

Supplemental Appendix for AER-2024-1465

Abundance from Abroad: Migrant Income
and Long-Run Economic Development

Gaurav Khanna
University of California – San Diego

Emir Murathanoglu
Oberlin College

Caroline Theoharides
Amherst College

Dean Yang
University of Michigan – Ann Arbor

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Online Appendix

1 Data Appendix

1.1 Migration Data

Calculation of migrant income per capita of each Philippine province in every overseas destination requires unusual data. We obtained two administrative datasets from Philippine government agencies. The Philippine Overseas Employment Administration's (POEA) migrant contract database contains name, date of birth, sex, marital status, occupation, destination country, employer, recruitment agency, salary, contract duration, and date deployed. The database of the Overseas Worker Welfare Administration (OWWA) includes migrants' names, date of birth, sex, destination country, date deployed, and home address in the Philippines (POEA, 2009; POEA, 2017; OWWA, 2012).

To create a dataset that includes migrant wages, destination, and province of origin, Theoharides (2018) combined the datasets from POEA and OWWA using fuzzy matching techniques for the years 1992-1997 and 2007-2009. The POEA and OWWA data are matched using first name, middle name, last name, date of birth, destination country, sex, and year of departure. The match rate is 95%. Starting in 2010, data from POEA included wages, destination, and province of origin, so our data from 2010-2015 is from POEA only and does not require matching. Several of the immediate post-shock (post-1997) years have relatively high rates of missing data on migrant origin address. We therefore focus on the years 2007-2015, which have low rates of missing address data, and which also span the 2007, 2010, and 2015 Philippine Censuses.¹ All wages are expressed in thousands of real 2010 Philippine pesos. We winsorize the wages at 99% within each destination-occupation category cell.²

We use the 1995 contract data to construct the shift-share variable $Shiftshare_o$. First, we calculate province-level migrant income per capita ($MigInc_o$) in 1995. We calculate province total migrant income by multiplying average migrant income for a province's migrants in 1995 (from the POEA/OWWA contract data) by the number of migrants in a given province (from the 1995 Census). We then divide by 1995 province population, obtaining migrant income per capita. We use an analogous calculation for migrant income per capita in 1994, 2009, 2012, and 2015 (corresponding to triennial FIES years). For each year, we calculate average migrant income from the POEA/OWWA data.³ We then multiply by the

¹In the 1992-2009 contract data, the home address variable in the OWWA data includes municipality, but not province. Out of 1630 municipalities in the Philippines, 332 have names that are duplicated in another province. This accounts for between 10 and 19% of migration episodes, depending on the year. Thus, to calculate province-level variables, we assign municipalities with such duplicate names their population share of the total wages across municipalities with the same name. For the 2010-2015 data, municipality and province are reported for each contract.

²When destination-occupation cells have fewer than 100 observations, we aggregate these cells and winsorize at the occupation level.

³For these years, we use the migrant wages from the previous three years of contract data to calculate average income

total number of migrants in the 1995 Census (for 1994 migrant income per capita), 2010 Census (for 2010 and 2012 migrant income per capita), or in the 2015 Census (for 2015 migrant income per capita).

Second, we use the contract data to construct $Rshock_o$, the weighted average exchange rate shock of province o 's migrants. Weights are the pre-shock share of migrant income from destination d . For each province o , we calculate these weights directly from the contract data, as the share of total province-level migrant annual income from each destination country in 1995 ($\frac{\omega_{do0}}{\sum_d \omega_{do0}}$). We then multiply each exchange rate change $\tilde{\Delta}R_{d0}$ by the corresponding province- o -specific weights to obtain $Rshock_o$.

A small minority of contracts have missing data on municipality in the OWWA data (14.5% in 1995). A concern is that the exchange rate shock might be correlated with the propensity to be missing municipality data in the pre-period, and thus introduce some chance correlation with province or destination characteristics into $Shiftshare_o$. To test this, we regress the exchange rate shock on the share of destination observations with a missing province on the exchange rate shock, weighting by [Borusyak et al. \(2022\)](#) shares. The coefficient on the share missing is very small in magnitude and not statistically significantly different from zero. A one-standard-deviation increase in the share of contracts missing province data is associated with a 0.007 increase in the exchange rate shock (which has a mean of 0.406 and a standard deviation of 0.138). The regression provides no indication that the propensity for migrant worker contracts for a given migration destination to have missing Philippine location data in the pre-period is correlated with that destination's exchange rate shock.

1.2 Domestic Income and Expenditure

All outcomes in money units in this paper (e.g., income and expenditure) are in 2010 real Philippine pesos (PhP; 17.8 PhP per PPP US\$ in 2010).

Data on household income and expenditure are from triennial rounds of the Philippine Family Income and Expenditure Survey (1985, 1988, 1991, 1994, 1997, 2000, 2003, 2006, 2009, 2012, 2015, and 2018) ([PSA, 1988-2018](#)). The FIES provides the Philippine government's official income and expenditure statistics. It includes detailed household income and expenditure items. Domestic income and expenditure (as in Table 1), are the aggregation of these detailed items. Domestic income is calculated as total household income minus income from international sources, transfers from domestic sources, and gifts from other households. Income from international sources includes migrant remittances, but also includes pensions, retirement, workmen's compensation, and other benefits; cash gifts, support, relief,

per migrant. For example, 2009 migrant income per capita uses the average of income reported in contracts in 2007, 2008, and 2009. Migrant contracts have an average contract length of 24 months, so the average wages of the stock of migrants in 2009 would reflect the average wages of migrants departing in 2009 as well as previous years.

etc., from abroad; and dividends from investments abroad. Migrant remittances are not explicitly reported in the data.

We calculate global income by adding migrant income from the POEA/OWWA data and domestic income from the FIES. To analyze global income's domestic and migrant components, we focus on a subset of time periods when both domestic and migrant income data are available. This allows us to examine one pre-shock year and three post-shock years in analyses of global income. For domestic income from the FIES, the pre-shock year is the 1994 FIES round, and the post-shock years are 2009, 2012, and 2015 FIES rounds.

1.3 Census Data

Education. We created a panel of schooling outcomes using the 1990, 1995, 2000, 2007, 2010, and 2015 Philippine Census of Population (NSO, 1990 ; NSO, 1995; NSO, 2000; NSO, 2007; NSO, 2010; PSA, 2015). In each census round, we calculate the provincial share of individuals with primary (6 or more years of schooling), high school (10 or more years), and college education (14 or more years) for the full population (aged 20-64) as well as for international migrant workers.

Sectoral Employment Share. We create a panel of the sectoral share of work-force using 1990, 1995, 2000, and 2010 Philippine Census of Population (the only years with available variables). In each census round, we calculate the share of employed individuals in primary, manufacturing, and non-tradable goods and services sectors. Primary sectors include agriculture, fishing, forestry, mining, and extraction (broadly corresponding to ISIC codes 1-9). The manufacturing sector includes manufacturing (broadly corresponding to ISIC codes 10-33). Non-tradable goods and services include construction, wholesale/retail trade, transportation, storage, communication, electricity, gas, water, waste, finance, insurance, real estate, business services, hotels and restaurants, education, health, social work, private household services, public administration, and other services (broadly corresponding to ISIC codes 35-98).

1.4 Labor Force Survey Data

The FIES, which we use for our main income and expenditure outcomes, is implemented as a rider every three years to the government's quarterly Labor Force Surveys (LFS). We use the merged LFS and FIES data to calculate domestic income per capita for skilled and unskilled households (used in the model-based quantification, Appendix Section 3) (PSA, 1988-2018; PSA, 2012, 2015). The LFS indicates the education level and the employment status of each member of the household. We define a household as "skilled" if any of the employed members have a college education or above. We then calculate domestic income per capita for skilled and unskilled households using the FIES.

1.5 Province Level Consumer Price Index

We obtained the data series for the 2018-Based Consumer Price Index for All Income Households by Commodity Group covering January 1994 to December 2017 from the Philippine Statistical Authority’s (PSA) OpenSTAT portal ([PSA, 1994-2017](#)). We re-normalize to set CPI for 1996 to be 100 for each province. To standardize province values back to our 1990 definition, we take a weighted average of component provinces’ CPIs, where weights are determined by 2015 population.

1.6 Data for Quantifying Contribution of the Education Channel

We create a database at the origin-destination-skill group-by-year level from our raw data in order to carry out the model-based quantifications. We use the 1990 Census to construct the baseline probability of migration by skill group (shares of working-age population who migrated, by skill group). In addition, we use the POEA/OWWA data to construct migrant income for each origin-destination pair, by skill group and year. We use the post-shock period to determine the returns to skill using these incomes. We exclude origin-destination-skill-time observations where there were no flows. We winsorize the salary data at the 99th percentile.

1.7 Regression Controls

1.7.1 Destination-Level Controls

The first set of destination controls is the baseline (1995) share of migrants going to three regions: Middle East and North Africa (MENA), East Asia, and OECD countries. MENA countries include Saudi Arabia, United Arab Emirates, Kuwait, Qatar, Oman, Bahrain, Egypt, Iran, Yemen, Syria, Jordan, Israel, and Lebanon. East Asia destinations include Japan, Taiwan, Hong Kong, Malaysia, South Korea, Brunei and Singapore. OECD destinations include Canada, United States, Italy, New Zealand, Australia, Belgium, Netherlands, the UK, France, Hungary, Austria, Sweden, Turkey, Spain, Norway, Germany, Denmark, Finland, Greece, Iceland, and Switzerland.

Remaining destination controls are destination-level controls, aggregated to the province level by taking weighted averages of destination-level variables for each province, weighted by baseline migrant earnings from each destination, following [Borusyak et al. \(2022\)](#). To construct baseline GDP per capita, we used 1995 values in current US dollars from World Development Indicators ([World Bank, 2024](#)).⁴ The baseline destination contract variables are the following four vari-

⁴For the following small set of destinations, this variable was not available in the WDI. For Taiwan, we used 1995 GDP per capita values from Taiwan’s national statistics <https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5>. For Guam, Midway Island, and Northern Mariana Islands, we used US baseline values as they are US territories. For British Overseas Territories Cayman Islands and Diego Garcia we use UK baseline values. For Netherlands Antilles, we used

ables from the 1995 POEA/OWWA data: (1) average 1995 salary (in real 2010 Philippine pesos) for each destination's contracts, (2) percent of 1995 contracts in professional occupations, (3) percent of 1995 contracts in production occupations, and (4) percent of all 1995 contracts for Philippine international migrant workers going to the destination.

1.7.2 Province-Level Controls

Baseline share of rural households is from the 1990 census. Baseline asset index is from the 1990 census. This is the first principal component of household-level indicators for ownership of a set of durable goods, utilities access, housing quality, and land and home ownership. We then take the mean of this household-level index within each province. Baseline domestic income and expenditure per capita are the average of domestic income per capita and expenditure for 1988, 1991, and 1994, calculated from FIES microdata. Baseline sector shares are shares of employed individuals in primary, industrial, service, and financial/business services sectors, calculated from the 1990 census.

1.7.3 Controls Included for Additional Robustness Results

Manufacturing export controls include total and per capita exports per province. We jointly include both levels and IHS transformations of these variables. Baseline controls include data from 1994 and 1996. Time-varying manufacturing controls include the same variables, but corresponding to the province-year of observation instead of the baseline. The sources of this export data are described in Section 1.8 below.

Baseline share of workforce in disaggregated manufacturing sectors jointly include 12 controls for the 1995 share of workforce in the following 12 manufacturing sectors: food/beverage, tobacco, textile/wearing, paper/printing, petroleum/chemicals/rubber, non-metallic mineral production, basic or fabricated metal production, wood/work/cane, furniture, machinery, transport equipment, and other manufacturing. Data is from the 1995 Census, and the sectors correspond to the most disaggregated manufacturing sector definitions possible given the available 1995 Census industry codes.

Baseline share of workforce in disaggregated primary sectors include 11 controls for the 1995 share of workforce in the following 11 sectors: palay farming, corn farming, banana farming, coconut farming, sugar cane farming, animal farming, other crops farming, hunting/foraging, fishing, metallic ore mining, non-metallic ore mining. Data is from the 1995 census, and the sectors correspond

Netherlands baseline values. For Palau, we use the closest available year of 2000 GDP per capita. Finally, Netherlands and Myanmar only had 1995 GDP per capita in 2010 US\$ and had 1999 GDP per capita in current US\$ (the closest year to 1995). We used the following estimate: $gdppc_{1995}^{currentUS\$} = gdppc_{1995}^{2010US\$} \times \frac{gdppc_{1999}^{currentUS\$}}{gdppc_{1999}^{2010US\$}}$

to the most disaggregated primary sector definitions possible given the available 1995 Census industry codes.

Tourism sectors are determined based on correspondence with the Philippine Statistical Authority (PSA). We define the tourism sector as “employment in tourism industries,” which includes employment in restaurants, hotels, and transport services. Data is from the 1995 Census.

1.8 Exports and Foreign Direct Investment

In Section 5.4, we examine potential other mechanisms for our causal effects: manufactured exports and foreign direct investment (FDI).

Data on manufacturing firm exports are from a set of firm sample surveys of the Philippine Statistics Authority: the Annual Survey of Establishments (1994, 1996, 1997, 1998) (PSA, 1994, 1996, 1997, 1998), Annual Survey of Philippine Business and Industry (2008, 2009, 2010, 2013, 2014, 2015) (PSA, 2008-2010, 2013-2015), and Census of Philippine Business and Industry (1999, 2006, 2012) (PSA, 1999, 2006, 2012). We obtain data for province-year observations that had three or more manufacturing establishments in the sample.⁵ We sum exports across firms to the province-year level, then divide by province population to obtain per capita figures. Summed exports within province-year cells account for survey sampling weights when available (2000 and after). (Results are robust to using unweighted sums for all years.) We winsorize province-year observations at 99%.

FDI data for 1996-2002 are available from the PSA’s Foreign Investment Reports, which provide the breakdown of total approved foreign investments by origin country. FDI data for 2003 and after are from the PSA’s OpenStat platform. Data on FDI is broken down at the country level for major investors. FDI coming from other countries are not broken down by country and are assumed to be zero in the analysis (PSA, 1996-2010; PSA, 2011-2016).⁶

2 Empirical Appendix

In this section, we provide additional empirical analyses to support the analyses in the main text.

2.1 Rotemberg Weights

Following Goldsmith-Pinkham et al. (2020), we compute Rotemberg weights to characterize which shares matter most for our estimates. These weights reveal

⁵Data are not released for province-year cells with fewer than three firms, for confidentiality reasons. We impute zeros for these province-year observations.

⁶The average share of yearly FDI not broken down by country is 6.9%.

which destination-specific shifts are driving our results and provide guidance on which shares should be the focus of balance tests (tests of pre-trends).

Appendix Table A3, Panel A displays summary information on the distribution of shares with positive and negative Rotemberg weights. The weights are predominantly positive. This suggests our estimates are a convex combination of destination-specific estimates. Panel B of Appendix Table A3 displays the top five destinations by Rotemberg weight, which correspond to the only destinations with shares larger than 5%. Saudi Arabia receives the highest weight (0.20), followed by Japan (0.19), the United States (0.18), Taiwan (0.10), and Hong Kong (0.08). These five destinations collectively account for 75% of the weights.

2.2 Diagnostics for Exogenous Shares Identification

2.2.1 Balance (Parallel Trend) Tests for Important Shares

To further validate our identification strategy, we conduct tests of parallel trends focusing on the exposure shares that carry the highest Rotemberg weights. We examine whether these influential shares exhibit pre-trends in our key outcomes prior to the 1997 Asian Financial Crisis. We test for parallel trends by regressing changes in outcomes between 1985-1994 on province-level exposure shares for high-Rotemberg-weight destinations (Saudi Arabia, Japan, the United States, Taiwan, and Hong Kong). The results – presented in Appendix Figure A2 – indicate no significant pre-trends across key outcomes across provinces with varying levels of exposure to the top Rotemberg-weight destinations. These tests provide further support for our parallel trends assumption.

2.2.2 Instrumenting for $Shiftshare_o$ with Top-Rotemberg-Weight Shares

As a diagnostic of our $Shiftshare_o$ measure, we follow Goldsmith-Pinkham et al. (2020) and present estimates using the high-Rotemberg-weight shares individually as instruments for $Shiftshare_o$ to assess the primary drivers of our identifying variation. The results are in Panel B of Appendix Table A3. For the four destinations out of five with highest Rotemberg weights, the coefficient estimates across our main outcome variables (global income, domestic income, migrant income, and consumption) demonstrate consistent patterns and are largely in line with our main results in Panel D of Table 1.⁷

2.2.3 Sensitivity to How Shares are Combined

To further assess the robustness of our shift-share estimates, we examine their sensitivity to alternative combinations of the exposure shares. We progressively

⁷The exceptions are the results for Hong Kong, which has the second smallest Rotemberg weight out of the top five and a first-stage F-statistic of near zero.

restrict the set of shares used in constructing our shift-share instrument, limiting it to only the top 20, top 15, top 10, and top 5 destinations by Rotemberg weight.

