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Liquidity, Local Opportunities, and Policy Design

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Abstract

Cross-border migration from developing countries has grown rapidly in recent decades. This paper examines how development policies shape local labor allocation and emigration, using Guatemala as a case study. We develop a theoretical framework in which a household member chooses whether to work in the tradable or non-tradable sector in her region, migrate internally, or emigrate. Heterogeneity in individual skills and regional productivity, together with migration costs, generates an inverted U-shaped relationship between income and emigration, which is pronounced in the less developed region and considerably flatter in the more developed one. We calibrate the model using detailed micro and aggregate data and simulate the effects of household transfers, productivity-enhancing interventions, reductions in migration costs, and policy responses to external shocks on emigration and welfare. Temporary transfers and reductions in migration costs increase emigration by relaxing liquidity constraints, particularly among lower-income households for whom migration costs are binding, whereas permanent transfers and productivity-enhancing interventions reduce it by raising the value of staying. The magnitude and direction of migration responses therefore depend on policy design, including targeting, duration, and financing, as well as on the underlying mechanisms.

Keywords: International migration, development practices, labor mobility, welfare, Guatemala

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1 Introduction

International migration has expanded substantially in recent decades and plays a central role in many developing economies. According to the International Organization for Migration (IOM, 2022), cross-border migration surged by 107 million over the last two decades, reaching 281 million international migrants worldwide in 2020 (equivalent to 3.6% of the world population), with Europe and the United States (US) as the main destinations. Many migrants originate from rural areas in developing countries (FAO, 2016) and leave their homes due to multiple, often overlapping factors, including socioeconomic constraints, food insecurity, climatic shocks, and conflict or violence, with migration serving as an important adaptation strategy to improve livelihoods and build resilience (Piguet et al., 2011; Barchfield, 2021; Josephson & Shively, 2021; Hernandez et al., 2023). In addition, emigration often occurs through irregular channels, defined as movements that take place outside the legal and regulatory frameworks of sending, transit, or receiving countries (IOM, 2019), exposing vulnerable migrants to considerable risks.[1]

In this context, immigration has become a central issue in policy debates concerning its implications for both origin and destination countries (see, e.g., Clemens, 2011; Clemens et al. (2019); Clemens & Pritchett, 2019; Alesina & Tabellini, 2024). Migration has also gained prominence in developing countries' policy agendas, with 94% of 70 developing countries with populations exceeding one million having a dedicated government agency implementing migration policy (Khanna et al., 2026). Until recently, substantial foreign aid was also directed toward addressing the root causes of irregular migration, with the aim of discouraging emigration to Europe and the US (Clemens & Postel, 2018). Notable examples include the European Union Emergency Trust Fund for Africa (EUTF), which pledged around 5 billion Euros since 2016, and the Biden Administration's US Strategy for Addressing the Root Causes of Migration in Central America, which proposed 4 billion US dollars over four years (CRS, 2024).[2]

[1] Estimations from the Missing Migrants Project of IOM indicate that over 50,000 people have lost their lives during migratory movements since 2014 (Black & Sigman, 2022).

[2] The EUTF was established following the 2015 spike in irregular migration to Europe to address the "root causes of instability, forced displacement, and irregular migration" and improve migration management. The US strategy emphasized long-term investments in socioeconomic development, security, and governance, as well as the use of migration data to better target assistance. This approach was substantially reversed in 2025, when most USAID programs were either terminated or transferred to the State Department,

Despite these discussions and commitments, Clemens & Postel (2018) remark that the evidence that aid can sustainably deter emigration from poor countries is inconclusive, as it requires both substantial improvements in origin-country conditions and a resulting decline, rather than an increase, in emigration.[3] In a related vein, Adhikari & Gentilini (2018) conclude that social assistance programs, especially cash transfers, may trigger migration among households already inclined to migrate, while social protection programs could play an important role in managing mobility, although further research is needed.

This paper examines the role of development policies in shaping aggregate local labor and emigration patterns and quantifies the welfare effects of alternative policy interventions, using the case of Guatemala as an example. The ultimate goal is to assess how alternative development policies affect local well-being and migration decisions. We develop a theoretical framework in which a household member has the option to work in the tradable or non-tradable sector in her region or to migrate internally or emigrate and receive an exogenous income. The model incorporates heterogeneous sector-specific skills and regional differences in aggregate productivity (level of development), allowing us to characterize labor and location choices across sectors and regions. The framework accommodates different policy interventions, including household transfers, productivity-enhancing investments, and reductions in migration costs, as well as policy responses to external shocks and targeted and non-targeted policy designs.

As we are particularly interested in modeling external migration dynamics, the setup incorporates relevant features linked to emigration decisions such as a fixed cost of migration and the extent of household networks in the foreign country. A key observed pattern in many developing countries is that emigrants generally originate from the poorest areas, but not necessarily from the poorest households, because migration costs can impose binding liquidity constraints (Mckenzie & Rapoport, 2007; Bazzi, 2017), especially when it is irregular. The model generates this inverted-U relationship within regions, with a more pronounced pattern in the low-development region, where liquidity constraints bind for a

substantially reducing US development assistance efforts in the region.

[3]More recently, Clist & Restelli (2021) and Restelli (2021) find that development aid does not significantly reduce migration, particularly irregular migration, to some European countries, while Fuchs et al. (2024) examine the global effects of foreign aid on migration and find that in the short term aid reduces individual migration preferences and asylum seeker flows but in the long term it increases income and leads to more regular migration. Gamso et al. (2021) document a negative association between adverse aid shocks and emigration using global cross-country data.

larger share of households. Modeling an inverted-U relationship between wealth and migration is critical for understanding the implications of different policies, depending on the nature and magnitude of their effects and whom they target (e.g., whether directed at the poorest or others within prioritized localities), and this regional heterogeneity implies that the same intervention can produce qualitatively different migration responses depending on where it is implemented.

Guatemala offers a pertinent setting to explore emigration patterns and assess the role of development policies. On one hand, the poverty rate is 56 percent and income inequality remains high, with a Gini coefficient of 45.2 (World Bank, 2025), while 46.5 percent of children under five years suffer from chronic malnutrition (MSPAS-INE-ICF, 2017). Insufficient income, low wages, and unemployment remain the main drivers of international migration in Guatemala, followed by family reunification, natural disasters, and insecurity (CAI, 2019; Soto et al., 2021). Net emigration has been substantial over the last two decades,[4] and the country is among the world's largest recipients of international remittances.[5] Most migrants originate from rural areas and migrate to the US, where apprehensions of Guatemalans at the border increased sharply between 2007 and 2022 (CRS, 2022; CRS, 2023).[6]

On the other hand, Guatemala is characterized by weak governance and limited public resources, which have constrained its capacity to address persistent socioeconomic challenges, insecurity, and natural disasters (CRS, 2024). The tax-to-GDP ratio ranged between 10 and 11.6 percent during 2010–2021 (World Bank, 2024), among the lowest in Latin America. At the same time, development assistance has played an important role in supporting economic and social programs. The United States has been by far the largest donor, with assistance focused on food security, governance, health and sanitation, emergency response, education, and agriculture.[7]

[4] According to the United Nations World Population Prospects database, net emigration from Guatemala amounted to approximately 856,000 people between 2002 and 2021 (`https://population.un.org/wpp/`, accessed September 2026).

[5] Family-related remittances reached over 15 billion US dollars in 2021, representing around 18% of Guatemala's GDP (Maldonado & Harris, 2022). Remittance inflows reached 19.1% of GDP in 2024 (World Bank, 2026).

[6] Apprehensions rose from 17,338 in fiscal year 2007 to 265,129 in 2019 and reached 228,220 in 2022, second only to Mexicans. Aggregate encounters eased during 2023 and 2024, before declining sharply in early 2025.

[7] Net official development assistance and official aid received exceeded 511 million US dollars in 2021

We calibrate the model to Guatemala using detailed micro (census and household) and aggregate data, replicating observed labor allocation and emigration patterns across regions with different levels of development. We then simulate alternative policy interventions and shocks to assess their implications for emigration and household welfare. The results highlight the central role of liquidity constraints in shaping migration responses. Temporary transfers and reductions in migration costs increase emigration by relaxing financial barriers to migration, with larger responses when interventions are targeted toward lower-income households. Permanent transfers instead reduce emigration by increasing the value of staying, while productivity-enhancing investments reduce emigration by improving local economic opportunities. The simulations also show that adverse shocks can affect migration through distinct income, liquidity, and migration-incentive channels, and that the effects of emergency compensation depend on the type and targeting of the policy response. More generally, the migration and welfare effects of development policies depend importantly on their design, including their targeting, duration, and financing. Overall, the analysis illustrates how the effects of development policies on international migration depend on policy design and the mechanisms through which they operate, and underscores that policies which relax liquidity constraints can increase emigration even as they improve local incomes.

The study contributes to several strands of the literature. First, the paper contributes to the literature on migration drivers from developing countries, focusing on the role of development programs. While it is well established that migration is driven by a wide set of "push" factors that encourage or force people to move away from their current location as well as "pull" factors that attract people to a new location (Rubenstein, J.M., 2017; World Bank, 2018),[8] less is known about how development policies shape these decisions through different supply and demand channels. We propose a theoretical framework and use rich data from Guatemala to examine the mechanisms underlying observed migration decisions and quantify how different development interventions affect local labor and emigration patterns. We are not aware of previous work that embeds the household-level inverted-U in a general equilibrium framework with endogenous prices and sectoral reallocation, or

(World Bank, 2024). In fiscal year 2024, US foreign assistance to Guatemala reached 271 million US dollars, ranking it among the largest recipients in the region, before declining to approximately 100 million in 2025 (`https://foreignassistance.gov/`, accessed September 2026).

[8]For an early review on the economics of international migration see Borjas (1999).

that characterizes how its shape varies with regional development within a country. We further characterize welfare effects and make some inferences about positive or negative selection into migration by portraying whether the most or least productive emigrate and whether this varies by the level of development of the region. The literature on selection from the developing world is still mixed (see, e.g., Chiquiar & Hanson, 2005; Orrenius & Zavodny, 2005; Borjas, 2008; Mckenzie & Rapoport, 2010; Grogger & Hanson, 2011; Moraga, 2011; Clemens & Mendola, 2024).

Second, the paper connects to the broader literature on the factors that affect labor decisions and mobility (e.g., Bryan et al., 2014; Brueckner & Lall, 2015; Munshi & Rosenzweig, 2016; Ngai et al., 2019; Asher & Novosad, 2020; Morten & Oliveira, 2023; Adamopoulos et al. (2024)). A growing subset of this literature examines how development policies affect emigration, although the evidence remains inconclusive. Some relatively recent examples examining particular policies such as unconditional and conditional cash transfer programs, land titling, health insurance programs, credit access, vocational training, and cash-for-work programs on migration include Cortina (2014), De Janvry et al. (2015), Angelucci (2015), Lopez Garcia (2018), Molina Millan et al. (2020), Cai (2020), Bah et al. (2023), and Gazeaud et al. (2023). Rather than analyzing a specific intervention, we examine how different types of policies affect emigration within a formal theoretical framework applied to the case of Guatemala.[9]

Third, the study relates to the discussion on the design of development policies to increase welfare, promote more equitable rural development, and reduce forced emigration from vulnerable areas. Mckenzie & Yang (2015) remark that there is an increasing interest in policies that can enhance the development benefits of international migration and mitigate the potential costs among migrants and sending communities (see also Yang, 2026). Adhikari & Gentilini (2018) additionally note that more research is needed to improve our understanding of the role of social assistance and protection programs on mobility and structural transformation across areas. More broadly, Karlan (2026) emphasizes the importance of distinguishing between the objectives of foreign aid and the design of interventions to achieve them, highlighting the role of evidence in identifying effective policy approaches.

[9]There is another strand of the literature directly examining the effect of migration deterrence policies at hosting countries on irregular migration (see, e.g., Czaika & Hobolth (2016) and Bazzi et al. (2021)), which is beyond the scope of this study.

Considering that development policies typically concentrate on poorer rural areas, but it is not always the poorest who emigrate, it is relevant to better understand how different policies are ultimately affecting existing disparities within and across areas with varying levels of development. This includes examining their effects on local labor decisions and emigration patterns. The framework allows us to evaluate these distributional implications across households and regions with different levels of development.

Finally, the study contributes to the broader debate on migration drivers from Latin America to the United States, amid the marked expansion of emigration from the region over the past decades, driven mainly by people seeking better economic opportunities (Hanson et al., 2023), and sustained encounters with unauthorized migrants at the US border.[10] Recent quantitative studies examine specific migration trigger factors using reduced-form empirical approaches. For example, Mahajan & Yang (2020) show that hurricanes increase migration to the US, with migrant networks facilitating post-disaster mobility, while Clemens (2021) finds that homicides in the Northern Triangle (El Salvador, Guatemala, and Honduras) raise undocumented migration and can generate self-reinforcing flows through migrant networks. Related work links drier-than-usual growing seasons and extreme temperatures to higher emigration from Central America (Linke et al., 2023; Ibañez et al., 2025). These contributions provide important evidence on how acute shocks influence migration decisions. Our paper instead focuses on how development interventions shape emigration incentives by embedding migration decisions in a structural framework with heterogeneous skills and migration costs to assess the effects of alternative policy designs.[11] A related structural approach is developed in Britos et al. (2025), who examine how distortions in agricultural markets shape emigration decisions in Guatemala.

The remainder of the paper is organized as follows. Section 2 presents motivating evidence about emigration and wealth trends in Guatemala. Section 3 describes the theoretical framework, detailing the model setup and solution. Section 4 calibrates the model

[10] `https://usafacts.org/articles/what-can-the-data-tell-us-about-unauthorized-immigration/` (accessed September 2026). See Abramitzky & Boustan (2017) for a general overview of immigration in the US and Massey & Riosmena (2010) for a discussion of undocumented migration from Latin America to the US and the limitations of US policies in a context of expanding migrant networks.

[11] Several additional studies characterize migrants from Central America to the US and the factors shaping their decisions using cross-sectional surveys, interviews, or anecdotal evidence (e.g., Cohn et al., 2017; CAI, 2019; NIF, 2019; Soto et al., 2021). While informative, these analyses typically rely on descriptive analysis rather than formal quantitative modeling of migration decisions.

for Guatemala using multiple data sources and discusses the estimation results. Section 5 presents simulations assessing the effects of alternative policy interventions on emigration patterns and household welfare. Section 6 provides concluding remarks.

2 Motivating evidence

In this section, we present important facts regarding the relationship between emigration and wealth (income) in Guatemala using Census and national household survey data. We distinguish between patterns at the aggregate and household level, which is key to our study and to understanding the potential role that different development policies and programs could be playing on emigration decisions. We also present some patterns on development interventions available at the sub-national level.

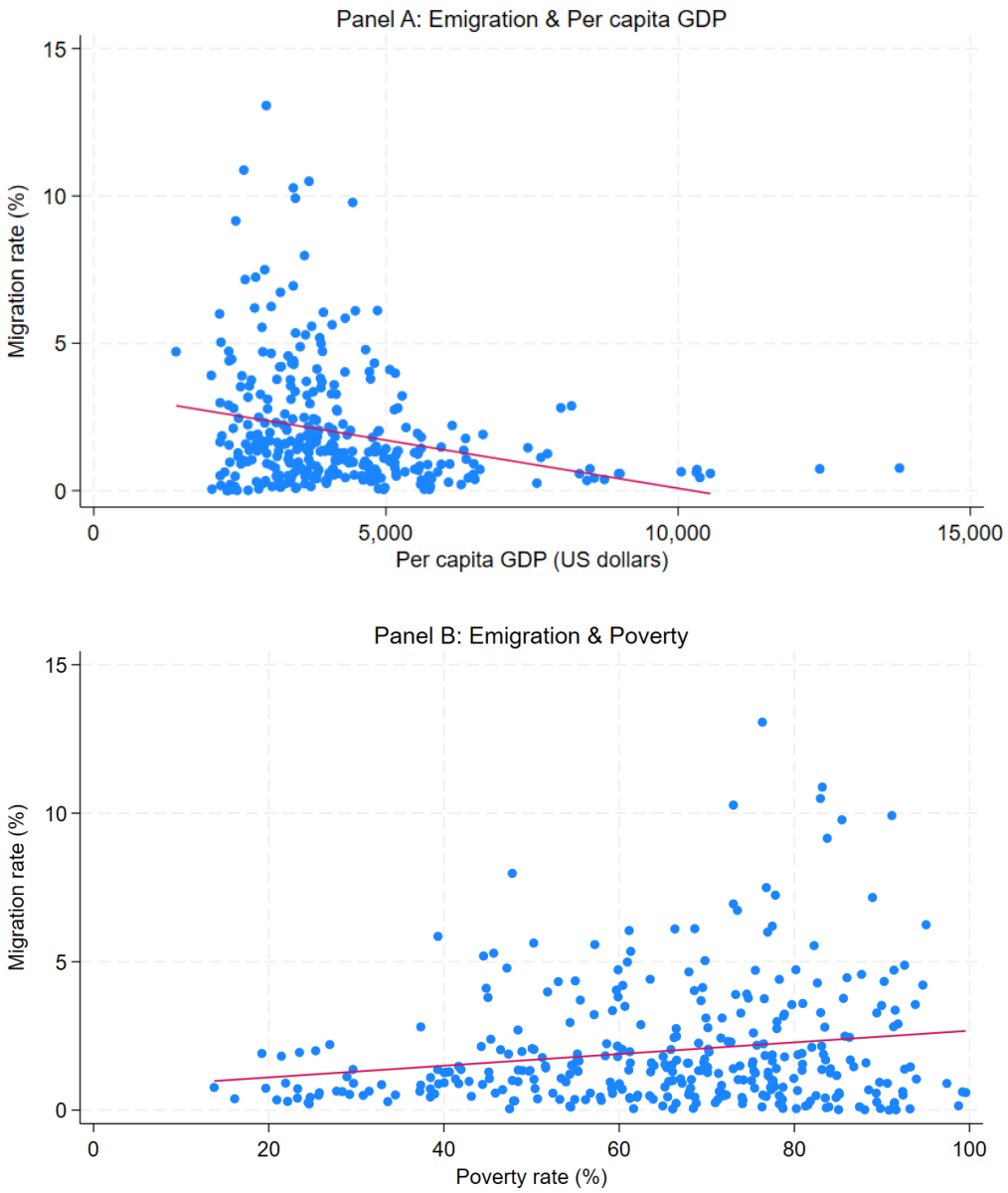
Figure 1 presents municipality-level scatterplots of the cumulative international migration rate (in percentage terms), defined as the total number of emigrants between 2002 and 2018 in each municipality divided by the municipality population, based on the 2018 Population and Housing Census (INE, 2020). Panel A plots the migration rate against per capita Gross Domestic Product (GDP), while Panel B plots it against the poverty rate.[12] The figure shows a negative relationship between emigration and income: municipalities with higher migration rates tend to have lower per capita GDP and, conversely, higher poverty rates.[13] Appendix Figure A1 complements this evidence by mapping the cumulative international migration rate (per 10,000 people) across municipalities. The map shows that emigrants are primarily concentrated in the Western Highlands and the Dry Corridor, regions characterized by high poverty rates, chronic malnutrition, and climate vulnerability (INE, 2015; Bouroncle et al., 2017; MSPAS-INE-ICF, 2017).

However, a closer look at the relationship between emigration and income at the household level reveals that it is not necessarily the poorest who emigrate. Appendix Figure A2 portrays the probability of a recent emigrant in a household as a function of household per capita expenditure (income) using data from the Living Standards Measurement Survey in

[12]Per capita GDP corresponds to 2017 and is obtained from FUNDESA (2018); the poverty rate corresponds to 2014 and is obtained from INE (2015).

[13]These relationships remain statistically significant after controlling for municipality distance to the Mexican border. Distance to the border is itself negatively associated with emigration, with municipalities located closer to Mexico exhibiting higher emigration rates.

Figure 1: Emigration and per capita GDP and poverty across municipalities



Note: Each circle in the figures represents a municipality. The migration rate (in percentage terms) is equivalent to the cumulative number of international migrants between 2002 and 2018 in each municipality divided by the population of the municipality in 2018 (INE, 2020). The per capita GDP is expressed in US dollars and corresponds to 2017 (FUNDESA, 2018). The poverty rate (in percentage terms) corresponds to 2014 (INE, 2015). Panel A reports the scatterplot of the migration rate against the per capita Gross Domestic Product (GDP) in the municipality, while Panel B reports the scatterplot of the migration rate against the poverty rate in the municipality. The line in each figure is the corresponding linear fit.

Guatemala (ENCOVI 2014) and shows an inverted-U relationship.[14] This pattern closely aligns with the nonlinear wealth-migration relationship that has been documented in other countries (e.g., Mckenzie & Rapoport, 2007, for Mexico; Bazzi, 2017, for Indonesia), typically attributed to liquidity constraints and migration costs.[15] The poorest are less likely to emigrate as migration can be costly (particularly when it is irregular), while the richest are less likely to emigrate due to the higher opportunity costs of leaving home.

A recent report by the World Bank that examines migration flows from North Central America (NCA) countries similarly documents that migrants in El Salvador and Honduras (as well as in Guatemala) tend to originate from areas with scarce economic opportunities and that not only the poorest migrate (World Bank, 2022).[16] The study finds a positive correlation between the probability of having a household member living abroad and both the municipality poverty rate and the household asset level (possession of durable goods and housing characteristics).

Central to our setup below, Figure 2 segments municipalities into below- and above-median levels of per capita GDP (Panel A) and poverty rate (Panel B) and shows that the inverted-U relationship between the probability of emigration and household income is stronger in lower-income municipalities and flattens as we move toward higher-income ones. This implies that in relatively poorer areas the probability of emigrating increases more steeply with income among households in the bottom half of the income distribution. In Panel A, for instance, an increase in annual per capita household expenditure from 10,000 to 15,000 Quetzales (equivalent to a daily increase from 3.54 to 5.31 US dollars) is associated with a 1.5 percentage point (pp) increase in the probability of emigration in municipalities below the median per capita GDP, compared to a 0.4 pp increase in municipalities above the median. In Panel B, an equivalent increase in household expenditure is associated

[14] The predicted probability of emigration results from regressing whether a household reports a recent emigrant (over the past five years) on their annual per capita expenditure and its squared term. The dotted lines in the figure are the corresponding 95% confidence intervals. We use a Logistic regression model but the results are not sensitive to alternatively using a linear regression model with municipality fixed effects.

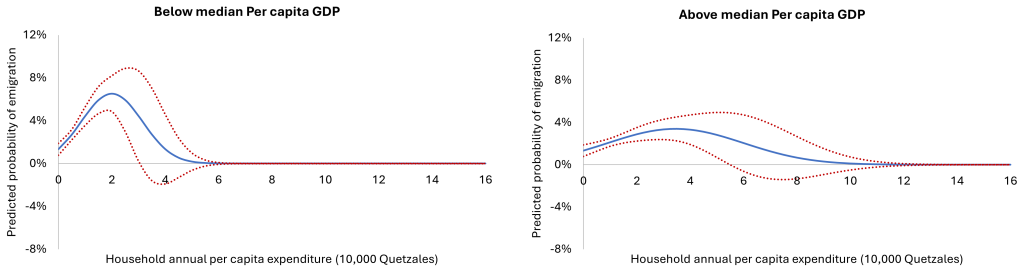
[15] See Dao et al. (2018) and Clemens & Mendola (2024) for a broader discussion on the income elasticity of migration using cross-country data and exploring other factors such as emigrant selection. On a related vein, Mckenzie & Rapoport (2010) show that the probability of migration in Mexico is increasing with education in communities with low migrant networks but decreasing in communities with high migrant networks.

[16] Arayavechkit et al. (2024) also shows that migrants from NCA are generally drawn from the middle and upper half of the wage distribution.

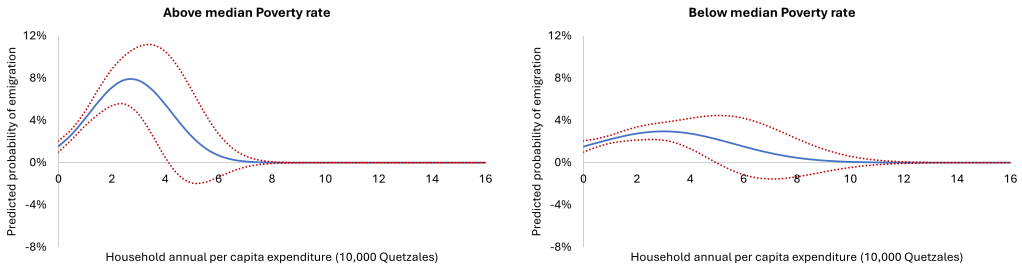
with a 1.6 pp increase in the probability of emigration in municipalities above the median poverty rate (i.e., poorer areas), compared to a 0.3 pp increase in municipalities below the median poverty rate. Hence, emigrants in Guatemala seem to mainly originate from the poorest municipalities, but not from the poorest households.[17]

Figure 2: Probability of emigration and household per capita expenditure, by municipality per capita GDP and poverty level (below versus above median)

Panel A: By per capita GDP



Panel B: By poverty rate



Note: The predicted probability of emigration results from regressing whether a household reports a recent emigrant (over the past five years) on annual per capita household expenditure and its squared term, using data from the 2014 Living Standards Measurement Survey in Guatemala (ENCOVI). The dotted lines represent the corresponding 95% confidence intervals. Panel A distinguishes households by the per capita Gross Domestic Product (GDP) of the municipality in which they are located, by including interaction terms between household expenditure (and its squared term) and an indicator for municipalities below versus above the median per capita GDP in the regression. Panel B distinguishes households by the municipality poverty rate, including analogous interaction terms based on whether municipalities are below versus above the median poverty rate.

Appendix Figure A4 shows that this pattern is robust when using the household asset

[17]Appendix Figure A3 further refines this comparison by dividing municipalities into tertiles of per capita GDP and poverty rate. The results reinforce the same pattern: the income-emigration gradient is steepest in the lowest-income tertile and becomes progressively flatter in middle- and highest-income municipalities. We also examined whether the Figure 2 patterns differ by whether the household head most frequently speaks an Indigenous language or Spanish, to explore whether factors beyond liquidity constraints, such as attachment to land, may matter. In municipalities with above-median poverty, predicted emigration is somewhat lower among Indigenous households, but the confidence intervals overlap. We do not see the same pattern when municipalities are divided by median per capita GDP.

index as an alternative measure of wealth, distinguishing municipalities below versus above the median per capita GDP and poverty rate.[18] The inverted-U relationship persists, and the responsiveness of emigration to wealth remains stronger in lower-income or higher-poverty municipalities than in their more advantaged counterparts.

