 - r)\right] \frac{dr}{dY_{2b}} = 0 \\ \frac{d^2 E[V]}{dr^2} &= -V_1''(Y_1 - r) \left[-\frac{dr}{d\pi}\right] + V_{2b}'' \left(Y_{2b} + \frac{r}{\pi}\right) \left[\frac{\pi \frac{dr}{d\pi} - r}{\pi^2}\right] \\ &= V_1''(Y_1 - r) \frac{dr}{d\pi} + V_{2b}'' \left(Y_{2b} + \frac{r}{\pi}\right) \left[\frac{dr}{\pi d\pi} - \frac{r}{\pi^2}\right] \\ &= -\frac{r}{\pi^2} V_{2b}'' \left(Y_{2b} + \frac{r}{\pi}\right) + \left[\frac{V_{2b}''}{\pi} \left(Y_{2b} + \frac{r}{\pi}\right) + V_1''(Y_1 - r)\right] \frac{dr}{d\pi} = 0 \end{aligned}$$

# APPENDIX B: CODESHEET FOR CATEGORICAL VARIABLES

# Female

0	Male
1	Female

# SpouseChildren

0	Neither Spouse Nor Children in Destination
1	Spouse or Children in Destination

# MaritalStatus

0	Single
1	Married, Monogamous
2	Engaged
3	Cohabiting
4	Separated
5	Divorced
6	Widowed
7	Married, Polygamous

# Urban

0	Rural
1	Urban

# WorkBefore and WorkCurrent

0	Not in Labor Force
1	Paid Employed, Full-Time
2	Paid Employed, Part-Time
3	Self-Employed
4	Student
5	Unemployed

# <u>Country</u>

1	Burkina Faso
2	Kenya
3	Nigeria
4	Senegal
5	Uganda

## LevelSchooling

0	None
1	Less Than Primary
2	Primary
3	Secondary
4	Post-Secondary Technical or Vocational
5	College or University
6	Graduate or Tertiary Technical or Vocational