The results of these sensitivity checks are reassuring. Our coefficient estimates for global income, domestic income, and migrant income remain stable across these alternative specifications. Results are presented in Appendix Figure A3. The magnitude and statistical significance of the estimates are robust to the subset of shares used to construct the shift-share instrument.⁸ Robustness to different share combinations further strengthens the credibility of our research design.

2.3 Persistence of *Shiftshare_o* Components

We provide here analyses showing the persistence of both components of the shift-share variable: the exchange rate shocks $\tilde{R}_d$ (the “shifts”) and the exposure weights ω_{do0} (the “shares”). We examine persistence over two decades after the 1997 Crisis.

Figure 1a showed the persistence of exchange rate shocks for major destinations, and regression analyses confirm these patterns. We run regressions at the level of 104 destinations, where the dependent variables are the change in the exchange rate from pre-Crisis to a certain post-Crisis year, and the right-hand side variable is the short-run (1997-1998) shock, $\tilde{R}_d$.⁹ We present coefficient estimates on $\tilde{R}_d$ from seven different regressions, for different post-shock time periods, in Appendix Figure A1a. Higher (more positive) coefficients indicate greater persistence, with a coefficient of 1 indicating complete persistence. Over nearly the entire study period, there is very strong persistence of the exchange rate shock. Point estimates are close to and statistically indistinguishable from 1 in nearly all post-shock periods. The only exceptions are 2009 and 2012, immediately following the 2007-2009 Great Recession, when the coefficients are closer to zero (very slightly negative in 2012), after which the coefficients rebound to levels near 1.¹⁰

Next, we analyze the persistence of the exposure weights ω_{dot} , migrant income per capita in destination-*d*/origin-*o* dyads. We create a dyad-level dataset with 7,696 observations (74 provinces times 104 destinations). For the post-shock periods for which we have migrant income data, we regress dyadic migrant income per capita in a post-shock year *t* (ω_{dot}) on dyadic migrant income per capita in 1995 (ω_{do0}), the pre-shock year in our shift-share variable. There is partial but substantial persistence over time in dyadic migrant income. Appendix Figure A1b presents coefficients on ω_{do0} in the three regressions (for 2009, 2012, and

⁸The coefficient estimates using just the “top 5” Rotemberg-weight destinations do tend to be somewhat larger in magnitude. However, they are also more imprecise as we likely discard useful variation, so we cannot reject equality with our main estimates.

⁹Observations are weighted by 1995 migrant income to that destination, following Borusyak et al. (2022) for any destination-level regressions.

¹⁰As complementary support for the persistence of exchange rate movements, a Harris and Tzavalis (1999) test for a unit root in the 1990-2017 exchange rate panel data fails to reject the null of non-stationarity.

2015). The coefficients range in magnitude from 0.4 to 0.6. Each is statistically significantly different from zero (and from 1, indicating partial persistence).

Overall, the components of the $Shiftshare_o$ variable – the exchange rate shocks and exposure shares – are highly persistent over two decades post-1997. The long-run impacts that we document in the main results tables result from an exogenous shock to migrant income ($Shiftshare_o$) that itself exhibits substantial persistence over time.

3 Model-Based Quantification: Full Elaboration of Model

We present a theoretical framework relating migrant exchange rate shocks to domestic and migrant income. We use this framework to derive our empirical specification and interpret our findings. We build on recent gravity models (Bryan and Morten, 2019; Tombe and Zhu, 2019) which adapt Eaton and Kortum (2002) to model migration. We endogenize skill investments, and allow for skill-dependent migration and income, to further deepen our understanding of mechanisms and magnitudes. Full derivations of the model equations are in Supplementary Appendix S of our NBER Working Paper, Khanna et al. (2022).

We start by introducing the migration decision, and how the migrant income shock helps us derive the empirical independent variable of interest: the shift-share we use for estimation. Then we study educational investments in the theoretical model, and we estimate our gravity equation to quantify the elasticity of migrant flows with respect to destination wages. With these estimates at hand, we evaluate the effects of the exchange rate shock on origin province migrant flows, migrant income, and domestic income in our model and quantify the importance of the education channel.

Our goal is to quantify the contribution of various channels. In doing so, we make a few assumptions. First, individuals have heterogeneous preferences on where to work (drawn from a Frechet distribution), and ability levels are allowed to vary at the origin-destination-time level. This flexibility allows, for instance, that people from a certain origin may be more productive at a certain destination, and this may change with time. Second, we assume a linear response of education changes to income shocks, but do not impose a specific mechanism behind the education responses (for instance, the alleviation of liquidity constraints.)

Our assumptions allow us to isolate the object of interest, by keeping everything else at the baseline level. For instance, when we identify the contribution of the education channel, we keep the returns to education (and destination wages) fixed at baseline, and the probability of migration to various destinations fixed. These assumptions allow us to isolate the role played by a particular object of interest. We also do not impose a reason why domestic income changes. These

could be because of returns to investments, or consumption-driven multipliers.¹¹

3.1 Migration Decisions

An individual i 's earnings vary across origin province o , destination country d , skill level s , and time t . They depend on destination-specific wage profiles w_{dst} (wages in destination differing by skill) and exchange rates R_{dt} . Additionally, ϵ_{dot} is any unobservable factor that makes migrants from origin o more productive in destination d . Overseas wages w_{dst} and unobservable component ϵ_{dot} are in destination- d currency units. Exchange rates R_{dt} are in Philippine pesos (PhP) per destination- d currency unit. We denote $w_{dost} \equiv w_{dst}\epsilon_{dot}$ as the wage profiles of workers from o in destination d .

Individuals have destination-specific preference draws q_{id} . Workers lose a fraction of their earnings to migration cost $0 \leq \tau_{dot} \leq 1$. Indirect utility from destination choice is:

$$V_{idost} = w_{dst}\epsilon_{dot}R_{dt}(1 - \tau_{dot})q_{id} \equiv w_{dost}R_{dt}(1 - \tau_{dot})q_{id} \quad A1$$

For all o , $\tau_{oo} = 0$ (migration cost is zero if remaining at origin) and $R_{ot} = 1$ (origin earnings are in origin currency). We assume preferences q_{id} are distributed multivariate Fréchet with shape parameter θ , as in [Bryan and Morten \(2019\)](#).¹² This parameter determines the dispersion of preferences across locations. Let π_{dost} be the fraction of people of skill s from origin o choosing to work in d . Through the properties of the Fréchet distribution, this share can be written as:¹³

$$\pi_{dost} = \frac{(w_{dst}R_{dt}(1 - \tau_{dot})\epsilon_{dot})^\theta}{\sum_k (w_{kst}R_{kt}(1 - \tau_{kot})\epsilon_{kot})^\theta} \quad A2$$

Intuitively, the share of individuals of skill s migrating from origin o to destination d is increasing in the destination wages in Philippine pesos, $w_{dst}R_{dt}$.

3.2 Migrant Income Shock and the Shift-Share Variable

Our model derives the shift-share variable that is our primary independent variable, making our model entirely consistent with our empirical framework.

We assume there are two skill groups in the population: high-skilled h and unskilled u ($s = \{h, u\}$).¹⁴ At baseline ($t = 0$), the share of high-skilled and unskilled

¹¹While the Philippines is a large migrant source country, Filipinos are typically not a substantial fraction of the overall labor force in destinations, and so fluctuations in Filipino migration are unlikely to change destination wages, especially as migrant contracts are pre-determined for 2-3 years.

¹²Here, θ is the elasticity of migration with respect to the destination wage. In the standard formulation: $F(q_1, \dots, q_D) = \exp\left\{-\left[\sum_{d=1}^D q_d^{-\theta}\right]^{-\frac{1}{\theta}}\right\}$. The Fréchet assumption, while widely used in the migration literature (e.g., [Bryan and Morten \(2019\)](#); [Tombe and Zhu \(2019\)](#)) relies on an IIA assumption. An alternative would be to separate the decision to emigrate from the location choice. In our setting, where international migration is fairly common (7.5% of households had a migrant abroad), and recruitment agencies facilitate migration, we think the Fréchet assumption is a reasonable approximation.

¹³Full derivations are in the Supplementary Appendix of our NBER Working Paper, [Khanna et al. \(2022\)](#).

¹⁴We micro-found the education decisions in Supplementary Appendix S2 of [Khanna et al. \(2022\)](#).

workers in province o are denoted, respectively, ℓ_{oh0} and ℓ_{ou0} , with $\ell_{ou0} = 1 - \ell_{oh0}$. Province-level global income per capita Y_{ot} depends on the distribution of worker locations and skill levels:

$$Y_{ot} = \sum_{s=h,u} \left[\ell_{ost} \sum_d (\pi_{dost} w_{dost} R_{dt}) \right] \quad A3$$

Our shift-share variable isolates exogenous variation in only the migrant income portion of Y_{ot} . $\tilde{\Delta}R_d$ is the short-run change in destination d exchange rate.¹⁵

The short-run migrant income change due to exchange rate shocks $\tilde{\Delta}R_d$ in province o depends on the share of workers in each destination for each skill level.¹⁶

$$\tilde{\Delta}Y_o = \sum_{s=h,u} \left[\ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \tilde{\Delta}R_d) \right] \equiv Shiftshare_o \quad A4$$

In the pre-shock period ($t = 0$), let total population in an origin be Pop_{o0} , and the number of workers by skill be L_{os0} . Also, let the number of workers going from o to destination d be L_{dos0} , so that $\ell_{os0} \equiv \frac{L_{os0}}{Pop_{o0}}$, and $\pi_{dos0} \equiv \frac{L_{dos0}}{L_{os0}}$. Let w_{dos0} be average pre-shock income in destination d for workers of skill s from origin o .

The “exposure weight” ω_{do0} , serves as the “share” in the shift-share. As in the main paper, we define this as province o ’s pre-shock aggregate migrant income from destination d (summed across skill groups), divided by province population to yield a *per capita* variable: $\omega_{do0} \equiv \frac{\sum_{s=h,u} L_{dos0} w_{dos0}}{Pop_{o0}}$. Now rewrite Equation A4:

$$Shiftshare_o = \sum_{s=h,u} \sum_d \frac{L_{os0}}{Pop_{o0}} \frac{L_{dos0}}{L_{os0}} w_{dos0} \tilde{\Delta}R_d = \sum_d (\omega_{do0} \tilde{\Delta}R_d) \quad A5$$

This is precisely the independent variable we use in our estimation.

3.3 Education Investments

Migrant income may drive educational investments at home, for instance, by easing liquidity constraints or changing the returns to schooling. In Supplementary Appendix S2 of [Khanna et al. \(2022\)](#), we micro-found changes to human capital under various scenarios, and derive how the change in the share of high-skilled

¹⁵Let $\tilde{\Delta}$ refer to a short-run change. In practice, we use the short-run 1997-1998 change following the July 1997 crisis to construct the shift-share variable. To signify this captures a short-run change, we include no subscript t in terms involving $\tilde{\Delta}$. Focusing on a shift-share variable capturing a short-run change is desirable because the immediate post-Crisis exchange rate changes are more plausibly exogenous than subsequent, longer-run exchange rate changes that may be endogenous to post-Crisis economic policies in destinations.

¹⁶The origin as a destination drops out as there are no exchange rate changes for the origin.

workers h in origin o is:

$$\Delta \ell_{oht} = \frac{1}{\Psi} \Delta Y_o = \frac{1}{\Psi} \sum_{s=h,u} \left[\ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \tilde{\Delta} R_d) \right] = \frac{1}{\Psi} \underbrace{\sum_d \omega_{do0}}_{MigInc_{o0}} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{Rshock_o}, \quad A6$$

where $\frac{1}{\Psi}$ captures the effect of the migrant income shock on skill share.¹⁷ The regression result in column 3 of Table 2 is our quantitative estimate of this skill response. Below, we unpack the implications of these changing skill shares.

3.4 Gravity Estimation of Migration Flows

Accounting for the impact of migrant income shocks first requires an estimate of impacts on migration itself. In our gravity equation, the Frechet parameter θ pins down the elasticity of migrant flows (from o to d) with respect to destination d wages. This determines subsequent location choices and migrant income. Taking logs of the gravity equation A2 yields the estimating equation:

$$\log \pi_{dost} = \theta \log w_{dst} + \theta \log R_{dt} + \theta \log (1 - \tau_{dot}) - \log \left[\sum_k (w_{kst} R_{kt} (1 - \tau_{kot}) \epsilon_{kot})^\theta \right] + \theta \epsilon_{dot} \quad A7$$

To estimate θ , we leverage the exogenous exchange rate shocks. The coefficient on $\log R_{dt}$ identifies θ . We implement this at the origin-destination-skill level using a differenced regression.¹⁸

$$\Delta \log \pi_{dos} = \gamma_{os} + \theta \Delta \log R_d + \tilde{\epsilon}_{dos}$$

Here, the Δ s are the change between before and after the shock; and so this differenced regression is equivalent to including destination fixed effects. We further include the origin-by-skill fixed effects and cluster our standard errors at the destination level. The results are in Appendix Table A10. We estimate $\theta = 3.42$.

3.5 Change in Migrant Flows: Predictions and Decomposition

Migration flows from origin o to destination d depend on the probability of migrating by skill level, and share of workers who are of each skill level: $\pi_{doht} \ell_{oht} + \pi_{dout} \ell_{out}$. Changes in wages both abroad (say, via exchange rates), and at home

¹⁷In Supplementary Appendix S2 of Khanna et al. (2022) we derive changes to human capital with liquidity constraints, with no liquidity constraints, or with no borrowing. For certain models, Ψ captures the cost of education. We are agnostic about whether the education response is due to liquidity constraints or changing returns to education. Some combination of the two is possible, and has little bearing on our quantification.

¹⁸As is common in such data, a large fraction of these units have no flows, and so we use a Poisson pseudo-maximum likelihood (PPML) estimator.

(say, via more entrepreneurial investment), will determine migration flows. The change in aggregate outflows from an origin o has the following components:¹⁹

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doh0} - \pi_{dou0})}_{\text{Education channel in outflows}} + \underbrace{\theta \sum_{d \neq o} (\ell_{oh0} \pi_{doh0} + \ell_{ou0} \pi_{dou0}) \frac{\Delta R_{dt}}{R_{d0}}}_{\text{Exchange rate channel in outflows}} \\ & - \underbrace{\theta \left(\ell_{oh0} \pi_{ooh0} \frac{\Delta w_{oht}}{w_{oh0}} + \ell_{ou0} \pi_{oou0} \frac{\Delta w_{out}}{w_{ou0}} \right)}_{\text{Domestic income stemming outflows}} - \underbrace{\chi_o}_{\text{Indirect re-sorting}} \end{aligned} \quad A8$$

First, the skilled and unskilled have different migration probabilities. If the skilled are more likely to migrate, then an increase in the fraction skilled will raise migration. If, alternatively, most jobs abroad are unskilled, then migration probabilities may fall. The effect of education on flows is captured by the first term, which is a product of two components: the education response $\Delta \ell_{oht}$, and skill-differential in migration probabilities $\pi_{doh0} - \pi_{dou0}$. Second, as exchange rates change favorably, there will be a migration response to higher compensation. This depends on θ (the elasticity of migration with respect to destination wages), the shock size ΔR_{dt} , and migration probabilities $\ell_{oh0} \pi_{doh0} + \ell_{ou0} \pi_{dou0}$. This second term is the “Exchange rate channel in outflows.” Finally, the shock can change local earning levels, affecting Δw_{ost} . For instance, earnings from abroad may fund investments in firms and household enterprises at origin locations. Increases in domestic income stem the outflow of migrants, as captured by this last channel, which again depends on the location elasticity with respect to wages θ . These components are each increasing functions of the exchange rate shocks, and suggest (as we test empirically) that the shock may change migrant flows. For instance, the first term (“Education channel in outflows”) can be seen from Equations A6 and A8 to be:

$$\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doh0} - \pi_{dou0}) = \underbrace{\frac{1}{\Psi} \sum_{d \neq o} (\pi_{doh0} - \pi_{dou0})}_{\text{Skill bias in outmigration}} \left(\underbrace{\sum_d \omega_{do0}}_{\text{MigInc}_o} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{\text{Rshock}_o} \right) \quad A9$$

We use this framework to quantify the importance of the education and exchange rate channels. To quantify the education channel, we obtain (a) the education response to the income shock $\Delta \ell_{oht}$ from column 3 of Table 2, and obtain

¹⁹The derivation is in Supplementary Appendix S4 of our NBER Working Paper, Khanna et al. (2022). The term $\chi_o \equiv \theta \sum_{s=h,u} \ell_{ost} \left[(1 - \pi_{oost}) \sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) - \pi_{oost} \left(\pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) \right]$ captures second-order equilibrium adjustments. We measure and include it in all accounting exercises. Intuitively, changes in wages at home or exchange rates in destinations indirectly affect the choice of specific destinations. For instance, if the US exchange rate changes favorably, it would lead to more outflows, and if the Malaysian exchange rate changes unfavorably, there will be less emigration. Since both sets of exchange rates change simultaneously, a portion of the lower Malaysian emigration is redirected to the increase in US emigration. Equation A36 shows a version with these indirect effects.