Development programs, in turn, generally concentrate in poorer areas. Appendix Figure A5 presents, for example, municipality-level scatterplots of the number of private and public interventions (per 10,000 people) against per capita GDP in Panel A and against the poverty rate in Panel B. The mapped interventions relate primarily to food security and nutrition programs and include activities in nutrition, health, agriculture, education, institutional strengthening, gender, and other areas.[19] We observe that municipalities with a larger number of interventions tend to be those with lower GDP levels or higher poverty rates. In addition, Appendix Figure A6 shows a positive association between the emigration rate and the number of interventions (per 10,000 people) in a municipality, indicating that locations with a greater presence of programs seem to exhibit higher emigration rates.[20]

These patterns are not surprising, given that development policies not only provide critical support to vulnerable populations but, in several instances, may directly or indirectly increase household income or relax credit constraints. Some of these interventions may therefore contribute, at least on the margin, to increased emigration. The extent of the influence of a given policy ultimately depends on several factors, including the characteristics of the intervention and the population it reaches.[21] In Guatemala, while several donors overlap in particular areas (e.g., in the Western Highlands, Verapaces, and Dry Corridor), some primarily target subsistence, small-scale farmers who produce staple crops and are among the most vulnerable, whereas others focus on small- and medium-scale farmers

[18]The asset index follows the approach of World Bank (2022) for NCA countries and is constructed using ENCOVI 2014 data for Guatemala. It aggregates information on ownership of durable goods (e.g., refrigerator, television, computer, vehicle, motorcycle), access to basic services (piped water, electricity, sanitation), and dwelling quality (materials of ceiling, flooring, and external walls). The index measures the proportion of 17 included assets, access to services, and housing characteristics (ranging from 0 to 1) available to the household.

[19]The data correspond to a 2021–2022 mapping exercise performed by Hernandez et al. (2022) using multiple sources. Approximately 80 percent of the mapped interventions are private and 20 percent are public.

[20]The positive association between intervention intensity and emigration remains statistically significant after controlling for municipality distance to the Mexican border.

[21]Certainly, poorly designed or implemented policies can have unintended consequences, including triggering migration (see, e.g., Clemens, 2022; Diaz-Bonilla & Centurión, 2022, for discussions related to cash transfer programs). We abstract from this dimension in the paper.

producing commercial crops and exhibiting greater potential for economic expansion.

All else equal, an intervention that eases liquidity or credit constraints by helping potential emigrants cover migration costs, particularly those in less developed or vulnerable areas, may increase migration. In Mexico, Cortina (2014) documents that unconditional cash transfers to smallholder farmers inadvertently stimulated migration to the US by helping poor households to cover the initial migration costs, while De Janvry et al. (2015) show that the provision of land ownership certificates resulted in large-scale adjustments to labor and land allocations that increased the probability of migration by reducing the opportunity cost of migrating. Angelucci (2015) similarly finds that Mexico's flagship conditional cash transfer program increased US migration among poor, low-skilled individuals within six months of receiving transfers, by easing financial constraints, although earlier work by Stecklov et al. (2005) shows that the program reduced overall emigration among recipient households during its first 20 months. Lopez Garcia (2018) also finds that affiliation with Mexico's main public health insurance program did not deter emigration but did encourage return migration. In Honduras, Molina Millan et al. (2020) find that exposure to a conditional cash transfer program increased the probability of emigration among young men. In China, Cai (2020) provides evidence that access to a village banking program is positively associated with migration, especially in locations with low levels of assets and high migration costs. In Comoros, Gazeaud et al. (2023) find that a cash-for-work program increased international migration by alleviating liquidity and risk constraints of program participants. Finally, in The Gambia, Bah et al. (2023) show that a vocational training program facilitated migration to a safer destination (Senegal) and reduced intentions but not attempts to irregularly migrate to Europe.

Overall, it is relevant to examine how different development policies affect local well-being and emigration decisions. To address this question within a unified structural framework, we develop a theoretical model that characterizes local labor allocation and emigration decisions and assesses the impacts of different types of policies, focusing on the case of Guatemala.

3 Model setup

Consider an economy with two regions and two sectors: a high productivity region (Region H) and a low productivity region (Region L), and a tradable (T) and non-tradable (N) sector. The tradable good can be freely traded between the two regions. The region with high (low) productivity corresponds to the region with the highest (lowest) ex-ante aggregate productivity in the tradable sector. A continuum of households of measure N_j is born in each region $j \in \{L, H\}$, each endowed with one working-age member who makes labor and migration decisions. Initial population is $N_0 = N_{L0} + N_{H0}$.

Agents in each region are born with associated idiosyncratic skills for working in each sector (s_{ij}^T,s_{ij}^N), where i identifies the household. They are assumed to live for two periods. In period 0, households select between working in the tradable or non-tradable sector, always in their region. At the start of period 1, they either (i) stay in their region, (ii) migrate to the other region paying a moving cost in non-tradable goods of the other region (they can work in the non-tradable sector only), or (iii) emigrate paying an upfront cost κ_j and receiving an income abroad that depends on their idiosyncratic ability.[22]

Sector-specific skills are drawn from log-normal distributions:

$$s_{ij}^T \sim \log \mathcal{N}(\mu_j^T, (\sigma_j^T)^2), \qquad s_{ij}^N \sim \log \mathcal{N}(\mu_j^N, (\sigma_j^N)^2),$$

which may differ across birth regions.

Agent heterogeneity helps us characterize an inverted U-shaped relationship between wealth and emigration, in line with Mckenzie & Rapoport (2007) and Bazzi (2017). In the model, low-income agents stay locally because they cannot afford the upfront cost of emigrating (even if their utility from emigrating, net of costs, would be higher), middle-income agents are most likely to emigrate, and high-income agents tend to stay due to the higher opportunity cost of leaving.

The emigration cost κ_j is a fixed upfront payment out of period-0 resources, decreasing

[22] We assume no interregional mobility in the tradable sector for two reasons. First, tradable productivity is tied to fixed local assets (land, natural resources, and region-specific technologies) that do not move with the worker. Second, for parsimony, allowing tradable-sector workers to migrate interregionally would require tracking an additional margin of occupational reallocation at the destination, without materially altering the model's core predictions. Non-tradable employment, by contrast, does not require region-specific assets and is the natural entry point for internal migrants.

in the region-specific migrant network size n_j:

$$\kappa_j = \bar{\kappa} \cdot \exp(-\eta\, n_j),$$

where $\bar{\kappa}$ is the base emigration cost and $\eta \geq 0$ governs the network elasticity. Regions with a larger established diaspora face lower effective costs, as migrant networks facilitate access to information, contacts, and financing, aligned with the family network effects highlighted by Mckenzie & Rapoport (2010), Mahajan & Yang (2020), and Clemens (2021).[23]

3.1 Production of the tradable and non-tradable good

Both tradable and non-tradable goods are produced with linear technology. There is only one available input, given by the skill of the individual in each sector. In period 0 all agents work in their birth region, so:

$$Y_{j0}^T = A_{j0}^T \int_0^{N_{j0}} \mathbb{I}_{ij0}^T \, s_{ij}^T \, di, \tag{1}$$

$$Y_{j0}^N = A_j^N \int_0^{N_{j0}} (1 - \mathbb{I}_{ij0}^T) \, s_{ij}^N \, di, \tag{2}$$

where $\mathbb{I}_{ijt}^T$ is an indicator variable that takes the value of 1 if individual i in region j works in the tradable sector at period t and 0 otherwise, A_{jt}^T is tradable total factor productivity (TFP), and A_j^N is non-tradable TFP, with $A_{H0}^T > A_{L0}^T$. In period 1, output excludes emigrants and internal migrants from their birth regions. Non-tradable output also includes incoming migrants from $j' \neq j$, whose skill is discounted by a factor $\lambda \geq 1$. The indicators $\mathbb{E}_{ij}$ and $\mathbb{M}_{ij}$ take the value of 1 when individual i born in j emigrates or migrates internally, respectively, and 0 otherwise (Section 3.3):

$$Y_{j1}^T = A_{j1}^T \int_0^{N_{j0}} \mathbb{I}_{ij1}^T \, s_{ij}^T \, (1 - \mathbb{E}_{ij} - \mathbb{M}_{ij}) \, di, \tag{3}$$

$$Y_{j1}^N = A_j^N \left[\int_0^{N_{j0}} (1 - \mathbb{I}_{ij1}^T) \, s_{ij}^N \, (1 - \mathbb{E}_{ij} - \mathbb{M}_{ij}) \, di + \frac{1}{\lambda} \int_0^{N_{j'0}} s_{ij'}^N \, \mathbb{M}_{ij'} \, di \right]. \tag{4}$$

[23] Gathmann (2008) documents that Mexican coyote fees rose sharply with US border enforcement after 1990, while Denton (2023) provides more recent evidence of substantial migration costs, motivating our treatment of $\bar{\kappa}$ as a sizable pecuniary deterrent rather than a small frictional cost.

Labor markets are assumed to be competitive. Let p_t^T be the tradable good price and p_{jt}^N be the non-tradable price in region j at period t. Therefore, in equilibrium, the labor income in the tradable sector is $I_{ijt}^T \equiv p_t^T A_{jt}^T s_{ij}^T$, while the labor income in the non-tradable sector is $I_{ijt}^N \equiv p_{jt}^N A_j^N s_{ij}^N$.

3.2 Fiscal policy and public goods

Tax revenue finances public goods that augment baseline regional TFP and amenities. The government levies a lump-sum tax T in tradable goods on each agent at $t = 0$, subject to a balanced budget:

$$T \cdot N = G_L + G_H,$$

where G_j is total public expenditure allocated to region j. Public goods are purchased at $t = 0$ but materialize at $t = 1$. A share $(1 - \delta_j)$ of regional expenditure finances productive public investment that augments tradable TFP, while the remaining share δ_j finances regional amenities that increase utility:

$$A_{j1}^T = \bar{A}_j^T \cdot \left(\frac{(1 - \delta_j)\, g_j}{\bar{g}} \right)^{\alpha_p}, \tag{5}$$

$$\gamma_{j1} = \bar{\gamma}_j \cdot \left(\frac{\delta_j\, g_j}{\bar{g}} \right)^{\alpha_u}, \tag{6}$$

where $\bar{A}_j^T$ and $\bar{\gamma}_j$ are baseline TFP and amenities, $\alpha_p, \alpha_u \in (0, 1)$ govern the respective elasticities, $g_j \equiv G_j / N_{j0}$ is regional expenditure per initial resident, and $\bar{g} \equiv (G_L + G_H)/N_0$ is the national counterpart. We set $A_{j0}^T = \bar{A}_j^T$ and $\gamma_{j0} = \bar{\gamma}_j$, so that $\bar{A}_j^T$ and $\bar{\gamma}_j$ have a direct interpretation as TFP and amenities at the reference level of per-capita public expenditure ($g_j = \bar{g}$, with the corresponding expenditure shares), and the ratio A_{j1}^T / A_{j0}^T measures policy-induced productivity growth.[24] In addition, the restriction $\alpha_p, \alpha_u \in (0, 1)$ implies an unbounded marginal return to public expenditure as $g_j \to 0$, so equilibrium and optimal allocations feature strictly positive spending in both regions.

Households may also receive lump-sum transfers τ_{ijt}. Transfers are denominated in tradable goods and can be directed toward agents below a given percentile of the regional income distribution. They can be temporary (first period only) or permanent (both periods), and

[24] Since population-weighted per-capita expenditures average to $\bar{g}$, differences in per-capita public expenditure across regions imply a redistribution of public resources across space.

may be funded by the public sector, the private sector, or international cooperation.

3.3 The household's problem

Households have three alternatives: stay in their birth region, migrate to the other region, or emigrate. Preferences are Cobb-Douglas over tradable and non-tradable consumption with expenditure share $\omega \in (0,1)$ on tradables and discount factor β. For simplicity, we assume individuals are hand-to-mouth.[25].

In period 0, all agents choose the sector yielding higher income in their birth region: $I_{ij0} = \max(I^T_{ij0},\, I^N_{ij0})$. In period 1, only stayers re-optimize across sectors; internal migrants work in the non-tradable sector at the destination. Stayers enjoy home amenities γ_{j1}, while internal migrants enjoy destination amenities $\gamma_{j'1}$.[26]

First, the indirect utility of an individual born in region j that stays is defined as:

$$V^S_{ij} = \omega \log(c^T_{ij0}) + (1-\omega)\log(c^N_{ij0}) + \beta\left[\gamma_{j1} + \omega \log(c^T_{ij1}) + (1-\omega)\log(c^N_{ij1})\right],$$

while the period-t budget constraints are:

$$\begin{aligned} p^T_0 c^T_{ij0} + p^N_{j0} c^N_{ij0} &= I_{ij0} - p^T_0 T + p^T_0 \tau_{ij0} \\ p^T_1 c^T_{ij1} + p^N_{j1} c^N_{ij1} &= I_{ij1} + p^T_1 \tau_{ij1}, \end{aligned}$$

where $I_{ij1} = \max(I^T_{ij1},\, I^N_{ij1})$.

Second, the indirect utility of an individual born in region j that migrates to region $j' \neq j$ at $t = 1$ is:

$$V^M_{ij} = \omega \log(c^T_{ij0}) + (1-\omega)\log(c^N_{ij0}) + \beta\left[\gamma_{j'1} + \omega \log(c^T_{ij1}) + (1-\omega)\log(c^N_{ij1})\right],$$

[25]While we assume individuals are hand-to-mouth, this captures in a parsimonious way the liquidity constraints that a large empirical literature has shown to shape migration decisions in developing countries, particularly among poorer households who typically lack access to formal savings or credit instruments (Mckenzie & Rapoport, 2007; Bryan et al., 2014; Angelucci, 2015; Bazzi, 2017; Lagakos et al., 2023). Under this assumption, the upfront emigration cost κ_j constitutes a genuine liquidity constraint rather than a mere intertemporal reallocation. Appendix C elaborates on a version of the model with a credit market and shows that the main qualitative results remain unchanged, as the inverted-U relationship between income and emigration continues to emerge from the interaction between liquidity constraints among poorer households and the higher opportunity cost of emigrating among wealthier households

[26]Since all agents reside in their birth region at $t = 0$, the period-0 amenity γ_{j0} is common across all choices and drops from the migration decision; only period-1 amenities drive the choice.

while the budget constraints are:

$$\begin{aligned} p_0^T c_{ij0}^T + p_{j0}^N c_{ij0}^N &= I_{ij0} - p_0^T T + p_0^T \tau_{ij0} - \phi p_{j'0}^N \\ p_1^T c_{ij1}^T + p_{j'1}^N c_{ij1}^N &= \frac{1}{\lambda} p_{j'1}^N A_{j'}^N s_{ij}^N, \end{aligned}$$

where the moving cost ϕ is denominated in destination non-tradable prices, and $\lambda \geq 1$ scales down the migrant's non-tradable skill (capturing the loss of local knowledge), in the spirit of Lagakos et al. (2020).[27] Internal migrants enter the non-tradable sector at j' in period 1.

Third, the indirect utility of an individual born in region j that emigrates at $t = 1$ and receives W_{ij}^e abroad, a composite measure of period-1 consumption resources, is:

$$V_{ij}^E = \omega \log(c_{ij0}^T) + (1 - \omega) \log(c_{ij0}^N) + \beta \log W_{ij}^e,$$

while the budget constraint at $t = 0$ becomes:

$$p_0^T c_{ij0}^T + p_{j0}^N c_{ij0}^N = I_{ij0} - p_0^T T + p_0^T \tau_{ij0} - p_0^T \kappa_j,$$

where κ_j is the network-adjusted emigration cost. We assume that the period-1 consumption composite abroad,

$$W_{ij}^e = a \left(1 - e^{-s_{ij}^N / b}\right),$$

is increasing and concave in the agent's non-tradable skill s_{ij}^N, with ceiling $a > 0$ and $b > 0$ governing how quickly income approaches it.

Because agents are hand-to-mouth, the upfront costs of moving must be paid out of period-0 resources. Emigration and internal migration are therefore available only when the associated period-0 budget admits strictly positive consumption: agents whose resources fall short of $p_0^T \kappa_j$ (for emigration) or $p_{j'0}^N \phi$ (for internal migration) cannot choose that option, regardless of the utility it would yield. Let $\mathcal{F}_{ij} \subseteq \{S, M, E\}$ denote individual i's feasible choice set; staying is always feasible, so $\mathcal{F}_{ij} \neq \emptyset$.[28] This is the sense in which the upfront

[27] In equilibrium, $p_H^N > p_L^N$, implying that moving from L to H is more expensive than the reverse.

[28] Feasibility of staying requires $I_{ij0} - p_0^T T + p_0^T \tau_{ij0} > 0$. We restrict attention to calibrations in which T is small enough for this to hold for all agents.

costs constitute genuine liquidity constraints rather than intertemporal reallocations.

Mobility decisions may also depend on idiosyncratic non-economic factors.[29] Following the quantitative migration literature (Caliendo et al., 2019; Lagakos et al., 2023), we capture these through additive i.i.d. Type-I extreme value shocks ϵ_{ij}^k with scale σ_ϵ. The mobility choice solves:

$$\max_{k \in \mathcal{F}_{ij}} \; V_{ij}^k + \epsilon_{ij}^k,$$

which yields multinomial logit choice probabilities over the feasible set:

$$P_{ij}^k = \frac{\mathbb{1}\{k \in \mathcal{F}_{ij}\} \, \exp\Big(V_{ij}^k/\sigma_\epsilon\Big)}{\sum\limits_{k' \in \{S,\, M,\, E\}} \mathbb{1}\{k' \in \mathcal{F}_{ij}\} \, \exp\Big(V_{ij}^{k'}/\sigma_\epsilon\Big)}, \qquad k \in \{S,\, M,\, E\}.$$

For notational convenience, we define two binary variables describing realized choices: $\mathbb{E}_{ij}$ takes the value of 1 if individual i from region j emigrates and 0 otherwise, while $\mathbb{M}_{ij}$ takes the value of 1 if the individual internally migrates and 0 otherwise, so that $\mathbb{E}_{ij} = \mathbb{M}_{ij} = 0$ whenever the corresponding option lies outside $\mathcal{F}_{ij}$. Given the continuum of agents, cross-sectional aggregates of these indicators coincide with the choice probabilities integrated over the skill distribution and the preference shocks.

3.4 Equilibrium

A *competitive equilibrium* is defined as a set of prices $\{p_t^T, p_{jt}^N\}$ for $j = L, H$ and $t = 0, 1$; occupational choices $\{\mathbb{I}_{ijt}^T\}$ for all (i, j, t); mobility choices $\{\mathbb{E}_{ij}, \mathbb{M}_{ij}\}$ for all (i, j); and consumption allocations $\{c_{ijt}^T, c_{ijt}^N\}$ for all households; such that (i) households optimize, (ii) all markets clear, and (iii) aggregates are consistent with individual decisions.

We have six market clearing conditions: one for the tradable good in each period and one for the non-tradable good in each region and period. The market clearing condition for the tradable good at $t = 0$ is defined as:

$$\sum_j \left[\int_0^{N_{j0}} \left(c_{ij0}^T + \kappa_j \mathbb{E}_{ij} \right) di + G_j \right] = \sum_j \int_0^{N_{j0}} \left(A_{j0}^T \mathbb{I}_{ij0}^T s_{ij}^T + \tau_{ij0} \right) di.$$

[29] Mobility decisions are made at $t = 0$, when the upfront costs are paid and the preference shocks ϵ_{ij}^k are known; relocation itself occurs at $t = 1$.

The market clearing condition for the non-tradable good at $t = 0$ becomes:

$$\int_0^{N_{j0}} c_{ij0}^N \, di + \phi \int_0^{N_{j'0}} \mathbb{M}_{ij'} \, di = \int_0^{N_{j0}} A_j^N (1 - \mathbb{I}_{ij0}^T) s_{ij}^N \, di, \quad \text{for} \quad j = L, H.$$

The market clearing condition for the tradable good at $t = 1$ can be written as:

$$\sum_j \int_0^{N_{j0}} c_{ij1}^T (1 - \mathbb{E}_{ij}) \, di = \sum_j \int_0^{N_{j0}} (A_{j1}^T \mathbb{I}_{ij1}^T s_{ij}^T + \tau_{ij1})(1 - \mathbb{E}_{ij} - \mathbb{M}_{ij}) \, di.$$

Finally, the market clearing condition for the non-tradable good at $t = 1$ is:

$$\int_0^{N_{j0}} c_{ij1}^N (1 - \mathbb{E}_{ij} - \mathbb{M}_{ij}) \, di + \int_0^{N_{j'0}} c_{ij'1}^N \, \mathbb{M}_{ij'} \, di =$$

$$\int_0^{N_{j0}} A_j^N (1 - \mathbb{I}_{ij1}^T) s_{ij}^N (1 - \mathbb{E}_{ij} - \mathbb{M}_{ij}) \, di + \int_0^{N_{j'0}} \tfrac{1}{\lambda} \, A_j^N \, s_{ij'}^N \, \mathbb{M}_{ij'} \, di, \quad \text{for} \quad j = L, H.$$

Equilibrium prices $\{p_t^T, p_{jt}^N\}$ are determined by the six market clearing conditions above, given occupational and mobility choices. Individual decisions admit a closed-form characterization conditional on prices (Section 3.5); the equilibrium price vector is solved numerically.

3.5 Mechanisms

Before turning to the quantitative analysis, we characterize individual decisions conditional on prices. This makes transparent the channels through which policy operates in the counterfactuals of Section 5.2.

Notation. Let $P_{jt} \equiv (p_t^T)^\omega (p_{jt}^N)^{1-\omega}$ denote the consumer price index in region j at date t, and $c_\omega \equiv \omega \log \omega + (1 - \omega) \log(1 - \omega)$ the Cobb–Douglas constant. Write:

$$x_{ij0} \;\equiv\; I_{ij0} - p_0^T T + p_0^T \tau_{ij0},$$

for period-0 resources before any mobility cost, and $x_{ij1}^S \equiv I_{ij1} + p_1^T \tau_{ij1}$ for a stayer's period-1 resources.

Sector choice. Because technologies are linear, the occupational decision is a threshold in the skill ratio: individual i works in the tradable sector at date t if and only if:

$$\frac{s_{ij}^T}{s_{ij}^N} \;>\; \frac{p_{jt}^N\, A_j^N}{p_t^T\, A_{jt}^T}. \tag{7}$$

The threshold falls when tradable productivity rises, reallocating workers toward tradables; it rises with the non-tradable price, so any policy that raises local demand for non-tradables pulls workers the other way.

Indirect utilities. Substituting the Cobb–Douglas demands into each budget constraint gives:

$$V_{ij}^S = \log\frac{x_{ij0}}{P_{j0}} + \beta\Big[\gamma_{j1} + \log\frac{x_{ij1}^S}{P_{j1}}\Big] + (1+\beta)\,c_\omega, \tag{8}$$

$$V_{ij}^M = \log\frac{x_{ij0} - p_{j'0}^N\phi}{P_{j0}} + \beta\Big[\gamma_{j'1} + \log\frac{\lambda^{-1}p_{j'1}^N A_{j'}^N s_{ij}^N}{P_{j'1}}\Big] + (1+\beta)\,c_\omega, \tag{9}$$

$$V_{ij}^E = \log\frac{x_{ij0} - p_0^T\kappa_j}{P_{j0}} + \beta\log W_{ij}^e + c_\omega. \tag{10}$$

Each option is therefore fully determined by prices, productivities, policy instruments and the household's own skill draws.

The emigration margin. Differencing (10) and (8) yields a decomposition into two terms with opposite slopes in income:

$$V_{ij}^E - V_{ij}^S \;=\; -\,\Lambda_{ij} \;-\; \beta\,\Omega_{ij}, \tag{11}$$

where

$$\Lambda_{ij} \;\equiv\; \log\frac{x_{ij0}}{x_{ij0} - p_0^T\kappa_j}, \qquad \Omega_{ij} \;\equiv\; \gamma_{j1} + \log\frac{x_{ij1}^S}{P_{j1}} + c_\omega - \log W_{ij}^e.$$

The *liquidity wedge* Λ_{ij} is the proportional consumption loss from paying the upfront cost out of period-0 resources. It is strictly decreasing in x_{ij0}, diverges as resources approach $p_0^T\kappa_j$, and vanishes for rich households: paying the emigration cost is ruinous for the poor and negligible for the wealthy. The *opportunity cost* Ω_{ij} is what the household forgoes by

leaving. It tends to increase with domestic earning potential, as domestic income rises with sector-specific skill while W_{ij}^e is bounded above by a.

The inverted-U relationship between income and emigration follows directly. At the bottom of the distribution Λ_{ij} dominates—and below the feasibility threshold $x_{ij0} \leq p_0^T \kappa_j$ emigration is not available at all, so $E \notin \mathcal{F}_{ij}$. At the top, $\Lambda_{ij} \approx 0$ but Ω_{ij} is large. Emigration is most attractive in between, where the household can afford the cost and has comparatively little to lose.

The internal migration margin. Differencing (9) and (8) gives an analogous expression with ϕ in place of κ_j in the liquidity wedge, and an opportunity cost that nets out the amenity differential $\gamma_{j'1} - \gamma_{j1}$, the price differential $P_{j'1}/P_{j1}$, and the skill penalty $\log \lambda$. Internal migration therefore responds to the same liquidity channel as emigration, but its return is reduced by the skill penalty λ and the requirement that the mover enter the non-tradable sector at the destination.

How policy operates. Equation (11) organizes the counterfactuals. Instruments that relax period-0 liquidity constraints shrink Λ_{ij} and so *raise* emigration, while easing the feasibility constraint at the bottom of the distribution. Temporary transfers do so by increasing period-0 resources, a lower κ_j by reducing the migration cost, and deferring the cost to period 1 by removing it from the period-0 budget. Instruments that raise the value of staying in period 1 raise Ω_{ij} and so *lower* emigration. Productive public investment through A_{j1}^T operates only through this channel, leaving Λ_{ij} unchanged. Permanent transfers combine both channels: their period-0 payment relaxes liquidity exactly as a temporary transfer does, while the period-1 payment, received only by households that remain in their region, raises Ω_{ij}. Their net effect on emigration is therefore ambiguous a priori, and comparing them with temporary transfers helps distinguish the retention component.[30]. The lump-sum tax works in reverse, tightening exactly the period-0 budgets that transfers loosen, which is why domestically financed programs deliver smaller effects than externally funded ones of the same size. An adverse productivity shock moves both terms at once,

[30]In the model, households consist of a single working-age member, so migrants no longer receive transfers in their region of origin. In practice, other household members may remain and continue receiving transfers (Angelucci, 2015), which could reduce the effect of permanent transfers on emigration

depressing period-0 resources (raising Λ_{ij}) and period-1 income (lowering Ω_{ij}), so its net effect on emigration is ambiguous a priori and depends on how many households sit near the liquidity threshold.

Table 1 summarizes how the different policy instruments and shocks operate through the liquidity and opportunity-cost channels, highlighting their potentially offsetting effects on emigration.

