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ABUNDANCE FROM ABROAD:  
MIGRANT INCOME AND LONG-RUN ECONOMIC DEVELOPMENT

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**ABSTRACT**

How does income from international migrant labor affect the long-run development of migrant-origin areas? We leverage the 1997 Asian Financial Crisis to identify exogenous changes in international migrant income across regions of the Philippines, derived from spatial variation in exposure to exchange rate shocks. The initial shock to migrant income is magnified in the long run, leading to substantial increases in income in the domestic economy in migrant-origin areas; increases in population education; better-educated migrants; and increased migration in high-skilled jobs. Four-fifths of long-run income gains are actually from domestic (rather than international migrant) income. A simple structural model yields insights on mechanisms and magnitudes, in particular that one-fifth of long-run income gains are due to increased educational investments in origin areas. Increased income from international labor migration not only benefits migrants themselves, but also fosters long-run economic development in migrant-origin areas.

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## 1 Introduction

Moving from a developing to a developed country for work leads to income gains that are larger than the impacts of any known economic development program (Clemens et al., 2019; Pritchett and Hani, 2020). International migrants from developing countries sent home \$548 billion in remittances in 2019, an amount as large as all foreign direct investment, and more than three times larger than foreign aid flows to the developing world (World Bank, 2021).<sup>1</sup> Motivated by these economic gains, most developing-country governments have policies facilitating international migrant labor (United Nations, 2019b).

There is ample evidence that international migration raises incomes for the migrants themselves. However, evidence is scarce on how international migrant income affects broader economic development in migrants-origin *areas*. Income from international labor migration could stimulate investments in origin areas, promoting longer-run economic development. Evidence of such broader development impacts would suggest that international migration policies should play a more prominent role in efforts to reduce global poverty (Nunn, 2019).

We ask how international migrant income affects long-run economic development in migrant-origin areas. We exploit a large-scale natural experiment: changes in international migrant incomes across Philippine migrant-origin areas driven by the 1997 Asian Financial Crisis. Philippine provinces varied prior to 1997 in the amount of migrant income earned by their citizens in many different countries. Overseas migrant income sources then experienced exogenous – and heterogeneous – exchange rate shocks in 1997. To undertake our analyses, we obtained unusual Philippine government administrative data on migrant worker contracts, with information on migrant incomes, origin provinces, and overseas destinations. The combination of the natural experiment and these unique data makes possible a shift-share identification strategy. We examine aggregate impacts on 74 Philippine provinces up to two decades later.

Our empirical analyses implement frontier methods for identification and inference in shift-share research designs, following Borusyak et al. (2022). Each province’s exposure “shares” are pre-shock levels of migrant income per capita

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<sup>1</sup>International migration also involves large numbers of people. 210 million people from developing countries were international migrants in 2019 (United Nations, 2019a), a magnitude similar to the number of microcredit clients, 140 million (Convergences, 2019), or conditional cash transfer (CCT) program beneficiaries, 185 million (World Bank, 2018b).

from each international migrant destination (which we call “exposure weights”). These exposure weights vary greatly across origin provinces and overseas destinations. For example, 1995 migrant income emanating from Japan is 10.7 times higher on a per capita basis for Bulacan province (PhP 3,540 per provincial resident) than for Leyte (PhP 332 per provincial resident).<sup>2</sup> Japan’s exchange rate shock should therefore have 10.7 times greater impact on population-level mean outcomes in Bulacan than in Leyte.

Each destination’s “shift” is its exchange rate shock. Table 1 displays the exchange rate shock for the top 20 migrant destinations in the immediate post-shock year (1997-1998).<sup>3</sup> The shocks range from a 4% depreciation against the Philippine peso for Korea to a 57% appreciation for Libya. Other important destinations such as Japan and Taiwan fall in between (32% and 26% appreciations, respectively). The identification assumption is that these exchange rate shocks are as-good-as-randomly assigned. Balance tests with respect to pre-shock characteristics support this identification assumption.

We present the resulting variation in the shift-share variable across provinces in Figure 1. The shift-share variable is interpreted as a shock to migrant income per capita (i.e., per provincial resident). We estimate the impacts of this shock on long-run provincial outcomes. Standard errors account for correlation of shocks across provinces with similar exposure weights (Borusyak et al., 2022).

We find, first, that the initial shock to migrant income (measured by our shift-share variable) is magnified over time. Each unit short-run (1997-1998) positive shock to migrant income is increased five-fold in the longer run (through 2009-2015). Below, we explore the mechanisms behind this five-fold magnification in the context of a structural model.

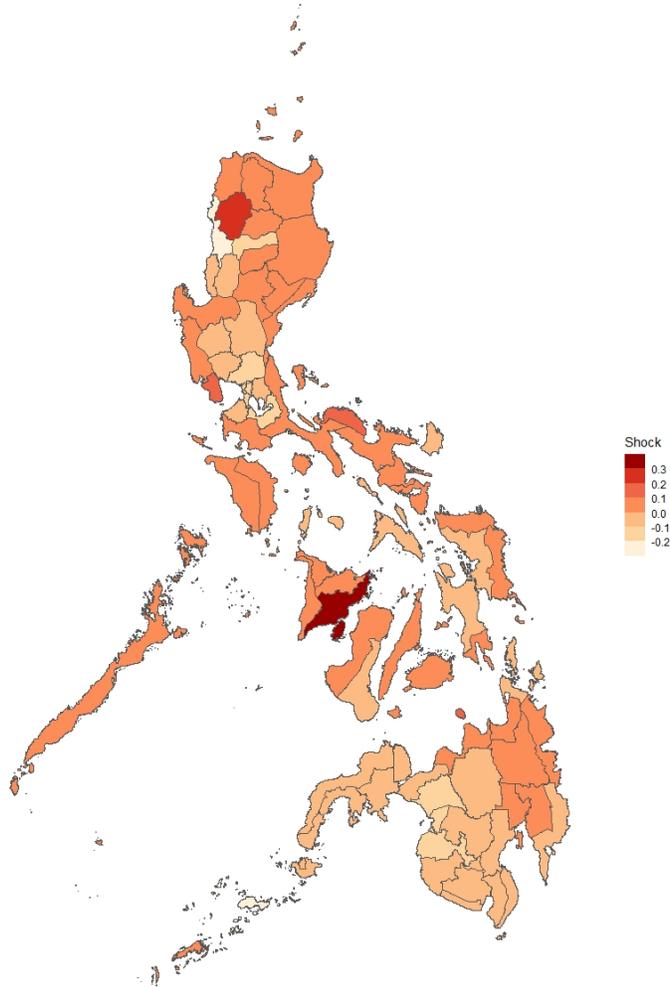
Second, we find that the positive migrant income shocks lead to substantial increases in *domestic* (Philippine) income in migrants’ origin provinces. A province’s “global income” is the sum of its domestic income and (international) migrant income. 80% of the long-run increase in global income is from the increase in domestic income, and 20% is from migrant income. We also see corresponding increases in household expenditure. The gains remain stable over roughly two decades after the 1997 shocks, reflecting persistence in the exchange rate changes

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<sup>2</sup>All Philippine peso (PhP) amounts in this paper are in real 2010 pesos (PPP exchange rate 17.8 PhP/USD).

<sup>3</sup>These exchange rate movements were persistent over the next two decades; see Section 5.4.

Figure 1: Spatial Distribution of Shift-Share Variable (Migrant Income Shock) Across Philippine Provinces



Notes: Spatial variation in province- $o$  shift-share variable (migrant income shock)  $Z_o = MigInc_o Rshock_o$  after partialling-out weighted average exchange rate shock  $Rshock_o$  and pre-shock migrant income per capita  $MigInc_o$ , for 74 Philippine provinces. See Subsection 3.2 and Section 5 for details.

and in the overseas sources of migrant income for particular Philippine provinces. The magnitude of the gains is nontrivial. A one-standard-deviation shock raises global income per capita 12-18 years later by 2,226 Philippine pesos (PhP) (5.8% of the mean; about one-sixth standard deviation).

We address potential threats to causal identification. First, we consider po-

tential omitted variables at the origin-province or migrant-destination level. Our estimates are not sensitive to controls accounting for ongoing trends related to pre-shock values of these variables. Second, we find no evidence of violations of parallel trends in the pre-shock period. Event-study diagrams and placebo regressions show that the relationship between key outcomes and the shift-share variable is flat over the pre-shock decade. Third, we consider alternate mechanisms through which our shift-share measure could affect outcomes, in particular trade and foreign direct investment (FDI). Our results are robust to controlling for time-varying trade and FDI flows. This helps confirm that the shift-share variable operates as a shock to migrant income, rather than trade or FDI.

We seek to provide further insights into mechanisms and effect magnitudes with the help of a simple structural model. We use the model to derive our estimating equation. Then, we have two additional objectives: 1) to quantify the contribution of education investments to the long-run effects, and 2) to account for the magnitude of the effect on migrant income (its five-fold magnification over the subsequent decade). We augment a gravity model of migration (Llull, 2018; Bryan and Morten, 2019; Lagakos et al., 2019) to allow workers to make educational investments and enter skilled occupations. Positive migrant income shocks may alleviate constraints on such investments.

Given the central role of skill in the model, we empirically estimate impacts on educational investments. We find large positive effects: a one-standard-deviation migrant income shock increases the share of the population with a college education by 0.43 percentage points (0.09 standard deviation). We also show that these increases in skill in the population are accompanied by increases in the share of migrants who are college-educated, and in new labor migration in highly-skilled occupations overseas.

We estimate that increases in education can account for roughly one-fifth of the increases in migrant, domestic, and global income. Furthermore, the model can fully explain the five-fold magnification of the effect of the shift-share shock on migrant income over the long run, as stemming from increases in educational investments in the population, increasing migrant skill levels, and changes in migration rates across destinations.

We also provide a stylized framework to understand the plausibility of our estimated effects on domestic income. We make assumptions regarding the share of

migrant income returned to origin economies, the aggregate demand multiplier, and the return on investments for capital-constrained entrepreneurs. A reasonable set of such assumptions yields the observed long-run increase in domestic income.

Our study is made possible by two unusual elements. First, the natural experiment of the 1997 Asian Financial Crisis generates the exogenous exchange rate variation central to our shift-share identification strategy.<sup>4</sup> Second, we obtained unusual Philippine government administrative data on migrant worker contracts. These data make it possible to construct the shift-share instrument at all; otherwise, Philippine-province exposure weights (“shares” in the shift-share) are unobservable.

This paper contributes to research on the economic impacts of international migration on developing-country populations. Prior research has established causal impacts of migrant economic conditions or migration opportunities on migrants’ origin *households*.<sup>5</sup>

Our work is related to a small body of recent research on economic impacts of international migrant income or opportunities on migrant-origin *areas*, that emphasizes causal identification. Theoharides (2020) finds that closing a prior migration opportunity reduces income and raises child labor in Philippine origin areas. Dinkelman and Mariotti (2016) and Dinkelman et al. (2020) examine long-run impacts of migrant work in South Africa on Malawian origin-area education and development. Caballero et al. (2021) study short-run effects of migrant exposure to Great Recession shocks on Mexican origin areas.<sup>6</sup>

Compared to prior research, our paper’s most distinctive feature is our focus on impacts of increased international income from formal, legal migrant labor. Unlike undocumented and unregulated migrant flows across borders, migration that is facilitated and regulated by governments is highly policy-relevant, and most developing country governments are taking concrete steps towards promoting it (as we discuss in Section 2). Credible evidence on the impacts of legal, reg-

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<sup>4</sup>Prior studies have exploited international migrants’ exchange rate shocks to study impacts on migrants and their origin households (Yang, 2006, 2008a; Kiradar, 2009; Nekoei, 2013; Abarcar, 2019; Dustmann et al., 2021).

<sup>5</sup>Such prior works include Dustmann and Kirchkamp (2002), Yang (2008b), Gibson et al. (2010), Gibson et al. (2011), Mendola (2012), Gibson et al. (2014), Clemens et al. (2016), Clemens and Tiongson (2017), Gröger (2019), Mobarak et al. (2018), and Bossavie et al. (2022).

<sup>6</sup>In studies of *internal* (within-country) migration, Kinnan et al. (2019) examine impacts of Chinese migration on origin areas using an instrument based on shocks in domestic migrant destinations, and Akram et al. (2017) examine Bangladeshi village-level impacts of randomly inducing rural-urban migration.

ulated international migrant labor flows on origin-area economic development is of interest to development policy-makers, in both migrant-sending and -receiving governments.

This paper has several additional distinguishing features, compared to prior research. First, we examine long-run impacts, up to two decades after the initial shock. Dinkelman and Mariotti (2016) and Dinkelman et al. (2020) also estimate long-run effects. Their work differs in studying long-run impacts of a brief historical episode of migrant work that did not persist. We study a shock to migrant income with long-run persistence, and a migrant flow that also persists. This allows us to examine how resulting investments in education initiate a virtuous migration cycle, by enabling high-skilled future migration, with corresponding future increases in migrant income.

In addition, our work is distinct in simultaneously examining impacts on migrant, domestic, and global income, due to our novel data on migrant income. We can therefore examine the relative magnitudes of impacts on domestic income and migrant income, and thus conclude that the vast majority of long-run gains are from increases in domestic income. Finally, we complement our reduced-form estimates with a structural approach to provide insights on mechanisms and the long-run magnification of income gains.

Our findings are reminiscent of the recent literature finding positive long-run impacts of asset transfers to catalyze income gains from household entrepreneurial enterprises (de Mel et al., 2008; Banerjee et al., 2015; Bandiera et al., 2017; Banerjee et al., 2021), and providing evidence of poverty traps (Balboni et al., 2021; Kaboski et al., 2022). The migrant income shocks we study could have long-run impacts, in part, by enabling escapes from poverty traps. Our findings that a substantial share of gains in domestic income come from household enterprises are consistent with the findings of this literature.

This paper also contributes to research on the impacts of migration on skill composition at origin. Our conclusions concord with prior findings that migration leads to “brain gain,” stimulating educational investments, and raising general skill levels back home (Stark et al., 1997; Mountford, 1997).<sup>7</sup> These findings contrast with studies finding that migration leads to a net loss of skilled indi-

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<sup>7</sup>Such studies include Batista et al. (2012), Docquier and Rapoport (2012), Clemens and Tiongson (2017), Shrestha (2017), Theoharides (2018), Chand and Clemens (2019), Khanna and Morales (2019), and Abarcar and Theoharides (2022).

viduals from the population (“brain drain”), in part via reductions in schooling investments (McKenzie and Rapoport, 2011; de Brauw and Giles, 2017; Tang et al., 2022).<sup>8</sup> We add to this literature by finding that increases in education may create a virtuous cycle, leading to higher-skilled future migration.

## 2 Context: International Labor Migration

210 million individuals from developing countries were international migrants in 2019. The largest source countries of international labor migrants are India, Mexico, and China; Bangladesh, Pakistan, the Philippines, and Indonesia also send substantial numbers abroad (United Nations, 2019a). Moving from a developing to developed country for work is associated with substantial income gains for migrants (Clemens et al., 2019). Gibson et al. (2018), Mobarak et al. (2018), and Gaikwad et al. (2022) find that random assignment to international migrant work opportunities leads to improved migrant income, and better outcomes for migrants and their origin households.<sup>9</sup> Income gains from increased international migration flows are orders of magnitude larger than the likely impacts of further liberalization of international trade or capital flows, or of *in situ* efforts to raise incomes in the domestic economy of developing countries (Clemens, 2011; Pritchett and Hani, 2020).

Motivated by these gains, most developing country governments facilitate their citizens’ international labor migration. We tabulate data on government policies on outbound international migration (United Nations, 2019b) in Appendix Table A1. Out of the 70 developing countries with populations exceeding 1 million, 94% have a dedicated government agency implementing migration policy; 88% have a dedicated government agency for overseas employment, citizens abroad, or diaspora engagement; and 78% have policies promoting remittances.

In the Philippines, two government agencies facilitate international labor migration. The Philippine Overseas Employment Administration (POEA) regulates international migrant recruitment, issuing operating licenses to recruitment agencies and reviewing and approving migrant work contracts. The Overseas Workers Welfare Administration (OWWA) works to ensure the well-being of overseas

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<sup>8</sup>Evidence on reductions in education investment due to factory openings in Mexico (Atkin, 2016) is also relevant.

<sup>9</sup>Moreover, many prior studies have established positive correlations between international migration and economic development outcomes in origin areas (e.g., Lopez-Cordoba (2005), Acosta et al. (2008), Orrenius et al. (2010)).

Table 1: 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, $\Delta R_d$ ) | 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  $\omega_{do}$ , across 74 Philippine provinces  $o$  ("shares" of the shift-share variable). See Subsection 3.2 and Section 5 for details on exposure weight definition. Columns 5 and 6 present exchange rate changes. Column 5 displays exchange rate shock  $\Delta R_d$  ("shift" of the shift-share variable). Exchange rate shock is change in Philippine pesos (PhP) per local currency unit. Exchange Rate Shock (1997-1998,  $\Delta R_d$ ) is fractional change between July 1996-July 1997 and October 1997- September 1998 (e.g., 10% appreciation 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.

Filipino workers (OFWs) and their families. It intercedes (via Philippine consulates worldwide) for workers experiencing abuse or contract violations, repatriates workers in conflict zones, assists OFW families in hardship, and facilitates the return and "reintegration" of OFWs to the Philippines. POEA and OWWA are the sources of the migrant contract data we use in our analyses (see Section 4).

In recent decades, increasing shares of the Philippine population have migrated, had a household member migrate, or had overseas income (Appendix Table A2). From 1990 to 2015, the fraction of the population currently overseas rose from 0.7% to 2.2%, and the fraction of households with an overseas migrant member rose from 3.2% to 7.5%. The share of households with overseas income

rose from 16.6% in 1991 to 29.7% in 2018.<sup>10</sup>

Migrant income in the Philippines comes from numerous overseas destinations, and migrant destinations also vary substantially across origin provinces. Table 1 shows the top 20 migrant destinations, ranked by mean “exposure weight” across provinces (1995 migrant income per capita, for province/destination dyads). For each destination, there is substantial variation in the exposure weight across provinces; our empirical approach exploits this variation in exposure weights.

### 3 Theory

How would we expect a shock to exchange rates faced by Philippine international migrant workers to affect long-run incomes in migrant origin areas? 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. After presenting empirical estimates, we return to the model in Section 7, where we endogenize skill investments, and allow for skill-dependent migration and income, to further deepen our understanding of mechanisms and magnitudes.

#### 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,  $\epsilon_{dot}$  is any unobservable factor that makes migrants from origin  $o$  more productive in destination  $d$ . Overseas wages  $w_{dst}$  and unobservable component  $\epsilon_{dot}$  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 destina-

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<sup>10</sup>Overseas income sources are primarily migrant remittances, but also include pensions, income from overseas investments, and other sources.

tion choice is:

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

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  $\theta$ , as in Eaton and Kortum (2002).<sup>11</sup> This parameter determines the dispersion of preferences across locations. Let  $\pi_{dost}$  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:<sup>12</sup>

$$\pi_{dost} = \frac{(w_{dst}R_{dt}(1 - \tau_{dot})\epsilon_{dot})^\theta}{\sum_k (w_{kst}R_{kt}(1 - \tau_{kot})\epsilon_{kot})^\theta} \quad (2)$$

Intuitively, the share of individuals of skill  $s$  migrating from origin  $o$  to destination  $d$  is increasing in the destination wages in Philippine pesos,  $w_{dst}R_{dt}$ . The logarithm of the above expression gives us the standard gravity equation.