(b) the skill-differential in migration probabilities $\pi_{doh0} - \pi_{dou0}$ from the raw data. Figure A5a shows that for every province, the likelihood of becoming an overseas worker is higher when the worker has more education. Therefore, increases in education should increase the flow of migrants from all provinces.

The role played by the exchange rate and wage channels is jointly determined by simultaneous changes to exchange rates across potential migration destinations (ΔR_{dt}) and increases in domestic wages Δw_{ost} . We obtain the increases in domestic wages for different skill groups from columns 1 and 2 of Appendix Table A11. Migration responses to these, in turn, depend on the Frechet parameter θ , estimated in section 3.4. We combine these estimates with measures of the shares of skilled and unskilled at each province, and propensity to migrate abroad by skill group at baseline to calculate the second and third terms in Equation A8.

Together, these channels predict outflows. We validate the structure of our model by comparing model-predicted flows to the OLS prediction from column 4 of Appendix Table A11 in Appendix Figure A6a. The strong upward sloping relationship indicates that the model does a good job of predicting migration flows. A number of provinces with a high predicted flow lie above the 45-degree line, suggesting that there may be other changes in those provinces or non-linearities in the empirical relationship between flows and migrant income changes.

Finally, we quantify the role played by each channel. We calculate the share of the total regression-based predicted flows attributable to the education channel: $\frac{\Delta \ell_{oh0} \sum_d (\pi_{doh0} - \pi_{dou0})}{Flows_{ot}^{OLS}}$. Appendix Figure A6b plots the distribution of the contribution of the education channel across provinces. A meaningful amount of the increase in migrant flows is attributable to the increased education response.²⁰ We do a similar exercise for the exchange rate channel. The exchange rate changes abroad will tend to drive migration abroad, as most exchange rates changed favorably relative to the Philippines. At the same time, however, improvements in domestic income stem such outflows, canceling out a large component of the gains from migration. On net, changes in relative prices explain a fair share of the outflows. The remainder is unexplained. We may not expect to explain the entire flows as we use baseline (1995) shares of migration flows.

3.6 Change in Migrant Income: Predictions and Decomposition

The change in migrant income per capita can be decomposed into: (1) the education channel, and (2) the persistent change in exchange rates, which raises

²⁰Theoretically, the education channel contribution can be negative if the low-skilled have a higher migration probability.

migrant income and encourages flows to favorable destinations.

$$\underbrace{\Delta\ell_{ost} \left(\sum_{d \neq o} w_{doh0} \pi_{doh0} R_{d0} - \sum_{d \neq o} w_{dou0} \pi_{dou0} R_{d0} \right)}_{\text{Education channel in migrant income}} + \underbrace{\theta \left(\sum_{s=h,u} \left[\ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \Delta R_{dt}) \right] \right)}_{\text{Exchange rate channel in migrant income}} - \tilde{\chi}_{o2} \quad \text{A10}$$

Here, we know $\Delta\ell_{ost}$ is a function of the migrant income shock from Equation A6. $\beta^{mig} = (\sum_{d \neq o} w_{doh0} \pi_{doh0} R_{d0} - \sum_{d \neq o} w_{dou0} \pi_{dou0} R_{d0})$ is the migrant skill premium. The education channel contribution to the change in income is $\frac{\beta^{mig}}{\psi} \tilde{\Delta}Y_o$. Similarly, the exchange rate channel is $\theta \tilde{\Delta}Y_o - \tilde{\chi}_{o2}$, and captures the increase in long run migrant income, not simply due to the fact that better exchange rates directly increase migrant income, but also because they induce a higher flows of migrants (both skilled and unskilled) to places with more positive exchange rate movements.²¹ Additionally, as captured by what we call ‘indirect resorting,’ simultaneous changes in the exchange rate affect the location choices of migrants, which in turn affects how much they earn. The total change in migrant income per capita $\left(\frac{\beta^{mig}}{\psi} + \theta \right) \tilde{\Delta}Y_o - \tilde{\chi}_{o2}$ is empirically shown in Table 1 col 5.

To quantify the importance of each component, we decompose the contributions of each channel. For the education channel, we first obtain $\Delta\ell_{ost}$ with the help of linear fit of the regression in column 3 of Table 2. The second component is the probability-weighted skill-premium abroad β^{mig} . We plot the skill premium $(w_{doh0} - w_{dou0})$ at the origin-destination pair in Figure A5b.²²

For the exchange rate channel, we use our estimate of θ . A higher migration elasticity θ means that migration flows, and thereby migrant income, are more responsive to exchange rate shocks. We measure the shares ℓ_{os0} and π_{dos0} , and wages w_{dos0} at baseline (1995), and use them as weights for exchange rate changes ΔR_{dt} as in the second term of Equation A10.

Together, the predicted migrant income estimate due to the education channel and the exchange rate channel can be compared to the simple OLS prediction based on the regression from column 5 of Table 1. We plot the relationship between these predicted flows in Figure A7a. As before, we see a strong upward sloping relationship in Figure A7a, which indicates that the model does a good job of predicting migrant income per capita. Predicted values are distributed around the forty-five-degree line.

To quantify the role played by each channel, we measure the predicted education channel as a ratio of the predicted increase in migrant incomes (Appendix Figure A7b). We do a similar exercise for the exchange rate channel in migrant

²¹As before, the second-order indirect effects of changes in location choice are captured by $\tilde{\chi}_{o2} \equiv \theta \sum_{s=h,u} \sum_d \left[\ell_{ost} w_{dst} \pi_{dost} \left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) \right]$.

²²Returns are weighted by migration probabilities, as for many low-skilled occupations, there are no migrant opportunities for certain destinations. As such, increases in skill raise earning prospects by raising employment prospects.

income. On average, the education channel explains 19.1% of the increase in migrant income, and the exchange rate channel explains 69.9% (Table A12).

3.7 Change in Domestic Income: Prediction and Decomposition

Domestic income can rise for at least two reasons. First, an increase in education and skills allows workers to work in high-paying, skilled jobs (the “Education channel”). Second, earnings from domestic work (conditional on skill) may also increase as a result of more local investment in enterprises and an increase in aggregate demand (the “Direct wage channel”). While simple to introduce, we do not explicitly model firm production to keep our framework tractable. While the underlying mechanisms are not modeled, our framework captures the ultimate effect of the shock on domestic earnings. Specifically, investments in entrepreneurial capital and aggregate demand will raise domestic income for each skill group Δw_{ost} , and investments in human capital will raise the share high-skilled $\Delta \ell_{oh}$. Together, these increase domestic income per capita:

$$\Delta W_{ot} = \underbrace{\Delta \ell_{oh} \left(\underbrace{w_{oh0} \pi_{ooh0}}_{\text{skilled wage at home}} - \underbrace{w_{ou0} \pi_{oou0}}_{\text{unskilled wage at home}} \right)}_{\text{Education channel in domestic income}} + \underbrace{\sum_{s=h,u} \ell_{os0} \pi_{oos0} (\Delta w_{ost}) - \tilde{\chi}_{o1}}_{\text{Direct wage (and resorting) channel}} \quad \text{A11}$$

Here, the domestic “direct wage channel” captures the direct effect of changes in local wages due to, say, expansion of household entrepreneurship (and the indirect effects of staying back/or emigrating given the relative changes in wages at home and abroad).²³ As we do not take a stance on the mechanisms underlying enterprises decisions, we allow Δw_{ost} to be a function of migrant income per capita. As we show in Section 3.6, migrant income per capita is a function of the exchange rate shock: $\left(\frac{\beta^{mig}}{\Psi} + \theta \right) \tilde{\Delta} Y_o$. Let ζ be a local multiplier driven by changes to aggregate demand and entrepreneurial investments. In that case, $\Delta w_{ost} \equiv \zeta \left(\frac{\beta^{mig}}{\Psi} + \theta \right) \tilde{\Delta} Y_o$. We empirically estimate the associated regression:

$$\begin{aligned} \Delta W_{ot} &= \underbrace{\sum_{s=h,u} \ell_{os0} \pi_{oos0} \left(\zeta \left(\frac{\beta^{mig}}{\Psi} + \theta \right) \tilde{\Delta} Y_o \right)}_{\text{Direct wage channel}} + \underbrace{\frac{1}{\Psi} \tilde{\Delta} Y_o (w_{oh0} \pi_{ooh0} - w_{ou0} \pi_{oou0})}_{\text{Education channel in domestic income}} \\ &= \left(\zeta \left(\frac{\beta^{mig}}{\Psi} + \theta \right) + \frac{\beta^{dom}}{\Psi} \right) \underbrace{\sum_d \omega_{do0}}_{\text{MigInc}_{o0}} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{\text{Rshock}_o}, \quad \text{A12} \end{aligned}$$

²³The indirect resorting is $\tilde{\chi}_{o1} \equiv \sum_{s=h,u} \ell_{ost} \theta \pi_{oost} w_{ost} \left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) - \sum_{s=h,u} \ell_{ost} \pi_{oost} \theta \Delta w_{ost}$

where $\beta^{dom} \equiv (w_{oh0}\pi_{ooh0} - w_{ou0}\pi_{oou0})$ are the domestic returns to education. We test for the change in domestic income per capita in Table 1 above.

We closely follow the methods described above for migrant income to again distinguish these channels. For instance, since the shock may directly change income at home, we use the baseline skill premium when quantifying the education channel. Again, we aggregate predicted domestic income due to the education channel and the direct wage channel, and create a composite measure of predicted increases in domestic income per capita. We validate the model by comparing the model-predicted domestic income per capita with the simple OLS prediction based on the regression from column 4 of Table 1. We plot the relationship between these predicted flows in Appendix Figure A8a. As before, we see a strong upward sloping relationship. The model slightly under-predicts domestic income per capita. Predicted values are distributed around the 45° line.

To quantify the role played by the direct wage channel, we estimate the impact of the migrant income shock on domestic income per worker by skill level in columns 1-2 of Table A11. The increases in skill-specific domestic incomes are weighted by the baseline skill-shares in each province, and the probabilities that individuals do not emigrate conditional on their skill levels, as in Equation A11.

Finally, we measure the role played by the education channel in domestic income, as a ratio of the predicted increase in domestic income per capita. We plot this in Figure A8b. We do a similar exercise for the direct wage channel. On average, the education channel explains 19.9% of the increase in domestic income, whereas the direct wage channel explains 71.0% (Table A12). The remaining component is likely driven by other aggregate changes to the income distribution.

3.7.1 Explaining Impacts on Direct Domestic Income

In this section, we investigate the assumptions needed to explain the magnitude of the impact on domestic income per capita. As discussed in Subsection 6.3 of the main text, we need to explain how a 1 PhP migrant income shock leads to a 18.81 PhP increase in long-run domestic income, which is the coefficient estimate on the shift-share variable in the domestic income per capita regression of Table 1, Panel D column 4. 19.9% of the increase in domestic income can be attributed to the increase in education induced by the shock (as discussed in Section 6.1). This leaves the remaining 14.6 PhP increase to be explained. Here, we describe the framework in which we assess whether an effect of this size is reasonable.

We examine whether this remaining 14.6 PhP increase in domestic income per capita can be generated in a stylized framework in which a portion of the exogenous increase in migrant income is devoted to capital accumulation in productive enterprises, and in which a demand multiplier also operates. In every post-shock period t , an origin area enjoys the following increment to income per capita (we suppress origin o subscripts for simplicity):

$y_t = \alpha m_t + r_t S_{t-1}$, where m_t is exogenous migrant income per capita, α is the share of migrant income that is spent in the origin economy, S_t is the induced savings in the economy due to the shock, and r_t is the return to capital.

An exogenous portion s of the additional income is saved (and invested) each period, with shock-induced savings accumulating as: $S_t = S_{t-1} + sy_t$.

The shock-induced increase in domestic income per capita is then simply the shock-induced incremental per period income (y_t) multiplied by the Keynesian multiplier ($\frac{1}{s}$). We set the savings rate to 0.35, which implies a Keynesian multiplier of 2.86 (comparable to the 2.9 estimate in [Breza and Kinnan \(2021\)](#)). For migrant income m_t , given we are interested in the result of a 1 PhP shock, we set the initial shock $m_1 = 1$ and let the shock to evolve according to a function that asymptotically reaches our migrant income coefficient for 2015 ($m_\infty = 6.08$), and passes through our migrant income coefficient for 2009 ($m_{12} = 6.05$) from the event study (Figure 2).

We set the rate of return to initial rate $r_1 = 0.45$; this is high, but not as high as the estimate of [de Mel et al. \(2008\)](#). We then let r_t decline over time, according to a function that asymptotically reaches 0.05. This decline captures that the initial rate of return to capital may be quite high when liquidity constraints on investment are first loosened, but r_t declines over time as the most profitable investment opportunities are taken.²⁴

Figures [A10a](#) and [A10b](#) trace out the shock-induced domestic income generated under these assumptions. The remaining 14.6 PhP increase in migrant income per capita is fully explainable, and is well within plausible assumptions.²⁵

Estimating Remittance Share $\alpha = 0.64$. To the best of our knowledge, there is no comprehensive data on the share of migrant income returned to the Philippines. We estimate this as follows:

1. We use the 2015 and 2016 KNOMAD/ILO Migrant Cost Survey data, which asks 849 Filipino labor migrants in Qatar and UAE across a variety of occupations about their earnings and remittances. The average migrant reports remitting 67% of their income ([KNOMAD and ILO, 2015-2016](#)).
2. We use the Survey on Overseas Filipinos (SOF) data, which reports the destination and amount remitted for overseas individuals ([PSA, 2007-2017](#)). However, earnings abroad are not reported, so we cannot calculate what share of overseas income is remitted. We use this data to estimate how much migrants in different destinations remit back home relative to migrants in UAE and Qatar. For example, the average overseas Filipino in Japan remits

²⁴The functional forms for the path of migrant income and rate of returns on savings are as follows: $m_t = \frac{6.08t^2 - 100t - 89.75}{t^2 + 15.34t}$ and $r_t = \frac{0.05t^2 + 0.85t}{t^2 + t}$. Time t is relative to 1997, where $t = 1$ is for 1998, and so on.

²⁵If we were to ignore the investment channel, our estimates would suggest a multiplier of about $14.6 / (0.64 \times 6.117) = 3.7$, which is also within the range of multipliers found in the literature.

about twice as much as the average Filipino in the UAE and Qatar, according to the SOF.

3. We use the contract data to estimate the relative salaries in different destinations compared to UAE and Qatar. For example, the average salaries for Filipino workers in Japan are 2.5 times as much as the salaries in UAE and Qatar.
4. We use all of this information to calculate the remittance rate of migrant workers in different destinations. For example, given migrant workers in UAE and Qatar remit 67% of their earnings, and given that migrant workers in Japan remit twice as much while earning 1.5 times more, implies that the remittance rate for migrant workers in Japan is about 53%. We note that the granularity of our destination geography is limited by the geographical granularity of the SOF data. For example, SOF data does not specify whether a migrant is in Germany or Italy, but instead reports they are in "Europe". However, for top migrant destinations, countries are specified.
5. After calculating the destination-specific remittance rates, we take a weighted average across destinations where the weights are determined by the share of total new contract salaries coming from the destination (calculated from the contract data). This leaves us with an estimate of 64%.

3.8 Change in Global Income: Predictions and Decomposition

Together, the longer-term change in the global income of individuals is:²⁶

$$\left(\frac{\beta^{mig} + \beta^{dom}}{\Psi} + \theta + \zeta \left(\frac{\beta^{mig}}{\Psi} + \theta \right) \right) \tilde{\Delta}Y_o - \tilde{\chi}_o \quad A13$$

There is intuition behind this relationship.²⁷ First, higher skill-premia (the β terms) imply that as individuals acquire schooling, incomes (both domestic and international) rise. Second, a higher migration elasticity θ means that migration flows, and thereby migrant incomes, are more responsive to favorable exchange rates. Finally, if incomes rise locally, then that would have a direct impact on income as well. Local incomes may rise through increases in aggregate demand or entrepreneurial investment, for instance.

In the long run, global income and household expenditure increase substantially, as we show in column 3 of Table 1. Overall changes in expenditure (column 2 of the same table) reflect changes in welfare. As we show, our theoretical predictions are consistent with our empirical predictions. This allows us to interpret

²⁶The derivation for global income is in Supplementary Appendix S5 of our NBER Working Paper, [Khanna et al. \(2022\)](#).