Table 1: Policy instruments, transmission channels, and emigration responses

Instrument / shock	Liquidity wedge Λ	Opportunity cost Ω	Emigration
Temporary transfer	$\downarrow$	–	$\uparrow$
Lower κ / credit for migration	$\downarrow$	–	$\uparrow$
Permanent transfer (stayers only)	$\downarrow$	$\uparrow$	Ambiguous
Productivity investment (A^T_{j1})	–	$\uparrow$	$\downarrow$
Domestic productivity shock	$\uparrow$	$\downarrow$	Ambiguous
Lower returns abroad (W^e)	–	$\uparrow$	$\downarrow$

Note: The table summarizes the qualitative effects of policy instruments and shocks on the liquidity wedge (Λ) and the opportunity cost of emigration (Ω), based on equation (11). Upward and downward arrows indicate increases and decreases, respectively; a dash indicates no direct effect. Ambiguous responses reflect offsetting effects through the two channels. The magnitudes of the effects are quantified with the calibrated model.

From mechanisms to magnitudes. The decomposition in (11) delivers the direction of each channel, but not its strength: whether the liquidity wedge or the opportunity cost dominates depends on how many households sit near the feasibility threshold, on how fast W^e_{ij} saturates in skill, and on the dispersion of skills within each region. These are quantitative questions. Taking the model to the data therefore requires disciplining the parameter vector Θ, which comprises skill distribution parameters $\{\mu^T_j, \sigma^T_j, \mu^N_j, \sigma^N_j\}$, productivity and amenity baselines $\{\bar{A}^T_j, \bar{\gamma}_j\}$, migration cost parameters $\{\phi, \lambda, \bar{\kappa}, \eta, a, b\}$, preference parameters $\{\omega, \beta, \sigma_\epsilon\}$, and fiscal parameters $\{\alpha_p, \alpha_u, \delta_j\}$, to which we turn next.

4 Model estimation

This section describes how the model is calibrated using Guatemalan data. We proceed in three steps. First, we divide the country into two economically coherent regions (low- and

high-development) that map onto the model's L and H regions (Subsection 4.1). Second, we calibrate the model's structural parameters using a combination of direct measurement from national data sources, reduced-form regressions, model-consistent residuals, and Simulated Method of Moments (Subsection 4.2). Third, we assess the model's baseline fit by examining how well it replicates the relationship between household income and emigration, as well as the allocation of workers across sectors and regions (Subsection 4.3). Together, these steps discipline the model and provide the basis for the policy simulations that follow.

4.1 Regional division of Guatemala

Guatemala exhibits substantial heterogeneity in economic development, infrastructure, and access to public goods across areas. To discipline the model while preserving tractability, we divide the country into two broad regions: a low-development region and a high-development region (see Appendix Figure A7). This classification reflects persistent structural differences in income levels, human capital, access to services, housing conditions, and market connectivity. Departments within each region are geographically contiguous, reinforcing the interpretation of the two-region structure as capturing spatially coherent economic environments.

The low-development region comprises fifteen departments, covering the Western Highlands, Dry Corridor, Verapaces, and Peten-Izabal subregions. The high-development region comprises the remaining seven departments corresponding to the Center and Pacifico-Bocacosta subregions and includes the department of Guatemala, which contains the capital city.

Appendix Table A1 reports municipality-level, population-weighted averages of key indicators by region.[31] The high-development region displays substantially higher GDP per capita and lower poverty rates, greater access to electricity, water and sanitation, and internet, improved housing quality, and shorter travel times to nearby urban centers. Differences in schooling and health inputs are comparatively smaller. Taken together, these differences point to higher living standards and stronger connectivity in the high-development region, consistent with greater economic integration relative to the low-development region.

[31] Climate exposure indicators are reported for completeness. They are not used in defining the regional classification and do not enter the model.

The two-region classification is further supported by Appendix Figure A8, which shows that the income-emigration relationship differs markedly across low- and high-development regions, aligned with the earlier municipality-level splits based on GDP and poverty. In the low-development region, emigration follows a hump-shaped pattern, peaking among households above the bottom of the income distribution before declining at higher income levels. In contrast, the relationship in the high-development region is much less pronounced and follows a generally declining pattern. These differences reinforce the relevance of modeling region-specific productivity, amenities, and migration costs.

4.2 Calibration

We calibrate the model's parameters using four complementary strategies, each corresponding to a distinct group in Table 2. A first set of preference, skill, demographic, and fiscal parameters is obtained directly from micro- and macro-data sources without any structural assumptions (Section 4.2.1). A second set (the TFP and amenity elasticities) is estimated from departmental regressions using per-capita public expenditure (Section 4.2.2). A third set is recovered without estimation. Baseline TFP and amenities are obtained as model-consistent residuals by inverting the model's structural equations at observed data values, using the parameters identified in the first two steps, while the emigration cost $\bar{\kappa}$ and the lump-sum tax T are pinned to external targets through a fixed-point iteration (Section 4.2.3). A fourth set of six structural parameters governing internal and international mobility costs, preference heterogeneity, and consumption abroad is estimated via Simulated Method of Moments (SMM) against seven moments (Section 4.2.4). The remaining parameters are normalizations and maintained assumptions that require no estimation. Additional details on data sources, variable construction, estimation procedures, and calibration steps are provided in Appendix B.

4.2.1 Parameters measured directly from data

The first group of parameters is recovered directly from observable data. The expenditure share on tradable goods $\omega = 0.546$ is computed from the 2023 CPI basket weights. Skill distributions (the log-normal means μ_j^s and standard deviations σ_j^s for $s \in \{T, N\}$ and $j \in \{L, H\}$) are estimated from Mincer regressions using the 2025 National Employ-

Table 2: Calibrated parameters

Parameter	Symbol	Value	Source
(i) Directly from data:			
Expenditure share (tradable)	ω	0.546	CPI weights 2023
Revenue allocation, L	δ_L	0.915	MINFIN
Revenue allocation, H	δ_H	0.941	MINFIN
Skill mean, L-tradable	μ_L^T	0.699	ENEI 2025
Skill mean, L-nontradable	μ_L^N	0.892	ENEI 2025
Skill mean, H-tradable	μ_H^T	0.722	ENEI 2025
Skill mean, H-nontradable	μ_H^N	0.778	ENEI 2025
Skill disp., L-tradable	σ_L^T	0.917	ENEI 2025
Skill disp., L-nontradable	σ_L^N	0.918	ENEI 2025
Skill disp., H-tradable	σ_H^T	0.799	ENEI 2025
Skill disp., H-nontradable	σ_H^N	0.856	ENEI 2025
Network intensity, L	n_L	0.175	FUNDESA 2018 (Table B20)
Network intensity, H	n_H	0.073	FUNDESA 2018 (Table B20)
Population share, L	w_L	0.598	INE 2018 Census
Population share, H	w_H	0.402	INE 2018 Census
(ii) From reduced-form regressions:			
TFP elasticity	α_p	0.334	Banguat, MINFIN, INE[a]
Amenity elasticity	α_u	0.076	QoL index, MINFIN, INE[b]
(iii) Model-consistent residuals and outer-pinned parameters:			
Baseline TFP, H	$\bar{A}_H^T$	1.48	Banguat, ENEI, MINFIN
Baseline amenity, L	$\bar{\gamma}_L$	0.250	QoL index, MINFIN
Baseline amenity, H	$\bar{\gamma}_H$	0.324	QoL index, MINFIN
Emigration cost	$\bar{\kappa}$	0.0744	ENEI 2025, coyote fee: $\bar{\kappa}/\text{med}(Y_1^{\text{stay}}) = 0.247$
Lump-sum tax	T	0.0204	MINFIN, Banguat: municipal expenditure/GDP = 0.046
(iv) From SMM:			
Utility abroad, ceiling	a	0.271	Table 3
Utility abroad, scale	b	1.028	Table 3
Gumbel dispersion	σ	0.467	Table 3
Network elasticity	η	4.967	Table 3
Internal skill penalty	λ	3.444	Table 3
Internal move cost	ϕ	0.459	Table 3
Normalizations and assumptions:			
Tradable price	p^T	1	Numéraire
Baseline TFP, L	$\bar{A}_L^T$	1.0	Normalization
Non-tradable TFP	$A_L^N = A_H^N$	1	Assumption
Total agents	N	50,000	Normalization
Interest rate	r	0	Assumption
Discount factor	β	1	Assumption

[a] Estimated from a departmental log regression of tradable value added per capita on total public expenditure per capita (Table B22, 2013–2023); significant at the 1% level.

[b] Estimated from a departmental log regression of the quality-of-life index on total public expenditure per capita (Table B21, 2013–2023); positive but not statistically significant at conventional levels.

ment and Income Survey (ENEI) (Appendix Section B.1). The revenue allocation shares δ_j, which govern the split between productive investment and amenity spending, are computed from the Ministry of Finance (MINFIN) departmental budget execution records and then aggregated to the two-region classification. Diaspora network intensities n_j are constructed from 2018 FUNDESA remittance data and defined as remittances relative to GDP (Table B20). Population shares w_j are computed from the 2018 Population and Housing Census conducted by the National Statistics Institute (INE).

4.2.2 Parameters from reduced-form regressions

Two elasticity parameters are estimated from departmental regressions using data on per-capita public expenditure for 2013–2023. The TFP elasticity $\alpha_p = 0.334$ is estimated from a log regression of departmental tradable value added per capita on total public expenditure per capita; the coefficient is significant at the 1% level (Table B22). The amenity elasticity $\alpha_u = 0.076$ is estimated from an analogous regression of the MINFIN quality-of-life (QoL) index on expenditure per capita; although the coefficient is not statistically significant at conventional levels, it suggests a modest positive amenity response to fiscal spending (Table B21). Both elasticities enter the model's fiscal–productivity and fiscal–amenity equations directly: α_p governs how public investment translates into tradable productivity, while α_u governs how amenity spending translates into utility. Together they determine the magnitude of the public-spending policy outcomes evaluated in Section 5.2. These elasticities are estimated from observational regressions and should not be interpreted as causal effects of public expenditure. Consequently, the fiscal costs and policy counterfactuals that rely on these parameters are conditional on the estimated expenditure–productivity and expenditure–amenity relationships.

4.2.3 Model-consistent residuals and outer-pinned parameters

A third group of parameters is recovered as residuals by inverting the model's structural equations at observed data values, using the elasticities and normalizations disciplined in the previous steps.

Baseline TFP. We normalize $\bar{A}_L^T = 1$ and recover $\bar{A}_H^T$ by inverting the endogenous TFP equation:

$$\ln \frac{\bar{A}_H^T}{\bar{A}_L^T} \;=\; \ln \frac{A_H^T}{A_L^T} \;-\; \alpha_p \ln \frac{(1-\delta_H)\, g_H}{(1-\delta_L)\, g_L},$$

where the TFP ratio A_H^T/A_L^T is constructed from tradable value added, employment, and average skills by region (Appendix Tables B5 and B11). Using 2013–2023 averages, this yields $\bar{A}_H^T = 1.48$, implying that the high-development region is about 48% more productive than the low-development region at baseline, after removing the contribution of differential public investment. The full derivation is in Appendix B.10.

Baseline amenities. Amenities enter utility additively, so that absolute levels matter; we therefore calibrate $\bar{\gamma}_j$ individually by inverting the amenity equation:

$$\bar{\gamma}_j \;=\; \frac{\gamma_j}{\left(\delta_j\, g_j/\bar{g}\right)^{\alpha_u}},$$

where γ_j is the regional quality-of-life index (Table B7). This yields $\bar{\gamma}_L = 0.250$ and $\bar{\gamma}_H = 0.324$. Derivation details are in Appendix B.10.

Emigration cost $\bar{\kappa}$. We set $\bar{\kappa}$ equal to the coyote fee (the payment to a migrant smuggler), which is the dominant out-of-pocket cost of unauthorized Guatemala–US migration, expressed as a share of the present discounted value of lifetime labor income. Per-worker permanent income is constructed from ENEI 2025 median worker earnings of USD 3,678 per year, then discounted over a 25-year horizon at an annual rate of 5%, yielding USD 53,155. The coyote fee of USD 12,500 (Denton, 2023), expressed in 2025 dollars for consistency with the income measure, amounts to USD 13,130.[32] The data-implied ratio is:

$$\bar{\kappa}_{\text{data}} \;=\; \frac{13{,}130}{53{,}155} \;\approx\; 0.247.$$

This is then rescaled to model units as $\bar{\kappa} = 0.247 \cdot \text{median}(Y_1^{\text{stay}}) = 0.0744$, ensuring the emigration cost is expressed in units consistent with the model's income measures. Ap-

[32] Denton (2023) report migration costs ranging from approximately USD 5,500 to USD 12,500 depending on destination and service package, and note that costs can vary substantially across traffickers and over time. We use the upper end of this range as the baseline migration-cost benchmark.

pendix Table B23 reports robustness across data sources, weighting schemes, and discount rates; $\bar{\kappa}_{\text{data}}$ stays within $[0.10, 0.33]$.

Lump-sum tax. We calibrate the lump-sum tax T to match public spending as a share of GDP (4.6%), based on municipal current expenditure and public investment during 2013–2023, yielding $T = 0.046 \cdot \text{mean}(Y_0) = 0.0204$.[33].

Non-tradable productivity. We normalize non-tradable productivity to unity in both regions, $A_L^N = A_H^N = 1$, so that all regional productivity differences operate through the tradable sector, where fiscal policy acts. Only the product $p_j^N A_j^N$ enters the sectoral choice margin, so this normalization is not separately identified from the regional non-tradable price level; we return to its implications for model fit in the cross-validation below.

4.2.4 Simulated Method of Moments

Identification. Six structural parameters are estimated in an overidentified SMM using seven moments. Consumption abroad, parameterized by its ceiling a and its scale b, is identified from three moments: the national emigration rate and, for each region, the ratio of the emigration rate of the second income tertile to that of the first; the Type-I extreme value (Gumbel) dispersion σ_ϵ from the cross-region ratio of below-median emigration rates (L to H), which captures how strongly idiosyncratic mobility frictions compress the migration response; the network elasticity η in $\kappa_j = \bar{\kappa} \exp(-\eta\, n_j)$ from the emigration rate in region L, which has a substantially larger diaspora network; and the internal move cost ϕ and skill penalty λ from the two cross-regional migration rates in the 2018 Census (Table B19).

As noted above, two additional parameters, $\bar{\kappa}$ and T, are calibrated outside the SMM loop through a fixed-point recursion, with both targets matched to within 10^{-3}. Additional details are reported in Appendix Table B24.

Results. Table 3 reports the targeted moments and model fit. All moments but the two tercile ratios are matched within 10%, with an SMM distance of $d = 0.052$. Consumption abroad is increasing and concave in non-tradable skill, and bounded above: with $a = 0.271$

[33] We use observed municipal public expenditure rather than national tax revenue as the calibration target, since the former more closely reflects the public resources spent at the regional level

and $b = 1.028$, the median emigrant reaches 54% of the ceiling. Because domestic income is linear in skill while consumption abroad saturates, the relative payoff to emigration declines at higher skill levels (the opportunity-cost channel of Section 3.5). The estimated dispersion $\sigma_\epsilon = 0.467$ indicates a non-negligible role for idiosyncratic mobility factors, while the systematic component of the emigration profile reflects income and skill differences. The network elasticity $\hat{\eta} = 4.967$ implies that the larger diaspora in region L ($n_L = 0.175$ vs. $n_H = 0.073$) reduces effective emigration costs by approximately 40% relative to region H, consistent with the family network effects discussed earlier.

Table 3: SMM: targeted moments

Moment	Source	Target	Model	Δ (%)
Emig. rate, national (%)	ACS 2021	7.90	7.62	−3.6
Emig. rate, L (%)	ACS 2021	10.10	10.02	−0.8
Below-median emig. rate, L/H	ENCOVI 2014	2.071	2.177	+5.1
Emig. ratio, H (tercile 2/1)	ENCOVI 2014	1.000	0.869	−13.1
Emig. ratio, L (tercile 2/1)	ENCOVI 2014	1.315	1.496	+13.7
Internal mig. rate, L (%)	Census 2018	0.57	0.54	−5.4
Internal mig. rate, H (%)	Census 2018	0.55	0.50	−9.5

Note: Overidentified SMM: the six parameters in group (iv) of Table 2 are estimated against these seven moments, minimizing the equally weighted sum of squared relative deviations; $\bar{\kappa}$ and T are pinned outside the SMM loop. Distance $d = 0.052$, two thirds of it from the two tercile ratios. National rates are population-weighted with $w_L = 0.598$, $w_H = 0.402$. Below-median rates split households at their own region's median period-0 income; the target is the L rate over the H rate (ENCOVI 2014: 2.62%/1.26%). Tercile ratios are logit-smoothed profiles over own-region period-0 income terciles.

Cross-validation. Table 4 assesses model fit on untargeted moments. The tradable/non-tradable wage ratio matches well in region H (model 1.03 vs. data 1.04) but overshoots in region L (model 1.25 vs. data 0.73). Income dispersion, measured by the coefficient of variation, is closely matched in region L (model 1.01 vs. data 0.99) and falls short in H, while the national CV runs 0.14 points above the data; the period-1 Gini exceeds its empirical counterpart by 0.04. The non-tradable/tradable price ratio undershoots in both regions, more so in L (-0.36) than in H (-0.13).

The main discrepancies are thus concentrated in relative prices and the L-region wage ratio. Both follow from the maintained assumption $A_L^N = A_H^N = 1$: equalizing non-tradable productivity across regions overstates non-tradable output in L, which raises the model's T/NT wage ratio and depresses the relative price of non-tradables there. We retain the

assumption in the baseline for parsimony, since regional heterogeneity in the model operates primarily through tradable productivity, which is also where fiscal policy acts.

Table 4: Cross-validation: untargeted moments

Moment	Source	Data	Model	Δ (Model − Data)
P_{NT}/P_T, H	Table B14, 2023 wtd.	0.746	0.616	−0.130
P_{NT}/P_T, L	Table B14, 2023 wtd.	0.555	0.199	−0.356
Wage ratio T/NT, H	Table B15	1.038	1.028	−0.010
Wage ratio T/NT, L	Table B15	0.732	1.247	+0.515
CV(I), H	ENCOVI 2023 (wtd.)	0.956	0.888	−0.068
CV(I), L	ENCOVI 2023 (wtd.)	0.987	1.007	+0.020
CV(I), nat.	ENCOVI 2023 (wtd.)	0.986	1.124	+0.138
Gini coefficient (period 1)	ENCOVI 2023 (wtd.)	0.452	0.488	+0.036

Note: ENEI 2025 weighted (wtd.) gives CV values of 0.996 (H), 1.048 (L), and 1.046 (national). Model wage ratios are computed among stayers choosing T versus NT at local prices.

Just-identified estimates. For completeness, we report the results of a just-identified version of the SMM, dropping the tercile ratio for region L. The estimates are $a = 0.662$ (vs. 0.271), $b = 2.393$ (vs. 1.028), $\sigma_\epsilon = 0.383$ (vs. 0.467), $\eta = 3.387$ (vs. 4.967), $\lambda = 2.313$ (vs. 3.444), and $\phi = 0.491$ (vs. 0.459). Five of the six targeted moments are matched to within 5%, while the region-H tercile ratio overshoots by 17%. The region-L tercile ratio, untargeted in this case, comes out at 2.64 against 1.315 in the data. The untargeted moments in Table 4 are essentially unchanged. The contrast between the two vectors (a higher ceiling and a lower shock dispersion under just-identification) reflects that the level of consumption abroad and the dispersion of preference shocks are disciplined by overlapping moments: both shift aggregate emigration rates in similar ways, so their separate identification rests largely on the shape of the emigration profile across income terciles. Notably, the untargeted moments and the main patterns discussed in Section 4.3, including the depicted income–emigration relationship across regions, remain robust across both specifications.

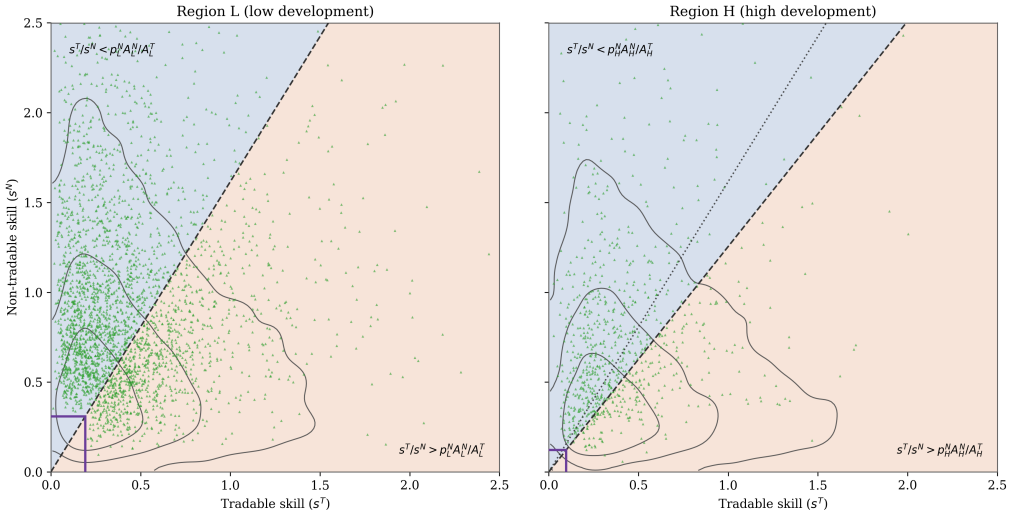
4.3 Model fit and baseline outcomes

We assess the model's baseline performance along two dimensions that are central to the paper's narrative: the allocation of workers across sectors and regions in skill space, and the relationship between household income and the probability of emigration.

Figure 3 plots the period-1 outcomes for each simulated household in the (s^T, s^N) skill space, separately for the low- and high-development regions. Each green triangle represents an emigrant, while the gray contours describe the distribution of workers in skill space. Background shading indicates the sector of comparative advantage, and the purple line marks the liquidity threshold for emigration. Three patterns stand out. First, sector selection follows the expected skill-comparative-advantage logic: households with relatively high tradable skills sort into the tradable sector, while those with relatively high non-tradable skills sort into the non-tradable sector, producing a diagonal boundary between the two sectors in both regions. Second, the tradable sector is relatively more attractive in region H, reflecting its higher baseline TFP $\bar{A}_H^T$, which shifts the sectoral boundary relative to region L. Third, and most relevant for what follows, emigrants in region L are concentrated above the liquidity threshold rather than at the bottom of the skill distribution: households with the lowest (s^T, s^N) pairs cannot afford the upfront cost κ_L, while those with high skills face large opportunity costs of leaving. This is the skill-space counterpart of the inverted-U profile documented below.

Figure 4 shows the smoothed probability of emigration as a function of household income, adjusted for regional purchasing power parity (PPP), separately for regions L and H. The two regions display strikingly different emigration profiles. In region L, the probability of emigration follows a clear inverted-U shape, peaking at 13.5%, three and a half times its value at the bottom of the distribution, before declining monotonically. This pattern is consistent with the empirical evidence shown in Appendix Figure A8 and reflects the interplay of two opposing forces: households at the very bottom of the distribution cannot afford the upfront cost κ_L (the liquidity constraint is binding), while households toward the top face increasingly high opportunity costs of leaving a region where, despite low average productivity, their absolute income is substantial. It is therefore households with enough resources to pay κ_L but not enough to forgo emigration that drive the bulk of outflows. Region H, by contrast, displays a much flatter emigration profile: the probability peaks at 4.5%, only 1.7 times its value at the bottom, and then declines slowly. This indicates that the liquidity constraint is much less relevant in region H, where incomes are generally high enough to cover κ_H, so that migration decisions are driven primarily by opportunity costs.

Figure 3: Sector choice and emigration in skill space (s^T, s^N), by region



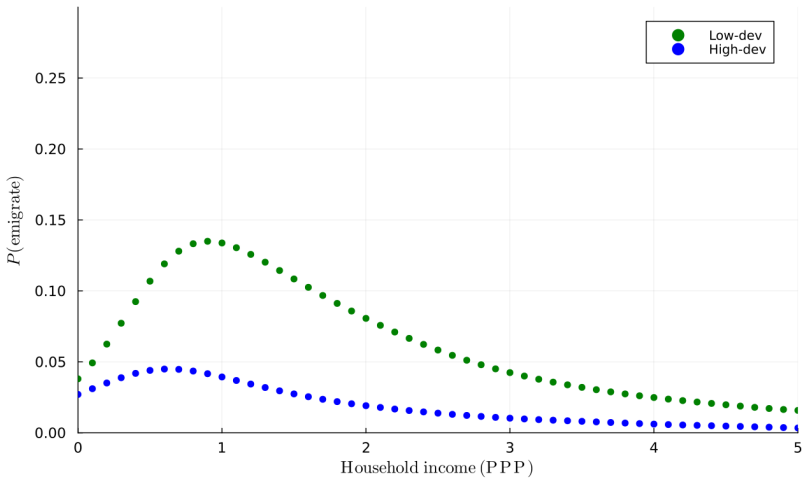
Note: Period-1 outcomes for region L (left panel) and region H (right panel). Each green triangle represents an emigrant located at her tradable skill s^T (horizontal axis) and non-tradable skill s^N (vertical axis). The thin gray contours enclose 25, 50, and 75 percent of the region's workers (smoothed density of the joint skill distribution). Background shading marks the comparative-advantage regions (blue = non-tradable, orange = tradable), separated by the region-specific frontier (dashed line); in the right panel, the dotted line reproduces the region-L frontier for comparison. The purple kinked line marks the liquidity threshold, along which period-0 income net of the lump-sum tax equals the emigration cost, $\max\left(p_0^T A_{j0}^T s^T,\, p_{j0}^N A_j^N s^N\right) - T = p_0^T \kappa_j$; workers inside the corner cannot afford the emigration cost. Axes are truncated at 2.5; 3% of emigrants from region L and 1% from region H lie outside the displayed range. The tradable good is the numeraire ($p^T \equiv 1$), and non-tradable TFP is normalized ($A_j^N \equiv 1$; $j = L, H$).

The contrast between the two profiles is itself a key result, implying that demand-side policies relaxing household budget constraints will have qualitatively different effects across regions, generating an emigration response concentrated above the bottom of the distribution in L but a more muted response in H. This mechanism underlies the heterogeneous policy responses examined in Section 5.2.

5 Development policies and counterfactual analysis

This section first examines the current development policy landscape in Guatemala and then presents the counterfactual policy analysis. It begins by documenting the spatial allocation of state presence and international cooperation, the composition of current devel-

Figure 4: Probability of emigration and household income, adjusted for regional PPP



Note: Probability of emigration as a function of household income adjusted for regional PPP in the calibrated model baseline, separately for the low-development (green) and high-development (blue) regions. Values are smoothed for readability.

opment interventions, and the targeting of these interventions across households, providing the empirical context for the policy analysis. It then evaluates a series of counterfactual policy scenarios and concludes by discussing their implications in light of the current development policy landscape.

5.1 Development policy landscape in Guatemala

5.1.1 State presence and international cooperation across regions

Table 5 summarizes average public expenditure per capita during 2013–2023 together with per capita budgets for major donor-funded food security and nutrition projects in 2024 across the low-development (L) and high-development (H) regions. Average donor budgets per capita are more than four times larger in the lower-development region, whereas average public expenditure per capita is almost four times larger in the higher-development region. This contrasting spatial pattern suggests that major donor investments in food security and nutrition are more heavily concentrated in territories where state presence is relatively limited, while higher-development regions benefit from substantially greater public resources. These differences are consistent with the regional heterogeneity represented

in the model and help motivate the regional focus of the counterfactual analysis.