### 3.2 Shift-Share Variable

We study outcomes of 74 Philippine provinces, such as mean household expenditure per capita. Our independent variable of interest is, correspondingly, also expressed on a per capita basis: provincial migrant income per capita. To obtain causal estimates, we exploit the component of changes in provincial migrant income per capita that is due to the 1997 Asian Financial Crisis exchange rate shocks. We define here the shift-share variable that isolates this exogenous variation in provincial migrant income per capita.

Anticipating our eventual interest in educational investments, we assume there are two skill groups in the population: high-skilled  $h$  and unskilled  $u$  ( $s = \{h, u\}$ ).<sup>13</sup> At baseline ( $t = 0$ ), the share of high-skilled and unskilled workers in province  $o$  are denoted, respectively,  $\ell_{oh0}$  and  $\ell_{ou0}$ , with  $\ell_{ou0} = 1 - \ell_{oh0}$ . Province-level income per capita depends on the distribution of worker locations and skill levels:

<sup>11</sup>Here,  $\theta$  is a elasticity of migration with respect to the destination wage. In the standard formulation:  $F(q_1, \dots, q_D) = \exp\left\{-\left[\sum_{d=1}^D q_d^{-\theta}\right]\right\}$ .

<sup>12</sup>The full derivation can be found in Supplementary Appendix S1.

<sup>13</sup>We micro-found the education decisions in Supplementary Appendix S2.

$$Y_{ot} = \sum_{s=h,u} \left[ \ell_{ost} \sum_d (\pi_{dost} w_{dost} R_{dt}) \right] \quad (3)$$

We refer to  $Y_{ot}$  as “global income” per capita because it includes income from both domestic (Philippine) and international migrant sources. In empirical analyses we examine global income as well as its domestic and migrant components.

Our shift-share variable isolates exogenous variation in only the migrant income portion of  $Y_{ot}$ , due to the 1997 Asian Financial Crisis exchange rate shocks. Let  $\tilde{\Delta}$  refer to a short-run change.  $\tilde{\Delta}R_d$  is the short-run change in the exchange rate in destination  $d$ .<sup>14</sup>

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.<sup>15</sup> Define this short-run income change as the shift-share variable  $Z_o$ :

$$\tilde{\Delta}Y_o = \sum_{s=h,u} \left[ \ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \tilde{\Delta}R_d) \right] \equiv Z_o \quad (4)$$

This shift-share variable is the causal variable of interest in all our regression analyses.  $Z_o$  is the predicted short-run change in migrant income per capita due to the exchange rate shocks.

For clean identification, we use population, migration and migrant income measures from the pre-shock period ( $t = 0$ ). In the pre-shock period, let total population in an origin be  $Pop_{o0}$ , and the number of workers by skill be  $L_{os0}$ .<sup>16</sup> 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  $o$ .

We now define a key variable, the “exposure weight”  $\omega_{do0}$ , which serves as the “share” in the shift-share.  $\omega_{do0}$  captures the extent to which a typical province- $o$  resident is exposed to a destination- $d$  exchange rate shock. We define this as province  $o$ ’s pre-shock aggregate migrant income from destination  $d$  (summed

<sup>14</sup>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. We discuss this further in Subsection 5.2.1.

<sup>15</sup>The origin as a destination drops out as there are no exchange rate changes for the origin.

<sup>16</sup>Population and worker counts include migrants working outside the Philippines.

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 (4):

$$Z_o = \sum_{s=h,u} \sum_d \frac{L_{os0}}{Pop_{o0}} \frac{L_{dos0}}{L_{os0}} w_{dos0} \tilde{\Delta}R_d = \sum_d (\omega_{do0} \tilde{\Delta}R_d) \quad (5)$$

In shift-share nomenclature, the “shifts” are the destination- $d$  exchange rate shocks  $\tilde{\Delta}R_d$ , while the “shares” are the  $\omega_{do0}$  terms. Exchange rate shocks  $\tilde{\Delta}R_d$  affect a province- $o$  resident in proportion to the magnitude of migrant income per capita coming from destination  $d$  prior to the crisis; we thus refer to the  $\omega_{do0}$  terms as “exposure weights”.<sup>17</sup>

To calculate province  $o$ ’s shift-share measure  $Z_o$ , each destination- $d$  exchange rate shock  $\tilde{\Delta}R_d$  is multiplied by the corresponding exposure weight  $\omega_{do0}$ , and then summed across destinations  $d$ .  $Z_o$  is thus interpreted as the predicted change in province- $o$  migrant income per capita due to the exchange rate shocks.

Now, multiply and divide  $Z_o$  by the pre-shock sum of migrant income across destinations ( $\sum_d \omega_{do0}$ , the sum of exposure weights). This yields the following expression, providing a complementary interpretation of our shift-share variable:

$$Z_o = \underbrace{\sum_d \omega_{do0}}_{MigInc_{o0}} \times \underbrace{\frac{\sum_d (\omega_{do0} \tilde{\Delta}R_d)}{\sum_d \omega_{do0}}}_{Rshock_o} \quad (6)$$

$Z_o$  is the product of two terms.  $MigInc_{o0}$  is pre-shock migrant income per capita in origin province  $o$ , across all migrant destinations. Provinces with higher  $MigInc_{o0}$  have more migrant income per capita facing exchange rate risk (greater aggregate exposure to exchange rate shocks).  $Rshock_o$  is the province- $o$  weighted average exchange rate shock, where the weights are pre-shock shares of migrant income from each destination  $d$ . In Section 5 below, we emphasize that we derive causal identification solely from  $Z_o$ , not the component factors  $MigInc_{o0}$  and  $Rshock_o$ .

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<sup>17</sup>Borusyak et al. (2022) call these terms “exposure shares”, but we say “exposure weights” since they are not shares in our application. Because the sum of our  $\omega_{do0}$  across destinations (within origins) is not one, we are in the “incomplete shares” case.

## 4 Data

We summarize data sources here, providing details in Appendix A. We examine outcomes of 74 Philippine provinces,<sup>18</sup> over time periods dictated by data availability (typically triennial periods or periods determined by census rounds).

### 4.1 Construction of Shift-Share Variable

To construct the shift-share variable  $Z_o$  (equation (5)), we need exposure weights  $\omega_{do0}$ , destination- $d$  pre-shock migrant income per capita of province  $o$ . The challenge is that these data are not reported in any Philippine Censuses or surveys.

We are able to estimate exposure weights  $\omega_{do0}$  using two datasets from Philippine government agencies OWWA and POEA (see Section 2). The OWWA dataset contains the Philippine home address of individuals departing on overseas work contracts. The POEA dataset provides data on migrant income and occupation. Both the OWWA and POEA data include name, date of birth, destination, and gender. We match the two datasets to determine province of origin for migrants in the POEA database, and can then estimate  $\omega_{do0}$ .

We combine estimates of  $\omega_{do0}$  with exchange rate data from Bloomberg LP and population data from the Philippine Census to construct  $Z_o$ . As discussed in Subsection 5.2.1, our shift-share variable uses only the immediate, short-run change in exchange rates. We calculate the short-run exchange rate change,  $\tilde{\Delta}R_d$ , as the proportional change in the average exchange rate (foreign currency per PhP) from immediately before (mean from Jul 1996 - Jun 1997) to immediately after (mean from Sep 1997 - Oct 1998) the shock (e.g., a 10% appreciation is 0.1).

### 4.2 Outcome Data

Primary outcomes are provincial mean household income and expenditure per capita. These outcomes are available from the Family Income and Expenditure Survey (FIES), conducted every three years by the Philippine Statistics Authority (PSA). In each triennial round, the FIES samples roughly 40,000 households nationwide. We use up to twelve rounds of the FIES from 1985 to 2018 (inclusive), covering up to four pre-shock observations (prior to 1997), the “partially-treated”

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<sup>18</sup>To deal with changes in provincial definitions and borders, we combine geographic areas and work with a consistent definition of 74 provinces with borders as they were defined in 1990.

1997 observation, and up to seven post-shock observations for each province. Income and expenditure outcomes are in 2010 real Philippine pesos (17.8 PhP/US\$ PPP).

Other important outcomes include migrant income, domestic income, and (their sum) global income per capita. We must analyze these outcomes at the same triennial frequency as the FIES, the data source for domestic income. The POEA/OWWA contract data are available for fewer years, and also have missing data on migrant origin address in the early-to-mid 2000s (details in Appendix A), preventing us from calculating migrant income in 2000, 2003, and 2006. It is also not available after 2016. Analyses of migrant, domestic, and global income therefore involve fewer triennial periods: 1994, 1997, 2009, 2012, and 2015.

Regression analyses exclude the partially-treated year 1997, but we include 1997 in event-study analyses.

Also in triennial periods, we examine secondary outcomes such as new migrant contracts as share of province population (by occupational skill), and domestic income subcomponents (wage, entrepreneurial, other).

We also examine impacts on provincial educational attainment from six rounds of the Philippine Census of Population (1990, 1995, 2000, 2007, 2010, and 2015).

## 5 Empirical Approach

We discuss the regression equation, causal identification, and temporal persistence of the shock measured our shift-share variable.

### 5.1 Regression Equation

We estimate causal effects using the shift-share approach of Borusyak et al. (2022). Our regression equation is:

$$y_{ot} = \alpha_o + \gamma_t + \beta_1(Z_o \times Post_t) + \beta_2(MigInc_{o0} \times \gamma_t) + \beta_3(Rshock_o \times Post_t) + \delta'(\mathbf{X}_{o0} \times Post_t) + \varepsilon_{ot}, \quad (7)$$

$y_{ot}$  is an outcome of interest for province  $o$  in period  $t$ .  $Z_o$  is the shift-share variable, which is interacted with  $Post_t$ , an indicator for periods after 1997 (data from the shock year, 1997, is omitted from regression analyses). This term's coefficient

$\beta_1$  is the coefficient of interest. Causal interpretation of  $\beta_1$  exploits changes in migrant income per capita driven by the 1997 exchange rate shocks, as discussed in Subsection 5.2.1 below.

$\alpha_o$  are province fixed effects, and  $\gamma_t$  are period fixed effects, accounting for time-invariant province characteristics and common time effects.  $\varepsilon_{ot}$  is a mean-zero error term.

$MigInc_{o0}$  is pre-shock migrant income per capita in the province. It is interacted with period fixed effects.<sup>19</sup>  $Rshock_o$  is the province- $o$  income-weighted exchange rate shock; it is interacted with the indicator for the post-period.

Inclusion in the regression of  $MigInc_{o0} \times \gamma_t$  and  $Rshock_o \times Post_t$  accounts for changes from before to after the shock related to  $MigInc_{o0}$  and  $Rshock_o$ . Identification of  $\beta_1$  therefore derives solely from the interaction between  $MigInc_{o0}$  and  $Rshock_o$  embodied in  $Z_o \times Post_t$ . We discuss this further in Subsection 5.2.2.

$\mathbf{X}_{o0} \times Post_t$  is a vector of pre-shock destination characteristics and province-level characteristics interacted with the post-shock dummy. We discuss these further in Subsection 5.2.1.

Following Borusyak et al. (2022), we do not impose the typical assumption of i.i.d. data. Destination- $d$  shocks are what are taken as random variables, and these shocks are common to provinces with similar exposure weights  $\omega_{do}$ . Borusyak et al. (2022) and Adao et al. (2019) demonstrate that conventional standard errors in shift-share designs are likely to be too small because observations with similar shock exposure will have correlated residuals. We report “exposure-robust” standard errors based on estimation of shock-level regressions using the Borusyak et al. (2022) method.<sup>20</sup>

## 5.2 Causal Identification

We discuss assumptions required for causal identification, and empirical evidence supporting these assumptions.

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<sup>19</sup>Following Borusyak et al. (2022), it is essential to interact this sum of exposure weights (which they call “sum of exposure shares”) with period indicators in shift-share designs with incomplete shares and panel data. Time period fixed effects ( $\gamma_t$ ) alone will not isolate variation in the shock within periods.  $MigInc_{o0} \times \gamma_t$  accounts for any time-period effects that vary according to  $MigInc_{o0}$ . Note that  $MigInc_{o0} \times \gamma_t$  absorbs  $MigInc_{o0} \times Post_t$ , obviating the need for the latter term.

<sup>20</sup>Adao et al. (2019) is not implementable when there are more shocks than observations, as in our context.

### 5.2.1 Exogeneity of Exchange Rate Shocks

In the Borusyak et al. (2022) shift-share approach, causal identification is based on exogeneity of the shifts (shocks), rather than on exogeneity of the shares. Our shifts are destination- $d$  exchange rate shocks,  $\tilde{\Delta}R_d$ . The shares are province- $o$  “exposure weights”,  $\omega_{do0}$ , for each destination.

Our identification assumption is therefore that the exchange rate shocks  $\tilde{\Delta}R_d$  are as good as randomly assigned (conditional on destination- $d$ -level controls). The exposure weights (shares)  $\omega_{do0}$  can actually be endogenous.<sup>21</sup>

Define the destination- $d$  exchange rate shock immediately after the crisis as  $\tilde{\Delta}R_d = \frac{R_{d,1998} - R_{d,1996}}{R_{d,1996}}$ .  $R_{d,1996}$  is the destination- $d$  exchange rate (nominal Philippine pesos per destination- $d$  currency unit) in the pre-period (twelve months leading up to June 1997), while  $R_{d,1998}$  is the destination- $d$  exchange rate in the immediate post-Crisis period (twelve months through October 1998). The exchange rate shock is thus a fractional change (e.g., a 10% appreciation is 0.1).

All components of the shift-share variable (equation (5)) are from the pre-shock period, except for the post-shock exchange rate  $R_{d,1998}$ . Identification derives from the change in the destination- $d$  exchange rate relative to its pre-shock level,  $R_{d,1996}$ .

It is plausible *a priori* that the exchange rate shocks are exogenous. The Asian Financial Crisis was unanticipated by global economic policy-makers and governments (Radelet and Sachs, 1998), so our causal estimates are unlikely to be clouded by anticipation of the shocks by households, firms, or officials in Philippine provinces.

Our shift-share variable exploits the fact that the Asian Financial Crisis was a surprise, using only the short-run (1997-1998) change in exchange rates immediately post-Crisis. We do not exploit further (post-1998) changes in exchange rates for identification. The short-run Crisis-induced exchange rate shocks are most plausibly exogenous. In the longer run, by contrast, the evolution of exchange rates may be endogenous to destination-country economic policies.

As it turns out, there is strong persistence of the short-run (1997-1998) exchange rate shocks over our entire two-decade study period. Destination- $d$  1997-1998 exchange rate shocks have strong predictive power for the long-run exchange rate up to 2018. We show this empirically in Subsection 5.4 below. By focusing on

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<sup>21</sup>In the Goldsmith-Pinkham et al. (2020) approach, the shares must be considered exogenous.

a shift-share variable defined with only the short-run 1997-1998 shocks, we estimate a reduced-form effect that includes any long-run exchange rate movements that are correlated with the short-run 1997-1998 exchange rate shocks, but that are not endogenous to subsequent destination-level economic policies.

We also provide statistical evidence for exogeneity of the exchange rate shocks. We run regressions at the level of all 104 migrant destinations. The dependent variable is the exchange rate shock,  $\tilde{\Delta}R_d$ , and the independent variables are pre-shock destination characteristics.<sup>22</sup>

The destination- $d$  characteristics we examine as independent variables are all pre-shock (1995). GDP per capita accounts for destination development status. Other independent variables are aspects of the destination's Philippine migrant flow. We account for the skill level of migrants going to particular destinations by, first, examining mean annual income per Philippine migrant in the destination. Second, we examine the share of Philippine migrants to the destination working in professional occupations (the highest-skilled occupation group), and separately the share of Philippine migrants to the destination working in manufacturing occupations (the intermediate-skilled group). (We omit the lowest-skilled occupation group, services.) In addition, we examine the share of all Philippine migrants going to the destination; this accounts for differences related to the aggregate size of the country as a migration destination. We also test the predictability of the exchange rate shocks with a sixth independent variable, the pre-shock (1994-1996) change in the exchange rate.<sup>23</sup> In a final regression we include all six independent variables.

Regression results in Appendix Table A3 show no statistically significant relationships between pre-shock destination characteristics and the exchange rate shocks  $\tilde{\Delta}R_d$ . We reject joint significance of the right-hand-side variables in Column 7. These results provide support for the assumption that destination- $d$  exchange rate shock can be considered as-good-as-randomly assigned.

While  $\tilde{\Delta}R_d$  is balanced vis-a-vis these destination-level variables, inclusion of these controls can improve precision of estimates by absorbing residual variation. We therefore include these destination-level variables (interacted with the post-

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<sup>22</sup>Following Borusyak et al. (2022), observations in these regressions are weighted by the destination's average exposure weight  $\omega_{d00}$  across provinces.

<sup>23</sup>Table 1 shows the change in the exchange rate in the pre-crisis period (1994-1996) alongside the change in the post-crisis period (1997-1998) for the top 20 destinations.

shock-period indicator) in the vector of controls  $\mathbf{X}_{o0}$  in equation (7) (aggregated to the province level using exposure weights  $\omega_{do0}$ , following Borusyak et al. (2022)).

### 5.2.2 Exogeneity of Shift-Share Variable

Exogeneity of the exchange rate shocks should lead to exogeneity of our shift-share variable,  $Z_o$ . As equation (6) shows,  $Z_o$  can be written as the product of two terms.  $MigInc_{o0}$  is migrant income per capita in province  $o$  in the pre-shock period.  $Rshock_o$  is the province- $o$  weighted average exchange rate shock. Table 2 shows  $MigInc_{o0}$  has mean PhP 4,044 (standard deviation 2,984), while  $Rshock_o$ 's mean is 0.415 (standard deviation 0.040).

We take only  $Z_o$  to be exogenous, not its component factors  $MigInc_{o0}$  and  $Rshock_o$ . In regression equation (7), we achieve this by interacting  $MigInc_{o0}$  and  $Rshock_o$  with fixed effects for the post-shock period, so that identification comes only from  $Z_o$  (times  $Post_t$ ).

It is important to *not* exploit variation in  $MigInc_{o0}$  by itself for identification. The worry is that provinces with different levels of  $MigInc_{o0}$  may differ on a host of other dimensions, and thus may be on different time trends from the pre- to post-shock period.<sup>24</sup>

The concern with exploiting variation in  $MigInc_{o0}$  for identification becomes apparent when examining its correlation with pre-shock province covariates. We regress provincial development measures (share of households rural, asset index, total income per capita, and expenditure per capita) on  $MigInc_{o0}$ . We construct development measure variables from pre-shock data, the 1990 Census and the 1991-1994 FIES. There are 74 provincial observations in the regression. Results are in Appendix Table A4, Panel A. Provinces with higher  $MigInc_{o0}$  are more developed along these pre-shock dimensions. They have lower rural share, and higher asset indices, total income per capita, and expenditure per capita.

There are also concerns with identifying off variation in  $Rshock_o$ . One might worry that provinces tending to earn migrant income in destinations that received better shocks may have different unobservables. Provincial characteristics may be correlated with the propensity of a province's migrants to be in destinations with

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<sup>24</sup>In the Borusyak et al. (2022) framework, the fact that  $MigInc_{o0}$  varies across provinces makes ours an "incomplete shares" setting. We do not take the shares as exogenous. Controlling for time trends associated with  $MigInc_{o0}$  (the "sum of exposure shares") is therefore necessary. In our panel regression, this involves controlling for  $MigInc_{o0}$  interacted with period indicators.