APPENDIX C: STATA CODE FOR REPLICATION

```
// Education, Remittances, and Return Migration
// Erlfang Tsai
// (Data available for download at
http://microdata.worldbank.org/index.php/catalog/mrs.)
clear all
cap log close
set more off, perm
cd "X:\Thesis\Output Files"
// Generate asset index.
use "X:\Clean Copy\Burkina Faso 2010\f3w.dta", clear
foreach X of varlist s311-s3119 {
recode `X' 2=0
tab `X', nola
}
egen AssetIndex=rowtotal(s311-s3119)
tab AssetIndex
save "X:\Thesis\OECD BF1.dta", replace
use "X:\Clean Copy\Burkina Faso 2010\f5iw.dta", clear
// Recode and rename variables.
tab s52
tab s52, nola
recode s52 1=0 2=1, gen(Female)
tab Female
tab s53
rename s53 Age
tab s54a
tab s54a, nola
recode s54a (7=0) (8=7) (9=.), gen(MaritalStatus)
tab MaritalStatus
tab s5102
tab s5102, nola
recode s5102 2=0 3=.
tab s5103
tab s5103, nola
recode s5103 2=0 3=.
gen SpouseChildren=s5102+s5103
tab SpouseChildren
recode SpouseChildren 2=1
tab SpouseChildren
tab milieu
tab milieu, nola
recode milieu 2=0, gen(Urban)
tab Urban
tab s511
tab s511, nola
recode s511 (1=0) (2=1) (3=2) (4=3) (5=4) (6=5) (8 7 =6) (-1 9 10 = .),
gen(LevelSchooling)
tab LevelSchooling
tab s512
tab s512, nola
```

```
recode s512 19 99 = ., gen(YearsSchooling)
tab YearsSchooling
tab s514
tab s514, nola
recode s514 (6 7 9 = 0) (10 11 = .), gen(WorkBefore)
tab WorkBefore
tab s515b
tab s515b, nola
recode s515b (6 7 8 9 = 0) (10 11 = .), gen(WorkCurrent)
tab WorkCurrent
tab s517
tab s517, nola
recode s517 2=0, gen(Remit)
tab Remit
desc, short
merge m:1 region prov vill men taillemen milieu typmen using
"X:\Thesis\OECD BF1.dta", keepusing(AssetIndex) keep(match) nogen
tab taillemen
rename taillemen HouseholdSize
// Subset OECD migrants.
tab s57
tab s57, nola
keep if s57>12 & s57<18
// Generate country code.
gen Country=1
// Save country dataset.
save "X:\Thesis\OECD_BF1.dta", replace
// Generate asset index.
use "X:\Clean Copy\Kenya 2009\Household.dta", clear
foreach X of varlist q3 1 1-q3 1 19 {
recode `X' 2=0
tab `X', nola
}
egen AssetIndex=rowtotal(q3 1 1-q3 1 19)
tab AssetIndex
tab hhmnum
rename hhmnum HouseholdSize
tab urbrural
tab urbrural, nola
recode urbrural 2=0, gen(Urban)
tab Urban
save "X:\Thesis\OECD K2.dta", replace
use "X:\Clean Copy\Kenya 2009\section5.dta", clear
// Recode and rename variables.
tab q5_2
tab q5 2, nola
recode q5 2 1=0 2=1, gen(Female)
tab Female
tab q5 3
rename q5 3 Age
tab q5 10
```

```
tab q5 10, nola
recode q5 10 (7=0) (8=.), gen(MaritalStatus)
tab MaritalStatus
tab q5 11
tab q5 11, nola
recode q5 11 (1 4 5 6 8 = 0) (2 3 9 = 1) (7 23=.), gen(SpouseChildren)
tab SpouseChildren
tab q5 12
tab q5 12, nola
recode q5_12 (1=0) (4 8 9 = .) (5=4) (6=5) (7=6), gen(LevelSchooling)
tab LevelSchooling
tab q5 13
recode q5 13 .6 = .
rename q5 13 YearsSchooling
tab YearsSchooling
tab q5 15
tab q5 15, nola
recode q5 15 (5=4) (6=5) (7 8 9 = 0) (10=.), gen(WorkBefore)
tab WorkBefore
tab q5 16
tab q5 16, nola
recode q5 16 (5=4) (6=5) (7 8 9 = 0) (11 12 = .), gen(WorkCurrent)
tab WorkCurrent
tab q5 18
tab q5 18, nola
recode q5 18 2=0, gen(Remit)
tab Remit
desc, short
merge m:1 qno using "X:\Thesis\OECD K2.dta", keepusing(Urban HouseholdSize
AssetIndex cunit) keep(match) nogen
// Subset OECD migrants.
tab q5 8 111
tab q5 8 111, nola
keep if q5 8 111==1
// Generate country code.
gen Country=2
// Save country dataset.
save "X:\Thesis\OECD K2.dta", replace
// Generate asset index.
use "X:\Clean Copy\Nigeria 2009\consolidated.dta", clear
duplicates drop hhno censusunit hhtype villagetown, force
assert censusunit==villagetown
foreach X of varlist agricland-tractorharvester {
recode `X' (2=0) (4 11 22 =.)
tab `X', nola
egen AssetIndex=rowtotal(agricland-tractorharvester)
tab AssetIndex
tab noinhh
rename noinhh HouseholdSize
save "X:\Thesis\OECD N3.dta", replace
```