Table 5: Public expenditure and international cooperation across regions

Variable	Region L	Region H	Difference (L−H)
Public expenditure per capita	29.7	111.0	−81.3**
Major donor budget per capita	53.8	12.6	41.2***

Note: Entries report unweighted municipal averages of annual public expenditure per capita (2013–2023) and major donor budget per capita (2024), both expressed in US dollars (USD). Major donor budgets correspond to food security and nutrition projects financed by major international development partners (G13) operating in Guatemala in 2024. Results are qualitatively unchanged when municipal averages are weighted by population. The Difference (L−H) column reports two-sample t-tests for differences in means. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Figure 5 further illustrates these spatial patterns at the municipal level. The left panel shows that higher levels of public expenditure are concentrated primarily in municipalities belonging to the higher-development region, whereas the right panel shows that higher levels of major donor funding are concentrated predominantly in municipalities belonging to the low-development region. Together, the two maps visually reinforce the complementary geographic allocation of state resources and international cooperation documented in Table 5.

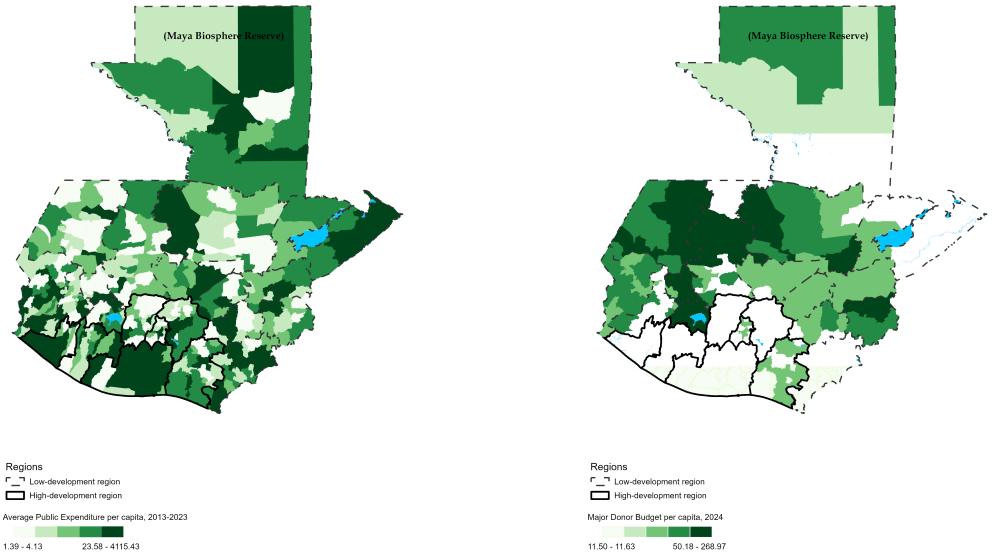
5.1.2 Current policy portfolio

This subsection characterizes the 2024 portfolio of major donor-funded food security and nutrition interventions in Guatemala to document the broad policy landscape that motivates the counterfactual policy scenarios analyzed below, rather than provide a comprehensive inventory of programs. Complementary evidence from the broader 2021–22 intervention mapping, previously used in the motivating analysis, is then used to assess the robustness of the observed patterns.[34]

Table 6 summarizes the composition of the 2024 portfolio. Nutrition and health, climate and environment, and agriculture account for the largest shares of both projects (61.1%, 57.4%, and 46.3%, respectively) and donor budgets (78.2%, 72.8%, and 77.4%, respectively). Institutional strengthening also represents an important component of the portfolio, whereas education and other interventions account for comparatively smaller

[34]To our knowledge, no other publicly accessible databases in Guatemala provide a comparable level of disaggregated information covering a broader range of development interventions beyond food security and nutrition.

Figure 5: Public expenditure and major donor budgets across municipalities



Note: The left panel reports average annual public expenditure per capita during 2013–2023, while the right panel reports major donor budget per capita in 2024. Major donor budgets correspond to food security and nutrition projects financed by major international development partners (G13) operating in Guatemala in 2024. Municipalities are classified into quintiles of public expenditure and donor budget per capita, respectively, with darker shades indicating higher quintiles.

shares.

Table 7 compares the average number of major donor-funded food security and nutrition projects per 10,000 inhabitants across municipalities in the low-development and high-development regions. All intervention categories are significantly more prevalent in the low-development region, consistent with the greater concentration of international cooperation documented in Table 5. The largest regional differences are observed for nutrition and health (2.53 versus 1.13 projects per 10,000 inhabitants), climate and environment (3.14 versus 1.86), and agriculture (2.25 versus 1.45).

The broader 2021–22 intervention mapping confirms these regional patterns despite differences in category definitions (Appendix Table A2).[35] Agriculture, institutional strength-

[35]Unlike the 2024 major donor database, the broader 2021–22 intervention mapping does not identify climate and environment as a separate intervention category. Moreover, emergency interventions are reported separately, whereas they are included within the residual "Other" category in the major donor database

Table 6: Composition of major donor-funded food security and nutrition interventions

Program category	Projects (%)	Budget (%)
Agriculture	46.3	77.4
Climate and environment	57.4	72.8
Education	16.7	20.9
Institutional strengthening	42.6	55.0
Gender	40.7	44.2
Nutrition and health	61.1	78.2
Other	25.9	13.1

Note: Entries report the percentage of projects and the percentage of total donor budget associated with each policy category. Major donor budgets correspond to food security and nutrition projects financed by major international development partners (G13) operating in Guatemala in 2024. Projects may be classified into more than one policy category; therefore, project and budget shares are not mutually exclusive and do not sum to 100%. The residual "Other" category includes emergency, financing, and tourism interventions after reclassifying open-ended project descriptions whenever appropriate.

Table 7: Intensity of major donor-funded interventions across regions

Program category	Region L	Region H	Difference (L−H)
Agriculture	2.25	1.45	0.80***
Climate and environment	3.14	1.86	1.28***
Education	0.17	0.02	0.15***
Institutional strengthening	2.04	1.36	0.68***
Gender	1.42	0.99	0.44**
Nutrition and health	2.53	1.13	1.40***
Other	3.09	2.33	0.75**

Note: Entries report unweighted municipal averages of the number of major donor-funded food security and nutrition projects per 10,000 inhabitants in 2024. Projects may operate in multiple municipalities and therefore contribute to each municipality in which they are implemented. Results are qualitatively unchanged when municipal averages are weighted by population. The Difference (L−H) column reports two-sample t-tests for differences in means. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

ening, nutrition, health, and emergency interventions are all significantly more prevalent in the low-development region, whereas education and gender interventions exhibit no statistically significant regional differences. Furthermore, the municipality-level correlation between the total number of interventions per 10,000 inhabitants recorded in the 2024 major donor database and the broader 2021–22 mapping is 0.66 ($p < 0.001$), indicating that both datasets capture similar territorial patterns despite differences in coverage, implementing organizations, and timing.

5.1.3 Targeting of interventions

To assess how interventions are targeted in practice, we focus on the low-development region, where development interventions are more concentrated and liquidity constraints are more relevant for emigration decisions. We use household survey data from the 2014 and 2023 ENCOVI surveys to identify households reporting receipt of support from any organization, including government, private-sector, and international-cooperation programs. Table 8 summarizes intervention receipt by expenditure tertile in the low-development region.

Intervention receipt is concentrated among lower-income households but extends beyond the poorest tertile. Across the two survey rounds, approximately 70–74% of households in the bottom expenditure tertile and 64–66% in the middle tertile report receiving some intervention, compared with only 37–45% in the top tertile. This pattern provides empirical support for the targeted policy scenarios considered in the counterfactual analysis.

Table 8: Targeting of development interventions in the low-development region

Survey year	First tertile	Second tertile	Third tertile
2014	74.4	65.7	37.1
2023	70.1	64.5	44.5

Note: Entries report the percentage of households in the low-development region (L) receiving support from at least one organization, based on the 2014 and 2023 ENCOVI household surveys. Expenditure terciles are constructed separately within the low-development region using household per capita expenditure.

together with financing and tourism interventions.

5.2 Counterfactual policy analysis

We use the calibrated model to evaluate eight counterfactual experiments, each varying one model component at a time relative to the baseline equilibrium. The experiments encompass both policy interventions and global shocks and are organized into three groups. *Demand-side policies* include transfers to households (Experiments 1–2) and reductions in migration barriers (Experiment 3). *Supply-side policies* involve public spending on productivity (Experiments 4–5). *Global shocks* include adverse productivity and destination-wage shocks (Experiments 6–7), together with policy interventions implemented as emergency compensation under these shocks (Experiment 8). Unless stated otherwise, all policies apply only in the low-development region L, where development interventions are more prevalent and liquidity constraints play a greater role in emigration decisions. Table 9 summarizes all experiments at their respective reference parameter values. Detailed results for the individual experiments are reported in Appendix A and referenced below.

Policies differ along three design dimensions: horizon, targeting, and funding. The horizon choice exists only for transfers: a *temporary* transfer operates in period 0 only, while a *permanent* transfer operates in both periods, paying the period-1 benefit only to households that remain in L. Supply-side programs have no horizon choice: public investment is paid in period 0 and delivers in period 1. Targeted designs cover the bottom share θ of households in L, ranked by pre-policy income. Finally, spending programs are financed by a lump-sum tax collected from all agents in period 0; we also consider external financing (paid from abroad, with no tax) as a benchmark. A financed program raises the lump-sum tax to $T + \Delta T$ and adds its outlays to the expenditure side of the government budget constraint:

$$(T + \Delta T)\, N = G_L + G_H + C_0 + C_1,$$

where C_0 and C_1 are the program's period-0 and period-1 costs, respectively.[36] Collected once in period 0, the lump-sum covers both periods' costs. We hold baseline spending $G_L + G_H$ fixed, so baseline TFP and amenities are unchanged and ΔT funds the program alone. The externally funded benchmark sets $\Delta T = 0$ and pays the cost from abroad. The two financing scenarios allow us to isolate the effect of domestic financing, although development

[36] $C_1 = 0$ for temporary transfers and for supply-side programs, whose single outlay is levied in period 0.

programs in practice may combine government resources, international cooperation, and multilateral financing.

The discussion of each experiment focuses on two responses. The *emigration response* is the change in the regional emigration rate against the baseline, in percentage points (pp). The *welfare response* is the equivalent variation (EV). Let V_i be household i's lifetime value at its realized choice, net of the Gumbel taste draw. Since draws are individual-specific and invariant across scenarios, they cancel for households that do not change their mobility decision; for households that do, netting them out isolates the economic component of the welfare change. With log utility, scaling consumption in both periods by $1 + e$ raises V_i by $(1 + \beta) \log(1 + e)$, so:

$$e_i \;=\; \exp\left(\frac{V_i^{\text{policy}} - V_i^{\text{baseline}}}{1+\beta}\right) - 1$$

is the uniform percentage change in consumption that makes household i indifferent between the baseline and the policy. For emigrants, period-1 utility is $\log W_{ij}^e$ rather than the log of a deflated consumption bundle, so their EV is the uniform percentage change in period-0 consumption and in W_{ij}^e jointly that leaves them indifferent. Positive EV means better off. We report median EVs: nationally, by region, and within terciles of baseline period-0 income (low, middle, high) in each region.

In addition to emigration and welfare, the experiment tables report the share of liquidity-constrained households (those whose period-0 income falls below the migration cost, $I_{i,0} < \kappa_L$), sectoral employment shares, the lump-sum tax as a share of GDP, and program costs. Additional results on non-tradable prices, internal migration, emigration selection, productivity, and income are reported in supplementary tables in Appendix A, as referenced below.

Demand-side policies

5.2.1 Experiment 1: Untargeted demand-side transfer

Policy design. We consider a lump-sum transfer τ^L to every household in region L, equivalent to a fraction ζ of mean period-0 income in L:

$$\tau^L \;=\; \zeta \cdot \bar{I}_{L0}, \qquad \bar{I}_{L0} \;\equiv\; \mathbb{E}_i\big[\max\big(p_0^T\, A_{L0}^T\, s_{iL}^T,\; p_{L0}^N\, A_L^N\, s_{iL}^N\big)\big]\,.$$

Table 9: Counterfactual policies: Summary of emigration and welfare effects

	Funding	ΔEmig L (pp)	EV L (%)	EV L low (%)	EV H (%)	Cost (% GDP)
Panel A: Demand-side policies						
Ex. 1: Untargeted transfer, temp.	Tax	+0.52	+1.7	+4.0	−0.7	1.56
	External	+1.17	+4.2	+9.5	0.0	1.56
Ex. 1: Untargeted transfer, perm.	Tax	−1.30	+2.3	+4.7	−1.4	2.98
	External	−0.15	+7.2	+15.8	0.0	2.96
Ex. 2: Targeted transfer, temp.	Tax	+1.97	−1.0	+19.6	−0.7	1.56
	External	+2.60	+1.9	+23.7	0.0	1.56
Ex. 2: Targeted transfer, perm.	Tax	−0.66	−1.8	+34.3	−1.4	3.01
	External	+0.26	+3.1	+43.9	0.0	2.98
Ex. 3a: Emigration-cost cut	—	+1.91	+0.2	+0.3	0.0	0.00
Ex. 3b: Credit for migration	—	+1.70	0.0	+0.9	0.0	0.00
Panel B: Supply-side policies						
Ex. 4: Untargeted investment	Tax	−0.80	+2.5	+2.5	0.0	0.02
	External	−0.79	+2.6	+2.6	0.0	0.02
Ex. 5: Targeted investment	Tax	−0.19	+0.5	+0.5	0.0	0.00
	External	−0.18	+0.5	+0.5	0.0	0.00
Panel C: Global shocks and emergency response						
Ex. 6: Productivity shock	—	−0.18	−13.0	−15.5	−11.9	0.00
Ex. 7: Emigration-wage shock	—	−3.25	−0.2	−0.2	+0.1	0.00
Ex. 8: Shock + untarg. transfer	Tax	+3.04	−5.7	+0.8	−15.3	6.25
	External	+6.09	+3.3	+19.1	−11.9	6.25
Ex. 8: Shock + untarg. investment	Tax	+1.71	−7.3	−7.7	−11.9	0.04
	External	+1.74	−7.2	−7.6	−11.9	0.04

Note: Each row reports one experiment at its reference parameter values: $\zeta = 0.05$ for transfers, $\Delta = 0.10$ for productivity investment, $\rho = 0.25$ for the emigration-cost cut, $\theta = 0.33$ for targeted designs, and $x = 0.20$ for shocks. Results for alternative parameter values, coverage rates, and the corresponding welfare results are reported in Appendix A. ΔEmig L: change in the L emigration rate relative to the no-policy baseline (10.02%), in percentage points. EV: median consumption-equivalent variation in %, for region L, its bottom income tercile, and region H. Cost: realized program cost, % of baseline period-0 GDP. Experiments 3, 6, and 7 do not involve expenditures and therefore do not include alternative funding scenarios. Experiment 8 includes the $x = 0.20$ shock, so its effects should be compared with the shock-only scenario (Ex. 6), rather than with the baseline.

Both temporary and permanent transfers are evaluated under the two financing scenarios, varying ζ over $\{0.025, 0.05, 0.10, 0.20, 0.33\}$ to examine the liquidity mechanism. Table 10 reports the results for both transfer durations at $\zeta \leq 0.10$.[37]

Economic mechanism. The temporary transfer generates an *income and liquidity effect*: by relaxing household budget constraints at $t = 0$, it allows agents who would otherwise be unable to cover the upfront emigration cost κ_L to reconsider their mobility deci-

[37] Appendix C examines the transfer experiments under a domestic credit market as a robustness check on the hand-to-mouth assumption.

sion. In line with Mckenzie & Rapoport (2007) and Bazzi (2017), the model predicts that the transfer will disproportionately affect households at intermediate skill levels (those for whom the emigration cost is binding but reachable), while leaving the decisions of the poorest and most skilled households largely unchanged. This non-monotonic migration response along the income distribution follows from the inverted-U relationship between wealth and emigration embedded in the model. Importantly, the transfer need not cover the full cost of emigration, but only the remaining financing gap for households close to the migration threshold.

The permanent transfer also generates a *retention effect*: because the period-1 benefit is paid only to households that remain in L, it is forfeited upon exit, raising the value of staying. Comparing temporary and permanent transfers therefore allows us to distinguish the liquidity effect from the incentive to remain, while comparing the two financing scenarios isolates the effect of domestic financing.

Table 10: Untargeted demand-side transfer (Experiment 1)

	Emig L (%)	ΔL (pp)	Constr. L (%)	Tax (% of GDP)	Cost (% of GDP)
Baseline	10.02	—	4.4	4.6	0.00
Panel A: Tax-financed					
Temp., $\zeta = 0.025$	10.27	+0.25	3.7	5.4	0.78
Temp., $\zeta = 0.05$	10.53	+0.52	3.2	6.2	1.56
Temp., $\zeta = 0.10$	10.98	+0.96	2.1	7.7	3.13
Perm., $\zeta = 0.025$	9.32	-0.70	4.6	6.1	1.49
Perm., $\zeta = 0.05$	8.72	-1.30	4.9	7.6	2.98
Perm., $\zeta = 0.10$	7.63	-2.38	5.5	10.7	6.00
Panel B: Externally funded					
Temp., $\zeta = 0.025$	10.63	+0.62	2.9	4.6	0.78
Temp., $\zeta = 0.05$	11.19	+1.17	1.7	4.6	1.56
Temp., $\zeta = 0.10$	12.39	+2.37	0.4	4.6	3.13
Perm., $\zeta = 0.025$	10.01	-0.01	2.9	4.6	1.48
Perm., $\zeta = 0.05$	9.87	-0.15	1.7	4.6	2.96
Perm., $\zeta = 0.10$	9.56	-0.46	0.4	4.6	5.94

Note: Temporary transfers are paid in period 0 only; *permanent* transfers are paid in both periods, with the period-1 payment going only to households that remain in L. Panel A is financed by a national lump-sum tax T collected in period 0 from all households in both regions, subject to their ability to pay. The tax balances the budget (baseline 4.6% of GDP). Panel B is financed externally, with no additional tax. The difference between the two panels reflects the effect of domestic financing. Emig L: % of L-born households that emigrate. ΔL (pp): change relative to baseline. Constr. L: % of L-born households with period-0 income below the migration cost ($I_{i,0} < \kappa_L$). Tax: per-household lump-sum tax T, expressed as a percentage of baseline period-0 GDP per household. Cost: realized program cost (present value over the periods of application), % of baseline period-0 GDP. Welfare effects are reported in Appendix Table A3.

Results. Table 10 shows that the direction of the emigration response depends on the duration of the transfer. Temporary transfers relax the period-0 liquidity constraint, allowing more households to cover the emigration cost. The share of liquidity-constrained households falls from 4.4% at baseline to 2.1% under the largest tax-financed transfer, while the emigration rate in L increases by 0.96 pp ($\zeta = 0.10$). Permanent transfers, by contrast, increase the incentive to remain in L, reducing emigration by 2.38 pp at the same transfer level. Domestic financing partially offsets these effects, as the lump-sum tax reduces the resources available to households in period 0. Under external financing, the increase in emigration reaches 2.37 pp for temporary transfers, while the reduction under permanent transfers is limited to 0.46 pp.

The welfare effects (Appendix Table A3) are progressive within L, with the largest gains accruing to the bottom income tercile (+7.8% under the tax-financed temporary transfer at $\zeta = 0.10$). In contrast, the welfare losses in H are regressive, as the lump-sum tax represents a larger share of consumption for poorer households (-3.1% for the bottom income tercile in H). The tax-financed program therefore redistributes resources from poor households in H to poor households in L, rather than simply from richer to poorer households. External financing eliminates the welfare losses in H and more than doubles the gains in L, with regional median welfare gains of 7.9% and 14.1% for temporary and permanent transfers, respectively, at $\zeta = 0.10$.

5.2.2 Experiment 2: Targeted demand-side transfer

Policy design. We allocate the same total expenditure as in Experiment 1 to the bottom θ share of households in region L, ranked within each period by income before taxes and transfers. Formally, let $\hat{I}_L^{\theta}$ denote the θ-th percentile of the pre-policy income distribution in region L, and define the binary eligibility indicator

$$\psi_{ij} \;=\; \mathbf{1}\Big[I_{ij0} \le \hat{I}_L^{\theta}\Big], \qquad \theta \in \{0.33,\, 0.50\},$$

so that $\psi_{ij} = 1$ for eligible households and zero otherwise. To keep total policy cost constant across Experiments 1 and 2, and thereby isolate the effect of targeting from the effect of

scale, the per-household transfer is scaled by the eligible share θ:

$$\tau^{L,\text{targ}} \;=\; \frac{\tau^{L}}{\theta} \;=\; \frac{\zeta \cdot \bar{I}_{L0}}{\theta},$$

so that total expenditure equals $\tau^{L,\text{targ}} \cdot \theta \cdot N_L = \zeta \cdot \bar{I}_{L0} \cdot N_L$ regardless of θ. We use the same values of ζ as in Experiment 1; Appendix Table A4 reports both transfer durations at $\zeta \leq 0.10$.

Economic mechanism. By restricting the transfer to the lower end of the income distribution, this experiment examines whether *distributional targeting* increases or reduces the migration response relative to the untargeted transfer. The model predicts two competing effects. Directing resources to the poorest households relaxes the liquidity constraints that prevent those below the migration-cost threshold κ_L from emigrating. However, these households also face greater subsistence needs and may devote the transfer entirely to local consumption rather than emigration. The effect of targeting therefore depends on whether the transfer reaches households close to the peak of the inverted-U relationship between income and emigration. Since total policy cost is held constant across Experiments 1 and 2, differences in migration and welfare outcomes reflect the allocation of transfers across households rather than differences in total expenditure.

Results. As in Experiment 1, the direction of the emigration response depends on the duration of the transfer (Appendix Table A4). Temporary transfers relax the liquidity constraint, and targeting increases the emigration response. At $\zeta = 0.10$, the tax-financed transfer to the bottom third raises emigration by 3.50 pp, compared with 0.96 pp under the untargeted transfer of equal cost (4.29 versus 2.37 pp under external financing). The share of liquidity-constrained households also falls to nearly zero at moderate transfer levels.[38] The increase in emigration is larger with tighter targeting ($\theta = 0.33$ versus $\theta = 0.50$) at every transfer level, confirming that directing resources to households closer to the migration-cost threshold has a larger effect on emigration. Permanent transfers, by contrast, increase the incentive to remain in L, reducing emigration by 1.41 to 1.80 pp

[38] At the reference parameter values in Table 9, the tax-financed targeted transfer increases emigration by 1.97 pp, compared with 0.52 pp under the untargeted transfer.

under domestic financing, with almost no effect under external financing. The lump-sum tax partially offsets the liquidity effect of temporary transfers and reinforces the incentive to remain under permanent transfers.

Targeting also affects the distribution of welfare gains (Appendix Table A5). The bottom income tercile receives gains of up to 69%, while all households not covered by the transfer experience welfare losses under domestic financing. Median welfare in L increases only when the transfer reaches the median household, with a gain of 7.5% at $\theta = 0.50$ under the permanent transfer ($\zeta = 0.10$). Under external financing, these losses disappear except for the top income tercile in L, which experiences welfare losses due to the increase in the non-tradable price.

5.2.3 Experiment 3: Migration cost reduction and credit for migration

Policy design. This experiment directly targets the frictions that constrain international emigration, isolating the role of upfront migration costs in shaping mobility decisions. We consider two variants of these emigration frictions, applying each either to region L alone or to both regions. In Variant A, the emigration cost falls exogenously by a fraction ρ, so that the effective cost entering the period-0 budget constraint becomes:

$$\kappa_j^{\text{cf}} \;=\; (1-\rho)\,\kappa_j \;=\; (1-\rho)\,\bar{\kappa}\,e^{-\eta\,n_j}, \qquad \rho \in \{0.10,\, 0.25,\, 0.50\},$$

applied to region L only or to both regions (the tables report $\rho \leq 0.25$). This parameterization is consistent with the empirical evidence on the magnitude of migration cost reductions achievable through diaspora network expansion (Mckenzie & Rapoport, 2010; Clemens, 2021) and reduced border enforcement (Gathmann, 2008). The *network channel* also operates through Variant A: an expansion of the emigrant network n_j (for example through diaspora engagement programs) reduces effective costs endogenously without direct fiscal expenditure.

Variant B keeps the cost but lets emigrants finance it against their period-1 foreign

income.[39] Formally, the period-0 budget constraint of a potential emigrant changes from:

$$p_0^T c_{ij0}^T + p_{j0}^N c_{ij0}^N \;=\; I_{ij0} - T + p_0^T \tau_{ij0} - p_0^T \kappa_L$$

to:

$$p_0^T c_{ij0}^T + p_{j0}^N c_{ij0}^N \;=\; I_{ij0} - T + p_0^T \tau_{ij0},$$

while the emigration cost is instead deducted from the period-1 foreign income stream, so that W^e is replaced by $W^e - \kappa_L$ in the emigrant's second-period utility. Results for Variants A and B are reported in Appendix Tables A6 and A7, respectively.

Economic mechanism. The two variants distinguish the effect of reducing the migration cost from that of relaxing the period-0 liquidity constraint. Variant A lowers the cost of emigration, while Variant B changes only its timing. Under hand-to-mouth preferences, this re-timing is not neutral: it allows poor households that lack sufficient period-0 resources to cover κ_L to emigrate, while leaving the total lifetime cost of emigration unchanged and requiring no fiscal expenditure. Comparing the emigration responses across the two variants, and with the demand-side transfers in Experiments 1 and 2, therefore separates the role of migration costs from that of liquidity constraints in shaping emigration decisions.

Results. A 25% reduction in the migration cost increases emigration in L by 1.91 pp (Appendix Table A6), while re-timing κ increases it by 1.70 pp (Appendix Table A7). This comparison indicates that relaxing the period-0 liquidity constraint accounts for a substantial share of the emigration response to a reduction in migration costs. Under both variants, the share of liquidity-constrained households in L falls, reaching zero under Variant B.

The L-only and global versions also show how the responses differ across regions. Restricting either policy to L leaves emigration in H unchanged. When applied globally, the 25% cost reduction increases emigration in H by 0.31 pp, while credit for migration reduces it by 2.36 pp. Because few households in H are liquidity constrained, deferring the

[39] This counterfactual should be interpreted primarily as a mechanism exercise rather than a specific policy intervention. By shifting the payment of migration costs from period 0 to period 1, it isolates the role of liquidity constraints while holding the lifetime cost of migration unchanged.

migration cost primarily shifts its payment to period 1 and reduces the value of emigrating. Welfare effects are small, remaining within ±0.9% (Appendix Table A14). The lower income terciles in L gain, while the top tercile experiences a small loss.