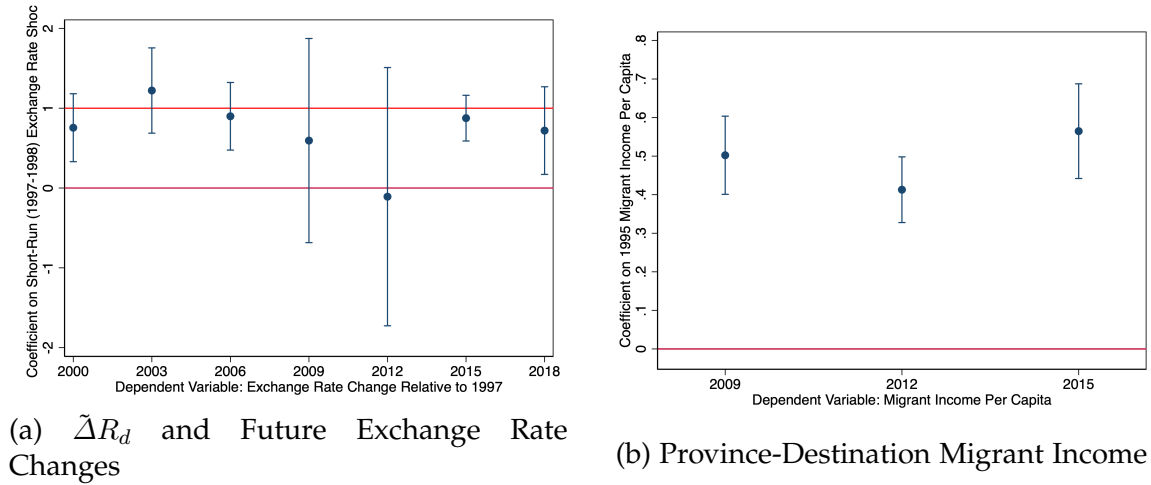
²⁷The total indirect effect on global income due to location resorting is $\tilde{\chi}_o \equiv \theta \sum_{s=h,u} \sum_d \left[\ell_{ost} w_{dst} \pi_{dost} \left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) \right] - \theta \sum_{s=h,u} [\ell_{ost} \pi_{oost} \Delta w_{ost}]$

our reduced form estimates, rationalize the magnitudes, and quantify the contribution of each channel discussed.²⁸

Together, the changes in migrant income and domestic income allow us to decompose the changes in global income per capita. To test the validity of the model, we again predict the change the global income per capita using the regression estimated in column 3 of Table 1 for global income. Appendix Figure A9a shows that our model again does a good job of predicting the change in global income. Since the domestic and migrant income channels both have an education component, we can again measure the total contribution of education investments to changes in global income. Figure A9b plots the distribution of this contribution across provinces. Table A12 shows that the education channel explains 19.7% of the overall increase in global income, while the changes in earnings potential (both at home and abroad) explain 60.8% of the overall increase in global income. Overall, the model explains 90.4% of the increase in global income.

4 Additional Tables and Figures

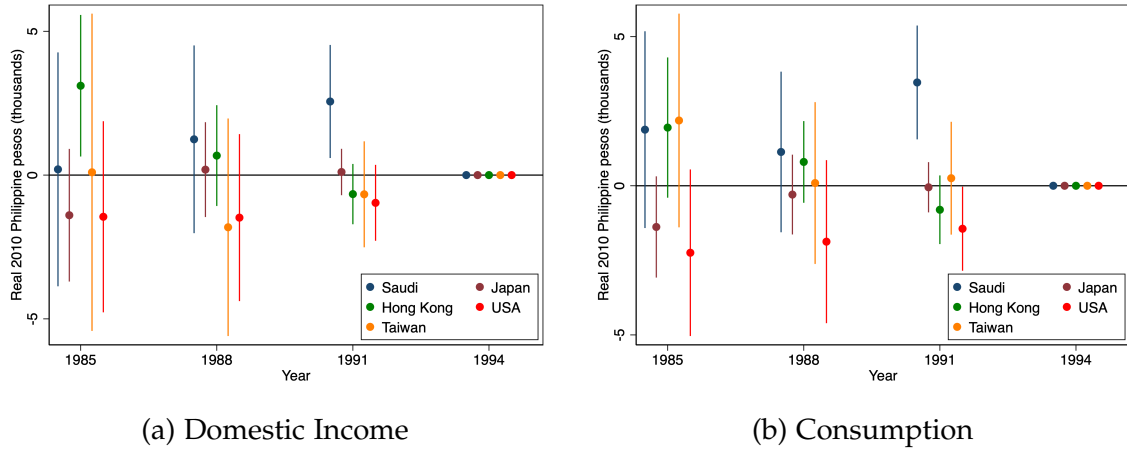
Figure A1: Persistence of Exchange Rate Shock and Province-Destination Migrant Income



Notes: (a) Coefficient estimates from regressing destination exchange rate changes relative to 1997 for 2000-2018 triennially on ΔR_d , weighted by 1995 migrant income shares ($N = 104$). (b) Figure examines persistence from before to after the 1997 Asian Financial Crisis of ω_{dot} (migrant income per capita of province o from destination d). Figure displays coefficient estimates from regressing ω_{dot} for 2009, 2012, and 2015 (respectively) on ω_{do0} (1995 migrant income per capita, or the “exposure weight” used in the shift-share variable.) $N = 74 \times 104 = 7696$, SEs clustered at province level.

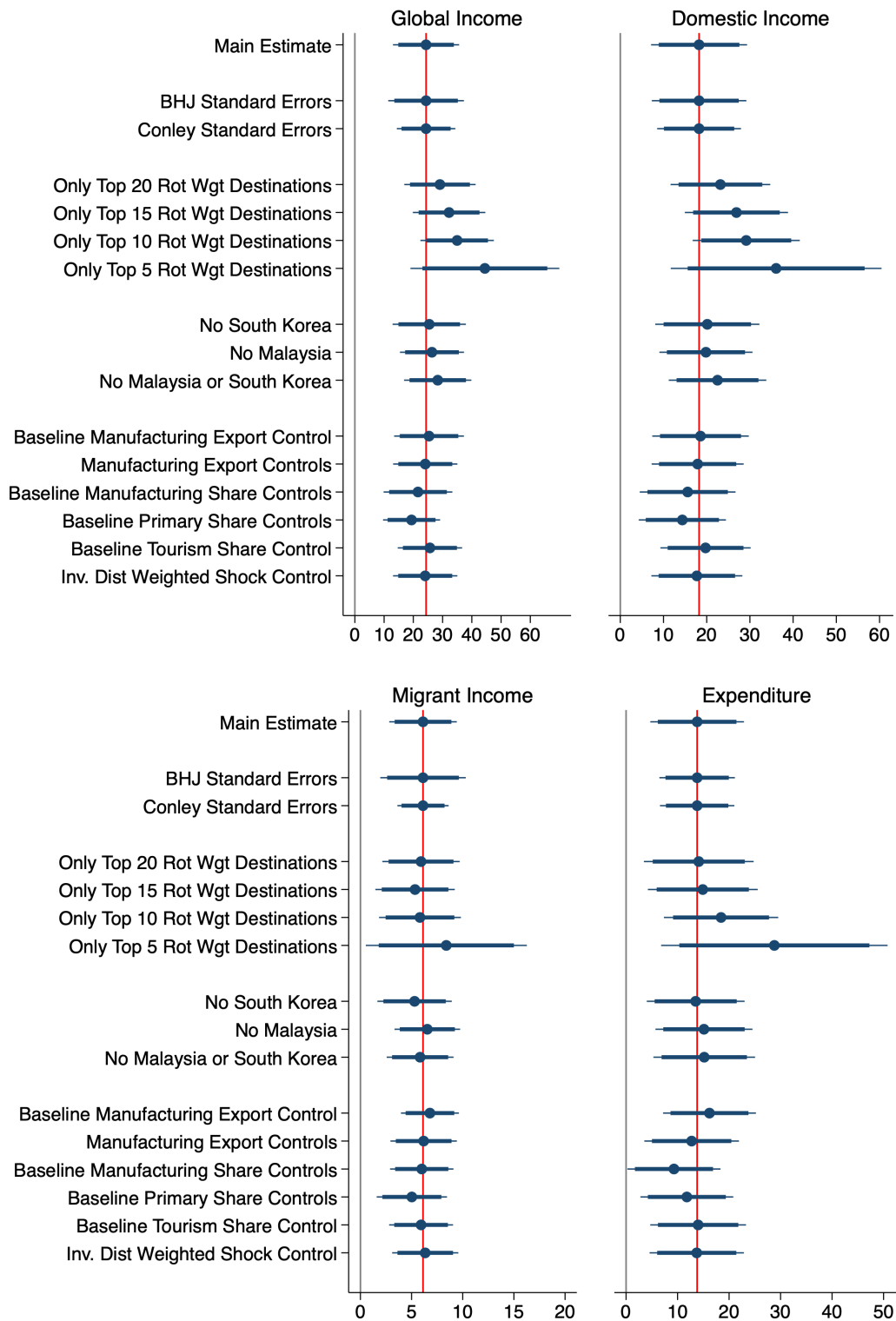
²⁸A short note on the model equilibrium. While simple to introduce, we do not explicitly model production to keep the analysis tractable and self-contained. Changes in production, whether at large firms or household enterprises, will affect domestic wages, changes to which are captured in our framework. Furthermore, this is not a spatial model of bilateral flows, where origins can be destinations and vice versa. With bounded migration costs, and a lack of agglomeration or congestion forces, we expect that labor and output markets clear in equilibrium (Allen et al., 2020).

Figure A2: Relationship Between Top Rotemberg Weight Destination Migrant Income Shares and Outcome Trends



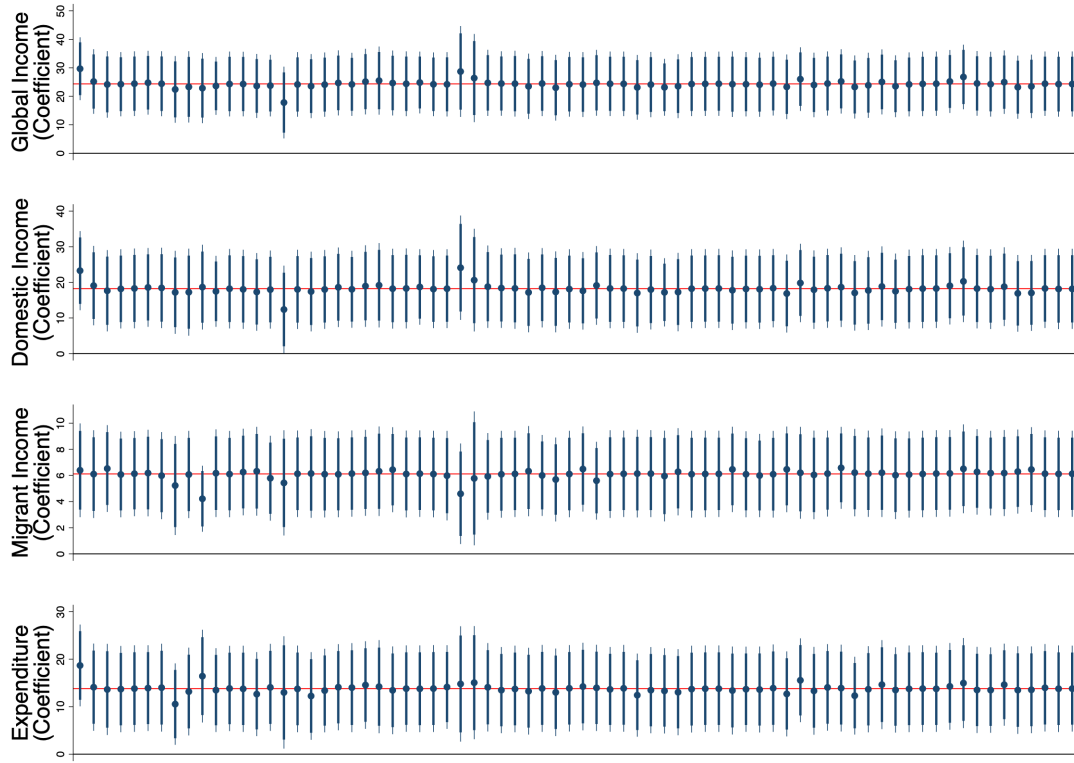
Notes: For each country, the coefficients are from a regression that interacts the migrant income “share” ω_{do0} of the country with indicator variables for each pre-shock year. Five individual regression are run (one for each country) per outcome. All regressions include province fixed effects, year fixed effects, and $MigInc_{o0}$ and $Rshock_o$ interacted with year fixed effects. Outcomes are in real 2010 PhP (PhP17.8/US\$ PPP). Observations are at the province-year level. 95% confidence intervals shown. Standard errors are clustered at the province level.

Figure A3: Additional Robustness Results



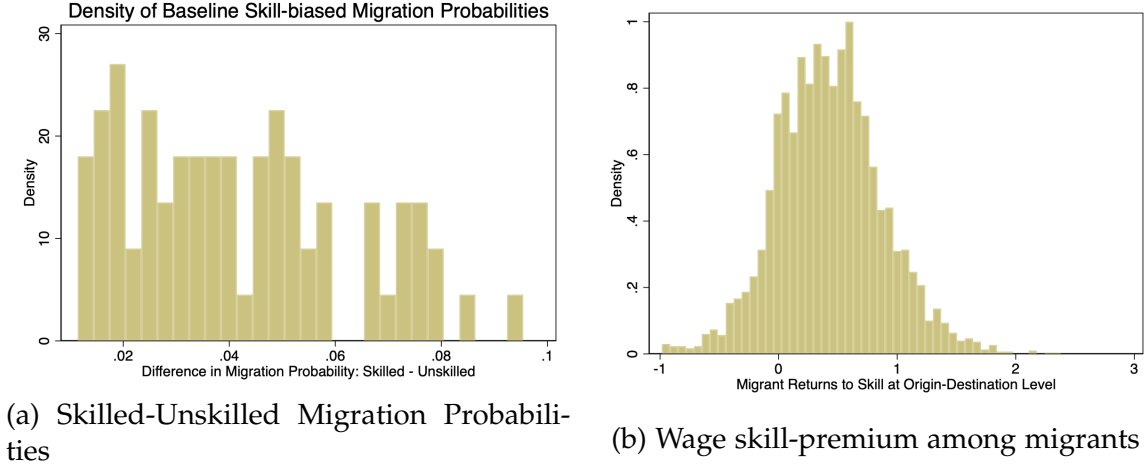
Notes: The figure presents the coefficients of interest on $Shiftshare_o$ from estimating equation (4) for our main income and expenditure results. All regressions include the full set of controls, corresponding to Columns 3-6 Panel D in Table 1. The vertical red lines denotes the coefficient estimates from Table 1. Thick blue lines correspond to 90% confidence interval, thin blue lines correspond to 95% confidence interval. The modifications for each estimate are described in Section 5.5.

Figure A4: Robustness To Dropping Provinces One-By-One



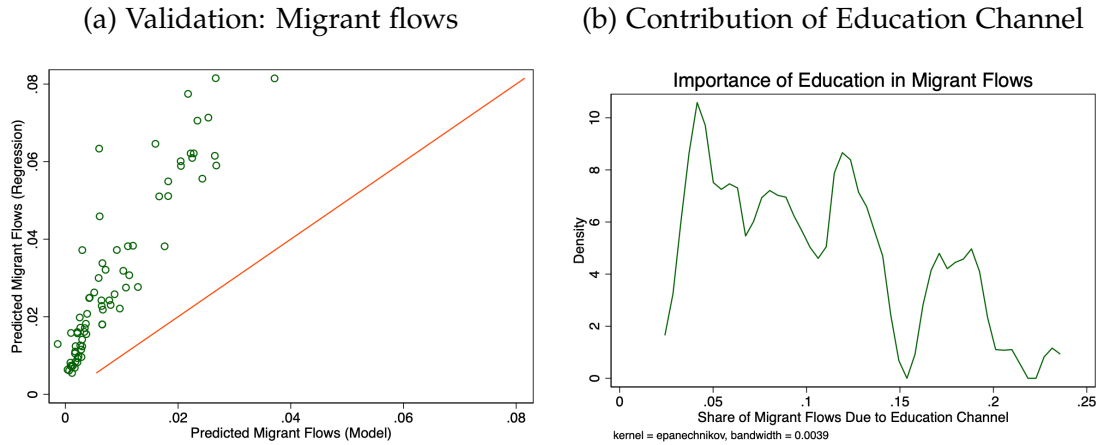
Notes: We present the coefficients of interest on $Shiftshare_o$ from estimating equation (4) for our main income and expenditure results. Each dot corresponds to estimates with one province dropped. All regressions include the full set of controls, corresponding to Columns 3-6 Panel D in Table 1. The red lines denotes the coefficient estimates from Table 1. Thick blue lines correspond to 90% confidence interval, thin blue lines correspond to 95% confidence interval.