Table 2: Summary Statistics

|  | Mean    | SD      | 10th P. | 25th P. | Median  | 75th P. | 90th P. | Obs. |
|--|---------|---------|---------|---------|---------|---------|---------|------|
| <b>Shock Variables</b>   |         |         |         |         |         |         |         |      |
| Residualized $R_o$   | 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   |
| <b>Expenditure and Income</b>  |         |         |         |         |         |         |         |      |
| Expenditure per Capita   | 29.167  | 10.680  | 18.328  | 21.935  | 26.945  | 33.638  | 42.645  | 887  |
| Total Income per Capita  | 35.867  | 13.764  | 21.609  | 26.272  | 32.833  | 42.120  | 55.269  | 887  |
| Global Income per Capita   | 38.178  | 13.061  | 24.145  | 28.712  | 35.565  | 44.564  | 56.989  | 296  |
| Domestic Income per Capita   | 33.572  | 11.218  | 21.618  | 25.729  | 31.450  | 38.235  | 48.372  | 296  |
| Migrant Income per Capita  | 4.606   | 2.924   | 1.537   | 2.310   | 3.746   | 6.608   | 8.812   | 296  |
| <b>Education and Migration</b>   |         |         |         |         |         |         |         |      |
| 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  |
| <b>New Migrant Contracts<br/>(per 10,000 working age people)</b>                 |         |         |         |         |         |         |         |      |
| Total  | 57.000  | 36.916  | 13.564  | 31.513  | 49.362  | 79.982  | 105.594 | 296  |
| Professional Occupations   | 6.636   | 5.952   | 1.762   | 2.965   | 5.244   | 8.659   | 12.459  | 296  |
| Production Occupations   | 17.787  | 15.290  | 3.259   | 6.776   | 13.299  | 25.218  | 36.179  | 296  |
| Service Occupations  | 29.793  | 24.687  | 5.762   | 14.107  | 24.819  | 39.143  | 59.634  | 296  |
| <b>Baseline Province Controls</b>  |         |         |         |         |         |         |         |      |
| Baseline Share Rural   | 0.643   | 0.193   | 0.337   | 0.564   | 0.696   | 0.761   | 0.819   | 74   |
| Baseline Asset Index   | -0.636  | 1.023   | -1.576  | -1.321  | -0.966  | -0.169  | 1.069   | 74   |
| Baseline Total Income per Capita   | 29.903  | 10.584  | 20.589  | 23.321  | 28.102  | 32.457  | 45.322  | 74   |
| Baseline Expenditure per Capita  | 24.371  | 8.106   | 16.283  | 20.144  | 22.714  | 26.203  | 35.020  | 74   |
| <b>Baseline Destination Controls<br/>(weighted by 1995 Migrant Income Share)</b> |         |         |         |         |         |         |         |      |
| 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 panel. For bottom panel, 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. Expenditure, total income, 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 and total income 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 (periods are 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. New 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. Per capita GDP is from the World Development Indicators, in thousands of 1995 USD. Destination level contract controls are calculated from POEA/OWWA dataset.

better exchange rate shocks (higher  $Rshock_o$ ).

In Appendix Table A4, Panel B, we examine the correlation of  $Rshock_o$  with pre-shock province covariates. Provinces with higher  $Rshock_o$  appear less developed along a number of pre-shock dimensions: they have higher share of households in rural areas, and lower asset indices, total income per capita, and expenditure per capita. These patterns raise concerns that ongoing trends in development outcomes may be correlated with  $Rshock_o$ . Therefore we do not identify causal effects off variation in  $Rshock_o$ .

By contrast, the shift-share variable  $Z_o$  is uncorrelated with pre-shock province characteristics, once  $MigInc_{o0}$  and  $Rshock_o$  are controlled for. This is apparent in Appendix Table A4, Panel C. There is no statistically significant relationship between  $Z_o$  and pre-shock measures of provincial development. These results bolster confidence in the exogeneity of  $Z_o$  (after conditioning on  $MigInc_{o0}$  and  $Rshock_o$ ).

Because we only consider  $Z_o$  exogenous when conditioning on  $MigInc_{o0}$  and  $Rshock_o$ , we report in Table 2 the residualized  $Z_o$  after partialling-out  $MigInc_{o0}$  and  $Rshock_o$ . It has a mean of 0 and a standard deviation of 0.093. We will use this standard deviation of 0.093 in all discussions of magnitudes of effects below.

Figure 1 displays the spatial distribution of residualized  $Z_o$  across provinces. The shock appears to be evenly distributed across the Philippines. All regions contain provinces with a range of shock values.

The pre-shock province-level characteristics examined in Appendix Table A4 are also included in the control vector  $\mathbf{X}_{o0}$  of regression equation (7). These controls capture changes over time that may be related to provincial pre-shock development. Inclusion of these controls can help improve precision by absorbing residual variation.

### 5.2.3 Parallel Trend Tests

Related tests of the exogeneity of  $Z_o$  involve examining whether changes in key outcome variables in the pre-shock period are correlated with it. This is analogous to tests of parallel trends in difference-in-difference approaches. We examine trends in the pre-period by running event-study specifications building on regression equation (7), as well as “false” or placebo regressions in the pre-period. We present these in Subsection 6.1. We find no evidence of violations of parallel

trends in the pre-shock period.

### 5.3 Additional Threats to Identification

We account for additional potential threats to identification. We rule out the possibility that the causal effects of the shift-share variable operate via changes in trade or FDI. We present these analyses in Subsection 6.3 below, and find no evidence that trade or FDI are important mechanisms through which our shift-share variable operates.

We also address the possibility of confounding changes in population composition (since we have a panel of provinces, not of individuals). We examine the relationship between  $Z_o$  and internal migration rates. Results are in Appendix Section B.1 and Appendix Table A5. We find no large or statistically significant relationship impact on net internal migration. There is a small negative effect on outmigration, driven by young adults (aged 16-24). This small effect, isolated among young adults, cannot account for the impacts we document in our analyses. Changes in population composition due to internal migration appear not to be a major concern.

### 5.4 Persistence of Shock

We seek to reveal the impact of changes in migrant income on longer-run provincial development outcomes, exploiting an exogenous shock measured by our shift-share variable  $Z_o$ . A key question relevant for interpreting our results is whether the shock to migrant income is transitory or persistent.

We examine whether the shift-share variable's components – in equation (5), the exchange rate shock  $\tilde{\Delta}R_d$  (the “shifts”) and migrant income from particular destinations to particular migrant origin provinces  $\omega_{do0}$  (our exposure weights, or “shares”) – show persistence over time, up to two decades after 1997. If both these components of the shift-share variable show persistence in the long run, the shock to migrant income would also be persistent.

We first examine temporal persistence of the the exchange rate shocks. Appendix Figure A1 shows nominal exchange rates (units of foreign currency per PhP, normalized to 1 in 1996) for selected major sources of Philippine provinces' international migrant income. The Asian Financial Crisis is denoted by the ver-

tical line in 1997. The 1997 exchange rate shock appears highly persistent. The substantial changes in exchange rates post-1997 show no apparent reversion to pre-shock levels.

Regression analyses confirm this conclusion. 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,  $\tilde{\Delta}R_d$ .<sup>25</sup> We present coefficient estimates on  $\tilde{\Delta}R_d$  from seven different regressions, for different post-shock time periods, in Appendix Figure A2a. Higher (more positive) coefficients would 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.

Next, we analyze persistence of the exposure weights  $\omega_{dot}$ , 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  $t$  ( $\omega_{dot}$ ) on dyadic migrant income per capita in 1995 ( $\omega_{do0}$ ), the pre-shock year in our shift-share variable. There is partial but substantial persistence over time in dyadic migrant income. Appendix Figure A2b presents coefficients on  $\omega_{do0}$  in the three regressions (for 2009, 2012, and 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).

In our theoretical framework, persistence in exposure weights  $\omega_{dot}$  can stem from persistent dyad-specific migration costs,  $\tau_{dot}$ , in equation (2). While migrants adjust their post-1997 migration destinations in response to exchange rate changes, adjustment is only partial, due to persistence in migration costs  $\tau_{dot}$ . Persistence of dyadic migration costs may be due to networks facilitating migration (Munshi (2003), Kleemans and Magruder (2019), Mahajan and Yang (2020)), and (relatedly) information frictions in the international labor market (Shrestha and

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<sup>25</sup>Observations are weighted by 1995 migrant income to that destination, following Borusyak et al. (2022) for any destination-level regressions.

Yang (2019), Shrestha (2020), Fernando and Singh (2021), Bazzi et al. (2021)).

In sum, destination-level exchange rate shocks and dyadic migrant income per capita are both highly persistent over two decades. The long-run impacts that we find therefore should be interpreted as resulting from an exogenous short-run shock to migrant income (measured by the shift-share variable  $Z_o$ ) that turns out to exhibit substantial persistence over time.

## 6 Empirical Results

We estimate impacts of the shift-share shock ( $\beta_1$  in Equation (7)) on a range of primary and secondary outcomes.

### 6.1 Total Income and Expenditure

We first examine impacts on key primary outcomes: province-level means of annual total income and expenditure per capita. These outcomes are from the FIES, and we use Philippine Statistical Agency’s (PSA) standard definitions. Microdata are not available for the 1985 and 1988 FIES, so for those years we obtain these outcomes from the PSA’s provincial FIES tabulations. Focusing on the PSA’s definition of these outcomes thus allows us to maximize the pre-shock period we can examine for tests of parallel trends in the pre-period. (In the next subsection, we also use a modified definition of household income constructed from microdata for 1991 onwards.)

The PSA’s definition of “total income” includes income from wages and entrepreneurial activity; income from other sources, such as dividends, interest, and the imputed rental value of owned housing; transfers from domestic sources; and income from international sources. Income from international sources includes migrant remittances, but also includes pensions, retirement, workmen’s compensation, and other benefits; cash gifts, support, relief, etc. from abroad; and dividends from investments abroad. Migrant remittances are not explicitly reported in the data.<sup>26</sup> Note that this income definition does *not* include international mi-

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<sup>26</sup>There are concerns that migrant remittances are considerably under-reported in the FIES, because of the rise in electronic banking. Particularly since 2000, international migrants have been increasingly depositing their earnings directly into origin-household bank accounts. Comparison of remittance data from the World Bank, Philippine Central Bank, and the FIES suggests that households responding to the FIES may not report funds deposited electronically into their bank accounts from overseas as remittances (Ducanes, 2010). “Total income” measured by the FIES is thus likely to understate international income sources, leading estimated treatment effects on this outcome to be lower bounds.

grant income, which is not recorded in the survey. We calculate international migrant income using the migrant contract data and examine it in the next subsection.

For expenditure per capita, we use PSA's definition of "family expenditures": expenses or disbursements made by the family purely for personal consumption. This covers numerous consumption categories, such as food, clothing, education, transport, communications, health, and utilities; consumption from own production; and money payments made during the annual reference period for durable goods, furniture, and household repairs and maintenance (rather than the "flow value" of durable consumption).

The data are a panel of provinces observed every three years. There are four pre-shock observations (1985, 1988, 1991, and 1994) and seven post-shock observations (2000, 2003, 2006, 2009, 2012, 2015, and 2018) for each province. The 1997 observation is excluded because it is partially treated (the Asian Financial Crisis occurred in July 1997).

Results are in Table 3, columns 1-2. Each cell displays the coefficient  $\beta_1$  on  $Z_o \times Post_t$ . We present estimates from regressions with destination controls only (Panel A), and both destination and province controls (Panel B). (All our regression results tables will follow this structure.)

The shock has positive and statistically significant effects on both total income and expenditure per capita. Coefficient estimates are stable across Panels A and B. The coefficient in the regressions for total income (column 1) declines slightly in magnitude between Panels A and B, but remains statistically significantly different from zero at the 10% level in Panel B. The coefficient in the expenditure regressions (column 2) is very stable across the panels, and in Panel B is statistically significantly different from zero at the 1% level.

The effects are large in magnitude. A one-standard-deviation shock (0.09) increases total income per capita by PhP1,226, and expenditure per capita by PhP1,011 (respectively, 0.089 and 0.095 standard deviations).

We also present event study diagrams illustrating dynamics of impacts, and testing for parallel trends in the pre-period. We estimate a modified Equation (7) in which we include the partially-treated year 1997 in the sample, and interact  $Z_o$  with indicators for each time period. The 1994 interaction term is omitted as the reference point. We plot point estimates and 95% confidence intervals on  $Z_o$

Table 3: Effects of Migrant Income Shock on Income and Expenditure: Main and Placebo Regressions

|   | Main Regressions: 1985 - 2018     |                                  | Placebo Regressions: 1985-1997    |                                  |
|---|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|
|   | (1)<br>Total Income<br>Per Capita | (2)<br>Expenditure<br>Per Capita | (3)<br>Total Income<br>Per Capita | (4)<br>Expenditure<br>Per Capita |
| <i>Panel A. Destination controls only</i>         |                                   |                                  |                                   |                                  |
| $Z_o \times Post_t$                               | 15.992<br>(4.757)***              | 11.827<br>(4.122)***             | 2.920<br>(10.678)                 | 2.076<br>(6.731)                 |
| <i>Panel B. Destination and province controls</i> |                                   |                                  |                                   |                                  |
| $Z_o \times Post_t$                               | 13.632<br>(7.345)*                | 11.262<br>(3.646)***             | 4.921<br>(9.910)                  | 4.646<br>(6.768)                 |
| Obs.  | 813                               | 813                              | 369                               | 369                              |
| Dep. Var. Mean                                    | 35.713                            | 29.075                           | 31.043                            | 25.594                           |

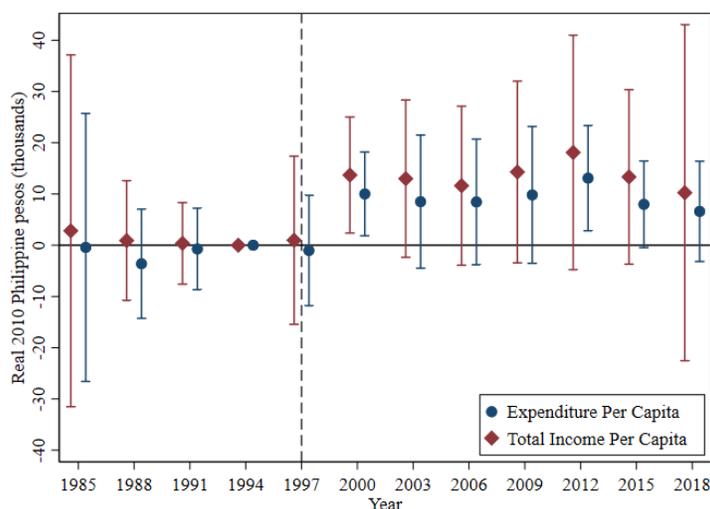
Note: Unit of observation is the province-year. Total income and expenditure per capita are from Family Income and Expenditure Survey (FIES). Income and expenditure are in thousand real 2010 Philippine pesos (17.8 PhP per PPP US\$ in 2010). In columns 1 and 2, the year 1997 is dropped from the analysis as the exchange rate shock takes place in 1997. In columns 3 and 4, the placebo post indicator is 1 for 1994 and 1997. Outcome data are not available for one province (Rizal) in 1988 due to a fire that destroyed survey records. Destination pre-shock controls are (all for 1995): GDP per capita of the destination; mean annual income per Philippine migrant in the destination; share of Philippine migrants to the destination working in professional occupations (highest-skilled general occupational category); share of Philippine migrants to the destination working in manufacturing occupations (intermediate-skilled general occupational category); the lowest skilled general occupational category, services, is the omitted category); share of all Philippine migrants going to the destination. Destination controls are aggregated to the province level using Borusyak et al. (2022) weights (province's pre-shock aggregate migrant income in the destination). Province pre-shock controls are as follows. From 1990 Census: share of households that are rural, and household asset index. Average across 1988/1991/1994 FIES: total income per capita, and expenditure per capita. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

interacted with each period indicator. Results in Figure 2 demonstrate, first of all, that there are no differential pre-trends: for both outcome variables, pre-1997 coefficients are small, statistically insignificant, and show no obvious trajectory. This provides support for the parallel-trend assumption. There is also no large or statistically significant effect in the partially-treated year 1997. The effect then becomes positive in 2000 (three years post-shock), and is stable and persistent over the next two decades.

We statistically confirm the absence of pre-trends in the pre-period with “placebo” regressions using the specification of equation (7), but for data in the pre-period (1985-1997 inclusive). We replace the indicator for the post-period,  $Post_t$ , with an indicator for a placebo post-period, 1994 and 1997. The years 1985, 1988, and 1991 are the placebo pre-period.<sup>27</sup> The coefficient on  $Z_o \times Post_t$  in this regression tests the parallel-trend assumption in the pre-shock period (whether changes over time

<sup>27</sup>We also modify the control variables in these placebo regressions so their values are from the placebo pre-period.

Figure 2: Event Studies for Total Income and Expenditure Per Capita



Note: Regressions modify Equation (7) to include interactions between  $Z_o$  and indicator variables for each pre- and post-shock year. The 1994 interaction term is omitted as reference point. Specification corresponds to that of Table 3, Panel B (including province fixed effects, year fixed effects, and controls for differential trends with respect to pre-shock province and destination characteristics). Total income per capita includes earned income from wage and entrepreneurial activities, along with income from all other sources. Expenditure per capita includes food, education, durable goods, and housing, among many other categories. Outcomes are in real 2010 PhP (PhP<sub>17.8</sub>/US\$ PPP). Observations are at the province-period level, and include each triennial period between 1985 and 2018 inclusive; unlike in Table 3, we now include partially-treated year 1997 in the sample. 95% confidence intervals also shown. Standard errors are exposure-robust, accounting for correlation of shocks across provinces via estimation of shock-level regressions (Borusyak et al., 2022).

in the pre-period are associated with a province's *future* value of the shift-share variable). Results are in columns 3 and 4 of Table 3. The coefficients on  $Z_o \times Post_t$  are all small in magnitude and none are statistically significantly different from zero. These placebo regressions confirm that there are no differential pre-trends related to the future value of the shift-share variable.

## 6.2 Global, Domestic, and Migrant Income per Capita

We now turn to examining impacts on migrant income; "Total income" in column 1 of Table 3 does not include migrant income. We also seek to understand the relative magnitudes of impacts on migrant income and domestic income.

We first define provincial "global income" as the sum of migrant income and domestic income. Migrant income is the sum of all income earned outside the Philippines by a province's international migrants. Domestic income is the sum of all income of non-migrant individuals in the province. Domestic income differs

slightly from the “total income” we examine in the previous subsection and in column 1 of Table 3: we define it to exclude income from international sources.<sup>28</sup>

We examine global, domestic, and migrant income on a per-capita basis, by dividing by provincial pre-shock population. Due to data constraints (see Section 4), we can only examine these outcomes over five triennial periods: one pre-shock period (1994), one “partially-treated” period (1997), and three post-shock periods (2009, 2012, and 2015). In regression analyses we exclude the partially-treated 1997 period, but include it in event-study analyses.