Supply-side policies

5.2.4 Experiment 4: Untargeted productivity investment

Policy design. We consider an increase in period-1 tradable productivity in region L. Specifically, the TFP anchor in equation (5) becomes:

$$\bar{A}_{L1}^{T} \;=\; (1+\Delta)\,\bar{A}_{L}^{T}, \qquad \Delta \in \{0.05,\, 0.10,\, 0.20\},$$

applied uniformly to all households in region L, with period-0 productivity unchanged. The investment is purchased in period 0 and raises productivity in period 1, and households anticipate this increase when making their location decisions. We price the rise in L's relative productivity by inverting equation (5): lifting A_L^T by Δ relative to H takes $(1-\delta_L)\,g_L\,[(1+\Delta)^{1/\alpha_p}-1]$ of productive spending per L resident, levied once in period 0. The amenity component $\delta_L\,g_L$ and the national reference $\bar{g}$ remain at their baseline values. Table 11 reports the results across the three values of Δ. These values of Δ are consistent with the range of productivity gains considered in the quantitative development literature (Lagakos et al., 2023).

Economic mechanism. Unlike the demand-side transfers of Experiments 1 and 2, which operate through a period-0 liquidity channel, the productivity investment increases the returns to staying in region L. It raises V_{ij}^{S} relative to V_{ij}^{E}, particularly for middle-skilled households whose migration decisions are more responsive to local wage prospects, while leaving period-0 budgets unchanged. The experiment therefore examines whether *local opportunity creation*, rather than income support, can reduce emigration while improving welfare.

Results. Emigration falls as the productivity increase becomes larger: by 0.41, 0.80, and 1.51 pp across the three values of Δ (Table 11). Because the productivity increase occurs

Table 11: Untargeted productivity investment (Experiment 4)

	Emig L (%)	ΔL (pp)	Constr. L (%)	T share $L0$ (%)	T share $L1$ (%)	Tax (% of GDP)	Cost (% of GDP)
Baseline	10.02	—	4.4	52.26	48.96	4.6	0.00
Panel A: Tax-financed							
$\Delta = 0.05$	9.61	-0.41	4.4	52.22	48.92	4.6	0.01
$\Delta = 0.10$	9.21	-0.80	4.4	52.20	48.90	4.6	0.02
$\Delta = 0.20$	8.51	-1.51	4.4	52.16	48.89	4.6	0.04
Panel B: Externally funded							
$\Delta = 0.05$	9.61	-0.40	4.4	52.22	48.92	4.6	0.01
$\Delta = 0.10$	9.23	-0.79	4.4	52.19	48.90	4.6	0.02
$\Delta = 0.20$	8.52	-1.49	4.4	52.13	48.90	4.6	0.04

Note: Tradable share $L0/L1$: % of L residents in the tradable sector in period 0 and period 1. Funding panels and remaining columns as in Table 10. Welfare effects are reported in Appendix Table A8.

in period 1, it leaves period-0 budgets unchanged and does not relax liquidity constraints. The share of liquidity-constrained households therefore remains at its baseline level of 4.4%. Sectoral employment changes little, while program costs reach at most 0.04% of GDP, substantially below those of the demand-side transfers (Table 9). Financing therefore has little effect on the results, with differences in the emigration response of at most 0.02 pp across the two financing scenarios.

All income terciles in L experience welfare gains, ranging from 4.8% for the bottom tercile to 5.3% for the top tercile at $\Delta = 0.20$ (Appendix Table A8). The slightly larger gain for the top tercile reflects its greater reliance on tradable-sector earnings, while welfare in H remains essentially unchanged.

5.2.5 Experiment 5: Targeted productivity investment

Policy design. We increase the period-1 tradable skills of the poorest households in region L. The bottom $\theta \in \{0.33, 0.50\}$ of households in L, ranked by pre-policy period-1 income among stayers, have their period-1 tradable income scaled by $(1 + \Delta)$ before the sector choice, with $\Delta \in \{0.05, 0.10, 0.20\}$. Period-0 skills are unchanged, and households anticipate the productivity increase when making their location decisions.

Program costs are calculated using the same approach as in Experiment 4. At baseline prices and sector choices, the targeted investment increases period-1 tradable output in L by the same amount as a uniform relative productivity increase of $\rho = \Delta \times$(covered share of baseline L tradable output). The corresponding values of ρ range from 0.5% to 3.5%. Appendix Table A9 reports the results across the values of θ and Δ.

Economic mechanism. This experiment is the distributional counterpart of Experiment 4, mirroring on the supply side the targeting exercise of Experiment 2. Concentrating the productivity investment among poorer households increases their returns to staying in region L while leaving their period-0 budgets unchanged. Comparing targeted and untargeted productivity investments therefore shows how targeting affects the emigration and welfare responses to *local opportunity creation*. This design reflects the rationale for targeting productivity-enhancing interventions toward poorer households or less-developed areas, where improving local economic opportunities may be particularly important.

Results. Emigration falls modestly, by up to 0.74 pp at $\theta = 0.50$ and $\Delta = 0.20$ (Appendix Table A9). The productivity increase raises the returns to staying for covered households while leaving period-0 budgets unchanged. The share of liquidity-constrained households therefore remains at its baseline level of 4.4%. The effect on sectoral allocation occurs in period 1, when the tradable employment share in L increases by up to 2.4 pp, while the period-0 share remains close to its baseline level. Program costs reach at most 0.01% of GDP, so the results are nearly identical under domestic and external financing.

The bottom and middle income terciles experience welfare gains of up to 1.7% (Appendix Table A10), while the uncovered top tercile experiences losses of up to 1.4%. These losses reflect the increase in the non-tradable price associated with the reallocation of covered households toward the tradable sector.[40] Welfare in H and the national median remain essentially unchanged.

Global shocks

5.2.6 Experiment 6: Global productivity shock

Experiment design. Guatemala, like many developing economies, is recurrently exposed to aggregate and regional shocks that can disrupt production, raise input costs, and weaken local economic opportunities (Hernandez et al., 2026). Rather than modeling these shocks separately, we examine their potential consequences for migration through an adverse productivity shock, reducing tradable TFP by a fraction x in both regions and in both periods, with $x \in \{0.10, 0.20, 0.30\}$, which we implement as a uniform decline in baseline productivity $\bar{A}_j^T$. This adverse productivity shock also provides the baseline scenario for the emergency compensation policies considered in Experiment 8. Appendix Table A12 reports the results across the three values of x.

Economic mechanism. The productivity shock reduces domestic income in both periods, increasing the relative return to emigration by lowering the opportunity cost Ω_{ij}, while simultaneously making it more difficult for liquidity-constrained households to finance the migration cost by raising the liquidity wedge Λ_{ij}. These two effects work in

[40] As covered households shift into tradables, the supply of non-tradables in L contracts and its price rises (Table A11). Uncovered households at the top of the distribution do not benefit from the productivity boost but consume non-tradables at the higher price, leading to a decline in their real income.

opposite directions, so the net effect on emigration is ambiguous a priori, as anticipated in Section 3.5.

Results. The liquidity effect dominates in region L. Emigration falls modestly, by 0.78 pp at $x = 0.30$, while the share of liquidity-constrained households increases from 4.4% to 12.2% (Appendix Table A12); the contrast between the two magnitudes indicates that many of the newly constrained households were not close to the migration margin to begin with. Region H has few liquidity-constrained households, so emigration instead increases by 0.66 pp at $x = 0.30$. Welfare losses are regressive within L, ranging from 15.5% for the bottom income tercile to 11.7% for the top tercile at $x = 0.20$ (Appendix Table A14). Experiment 8 considers alternative policies in response to this shock.

5.2.7 Experiment 7: Global emigration-wage shock

Experiment design. Recent changes in migration and enforcement policies in destination countries, particularly the United States, have altered the environment facing Guatemalan migrants and increased uncertainty about the returns to emigration (Ruiz Soto et al., 2026). We capture the potential effect of these developments on migration incentives through a decline in the expected foreign return to emigration, modeled as a reduction in the foreign wage W^e by a fraction x for emigrants from both regions, with $x \in \{0.10, 0.20, 0.30\}$. The shock can therefore be interpreted more broadly as a deterioration in expected opportunities abroad rather than as a literal decline in foreign wages. Because W^e_{ij} is scaled proportionally, the shock shifts $\log W^e_{ij}$ uniformly across households and therefore alters how many agents emigrate rather than which ones. Enforcement also operates through the upfront cost κ_j, a channel isolated in Experiment 3; here we hold costs fixed to isolate the expected return abroad. Whereas Experiment 6 reduces domestic productivity, this experiment directly reduces the value of the emigration option while leaving domestic incomes unchanged. Appendix Table A13 reports the results across the three values of x.

Economic mechanism. The decline in the foreign wage reduces the return to emigration without affecting households' period-0 resources: it raises the opportunity cost Ω_{ij} while

leaving the liquidity wedge Λ_{ij} unaffected. Unlike Experiment 6, the two channels therefore do not offset. Emigration therefore becomes less attractive without tightening the liquidity constraint, implying a decline in emigration in both regions.

Results. Emigration falls in both regions, by 4.81 pp in L and 2.08 pp in H at $x = 0.30$ (Appendix Table A13). The share of liquidity-constrained households changes little, consistent with the shock operating through the return to emigration rather than current income. Welfare effects are considerably smaller than the emigration responses. Most households remain in their region and their domestic income is unaffected, while households that change their migration decision are close to indifferent between staying and emigrating.

The bottom and middle income terciles in L bear welfare losses of up to 0.4%, while the top tercile and households in H experience small gains. The national median remains within 0.2% of its baseline value (Appendix Table A14).

5.2.8 Experiment 8: Emergency compensation under a productivity shock

Policy design. Motivated by the emergency assistance commonly deployed by governments and development partners following adverse shocks, we consider temporary policy responses to the productivity shock examined in Experiment 6. Specifically, we take the shock at $x = 0.20$ and combine it with a temporary L-only policy, considering either a demand-side transfer or a supply-side productivity investment. Each policy is implemented in untargeted and targeted versions, at $\zeta = 0.20$ for transfers and $\Delta = 0.20$ for productivity investments. Targeted versions cover the bottom $\theta \in \{0.33, 0.50\}$ of households in L, ranked in the shocked equilibrium. Transfers retain their pre-shock size, while the productivity investment raises shocked TFP by 20% relative to its depressed level. Outcomes are reported relative to the no-shock baseline, while the effect of emergency compensation is assessed relative to the shock-only scenario. Appendix Table A15 reports the results across the alternative policy designs.

Economic mechanism. The experiment compares the two policy responses studied above when they are deployed after an adverse productivity shock. Transfers provide immediate income support and relax the liquidity constraint, potentially allowing households

to finance emigration. Productivity investment instead raises local economic opportunities and the return to staying. But it also raises income, and since the shock has left many households below the migration-cost threshold, this relaxes liquidity constraints and increases emigration. Targeting determines which households receive these benefits and therefore how each policy affects migration and welfare across the income distribution.

Results. Both policy responses increase emigration relative to the shock-only scenario, but the effects differ substantially in magnitude and cost (Appendix Table A15). Transfers eliminate the liquidity constraint among covered households and increase emigration in L by up to 6.5 pp relative to the shock-only scenario under domestic financing and 8.2 pp under external financing. Productivity investment produces a considerably smaller increase in emigration, ranging from 0.7 to 1.9 pp, as the higher productivity both relaxes liquidity constraints and increases the return to staying. The difference in fiscal cost is also substantial. Transfers cost 6.25% of GDP, compared with at most 0.04% for the productivity investment.

The welfare effects also differ sharply across policies and financing scenarios (Appendix Table A16). Under domestic financing, the untargeted transfer improves welfare among poorer households in L but deepens the losses in H, whose households also finance the program through the lump-sum tax. The targeted transfer leaves households outside its coverage worse off, with the national median falling by 15.6%, compared with 12.3% under the shock alone. The untargeted productivity investment provides a broader partial recovery in L and limits the decline in national median welfare to 7.7%. Under external financing, the untargeted transfer raises median welfare in L above its pre-shock level, as the transfer supports consumption among stayers while relaxing the liquidity constraint for households that emigrate.

Emigration profiles across experiments

Figure 6 summarizes how the main counterfactual experiments shift the relationship between baseline household income and the probability of emigration in region L. Demand-side policies pivot the profile at the bottom of the distribution and converge to the baseline above the median, consistent with their operating through the liquidity wedge Λ_{ij}, which

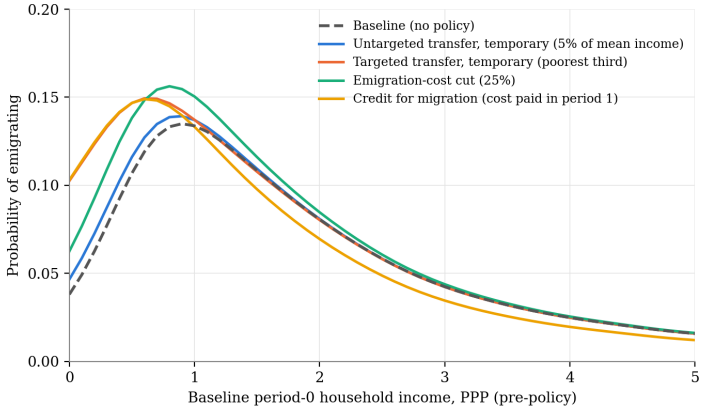
binds only where resources are close to the migration cost. Deferring the cost to period 1 raises emigration among the poorest households almost threefold, while lowering it slightly at the top, where the deferred payment reduces consumption abroad without relieving any constraint. Supply-side investment instead shifts the profile down across the distribution, as it operates through the opportunity cost Ω_{ij}. The adverse productivity shock illustrates the interaction of the two channels: it lowers emigration among the poorest, who are pushed below the migration-cost threshold, while raising it further up the distribution, where the fall in domestic income dominates. The aggregate migration responses documented above therefore mask substantial heterogeneity across the baseline income distribution.

5.3 Policy implications

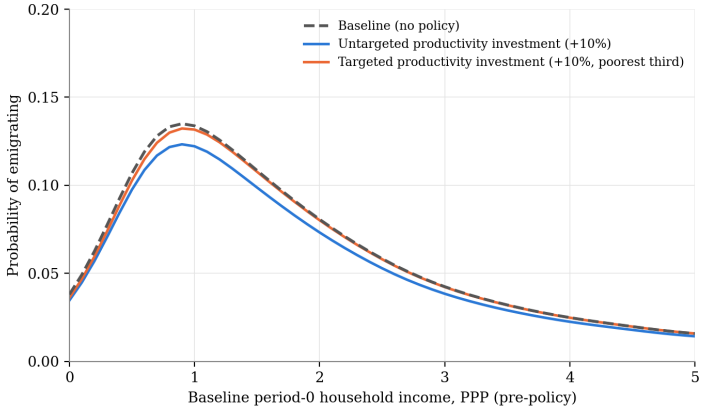
The counterfactual policy experiments are intentionally stylized and do not seek to replicate specific development programs implemented in Guatemala. Rather, the descriptive evidence in Section 5.1 provides the institutional context for interpreting these experiments, documenting the spatial allocation, composition, and targeting of development interventions currently observed in practice.

The development policy landscape maps naturally into the broad policy classes represented in the model. Demand-side interventions primarily affect household resources and liquidity constraints, whereas supply-side interventions seek to expand local productive capacity and employment opportunities. Institutional strengthening does not correspond to a separate policy instrument in the model but may complement both types of interventions. The counterfactual experiments suggest that these policy classes generate distinct responses and trade-offs across migration, labor allocation, and welfare. Consequently, the choice among alternative interventions depends not only on their effectiveness in achieving a particular objective, but also on the broader set of outcomes policymakers seek to influence.

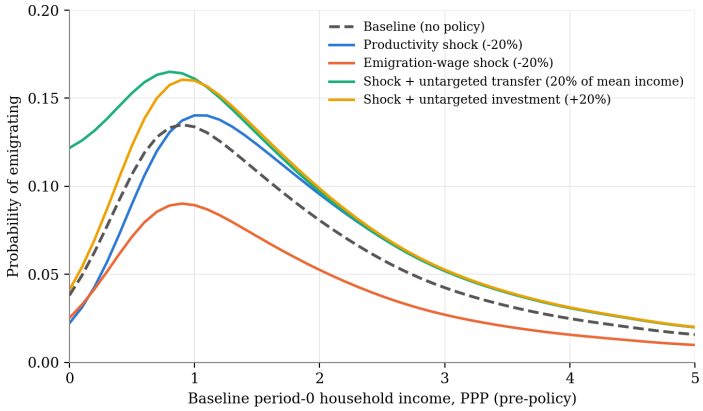
Among demand-side interventions, the simulations highlight the importance of both targeting and policy duration. Temporary transfers primarily relax liquidity constraints and may increase emigration by enabling constrained households to finance migration, whereas permanent transfers raise the opportunity cost of migration by improving expected welfare at origin. This mechanism is consistent with evidence that financial constraints can limit



(a) Demand-side policies



(b) Supply-side policies



(c) Global shocks and emergency responses

Figure 6: Emigration probability profiles across policy experiments

Note: The figure reports the probability of emigration in region L as a function of baseline period-0 household income, adjusted for regional PPP. Panel (a) reports demand-side policies, Panel (b) supply-side policies, and Panel (c) global shocks and emergency responses. The dashed line denotes the no-policy baseline. Policy and shock parameters correspond to the reference values indicated in the figure legends. Income is measured before the policy or shock.

migration and that transfers or credit can facilitate migration by relaxing those constraints (Yang, 2026). Targeted transfers also generate larger welfare gains for vulnerable households and stronger responses per unit of public expenditure than comparable untargeted policies. These results are consistent with the mixed empirical evidence on transfers and migration, as similar interventions may generate different migration responses depending on their duration and targeting. They also broadly support the emphasis on targeting observed in Guatemala while illustrating how alternative designs may affect both welfare and migration.

Supply-side interventions exhibit a different pattern of trade-offs. Productivity-enhancing investments raise the returns to staying by improving local economic opportunities, generating welfare gains while producing comparatively modest migration responses. Their principal contribution therefore lies in strengthening local productive capacity rather than directly discouraging migration. This distinction suggests that productivity-enhancing interventions should primarily be evaluated according to their broader development effects, with migration outcomes emerging as an indirect consequence of improved local opportunities. The predominance of agriculture, climate adaptation, and productivity-related interventions documented in Section 5.1 is broadly consistent with this development-oriented role.

The migration-specific experiments illustrate the distinct role of migration frictions in shaping migration decisions. Policies that directly reduce migration costs or relax financial constraints for prospective migrants generate larger migration responses than conventional development interventions because they operate directly on the migration decision rather than indirectly through local economic opportunities (Yang, 2026). Similarly, deteriorations in expected opportunities abroad reduce emigration incentives independently of domestic incomes. These experiments therefore help identify the mechanisms through which migration responds to changes in migration costs and expected returns abroad. Because interventions explicitly targeting migration costs have only limited counterparts within the current development portfolio, these simulations should primarily be interpreted as analytical benchmarks that distinguish migration-specific policies and shocks from broader development interventions.

The experiments also highlight the importance of policy design under adverse external

shocks. Although the productivity shock considered in the model is stylized, it captures adverse events that reduce production opportunities and household incomes. The simulations show that emergency compensation can mitigate welfare losses, particularly among vulnerable households, while productivity-enhancing investments can partially offset the deterioration in local economic opportunities. While emergency interventions represent a relatively small component of the development portfolio documented in Section 5.1, the results suggest that contingency mechanisms can complement longer-term development investments when adverse shocks occur.

Taken together, the descriptive evidence and counterfactual analysis suggest two considerations for policy design. First, maintaining effective targeting can improve the performance of demand-side interventions and concentrate welfare gains among vulnerable households. Second, contingency mechanisms that respond rapidly to adverse shocks can complement the existing emphasis on productivity-enhancing investments. More generally, the results highlight the importance of policy design: interventions that relax liquidity constraints, improve local economic opportunities, or respond to adverse shocks can have distinct implications for migration and welfare.

6 Conclusion

This paper develops a structural framework to examine how development policies shape labor allocation and international migration decisions in developing countries, using Guatemala as a case study. The model incorporates heterogeneous skills, regional productivity differences, migration costs, and household networks to characterize labor and location choices under varying levels of development and mobility constraints. Our framework allows us to jointly evaluate labor allocation, migration responses, and welfare implications under alternative policy designs within a unified structural setting.

The results suggest that the relationship between development interventions and migration is nonlinear and, at times, counterintuitive. Policies that relax households' liquidity constraints can increase emigration from the lower-development region, particularly among lower-income households for whom migration costs are binding. Temporary transfers can therefore facilitate emigration, with stronger responses when resources are targeted toward

poorer households, whereas permanent transfers reduce emigration by increasing the value of remaining at origin. Reductions in migration costs generate even larger migration responses, while productivity-enhancing interventions reduce emigration by strengthening local economic opportunities. The analysis of adverse shocks further shows that migration responses depend on whether shocks affect resources at origin or expected opportunities abroad, and that emergency policy responses can mitigate welfare losses while generating different migration effects depending on the type and targeting of the intervention.

Taken together, these findings indicate that the migration and welfare consequences of development policies depend not only on the resources devoted to an intervention, but also on the mechanisms through which it operates and on its design, including targeting, duration, and financing. Policies that ease financial constraints may enable migration even as they improve household welfare, whereas interventions that raise local returns can alter migration incentives by improving economic opportunities at origin. Evaluations that focus only on local economic outcomes, without accounting for induced migration responses, may therefore provide an incomplete assessment of alternative development interventions. These results do not imply that productivity-enhancing interventions are necessarily preferable to cash transfers, as migration decisions reflect households' optimal choices given their preferences, opportunities, and constraints. Policy choices also depend on implementation feasibility and administrative capacity, particularly where cash transfers may be easier to deliver and monitor than productivity-enhancing interventions. Future research could extend the framework to incorporate dynamic migration decisions, including return migration and intergenerational dynamics, examining how productivity gains and higher household incomes shape migration choices over time by affecting both liquidity constraints and local economic opportunities.

Although the model is calibrated to Guatemala, the mechanisms examined here are also relevant for other migrant-origin countries in Central America that face similar development constraints and have strong migration corridors to the United States. These mechanisms may become increasingly relevant as changes in destination-country immigration and enforcement policies alter migration incentives and increase the importance of return migration for origin countries.

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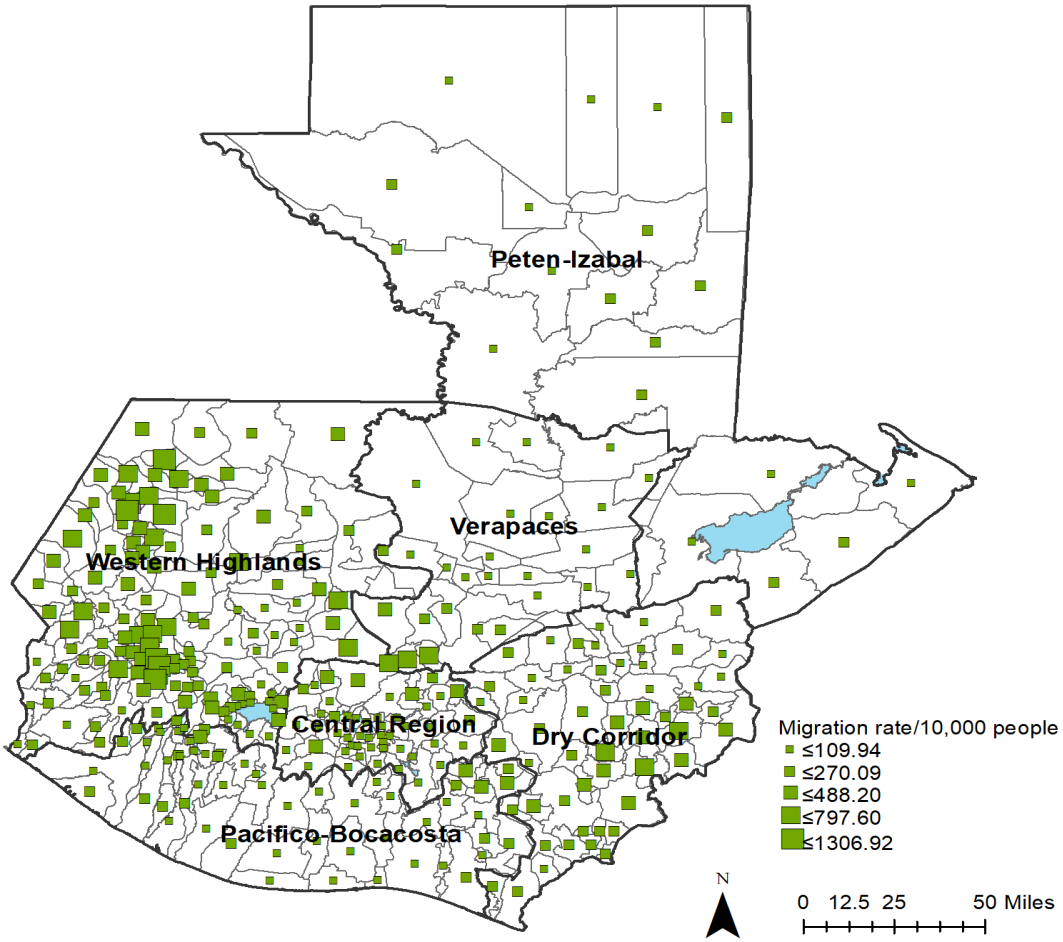
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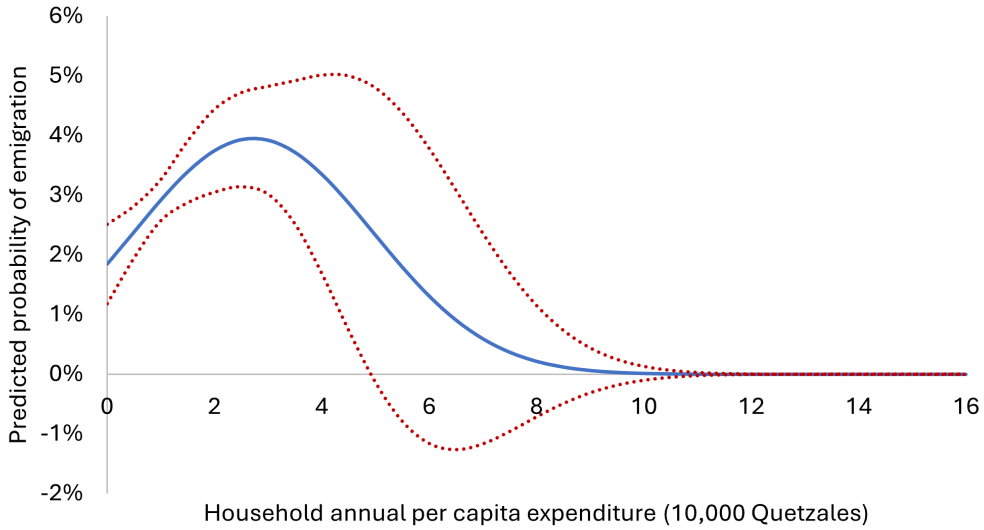
A Supplementary Figures and Tables

Figure A1: Emigration rate by municipality, 2002-2018



Note: The migration rate per 10,000 people is based on the cumulative number of international migrants between 2002 and 2018 in each municipality divided by the population of the municipality in 2018, using data from the 2018 Population and Housing Census (INE, 2020).