use "X:\Clean Copy\Nigeria 2009\migrants 2.dta", clear // Recode and rename variables. tab Sex tab Sex, nola recode Sex 1=0 2=1, gen(Female) tab Female tab Maritalstatus tab Maritalstatus, nola recode Maritalstatus 7=0, gen(MaritalStatus) tab MaritalStatus tab Liveswith tab Liveswith, nola recode Liveswith  $(1 \ 4 \ 5 \ 6 = 0)$   $(2 \ 3 = 1)$  (7=.), gen(SpouseChildren) tab SpouseChildren tab Urbanrural tab Urbanrural, nola recode Urbanrural 2=0, gen(Urban) tab Urban tab Highestschoolbeforeleaving tab Highestschoolbeforeleaving, nola recode Highestschoolbeforeleaving (1=0) (2=1) (3=2) (4=3) (5=4) (6=5) (7 8 = 6)  $(9 \ 10 = .)$ , gen(LevelSchooling) tab LevelSchooling tab Schoolyrsbeforeleaving rename Schoolyrsbeforeleaving YearsSchooling tab Worksitbeforeleaving tab Worksitbeforeleaving, nola recode Worksitbeforeleaving (6 7 8 9 = 0) (10=.), gen(WorkBefore) tab WorkBefore tab Currentworksit tab Currentworksit, nola recode Currentworksit (6 7 8 9 10 = 0) (11 12 = .), gen(WorkCurrent) tab WorkCurrent tab Sendmoney tab Sendmoney, nola recode Sendmoney 2=0, gen(Remit) tab Remit rename HHNo hhno rename Town villagetown rename HHType hhtype desc, short merge m:1 hhno villagetown hhtype using "X:\Thesis\OECD N3.dta", keepusing (HouseholdSize AssetIndex) keep (match) nogen // Subset OECD migrants. tab Migrantin tab Migrantin, nola keep if Migrantin>2 & Migrantin<12 // Generate country code. gen Country=3 // Save country dataset. save "X:\Thesis\OECD N3.dta", replace // Generate asset index.

```
use "X:\Clean Copy\Senegal 2009\base menage 21avril2011.dta", clear
foreach X of varlist q31 1-q31bis 15 {
recode `X' 2=0
tab `X', nola
}
egen AssetIndex=rowtotal(q31 1 - q31bis 15)
tab AssetIndex
tab taille men
rename taille men HouseholdSize
save "X:\Thesis\OECD S4.dta", replace
use "X:\Clean Copy\Senegal
2009\base anciens membres du menage final 21 avril11.dta", clear
// Recode and rename variables.
tab q52
tab q52, nola
recode q52 (2=1) (1=0), gen(Female)
tab Female
tab q53
rename q53 Age
tab q54a
tab q54a, nola
recode q54a (7=0) (8=7) (9=.), gen(MaritalStatus)
tab MaritalStatus
tab q510 2
tab q510 2, nola
recode q510 2 2 3 = 0
tab q510 2
tab q510 3
tab q510_3, nola
recode q510_3 2 3 = 0
tab q510 3
gen SpouseChildren=q510 2+q510 3
recode SpouseChildren 2=1
tab SpouseChildren
tab q06
tab q06, nola
recode q06 2=0, gen(Urban)
tab Urban
tab q511
tab q511, nola
recode q511 (1=0) (2=1) (3=2) (4=3) (5=4) (6=5) (7 8 = 6) (9 10 = .),
gen(LevelSchooling)
tab LevelSchooling
tab q512
tab q512, nola
recode q512 19 99 = ., gen(YearsSchooling)
tab YearsSchooling
tab q514
tab q514, nola
recode q514 (6 7 8 9 = 0) (10 11 = .), gen(WorkBefore)
tab WorkBefore
tab q515b
tab q515b, nola
recode q515b (6 7 8 9 = 0) (10 11 = .), gen(WorkCurrent)
tab WorkCurrent
tab q517
```

```
tab q517, nola
recode q517 (2=0) (3=.), gen(Remit)
tab(Remit)
desc, short
merge m:1 numqest q01 q02 q09 using "X:\Thesis\OECD S4.dta",
keepusing(HouseholdSize AssetIndex) keep(match) nogen
// Subset OECD migrants.
tab q57
tab q57, nola
keep if q57>2 & q57<12
// Generate country code.
gen Country=4
// Save country dataset.
save "X:\Thesis\OECD S4.dta", replace
// Generate asset index.
use "X:\Clean Copy\Uganda 2010\uganda sections 2 and 3
household 21 03 2011.dta", clear
foreach X of varlist q31a1i-q31b15m {
recode `X' 2=0
tab `X', nola
}
egen AssetIndex=rowtotal(q31a1i-q31b15m)
tab AssetIndex
save "X:\Thesis\OECD U5.dta", replace
use "X:\Clean Copy\Uganda 2010\uganda section 5 household member
migrants 21 03 2011.dta", clear
// Recode and rename variables.
// Note: Since q512 1 does not distinguish between undergraduate and graduate
levels, I code those with more than 19 years of schooling as graduates.
tab q52
tab q52, nola
recode q52 (1=0) (2=1), gen(Female)
tab Female
tab q53
rename q53 Age
tab q510 1
tab q510 1, nola
recode q510 1 7=0, gen(MaritalStatus)
tab MaritalStatus
tab q511 1
tab q511 1, nola
recode q511_1 (1 4 5 = 0) (2 3 = 1) (6 7 = . ), gen(SpouseChildren)
tab SpouseChildren
tab stratum
tab stratum, nola
recode stratum 2=0, gen(Urban)
tab Urban
tab q512 1
tab q512 1, nola
recode q512 1 6=., gen(LevelSchooling)
replace LevelSchooling=6 if q513>19 & q513!=. & LevelSchooling!=.
```