Table 4: Effects of Migrant Income Shock on Global Income and Consumption

|   | 1994, 2009, 2012, and 2015         |                                      |                                     |                                  |
|---|------------------------------------|--------------------------------------|-------------------------------------|----------------------------------|
|   | (1)<br>Global Income<br>Per Capita | (2)<br>Domestic Income<br>Per Capita | (3)<br>Migrant Income<br>Per Capita | (4)<br>Expenditure<br>Per Capita |
| <i>Panel A. Destination controls only</i>         |                                    |                                      |                                     |                                  |
| $Z_o \times \text{Post}_t$                        | 29.973<br>(5.282)***               | 25.689<br>(4.387)***                 | 4.284<br>(1.916)**                  | 18.056<br>(4.626)***             |
| <i>Panel B. Destination and province controls</i> |                                    |                                      |                                     |                                  |
| $Z_o \times \text{Post}_t$                        | 24.733<br>(7.150)***               | 19.744<br>(5.774)***                 | 4.989<br>(2.195)**                  | 13.518<br>(3.395)***             |
| Obs.  | 296                                | 296                                  | 296                                 | 296                              |
| Dep. Var. Mean                                    | 38.178                             | 33.572                               | 4.606                               | 30.181                           |

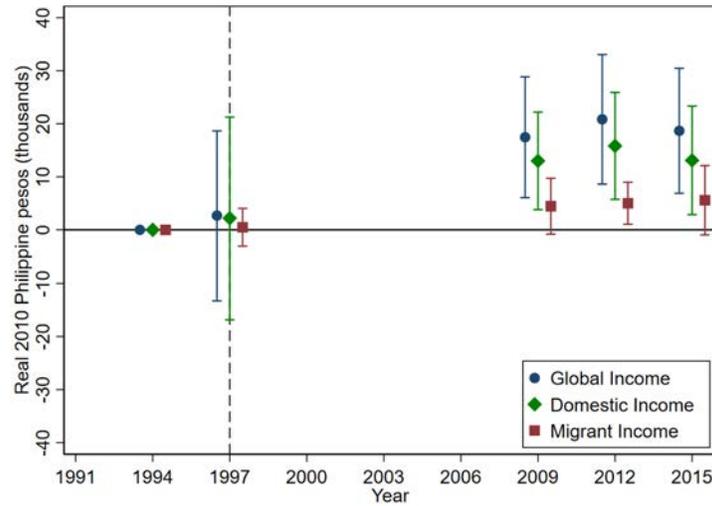
Note: Unit of observation is the province-year. Migrant income per capita is calculated from POEA/OWWA and Philippine Census data. Total income, domestic income and expenditure per capita are from Family Income and Expenditure Survey (FIES). Global income per capita is migrant income per capita plus domestic income per capita. Income and expenditure are in thousands of real 2010 Philippine pesos (17.8 PhP per PPP US\$ in 2010). The year 1997 is dropped from the analysis as the exchange rate shock takes place in 1997. For list of destination and provincial controls, see Table 3. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

Regression results for global, domestic, and migrant income per capita are in columns 1-3 of Table 4. Within each Panel, the coefficient in column 1 is mechanically the sum of the corresponding coefficients in columns 2 and 3 (since global income is the sum of domestic and migrant income). The shock has positive and statistically significant effects on global, domestic, and migrant income per capita. Coefficient estimates are stable across regressions in Panels A and B.

Impacts are large in magnitude. The coefficient estimate in column 1, Panel B indicates that each one-standard-deviation shock increases global income per

<sup>28</sup>Excluding overseas income sources from domestic income also avoids double-counting when we sum domestic and migrant income to obtain global income, since overseas income sources are likely to be predominantly derived from migrant income.

Figure 3: Event Studies for Global, Domestic, and Migrant Income Per Capita



Note: Regressions modify Equation (7) to include interactions between  $Z_{j,post}$  and indicator variables for each pre- and post-1997 year. The 1994 interaction term is omitted as reference point. Specification corresponds to that of Table 4, Panel B (including province fixed effects, year fixed effects, and controls for differential trends with respect to pre-shock province and destination characteristics). Migrant income per capita is the sum of all income earned outside the Philippines by a province’s migrants. Domestic income per capita sums earned income from wage and entrepreneurial activities, along with income from all other sources, excluding income from international sources. Global income is the sum of migrant income and domestic income. All income values are in real 2010 PhP. Observations are at the province-period level, and include the periods 1994, 1997 (partially-treated year, not included in Table 3 regressions), 2009, 2012, and 2015. 95% confidence intervals also shown. Standard errors are exposure robust, accounting for correlation of shocks across provinces via estimation of shock-level regressions (Borusyak et al., 2022).

capita by 2,226 pesos ( $24,733 \text{ pesos} \times 0.09$ ) in 2009-2015 (0.170 standard deviation). Corresponding effect sizes for domestic income and migrant income per capita are 1,778 pesos and 449 pesos, respectively (0.158 and 0.154 standard deviations, respectively).

The coefficient estimate on migrant income (4.989) indicates that the initial shock to migrant income is substantially magnified over time: for each unit migrant income per capita shock (measured by our shift-share variable), migrant income per capita is nearly five times higher a decade later. We will turn shortly to the mechanisms behind this five-fold magnification of the migrant income shock, examining the role of increases in migration rates, educational investments, and migrant skill levels.

Figure 3 shows event study diagrams analogous to Figure 2, corresponding to these regressions for global, domestic, and migrant income (now including the partially-treated 1997 period). There is no apparent violation of the parallel-trend

assumption in the short 1994-1997 pre-shock period. The effect is positive and stable in the post-periods.

To show the robustness of impacts on expenditure per capita, we also show regression estimates for this outcome in the restricted set of periods (1994, 2009, 2012, and 2015), in column 4. Point estimates and significance levels are very similar to the estimates of column 2 of Table 3, using data that spans 1985-2018.

### 6.3 Ruling out Trade and FDI Mechanisms

Table 5: Investigating Alternate Channels: Trade and FDI

|   | Triennial: 1985 - 2018            |                                  | 1994, 2009, 2012, and 2015         |                                      |                                     |
|---|-----------------------------------|----------------------------------|------------------------------------|--------------------------------------|-------------------------------------|
|   | (1)<br>Total Income<br>Per Capita | (2)<br>Expenditure<br>Per Capita | (3)<br>Global Income<br>Per Capita | (4)<br>Domestic Income<br>Per Capita | (5)<br>Migrant Income<br>Per Capita |
| <i>Panel A. Destination and province controls</i>           |                                   |                                  |                                    |                                      |                                     |
| $Z_o \times \text{Post}_t$                                  | 13.632<br>(7.345)*                | 11.262<br>(3.646)***             | 24.733<br>(7.150)***               | 19.744<br>(5.774)***                 | 4.989<br>(2.195)**                  |
| <i>Panel B. Additional import, export, and FDI controls</i> |                                   |                                  |                                    |                                      |                                     |
| $Z_o \times \text{Post}_t$                                  | 13.557<br>(7.365)*                | 11.250<br>(3.440)***             | 22.259<br>(7.679)***               | 18.238<br>(7.086)**                  | 4.020<br>(1.944)**                  |
| Obs.  | 813                               | 813                              | 296                                | 296                                  | 296                                 |
| Dep. Var. Mean  | 35.713                            | 29.075                           | 38.178                             | 33.572                               | 4.606                               |

Note: Unit of observation is the province-year. Migrant income per capita is calculated from POEA/OWWA and Philippine Census data. Total income, domestic income and expenditure per capita are from Family Income and Expenditure Survey (FIES). Global income per capita is migrant income per capita plus domestic income per capita. Income and expenditure are in thousands of real 2010 Philippine pesos (17.8 PhP per PPP US\$ in 2010). The year 1997 is dropped from the analysis as the exchange rate shock takes place in 1997. For list of destination and provincial controls, see Table 3. Panel B additionally controls for time-varying imports, exports, and FDI at the destination level. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

An important interpretive question is whether the coefficient  $\beta_1$  solely reflects changes in migrant income, or potentially other mechanisms. The most obvious alternative mechanisms are trade and foreign direct investment (FDI) flows. We test the role of these other mechanisms by controlling for contemporaneous (time-varying) Philippine exports to, imports from, and FDI inflows from other countries. These are included in the regressions after aggregation across destinations exposure weights (following Borusyak et al. (2022)), in the same manner as the other destination controls. If coefficient estimates decline in magnitude with the inclusion of these controls, this would suggest that trade and/or FDI are operative channels of the causal effects.

Results are in Table 5. In Panel A, for comparison, we repeat the coefficients from Panel B of Tables 3 and 4. Then in Panel B, we add time-varying controls for trade and FDI. For all outcome variables in the table, coefficient estimates are very similar whether or not time-varying trade and FDI controls are included in the regressions. These results provide no indication that trade or FDI are important channels for the causal effects of the shift-share variable.

## 6.4 Mechanisms

We now examine potential mechanisms through which these substantial increases in income take place. We examine educational investments, migrant skill levels and occupations, and domestic wage and entrepreneurial income.

### 6.4.1 Education

Relaxation of household liquidity constraints has been shown to lead to higher educational investments in the long run (Agte et al., 2022). Positive migrant income shocks could loosen such constraints on educational investments (Yang, 2008b; Gibson et al., 2011, 2014; Clemens and Tiongson, 2017; Theoharides, 2018), and also change the expected return to education in the population at large.<sup>29</sup>

In Table 6 we present coefficient estimates from regressions where the dependent variables are the share of the population having reached key threshold levels of education: primary (6 years of completed schooling), high school (10 years), and college (14 years). Dependent variables are from the Philippine Census (pre-shock periods 1990 and 1995; post-shock periods 2000, 2007, 2010, and 2015). The positive shock to migrant income has positive and statistically significant effects on high school and college (but not primary) completion rates.

Coefficient estimates in columns 2 and 3 indicate that a one-standard-deviation migrant income shock causes 0.85 percentage points higher high school completion, and 0.39 percentage points higher college completion. Point estimates in the high school and college regressions are relatively stable across sets of controls and statistically significantly different from zero at the 1% and 10% levels, respectively,

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<sup>29</sup>Positive migrant income shocks could raise schooling investments overall if the return to education is perceived to rise (Batista et al., 2012; Docquier and Rapoport, 2012; Clemens and Tiongson, 2017; Shrestha, 2017; Theoharides, 2018; Chand and Clemens, 2019; Khanna and Morales, 2019; Abarcar and Theoharides, 2022), but could reduce schooling investments if returns to education are seen to fall (McKenzie and Rapoport, 2011; de Brauw and Giles, 2017; Tang et al., 2022).

Table 6: Effects of Migrant Income Shock on Education

|   | Share Completed:         |                            |                   |
|---|--------------------------|----------------------------|-------------------|
|   | (1)<br>Primary<br>School | (2)<br>Secondary<br>School | (3)<br>College    |
| <i>Panel A. Destination controls only</i>         |                          |                            |                   |
| $Z_o \times \text{Post}_t$                        | -0.002<br>(0.046)        | 0.092<br>(0.039)**         | 0.027<br>(0.030)  |
| <i>Panel B. Destination and province controls</i> |                          |                            |                   |
| $Z_o \times \text{Post}_t$                        | 0.010<br>(0.032)         | 0.094<br>(0.036)***        | 0.043<br>(0.026)* |
| Obs.  | 444                      | 444                        | 444               |
| Dep. Var. Mean                                    | 0.789                    | 0.486                      | 0.133             |

Note: Unit of observation is the province-year. Analysis uses Census data; periods are 1990, 1995, 2000, 2007, 2010, and 2015. Dependent variables are share of population (aged 20-64) who have completed primary, secondary (high school), and college education. Primary school, secondary school, and college completion is defined as having completed at least 6, 10, and 14 years of schooling respectively. For list of destination and provincial controls, see Table 3. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

in Panel B.

These educational responses to the shock are plausible in magnitude. We gauge magnitude plausibility by examining the extent to which the increases in education we document are associated with increases in household income, since loosened financing constraints are likely a key reason behind the increase in education. Our regression results, comparing Panel B of Table 4 (col 1) with Table 6 (col 3) indicate that about 5,800 pesos more in global income is associated with 0.01 higher college completion.<sup>30</sup>

How does this relationship between increased income and increased education compare to relationships seen in cross-sectional data in the pre-period? The cross-sectional relationship between global income and share skilled in the population in the pre-period (1994) indicates that each 0.01 higher college completion is associated with about 4,000 pesos more in provincial global income per capita. While this is not a causal effect, it is a reasonable point of comparison. The education response we estimate is slightly smaller: 5,800 PhP is “needed” to generate the same increase in college completion.

<sup>30</sup>Note of course that the increase in education investments due to the shock could also be driven in part by perceived changes in the return to education, not only by loosened financing constraints.

## 6.4.2 Migrant Skills and Occupations

The increase in education in the population may also raise occupational skill levels of migrant workers. We first examine whether the shocks to migrant income have had a causal impact on the share of migrants who are skilled, which we take to mean college-educated (at least 14 years of schooling). This outcome is available in Census data: international migrants and their education levels are recorded. Periods included in the regression are the Census years 1990, 1995, 2000, 2007, 2010, and 2015.

In column 1 of Table 7, we report results from estimating equation (7) where the dependent variable is the share of international migrants who are skilled. There is a substantial positive effect that is stable across panels with different sets of controls. The coefficient in Panel B is statistically significantly different from zero at the 1% level. A one-standard-deviation higher shock leads to 1.7 percentage points higher share of migrants who are skilled (0.13 standard deviations).

Table 7: Effects of Migrant Income Shock on Contract Types and Migrant Skill

|   | Census                           | Contracts per 10,000 Working Age People |                      |                    |                    |
|---|----------------------------------|---|----------------------|--------------------|--------------------|
|   | (1)<br>Share Skilled<br>Migrants | (2)<br>Professional                     | (3)<br>Production    | (4)<br>Service     | (5)<br>Total       |
| <i>Panel A. Destination controls only</i>         |                                  |   |                      |                    |                    |
| $Z_o \times \text{Post}_t$                        | 0.165<br>(0.052)**               | 23.475<br>(9.548)**                     | 21.810<br>(11.031)** | -0.085<br>(21.458) | 47.746<br>(32.681) |
| <i>Panel B. Destination and province controls</i> |                                  |   |                      |                    |                    |
| $Z_o \times \text{Post}_t$                        | 0.192<br>(0.053)**               | 20.544<br>(8.889)**                     | 17.221<br>(10.000)*  | -1.018<br>(21.228) | 38.716<br>(31.792) |
| Obs.  | 444                              | 296                                     | 296                  | 296                | 296                |
| Dep. Var. Mean                                    | 0.338                            | 6.636                                   | 17.787               | 29.793             | 57.000             |

Note: Unit of observation is the province-year. Share of migrant workers who are skilled is from the Census (periods are 1990, 1995, 2000, 2007, 2010, and 2015). Skilled is defined as completing 14 years of education, which corresponds to finishing a college degree. Migrant contract variables are calculated from POEA/OWWA data (periods are 1994, 2009, 2012, and 2015). For list of destination and provincial controls, see Table 3. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

Is this increase in migrant's educational levels associated with working in higher-skilled jobs? We examine impacts on the propensity to enter into skilled international migrant work. These analyses require the migrant contract data, so the periods included in the regression are 1994, 2009, 2012, and 2015 (as in Table 4). The dependent variable is new migrant contracts per 10,000 working age (age

20-64) population.

We estimate equation (7) for new migrant contracts in three broad occupation groups. “Professional” jobs are done by migrants with the most education, followed by “production” jobs. Workers in “service” jobs have the least education.<sup>31</sup> Table A6 displays estimated mean education levels in these migrant occupational categories from 1995 through 2015.<sup>32</sup>

Results are in columns 2-4 of Table 7. Shocks to migrant income have positive effects on new international migration in skilled occupations – professional and production work (columns 2 and 3) – but not for the lowest-skilled work, service jobs (column 4). We also estimate impacts on total contracts across all categories (column 5). This coefficient is also positive, but lacks precision (due to noise in the service jobs data).

In sum, migrant income shocks increase the skilled share of the general population and of migrant workers in particular, as well as migrant flows in higher-skilled jobs. These effects are likely to be mechanisms leading to the substantial gains in income over the long run.

### 6.4.3 Entrepreneurial, Wage, and Other Domestic Income Sources

We now examine impacts on sub-types of domestic income. Table 8 presents regression results from estimating Equation (7) where dependent variables are domestic wage income, entrepreneurial and rental income, and other income per capita. Wage income is compensation (cash or in-kind) from regular or seasonal work. Entrepreneurial and rental income is from any entrepreneurial activity (such as poultry/livestock raising, wholesale/retail, transportation services, and rental of land/property). Other income includes pensions, interest, dividends, and other sources.

The shock led to increases in both wage income as well as entrepreneurial and rental income. Coefficient estimates for both these outcomes are robust to the set of controls. They are statistically significantly different from zero at conventional levels in Panel B, and similar to one another in magnitude. By contrast, there

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<sup>31</sup>These three categories account for 95.1% of contracts. Other occupation groups (included in “Total”, but not shown separately) include managerial, agricultural, clerical, and sales.

<sup>32</sup>The contract data do not include migrant worker education, so we calculate mean years of education in 80 detailed migrant occupations in the 1992-2003 Survey of Overseas Filipinos (SOF). We then assign the mean years of education for the occupation from the SOF to each migrant working in the occupation in the contract data. Then, we calculate mean migrant education within the three occupation groups (professional, production, and services) in the contract data.

Table 8: Effects of Migrant Income Shock on Components of Domestic Income

|   | Domestic Income Components: |   |                   |
|---|-----------------------------|---|-------------------|
|   | (1)                         | (2)                                     | (3)               |
|   | Wage<br>Income              | Entrepreneurial<br>and Rental<br>Income | Other<br>Income   |
| <i>Panel A. Destination controls only</i>         |                             |   |                   |
| $Z_o \times \text{Post}_t$                        | 10.022<br>(3.081)***        | 9.741<br>(1.295)***                     | 5.926<br>(3.056)* |
| <i>Panel B. Destination and province controls</i> |                             |   |                   |
| $Z_o \times \text{Post}_t$                        | 9.537<br>(4.353)**          | 7.574<br>(1.953)***                     | 2.633<br>(2.279)  |
| Obs.  | 296                         | 296                                     | 296               |
| Dep. Var. Mean                                    | 15.110                      | 10.155                                  | 8.307             |

Note: Unit of observation is the province-year. Data from the Family Income and Expenditure Survey (FIES); periods are 1994, 2009, 2012, and 2015. For list of destination and provincial controls, see Table 3. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

is no robust evidence that “other” income is a major part of the increase in domestic income. The positive impact on wage income and on entrepreneurial and rental income are likely to reflect higher levels of education in the population, as well as increased capital investment in enterprises (both within and outside the household). We explore this further in Section 7 below.

## 7 Model-Based Quantification and Discussion of Magnitudes

We now provide further insight into mechanisms and magnitudes of the results thus far. First, we develop the theoretical framework introduced in Section 3 to shed additional light on the long-run effects on global income and its components, migrant and domestic income. We take a simple model-based approach to quantifying the contribution of educational investments to the long-run income gains. The theoretical framework derives changes in skill shares, migration flows, migrant income, and domestic income as a function of the shift-share variable. In addition, the model allows us to shed light on whether the magnitude of the effect on migrant income per capita in the long run is explicable. (We summarize this model-based quantification here. For full details of the model and calculations, please refer to Appendix Section C.) Finally, we investigate the assumptions needed to deliver the magnitude of the effect on domestic income.

## 7.1 Contribution of the Education Channel

The long-run impact of the migrant income shock may be partly due to increased educational investments. First, skilled workers earn more. Furthermore, better-educated individuals have higher migration rates, and better-educated migrants work in higher-skilled jobs overseas. We seek to quantify how much of the long-run changes in both migrant and domestic income can be attributed to educational investments.

The college completion regression in Table 6 is our quantitative estimate of the educational investment response to the shock. To estimate the contribution of educational investments to the income gains, we do the following. We multiply each province's specific value of the shift-share variable by the regression coefficient (0.043, Panel B, column 3 of Table 6) to estimate the change in the province's population share skilled. We then estimate how migration (to different destinations, as well as remaining at origin) would change in response to the change in the population skill composition, presuming the same dyadic migration probabilities by skill (the probability someone with skill  $s$  migrates from origin  $o$  to destination  $d$ ) from the pre-shock period (1995). That is, to estimate the changes in migration flows to the various destinations, we first take the difference between skill groups in the baseline proclivity to migrate to various destinations, and multiply this difference by the change in the share skilled.

Then, we calculate how both migrant and domestic income would change in response to such migration changes, presuming the same dyadic skill premium (difference in skilled vs. unskilled income, in origin-destination dyads) from the pre-shock period. That is, we take the baseline skill premia, both for domestic and for migrant income, and multiply it by the change in share skilled to predict the education-driven change in incomes.