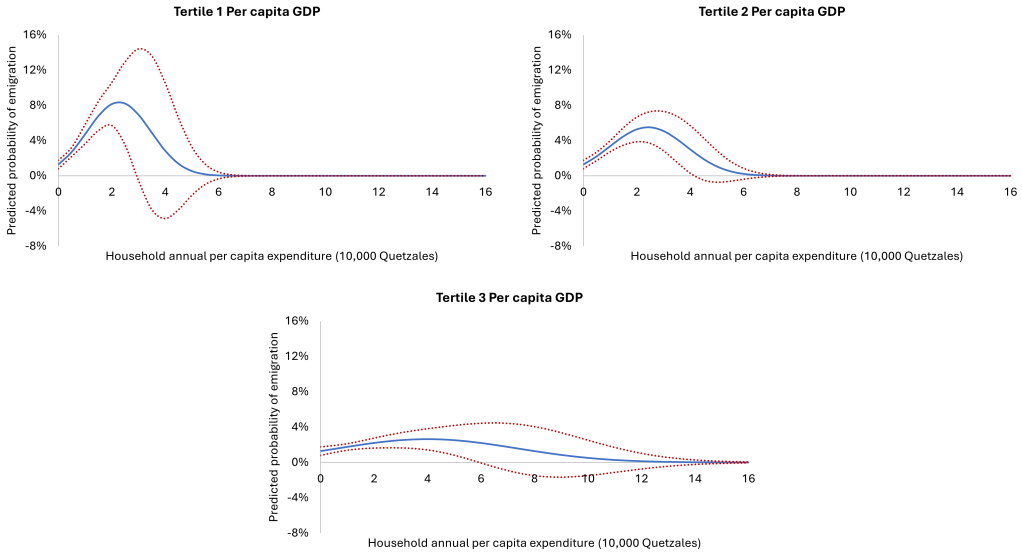
Figure A2: Probability of emigration and per capita expenditure at the household level



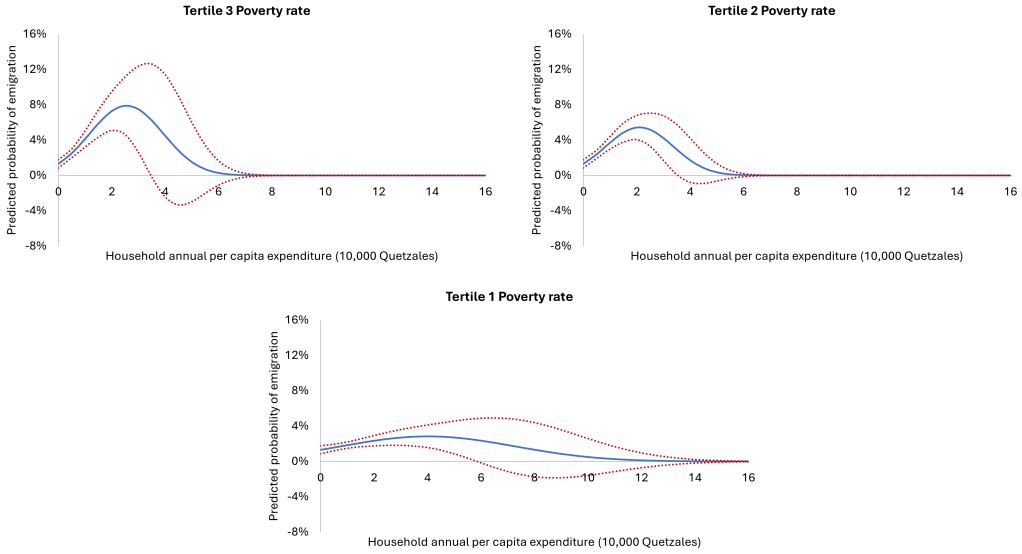
Note: The predicted probability of emigration results from regressing whether a household reports a recent emigrant (over the past five years) on annual per capita household expenditure and its squared term, using data from the 2014 Living Standards Measurement Survey in Guatemala (ENCOVI). The dotted lines represent the corresponding 95% confidence intervals.

Figure A3: Probability of emigration and household per capita expenditure, by municipality per capita GDP and poverty level (tertiles)

Panel A: By per capita GDP



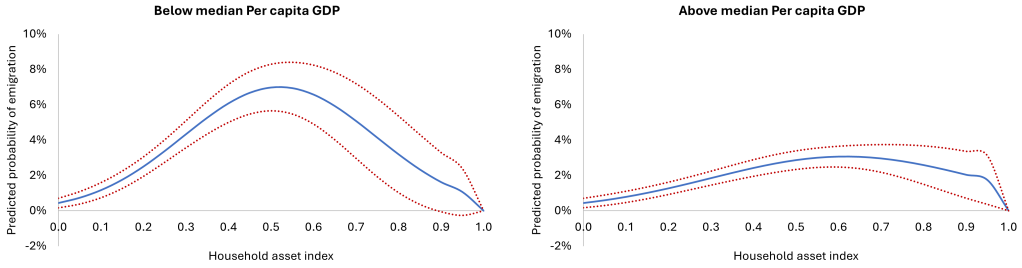
Panel B: By poverty rate



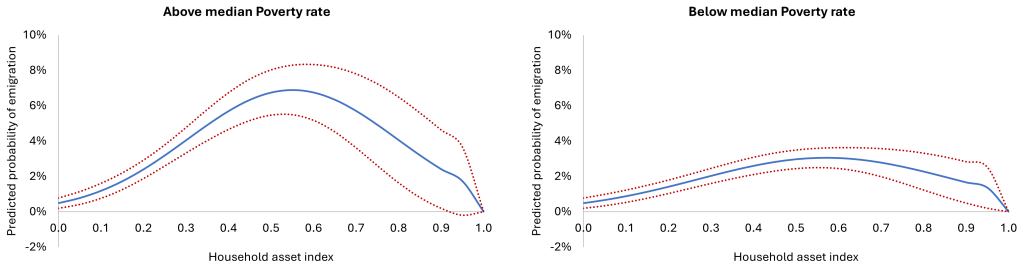
Note: The predicted probability of emigration results from regressing whether a household reports a recent emigrant (over the past five years) on annual per capita household expenditure and its squared term, using data from the 2014 Living Standards Measurement Survey in Guatemala (ENCOVI). The dotted lines represent the corresponding 95% confidence intervals. Panel A distinguishes households by the per capita Gross Domestic Product (GDP) of the municipality in which they are located, by including interaction terms between household expenditure (and its squared term) and municipality tertile indicators in the regression. Panel B distinguishes households by the municipality poverty rate, including analogous interaction terms in the regression.

Figure A4: Probability of emigration and household asset index, by municipality per capita GDP and poverty level (below versus above median)

Panel A: By per capita GDP

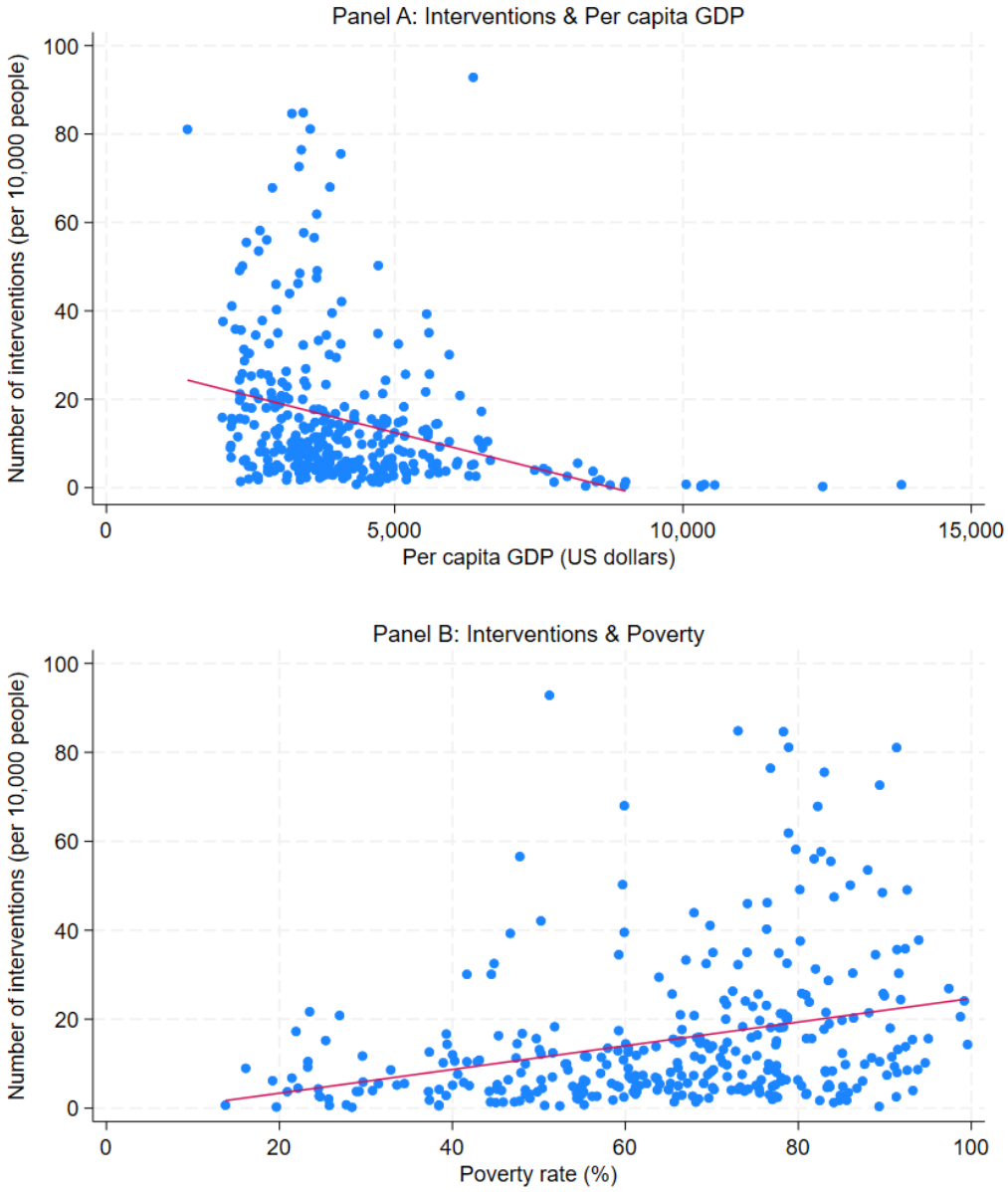


Panel B: By poverty rate



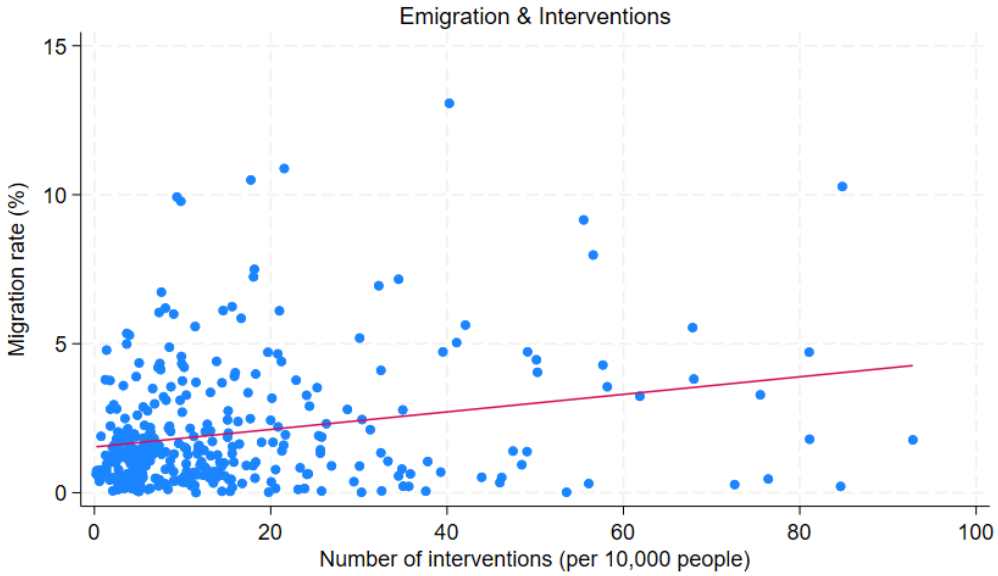
Note: The predicted probability of emigration results from regressing whether a household reports a recent emigrant (over the past five years) on the household asset index and its squared term, using data from the 2014 Living Standards Measurement Survey in Guatemala (ENCOVI). The index serves as a proxy for accumulated household wealth and measures the proportion of 17 durable goods, access to services, and housing characteristics available to the household, ranging from 0 to 1. The dotted lines represent the corresponding 95% confidence intervals. Panel A distinguishes households by the per capita Gross Domestic Product (GDP) of the municipality in which they are located, by including interaction terms between the household asset index (and its squared term) and an indicator for municipalities below versus above the median per capita GDP in the regression. Panel B distinguishes households by the municipality poverty rate, including analogous interaction terms based on whether municipalities are below versus above the median poverty rate.

Figure A5: Food security and nutrition policies and per capita GDP and poverty across municipalities



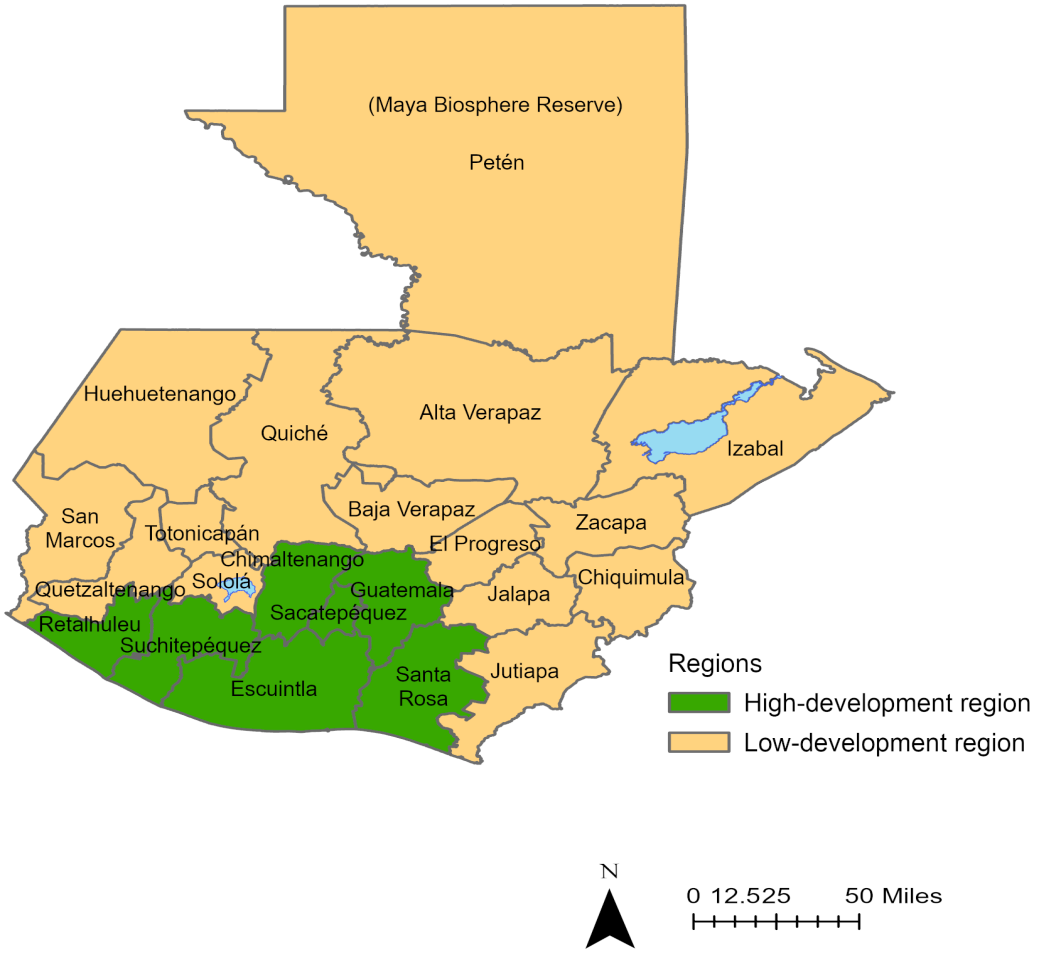
Note: Each circle in the figures represents a municipality. The number of interventions (per 10,000 people) is equivalent to the total number of food security and nutrition programs in each municipality that result from the 2021-2022 mapping exercise performed by Hernandez et al. (2022), divided by the population of the municipality in 2018 (INE, 2020). The per capita GDP is expressed in US dollars and corresponds to 2017 (FUNDESA, 2018). The poverty rate (in percentage terms) corresponds to 2014 (INE, 2015). Panel A reports the scatterplot of the number of interventions (per 10,000 people) against the per capita Gross Domestic Product (GDP) in the municipality, while Panel B reports the scatterplot of the number of interventions against the poverty rate in the municipality. The line in each figure is the corresponding linear fit.

Figure A6: Food security and nutrition policies and emigration across municipalities



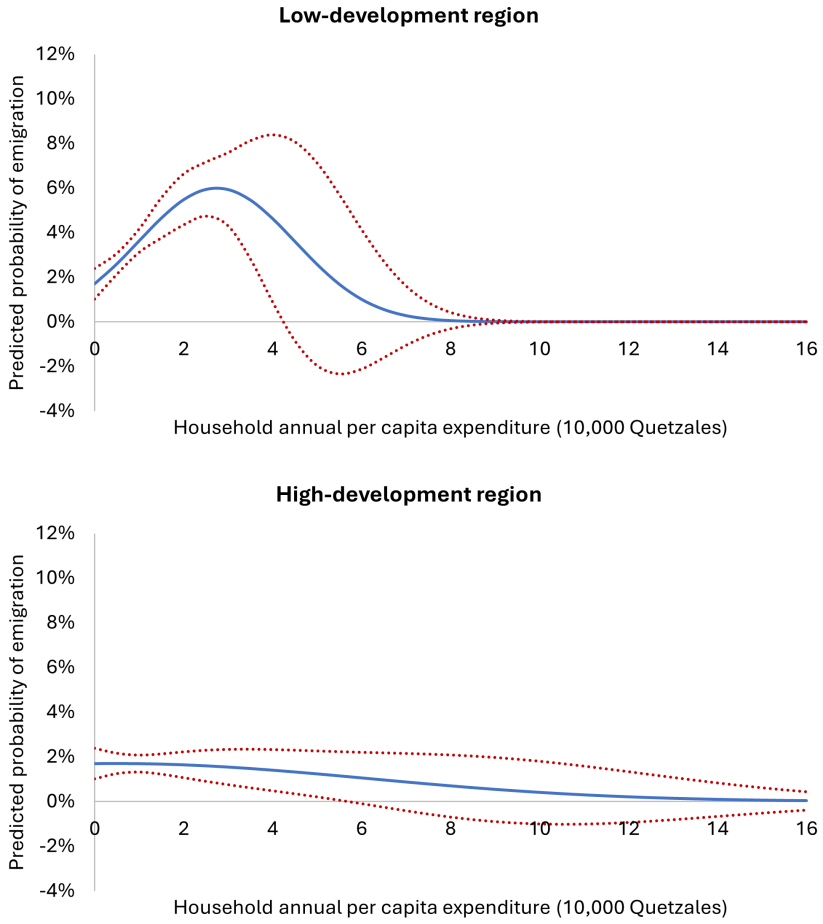
Note: Each circle in the figures represents a municipality. The migration rate (in percentage terms) is equivalent to the cumulative number of international migrants between 2002 and 2018 in each municipality divided by the population of the municipality in 2018 (INE, 2020). The number of interventions (per 10,000 people) is equivalent to the total number of food security and nutrition programs in each municipality that result from the 2021-2022 mapping exercise performed by Hernandez et al. (2022), divided by the population of the municipality in 2018 (INE, 2020). The figure reports the scatterplot of the migration rate against the number of interventions (per 10,000 people) in the municipality. The line in the figure is the corresponding linear fit.

Figure A7: Regional classification of Guatemala into low- and high-development regions used in the model



Note: The low-development region comprises 15 departments covering the Western Highlands, Dry Corridor, Verapaces, and Peten-Izabal subregions, while the high-development region comprises 7 departments corresponding to the Center and Pacifico-Bocacosta subregions and includes the department of Guatemala (which contains the capital).

Figure A8: Probability of emigration and household per capita expenditure, by low- and high-development regions



Note: The predicted probability of emigration results from regressing whether a household reports a recent emigrant (over the past five years) on annual per capita household expenditure and its squared term, including interactions of both terms with a region indicator equal to 1 for high-development regions and 0 for low-development regions, using data from the 2014 Living Standards Measurement Survey in Guatemala (ENCOVI). The dotted lines represent the corresponding 95% confidence intervals. The low-development region comprises 15 departments covering the Western Highlands, Dry Corridor, Verapaces, and Peten-Izabal subregions, while the high-development region comprises 7 departments corresponding to the Center and Pacifico-Bocacosta subregions and includes the department of Guatemala (which contains the capital).

Table A1: Characteristics of low- and high-development regions (population-weighted)

Variable	Low-development	High-development
Income and welfare		
GDP per capita (USD)	3,871.06	8,021.41
	(2,035.82)	(5,428.17)
Poverty rate (%)	68.98	45.67
	(18.12)	(24.37)
Gini coefficient	0.515	0.491
	(0.160)	(0.076)
Education		
Primary schools per 10,000 people	15.81	8.88
	(5.40)	(3.03)
Pupil–teacher ratio	14.24	11.98
	(3.22)	(2.49)
Gross enrollment rate (%)	98.83	99.28
	(2.96)	(2.39)
Health		
Health facilities per 10,000 people	1.18	0.80
	(0.96)	(0.83)
Vaccination coverage (%)	89.34	85.47
	(11.71)	(12.74)
Access to services		
Households with electricity (%)	80.18	96.96
	(18.31)	(3.25)
Households with water and sanitation (%)	52.98	77.04
	(19.48)	(18.47)
Households with internet (%)	8.40	26.71
	(8.37)	(19.08)
Housing quality		
Block walls and concrete roof (%)	11.72	25.16
	(12.43)	(15.27)
Cement or ceramic floors (%)	23.34	44.70
	(17.08)	(20.15)
Accessibility		
Road density index (0–10)	6.59	6.60
	(3.61)	(2.21)
Travel time to town of 20,000 inhabitants (hours)	1.63	0.65
	(1.14)	(0.33)
Cell towers per km^2	0.29	2.33
	(0.58)	(2.93)
Climate exposure		
Frost index (0–1)	0.19	0.03
	(0.28)	(0.07)
Drought index (0–1)	0.60	0.65
	(0.21)	(0.16)
Flood index (0–1)	0.15	0.30
	(0.25)	(0.30)
Number of municipalities	233	107

Note: This table reports municipality-level averages by region (standard deviations in parentheses). Averages and standard deviations are weighted by municipal population. The low-development region comprises 15 departments covering the Western Highlands, Dry Corridor, Verapaces, and Peten-Izabal subregions. The high-development region comprises 7 departments corresponding to the Center and Pacifico-Bocacosta subregions and includes the department of Guatemala (which contains the capital). Variables are obtained from multiple official sources as detailed in Appendix B.

Table A2: Intensity of food security and nutrition interventions across regions: 2021–22 intervention mapping

Program category	Region L	Region H	Difference (L−H)
Agriculture	1.40	0.61	0.79***
Education	0.08	0.08	−0.00
Institutional strengthening	2.95	1.75	1.21***
Gender	1.05	1.00	0.05
Nutrition	9.87	4.07	5.80***
Health	5.42	1.83	3.59***
Emergency	1.73	0.36	1.37***

Note: Entries report unweighted municipal averages of the number of food security and nutrition interventions per 10,000 inhabitants from the 2021–22 intervention mapping. Results are qualitatively unchanged when municipal averages are weighted by population. The Difference (L−H) column reports two-sample t-tests for differences in means. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A3: Welfare effects: Untargeted demand-side transfer (Experiment 1)

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Panel A: Tax-financed									
Temp., $\zeta = 0.025$	+0.2	+0.9	-0.4	+2.1	+0.9	+0.2	-0.8	-0.3	-0.1
Temp., $\zeta = 0.05$	+0.3	+1.7	-0.7	+4.0	+1.8	+0.3	-1.5	-0.6	-0.2
Temp., $\zeta = 0.10$	+0.5	+3.4	-1.5	+7.8	+3.6	+0.6	-3.1	-1.3	-0.4
Perm., $\zeta = 0.025$	+0.1	+1.2	-0.7	+2.4	+1.3	+0.4	-1.5	-0.6	-0.2
Perm., $\zeta = 0.05$	+0.3	+2.3	-1.4	+4.7	+2.4	+0.8	-3.0	-1.2	-0.4
Perm., $\zeta = 0.10$	+0.7	+4.5	-2.9	+8.5	+4.7	+1.5	-6.1	-2.5	-0.8
Panel B: Externally funded									
Temp., $\zeta = 0.025$	+0.4	+2.2	0.0	+5.0	+2.2	+0.4	0.0	0.0	0.0
Temp., $\zeta = 0.05$	+0.7	+4.2	0.0	+9.5	+4.4	+0.8	0.0	0.0	0.0
Temp., $\zeta = 0.10$	+1.1	+7.9	0.0	+17.5	+8.4	+1.7	0.0	0.0	0.0
Perm., $\zeta = 0.025$	+0.9	+3.6	0.0	+8.0	+3.5	+0.9	0.0	0.0	0.0
Perm., $\zeta = 0.05$	+1.7	+7.2	0.0	+15.8	+7.1	+1.9	0.0	0.0	0.0
Perm., $\zeta = 0.10$	+3.5	+14.1	0.0	+30.7	+14.0	+3.9	0.0	0.0	0.0

Note: Median consumption-equivalent EV in %, versus the no-policy baseline. Nat, L, H: national and regional medians. L and H low/mid/high: medians within terciles of baseline period-0 income in each region. Panel A is tax-financed, Panel B externally funded. Scenarios and parameter values as in Table 10.