tab LevelSchooling tab q513 1 if q513>19 rename q513 1 YearsSchooling tab q515\_1 tab q515 1, nola recode q515 1  $(7 \ 8 \ 9 = 0)$  (10=.), gen(WorkBefore) tab WorkBefore tab q516 1 tab q516 1, nola recode q516 1 (6 7 8 9 = 0) (10 11 = .), gen(WorkCurrent) tab WorkCurrent tab q518 1 tab q518 1, nola recode q518 1 2=0, gen(Remit) tab Remit tab hhmemno rename hhmemno HouseholdSize desc, short merge m:1 qnaireno district county parish earea stratum hhno respcode using "X:\Thesis\OECD U5.dta", keepusing(AssetIndex) keep(match) nogen // Subset OECD migrants. tab q58 tab q58, nola keep if q58==3|q58==5|q58==7|q58==8|q58==11|q58==19|q58==20 // Generate country code. gen Country=5 // Save country dataset. save "X:\Thesis\OECD\_U5.dta", replace // Merge country datasets. use "X:\Thesis\OECD BF1.dta", clear cd X:\Thesis append using OECD K2 OECD N3 OECD S4 OECD U5, keep(Remit Female Age MaritalStatus SpouseChildren Urban HouseholdSize AssetIndex WorkBefore WorkCurrent Country LevelSchooling YearsSchooling) nolabel desc, short gen lnAge=ln(Age) gen lnHouseholdSize=ln(HouseholdSize) label define MaritalStatusCodes 0 "Single" 1 "Married, Monogamous" 2 "Engaged" 3 "Cohabiting/In Union" 4 "Separated" 5 "Divorced" 6 "Widowed" 7 "Married, Polygamous" label values MaritalStatus MaritalStatusCodes label define WorkCodes 0 "Not in Labor Force" 1 "Full-Time Employed" 2 "Part-Time Employed" 3 "Self-Employed" 4 "Student" 5 "Unemployed" label values WorkBefore WorkCodes label values WorkCurrent WorkCodes label define CountryCodes 1 "Burkina Faso" 2 "Kenya" 3 "Nigeria" 4 "Senegal" 5 "Uganda" label values Country CountryCodes label define LevelSchoolingCodes 0 "None" 1 "Less Than Primary" 2 "Primary" 3 "Secondary" 4 "Post-Secondary Technical/Vocational" 5 "Tertiary/University" 6 "Graduate/Technical/Vocational" label values LevelSchooling LevelSchoolingCodes