Figure A5: Skill Level, Migration Probabilities, and Migrant Wages



Notes: (a) Figure plots a binned histogram of the difference in migration probabilities by skill, across provinces in 1990. We calculate the share of the skilled population that in the age-group 25-64 that is an overseas worker in destination d to be π_{dos} . We similarly do this for unskilled workers in π_{dou} . We then aggregate the difference across destinations, and plot $\sum_k (\pi_{kos} - \pi_{kou})$. (b) Figure plots the distribution of $w_{dost} - w_{dout}$ at the origin-destination pair level.

Figure A6: Model Validation & Contribution of Education Channel in Migrant Flows

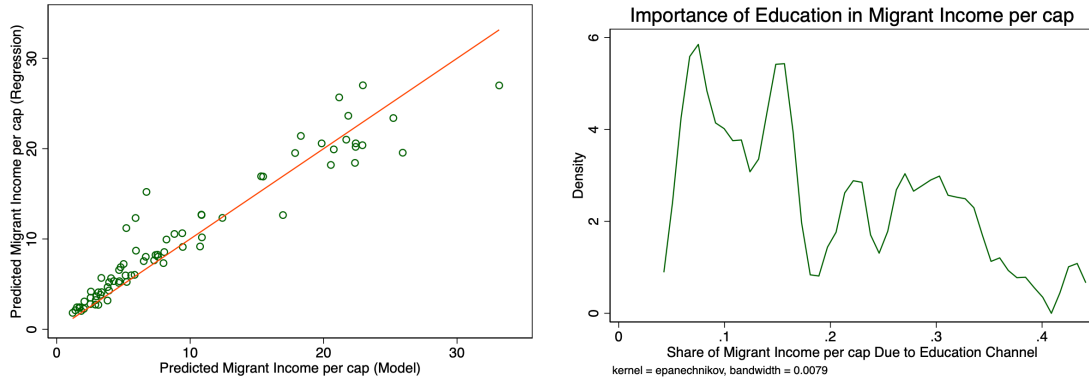


Notes: Figure A6a plots the predicted flows of migrants vs the predicted flows as determined by the components of Equation A8. The red line has an angle of 45 degrees. Each point represents a province. Figure A6b plots the province-level distribution of the contribution of the education channel in predicting migrant flows:

$$\frac{\Delta \ell_{ost} \sum_k (\pi_{kos0} - \pi_{kou0})}{Flows_{ot}^{OLS}}$$

Figure A7: Model Validation & Contribution of Education in Migrant Income

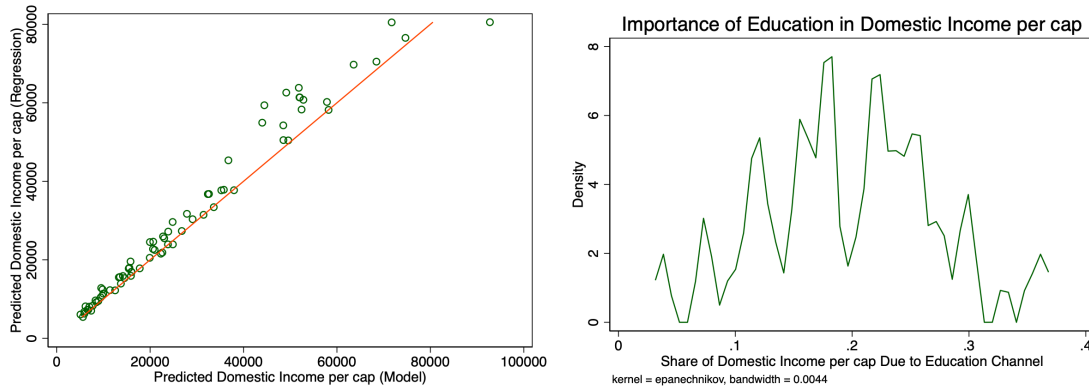
(a) Validation: Migrant Income per capita (b) Contribution of Education Channel



Notes: Figure A7a plots the predicted migrant income per capita from the regressions (vertical axis) vs the predicted migrant income as determined by the education and exchange rate components. The red line has an angle of 45 degrees. Each point represents a province. Figure A7b plots the province-level distribution of the contribution of the education channel in predicting migrant income per capita.

Figure A8: Model Validation & Contribution of Education in Domestic Income

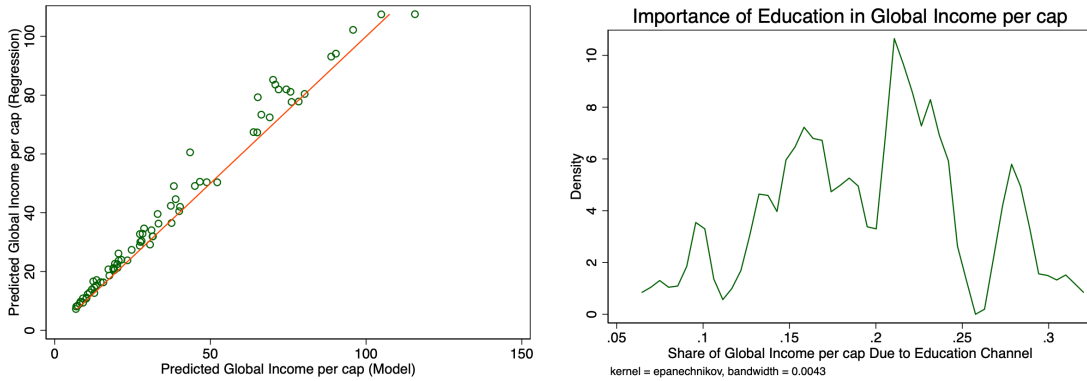
(a) Validation: Domestic Income per capita (b) Contribution of Education Channel



Notes: Figure A8a plots the predicted domestic income per capita from the regressions vs the predicted domestic income per capita as determined by the education and exchange rate components. The red line has an angle of 45 degrees. Each point represents a province. Figure A8b plots the province-level distribution of the contribution of the education channel in predicting domestic income per capita.

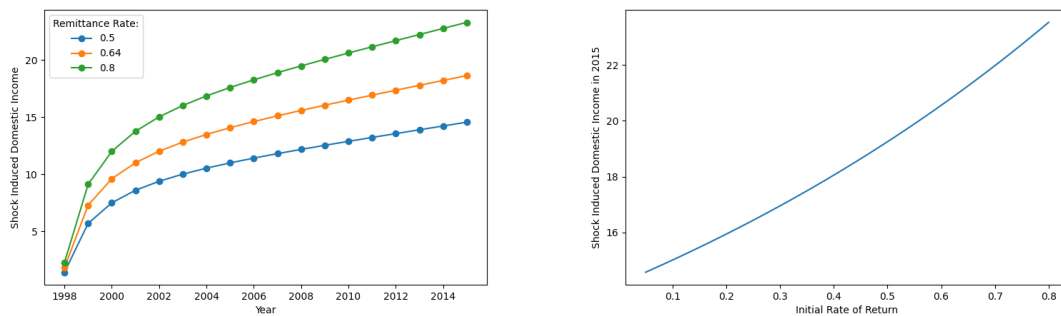
Figure A9: Model Validation & Contribution of Education to Global Income

(a) Validation: Global Income per capita (b) Contribution of Education Channel



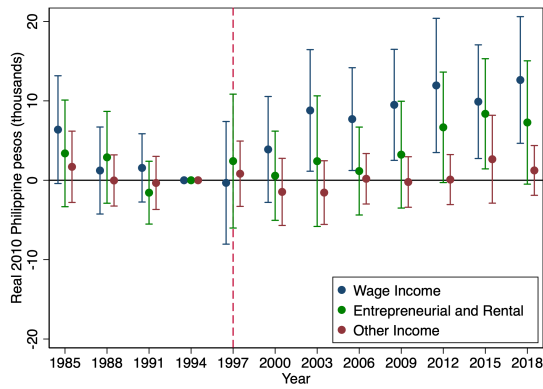
Notes: Figure A9a plots the predicted global income per capita (domestic plus migrant income) from the regressions vs the predicted global income per capita as determined by the education and exchange rate components. The red line has an angle of 45 degrees. Each point represents a province. Figure A9b plots the province-level distribution of the contribution of the education channel in predicting global income per capita.

Figure A10: Explaining Effect on Domestic Income: Sensitivity to Key Assumptions

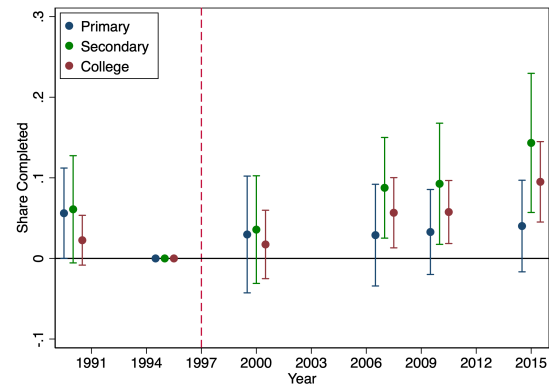


(a) Domestic Income Effects by Share of Migrant Income Spent at Origin (α) (b) Impact on Domestic Income by 2015, by Initial Rate of Return to Capital

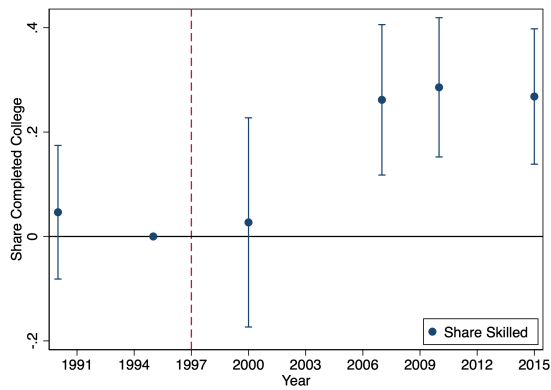
Figure A11: Event Studies for Other Outcomes



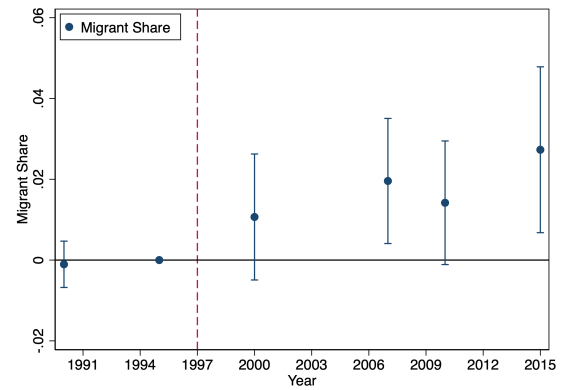
(a) Domestic Income Subcomponents



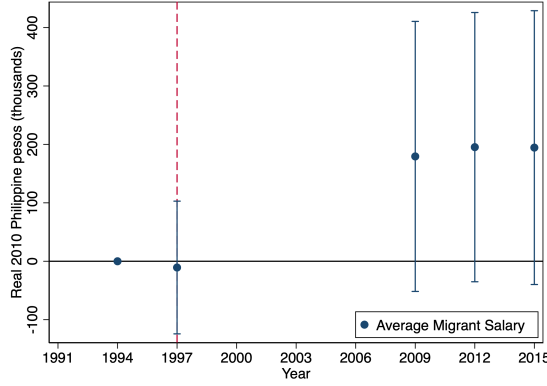
(b) Educational Attainment



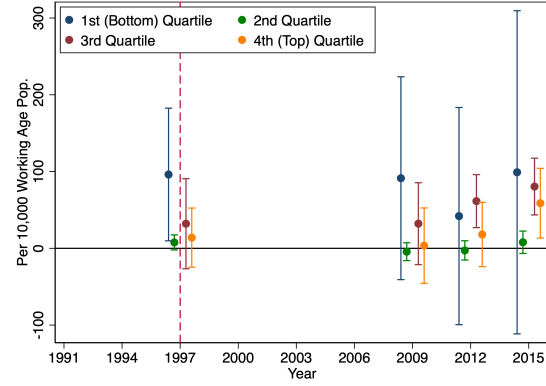
(c) Share of Migrant Workers Skilled



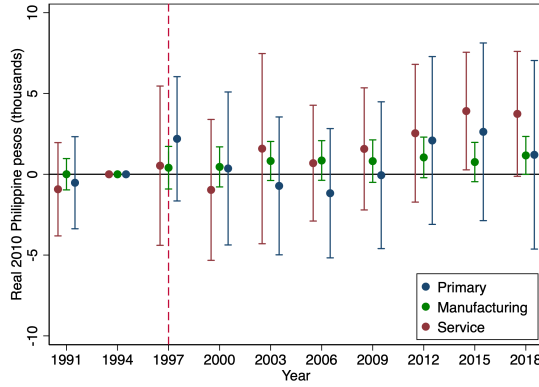
(d) Migrant Share



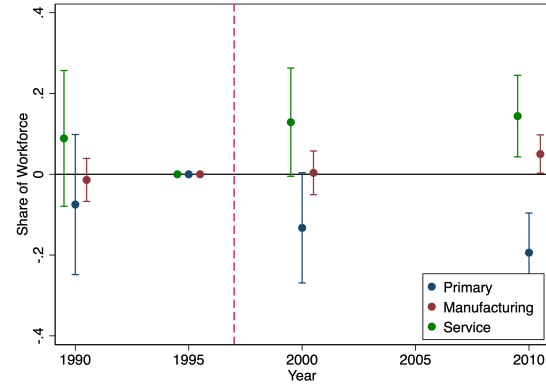
(e) Average Migrant Salary



(f) Migrant Occupations by Education Qtile



(g) Entrepreneurial Income Sector



(h) Share of Labor Force

Note: Regressions modify Equation (4) to include interactions between $Shiftshare_o$ and indicator variables for each pre- and post-shock year. Panel (a) corresponds to outcomes in Table 4, panel (b) corresponds to outcomes in Table 2, panels (c) - (f) corresponds to outcomes in Table 3, and panels (e) and (f) corresponds to outcomes in Table 5. The 1994 or 1995 interaction term, for contract/FIES or census outcomes respectively, is omitted as the reference point. Monetary outcomes are in real 2010 PhP (PhP17.8/US\$ PPP). Observations are at the province-period level. We include the partially-treated year 1997 in event study samples. 95% confidence intervals shown. Standard errors are clustered at the province level.

Table A1: Exposure Weights and Exchange Rate Shocks in Top 20 Destinations of Filipino Migrants

Destination	Mean Exposure Weight	Std. Dev. of Exposure Weight	10th Percentile Exposure Weight	90th Percentile Exposure Weight	Exchange Rate Shock (1997-1998, $\bar{\Delta}R_d$)	Exchange Rate Change, 1994 - 1996 (pre-shock)
Japan	792.10	1130.49	81.69	2326.40	0.32	-0.07
Taiwan	709.79	804.84	63.41	1872.03	0.26	-0.04
Saudi Arabia	670.42	583.41	196.61	1635.78	0.52	-0.01
Hong Kong	576.08	787.50	37.90	1640.57	0.52	-0.01
United States	452.86	509.16	48.32	1045.28	0.52	-0.01
United Arab Emirates	126.23	132.14	21.35	236.41	0.52	-0.01
Malaysia	74.56	85.63	5.30	172.55	-0.01	0.04
Kuwait	72.27	218.87	0.00	77.34	0.50	-0.02
Qatar	66.98	91.55	0.74	142.48	0.52	-0.01
South Korea	54.51	108.20	0.00	103.49	-0.04	-0.01
Brunei Darussalam	50.87	43.54	8.47	108.42	0.30	0.08
Oman	47.40	319.45	0.00	21.25	0.52	-0.01
Libya	40.85	38.73	2.64	83.48	0.57	-0.21
Guam	38.10	90.22	0.00	89.82	0.52	-0.01
Italy	30.43	55.54	0.00	100.28	0.38	0.04
Canada	29.91	44.13	0.00	84.75	0.42	-0.01
Northern Mariana Islands	28.17	40.10	0.00	73.16	0.52	-0.01
Bahrain	25.67	43.89	0.00	49.30	0.52	-0.01
Singapore	25.18	24.68	0.00	72.84	0.29	0.08
Israel	17.12	94.28	0.00	16.59	0.38	-0.06

Notes: Table displays 20 destinations d with the highest mean exposure weight (across provinces o). Columns 1-4 present summary statistics for exposure weights ω_{do0} , across 74 Philippine provinces o ("shares" of the shift-share variable). See Subsection 3.2 and Section 4 for details on exposure weight definition. Columns 5 and 6 present exchange rate changes. Column 5 displays exchange rate shock $\bar{\Delta}R_d$ ("shift" of the shift-share variable). Exchange rate shock is change in Philippine pesos (PhP) per foreign currency unit. Exchange Rate Shock (1997-1998, $\bar{\Delta}R_d$) is fractional change between July 1996-June 1997 and October 1997- September 1998 (e.g., 10% appreciation of the foreign currency against the Philippine peso is 0.1). Column 6 (Exchange rate change 1994-1996) is corresponding fractional change in exchange rate between 1996 and 1994, before July 1997 Asian Financial Crisis. 84 additional destinations not shown.