This calculation provides us with estimates of the change in migrant and domestic income per capita due to the education channel. We estimate that the education channel explains 21.6% of the increase in migrant income, and 17.6% of the increase in domestic income. Global income is the sum of migrant and domestic income; the implied share of global income explained by increased education is 18.4%. In sum, the increases in education induced by the exogenous increase in migrant income (captured by our shift-share variable) account for roughly one-fifth of long-run income gains.

## 7.2 Explaining Impact on Migrant Income

We also use the model to explain the large increase in migrant income, relative to the initial migrant income shock measured by the shift-share variable (the coefficient estimate of 4.989 in Table 4's migrant income regression). As discussed above, 21.6% of the increase in migrant income is explained by increased educational attainment. We seek to explain the remaining four-fifths of the migrant income increase. Additional mechanisms leading to further migrant income gains include the exchange rate shocks themselves, as well as changes in migration flows across destinations.

We first estimate changes in migration flows. Destination exchange rate shocks could change migration decisions, contributing to the eventual changes in long-run migrant income. In our gravity equation, the Fréchet parameter  $\theta$  is the elasticity of migrant flows (from origin- $o$  to destination- $d$ ) with respect to destination wages. This determines subsequent location choices and migrant income. Higher  $\theta$  means that migration flows, and thereby migrant income, respond more to exchange rate shocks. We use the exchange rate shocks to estimate  $\theta$  using a Poisson pseudo-maximum likelihood (PPML) estimator (as many origin-destination dyads have zero flows). This yields an estimate of 3.42, which we use along with the actual exchange rate shocks to predict changes in migration in origin-destination dyads.<sup>33</sup>

We then calculate the change in total migrant income resulting from all dyadic (origin-destination) changes in migration flows, by skill, along with changes in destination exchange rates. We presume that skill-specific migrant wages (in destination currency) in each destination are fixed at pre-shock levels, so that changes in migrant income are driven only by exchange rate shocks and changes in migration flows. We estimate that these factors explain an additional 83.7% of the change in migrant income. This is on top of the 21.6% of the increase in migrant income attributed to education investments. The modeled components therefore explain essentially all (105.3%) of the increase in migrant income.

In sum, the model accounts for the entire magnitude of the effect on migrant income. The five-fold magnification of the initial migrant income shock is fully

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<sup>33</sup>We account for "indirect resorting": potential migrants simultaneously consider the full set of exchange rate changes in migration decisions, rather than simply choosing between migrating to specific destination- $d$  or remaining at origin. For example, if Japan's exchange rate appreciates, while Malaysia's depreciates, migration to Malaysia will fall, but some individuals deterred from Malaysian migration will migrate to Japan instead of not migrating.

explained by the combination of increased education, exchange rate shocks, and changes in migration across destinations.

### 7.3 Explaining Impact on Domestic Income

We investigate assumptions needed to explain the magnitude of the impact on domestic income per capita. The coefficient on the shift-share variable in the domestic income per capita regression of Table 4, Panel B indicates that a PhP 1 migrant income shock leads to a PhP 19.74 increase in long-run domestic income. 17.6% of this increase is attributable to the increases in education investments (see Subsection 7.1). This leaves PhP 16.3 PhP to be explained. We consider two mechanisms that could explain this remainder: a demand multiplier, and investments in domestic enterprises.

Recent studies have estimated large demand multipliers in low-income contexts. Egger et al. (2021) estimate a multiplier 2.5 in response to cash transfers in Kenya. The multiplier due to a credit supply shock in India is 2.9 (Breza and Kinnan, 2021). We consider how much of our effect on domestic income could be explained by such multipliers. In our context, multipliers operate on the portion of migrant income sent back to origin provinces. The coefficient estimate in the migrant income regression of Table 4, Panel B indicates that the multiplier would operate on the portion of the 4.989 increase in migrant income per capita that is sent back to origin provinces. Assuming 70% of the migrant income returns to the local economy, that coefficient and a multiplier of 2.9 implies an increase in domestic income per capita of 10.15 PhP ( $4.989 \times 0.7 \times 2.9$ ). A simple demand multiplier thus explains 62% of the remaining 16.3 PhP.

We now consider an additional contributor to the increase in domestic income: migrant income could alleviate constraints on capital investments. The migrant income shock was not a one-time windfall, but was sustained and grew over time, and so likely led to a sustained increase in capital accumulation. It is widely recognized that household enterprises and firms face binding constraints on capital investment (Karlan and Morduch, 2010), and that when such constraints are loosened, firms have high rates of return on investment. For example, de Mel et al. (2008) estimate a rate of return to Sri Lankan microenterprise investments from

randomly-assigned capital investments of 5% per month (80% per year).<sup>34</sup> Such returns likely explain part of the increases in wage and entrepreneurial incomes we document in Table 8.

We examine whether our domestic income results 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. We summarize the framework here; details are in Appendix Section C.6.

We trace the dynamics of domestic income per capita following the initial shift-share shock. Shock-induced migrant income per capita grows over time, reaching the amounts reflected in the event-study coefficients for migrant income per capita in Figure 3. In each post-shock year, a portion of shock-induced higher migrant income returns to origin provinces. Migrant income returned to origin economies generates an aggregate demand multiplier. In every period, households save a portion of shock-induced higher incomes, investing them in enterprises and firms.<sup>35</sup> We assume relatively high initial rates of return on investment (but not as high as the findings of de Mel et al. (2008)), which decline over time as the initial low-hanging investment fruits are exhausted. Higher incomes induced by these capital investments also generate a multiplier.

In Appendix Figure A8a, we display the shock-induced domestic income of the model between 1998 and 2015, for three values of the share of migrant income spent at origin,  $\alpha$ . With  $\alpha=0.7$ , a PhP 1 initial migrant income shock becomes PhP 16.6 of domestic income by the year 2015. In Appendix Figure A8b, we set  $\alpha=0.7$ , and vary the initial rate of return on investment and trace the shock-induced domestic income in 2015. Our estimates range from 13.1 for a flat rate of return of 0.05 to 20.7 when the rate of return starts at 0.8 (the estimate of de Mel et al. (2008)).

We view this calculation primarily as a sanity check, demonstrating that a set of reasonable assumptions can generate the observed long-run impact on domestic income per capita. The framework does not incorporate all possible channels through which the effect on domestic income may arise. Importantly, we do not model potential escapes from poverty traps, such as those due to investment in-

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<sup>34</sup>Similarly high returns are found by Banerjee and Duflo (2014), Hussam et al. (2022), and Cai and Szeidl (2022).

<sup>35</sup>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)).

divisibilities (Ghatak, 2015; Balboni et al., 2021; Kaboski et al., 2022). Considering escapes from poverty traps would make it even easier to explain the magnitude of the long-run effect on domestic income.

## 8 Conclusion

We study the long-run consequences of increases in international migrant income for migrant-origin regions. We find that the vast majority of income gains are from *domestic* (origin-area) sources; gains in international migrant income, while also substantial, account for only a minority of gains. In addition, model-based estimates suggest that about one-fifth of the income gains (both domestically and international) are due to increased educational investments.

While we use overseas exchange rate shocks for causal identification, our results are likely to shed light on the impacts of policies – in both origin and destination countries – that affect international migrant income. Origin-country policies include efforts to facilitate international labor migration, as well as regulation to reduce market power of international labor market intermediaries (ensuring migrants retain more of their income gains). They might also include origin-country educational policies that raise population skill levels and make citizens more competitive for international jobs. Destination country policies include increases in legal immigration opportunities, enforcement against undocumented immigrants, and labor market policies that affect immigrants' ability to work legally.

There are also implications for how we think about overseas development assistance (foreign aid). We find that improvements in migrant income have substantial positive impacts on development of the *domestic* economy of migrant *origin* areas. Development agencies could consider supplementing traditional foreign aid with programs that facilitate international labor migration (Clemens, 2010; Clemens and Pritchett, 2013; World Bank, 2018a; Nunn, 2019).

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## Online Appendix

### A Data Appendix

#### A.1 Migration Data

Calculation of key variables in our analyses (the migrant-income-weighted exchange rate shock and migrant income per capita from each Philippine province) requires unusual data on migrant income and migrant overseas locations by province. To calculate these variables, we obtained two unique administrative datasets from agencies of the the Philippine government. The Philippine Overseas Employment Administration (POEA) is tasked with approving migrant contracts and providing exit clearance. They maintain a rich database on all new contract migrants, including data on name, date of birth, sex, marital status, occupation, destination country, employer, recruitment agency, salary, contract duration, and date deployed. The detailed occupations are also classified into broad occupation categories by the POEA. The Overseas Worker Welfare Administration (OWWA) is responsible for the welfare of overseas workers and their families, and all migrants are required to register with OWWA. OWWA maintains a database that includes migrants' name, date of birth, sex, destination country, date deployed and home address in the Philippines.

To create a dataset that includes migrant wages, destination, and province of origin, we combine the datasets from POEA and OWWA using fuzzy matching techniques for the years 1992-1997 and 2007-2009. We match the POEA and OWWA data using first name, middle name, last name, date of birth, destination country, sex, and year of departure. We achieve a match rate of 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. In the immediate post-shock (post-1997) years, several 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. This temporal overlap with census years is useful for estimating migrant income per capita, as discussed below. All wages are expressed in thousands of real 2010 Philippine pesos. We winsorize the wages at 99% within each destination-occupation category cell.<sup>36</sup>

We use the 1995 contract data to construct the the shift-share variable  $Z_o$ , defined in equation (6). First, we calculate province-level migrant income per capita ( $MigInc_{o0}$ ) in 1995, the pre-shock period. We calculate the province's 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 popu-

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<sup>36</sup>For destination-occupation cells containing fewer than 100 observations, we aggregate these cells and winsorize at occupation category level.

lation, obtaining migrant income per capita. We go through a similar calculation for migrant income per capita in 1994, 2009, 2012, and 2015 (the years we include in our analysis as they correspond to years the FIES is conducted). For each year, we calculate average migrant income from the POEA/OWWA data.<sup>37</sup> We then multiply by the 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, where the weights are the pre-shock share of migrant income from each 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  $\tilde{\Delta}R_{d0}$  for destination  $d$  by the corresponding province- $o$ -specific weights to obtain  $Rshock_o$ . The product of  $Rshock_o$  and  $MigInc_{o0}$  gives us the shift share variable  $Z_o$ .

In analyses of impacts on new contracts by skill (in Subsection 6.4.2, Table 7), we use the POEA/OWWA classification of broad occupations to create migration rates by occupation category. We examine three broad categories: (1) Professional occupations (performing artists, engineers, medical professionals and teachers, among others), (2) Production workers (brick-layers and carpenters, electrical workers, and plumbers, among others), and (3) Service workers (caretakers and caregivers, cooks and waiters, and domestic helpers among others). Together, these three categories cover about 95 percent of migrant contracts.

There is one caveat with using the home address variable to calculate province-level wages: the home address variable in the OWWA data includes municipality, but not province, in the data from 1992-2009. Out of 1630 municipalities in the Philippines, 332 have ambiguous names that are used in more than one 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.

In addition, 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  $Z_o$ . To test this, we regress the exchange rate shock on the share of destination observations with a missing province on the exchange rate

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<sup>37</sup>For these years, we use the migrant wages from the previous three years of contract data to calculate average income 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.

shock, weighting by Borusyak et al. (2022) shares. The regression specification is the same as in Appendix Table A3. 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.

## **A.2 Census Data**

We created a panel of schooling outcomes using the 1990, 1995, 2000, 2007, 2010, and 2015 Philippine Census of Population from the Philippine Statistical Authority. Each census wave includes 100% of the non-institutionalized Philippine population. In each round of the census, we calculate the provincial share individuals with primary education (6 or more years of schooling), high school education (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 who are reported on household rosters. We also create a household asset index using the 1990 census to use as a baseline control. The census contains data on ownership of a number of durable goods, access to utilities, housing quality, and land and home ownership. We construct the index of household assets by taking the first principal component of these variables.

To study the impact on the skill composition of jobs, we use information on occupations and educational attainment from the Survey of Overseas Filipinos (SOF) to match overseas occupations with education levels, as detailed in footnote 32.

## **A.3 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). The FIES provides the Philippine government's official income and expenditure statistics. FIES enumeration occurs over two visits: the first in July of the survey year, with January to June as the reference period, and the second in January of the subsequent year, with July to December as the reference period. In triennial years when the FIES is implemented, the FIES sample is the sample of the government's quarterly Labor Force Survey (LFS, described below) in July of the FIES triennial year, and households

included in the subsequent January LFS round. Each survey also includes sampling weights.

The FIES includes detailed household income and expenditure categories. Total income and expenditure, as included in Table 3, are the aggregation of these detailed categories. Domestic income is calculated as total income minus income from international sources. Income from international sources includes migrant remittances, but also includes pensions, retirement, workmen’s compensation, and other benefits; cash gifts, support, relief, 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 over our period of analysis (which come from different data sources), we need to focus on a subset of time periods when both domestic and migrant income data are available. The intersection of the two datasets 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. We use the three years’ migrant wage data (the given year and the two prior years) from the POEA/OWWA dataset to estimate migrant income for a given year. For example, the estimate for 2009 migrant income uses the average wages of new contracts in 2007, 2008, and 2009. Most migrant contracts have duration of over a year, so the average wages of the stock of migrants in 2009 would reflect the average wages of migrants not just from the year 2009, but immediate prior years as well.

#### **A.4 Labor Force Survey Data**

The FIES, which we use for our main income and expenditure outcomes, is implemented as a rider 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 C). 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 income data as above.

#### **A.5 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 perform the quantification exercise. From the 1990 Census we construct the baseline shares of the working-age population that migrated abroad for each skill group. We use these baseline shares as the probability of migration

by skill-group. In addition, we use the POEA/OWWA data to construct measures of 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.

## A.6 Regression Controls

Our regression equation (7) includes destination-level and province-level controls. We aggregate the destination level controls to province-level by taking weighted averages of destination-level variables for each province, weighted by baseline migrant earnings coming from each destination, following the Borusyak et al. (2022) method. All controls are interacted with a post-1997 indicator when included in regression equation (7).

### A.6.1 Destination-Level Controls

- **Baseline GDP Per Capita:** We used values from 1995 as the baseline (pre-shock) value. We obtained this from World Development Indicators (WDI) for most countries, in current US dollars. For a small set of destinations this variable was not available in the WDI. We determined values for these destinations as follows:
  1. 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:  $gdppc_{1995}^{currentUS\$} = gdppc_{1995}^{2010US\$} \times \frac{gdppc_{1999}^{currentUS\$}}{gdppc_{1999}^{2010US\$}}$ .
  2. Guam, Midway Island, and Northern Mariana Islands: US territories, therefore used US values.
  3. Cayman Islands and Diego Garcia: British Overseas Territories, therefore used UK values.
  4. Netherlands Antilles: Used Netherlands value.
  5. Palau: Used 2000 GDP per capita (closest available year to 1995).
  6. Taiwan: Used 1995 GDP per capita values from Taiwan’s national statistics website.<sup>38</sup>
- **Baseline average yearly earnings of migrants in destination:** From the POEA/OWWA data. The average 1995 salary (in real 2010 Philippine pesos) for each destination’s contracts.

<sup>38</sup><https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5>

- **Baseline percent of contracts that are professional occupations:** From the POEA/OWWA data. Percent of 1995 contracts to a given destination that are for professional occupations.
- **Baseline percent of contracts that are production occupations:** From the POEA/OWWA data. Percent of 1995 contracts to a given destination that are for production occupations.
- **Baseline percent of migrant contracts going to the destination:** From the POEA/OWWA data. Percent of 1995 all contracts for Philippine international migrant workers going to the given destination.

#### A.6.2 Province-Level Controls

- **Baseline share of rural households:** Share of rural households in 1990. Calculated from the 1990 census.
- **Baseline asset index:** Province-level asset index in 1990. The household-level asset index is calculated from the 1990 census as described in Section A.2. Province-level index is the mean across the households within the province.
- **Baseline total income per capita:** Average of total income per capita for 1988, 1991, and 1994. Total income per capita is calculated from the FIES for 1991 and 1994. 1988 values are taken directly from Philippines NSO 1988 FIES report.
- **Baseline expenditure per capita:** Average of expenditure per capita for 1988, 1991, and 1994. Expenditure per capita is calculated from the FIES microdata for 1991 and 1994. 1988 values are taken directly from Philippines NSO 1988 FIES report.

### A.7 Trade and Foreign Direct Investment Controls

Data on imports from and exports to the Philippines are from the UN Comtrade database for each country. FDI data for 1996-2002 are from the PSA's Foreign Investment Reports.<sup>39</sup> The reports include the breakdown of total approved foreign investments by country. FDI data for after 2003 are from the PSA's OpenStat platform.<sup>40</sup> 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

<sup>39</sup>The reports can be accessed from <https://psa.gov.ph/content/foreign-investments-0?page=9>

<sup>40</sup>Variable is titled Approved Foreign Investor by Country, accessed from [https://openstat.psa.gov.ph/PXWeb/pXweb/en/DB/DB\\_\\_2B\\_\\_FI/0022B5DICI0.px/?rxid=8ceb0f2b-530e-425e-abc0-dc169fa025ba](https://openstat.psa.gov.ph/PXWeb/pXweb/en/DB/DB__2B__FI/0022B5DICI0.px/?rxid=8ceb0f2b-530e-425e-abc0-dc169fa025ba). Between 2003-2011, some countries continue to appear in the PSA's Foreign Investment Reports but not in the OpenStat platform. Data for these countries are from the reports and are included in the dataset.

to be zero in the analysis.<sup>41</sup> FDI data by country are not available prior to 1996. Therefore, we use the 1996 value for every pre-1996 country-year pair. All values are expressed in 2010 real Philippine pesos (PhP, 17.8 per PPP US\$). We aggregate the migrant-destination-country-level import, export, and the FDI values to the Philippine province level taking the weighted average by the baseline migrant earnings coming from each destination (consistent with other destination level controls, following the Borusyak et al. (2022) method).

## **B Additional Empirical Analyses**

### **B.1 Internal Migration**

We examine internal migration outcomes in Appendix Table A5. The dependent variables are the in-migration rate (individuals reporting having moved into the province within the last 5 years, as share of provincial population), the out-migration rate (analogously, the share who moved out of the province in the last 5 years), and the net migration rate (the out-migration rate minus the in-migration rate). We examine these outcomes for individuals adults (aged 25-64), and young adults (aged 18-24).

Observations are at the province-period level, and periods are the 1990, 2010, and 2010 Censuses. Compared to prior tables, five provinces are missing due to missing internal migration data (Camarines Sur, Capiz, Cavite, Mindoro Oriental, and Zamboanga Del Sur). Sample size is therefore 207 (69 provinces over three periods). For each outcome, we show results for different sets of control variables as in prior results tables.

The migrant income shocks appear to have little effect on in-migration, out-migration, or net migration of adults. Coefficients in the regressions for adults are all small and not statistically significantly different from zero. They do appear to have a negative effect on out-migration of young adults (column 5). This effect is statistically significantly different from zero at the 1% level in the regression with all controls. The effect on net migration for young adults is similar in magnitude to the effects on out-migration, but not precisely estimated.

Young adults respond to positive migrant income shocks in their provinces by out-migrating less. This could reflect decisions to work in home areas experiencing improved economic prospects, or continue their educations in home-province institutions (funded by improved income levels), instead of out-migrating for work to other Philippine provinces.

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<sup>41</sup>The average share of yearly FDI not broken down by country is 6.9%.