// Check for uniform variable values. order Remit Female Age lnAge MaritalStatus SpouseChildren Urban HouseholdSize InHouseholdSize AssetIndex WorkBefore WorkCurrent Country LevelSchooling YearsSchooling drop region-s522tot foreach X of varlist Remit-YearsSchooling { tab `X' save "X:\Thesis\OECD.dta", replace cd "X:\Thesis\Output Files" log using "Summary Statistics.log", replace use "X:\Thesis\OECD.dta", clear bysort Country: tab Remit bysort Country: tab LevelSchooling bysort Country: sum YearsSchooling bysort Country: sum Age bysort Country: tab Female bysort Country: tab MaritalStatus bysort Country: tab SpouseChildren bysort Country: tab WorkBefore bysort Country: tab WorkCurrent bysort Country: tab Urban bysort Country: sum AssetIndex log close cd "X:\Thesis\Output Files" log using "Empirical Analysis.log", replace use "X:\Thesis\OECD.dta", clear // Run regressions and output tables. // Original specification. probit Remit Female c.Age c.Age#c.Age i.SpouseChildren i.MaritalStatus Urban AssetIndex i.WorkBefore i.WorkCurrent i.Country i.LevelSchooling, robust noloq outreg2 using Results1, word replace ctitle(" ") alpha(0.001, 0.01, 0.05) addstat (Pseudo R-Squared, `e(r2 p)') probit Remit Female c.Age c.Age#c.Age i.SpouseChildren i.MaritalStatus Urban AssetIndex i.WorkBefore i.WorkCurrent i.Country c.YearsSchooling, robust noloq outreg2 using Results1, word append ctitle(" ") alpha(0.001, 0.01, 0.05) addstat(Pseudo R-Squared, `e(r2 p)') probit Remit Female c.lnAge c.lnAge #c.lnAge i.SpouseChildren i.MaritalStatus Urban AssetIndex i.WorkBefore i.WorkCurrent i.Country i.LevelSchooling, robust nolog outreg2 using Results1, word append ctitle(" ") alpha(0.001, 0.01, 0.05) addstat(Pseudo R-Squared, `e(r2 p)') probit Remit Female c.lnAge c.lnAge#c.lnAge i.SpouseChildren i.MaritalStatus Urban AssetIndex i.WorkBefore i.WorkCurrent i.Country c.YearsSchooling, robust nolog outreg2 using Results1, word append ctitle(" ") alpha(0.001, 0.01, 0.05) addstat(Pseudo R-Squared, `e(r2 p)')

```
// Removing WorkBefore, adding lnHouseholdSize.
probit Remit Female c.Age c.Age #c.Age i.SpouseChildren i.MaritalStatus Urban
InHouseholdSize AssetIndex i.WorkCurrent i.Country i.LevelSchooling, robust
nolog
outreg2 using Results2, word replace ctitle(" ") alpha(0.001, 0.01, 0.05)
addstat(Pseudo R-Squared, `e(r2 p)')
probit Remit Female c.Age c.Age#c.Age i.SpouseChildren i.MaritalStatus Urban
InHouseholdSize AssetIndex i.WorkCurrent i.Country c.YearsSchooling, robust
noloq
outreg2 using Results2, word append ctitle(" ") alpha(0.001, 0.01, 0.05)
addstat(Pseudo R-Squared, `e(r2 p)')
// Testing interaction between years of schooling and sending country.
probit Remit Female c.Age c.Age#c.Age i.SpouseChildren i.MaritalStatus Urban
lnHouseholdSize AssetIndex i.WorkCurrent c.YearsSchooling##i.Country, robust
noloq
outreg2 using Results2, word append ctitle(" ") alpha(0.001, 0.01, 0.05)
addstat(Pseudo R-Squared, `e(r2 p)')
log close
// Note: Burkina Faso, Nigeria, and Uganda each had fewer than 5 OECD return
migrants, and are therefore omitted from this analysis.
log using "X:\Thesis\Output Files\Kenya Return Migration.log", replace
use "X:\Clean Copy\Kenya 2009\section7.dta", clear
tab q7 2
tab q7 2, nola
keep if q7 2==3|q7 2==5|(q7 2>6&q7 2<10)|q7 2==12|q7 2==14
tab q7_7
tab q7_8 q7_7
tab q7_9 q7_7
tab q7 10 q7 7
tab q7 12 q7 7
tab q7 13 q7 7
tab q7<sup>19</sup> q7<sup>7</sup>
save "X:\Thesis\OECD RK1.dta", replace
log close
log using "X:\Thesis\Output Files\Senegal Return Migration.log", replace
use "X:\Clean Copy\Senegal 2009\base individu 21 avril 2011.dta", clear
tab q72
tab q72, nola
keep if q72>2&q72<12
tab q77
tab q78 q77
tab q79 q77
tab q711a q77
tab q711b q77
tab q712 q77
tab q713 q77
tab q811 q77
tab q89 q77
save "X:\Thesis\OECD RS2.dta", replace
log close
```