Table A2: Summary Statistics

	Mean	SD	10th P.	25th P.	Median	75th P.	90th P.	Obs.
Shock Variables								
Residualized $Shiftshare_o$	0.000	0.093	-0.105	-0.040	0.002	0.031	0.084	74
$MigInc_{o0}$	4.044	2.984	0.967	1.684	3.072	5.974	8.616	74
$Rshock_o$	0.415	0.040	0.371	0.389	0.412	0.436	0.454	74
Import Shock	10.673	9.180	2.766	4.148	7.661	12.864	24.678	74
Export Shock	10.431	10.057	2.786	4.626	6.801	12.739	21.966	74
Expenditure and Income								
Expenditure per Capita	29.074	10.525	18.220	22.041	26.939	33.557	42.329	887
Global Income per Capita	35.269	12.466	22.427	26.652	32.484	41.215	52.412	296
Domestic Income per Capita	30.699	10.618	20.007	23.453	28.570	35.151	44.949	296
Migrant Income per Capita	4.570	2.927	1.536	2.281	3.741	6.608	8.812	296
Average Migrant Salary	319.519	104.876	232.558	253.662	293.700	345.532	433.095	296
Education and Migration								
Share Primary School	0.789	0.114	0.638	0.719	0.799	0.880	0.927	444
Share Secondary School	0.486	0.146	0.291	0.374	0.490	0.580	0.689	444
Share College	0.133	0.046	0.082	0.098	0.126	0.158	0.191	444
Share College: Migrants	0.338	0.135	0.174	0.236	0.336	0.433	0.530	444
Migrant Share	0.013	0.009	0.003	0.006	0.011	0.018	0.025	444
Sectoral Share of Workforce								
Share in Primary Sector	0.530	0.185	0.232	0.435	0.563	0.667	0.733	296
Share in Manufacturing	0.063	0.056	0.016	0.025	0.043	0.074	0.139	296
Share in Service Sector	0.407	0.147	0.243	0.301	0.377	0.499	0.627	296
Migrant Contracts								
(per 10,000 working age people)								
1st Quartile Education Occupations	94.191	71.725	22.301	44.736	82.824	120.183	178.979	296
2nd Quartile Education Occupations	8.694	6.616	1.730	3.760	6.886	12.455	16.924	296
3rd Quartile Education Occupations	24.690	19.297	5.942	12.679	19.967	34.584	47.180	296
4th Quartile Education Occupations	43.096	32.762	7.236	17.110	35.481	62.302	87.562	296
Baseline Province Controls								
Baseline Share Rural	0.643	0.193	0.337	0.564	0.696	0.761	0.819	74
Baseline Asset Index	-0.671	1.024	-1.628	-1.367	-0.983	-0.208	1.116	74
Baseline Total Income per Capita	29.914	10.333	20.504	23.191	27.803	32.582	46.112	74
Baseline Expenditure per Capita	24.368	7.891	16.416	19.454	22.683	26.817	35.265	74
Share of Workforce in Primary Sector	0.567	0.175	0.282	0.491	0.596	0.692	0.760	74
Share of Workforce in Industry	0.121	0.082	0.042	0.066	0.095	0.150	0.256	74
Share of Workforce in Service Sector	0.299	0.095	0.194	0.234	0.287	0.348	0.421	74
Share of Workforce in Financial Services	0.013	0.013	0.004	0.006	0.009	0.015	0.026	74
Baseline Destination Controls								
Share of Migrant Workers in MENA	0.443	0.202	0.234	0.321	0.414	0.489	0.719	74
Share of Migrant Workers in OECD	0.055	0.048	0.011	0.024	0.044	0.070	0.106	74
Share of Migrant Workers in East Asia	0.459	0.194	0.203	0.364	0.455	0.581	0.717	74
1995 GDP Per Capita	21.721	13.245	7.691	12.565	23.497	28.691	43.429	104
Average Contract Salary	329.291	258.947	108.387	108.387	166.838	669.068	708.831	104
Share of Contracts Professional	0.351	0.429	0.002	0.012	0.154	0.962	0.994	104
Share of Contracts Manufacturing	0.285	0.305	0.001	0.001	0.179	0.477	0.716	104
Share of all 1995 Contracts	0.126	0.098	0.011	0.024	0.108	0.192	0.299	104

Note: Unit of observation is 74 provinces (times periods as relevant) in all cases except bottom five rows. For bottom rows, unit of observation is 104 migrant destination countries. Shock variables are constructed from POEA/OWWA dataset and other sources (see text). $MigInc_{o0}$ denotes pre-shock (1995) migrant income per capita. $Rshock_o$ denotes weighted-average exchange rate shock. Import and export shocks are as described in Section 4.3.1. Expenditure and domestic income data are from FIES. Migrant income is constructed from POEA/OWWA dataset and Philippine Census. Income and expenditure variables are in thousands of real 2010 Philippine pesos (17.8 PhP per PPP US\$ in 2010). Periods for expenditure are triennial, from 1985 to 2018 inclusive. (One observation, Rizal province in 1988, is missing due to loss of FIES data in a fire.) Periods for global, domestic, and migrant income data are 1994, 2009, 2012, and 2015. Shares of population by education level and share of population migrants are from Census (1990, 1995, 2000, 2007, 2010, 2015). Shares of population with primary, secondary, and college education are for those aged 20-64. "Share College: Migrants" is share of migrants reported in Census who have college or more education. Sectoral share of workforce variables from Census (1990, 1995, 2000, 2010). Migrant contracts are from the POEA/OWWA dataset (periods are 1994, 2009, 2012, and 2015); working age defined as 20-64. Baseline province controls are from Census for share rural and asset index; and from FIES for total income and expenditure. Baseline service sector excludes financial services (examined separately). Per capita GDP is from the World Development Indicators, in thousands of 1995 USD. Other destination level contract controls are calculated from POEA/OWWA dataset.

Table A3: Rotemberg Weights

Panel A. Positive and negative weights		Sum	Mean	Share			
$\hat{\alpha} > 0$		1.003	0.011	0.997			
$\hat{\alpha} \leq 0$		-0.003	-0.000	0.003			
Panel B. Top 5 Destinations		Rot Wgt.	F-Stat	$\hat{\beta}_k^{Global}$	$\hat{\beta}_k^{Domestic}$	$\hat{\beta}_k^{Migrant}$	$\hat{\beta}_k^{Consumption}$
Saudi Arabia		0.23	25.9	39.8***	32.1***	7.7***	22.8***
Japan		0.19	9.9	30.8***	28.4**	2.5	9.6
United States		0.16	3.9	30.7**	30.2**	0.5	7.5
Hong Kong		0.10	0.9	-19.5	-10.9	-8.6	-36.9
Taiwan		0.09	20.9	36.1***	27.9***	8.2***	18.9**

Note: The table presents diagnostic results for the shift-share following the approach suggested by Goldsmith-Pinkham et al. (2020). Panel A provides the sum, mean, and distribution of negative and positive Rotemberg weights $\hat{\alpha}$. Panel B displays the 5 destinations with largest Rotemberg weights. It presents the Rotemberg weights assigned to each destination when used collectively. Additionally, it reports the second stage coefficients for income $\hat{\beta}_k$ and F-statistics when each destination share is used individually as an instrument for the overall shift-share measure. The coefficients are provided for each main outcome presented in Table 1, corresponding to panel D, columns 3-6. *** p<0.01, ** p<0.05, * p<0.10.

Table A4: Placebo Regressions

Variables Constructed from FIES Data										
Pre Period: 1985, 1988, 1991; Post Period: 1994, 1997										
			Domestic Income Subcomponents			Entrepreneurial Income Sectors				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Domestic Income Per Cap.	Expenditure Per Cap.	Wage	Entrepreneurial and Rental	Other	Primary	Manu.	Service	Agr. Income	Non Agr. Income
$Shiftshare_o \times Post$	-2.527 (5.501)	2.248 (4.714)	-2.510 (2.905)	-0.205 (1.959)	0.188 (1.592)	1.589 (1.407)	0.159 (0.499)	1.272 (1.315)	0.938 (1.423)	-3.465 (5.270)
Obs.	369	369	369	369	369	222	222	222	369	369
Baseline DV Mean	26.962	25.372	11.585	10.843	4.534	6.038	0.623	4.170	8.305	18.657
Baseline DV St. Dev.	10.150	8.951	6.879	3.620	2.217	3.252	0.556	2.635	3.677	11.035

Variables Constructed from Census Data								
Pre Period: 1990; Post Period: 1995								
	Share Aged 20-64 Completed:				Share of Workforce in Sector:			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary School	Secondary School	College	Migrant Share Age 20 - 64	Share Skilled Migrants	Primary	Manufacturing	Service
$Shiftshare_o \times Post$	-0.058 (0.027)**	-0.061 (0.032)*	-0.022 (0.015)	0.003 (0.005)	-0.045 (0.062)	0.066 (0.095)	0.010 (0.023)	-0.076 (0.093)
Obs.	148	148	148	148	148	148	148	148
Baseline DV Mean	0.734	0.383	0.112	0.016	0.301	0.560	0.073	0.367
Baseline DV St. Dev.	0.114	0.117	0.038	0.013	0.095	0.180	0.063	0.134

Variables Constructed from Contract Data							
Pre Period: 1994; Post Period: 1997							
	Contracts per 10,000 Working Age People						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Global Income Per Capita	Migrant Income Per Capita	Average Mig. Salary	1st Qtile Edu.	2nd Qtile Edu.	3rd Qtile Edu.	4th Qtile Edu.
$Shiftshare_o \times Post$	4.693 (8.684)	0.579 (0.646)	-19.168 (61.048)	94.758 (42.742)**	7.695 (4.795)	29.691 (29.219)	12.897 (18.924)
Obs.	148	148	148	148	148	148	148
Baseline DV Mean	33.485	3.893	405.084	45.449	6.000	18.254	19.579
Baseline DV St. Dev.	13.519	2.874	123.997	41.849	7.522	24.503	23.314

Note: Table presents coefficients on $Shiftshare_o \times Post_t$ in placebo regressions with false “post” periods. For definitions of outcomes, see: Table 1 (global, domestic, and income; and domestic income subcomponents), Table 2 (education outcomes), and Table 3 (share skilled migrants; migrant occupation outcomes). Compared to these other tables, $Post_t$ is redefined to refer to periods no later than 1997. All regressions include province fixed effects, year fixed effects, and $MigInc_{o0}$ and $Rshock_o$ interacted with year fixed effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A5: Import and Export Shift-Share Variables Do Not Predict the Migrant Income Shift-Share Variable

	Migrant Income Shift-Share Variable ($Shiftshare_o$)			
	(1)	(2)	(3)	(4)
Panel A. Import and Export Shocks Jointly				
Import Shift-share ($Shiftshare_o^{import}$)	0.000742 (0.00173)	0.000507 (0.00143)	-0.000432 (0.00128)	0.000162 (0.00148)
Export Shift-share ($Shiftshare_o^{export}$)	0.0000892 (0.00133)	-0.000115 (0.00177)	0.0000160 (0.00168)	-0.0000963 (0.00176)
Panel B. Import Shock Only				
Import Shift-share ($Shiftshare_o^{import}$)	0.000807 (0.00168)	0.000432 (0.00172)	-0.000422 (0.00135)	0.0000983 (0.00149)
Panel C. Export Shock Only				
Export Shift-share ($Shiftshare_o^{export}$)	0.000547 (0.00145)	0.000207 (0.00192)	-0.000203 (0.00168)	-0.0000132 (0.00162)
Obs.	74	74	74	74
Controls	None	Panel A	Panel B	Panel C

Note: Unit of observation is province. The outcome variable is the migrant income shift-share variable, $Shiftshare_o$. All columns control for $MigInc_{o0}$ and $Rshock_o$. "Controls" row in table indicates set of additional control variables included in the regression, with panels corresponding to the structure of our main effect tables. Panel A includes destination controls only. Panel B additionally includes province development status controls. Panel C additionally includes province industrial structure controls. For list of destination and provincial controls, see Table 1. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A6: Effects of Migrant Income Shock on Internal Migration

	Census: 1990, 2000, 2010					
	Age: 25 - 64			Age: 16 - 24		
	(1) In Migration Rate	(2) Out Migration Rate	(3) Net Migration Rate	(4) In Migration Rate	(5) Out Migration Rate	(6) Net Migration Rate
<i>Panel A. Destination controls only</i>						
<i>Shiftshare_o × Post</i>	-0.011 (0.024)	-0.016 (0.010)*	-0.005 (0.026)	-0.010 (0.029)	-0.035 (0.017)*	-0.025 (0.037)
<i>Panel B. Additional province development status controls</i>						
<i>Shiftshare_o × Post</i>	-0.024 (0.025)	-0.015 (0.011)	0.009 (0.029)	-0.025 (0.028)	-0.032 (0.016)*	-0.007 (0.035)
<i>Panel C. Additional province industrial structure controls</i>						
<i>Shiftshare_o × Post</i>	-0.030 (0.025)	-0.015 (0.011)	0.016 (0.029)	-0.034 (0.028)	-0.034 (0.016)**	0.000 (0.034)
<i>Panel D. Additional import and export shift-share variables</i>						
<i>Shiftshare_o × Post</i>	-0.030 (0.024)	-0.015 (0.011)	0.015 (0.027)	-0.033 (0.028)	-0.034 (0.016)**	-0.001 (0.033)
Obs.	217	217	217	217	217	217
Baseline DV Mean	0.036	0.036	-0.001	0.041	0.056	0.015
Baseline DV St. Dev.	0.024	0.014	0.023	0.030	0.025	0.040

Note: Internal migration data is from 1990, 2010, and 2010 Censuses. Due to missing internal migration data in the 1990 Census, five provinces are dropped at the recommendation of the Philippine Statistical Authority (Camarines Sur, Capiz, Cavite, Mindoro Oriental, and Zamboanga Del Sur). Dependent variables are in-migration rate (individuals reporting having moved into the province within the last five years, as share of provincial population), out-migration rate (analogously, share who moved out of the province in the last five years), and net migration rate (the out-migration rate minus the in-migration rate). For list of destination and provincial controls, see Table 1. Baseline dependent variable mean and standard deviation calculated based on data from nearest pre-shock year. All regressions include province and year fixed effects. Standard errors are clustered at the province level. *** p<0.01, ** p<0.05, * p<0.10.