## C Model-Based Quantification: Full Elaboration of Model

In this appendix, we provide the details of the model-based quantification discussed in Section 7. We present the equations yielded by the model, discuss their intuition, and describe how we connect the equations to the data. Full derivations of the model equations are in Supplementary Appendix S, below. Throughout this appendix, when we refer to empirical results from the main text, we refer to regression results using our preferred specification with destination and province controls. We use the exogenous and persistent exchange rate shock  $\tilde{\Delta}R_d$  as the empirical counterpart for the change in exchange rate term  $\Delta R_{dt}$  in the quantification equations below.

We start by introducing educational investments in the theoretical model. Then, 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.

### C.1 Education Investments

Migrant income may drive educational investments at home, for instance, by easing liquidity constraints or changing the returns to schooling. In Appendix S2 we micro-found changes to human capital under various scenarios, and derive how the change in the share of high-skilled workers  $h$  in origin  $o$  is:

$$\Delta \ell_{oht} = \frac{1}{\Psi} \Delta Y_o = \frac{1}{\Psi} \sum_{s=h,u} \left[ \ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \tilde{\Delta}R_d) \right] = \frac{1}{\Psi} \underbrace{\sum_d \omega_{do0}}_{MigInc_o} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta}R_d}{\sum_d \omega_{do0}}}_{Rshock_o}, \quad \text{A8}$$

where  $\frac{1}{\Psi}$  captures the effect of the migrant income shock on skill share.<sup>42</sup> The regression result in column 3 of Table 6 is our quantitative estimate of this skill response. Below, we unpack the implications of these changing skill shares.

### C.2 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 Fréchet parameter  $\theta$  pins down the elasticity of migrant flows (from  $o$  to  $d$ ) with respect to destination  $d$

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<sup>42</sup>In Supplementary Appendix S2 we derive changes to human capital with liquidity constraints, with no liquidity constraints, or with no borrowing. For certain models,  $\Psi$  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 for our quantification.

wages. This determines subsequent location choices and migrant income. Taking logs of the gravity equation (2) yields the estimating equation:

$$\log \pi_{dost} = \theta \log w_{dst} + \theta \log R_{dt} + \theta \log (1 - \tau_{dot}) - \log \left[ \sum_k (w_{kst} R_{kt} (1 - \tau_{kot}) \epsilon_{kot})^\theta \right] + \theta \epsilon_{dot} \quad \text{A9}$$

To estimate  $\theta$ , we leverage the exogenous exchange rate shocks. The coefficient on  $\log R_{dt}$  identifies  $\theta$ . We implement this at the origin-destination-skill level.<sup>43</sup> We include the origin by skill fixed effects and cluster our standard errors at the destination level. The results are in Appendix Table A7. We estimate  $\theta = 3.42$ .

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:  $\pi_{doh0} \ell_{oh0} + \pi_{dout0} \ell_{out0}$ . Changes in wages both abroad (say, via exchange rates), and at home (say, via more entrepreneurial investment), will determine migration flows. The change in aggregate outflows from an origin  $o$  has the following components:<sup>44</sup>

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oh0} \sum_{d \neq o} (\pi_{doh0} - \pi_{dout0})}_{\text{Education channel in outflows}} + \underbrace{\theta \sum_{d \neq o} (\ell_{oh0} \pi_{doh0} + \ell_{ou0} \pi_{dout0}) \frac{\Delta R_{dt}}{R_{d0}}}_{\text{Exchange rate channel in outflows}} \quad \text{A10} \\ & - \underbrace{\theta \left( \ell_{oh0} \pi_{ooh0} \frac{\Delta w_{oh0}}{w_{oh0}} + \ell_{ou0} \pi_{oou0} \frac{\Delta w_{out}}{w_{ou0}} \right)}_{\text{Domestic income stemming outflows}} - \underbrace{\chi_o}_{\text{Indirect re-sorting}} \end{aligned}$$

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  $\Delta \ell_{oh0}$ , and skill-differential in migration probabilities  $\pi_{doh0} - \pi_{dout0}$ . Second, as exchange rates change favorably, there will be a migration response to higher compensation. This depends on  $\theta$  (the elasticity of migration with respect to destination

<sup>43</sup>As 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.

<sup>44</sup>The derivation is in Supplementary Appendix S4. 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 A38 in Supplementary Appendix S4 shows a version with these indirect effects.

wages), the shock size  $\Delta R_{dt}$ , and migration probabilities  $\ell_{oht}\pi_{doh0} + \ell_{out}\pi_{dout}$ . This second term is the “Exchange rate channel in outflows.” Finally, the shock can change local earning levels, affecting  $\Delta w_{ost}$ . 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  $\theta$ . 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 A8 and A10 to be:

$$\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doh0} - \pi_{dou0}) = \frac{1}{\Psi} \underbrace{\sum_{d \neq o} (\pi_{doh0} - \pi_{dou0})}_{\text{Skill bias in outmigration}} \left( \underbrace{\sum_d \omega_{do0}}_{\text{MigInc}_{o0}} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{\text{Rshock}_o} \right) \quad \text{A11}$$

We use this framework to quantify the importance of the education and exchange rate channels. To obtain the contribution of the education channel, we obtain (a) the education response to the income shock  $\Delta \ell_{oht}$  from column 3 of Table 6, and obtain (b) the skill-differential in migration probabilities  $\pi_{doh0} - \pi_{dou0}$  from the raw data. Figure A3a 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 ( $\Delta R_{dt}$ ) and increases in domestic wages  $\Delta w_{ost}$ . We obtain the increases in domestic wages for different skill groups from columns 1 and 2 of Appendix Table A8. Migration responses to these, in turn, depend on the Frchet parameter  $\theta$ , which we estimate above in section C.2. 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 A10.

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 A8 in Appendix Figure A4a. 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, by calculating the share

of the total regression based predicted flows that are attributable to the education channel. We measure:  $\frac{\Delta \ell_{oht} \sum_d (\pi_{doh0} - \pi_{dou0})}{Flows_{ot}^{OLS}}$ . Appendix Figure A4b plots the distribution of the contribution of the education channel across provinces. On average about 18.6% of the increase in migrant flows is attributable to the increased education response (Table A9).<sup>45</sup> 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 about 37.7% of the outflows. The remaining portion is unexplained. We may not expect to explain the entirety of flows as we use baseline (1995) shares of migration flows.

### C.3 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 migrant income and encourages flows to favorable destinations.

$$\underbrace{\Delta \ell_{oht} \left( \sum_{d \neq o} w_{doh0} \pi_{doh0} R_{d0} - \sum_{d \neq o} w_{dou0} \pi_{dou0} R_{d0} \right)}_{\text{Education channel in migrant income}} + \underbrace{\theta \left( \sum_{s=h,u} \left[ \ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \Delta R_{dt}) \right] \right)}_{\text{Exchange rate channel in migrant income}} - \tilde{\chi}_o \quad \text{A12}$$

Here, we know  $\Delta \ell_{ost}$  is a function of the migrant income shock from Equation A8. We define  $\beta^{mig} = (\sum_{d \neq o} w_{doh0} \pi_{doh0} R_{d0} - \sum_{d \neq o} w_{dou0} \pi_{dou0} R_{d0})$  as the migrant skill premium. The education channel contribution to the change in income is simply  $\frac{\beta^{mig}}{\psi} \tilde{\Delta} Y_o$ . Similarly, the exchange rate channel is simply  $\theta \tilde{\Delta} Y_o - \tilde{\chi}_o$ , 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.<sup>46</sup> 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 overall change in migrant income per capita  $\left( \frac{\beta^{mig}}{\psi} + \theta \right) \tilde{\Delta} Y_o - \tilde{\chi}_o$  is empirically shown in column 3 of Table 4 where migrant income per capita changes with  $\tilde{\Delta} Y_o$ .

To quantify the importance of each component, we decompose the contribu-

<sup>45</sup>Theoretically, the education channel contribution can be negative if the low-skilled have a higher migration probability.

<sup>46</sup>As before, the second-order indirect effects of changes in location choice are captured by  $\tilde{\chi}_o \equiv \theta \sum_{s=h,u} \sum_d \left[ \ell_{ost} w_{dst} \pi_{dost} \left( \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right) \right] - \theta \sum_{s=h,u} \left[ \ell_{ost} \pi_{oost} \Delta w_{ost} \right]$ .

tions 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 6. The second component is the probability-weighted skill-premium abroad  $\beta^{mig}$ . We plot the skill premium ( $w_{doh0} - w_{dow0}$ ) at the origin-destination pair in Figure A3b.<sup>47</sup>

For the exchange rate channel, we use our estimate of  $\theta$ . A higher migration elasticity  $\theta$  means that migration flows, and thereby migrant income, are more responsive to exchange rate shocks. We measure the shares  $\ell_{os0}$  and  $\pi_{dos0}$ , and wages  $w_{dos0}$  at baseline (1995), and use them as weights for exchange rate changes  $\Delta R_{dt}$  as in the second term of Equation A12.

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 3 of Table 4. We plot the relationship between these predicted flows in Figure A5a. As before, we see a strong upward sloping relationship in Figure A5a 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 in migrant income as a ratio of the predicted increase in migrant incomes (Appendix Figure A5b). We do a similar exercise for the exchange rate channel in migrant income. On average, the education channel explains 21.6% of the increase in migrant income, whereas the exchange rate channel explains 83.7% (Table A9).<sup>48</sup>

#### C.4 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 the production side to keep our framework simple and tractable. While the underlying mechanisms are not modeled, our framework captures the ultimate affect of the shock on domestic earnings. Specifically, investments in entrepreneurial capital and aggregate demand will raise domestic income for each skill group  $\Delta w_{ost}$ , and investments in human capital will raise the share high-skilled  $\Delta\ell_{oht}$ . Together, these increase aggregate domestic income per capita:

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<sup>47</sup>Returns 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.

<sup>48</sup>It is not unreasonable for our model to explain a little more than the entirety of the changes, as we use baseline earnings in various destinations that may change for reasons unrelated to the shocks.

$$\Delta W_{ot} = \underbrace{\sum_{s=h,u} \ell_{os0} \pi_{oos0} (\Delta w_{ost})}_{\text{Direct wage channel}} + \underbrace{\Delta \ell_{oht} \left( \underbrace{w_{oh0} \pi_{ooh0}}_{\text{skilled wage at home}} - \underbrace{w_{ou0} \pi_{oou0}}_{\text{unskilled wage at home}} \right)}_{\text{Education channel in domestic income}} \quad \text{A13}$$

Here, the domestic “direct wage channel” captures the direct effect of changes in local wages due to, say, expansion of household entrepreneurship. As we do not take a stance on the mechanisms underlying enterprises decisions, we allow  $\Delta w_{ost}$  to be a function of migrant income per capita. As we show in Section C.3, migrant income per capita is a function of the exchange rate shock:  $\left(\frac{\beta^{mig}}{\Psi} + \theta\right) \tilde{\Delta} Y_o$ . Let  $\zeta$  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:

$$\begin{aligned} \Delta W_{ot} &= \underbrace{\sum_{s=h,u} \ell_{os0} \pi_{oos0} \left( \zeta \left( \frac{\beta^{mig}}{\Psi} + \theta \right) \tilde{\Delta} Y_o \right)}_{\text{Direct wage channel}} + \underbrace{\frac{1}{\Psi} \tilde{\Delta} Y_o (w_{oh0} \pi_{ooh0} - w_{ou0} \pi_{oou0})}_{\text{Education channel in domestic income}} \\ &= \left( \zeta \left( \frac{\beta^{mig}}{\Psi} + \theta \right) + \frac{\beta^{dom}}{\Psi} \right) \underbrace{\sum_d \omega_{do0}}_{\text{MigInc}_o} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{\text{Rshock}_o}, \quad \text{A14} \end{aligned}$$

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 4 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 attributing changes to 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 2 of Table 4. We plot the relationship between these predicted flows in Appendix Figure A6a. As before, we see a strong upward sloping relationship. The model slightly under-predicts domestic income per capita. Predicted values are distributed around the forty-five degree 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 A8. 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 A13.

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 A6b. We do a similar exercise for the direct wage channel. On average, the education channel explains 17.6% of the increase in domestic income, whereas the direct wage channel explains 69.6% (Table A9). The remaining component is likely driven by other aggregate changes to the income distribution.

## C.5 Change in Global Income: Predictions and Decomposition

Together, the longer-term change in the global income of individuals is:<sup>49</sup>

$$\left( \frac{\beta^{mig} + \beta^{dom}}{\Psi} + \theta + \zeta \left( \frac{\beta^{mig}}{\Psi} + \theta \right) \right) \tilde{\Delta}Y_o - \tilde{\chi}_o \quad A15$$

There is intuition behind this relationship. First, higher skill-premia (the  $\beta$  terms) imply that as individuals acquire schooling, incomes (both domestic and international) rise. Second, a higher migration elasticity  $\theta$  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 1 of Table 4. Overall changes in expenditure (column 4 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 our reduced form estimates, rationalize the magnitudes, and quantify the contribution of each channel discussed.<sup>50</sup>

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 1 of Table 4 for global income. Appendix Figure A7a 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 A7b plots the distribution of this contribution

<sup>49</sup>The derivation for global income is in Supplementary Appendix S5.

<sup>50</sup>A 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).

across provinces. Table A9 shows that the education channel explains 18.4% of the overall increase in global income, while the changes in earnings potential (both at home and abroad) explain 72.4% of the overall increase in global income. Overall, the model explains 90.8% of the increase in global income.

## C.6 Explaining Impact on Domestic Income

In this subsection, we investigate the assumptions needed to explain the magnitude of the impact we estimate on domestic income per capita. As discussed in Subsection 7.3 of the main text, we need to explain how a 1 PhP migrant income shock leads to a 19.74 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 4, Panel B. 17.6% of the increase in domestic income can be attributed to the increase in education induced by the shock (as discussed in Subsection 7.1). This leaves the remaining 16.3 PhP increase to be explained. Here, we describe the stylized framework in which we assess whether an effect of this size is reasonable.

We examine whether this remaining 16.3 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,  $\alpha$  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:

$$S_t = S_{t-1} + s y_t.$$

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 ( $m_\infty = 5.6$ ), and passes through our migrant income coefficient for 2012 ( $m_{15} = 5$ ) from the event study (Figure 3).

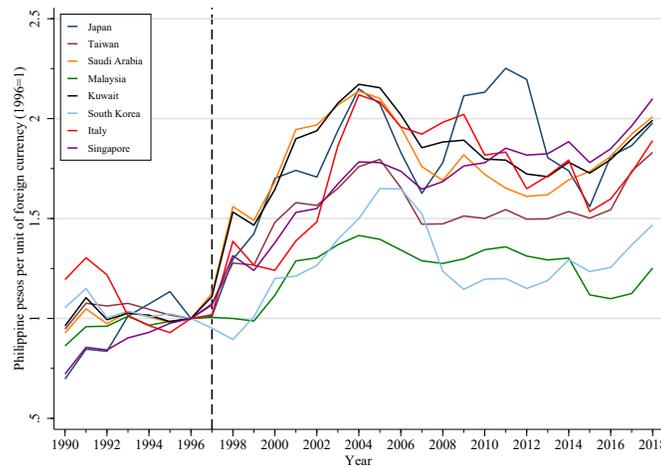
We set the rate of return to initial rate  $r_1 = 0.45$ ; this is high, but not as high as the estimate of de Mel et al. (2008). We then let  $r_t$  decline over time, according to a function that asymptotically reaches 0.05. This decline captures that the initial rate

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.<sup>51</sup>

Appendix Figures A8a and A8b trace out the shock-induced domestic income generated under these assumptions. The remaining 16.3 PhP increase in migrant income per capita is fully explainable, and is well within plausible assumptions. See the main text for discussion.

## D Additional Tables and Figures

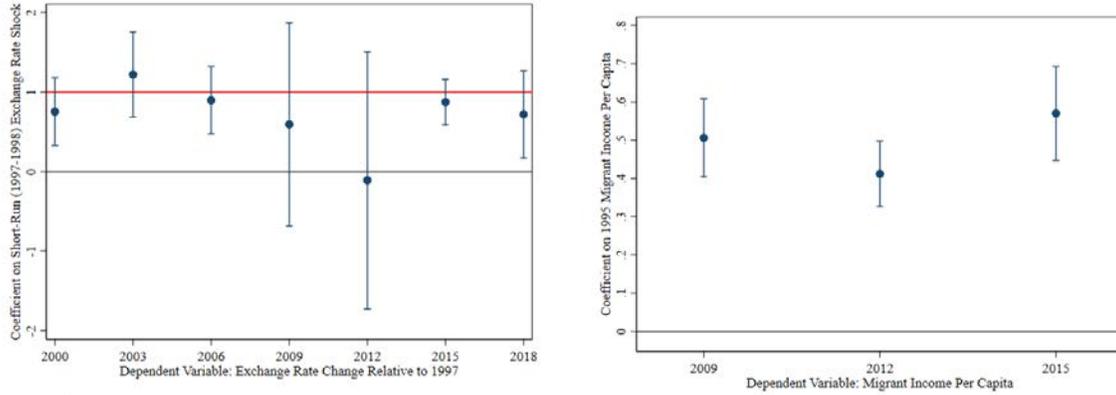
Figure A1: Exchange Rate Shocks Due to 1997 Asian Financial Crisis



Notes: Data are from World Development Indicators. Annual average nominal exchange rates are in units of foreign currency per Philippine peso, normalized to 1 in 1996, for 8 large sources of international migrant income for Philippine provinces. Vertical dashed line indicates 1997 (year of the Asian Financial Crisis).

<sup>51</sup>The functional forms for the path of migrant income and rate of returns on savings are as follows:  $m_t = \frac{5.57t^2 + 7.14t - 8.72}{t^2 + 3t}$  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.

Figure A2: Persistence of Exchange Rate Shock and Province-Destination Migrant Income

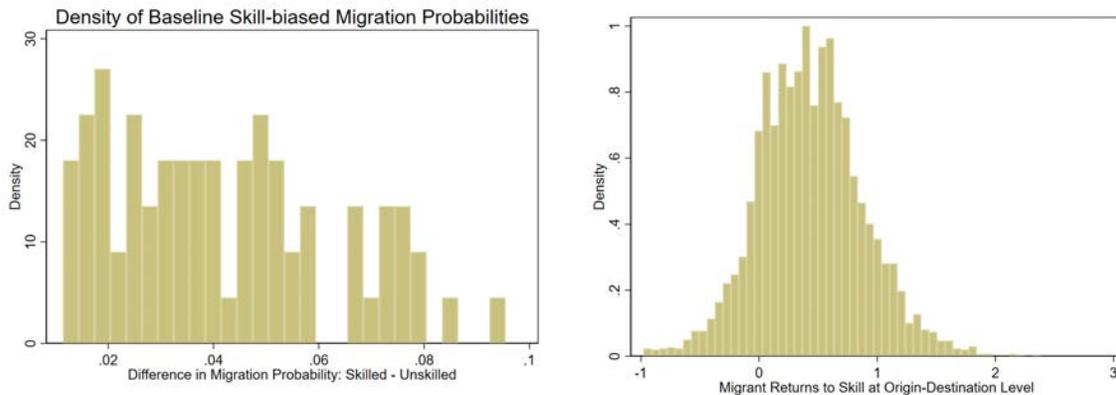


(a)  $\tilde{\Delta}R_d$  and Future Exchange Rate Changes

(b) Province-Destination Migrant Income

Notes: (a) Coefficient estimates from regressing destination exchange rate changes relative to 1997 for 2000-2018 triennially on  $\tilde{\Delta}R_d$ , weighted by 1995 migrant income shares ( $N = 104$ ). (b) Figure examines persistence from before to after the 1997 Asian Financial Crisis of  $\omega_{dot}$  (migrant income per capita of province  $o$  from destination  $d$ ). Figure displays coefficient estimates from regressing  $\omega_{dot}$  for 2009, 2012, and 2015 (respectively) on  $\omega_{d00}$  (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.