Table A4: Targeted demand-side transfer (Experiment 2)

	Emig L (%)	ΔL (pp)	Constr. L (%)	Tax (% of GDP)	Cost (% of GDP)
Baseline	10.02	—	4.4	4.6	0.00
Panel A: Tax-financed					
Temp., $\theta = 0.33$, $\zeta = 0.025$	11.01	+0.99	1.5	5.4	0.78
Temp., $\theta = 0.33$, $\zeta = 0.05$	11.98	+1.97	0.0	6.2	1.56
Temp., $\theta = 0.33$, $\zeta = 0.10$	13.52	+3.50	0.0	7.7	3.13
Temp., $\theta = 0.50$, $\zeta = 0.025$	10.68	+0.66	2.5	5.4	0.78
Temp., $\theta = 0.50$, $\zeta = 0.05$	11.34	+1.33	1.2	6.2	1.56
Temp., $\theta = 0.50$, $\zeta = 0.10$	12.70	+2.68	0.0	7.7	3.13
Perm., $\theta = 0.33$, $\zeta = 0.025$	9.73	-0.28	2.0	6.1	1.50
Perm., $\theta = 0.33$, $\zeta = 0.05$	9.36	-0.66	0.0	7.6	3.01
Perm., $\theta = 0.33$, $\zeta = 0.10$	8.61	-1.41	0.0	10.7	6.06
Perm., $\theta = 0.50$, $\zeta = 0.025$	9.44	-0.57	3.2	6.1	1.49
Perm., $\theta = 0.50$, $\zeta = 0.05$	8.99	-1.03	2.2	7.6	2.99
Perm., $\theta = 0.50$, $\zeta = 0.10$	8.22	-1.80	0.0	10.7	6.02
Panel B: Externally funded					
Temp., $\theta = 0.33$, $\zeta = 0.025$	11.38	+1.37	1.0	4.6	0.78
Temp., $\theta = 0.33$, $\zeta = 0.05$	12.61	+2.60	0.0	4.6	1.56
Temp., $\theta = 0.33$, $\zeta = 0.10$	14.30	+4.29	0.0	4.6	3.13
Temp., $\theta = 0.50$, $\zeta = 0.025$	11.03	+1.01	1.8	4.6	0.78
Temp., $\theta = 0.50$, $\zeta = 0.05$	12.05	+2.04	0.4	4.6	1.56
Temp., $\theta = 0.50$, $\zeta = 0.10$	13.76	+3.74	0.0	4.6	3.13
Perm., $\theta = 0.33$, $\zeta = 0.025$	10.33	+0.31	1.0	4.6	1.49
Perm., $\theta = 0.33$, $\zeta = 0.05$	10.27	+0.26	0.0	4.6	2.98
Perm., $\theta = 0.33$, $\zeta = 0.10$	9.79	-0.23	0.0	4.6	6.02
Perm., $\theta = 0.50$, $\zeta = 0.025$	10.14	+0.12	1.8	4.6	1.48
Perm., $\theta = 0.50$, $\zeta = 0.05$	10.01	-0.01	0.4	4.6	2.96
Perm., $\theta = 0.50$, $\zeta = 0.10$	9.49	-0.52	0.0	4.6	5.96

Note: Policy duration, funding panels, and columns as in Table 10.

Table A5: Welfare effects: Targeted demand-side transfer (Experiment 2)

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Panel A: Tax-financed									
Temp., $\theta = 0.33$, $\zeta = 0.025$	-0.4	-0.5	-0.4	+10.6	-1.1	-0.5	-0.8	-0.3	-0.1
Temp., $\theta = 0.33$, $\zeta = 0.05$	-0.8	-1.0	-0.7	+19.6	-2.2	-1.1	-1.5	-0.6	-0.2
Temp., $\theta = 0.33$, $\zeta = 0.10$	-1.6	-1.8	-1.5	+35.1	-4.4	-2.1	-3.1	-1.3	-0.4
Temp., $\theta = 0.50$, $\zeta = 0.025$	-0.3	+0.2	-0.4	+6.4	-0.4	-0.5	-0.8	-0.3	-0.1
Temp., $\theta = 0.50$, $\zeta = 0.05$	-0.5	+0.3	-0.7	+12.2	-0.7	-1.1	-1.5	-0.6	-0.2
Temp., $\theta = 0.50$, $\zeta = 0.10$	-1.1	+0.2	-1.5	+22.2	-1.5	-2.1	-3.1	-1.3	-0.4
Perm., $\theta = 0.33$, $\zeta = 0.025$	-0.8	-0.9	-0.7	+17.3	-2.1	-1.0	-1.5	-0.6	-0.2
Perm., $\theta = 0.33$, $\zeta = 0.05$	-1.6	-1.8	-1.4	+34.3	-4.2	-1.9	-3.0	-1.2	-0.4
Perm., $\theta = 0.33$, $\zeta = 0.10$	-3.1	-3.5	-2.9	+68.7	-8.6	-4.0	-6.2	-2.5	-0.8
Perm., $\theta = 0.50$, $\zeta = 0.025$	-0.5	+1.8	-0.7	+9.7	+1.8	-0.9	-1.5	-0.6	-0.2
Perm., $\theta = 0.50$, $\zeta = 0.05$	-1.0	+3.7	-1.4	+19.4	+3.7	-1.9	-3.0	-1.2	-0.4
Perm., $\theta = 0.50$, $\zeta = 0.10$	-2.1	+7.5	-2.9	+38.5	+7.4	-3.9	-6.1	-2.5	-0.8
Panel B: Externally funded									
Temp., $\theta = 0.33$, $\zeta = 0.025$	0.0	+1.0	0.0	+13.1	+1.0	-0.7	0.0	0.0	0.0
Temp., $\theta = 0.33$, $\zeta = 0.05$	0.0	+1.9	0.0	+23.7	+1.9	-1.4	0.0	0.0	0.0
Temp., $\theta = 0.33$, $\zeta = 0.10$	0.0	+3.7	0.0	+42.1	+3.6	-2.6	0.0	0.0	0.0
Temp., $\theta = 0.50$, $\zeta = 0.025$	0.0	+1.2	0.0	+9.1	+1.3	-0.7	0.0	0.0	0.0
Temp., $\theta = 0.50$, $\zeta = 0.05$	0.0	+2.1	0.0	+16.9	+2.4	-1.4	0.0	0.0	0.0
Temp., $\theta = 0.50$, $\zeta = 0.10$	0.0	+4.1	0.0	+30.1	+4.7	-2.6	0.0	0.0	0.0
Perm., $\theta = 0.33$, $\zeta = 0.025$	0.0	+1.6	0.0	+22.3	+1.4	-1.2	0.0	0.0	0.0
Perm., $\theta = 0.33$, $\zeta = 0.05$	0.0	+3.1	0.0	+43.9	+3.0	-2.3	0.0	0.0	0.0
Perm., $\theta = 0.33$, $\zeta = 0.10$	0.0	+6.0	0.0	+86.6	+6.0	-4.4	0.0	0.0	0.0
Perm., $\theta = 0.50$, $\zeta = 0.025$	0.0	+1.9	0.0	+15.1	+3.6	-1.2	0.0	0.0	0.0
Perm., $\theta = 0.50$, $\zeta = 0.05$	0.0	+3.7	0.0	+29.5	+7.2	-2.3	0.0	0.0	0.0
Perm., $\theta = 0.50$, $\zeta = 0.10$	0.0	+12.5	0.0	+58.1	+13.6	-4.3	0.0	0.0	0.0

Note: Median consumption-equivalent EV in %, versus the no-policy baseline. Nat, L, H: national and regional medians. L and H low/mid/high: medians within terciles of baseline period-0 income in each region. Panel A is tax-financed, Panel B externally funded. Scenarios and parameter values as in Table A4.

Table A6: Migration cost reduction, Variant A: Cost shock (Experiment 3a)

	Emig L (%)	ΔL (pp)	Emig H (%)	ΔH (pp)	Constr. L (%)	Cost (% of GDP)
Baseline	10.02	—	4.04	—	4.4	0.00
L-only, $\rho = 0.10$	10.71	+0.69	4.04	0.00	3.6	0.00
L-only, $\rho = 0.25$	11.93	+1.91	4.04	0.00	2.6	0.00
Global, $\rho = 0.10$	10.71	+0.69	4.16	+0.12	3.6	0.00
Global, $\rho = 0.25$	11.93	+1.91	4.35	+0.31	2.6	0.00

Note: The cost falls exogenously (e.g. cheaper legal pathways), not as a payment to migrants: $\kappa_j^{cf} = (1-\rho)\kappa_j$, L-only or both regions. The experiment involves no expenditure, so Cost is zero. Emig H, ΔH (pp): as the L columns, for H-born. Remaining columns as in Table 10.

Table A7: Migration cost reduction, Variant B: Credit for migration (Experiment 3b)

	Emig L (%)	ΔL (pp)	Emig H (%)	ΔH (pp)	Constr. L (%)	Cost (% of GDP)
Baseline	10.02	—	4.04	—	4.4	0.00
L-only	11.71	+1.70	4.04	0.00	0.0	0.00
Global (both regions)	11.71	+1.70	1.69	-2.36	0.0	0.00

Note: κ_L is deferred to period 1 and repaid out of the foreign wage, so the emigrant's period-1 income is $W^e - \kappa_L$, truncated at a small positive floor for the lowest-skill agents; lifetime cost is unchanged and the loan breaks even at $r = 0$, so Cost is zero. Columns as in Table A6.

Table A8: Welfare effects: Untargeted productivity investment (Experiment 4)

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Panel A: Tax-financed									
$\Delta = 0.05$	+1.2	+1.3	0.0	+1.3	+1.3	+1.4	0.0	0.0	0.0
$\Delta = 0.10$	+2.4	+2.5	0.0	+2.5	+2.5	+2.7	0.0	0.0	0.0
$\Delta = 0.20$	+4.7	+4.8	0.0	+4.8	+4.8	+5.3	0.0	0.0	0.0
Panel B: Externally funded									
$\Delta = 0.05$	+1.3	+1.3	0.0	+1.3	+1.3	+1.4	0.0	0.0	0.0
$\Delta = 0.10$	+2.5	+2.6	0.0	+2.6	+2.5	+2.7	0.0	0.0	0.0
$\Delta = 0.20$	+4.9	+5.0	0.0	+5.0	+4.9	+5.3	0.0	0.0	0.0

Note: Median consumption-equivalent EV in %, versus the no-policy baseline. Nat, L, H: national and regional medians. L and H low/mid/high: medians within terciles of baseline period-0 income in each region. Panel A is tax-financed, Panel B externally funded. Scenarios and parameter values as in Table 11.

Table A9: Targeted productivity investment (Experiment 5)

	Emig L (%)	ΔL (pp)	Constr. L (%)	T share $L0$ (%)	T share $L1$ (%)	Tax (% of GDP)	Cost (% of GDP)
Baseline	10.02	—	4.4	52.26	48.96	4.6	0.00
Panel A: Tax-financed							
$\theta = 0.33$, $\Delta = 0.05$	9.91	-0.10	4.4	52.25	49.52	4.6	0.00
$\theta = 0.33$, $\Delta = 0.10$	9.83	-0.19	4.4	52.24	50.06	4.6	0.00
$\theta = 0.33$, $\Delta = 0.20$	9.57	-0.44	4.4	52.22	51.13	4.6	0.00
$\theta = 0.50$, $\Delta = 0.05$	9.87	-0.15	4.4	52.24	49.58	4.6	0.00
$\theta = 0.50$, $\Delta = 0.10$	9.70	-0.32	4.4	52.23	50.19	4.6	0.00
$\theta = 0.50$, $\Delta = 0.20$	9.27	-0.74	4.4	52.20	51.31	4.6	0.01
Panel B: Externally funded							
$\theta = 0.33$, $\Delta = 0.05$	9.91	-0.10	4.4	52.25	49.52	4.6	0.00
$\theta = 0.33$, $\Delta = 0.10$	9.83	-0.18	4.4	52.24	50.06	4.6	0.00
$\theta = 0.33$, $\Delta = 0.20$	9.58	-0.44	4.4	52.22	51.13	4.6	0.00
$\theta = 0.50$, $\Delta = 0.05$	9.87	-0.15	4.4	52.24	49.58	4.6	0.00
$\theta = 0.50$, $\Delta = 0.10$	9.70	-0.32	4.4	52.23	50.19	4.6	0.00
$\theta = 0.50$, $\Delta = 0.20$	9.28	-0.74	4.4	52.20	51.31	4.6	0.01

Note: Funding panels and columns as in Tables 10 and 11.

Table A10: Welfare effects: Targeted productivity investment (Experiment 5)

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Panel A: Tax-financed									
$\theta = 0.33$, $\Delta = 0.05$	0.0	+0.2	0.0	+0.2	+0.2	-0.2	0.0	0.0	0.0
$\theta = 0.33$, $\Delta = 0.10$	0.0	+0.5	0.0	+0.5	+0.5	-0.4	0.0	0.0	0.0
$\theta = 0.33$, $\Delta = 0.20$	0.0	+1.0	0.0	+1.0	+0.9	-0.8	0.0	0.0	0.0
$\theta = 0.50$, $\Delta = 0.05$	0.0	+0.4	0.0	+0.4	+0.4	-0.3	0.0	0.0	0.0
$\theta = 0.50$, $\Delta = 0.10$	0.0	+0.8	0.0	+0.8	+0.8	-0.7	0.0	0.0	0.0
$\theta = 0.50$, $\Delta = 0.20$	0.0	+1.7	0.0	+1.7	+1.7	-1.4	0.0	0.0	0.0
Panel B: Externally funded									
$\theta = 0.33$, $\Delta = 0.05$	0.0	+0.2	0.0	+0.2	+0.2	-0.2	0.0	0.0	0.0
$\theta = 0.33$, $\Delta = 0.10$	0.0	+0.5	0.0	+0.5	+0.5	-0.4	0.0	0.0	0.0
$\theta = 0.33$, $\Delta = 0.20$	0.0	+1.0	0.0	+1.0	+0.9	-0.8	0.0	0.0	0.0
$\theta = 0.50$, $\Delta = 0.05$	0.0	+0.4	0.0	+0.4	+0.4	-0.3	0.0	0.0	0.0
$\theta = 0.50$, $\Delta = 0.10$	0.0	+0.8	0.0	+0.9	+0.8	-0.7	0.0	0.0	0.0
$\theta = 0.50$, $\Delta = 0.20$	0.0	+1.7	0.0	+1.7	+1.7	-1.4	0.0	0.0	0.0

Note: Median consumption-equivalent EV in %, versus the no-policy baseline. Nat, L, H: national and regional medians. L and H low/mid/high: medians within terciles of baseline period-0 income in each region. Panel A is tax-financed, Panel B externally funded. Scenarios and parameter values as in Table A9.

Table A11: Non-tradable prices by scenario (Experiments 1–2)

	p^N_{L0}	p^N_{L1}	p^N_{H0}	p^N_{H1}
Baseline	0.1670	0.1995	0.5908	0.6163
Ex1: Temp., $\zeta = 0.025$ (fin)	0.1688	0.1998	0.5878	0.6161
Ex1: Temp., $\zeta = 0.025$ (ext)	0.1717	0.2002	0.5910	0.6160
Ex1: Temp., $\zeta = 0.05$ (fin)	0.1707	0.2000	0.5842	0.6159
Ex1: Temp., $\zeta = 0.05$ (ext)	0.1760	0.2009	0.5915	0.6156
Ex1: Temp., $\zeta = 0.10$ (fin)	0.1744	0.2007	0.5782	0.6153
Ex1: Temp., $\zeta = 0.10$ (ext)	0.1847	0.2024	0.5919	0.6150
Ex1: Perm., $\zeta = 0.025$ (fin)	0.1665	0.2034	0.5842	0.6167
Ex1: Perm., $\zeta = 0.025$ (ext)	0.1719	0.2041	0.5909	0.6164
Ex1: Perm., $\zeta = 0.05$ (fin)	0.1660	0.2073	0.5780	0.6167
Ex1: Perm., $\zeta = 0.05$ (ext)	0.1764	0.2088	0.5912	0.6165
Ex1: Perm., $\zeta = 0.10$ (fin)	0.1652	0.2155	0.5655	0.6167
Ex1: Perm., $\zeta = 0.10$ (ext)	0.1855	0.2175	0.5915	0.6163
Ex2: Temp., $\theta = 0.33$, $\zeta = 0.025$ (fin)	0.1686	0.2002	0.5878	0.6162
Ex2: Temp., $\theta = 0.33$, $\zeta = 0.025$ (ext)	0.1714	0.2006	0.5910	0.6160
Ex2: Temp., $\theta = 0.33$, $\zeta = 0.05$ (fin)	0.1703	0.2007	0.5840	0.6161
Ex2: Temp., $\theta = 0.33$, $\zeta = 0.05$ (ext)	0.1758	0.2013	0.5910	0.6160
Ex2: Temp., $\theta = 0.33$, $\zeta = 0.10$ (fin)	0.1739	0.2015	0.5776	0.6158
Ex2: Temp., $\theta = 0.33$, $\zeta = 0.10$ (ext)	0.1843	0.2027	0.5916	0.6155
Ex2: Temp., $\theta = 0.50$, $\zeta = 0.025$ (fin)	0.1687	0.2000	0.5878	0.6162
Ex2: Temp., $\theta = 0.50$, $\zeta = 0.025$ (ext)	0.1716	0.2005	0.5910	0.6160
Ex2: Temp., $\theta = 0.50$, $\zeta = 0.05$ (fin)	0.1706	0.2005	0.5840	0.6161
Ex2: Temp., $\theta = 0.50$, $\zeta = 0.05$ (ext)	0.1759	0.2012	0.5911	0.6160
Ex2: Temp., $\theta = 0.50$, $\zeta = 0.10$ (fin)	0.1741	0.2014	0.5777	0.6158
Ex2: Temp., $\theta = 0.50$, $\zeta = 0.10$ (ext)	0.1845	0.2026	0.5916	0.6155
Ex2: Perm., $\theta = 0.33$, $\zeta = 0.025$ (fin)	0.1664	0.2038	0.5839	0.6167
Ex2: Perm., $\theta = 0.33$, $\zeta = 0.025$ (ext)	0.1717	0.2045	0.5909	0.6164
Ex2: Perm., $\theta = 0.33$, $\zeta = 0.05$ (fin)	0.1659	0.2082	0.5776	0.6169
Ex2: Perm., $\theta = 0.33$, $\zeta = 0.05$ (ext)	0.1764	0.2095	0.5909	0.6166
Ex2: Perm., $\theta = 0.33$, $\zeta = 0.10$ (fin)	0.1648	0.2170	0.5650	0.6169
Ex2: Perm., $\theta = 0.33$, $\zeta = 0.10$ (ext)	0.1855	0.2190	0.5914	0.6163
Ex2: Perm., $\theta = 0.50$, $\zeta = 0.025$ (fin)	0.1665	0.2034	0.5840	0.6167
Ex2: Perm., $\theta = 0.50$, $\zeta = 0.025$ (ext)	0.1718	0.2042	0.5909	0.6164
Ex2: Perm., $\theta = 0.50$, $\zeta = 0.05$ (fin)	0.1660	0.2078	0.5778	0.6167
Ex2: Perm., $\theta = 0.50$, $\zeta = 0.05$ (ext)	0.1764	0.2090	0.5909	0.6166
Ex2: Perm., $\theta = 0.50$, $\zeta = 0.10$ (fin)	0.1650	0.2165	0.5652	0.6169
Ex2: Perm., $\theta = 0.50$, $\zeta = 0.10$ (ext)	0.1856	0.2181	0.5914	0.6163

Note: Equilibrium non-tradable prices by scenario (with the baseline reported first, followed by experiment-specific scenarios). Subscript 0 denotes period 0 and subscript 1 period 1; region L is the sending region, H the destination. Spending scenarios appear twice: (fin) tax-financed, (ext) externally funded. p^N_{jt} denotes the non-tradable price in region j at period t.

Table A11: Non-tradable prices by scenario, continued (Experiments 3–4)

	p^N_{L0}	p^N_{L1}	p^N_{H0}	p^N_{H1}
Baseline	0.1670	0.1995	0.5908	0.6163
Ex3: Domestic credit, $\zeta = 0$	0.1835	0.2010	0.5796	0.5964
Ex3a: $\zeta = 0.10$	0.1929	0.2109	0.5809	0.5967
Ex3a: $\zeta = 0.33$	0.2154	0.2313	0.5849	0.5986
Ex3a: $\zeta = 1.00$	0.2784	0.2890	0.5976	0.6026
Ex3a: $\zeta = 2.00$	0.3669	0.3772	0.6272	0.6153
Ex3b: $\theta = 0.33$, $\zeta = 0.10$	0.1932	0.2109	0.5806	0.5970
Ex3b: $\theta = 0.33$, $\zeta = 0.33$	0.2162	0.2299	0.5837	0.5988
Ex3b: $\theta = 0.33$, $\zeta = 1.00$	0.2736	0.2854	0.6068	0.6104
Ex3b: $\theta = 0.33$, $\zeta = 2.00$	0.3555	0.3592	0.6462	0.6512
Ex3b: $\theta = 0.50$, $\zeta = 0.10$	0.1931	0.2111	0.5807	0.5970
Ex3b: $\theta = 0.50$, $\zeta = 0.33$	0.2165	0.2300	0.5836	0.5987
Ex3b: $\theta = 0.50$, $\zeta = 1.00$	0.2769	0.2866	0.6013	0.6050
Ex3b: $\theta = 0.50$, $\zeta = 2.00$	0.3601	0.3658	0.6420	0.6337
Ex4a: L-only, $\rho = 0.10$	0.1671	0.2000	0.5908	0.6163
Ex4a: L-only, $\rho = 0.25$	0.1672	0.2011	0.5907	0.6165
Ex4a: Global, $\rho = 0.10$	0.1671	0.2000	0.5909	0.6166
Ex4a: Global, $\rho = 0.25$	0.1672	0.2011	0.5911	0.6168
Ex4b: L-only	0.1696	0.2022	0.5909	0.6163
Ex4b: Global (both regions)	0.1696	0.2021	0.5925	0.6130

Note: Equilibrium non-tradable prices by scenario (with the baseline reported first, followed by experiment-specific scenarios). Subscript 0 denotes period 0 and subscript 1 period 1; region L is the sending region, H the destination. Experiment 3 rows are a subset of the swept grid. p^N_{jt} denotes the non-tradable price in region j at period t.

Table A11: Non-tradable prices by scenario, continued (Experiments 5–9)

	p^N_{L0}	p^N_{L1}	p^N_{H0}	p^N_{H1}
Baseline	0.1670	0.1995	0.5908	0.6163
Ex5: $\Delta = 0.05$ (fin)	0.1671	0.2089	0.5906	0.6171
Ex5: $\Delta = 0.05$ (ext)	0.1672	0.2089	0.5906	0.6171
Ex5: $\Delta = 0.10$ (fin)	0.1672	0.2180	0.5904	0.6172
Ex5: $\Delta = 0.10$ (ext)	0.1673	0.2180	0.5905	0.6172
Ex5: $\Delta = 0.20$ (fin)	0.1675	0.2367	0.5899	0.6177
Ex5: $\Delta = 0.20$ (ext)	0.1676	0.2367	0.5901	0.6177
Ex6: $\theta = 0.33$, $\Delta = 0.05$ (fin)	0.1670	0.2011	0.5907	0.6165
Ex6: $\theta = 0.33$, $\Delta = 0.05$ (ext)	0.1670	0.2011	0.5907	0.6165
Ex6: $\theta = 0.33$, $\Delta = 0.10$ (fin)	0.1671	0.2029	0.5907	0.6166
Ex6: $\theta = 0.33$, $\Delta = 0.10$ (ext)	0.1671	0.2029	0.5907	0.6166
Ex6: $\theta = 0.33$, $\Delta = 0.20$ (fin)	0.1671	0.2066	0.5907	0.6168
Ex6: $\theta = 0.33$, $\Delta = 0.20$ (ext)	0.1672	0.2066	0.5907	0.6168
Ex6: $\theta = 0.50$, $\Delta = 0.05$ (fin)	0.1670	0.2024	0.5907	0.6166
Ex6: $\theta = 0.50$, $\Delta = 0.05$ (ext)	0.1671	0.2024	0.5907	0.6166
Ex6: $\theta = 0.50$, $\Delta = 0.10$ (fin)	0.1671	0.2055	0.5907	0.6167
Ex6: $\theta = 0.50$, $\Delta = 0.10$ (ext)	0.1671	0.2055	0.5907	0.6167
Ex6: $\theta = 0.50$, $\Delta = 0.20$ (fin)	0.1672	0.2118	0.5906	0.6172
Ex6: $\theta = 0.50$, $\Delta = 0.20$ (ext)	0.1672	0.2118	0.5906	0.6172
Ex7: $x = 0.10$	0.1484	0.1797	0.5294	0.5550
Ex7: $x = 0.20$	0.1299	0.1600	0.4677	0.4942
Ex7: $x = 0.30$	0.1117	0.1396	0.4063	0.4330
Ex8: $x = 0.10$	0.1674	0.1978	0.5912	0.6143
Ex8: $x = 0.20$	0.1677	0.1964	0.5917	0.6121
Ex8: $x = 0.30$	0.1681	0.1949	0.5920	0.6098
Ex9: Untargeted demand ($\zeta = 0.20$) (fin)	0.1443	0.1630	0.4433	0.4919
Ex9: Untargeted demand ($\zeta = 0.20$) (ext)	0.1645	0.1658	0.4708	0.4919
Ex9: Targeted demand, $\theta = 0.33$ (fin)	0.1438	0.1629	0.4423	0.4930
Ex9: Targeted demand, $\theta = 0.33$ (ext)	0.1644	0.1652	0.4696	0.4928
Ex9: Targeted demand, $\theta = 0.50$ (fin)	0.1438	0.1636	0.4423	0.4931
Ex9: Targeted demand, $\theta = 0.50$ (ext)	0.1644	0.1656	0.4695	0.4929
Ex9: Untargeted supply ($\Delta = 0.20$) (fin)	0.1588	0.1620	0.4692	0.4928
Ex9: Untargeted supply ($\Delta = 0.20$) (ext)	0.1589	0.1621	0.4695	0.4928
Ex9: Targeted supply, $\theta = 0.33$ (fin)	0.1352	0.1604	0.4680	0.4941
Ex9: Targeted supply, $\theta = 0.33$ (ext)	0.1352	0.1604	0.4680	0.4941
Ex9: Targeted supply, $\theta = 0.50$ (fin)	0.1391	0.1605	0.4683	0.4940
Ex9: Targeted supply, $\theta = 0.50$ (ext)	0.1391	0.1605	0.4683	0.4940

Note: Equilibrium non-tradable prices by scenario (with the baseline reported first, followed by experiment-specific scenarios). Subscript 0 denotes period 0 and subscript 1 period 1; region L is the sending region, H the destination. Spending scenarios appear twice: (fin) tax-financed, (ext) externally funded. p^N_{jt} denotes the non-tradable price in region j at period t.