Table A7: Effects of Migrant Income Shock on Manufactured Exports

	Manufactured Exports per Capita	
	Full Period	Long Run
	(1) Levels	(2) Levels
<i>Panel A. Destination controls only</i>		
$Shiftshare_o \times Post$	3.991 (8.966)	4.412 (13.446)
<i>Panel B. Additional province development status controls</i>		
$Shiftshare_o \times Post$	5.648 (9.555)	3.600 (14.673)
<i>Panel C. Additional province industrial structure controls</i>		
$Shiftshare_o \times Post$	2.659 (7.405)	-2.592 (10.853)
<i>Panel D. Additional import and export shift-share variables</i>		
$Shiftshare_o \times Post$	2.847 (7.456)	-2.301 (11.053)
Obs.	888	370
Baseline DV Mean	3.195	3.195
Baseline DV St. Dev.	8.091	8.091

Note: Unit of observation is the province-year. Dependent variable is total value of manufactured exports, in thousands of real 2010 Philippine pesos (PhP), divided by province population. Dependent variable winsorized at 99%. Manufactured exports data are from Annual Survey of Philippine Business and Industry (ASPBI), Annual Survey of Establishments (ASE) and Census of Philippine Business and Industry (CPBI) (depending on year). Full period includes all years with export data available, except the year 1997 (1994, 1996, 1998, 1999, 2006, 2008, 2009, 2010, 2012, 2013, 2014, and 2015). Long run includes years 1994, 1996, 2009, 2012, and 2015. For list of destination and provincial controls, see Table 1. Baseline dependent variable mean and standard deviation calculated based on data from nearest pre-shock year. All regressions include province and year fixed effects. Standard errors are clustered at the province level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A8: Exchange Rates and Foreign Direct Investment to Philippines

	FDI	
	Full Period	Long Run
	(1)	(2)
<i>Panel A. No Controls</i>		
Erchange X Post	-0.888 (1.780)	-1.007 (1.791)
Obs.	4,378	995
Dep. Var. Mean	0.747	0.845
Dep. Std. Dev.	5.107	6.156
<i>Panel B. Destination Controls</i>		
Erchange X Post	-1.037 (3.327)	-1.512 (3.667)
Obs.	2,332	530
Dep. Var. Mean	1.402	1.585
Dep. Std. Dev.	6.932	8.369

Note: Unit of observation is country-year. Countries are weighted by the baseline migrant income in each destination. FDI data are from the PSA's Foreign Investment Reports for 1996-2002 and from PSA's OpenStat platform for after 2002. Yearly FDI are in billions of real 2010 PhPs. Full period includes years from 1996 to 2018. 1997 is dropped from the analysis due to partial treatment. Long run includes years 1996, 2009, 2012, 2015, and 2018. For list of destination controls, see Table 1. Two panels have different samples since destination controls can only be constructed for countries with baseline Philippine migration. All regressions include province and year fixed effects. Standard errors are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A9: Migrant Income Shock and Price Levels

	Consumer Price Index (1996 = 100)		Inflation
	(1)	(2)	(3)
	Full Period	Long Run	$\frac{CPI_{2017} - CPI_{1996}}{CPI_{1996}}$
<i>Panel A. Destination controls only</i>			
$Shiftshare_o \times Post$	-28.605 (24.596)	-41.791 (34.681)	-0.324 (0.404)
<i>Panel B. Additional province development status controls</i>			
$Shiftshare_o \times Post$	-26.023 (28.004)	-38.941 (38.361)	-0.201 (0.460)
<i>Panel C. Additional province industrial structure controls</i>			
$Shiftshare_o \times Post$	-26.185 (27.507)	-39.446 (38.077)	-0.223 (0.464)
<i>Panel D. Additional import and export shift-share variables</i>			
$Shiftshare_o \times Post$	-26.515 (27.584)	-39.898 (38.555)	-0.233 (0.476)
Obs.	1,702	296	74
Dep. Var. Mean	100.000	100.000	1.551
Dep. Var. St. Dev.	0.000	0.000	0.260

Note: For columns 1 and 2 unit of observation is the province-year and the dependent variable is province CPI. "Full period" includes 1994-2017, with 1997 excluded. "Long run" includes years included in our Global Income analysis in Table 1: 1994, 2009, 2012, and 2015. Regressions in columns 1 and 2 include province and year fixed effects. Standard errors are clustered at the province level. For column 3 the unit of observation is the province, and the dependent variable is the percent change in CPI from 1996 to 2017. $Shiftshare_o$ is not interacted with a post indicator for this cross-sectional specification. For list of destination and provincial controls, see Table 1. Baseline dependent variable mean and standard deviation calculated based on data from nearest pre-shock year (1996). *** p<0.01, ** p<0.05, * p<0.10.

Table A10: Estimating θ using Poisson Pseudo-maximum Likelihood

	OLS	PPML	PPML
	Change in Migrants		
$\text{Log}(\Delta R_d)$	9.374* (5.146)	3.471** (1.720)	3.417** (1.707)
Observations	26,344	24,788	24,788
Fixed Effects	Origin x Skill	None	Origin x Skill

Note: OLS and PPML estimates of θ using the migration response to a destination shock, at the origin-destination-skill level. Standard errors clustered at the destination level. ΔR_d is the change in exchange rates across destinations d over the course of the Asian Financial Crisis. Migrant earnings and migrant flows are from the POEA/OWWA dataset. *** indicates significance at the 1% level. ** indicates significance at the 5% level * indicates significance at the 10% level.

Table A11: Impacts on Domestic Income by Skill

	1994, 2009, 2012, and 2015	
	(1) Domestic Income Per Capita Skilled	(2) Domestic Income Per Capita Unskilled
<i>Panel A. Destination controls only</i>		
$Shiftshare_o \times \text{Post}$	59.929 (27.682)**	15.332 (5.313)***
<i>Panel B. Additional province development status controls</i>		
$Shiftshare_o \times \text{Post}$	27.828 (19.494)	12.012 (5.015)**
<i>Panel C. Additional province industrial structure controls</i>		
$Shiftshare_o \times \text{Post}$	29.080 (20.186)	11.073 (4.634)**
<i>Panel D. Additional import and export shift-share variables</i>		
$Shiftshare_o \times \text{Post}$	28.502 (19.694)	11.080 (4.364)**
Obs.	296	296
Dep. Var. Mean	58.508	21.084
Dep. Var. St. Dev.	17.982	6.955

Note: Unit of observation is the province-year. Domestic income by skill are calculated from merged Family Income and Expenditure Survey (FIES) and Labor Force Survey (LFS) data, where we define a household as skilled if any working member is skilled. For list of destination and provincial controls, see Table 1. Baseline dependent variable mean and standard deviation calculated based on data from nearest pre-shock year. All regressions include province and year fixed effects. Standard errors are clustered at the province level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A12: Overall Changes and Model-based Decomposition of Flows and Income

	Domestic Income	Migrant Income	Global Income
Mean	26.102	4.087	30.189
Std. Dev.	(9.406)	(2.993)	(11.400)
Impact of 1-std.-dev. shock	1.696	0.569	2.265
Increase as % of mean	6.5%	13.9%	7.5%
Share of global income increase	74.9%	25.1%	100.0%
Model-based decomposition:			
Education channel	19.9%	19.1%	19.7%
Exchange rate channel	—	69.9%	17.6%
Direct wage channel	71.0%	—	53.2%
Explained by model	90.9%	89.0%	90.4%

Note: The table summarizes the changes to the variables for which we decompose the overall changes and derive the changes due to the education channel component. The mean and standard deviation values are for the closest available year before the crisis (1995 for migrant flows and 1994 income). The impact of a 1 std dev shock in migrant income is the coefficient from the regressions multiplied by 0.093 (the std. dev. of the migrant income shock). Monetary units are in thousands of Philippine pesos (PhP). The bottom panel describes the contributions of each model-based decomposition.

References

- Allen, Treb, Costas Arkolakis, and Yuta Takahashi**, “Universal Gravity,” *Journal of Political Economy*, 2020, 128 (2), 393–433.
- Borusyak, Kirill, Peter Hull, and Xavier Jaravel**, “Quasi-Experimental Shift-Share Designs,” *Review of Economic Studies*, 2022, 89 (1), 181–213.
- Breza, Emily and Cynthia Kinnan**, “Measuring the Equilibrium Impacts of Credit: Evidence from the Indian Microfinance Crisis,” *The Quarterly Journal of Economics*, May 2021, 136 (3), 1447–1497.
- Bryan, Gharad and Melanie Morten**, “The Aggregate Productivity Effects of Internal Migration: Evidence from Indonesia,” *Journal of Political Economy*, 2019.
- de Mel, Suresh, David McKenzie, and Christopher Woodruff**, “Returns to Capital in Microenterprises: Evidence from a Field Experiment,” *The Quarterly Journal of Economics*, November 2008, 123 (4), 1329–1372.
- Eaton, Jonathan and Samuel Kortum**, “Technology, geography and trade,” *Econometrica*, 2002, 70, 1741–1779.
- Global Knowledge Partnership on Migration and Development (KNOMAD) and the International Labor Organization (ILO)**, “The Migration Cost Surveys (MCS),” 2015–2016. Data obtained in March 2025. Available in <https://microdata.worldbank.org/index.php/catalog/2938/get-microdata> for 2015 and <https://microdata.worldbank.org/index.php/catalog/2944/get-microdata> for 2016.
- Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift**, “Bartik Instruments: What, When, Why, and How,” *American Economic Review*, 2020, 110 (8), 2586–2624.
- Harris, Richard D.F. and Elias Tzavalis**, “Inference for unit roots in dynamic panels where the time dimension is fixed,” *Journal of Econometrics*, 1999, 91 (2), 201–226.
- Khanna, Gaurav, Emir Murathanoglu, Caroline Theoharides, and Dean Yang**, “Abundance from Abroad: Migrant Income and Long-Run Economic Development,” *NBER Working Paper No. 29862*, March 2022.
- Philippine National Statistics Office (NSO)**, “1990 Census of Population and Housing,” 1990. Data obtained in 2012.
- , “1995 Census of Population and Housing,” 1995. Data obtained in 2012.
- , “2000 Census of Population and Housing,” 2000. Data obtained in 2012.
- , “2007 Census of Population and Housing,” 2007. Data obtained in 2012.
- , “2010 Census of Population and Housing,” 2010. Data obtained in 2012.
- Philippine Overseas Employment Administration (POEA)**, “Overseas Filipino Worker Contract Database,” 2009.
- , “Overseas Filipino Worker Contract Database,” 2017.
- Philippine Overseas Worker Welfare Administration (OWWA)**, “OWWA Membership Database,” 2012.

- Philippine Statistics Authority (PSA)**, “Family Income and Expenditure Survey,” 1991-2018. Data obtained in 2018 (until for 1991-2015) and 2021 (for 2018 data).
- , “the Annual Survey of Establishments (ASE),” 1994, 1996, 1997, 1998. Data accessed on-site in PSA offices in Manila in July 2019.
 - , “Consumer Price Index for All Income Households by Commodity Group (2018=100): January 1994 - December 2017,” 1994-2017. Data obtained in 2025. Latest version available at https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2M__PI__CPI__2018NEW/0012M4ACP28.px/?rxid=81a6dcoc-89c3-4068-b133-odc4f5adaa25.
 - , “Foreign Investment Reports,” 1996-2010. Data obtained in 2021. Scanned documents obtained from <https://psa.gov.ph/content/foreign-investments-o>.
 - , “Census of Philippine Business and Industry (CPBI),” 1999, 2006, 2012. Data accessed on-site in PSA offices in Manila in July 2019.
 - , “Survey of Overseas Filipinos,” 2007-2017. Data obtained in January 2023.
 - , “Annual Survey of Philippine Business and Industry (ASPBI),” 2008-2010, 2013-2015. Data accessed on-site in PSA offices in Manila in July 2019.
 - , “Approved Foreign Investments by Country of Investor at Current Prices,” 2011-2016. Data obtained in 2021. Latest version available at https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2B__FI/0032B5DICI0.px/?rxid=ab360a1b-8df4-4095-bf9e-e8a678cf1e1c.
 - , “Merged Family Income and Expenditure Survey and Labor Force Survey,” 2012 and 2015. Data obtained in 2021.
 - , “2015 Census of Population and Housing,” 2015. Data obtained in 2021.
- Theoharides, Caroline**, “Manila to Malaysia, Quezon to Qatar: International Migration and the Effects on Origin-Country Human Capital,” *Journal of Human Resources*, 2018.
- Tombe, Trevor and Xiaodong Zhu**, “Trade, Migration and Productivity: A Quantitative Analysis of China,” *American Economic Review*, 2019, 109 (5), 1843–1872.
- World Bank**, “World Development Indicators,” 2024. Data obtained in September 2022 for GDP, March 2023 for CPI and exchange rates. Currently available from <https://databank.worldbank.org/source/world-development-indicators>.

S Supplementary Appendix: Model Derivations

S1 Deriving share of flows from o to d

Indirect utility of worker i is as defined in the text:

$$V_{idost} = w_{dst} R_{dt} (1 - \tau_{dost}) q_{id} \epsilon_{dot} \equiv \widetilde{w_{dst} q_{id}} \quad \text{A14}$$

Workers will pick the destination p with the highest value of $w_{idost} = \widetilde{w_{dst} q_{id}}$. The probability that they pick destination 1 is given by:

$$\begin{aligned} \pi_{1ost} &= Pr [\widetilde{w_{1ost} q_1} > \widetilde{w_{d'ost} q_{d'}}] \quad \forall d' \neq 1 \\ &= Pr \left[q_{d'} < \frac{\widetilde{w_{1ost} q_1}}{\widetilde{w_{d'ost}}} \right] \quad \forall d' \neq 1 \\ &= \int \frac{dF}{dq_1} (q_1, \alpha_2 q_1, \dots, \alpha_D q_1) dq_1 \end{aligned} \quad \text{A15}$$

where we define $\alpha_d \equiv \frac{\widetilde{w_{1ost}}}{\widetilde{w_{d'ost}}}$. We assume that the abilities are distributed with the following Frechet distribution:

$$F(q_1, \dots, q_D) = \exp \left\{ - \left[\sum_{d=1}^D q_d^{-\theta} \right] \right\} \quad \text{A16}$$

So the derivative of the CDF is given by:

$$\frac{dF}{dq} = \theta q^{-\theta-1} \exp \left\{ - \left[\sum_{d=1}^D q_d^{-\theta} \right] \right\} \quad \text{A17}$$

This derivative evaluated at $(q_1, \alpha_2 q_1, \dots, \alpha_D q_1)$, allows us to determine the probability of choosing destination 1:

$$\begin{aligned} \pi_{1ost} &= \int \theta q^{-\theta-1} \exp \left\{ - \left[\sum_{d=1}^D (\alpha_d q)^{-\theta} \right] \right\} dq \\ &= \frac{1}{\sum_{d=1}^D \alpha_d^{-\theta}} \int \left(\sum_{d=1}^D \alpha_d^{-\theta} \right) q^{-\theta-1} \exp \left\{ - \left[q^{-\theta} \left(\sum_{d=1}^D \alpha_d^{-\theta} \right) \right] \right\} dq \\ &= \frac{1}{\sum_{d=1}^D \alpha_d^{-\theta}} \int dF(q) \\ &= \frac{1}{\sum_{d=1}^D \alpha_d^{-\theta}} \cdot 1 \\ &= \frac{\widetilde{w_{1ost}}^\theta}{\sum_{d=1}^D \widetilde{w_{dost}}^\theta} \end{aligned} \quad \text{A18}$$

The third line comes from the properties of the Frechet distribution, where we know that the term in the integral of the second line is simply the PDF with a shape parameter θ , and a scale parameter $\sum_{d=1}^D \alpha_d^{-\theta}$. Expanding on the definitions for $\widetilde{w_{dost}}$, and including the subscripts, we get equation A2:

$$\pi_{dost} = \frac{(w_{dst} R_{dt} (1 - \tau_{dot}) \epsilon_{dot})^\theta}{\sum_k (w_{kst} R_{kt} (1 - \tau_{kot}) \epsilon_{kot})^\theta} \quad \text{A19}$$

S2 Micro-founding the Education Responses

Baseline Framework: Households choose schooling levels S when young, and how much to borrow b_{io} . They maximize two period utility: $u(c_1) + u(c_2)$. Period 1 consumption depends on wealth Y (including migrant income), the price of schooling p , and borrowing. Period 2 consumption depends on income and period 1 debt with interest I :

$$c_{1io} = Y_{io} - p_o S_{io} + b_{io} \quad \text{and} \quad c_{2io} = V_{idost} - I_o b_{io}, \quad \text{A20}$$

where w_{idost} is the wage after the location choice.

We may expect that changes in migrant income help drive investments in human capital at home, for instance, by easing liquidity constraints for households or changing the returns to schooling. For instance, under certain assumptions on $u(\cdot)$ and w say, $w_{do}(S)$ linear in S , and log-utility $u(c)$ and for credit constrained households $\bar{b} = 0$, average province-level schooling responds to shocks to migrant income: $\Delta S_{ot} = \frac{1}{2p} \Delta Y_o$. In this case, for $\Psi \equiv (ed_1 - ed_0)2p$, the change in the share of high-skilled workers h in origin o is:

$$\Delta \ell_{oht} = \frac{1}{\Psi} \Delta Y_o = \frac{1}{\Psi} \sum_{s=h,u} \left[\ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \Delta R_{d0}) \right] = \frac{1}{\Psi} \underbrace{\sum_d \omega_{do0}}_{MigInc_o} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{Rshock_o} \quad \text{A6}$$

Non Credit Constrained Households and Changes in Returns: Non-constrained households may also respond to exchange rate shocks. Exchange rate shocks may not change the returns to education as they change both the educated and non-educated wage. For those who are not constrained, we derive that for a cost of education $= p_1 S + p_2 S^2$, the optimal amount of schooling does not depend on Y , but only on the returns to education:

$$S_i^u = \frac{w'(s)_d (1 - \tau_{dot}) R_{dt} q_{id} - p_1}{2p_2} \quad \text{A21}$$

where S_i^u are the years of schooling for unconstrained households. The average education levels of non-constrained households from origin o to destination d are:

$$S_{do}^u = \frac{w'(s)_d (1 - \tau_{dot}) R_{dt} \pi_{dot}^{\frac{-1}{\theta}} \Gamma - p_1}{2p_2} \quad \text{A22}$$

And the average change in education for unconstrained households from origin o is:

$$S_o^u = \sum_d S_{do} \pi_{dot} = \sum_d \frac{w'(s)_d (1 - \tau_{dot}) R_{dt} \pi_{dot}^{\frac{-1}{\theta} + 1} \Gamma - p_1}{2p_2} \quad \text{A23}$$

Since $\Delta \pi_{dot}^{\frac{-1}{\theta}} = -\pi_{dot}^{\frac{-1}{\theta}} \frac{\Delta R_{dt}}{R_{dt}}$, we know that:

$$\Delta S_o^u = \sum_d \frac{w'(s)_d (1 - \tau_{dot}) \theta \pi_{dot} \Gamma}{2p_2} \frac{\Delta R_{dt}}{R_{dt}} \quad \text{A24}$$

If δ fraction of the population is credit constrained, then the education response will also depend on δ . Notice that for unconstrained households to respond, students must also expect the exchange rate shocks to be long lasting.