Figure A3: Skill Level, Migration Probabilities, and Migrant Wages

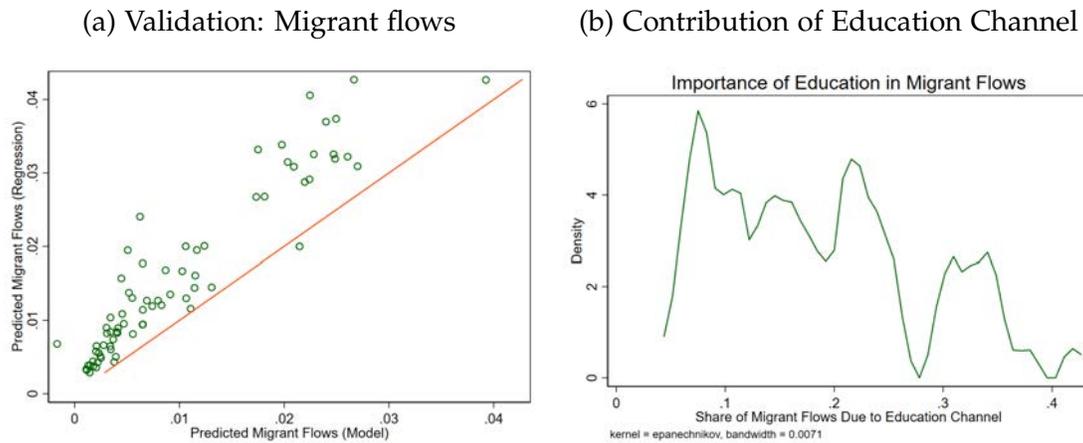


(a) Skilled-Unskilled Migration Probabilities

(b) Wage skill-premium among migrants

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  $\pi_{dos}$ . We similarly do this for unskilled workers in  $\pi_{dou}$ . 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 A4: Model Validation & Contribution of Education Channel in Migrant Flows

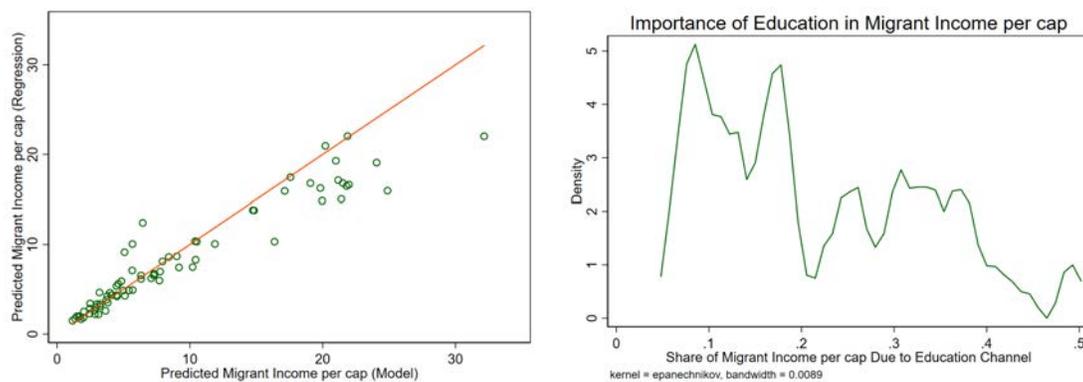


Notes: Figure A4a plots the predicted flows of migrants vs the predicted flows as determined by the components of Equation A10. The red line has an angle of 45 degrees. Each point represents a province. Figure A4b plots the province-level distribution of the contribution of the education channel in predicting migrant flows:

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

Figure A5: Model Validation & Contribution of Education in Migrant Income

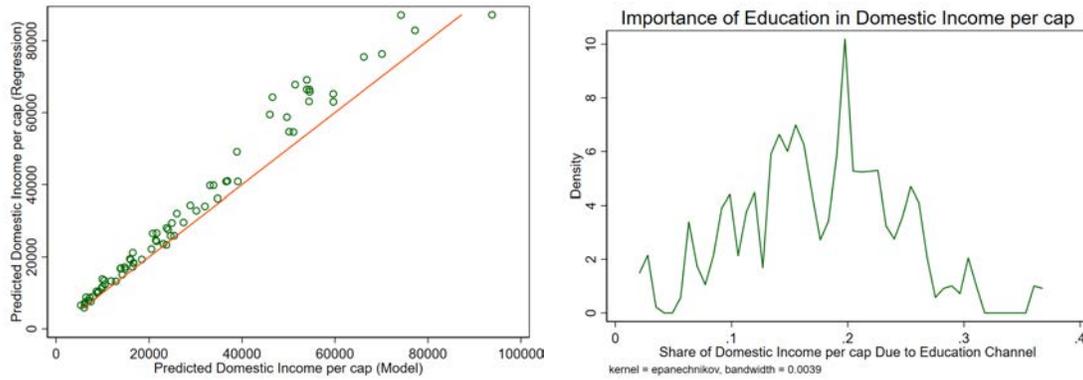
(a) Validation: Migrant Income per capita (b) Contribution of Education Channel



Notes: Figure A5a 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 A5b plots the province-level distribution of the contribution of the education channel in predicting migrant income per capita.

Figure A6: Model Validation & Contribution of Education in Domestic Income

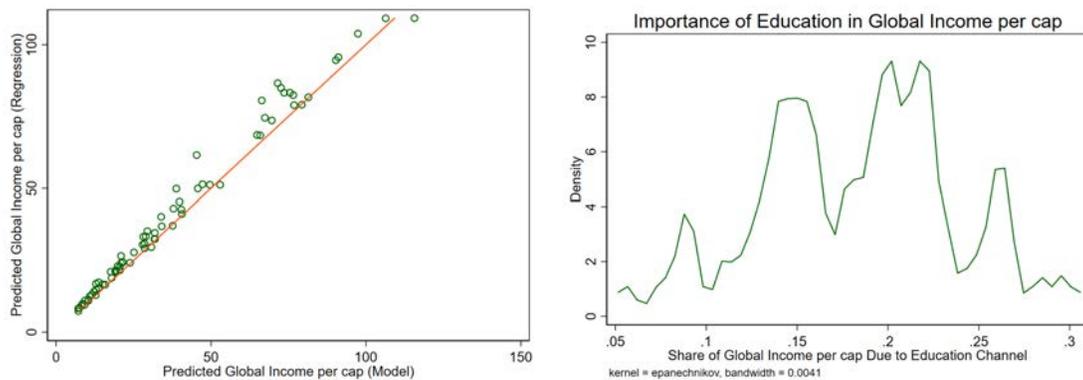
(a) Validation: Domestic Income per capita (b) Contribution of Education Channel



Notes: Figure A6a 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 A6b plots the province-level distribution of the contribution of the education channel in predicting domestic income per capita.

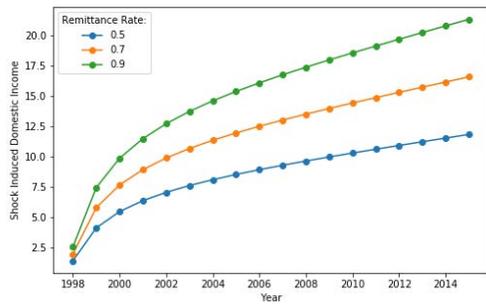
Figure A7: Model Validation & Contribution of Education to Global Income

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

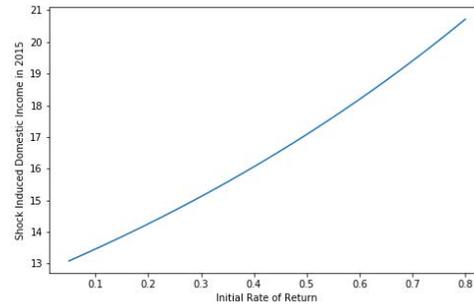


Notes: Figure A7a plots the predicted global income per capita (domestic plus migrant income) from the regressions vs the predicted global income per capita as determined by the education and exchange rate components. The red line has an angle of 45 degrees. Each point represents a province. Figure A7b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

Figure A8: Explaining Effect on Domestic Income: Sensitivity to Key Assump-  
tions



(a) Domestic Income Effects by Share of Mi-  
grant Income Spent at Origin ( $\alpha$ )



(b) Impact on Domestic Income by 2015, by  
Initial Rate of Return to Capital

Table A1: International Migration Policies and Programs of Developing Country Governments

|   | Panel A: Does the Government have any of the following institutions, policies or strategies to govern immigration or emigration? |                                     | Panel B: Does the Government take any of the following measures to maximize the positive development impact of migration and the socioeconomic well-being of migrants? |                                     |
|---|--|-------------------------------------|--|-------------------------------------|
|   | Number of Countries Responding Yes   | Percent of Countries Responding Yes | Number of Countries Responding Yes   | Percent of Countries Responding Yes |
| <i>A dedicated government agency to implement national migration policy</i>   | 66   | 94.29                               | <i>Align, through periodic assessments, labour migration policies with actual and projected labour market needs</i>  | 40<br>65.57                         |
| <i>A national policy or strategy for regular migration pathways, including labour migration</i>                             | 57   | 82.61                               | <i>Facilitate the portability of social security benefits</i>  | 39<br>66.10                         |
| <i>A national policy or strategy to promote the inclusion or integration of immigrants</i>                                  | 53   | 77.94                               | <i>Facilitate the recognition of skills and qualifications acquired abroad</i>   | 54<br>83.08                         |
| <i>A national policy or strategy on the emigration of its citizens</i>  | 39   | 62.90                               | <i>Facilitate or promote the flow of remittances</i>   | 49<br>77.78                         |
| <i>A dedicated Government unit, department or ministry for diaspora engagement, citizens abroad or overseas employment</i>  | 59   | 88.06                               | <i>Promote fair and ethical recruitment of migrant workers</i>   | 51<br>78.46                         |
| <i>Formal mechanisms to ensure that the migration policy is gender responsive</i>   | 38   | 57.58                               |  |                                     |
| <i>A mechanism to ensure that migration policy is informed by data, appropriately disaggregated</i>                         | 49   | 71.01                               |  |                                     |
| <i>An annual national report on migration that includes migration data collected by the Government and/or other sources</i> | 47   | 72.31                               |  |                                     |

Notes: Statistics are authors' tabulations for 70 countries using data from UN survey of governments (United Nations, 2019b). 70 countries in sample are developing countries (as defined by World Bank) with at least 1 million population in 2020.

Table A2: Migration & International Income Sources in the Philippine Population

| Year | Migrants as % of population | % of households with a migrant member | % of households with income from overseas |
|------|-----------------------------|---------------------------------------|---|
| 1990 | 0.7                         | 3.2                                   |   |
| 1991 |                             |                                       | 16.6                                      |
| 1994 |                             |                                       | 18.7                                      |
| 1995 | 1.1                         | 5.0                                   |   |
| 1997 |                             |                                       | 16.7                                      |
| 2000 | 1.3                         | 5.2                                   | 17.4                                      |
| 2003 |                             |                                       | 22.1                                      |
| 2006 |                             |                                       | 24.1                                      |
| 2007 | 1.6                         | 6.4                                   |   |
| 2009 |                             |                                       | 27.3                                      |
| 2010 | 1.6                         | 6.3                                   |   |
| 2012 |                             |                                       | 27.0                                      |
| 2015 | 2.2                         | 7.5                                   | 28.1                                      |
| 2018 |                             |                                       | 29.7                                      |

Note: Authors' calculations from the Philippine Census (1990, 1995, 2000, 2007, 2010, and 2015) and the triennial Family Income and Expenditure Survey (FIES, a nationally representative household survey) from 1991-2018 inclusive. Migrants as % of population is number of individuals reported as migrants divided by total population in Census. % of households with a migrant member is fraction of all households reporting a migrant member in Census. % of households with income from overseas is from FIES, and is share of households receiving "transfers from international sources" (not necessarily from a household member); this includes migrant remittances, but also includes pensions, retirement, workmen's compensation, and other benefits; cash gifts, support, relief, etc. from abroad; and dividends from investments abroad.

Table A3: Exchange Rate Shocks and Destination Characteristics

|                                  | Dependent Variable: Exchange Rate Change ( $\Delta R_{id}$ ) |                   |                   |                   |                  |                  |                   |
|----------------------------------|--|-------------------|-------------------|-------------------|------------------|------------------|-------------------|
|                                  | (1)  | (2)               | (3)               | (4)               | (5)              | (6)              | (7)               |
| 1995 GDP Per Capita              | -0.001<br>(0.007)  |                   |                   |                   |                  |                  | -0.004<br>(0.011) |
| Average Contract Salary          |  | -0.009<br>(0.248) |                   |                   |                  |                  | 0.144<br>(0.347)  |
| Share of Contracts Professional  |  |                   | -0.005<br>(0.188) |                   |                  |                  | -0.099<br>(0.339) |
| Share of Contracts Manufacturing |  |                   |                   | -0.137<br>(0.213) |                  |                  | -0.317<br>(0.253) |
| Share of all 1995 Contracts      |  |                   |                   |                   | 0.073<br>(1.011) |                  | 0.374<br>(1.152)  |
| 1994-1996 Exchange Rate Change   |  |                   |                   |                   |                  | 0.434<br>(0.435) | 0.085<br>(0.670)  |
| Observations                     | 104  | 104               | 104               | 104               | 104              | 104              | 104               |
| Dep. Var. Mean                   | 0.406  | 0.406             | 0.406             | 0.406             | 0.406            | 0.406            | 0.406             |
| Joint F-Test P-value             |  |                   |                   |                   |                  |                  | 0.833             |

Note: The table reports coefficients from regressions of the exchange rate shock on baseline destination characteristics, weighting by baseline migrant income in each destination. Standard deviation of the dependent variable is 0.138. GDP per capita is in thousands 1995 USD. Average contract salary is in millions 2010 PHPs (17.8 PhP per PPP US\$ in 2010). Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table A4: Baseline Province Characteristics and Shock Components

|  | Share Rural          | Asset Index           | Baseline Total Income Per Capita | Baseline Expenditure Per Capita |
|--|----------------------|-----------------------|----------------------------------|---------------------------------|
| <b>Panel A. MigInc<sub>00</sub> only</b> |                      |                       |                                  |                                 |
| <i>MigInc<sub>00</sub></i>               | -0.029<br>(0.010)*** | 0.277<br>(0.037)***   | 2.341<br>(0.540)***              | 1.876<br>(0.396)***             |
| <b>Panel B. Rshock<sub>o</sub> only</b>  |                      |                       |                                  |                                 |
| <i>Rshock<sub>o</sub></i>                | 1.696<br>(0.568)***  | -10.631<br>(3.330)*** | -70.338<br>(36.708)*             | -61.424<br>(28.290)**           |
| <b>Panel C. Z<sub>o</sub></b>            |                      |                       |                                  |                                 |
| <i>Z<sub>o</sub></i>                     | 0.241<br>(0.351)     | -1.754<br>(1.524)     | -27.036<br>(19.556)              | -17.224<br>(14.293)             |
| <i>MigInc<sub>00</sub></i>               | -0.121<br>(0.147)    | 0.960<br>(0.635)      | 13.088<br>(8.268)                | 8.688<br>(6.034)                |
| <i>Rshock<sub>o</sub></i>                | 0.430<br>(0.907)     | 0.415<br>(3.844)      | 60.848<br>(51.209)               | 30.151<br>(37.515)              |
| <i>N</i>                                 | 74                   | 74                    | 74                               | 74                              |
| Dep. Var. Mean                           | 0.643                | -0.636                | 29.903                           | 24.371                          |
| Dep. Var. SD                             | 0.193                | 1.023                 | 10.584                           | 8.106                           |

Note: Table reports coefficients from three regressions for each baseline province characteristic: regressing (a) only on baseline migrant income per capita *MigInc<sub>00</sub>*, (b) only on income weighted exchange rate shock *Rshock<sub>o</sub>*, and (c) their interaction,  $Z_{o,post} = MigInc_{00} \times Rshock_o$ , with controls for the main effects of *MigInc<sub>00</sub>* and *Rshock<sub>o</sub>*. Income and expenditure are in thousand 2010 PhP (17.8 PhP per PPP US\$ in 2010). Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table A5: Effects of Migrant Income Shock on Internal Migration

|   | Census: 1990, 2000, 2010       |                                 |                                 |                                |                                 |                                 |
|---|--------------------------------|---------------------------------|---------------------------------|--------------------------------|---------------------------------|---------------------------------|
|   | Age: 25 - 64                   |                                 |                                 | Age: 16 - 24                   |                                 |                                 |
|   | (1)<br>In<br>Migration<br>Rate | (2)<br>Out<br>Migration<br>Rate | (3)<br>Net<br>Migration<br>Rate | (4)<br>In<br>Migration<br>Rate | (5)<br>Out<br>Migration<br>Rate | (6)<br>Net<br>Migration<br>Rate |
| <i>Panel A. Destination controls only</i>         |                                |                                 |                                 |                                |                                 |                                 |
| $Z_o \times Post_t$                               | -0.002<br>(0.023)              | -0.016<br>(0.012)               | -0.013<br>(0.033)               | -0.007<br>(0.028)              | -0.047<br>(0.021)**             | -0.040<br>(0.046)               |
| <i>Panel B. Destination and province controls</i> |                                |                                 |                                 |                                |                                 |                                 |
| $Z_o \times Post_t$                               | 0.001<br>(0.015)               | -0.017<br>(0.013)               | -0.019<br>(0.025)               | -0.003<br>(0.020)              | -0.053<br>(0.017)***            | -0.050<br>(0.033)               |
| Obs.  | 207                            | 207                             | 207                             | 207                            | 207                             | 207                             |
| Dep. Var. Mean                                    | 0.027                          | 0.026                           | -0.001                          | 0.032                          | 0.043                           | 0.012                           |

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 (PSA). 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 3. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table A6: Distribution of Education by Occupation

| Occupation   |           | 1995   | 2007-9 | 2010-2 | 2013-5 |
|--------------|-----------|--------|--------|--------|--------|
| Professional | Mean      | 13.9   | 15.1   | 15.2   | 15.1   |
|              | Std. Dev. | (1.35) | (0.85) | (0.71) | (0.81) |
| Production   | Mean      | 12.9   | 12.8   | 12.9   | 12.9   |
|              | Std. Dev. | (0.78) | (0.80) | (0.78) | (0.75) |
| Services     | Mean      | 12.6   | 12.7   | 12.6   | 12.6   |
|              | Std. Dev. | (0.34) | (0.39) | (0.35) | (0.32) |

Notes: Table shows the average years of education by major occupation category. The last three columns present summary stats from three years of data. Years of education for each occupation are obtained from the by calculating the mean years of education for each occupation across the 1992 through 2003 Survey of Overseas Filipinos and matched by occupation POEA/OWWA contract database. We then calculate average years of education for all migrants with occupations contained within this major occupation category.