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# Erlfang Tsai

## EDUCATION

Pennsylvania State University, Schreyer Honors College

B.S. Economics, B.A. Political Science, Mathematics Minor, French Minor

#### **RELEVANT COURSEWORK**

Microeconomics	Economics of Education	Law and Regulation	Matrix Algebra
Macroeconomics	Economic Demography	Differential Equations	Real Analysis
Econometrics	Labor Economics	Mathematical Statistics	Vector Calculus

### HONORS

Department of Economics Student Marshal	2017
Department of Economics Undergraduate Award	2015, 2016
Evan Pugh Scholar Junior Award	2016
College of Liberal Arts Ripp Family Award	2015
President's Sparks Award	2015
President's Freshman Award	2014
Dean's List	2013-2017

# LANGUAGES

English (native), French (fluent)

### SKILLS

STATA, R, LaTeX

### **RESEARCH INTERESTS**

Applied Microeconomics, Development Economics, Labor Economics, Economics of Education

### **RESEARCH EXPERIENCE**

#### Pennsylvania State University, Department of Economics

Research Assistant

• Estimating returns to education in the United States from Current Population Survey data, and supporting additional empirical work on educational demand, supply, equilibrium, and policy issues for Professor Russell Cooper's book on the economics of higher education

#### Federal Reserve Bank of Boston, Research Department

Intern, New England Public Policy Center

• Worked with economists Osborne Jackson and Bo Zhao to construct and implement differences-in-differences analysis of the effect of criminal history screening questions in the college admissions process on ex-offenders' higher educational attainment

#### Present

May 2016 - August 2016

- Cleaned data extract from 1997 National Longitudinal Survey of Youth consisting of demographic, education, and criminal history variables for thousands of individuals, ensuring accurate estimation results
- Programmed, summarized, and analyzed results of numerous regression iterations in STATA, varying specifications by age cohort, subsample, time window, controls, interaction terms, weighting, and robust or clustered standard errors

#### Pennsylvania State University, Department of Economics August 2015 - May 2016

Research Assistant, Bates White Research Experiences for Undergraduates Program

- Led team of assistants working under Professor David Shapiro on empirical projects studying labor force participation, education, ethnicity, and fertility in sub-Saharan Africa using data from the Enquête 1-2-3 and the Demographic and Health Surveys
- Estimated multiple regression models, produced cross-tabulations, and generated several series of graphs to analyze outcome differentials by gender, age, education, and place of residence, as featured in papers accepted to the 2016 Population Association of America Annual Meeting

#### Pennsylvania State University, Department of Political Science January 2015 - May 2015 **Research Assistant**

Collected geographical, political, and economic information on autonomous political entities in Lesotho and Côte d'Ivoire for "De Facto States in World Politics," a National Science Foundation-funded project directed by Professor Douglas Lemke

# TEACHING EXPERIENCE

### Pennsylvania State University, Department of Economics

Teaching Assistant, Economic Demography (ECON463)

٠ Held weekly office hours to answer students' questions and review concepts, graded and commented on students' homework assignments, and conducted exam postmortems

# **OTHER EXPERIENCE**

### Pennsylvania Governor's Office of the Budget

Intern

Researched and wrote report on efficacy of Pennsylvania Department of Education program, proposed modifications of program statistics reported in Executive Budget, completed submission to nation-wide state expenditure survey, and prepared materials for comprehensive state agency fees inventory

# **LEADERSHIP**

### Penn State Economics Association

Vice President of Education and Print Education Associate

Oversaw four committees' creation of weekly presentations and publications designed to inform • undergraduates about economic theory and research, with emphasis on its implications for current events, markets, and modern society

### January 2016 - May 2016

# May 2014 - August 2014

January 2014 - present

• Mentored and assisted in planning academic enrichment activities for undergraduates, including economic simulations, the Great Debate, and professional development workshops

## Anti-Hunger Games Club

April 2014 - May 2016

Founder and President

- Established annual Thanksgiving food drive in South Halls residence halls benefiting local families in need, delivering hundreds of pounds of nonperishables to homes, churches, and food banks each year
- Joined with other campus organizations to organize service opportunities for students that raised awareness of and provided relief from hunger and homelessness, such as panel discussions, meal-packaging events, and volunteering at community shelters