Constraints on borrowing from future: For borrowing constrained households, the amount of schooling will depend on the income in the first period (and thereby any shocks to the income from abroad). Consider the two period consumption problem in Equation A20, and the lifetime utility $u(c_1) + u(c_2)$. If $b = \bar{b}$ is binding, then schooling is the only choice. From the first order conditions with respect to schooling, we know that:

$$pu'(c_1) = w'(S)u'(c_2) \quad \text{A25}$$

For continuous, increase, and concave utility and earnings functions, using the implicit function theorem, we can show education is an increasing function of income $\frac{\Delta S}{\Delta Y} > 0$.²⁹ We can also derive meaningful closed form solutions under other assumptions, such as for a linear earnings function: $w(S) = w'(S)S$, and Cobb-Douglas utility, say $u(c) = \alpha \log c$, we can show that for $\bar{b} = 0$ (completely constrained households), the first order condition is simply: $\frac{p\alpha}{Y-pS} = \frac{\alpha}{w(S)}w'(S)$.

We can derive a simple closed form relationship: $S_o = \frac{1}{2p}Y_o$.

For partially binding credit constraints, we can show $\Delta S = \frac{-I\bar{b}}{4p\gamma_d(1-\tau_{do})q_{id}R_{dt}} \frac{\Delta R_{dt}}{R_{dt}}$, where I is the rate of interest on borrowing

We are agnostic about whether the education response is due to liquidity constraints or changing returns to education. Some combination of the two is possible. Additionally, if period 2 consumption is subjectively discounted, say at rate β , then both the education and skill-share response will be scaled by $\frac{\beta}{1+\beta}$.

S3 Deriving the changes in π_{dost}

Flows from origin o to destination d are given by Equation A19. We define V_{ost} as the denominator of Equation A19. That is, $V_{ost} \equiv \sum_k (w_{kst}R_{dt}(1 - \tau_{kot})\epsilon_{kot})^\theta$. This comes to represent the option value of working in the various possible destinations. Similarly, let us define the numerator of Equation A19 to be $V_{dost} = (w_{dst}R_{dt}(1 - \tau_{dot})\epsilon_{dot})^\theta$.

$$\pi_{dost} = \frac{(w_{dst}R_{dt}(1 - \tau_{dot})\epsilon_{dot})^\theta}{\sum_k (w_{kst}R_{kt}(1 - \tau_{kot})\epsilon_{kot})^\theta} \equiv \frac{V_{dost}}{V_{ost}} \quad \text{A19}$$

²⁹To be specific: $\frac{\Delta S}{\Delta Y} = p + \frac{u''(c_2)}{u''(c_1)} \frac{w'(S)}{p} + \frac{u'(c_2)}{u''(c_1)} \frac{w''(S)}{p}$. Since $u'(c) > 0$, $u''(c) < 0$, $w'(S) > 0$, $w''(S) < 0$, we know $\frac{\Delta S}{\Delta Y} > 0$.

We can take the total derivative of these flows with respect to changes (derivative) in the exchange rate for one specific destination ΔR_{dt} .³⁰

$$\Delta\pi_{dost} = \underbrace{\frac{((1 - \tau_{dot})\epsilon_{dot})^\theta}{V_{ost}} \left(w_{dst}^\theta \theta R_{dt}^{\theta-1} \Delta R_{dt} + R_{dt}^\theta \theta w_{dst}^{\theta-1} \Delta w_{dst} \right)}_{\text{from the numerator of Equation A19}} - \underbrace{\frac{V_{dost}}{V_{ost}^2} \Delta V_{ost}}_{\text{from the denominator of Equation A19}} \quad \text{A26}$$

The above equation is derived using the quotient rule. The first part takes changes in the numerator, where only R_{dt} and w_{dst} change. This captures the effect of the exchange rate shocks to destination d specifically. Yet, simultaneously every exchange rate and every origin's wage changes as a result of the shock. So how does the π_{dost} change when there are multiple indirect changes as well? The second part takes the total derivative of the denominator. Now, since $\pi_{dost} \equiv \frac{V_{dost}}{V_{ost}}$, we can simplify this further:

$$\Delta\pi_{dost} = \underbrace{\theta\pi_{dost} \left(\frac{\Delta R_{dt}}{R_{dt}} + \underbrace{\frac{\Delta w_{dst}}{w_{dst}}}_{=0 \text{ if } o \neq d} \right)}_{\text{from the numerator of Equation A19}} - \underbrace{\frac{\pi_{dost}}{V_{ost}} \Delta V_{dost}}_{\text{from denominator of Equation A19}} \quad \text{A27}$$

For all $d \neq o$ the shocks do not change destination wages (i.e. Filipino migrants are small enough a group in destinations to affect their equilibrium wages). As such, for such destinations, we know that there is a direct effect, and an indirect effect to go to specific destination d :

$$\Delta\pi_{dost} = \theta\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} - \frac{\pi_{dost}}{V_{ost}} \left[\sum_{d \neq o} \left(V_{dost} \theta \frac{\Delta R_{dt}}{R_{dt}} \right) + \left(V_{oost} \theta \frac{\Delta w_{ost}}{w_{ost}} \right) \right] \quad \text{A28}$$

This can be rewritten as:

$$\Delta\pi_{dost} = \theta\pi_{dost} \left[\underbrace{\frac{\Delta R_{dt}}{R_{dt}}}_{\text{Direct effect}} - \left(\underbrace{\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Indirect resorting}} + \underbrace{\pi_{oost} \frac{\Delta w_{ost}}{w_{ost}}}_{\text{Domestic earnings stemming flows}} \right) \right] \quad \text{A29}$$

Change in flows depends on shock on own destination, but also how flows would change to other destinations, and how increases to domestic income would

³⁰Here, and elsewhere, we use Δ to denote a derivative, as d is already used for destinations.

stem such flows. This captures how flows to other destinations change, indirectly affect flows to the current destination.

We can sum up across destinations, and rewrite this equation

$$\sum_{d \neq o} \Delta \pi_{dost} = \theta \sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \left[1 - \sum_{d \neq o} \pi_{dost} \right] \right) - \left(\theta \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \left[\sum_{d \neq o} \pi_{dost} \right] \right) \quad A30$$

$$\sum_{d \neq o} \Delta \pi_{dost} = \underbrace{\pi_{oost} \left[\theta \sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) \right]}_{\text{Exchange rates driving outflows}^*} - \underbrace{[1 - \pi_{oost}] \left(\theta \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Domestic earnings stemming outflows}^*} \quad A31$$

Alternatively, we could separate out the indirect sorting effects:

$$\begin{aligned} \sum_{d \neq o} \Delta \pi_{dost} = & \underbrace{\theta \sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rates driving outflows}} - \underbrace{\theta \left(\pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Domestic earnings stemming outflows}} \\ & - \underbrace{\theta \left[\sum_{d \neq o} \pi_{dost} \sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) - \left[1 - \sum_{d \neq o} \pi_{dost} \right] \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right]}_{\text{Indirect resorting}} \end{aligned} \quad A32$$

S4 Deriving the changes in total flows

The above derivation is for a specific skill level s . Yet, skill levels may change as a result of the shock, and different skill groups have different propensities to migration. We know that flows from a specific origin to a specific destination can be characterized by:

$$\pi_{doht} \ell_{oht} + \pi_{dout} \ell_{out} \quad A33$$

Suppose, only R_{dt} changed for one d , and there were no changes to domestic wages, then the direct effect would come from the first part of Equation A29:

$$\Delta Flows_{dot} = \underbrace{\Delta \ell_{oht} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in flows}} + \underbrace{\theta (\ell_{oht} \pi_{doht} + \ell_{out} \pi_{dout}) \frac{\Delta R_{dt}}{R_{dt}}}_{\text{Exchange rate channel in direct flows}} \quad A34$$

The second part above (exchange rate channel in direct flows) comes straight from the first part (direct effect) of Equation A29 replaced into Equation A33.

Equation A31 allows us to derive $\Delta Flows_{ot} \equiv \sum_{d \neq o} \Delta Flows_{dot}$:

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in outflows}} + \underbrace{\theta \sum_{d \neq o} (\ell_{oht} \pi_{ooht} \pi_{doht} + \ell_{out} \pi_{oout} \pi_{dout}) \frac{\Delta R_{dt}}{R_{dt}}}_{\text{Exchange rate channel in outflows (from Equation A31 part 1)}} \\ & - \underbrace{\theta \left(\ell_{oht} [1 - \pi_{ooht}] \pi_{ooht} \frac{\Delta w_{oht}}{w_{oht}} + \ell_{out} [1 - \pi_{oout}] \pi_{oout} \frac{\Delta w_{out}}{w_{out}} \right)}_{\text{Domestic earnings stemming outflows (from Equation A31 part 2)}} \end{aligned} \quad \text{A35}$$

We can split up the exchange rate channel by skill group:

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in outflows}} \\ & + \theta \left[\underbrace{\ell_{oht} \pi_{ooht} \sum_{d \neq o} \left(\pi_{doht} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rate driving skilled outflows}^*} + \underbrace{\ell_{out} \pi_{oout} \sum_{d \neq o} \left(\pi_{dout} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rate driving unskilled outflows}^*} \right] \\ & - \theta \left[\underbrace{\ell_{oht} [1 - \pi_{ooht}] \pi_{ooht} \frac{\Delta w_{oht}}{w_{oht}}}_{\text{Domestic earnings stemming skilled outflows}^*} + \underbrace{\ell_{out} [1 - \pi_{oout}] \pi_{oout} \frac{\Delta w_{out}}{w_{out}}}_{\text{Domestic earnings stemming unskilled outflows}^*} \right] \end{aligned} \quad \text{A36}$$

Here, the channels above include the indirect re-sorting to the alternative destinations. Alternatively, we can keep the indirect re-sorting separate and use Equation A32:

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in outflows}} - \underbrace{\chi_o}_{\text{Indirect re-sorting}} \\ & + \theta \left[\underbrace{\ell_{oht} \sum_{d \neq o} \left(\pi_{oht} \frac{\Delta R_{dt}}{R_{dt}} \right) + \ell_{out} \sum_{d \neq o} \left(\pi_{dout} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rate driving outflows by skill group}} \right] \\ & - \theta \left[\underbrace{\ell_{oht} \pi_{ooht} \frac{\Delta w_{oht}}{w_{oht}} + \ell_{out} \pi_{oout} \frac{\Delta w_{out}}{w_{out}}}_{\text{Domestic earnings stemming outflows by skill group}} \right] \end{aligned} \quad \text{A8}$$

where $\chi_o \equiv \theta \sum_{s=h,u} \ell_{ost} \left[(1 - \pi_{oost}) \sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) - \pi_{oost} \left(\pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) \right]$

S5 Contributions to changes in global income

The changes to income consist of two main components. First, let us look at domestic income (for those who do not migrate):

$$\sum_{s=h,u} \ell_{ost} \pi_{oost} w_{ost} \quad A37$$

The direct effect on the domestic income would exist if wages increased $\Delta w_{ost} \neq 0$. The first is just the direct “wage channel” – higher wage rates imply higher domestic income. The second is driven by the fact that measured income rises only because education levels rise, and skilled workers are paid more.

$$\Delta W_{ot} = \underbrace{\Delta \ell_{oh} \left(\underbrace{w_{oh0} \pi_{ooh0}}_{\text{skilled wage at home}} - \underbrace{w_{ou0} \pi_{oou0}}_{\text{unskilled wage at home}} \right)}_{\text{Education channel in domestic income}} + \underbrace{\sum_{s=h,u} \ell_{os0} \pi_{oos0} (\Delta w_{ost}) - \tilde{\chi}_{o1}}_{\text{Direct wage (and resorting) channel}} \quad A11$$

Overall income generated by the individuals that originate from these regions changes by more than simply the direct wage and education channels. This is because the location choices of individuals change as well, in response to lucrative exchange rates, and domestic wage increases. If domestic wages increase, then more people may remain behind locally, and earn at home: $\Delta \pi_{oost}$. We can return to Equation A27, and set $d = o$, and $\Delta R_{ot} = 0$. But this time, $\Delta w_{ost} \neq 0$. So the analogue of Equation A29 is given by:

$$\Delta \pi_{oost} = \theta \pi_{oost} \left[\underbrace{\frac{\Delta w_{ost}}{w_{ost}}}_{\text{Remainers}} - \underbrace{\left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Indirect resorting}} \right] \quad A38$$

There is also the indirect effect once again. If wages do not increase at home, more workers may leave if exchange rates abroad become more favorable, reducing domestic income.

How does $\Delta \pi_{oost}$ contribute to domestic earning increases? We can replace the result for $\Delta \pi_{oost}$ above into Equation A37, and derive the indirect resorting $\tilde{\chi}_{o1} \equiv \sum_{s=h,u} \ell_{ost} \theta \pi_{oost} w_{ost} \left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) - \sum_{s=h,u} \ell_{ost} \pi_{oost} \theta \Delta w_{ost}$.

While this captures the domestic income gains, migrant income may change as well. Migrant income is given by:

$$\sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} R_{dt} \quad A39$$

Again, changes to ℓ_{ost} (upskilling) will contribute to the education channel, as always:

$$\Delta \ell_{oht} \left(\underbrace{\sum_{d \neq o} w_{doht} \pi_{doht} R_{dt}}_{\text{skilled wage abroad}} - \underbrace{\sum_{d \neq o} w_{dout} \pi_{dout} R_{dt}}_{\text{unskilled wage abroad}} \right) \quad A40$$

Now to get at how changes to exchange rates directly (and changes to local wages indirectly) affect flows, and thereby incomes, we need to go back to Equation A29, which described how flows changed. To be specific, the effects on income due to more favorable exchange rates are driven by higher persistent income, and more flows abroad to avail of these favorable exchange rates. To a specific destination d , this is again given by:

$$\Delta \pi_{dost} = \theta \pi_{dost} \left[\underbrace{\frac{\Delta R_{dt}}{R_{dt}}}_{\text{Direct effect}} - \underbrace{\left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Indirect resorting}} \right] \quad A29$$

Again, the indirect resorting channel depends on the relative changes to exchange rates in other destinations. From Equation A39, we can see that the changes to income are driven by (1) $\Delta \ell_{ost}$ (shown in Equation A40), (2) $\Delta \pi_{dost}$ (shown in Equation A29), and (3) just direct changes to ΔR_{dt} (say, in the short run). Since Equation A40 already documents how changes to skill affect income, let us concentrate on (2) and (3) here:

$$\sum_{s=h,u} \ell_{ost} \sum_d \Delta \pi_{dost} w_{dost} R_{dt} + \sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt} \quad A41$$

Replacing the result from Equation A29 in the first part of the equation above, we know:

$$\sum_{s=h,u} \ell_{ost} \sum_d \theta \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} w_{dost} R_{dt} - \tilde{\chi}_{o2} + \sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt} \quad A42$$

where $\tilde{\chi}_{o2} \equiv \theta \sum_{s=h,u} \sum_d \left[\ell_{ost} w_{dost} \pi_{dost} \left(\sum_{d \neq o} \left(\pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) \right]$ is the indirect resorting (from Equation A29). Rewriting this in terms of the initial shock ΔY_o :

$$\underbrace{\theta \sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt}}_{\Delta Y_o = \text{Migrant Earnings Shock}} + \underbrace{\sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt}}_{\text{Short run } \Delta c_{1o} = \Delta Y_o} - \tilde{\chi}_{o2} \quad \text{A43}$$

So together the contribution of wages and exchange rate changes (not skill-upgrading) to longer-run changes in global income generated (and consumption Δc_{2o}) by individuals from these regions (whether they are located at home or abroad) is given by:

$$\underbrace{\sum_{s=h,u} \left[\ell_{ost} \pi_{oost} \left(\underbrace{\Delta w_{ost}}_{\text{Direct wage channel}} + \underbrace{\theta \Delta w_{ost}}_{\text{Remainers channel}} \right) \right]}_{\text{Domestic earnings due to firm-side responses}} - \tilde{\chi}_{o2} + \underbrace{\theta \left(\sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt} \right)}_{\substack{\Delta Y_o = \text{Migrant Earnings Shock} \\ \text{Earnings from Abroad: Exchange Rate Channel}}} \quad \text{A44}$$