Table A7: Estimating  $\theta$  using Poisson Pseudo-maximum Likelihood

|                     | OLS                | PPML               | PPML               |
|---------------------|--------------------|--------------------|--------------------|
|                     | Change in Migrants |                    |                    |
| Log( $\Delta R_d$ ) | 9.374*<br>(5.146)  | 3.471**<br>(1.720) | 3.417**<br>(1.707) |
| Observations        | 26,344             | 24,788             | 24,788             |
| Fixed Effects       | Origin x Skill     | None               | Origin x Skill     |

Note: OLS and PPML estimates of  $\theta$  using the migration response to a destination shock, at the origin-destination-skill level. Standard errors clustered at the destination level.  $\Delta R_d$  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 A8: Impacts on Domestic Income by Skill, Migrant Income, and Migrant Shares

|   | 1994, 2009, 2012, and 2015                      |   |                                      | Census                              |
|---|---|---|--------------------------------------|-------------------------------------|
|   | (1)<br>Domestic Income<br>Per Capita<br>Skilled | (2)<br>Domestic Income<br>Per Capita<br>Unskilled | (3)<br>Migrant Income<br>Per Migrant | (4)<br>Migrant Share<br>Age 20 - 64 |
| <i>Panel A. Destination controls only</i>         |   |   |                                      |                                     |
| $Z_o \times \text{Post}_t$                        | 57.373<br>(20.955)***                           | 15.144<br>(5.485)***                              | 98.761<br>(118.020)                  | 0.007<br>(0.012)                    |
| <i>Panel B. Destination and province controls</i> |   |   |                                      |                                     |
| $Z_o \times \text{Post}_t$                        | 28.080<br>(12.336)**                            | 12.036<br>(5.149)**                               | 163.357<br>(134.513)                 | 0.010<br>(0.012)                    |
| Obs.  | 296   | 296   | 296                                  | 444                                 |
| Dep. Var. Mean                                    | 69.277  | 25.132  | 319.519                              | 0.018                               |

Note: Unit of observation is the province-year. Overseas worker rate values are from the Census and covers 1990, 1995, 2000, 2007, 2010, and 2015. Migrant income per migrant is calculated from POEA/OWWA data. 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 3. All regressions include province and year fixed effects. Standard errors are exposure-robust, accounting for correlation of shocks across provinces, based on estimation of shock-level regressions (Borusyak et al., 2022). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

Table A9: Overall Changes and Model-based Decomposition of Flows and Income

|                                 | Migrant Flows | Domestic Income | Migrant Income | Global Income |
|---------------------------------|---------------|-----------------|----------------|---------------|
| Mean                            | 0.020         | 27.811          | 4.087          | 31.899        |
| Std. Dev.                       | (0.015)       | (9.816)         | (2.993)        | (11.830)      |
| Impact of 1-std.-dev. shock     | <b>0.001</b>  | <b>1.836</b>    | <b>0.464</b>   | <b>2.300</b>  |
| Increase as % of mean           | 4.5%          | 6.6%            | 11.3%          | 7.2%          |
| Share of global income increase | —             | 79.8%           | 20.2%          | 100.0%        |
| Model-based decomposition:      |               |                 |                |               |
| Education channel               | 18.6%         | 17.6%           | 21.6%          | 18.4%         |
| Exchange rate channel           | 37.7%         | —               | 83.7%          | 16.9%         |
| Direct wage channel             | —             | 69.6%           | —              | 55.6%         |
| Explained by model              | 56.3%         | 87.2%           | 105.3%         | 90.8%         |

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 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. For instance, the education channel explains 42.3% of the increase in migrant income.

## 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:

$$V_{idost} = w_{dst} R_{dt} (1 - \tau_{dost}) q_{id} \epsilon_{dot} \equiv \widetilde{w}_{dost} q_{id} \quad \text{A16}$$

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

$$\begin{aligned} \pi_{1ost} &= Pr \left[ \widetilde{w}_{1ost} q_1 > \widetilde{w}_{d'ost} q_{d'} \right] \quad \forall d' \neq 1 \\ &= Pr \left[ q_{d'} < \frac{\widetilde{w}_{1ost} q_1}{\widetilde{w}_{d'ost}} \right] \quad \forall d' \neq 1 \\ &= \int \frac{dF}{dq_1} (q_1, \alpha_2 q_1, \dots, \alpha_D q_1) dq_1 \end{aligned} \quad \text{A17}$$

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:

$$F(q_1, \dots, q_D) = exp \left\{ - \left[ \sum_{d=1}^D q_d^{-\theta} \right] \right\} \quad \text{A18}$$

So the derivative of the CDF is given by:

$$\frac{dF}{dq} = \theta q^{-\theta-1} exp \left\{ - \left[ \sum_{d=1}^D q_d^{-\theta} \right] \right\} \quad \text{A19}$$

This derivative evaluated at  $(q_1, \alpha_2 q_1, \dots, \alpha_D q_1)$ , allows us to determine the prob-

ability of choosing destination 1:

$$\begin{aligned}
\pi_{1ost} &= \int \theta q^{-\theta-1} \exp \left\{ - \left[ \sum_{d=1}^D (\alpha_d q)^{-\theta} \right] \right\} dq \\
&= \frac{1}{\sum_{d=1}^D \alpha_d^{-\theta}} \int \left( \sum_{d=1}^D \alpha_d^{-\theta} \right) q^{-\theta-1} \exp \left\{ - \left[ q^{-\theta} \left( \sum_{d=1}^D \alpha_d^{-\theta} \right) \right] \right\} dq \\
&= \frac{1}{\sum_{d=1}^D \alpha_d^{-\theta}} \int dF(q) \\
&= \frac{1}{\sum_{d=1}^D \alpha_d^{-\theta}} \cdot 1 \\
&= \frac{\widetilde{w_{1ost}}^{-\theta}}{\sum_{d=1}^D \widetilde{w_{dost}}^{-\theta}}
\end{aligned} \tag{A20}$$

The third line comes from the properties of the Fréchet distribution, where we know that the term in the integral of the second line is simply the PDF with a shape parameter  $\theta$ , 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 (2):

$$\pi_{dost} = \frac{(w_{dst} R_{dt} (1 - \tau_{dot}) \epsilon_{dot})^\theta}{\sum_k (w_{kst} R_{kt} (1 - \tau_{kot}) \epsilon_{kot})^\theta} \tag{A21}$$

## 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  $I$ :

$$c_{1io} = Y_{io} - p_o S_{io} + b_{io} \quad \text{and} \quad c_{2io} = V_{idost} - I_o b_{io}, \tag{A22}$$

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:

$$\Delta \ell_{oh} = \frac{1}{\Psi} \Delta Y_o = \frac{1}{\Psi} \sum_{s=h,u} \left[ \ell_{os0} \sum_d (\pi_{dos0} w_{dos0} \Delta R_{d0}) \right] = \frac{1}{\Psi} \underbrace{\sum_d \omega_{do0}}_{MigInc_o} \times \underbrace{\frac{\sum_d \omega_{do0} \tilde{\Delta} R_d}{\sum_d \omega_{do0}}}_{Rshock_o} \quad \text{A8}$$

**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:

$$S_i^u = \frac{w'(s)_d (1 - \tau_{dot}) R_{dt} q_{id} - p_1}{2p_2} \quad \text{A23}$$

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:

$$S_{do}^u = \frac{w'(s)_d (1 - \tau_{dot}) R_{dt} \pi_{dot}^{\frac{-1}{\theta}} \Gamma - p_1}{2p_2} \quad \text{A24}$$

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

$$S_o^u = \sum_d S_{do}^u \pi_{dot} = \sum_d \frac{w'(s)_d (1 - \tau_{dot}) R_{dt} \pi_{dot}^{\frac{-1}{\theta} + 1} \Gamma - p_1}{2p_2} \quad \text{A25}$$

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

$$\Delta S_o^u = \sum_d \frac{w'(s)_d (1 - \tau_{dot}) \theta \pi_{dot} \Gamma}{2p_2} \frac{\Delta R_{dt}}{R_{dt}} \quad \text{A26}$$

If  $\delta$  fraction of the population is credit constrained, then the education response will also depend on  $\delta$ . 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 A22, 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:

$$pu'(c_1) = w'(S)u'(c_2) \quad \text{A27}$$

For continuous, increase and concave utility and earnings functions, using the implicit function theorem, we can show education is an increasing function of income  $\frac{\Delta S}{\Delta Y} > 0$ .<sup>52</sup> 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:  $\frac{p\alpha}{Y^{-p}S} = \frac{\alpha}{w(S)}w'(S)$ .

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  $\beta$ , then both the education and skill-share response will be scaled by  $\frac{\beta}{1+\beta}$ .

### S3 Deriving the changes in $\pi_{dost}$

Flows from origin  $o$  to destination  $d$  are given by Equation A21. We define  $V_{ost}$  as the denominator of Equation A21. 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 A21 to be  $V_{dost} = (w_{dst}R_{dt}(1-\tau_{dot})\epsilon_{dot})^\theta$ .

$$\pi_{dost} = \frac{(w_{dst}R_{dt}(1-\tau_{dot})\epsilon_{dot})^\theta}{\sum_k (w_{kst}R_{kt}(1-\tau_{kot})\epsilon_{kot})^\theta} \equiv \frac{V_{dost}}{V_{ost}} \quad \text{A21}$$

We can take the total derivative of these flows with respect to changes (derivative) in the exchange rate for one specific destination  $\Delta R_{dt}$ :<sup>53</sup>

$$\Delta\pi_{dost} = \underbrace{\frac{((1-\tau_{dot})\epsilon_{dot})^\theta}{V_{ost}} \left( w_{dst}^\theta \theta R_{dt}^{\theta-1} \Delta R_{dt} + R_{dt}^\theta \theta w_{dst}^{\theta-1} \Delta w_{dst} \right)}_{\text{from the numerator of Equation A21}} - \underbrace{\frac{V_{dost}}{V_{ost}^2} \Delta V_{ost}}_{\text{from the denominator of Equation A21}} \quad \text{A28}$$

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

<sup>52</sup>To 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  $\frac{\Delta S}{\Delta Y} > 0$ .

<sup>53</sup>Here, and elsewhere, we use  $\Delta$  to denote a derivative, as  $d$  is already used for destinations.

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  $\pi_{dost}$  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:

$$\Delta\pi_{dost} = \underbrace{\theta\pi_{dost} \left( \frac{\Delta R_{dt}}{R_{dt}} + \underbrace{\frac{\Delta w_{dst}}{w_{dst}}}_{=0 \text{ if } o \neq d} \right)}_{\text{from the numerator of Equation A21}} - \underbrace{\frac{\pi_{dost}}{V_{ost}} \Delta V_{dost}}_{\text{from denominator of Equation A21}} \quad \text{A29}$$

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  $d$ :

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

This can be rewritten as:

$$\Delta\pi_{dost} = \theta\pi_{dost} \left[ \underbrace{\frac{\Delta R_{dt}}{R_{dt}}}_{\text{Direct effect}} - \left( \underbrace{\sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Indirect resorting}} + \underbrace{\pi_{oost} \frac{\Delta w_{ost}}{w_{ost}}}_{\text{Domestic earnings stemming flows}} \right) \right] \quad \text{A31}$$

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 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

$$\sum_{d \neq o} \Delta\pi_{dost} = \theta \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \left[ 1 - \sum_{d \neq o} \pi_{dost} \right] \right) - \left( \theta \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \left[ \sum_{d \neq o} \pi_{dost} \right] \right) \quad \text{A32}$$

$$\sum_{d \neq o} \Delta \pi_{dost} = \underbrace{\pi_{oost} \left[ \theta \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) \right]}_{\text{Exchange rates driving outflows}^*} - \underbrace{[1 - \pi_{oost}] \left( \theta \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Domestic earnings stemming outflows}^*} \quad \text{A33}$$

Alternatively, we could separate out the indirect sorting effects:

$$\begin{aligned} \sum_{d \neq o} \Delta \pi_{dost} = & \underbrace{\theta \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rates driving outflows}} - \underbrace{\theta \left( \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Domestic earnings stemming outflows}} \\ & - \underbrace{\theta \left[ \sum_{d \neq o} \pi_{dost} \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) - \left[ 1 - \sum_{d \neq o} \pi_{dost} \right] \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right]}_{\text{Indirect resorting}} \end{aligned} \quad \text{A34}$$

#### 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:

$$\pi_{doht} \ell_{oht} + \pi_{dout} \ell_{out} \quad \text{A35}$$

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 A31:

$$\Delta Flows_{dot} = \underbrace{\Delta \ell_{oht} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in flows}} + \underbrace{\theta (\ell_{oht} \pi_{doht} + \ell_{out} \pi_{dout}) \frac{\Delta R_{dt}}{R_{dt}}}_{\text{Exchange rate channel in direct flows}} \quad \text{A36}$$

The second part above (exchange rate channel in direct flows) comes straight from the first part (direct effect) of Equation A31 replaced into Equation A35.

Equation A33 allows us to derive  $\Delta Flows_{ot} \equiv \sum_{d \neq o} \Delta Flows_{dot}$ :

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in outflows}} + \underbrace{\theta \sum_{d \neq o} (\ell_{oht} \pi_{ooht} \pi_{doht} + \ell_{out} \pi_{oout} \pi_{dout}) \frac{\Delta R_{dt}}{R_{dt}}}_{\text{Exchange rate channel in outflows (from Equation A33 part 1)}} \\ & - \theta \underbrace{\left( \ell_{oht} [1 - \pi_{ooht}] \pi_{ooht} \frac{\Delta w_{oht}}{w_{oht}} + \ell_{out} [1 - \pi_{oout}] \pi_{oout} \frac{\Delta w_{out}}{w_{out}} \right)}_{\text{Domestic earnings stemming outflows (from Equation A33 part 2)}} \end{aligned} \quad \text{A37}$$

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

$$\begin{aligned} \Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in outflows}} \quad \text{A38} \\ & + \theta \left[ \underbrace{\ell_{oht} \pi_{ooht} \sum_{d \neq o} \left( \pi_{doht} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rate driving skilled outflows}^*} + \underbrace{\ell_{out} \pi_{oout} \sum_{d \neq o} \left( \pi_{dout} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rate driving unskilled outflows}^*} \right] \\ & - \theta \left[ \underbrace{\ell_{oht} [1 - \pi_{ooht}] \pi_{ooht} \frac{\Delta w_{oht}}{w_{oht}}}_{\text{Domestic earnings stemming skilled outflows}^*} + \underbrace{\ell_{out} [1 - \pi_{oout}] \pi_{oout} \frac{\Delta w_{out}}{w_{out}}}_{\text{Domestic earnings stemming unskilled outflows}^*} \right] \end{aligned}$$

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 A34:

$$\begin{aligned}
\Delta Flows_{ot} = & \underbrace{\Delta \ell_{oht} \sum_{d \neq o} (\pi_{doht} - \pi_{dout})}_{\text{Education channel in outflows}} - \underbrace{\chi_o}_{\text{Indirect re-sorting}} & \text{A10} \\
& + \theta \left[ \underbrace{\ell_{oht} \sum_{d \neq o} \left( \pi_{oht} \frac{\Delta R_{dt}}{R_{dt}} \right) + \ell_{out} \sum_{d \neq o} \left( \pi_{dout} \frac{\Delta R_{dt}}{R_{dt}} \right)}_{\text{Exchange rate driving outflows by skill group}} \right] \\
& - \theta \left[ \underbrace{\ell_{oht} \pi_{ooht} \frac{\Delta w_{oht}}{w_{oht}} + \ell_{out} \pi_{oout} \frac{\Delta w_{out}}{w_{out}}}_{\text{Domestic earnings stemming outflows by skill group}} \right]
\end{aligned}$$

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):

$$\sum_{s=h,u} \ell_{ost} \pi_{oost} w_{oost} \quad \text{A39}$$

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.

$$\begin{aligned}
\Delta W_{ot} = & \underbrace{\sum_{s=h,u} \ell_{ost} \pi_{oost} (\Delta w_{ost})}_{\text{Direct wage channel}} + \underbrace{\Delta \ell_{oht} \left( \underbrace{w_{oht} \pi_{ooht}}_{\text{skilled wage at home}} - \underbrace{w_{out} \pi_{oout}}_{\text{unskilled wage at home}} \right)}_{\text{Education channel in domestic earnings}} & \text{A13}
\end{aligned}$$

Yet, overall income generated by the individuals that originate from these regions changes by more than simply these components.<sup>54</sup> This is because, the location choices of individuals change as well, in response to lucrative exchange

<sup>54</sup>This concept of global income of individuals from a region is similar to that of national product, rather than domestic product.

rates, and domestic wage increases. If wage rates increase, then more people may remain behind locally, and earn at home:  $\Delta\pi_{oost}$ . We can return to Equation A29, and set  $d = o$ , and  $\Delta R_{ot} = 0$ . But this time,  $\Delta w_{ost} \neq 0$ . So the analogue of Equation A31 is given by:

$$\Delta\pi_{oost} = \theta\pi_{oost} \left[ \underbrace{\frac{\Delta w_{ost}}{w_{ost}}}_{\text{Remainers}} - \underbrace{\left( \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Indirect resorting}} \right] \quad \text{A40}$$

There is also the indirect effect once again. Even if wages do not increase at home, more workers may stay behind if exchange rates abroad become less favorable.

How does  $\Delta\pi_{oost}$  contribute to domestic earning increases? We can replace the result for  $\Delta\pi_{oost}$  above into Equation A39, and get  $\sum_{s=h,u} \ell_{ost} \theta \pi_{oost} \Delta w_{ost} - \tilde{\chi}_{o1}$ , where  $\tilde{\chi}_{o1}$  is the indirect resorting channel's contribution.

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

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

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

$$\Delta\ell_{oht} \left( \underbrace{\sum_{d \neq o} w_{doht} \pi_{doht} R_{dt}}_{\text{skilled wage abroad}} - \underbrace{\sum_{d \neq o} w_{dout} \pi_{dout} R_{dt}}_{\text{unskilled wage abroad}} \right) \quad \text{A42}$$

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 A31, 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:

$$\Delta\pi_{dost} = \theta\pi_{dost} \left[ \underbrace{\frac{\Delta R_{dt}}{R_{dt}}}_{\text{Direct effect}} - \underbrace{\left( \sum_{d \neq o} \left( \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} \right) + \pi_{oost} \frac{\Delta w_{ost}}{w_{ost}} \right)}_{\text{Indirect resorting}} \right] \quad \text{A31}$$

Again, the indirect resorting channel depends on the relative changes to exchange rates in other destinations. From Equation A41, we can see that the changes to income are driven by (1)  $\Delta\ell_{ost}$  (shown in Equation A42), (2)  $\Delta\pi_{dost}$  (shown in Equation A31), and (3) just direct changes to  $\Delta R_{dt}$  (say, in the short run). Since Equation A42 already documents how changes to skill affect income, let us concentrate on (2) and (3) here:

$$\sum_{s=h,u} \ell_{ost} \sum_d \Delta\pi_{dost} w_{dost} R_{dt} + \sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt} \quad \text{A43}$$

Replacing the result from Equation A31 in the first part of the equation above, we know:

$$\sum_{s=h,u} \ell_{ost} \sum_d \theta \pi_{dost} \frac{\Delta R_{dt}}{R_{dt}} w_{dost} R_{dt} - \tilde{\chi}_{o2} + \sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt} \quad \text{A44}$$

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 A31). Rewriting this in terms of the initial shock  $\Delta Y_o$ :

$$\underbrace{\theta \sum_{s=h,u} \ell_{ost} \sum_d \theta \pi_{dost} w_{dost} \Delta R_{dt}}_{\Delta Y_o = \text{Migrant Earnings Shock}} + \underbrace{\sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt}}_{\text{Short run } \Delta c_{1o} = \Delta Y_o} - \tilde{\chi}_o \quad \text{A45}$$

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

$$\underbrace{\sum_{s=h,u} \left[ \ell_{ost} \pi_{oost} \left( \underbrace{\frac{\Delta w_{ost}}{w_{ost}}}_{\text{Direct wage channel}} + \underbrace{\frac{\theta \Delta w_{ost}}{w_{ost}}}_{\text{Remainers channel}} \right) \right]}_{\text{Domestic earnings due to firm-side responses}} - \tilde{\chi}_o + \underbrace{\theta \left( \sum_{s=h,u} \ell_{ost} \sum_d \pi_{dost} w_{dost} \Delta R_{dt} \right)}_{\Delta Y_o = \text{Migrant Earnings Shock}} \quad \text{Earnings from Abroad: Exchange Rate Channel} \quad \text{A46}$$