Table A12: Adverse productivity shock, both regions (Experiment 6)

	Emig L (%)	ΔL (pp)	Emig H (%)	ΔH (pp)	Constr. L (%)	Constr. H (%)	T share $L0$ (%)	T share $L1$ (%)	T share $H0$ (%)	T share $H1$ (%)	Cost (% of GDP)
Baseline	10.02	—	4.04	—	4.4	0.19	52.26	48.96	54.50	53.92	0.00
$x = 0.10$	9.97	-0.04	4.25	+0.21	6.1	0.30	52.58	48.83	54.65	53.96	0.00
$x = 0.20$	9.84	-0.18	4.47	+0.43	8.6	0.55	53.02	48.75	54.78	53.97	0.00
$x = 0.30$	9.23	-0.78	4.70	+0.66	12.2	0.93	53.61	48.57	54.97	53.97	0.00

Note: The shock involves no expenditure, so Cost is zero. Constr. H and T share $H0/H1$: as the L columns, for H. Remaining columns as in Tables 10, A6, and 11.

Table A13: Adverse emigration-wage shock (Experiment 7)

	Emig L (%)	ΔL (pp)	Emig H (%)	ΔH (pp)	Constr. L (%)	Cost (% of GDP)
Baseline	10.02	—	4.04	—	4.4	0.00
$x = 0.10$	8.42	-1.59	3.27	-0.78	4.4	0.00
$x = 0.20$	6.76	-3.25	2.51	-1.53	4.4	0.00
$x = 0.30$	5.21	-4.81	1.97	-2.08	4.3	0.00

Note: Columns as in Table A6. The shock involves no expenditure, so Cost is zero.

Table A14: Welfare effects: No-spending experiments (Experiments 3, 6, 7)

	Nat	*L*	*H*	*L* low	*L* mid	*L* high	*H* low	*H* mid	*H* high
Experiment 3a: emigration-cost shock									
L-only, $\rho = 0.10$	0.0	+0.1	0.0	+0.1	+0.1	-0.1	0.0	0.0	0.0
L-only, $\rho = 0.25$	0.0	+0.2	0.0	+0.3	+0.3	-0.2	0.0	0.0	0.0
Global, $\rho = 0.10$	0.0	+0.1	0.0	+0.1	+0.1	-0.1	0.0	0.0	0.0
Global, $\rho = 0.25$	0.0	+0.2	0.0	+0.3	+0.3	-0.2	0.0	0.0	0.0
Experiment 3b: credit for migration									
L-only	0.0	0.0	0.0	+0.9	+0.3	-0.6	0.0	0.0	0.0
Global (both regions)	0.0	0.0	+0.1	+0.9	+0.3	-0.6	+0.1	+0.1	+0.1
Experiment 6: adverse productivity shock									
$x = 0.10$	-6.0	-6.3	-5.8	-7.5	-6.2	-5.7	-6.0	-5.8	-5.6
$x = 0.20$	-12.3	-13.0	-11.9	-15.5	-12.9	-11.7	-12.4	-11.9	-11.6
$x = 0.30$	-19.0	-20.2	-18.4	-24.0	-20.0	-18.1	-19.2	-18.3	-17.9
Experiment 7: emigration-wage shock									
$x = 0.10$	-0.1	-0.1	+0.1	-0.1	-0.2	+0.1	-0.1	+0.1	+0.1
$x = 0.20$	+0.1	-0.2	+0.1	-0.2	-0.3	+0.3	+0.1	+0.1	+0.1
$x = 0.30$	+0.2	0.0	+0.2	-0.3	-0.4	+0.4	+0.2	+0.2	+0.2

Note: Median consumption-equivalent EV in %, versus the baseline. Columns as in Table A3. These experiments involve no policy expenditures, so there are no funding panels. Scenarios and parameter values are as in Tables A6, A7, A12, and A13.

Table A15: Emergency compensation under an adverse productivity shock (Experiment 8)

	Emig L (%)	ΔL (pp)	Emig H (%)	ΔH (pp)	Constr. L (%)	Tax (% of GDP)	Cost (% of GDP)
Baseline	10.02	—	4.04	—	4.4	4.6	0.00
Shock only ($x = 0.20$)	9.84	-0.18	4.47	+0.43	8.6	4.6	0.00
Panel A: Tax-financed							
Untargeted demand ($\zeta = 0.20$)	13.06	+3.04	4.00	-0.04	0.0	11.0	6.25
Targeted demand, $\theta = 0.33$	16.31	+6.30	4.00	-0.05	0.0	11.0	6.25
Targeted demand, $\theta = 0.50$	16.39	+6.37	4.00	-0.05	0.0	11.0	6.25
Untargeted supply ($\Delta = 0.20$)	11.72	+1.71	4.48	+0.44	5.1	4.6	0.04
Targeted supply, $\theta = 0.33$	10.51	+0.49	4.47	+0.42	6.5	4.6	0.00
Targeted supply, $\theta = 0.50$	10.85	+0.83	4.47	+0.42	6.2	4.6	0.01
Panel B: Externally funded							
Untargeted demand ($\zeta = 0.20$)	16.10	+6.09	4.50	+0.45	0.0	4.6	6.25
Targeted demand, $\theta = 0.33$	18.02	+8.00	4.49	+0.45	0.0	4.6	6.25
Targeted demand, $\theta = 0.50$	18.00	+7.98	4.49	+0.44	0.0	4.6	6.25
Untargeted supply ($\Delta = 0.20$)	11.76	+1.74	4.49	+0.44	5.0	4.6	0.04
Targeted supply, $\theta = 0.33$	10.52	+0.50	4.47	+0.42	6.5	4.6	0.00
Targeted supply, $\theta = 0.50$	10.86	+0.84	4.47	+0.42	6.2	4.6	0.01

Note: All policy scenarios are implemented under the $x = 0.20$ shock and are temporary. Productivity investments are priced as in Experiments 4 and 5, relative to the shocked economy. Taxes are levied on the shocked economy, increasing the number of households subject to the ability-to-pay cap. The Δ columns report changes relative to the no-shock baseline and therefore incorporate the effect of the shock. The effect of each policy is assessed relative to the shock-only scenario. Funding panels and columns are as in Tables 10 and A6.

Table A16: Welfare effects: Emergency compensation (Experiment 8)

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Shock only ($x = 0.20$)	-12.3	-13.0	-11.9	-15.5	-12.9	-11.7	-12.4	-11.9	-11.6
Panel A: Tax-financed									
Untargeted demand ($\zeta = 0.20$)	-10.7	-5.7	-15.3	+0.8	-5.4	-10.6	-19.7	-14.7	-12.4
Targeted demand, $\theta = 0.33$	-15.6	-16.1	-15.3	+53.3	-22.8	-16.2	-19.7	-14.7	-12.4
Targeted demand, $\theta = 0.50$	-14.3	-10.4	-15.3	+29.4	-15.6	-16.2	-19.7	-14.7	-12.4
Untargeted supply ($\Delta = 0.20$)	-7.7	-7.3	-11.9	-7.7	-7.3	-7.1	-12.5	-11.9	-11.6
Targeted supply, $\theta = 0.33$	-12.1	-12.4	-11.9	-7.5	-12.8	-12.1	-12.4	-11.9	-11.6
Targeted supply, $\theta = 0.50$	-11.9	-11.5	-11.9	-8.3	-11.4	-12.7	-12.4	-11.9	-11.6
Panel B: Externally funded									
Untargeted demand ($\zeta = 0.20$)	-8.6	+3.3	-11.9	+19.1	+4.3	-8.2	-12.4	-11.9	-11.6
Targeted demand, $\theta = 0.33$	-11.7	-5.5	-11.9	+63.3	-5.6	-16.5	-12.4	-11.9	-11.6
Targeted demand, $\theta = 0.50$	-11.6	-0.6	-11.9	+43.1	-0.7	-16.5	-12.4	-11.9	-11.6
Untargeted supply ($\Delta = 0.20$)	-7.6	-7.2	-11.9	-7.6	-7.2	-7.1	-12.4	-11.9	-11.6
Targeted supply, $\theta = 0.33$	-12.1	-12.3	-11.9	-7.5	-12.8	-12.1	-12.4	-11.9	-11.6
Targeted supply, $\theta = 0.50$	-11.8	-11.5	-11.9	-8.2	-11.4	-12.7	-12.4	-11.9	-11.6

Note: Median consumption-equivalent EV in %, versus the no-shock baseline. Nat, L, H: national and regional medians. L and H low/mid/high: medians within terciles of baseline period-0 income in each region. Panel A is tax-financed, Panel B externally funded. Scenarios and parameter values are as in Table A15. Welfare effects incorporate the shock; the effect of each policy is assessed relative to the shock-only scenario.

B Data Appendix

B.1 Skills

We estimate individual skills by sector (tradable and non-tradable) and region (low- and high-development). We use data from the National Employment and Income Survey (ENEI), Q2 2025 (INE, 2025).[1] Our sample includes all individuals aged 14 and above with positive primary-job income. We rely on an augmented Mincerian equation.

Sector classification. We group individuals into tradable and non-tradable sectors by their primary economic activity. We rely on 2-digit ISIC Rev. 4 codes (UN, 2008). Table B1 lists the economic activities in each sector.

Table B1: Sector classification based on ISIC Rev. 4

Sector	ISIC Divisions	Economic activities
Tradable		
Agriculture	01–03	Crop/animal production, forestry, fishing
Mining and quarrying	05–09	Mining, extraction
Manufacturing	10–33	Food, textiles, chemicals, metals, etc.
Electricity and gas	35	Electricity, gas supply
Information and communication	58–63	Publishing, telecom, IT services
Financial and insurance	64–66	Banking, insurance, financial services
Professional and scientific	69–75	Legal, accounting, consulting, R&D
Non-tradable		
Water and waste management	36–39	Water supply, sewerage, waste
Construction	41–43	Building, civil engineering
Wholesale and retail trade	45–47	Trade, repair of motor vehicles
Transportation and storage	49–53	Land, water, air transport, postal
Accommodation and food	55–56	Hotels, restaurants
Real estate	68	Real estate activities
Administrative services	77–82	Rental, employment, security services
Public administration	84	Government, defense, social security
Education	85	Education services
Health and social work	86–88	Hospitals, medical, social assistance
Arts and recreation	90–93	Cultural, sports, entertainment
Other services	94–96	Membership organizations, repair
Household activities	97–98	Domestic personnel
Extraterritorial organizations	99	International organizations

[1] This wave includes a department identifier, which earlier ENEI waves (2011, 2014, and 2019) do not. The department identifier allows for our regional classification (Table B2). When comparing skill distributions at the national level and across sectors as well as urban and rural areas, we find that the distributions are broadly similar across survey waves, suggesting that the 2025 patterns are to some extent representative of earlier periods.

Regional classification. We group departments into high-development (H) and low-development (L) regions. Table B2 lists the departments in each region.

Table B2: Development region classification by department

Region	Departments
High-development	Guatemala, Sacatepéquez, Chimaltenango, Escuintla, Santa Rosa, Suchitepéquez, Retalhuleu
Low-development	El Progreso, Sololá, Totonicapán, Quetzaltenango, San Marcos, Huehuetenango, Quiché, Baja Verapaz, Alta Verapaz, Petén, Izabal, Zacapa, Chiquimula, Jalapa, Jutiapa

Primary-job income. We measure primary-job income using three components: labor income, periodic payments, and self-employment earnings. Table B3 details each component.

Table B3: Components of monthly primary-job income

Component	Items included	Periodicity
Labor income	Salary Overtime pay Commissions	Monthly
Periodic payments	Bonuses Profit-sharing Other periodic payments	Annual ÷ 12
Self-employment earnings	Net earnings from main activity	Monthly

Note: All values measured in Guatemalan Quetzales (GTQ).

Years of education. We map the highest completed educational level and grade into years of education. Table B4 presents the mapping.

Table B4: Years of education mapping

Level	Spanish name	Years
No education or preschool	Ninguno / Preprimaria	0
Primary	Primaria	grade
Lower secondary	Ciclo Básico	6 + grade
Upper secondary	Ciclo Diversificado	9 + grade
Bachelor's	Licenciatura	12 + grade
Master's	Maestría	16 + grade
Doctorate	Doctorado	18 + grade

Note: Years of education are capped at 30.

Individual skills. We estimate individual skills in two steps, as in Britos et al. (2022). First, for each development region, we fit the following equation:

$$\begin{aligned}\ln y_{ir} \;&= \beta_1\, educ_{ir} + \beta_2\, age_{ir} + \beta_3\, age_{ir}^2 + \beta_4\, female_{ir} + \gamma_0\, T_{ir} \\ &\quad + \gamma_1(educ_{ir}T_{ir}) + \gamma_2(age_{ir}T_{ir}) + \gamma_3(age_{ir}^2 T_{ir}) + \gamma_4(female_{ir}T_{ir}) \\ &\quad + \delta_d + \varepsilon_{ir},\end{aligned} \tag{12}$$

where y_{ir} is the monthly primary-job income of individual i in region r, $educ_{ir}$ is years of education, age_{ir} and age_{ir}^2 capture the experience profile, $female_{ir}$ is a gender dummy, T_{ir} is a tradable sector dummy, and δ_d is residence department fixed effects.[2] Second, we sum unobservable individual factors and observable sector-specific demographic factors (age and gender) affecting y_{ir}.[3] For individual i working in sector s, the estimated skills are:

$$\hat{s}_{ir}^{s} \;=\; \hat{\varepsilon}_{ir} \;+\; (\hat{\beta}_2 + \hat{\gamma}_2\, T_{ir})\, age_{ir} \;+\; (\hat{\beta}_3 + \hat{\gamma}_3\, T_{ir})\, age_{ir}^2 \;+\; (\hat{\beta}_4 + \hat{\gamma}_4\, T_{ir})\, female_{ir}. \tag{13}$$

Aggregate skills. We collapse individual skills by sector and region. This gives four groups, each with their corresponding aggregate skills: (i) tradable sector in the low-development region; (ii) non-tradable sector in the low-development region; (iii) tradable sector in the high-development region; and (iv) non-tradable sector in the high-development region.

Results. In both regions, the non-tradable sector has higher average skills than the tradable sector. The log-normal means μ_s^j and standard deviations σ_s^j for $s \in \{T, N\}$ and $j \in \{L, H\}$ are reported in Table B5.

Table B5: Summary statistics of estimated skills by development region and sector

Region	Sector	Mean	Median	Std. Dev.	N
High-development	Non-tradable	0.778	0.961	0.856	6,914
	Tradable	0.722	0.861	0.799	3,226
Low-development	Non-tradable	0.892	1.068	0.918	6,115
	Tradable	0.699	0.858	0.917	3,802

[2] We trim the 1st and 99th percentiles to eliminate outliers and cluster standard errors at the residence department level.

[3] By doing this, we net out human capital investment and department-specific factors affecting y_{ir}.

B.2 Quality of Life Index

We construct a municipal-level structural quality of life index based on five core dimensions: (i) health (infrastructure and prevention), (ii) education, (iii) access to basic services, (iv) housing quality, and (v) accessibility and connectivity. Table B6 lists the variables in each dimension. We exclude criminality, violence, and mortality because they reflect multidimensional outcomes influenced by violence dynamics, income, access to services, and institutional capacity; including them would risk double counting and loss of conceptual coherence.

We construct the index in five steps. First, we multiply by -1 any variable where higher values indicate worse conditions, so that higher values now indicate better conditions. Second, we normalize all variables to $[0, 1]$ using min–max scaling based on national municipal-level minima and maxima. Third, we shift normalized variables away from zero by a small positive constant to ensure the validity of geometric aggregation.[4] Fourth, we compute each dimension-specific index as the geometric mean of its underlying variables, and the overall municipal index as the geometric mean of the dimension scores. Fifth, we aggregate municipal indices into regional indices using a population-weighted geometric mean, so that regional values reflect average well-being across the region's population. This regional quality-of-life index γ_j is higher in the high-development region (see Table B7).

B.3 Public Expenditure

We measure public expenditure at the departmental and regional level by aggregating municipal-level data from the Ministry of Finance (MINFIN).[5] We use municipal current expenditure and public investment.

Municipal public expenditure. We work with total current expenditure and public investment by municipality for the years 2013–2023 (MINFIN). We obtain per capita values at the departmental level by dividing yearly departmental public expenditure by population.[6]

[4]Normalized variables are shifted by $\epsilon = 0.001$. This shift keeps all dimension scores strictly bounded between 0 and 1.

[5]Municipal expenditure from MINFIN's SIAF system is reported in US dollars.

[6]We do this due to lack of data for municipal population before 2015. See INE population projections (INE, 2019).

Table B6: Variable definitions — Quality of life index

Dimension	Variable	Description	Unit	Year	Source
Health	Vaccination coverage	Pentavalent 3rd dose vaccination coverage rate among children	%	2019	MSPAS
	Health facilities per 10,000 people	Number of health facilities (health centers and health posts) per 10,000 people	Per 10,000	2010	USAID
Education	Primary schools per 10,000 people	Number of primary schools per 10,000 people	Per 10,000	2019	MINEDUC
	Gross enrollment rate	School enrollment rate as a percentage of school-age population	%	2018	Census
	Students per teacher†	Number of students per teacher in primary schools	Ratio	2019	MINEDUC
Services	Electricity	Percentage of households with access to electricity	%	2018	Census
	Average water and sanitation coverage (%)	Average of household access rates to water and sanitation	%	2018	Census
	Internet	Percentage of households with internet access	%	2018	Census
Housing	Adequate walls	Percentage of households with concrete block walls	%	2018	Census
	Adequate floors	Percentage of households with ceramic tile or cement floors	%	2018	Census
Accessibility	Cell towers per km^2	Density of cellular telephone base stations per square kilometer	Per km^2	2019	SIT
	Road density index	Index of road network density	Index (0–10)	2016	INFORM
	Travel time†	Access time to the nearest town with at least 20,000 inhabitants	Hours	2021	IFPRI

Note: † marks negatively oriented variables; we negate them before normalization so that higher values indicate better outcomes. We obtain municipal population in 2010, used for per 10,000 health facilities, by geometric interpolation between the 2002 and 2018 Population Censuses. For nine municipalities created after 2002, we impute population using the corresponding departmental growth rate.

Table B7: Quality of life index by development region

Region	Index
High-development	0.342
Low-development	0.222

We obtain regional values by summing expenditure and population across departments and taking the ratio. Table B8 reports per capita current expenditure and public investment over the periods used in the calibration and regressions; both are markedly higher in the high-development region.

Table B8: Municipal public expenditure per capita by development region (USD)

Region	Current	Investment	Total
Panel A: 2013–2023			
High-development	434.33	27.10	461.43
Low-development	45.62	4.27	49.90
National	203.86	13.57	217.43
Panel B: 2018–2019			
High-development	467.70	28.06	495.76
Low-development	49.64	5.01	54.65
National	219.91	14.40	234.30

Revenue allocation shares. The revenue allocation share δ_j governs the split of public revenue between productive investment and amenity spending. We compute it from the departmental current-versus-investment split in the MINFIN budget execution records (Table B8), aggregated to the two-region classification. Using the 2013–2023 panel, $\delta_H = 0.941$ and $\delta_L = 0.915$.

B.4 Employment

Employment levels by sector. Table B9 reports total employment by sector and development region, using the full sample of employed individuals (`OCUPADOS` = 1) in the ENEI Q2 2025. Panel A applies expansion factors to obtain population-level estimates; Panel B reports unweighted sample counts. Sector and region classifications follow Ta-

bles B1 and B2. The tradable employment share is higher in the low-development region under both weighting schemes.

Table B9: Employment by sector and development region (ENEI Q2 2025)

Region	Tradable	Non-tradable	Tradable share (%)
Panel A: Weighted (expansion factors)			
High-development	1,145,082	2,128,461	35.0
Low-development	1,889,836	2,814,529	40.2
Panel B: Unweighted (sample counts)			
High-development	3,417	7,299	31.9
Low-development	4,346	7,096	38.0

B.5 Value Added

Value added by sector. We calculate the value added by the tradable and non-tradable sectors within each development region. We rely on departmental value-added data from the Banco de Guatemala (Banguat, 2025). Table B10 details the mapping between Banguat categories and our sector classification. Table B11 reports value added by region and sector. The non-tradable share of value added is consistently higher in the high-development region across all years.

Value added per capita. Table B12 reports tradable and non-tradable value added per capita by development region in USD, over the periods used in the calibration and regressions.

B.6 Prices and Expenditure Shares

Relative prices. We compute the relative price index from the INE's Consumer Price Index. The INE reports monthly price indices for 12 expenditure divisions across 8 statistical regions; we use data for 2014, 2018, and 2023. We average each division's index over the 12 months in a given year and classify divisions as tradable or non-tradable following Table B13, the expenditure-side counterpart of Table B1. Within each INE region, we aggregate division-level indices into P_T and P_{NT} using the INE's expenditure weights

Table B10: Sector classification of Banguat value-added categories

ISIC	Banguat category	ISIC divisions	Assigned sector
A	Agriculture, forestry and fishing	01–03	Tradable
B	Mining and quarrying	05–09	Tradable
C	Manufacturing	10–33	Tradable
D–E	Electricity, water supply and sanitation[a]	35–39	Non-tradable
F	Construction	41–43	Non-tradable
G	Wholesale and retail trade; repair of motor vehicles	45–47	Non-tradable
H	Transportation and storage	49–53	Non-tradable
I	Accommodation and food service	55–56	Non-tradable
J	Information and communication	58–63	Tradable
K	Financial and insurance activities	64–66	Tradable
L	Real estate activities	68	Non-tradable
M	Professional, scientific and technical activities	69–75	Tradable
N	Administrative and support services	77–82	Non-tradable
O	Public administration and defense	84	Non-tradable
P	Education	85	Non-tradable
Q	Health and social work	86–88	Non-tradable
R–S–T–U	Arts/recreation, other services, household activities, extraterritorial organizations	90–99	Non-tradable

Note: [a]Banguat reports electricity (ISIC D, division 35) and water supply and sanitation (ISIC E, divisions 36–39) as a single combined category. Since the data cannot be disaggregated, the entire category is assigned to the non-tradable sector.

and compute the ratio. We then assign each department the ratio of its INE region and take a population-weighted average across departments within each development region; department mappings follow Table B2. Table B14 reports the results. Non-tradables are relatively more expensive in the high-development region across all three years.

Sectoral wage index. We compute mean wages by sector and development region using the same ENEI Q2 2025 sample as in Section B.1. Table B15 reports the ratio of mean tradable to mean non-tradable wages. In the high-development region, tradable wages slightly exceed non-tradable wages; in the low-development region, the pattern reverses.

Expenditure shares by sector. Using the 2023 regional CPI expenditure weights from Guatemala's National Statistics Institute (INE), we compute the share of tradable and non-tradable expenditures by region. We assign each department the expenditure structure of its corresponding INE region and aggregate to our high- and low-development regions using population weights. We have tradable expenditure shares of 49.1% in the high-development region and 58.4% in the low-development region (see Table B16). This relative pattern is consistent with estimates based on household expenditure data from the ENCOVI surveys

Table B11: Value added by development region and sector (millions of USD)

Region	Sector	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
High-dev	Non-Tradable	153,422	167,173	180,956	193,271	201,882	212,599	229,894	228,752	256,500	287,286	314,565
High-dev	Tradable	95,064	101,281	107,681	111,838	115,788	119,136	126,829	130,848	141,174	156,095	176,273
Low-dev	Non-Tradable	86,021	92,641	96,851	103,887	111,321	117,064	126,101	128,766	143,362	158,190	172,586
Low-dev	Tradable	57,379	59,996	62,559	63,557	66,178	68,894	74,585	77,257	83,142	90,776	99,787

Table B12: Value added per capita by development region (USD)

Region	Tradable	Non-tradable	Total
Panel A: 2013–2023			
High-development	2,444	4,284	6,728
Low-development	977	1,621	2,598
National	1,574	2,705	4,280
Panel B: 2018–2019			
High-development	2,408	4,332	6,740
Low-development	965	1,636	2,601
National	1,553	2,734	4,287

Table B13: Sector classification of CPI expenditure divisions

Code	Division	Components	Sector
01	Food and non-alcoholic beverages		T
02	Alcoholic beverages and tobacco		T
03	Clothing and footwear		T
04	Housing, water, electricity, gas	Rent, maintenance, water (04.1, 04.3, 04.4)	NT
		Electricity, gas, fuels (04.5)	T
05	Furniture and household goods		T
06	Health		NT
07	Transport		NT
08	Communications		NT
09	Recreation and culture		NT
10	Education		NT
11	Restaurants and hotels		NT
12	Miscellaneous goods and services		NT

Note: Division 04 is split using sub-group expenditure weights from the INE basket. Both components share the same division-level price index; the split operates through the weights alone. The expenditure weights follow a 13-division classification that separates the CPI's division 12 into codes 12 and 13; we sum their weights to match the CPI's 12-division structure.

Table B14: Relative price index of non-tradables to tradables (P_{NT}/P_T) by development region

	2014		2018		2023	
Region	Simple	Weighted	Simple	Weighted	Simple	Weighted
High-development	0.963	0.901	0.902	0.805	0.866	0.746
Low-development	0.940	0.851	0.816	0.657	0.739	0.555

Note: Simple: unweighted average of division-level CPIs. Weighted: using INE expenditure weights. Population data from INE departmental projections.

Table B15: Sectoral wage index by development region

Region	Mean wage, T	Mean wage, NT	Wage index (T/NT)
High-development	3,697	3,563	1.038
Low-development	2,182	2,982	0.732

Note: Mean monthly primary-job income in Guatemalan Quetzales (GTQ) by sector and development region. The wage index is the ratio of mean tradable (T) to mean non-tradable (NT) wages. Source: ENEI Q2 2025 (INE, 2025).

(2014 and 2023), which similarly indicate a higher tradable spending share in the low-development region (see Table B17).

Table B16: Share of expenditures by sector and development region (%, 2023)

Region	Tradable	Non-Tradable
High-development	49.06	50.94
Low-development	58.40	41.60
National	54.66	45.34

Note: The classification of expenditure divisions follows Table B13.

Table B17: Tradable and non-tradable expenditure shares by development region (%)

	2014		2023	
Region	Tradable	Non-Tradable	Tradable	Non-Tradable
High-development	53.1	46.9	50.2	49.8
Low-development	59.7	40.3	54.0	46.0
National	57.1	42.9	52.5	47.5

Note: Tradable expenditure includes food, equipment, and household goods. Non-tradable includes housing, utilities, education, health, transport and communications, and legal and personal services. Shares are computed from household-level data using survey weights from ENCOVI 2014 and 2023. See Table B2 for the regional classification.

B.7 Migration

Emigration rates. We estimate emigration rates by development region for workers. We take the total number of Guatemalan workers in the United States (682,995) from the American Community Survey 2021 (ACS). We distribute them across regions using the regional shares of emigrants between 2002 and 2018 reported in the XII Census (INE, 2020):

77.2% originated from the low-development region and 22.8% from the high-development region. We define the emigration rate as the number of workers abroad divided by the sum of domestic and emigrant workers. Domestic employment by region comes from the ENEI Q2 2025 using expansion factors (Table B9, Panel A). The emigration rate is more than twice as high in the low-development region (Table B18).

Table B18: Emigration rates by development region

Region	Workers in USA	Domestic workers	Emigration rate (%)
High-development	155,996	3,273,543	4.5
Low-development	526,999	4,704,365	10.1
National	682,995	7,977,908	7.9

Internal migration rates. We compute cross-regional internal migration rates from the XII Census 2018 (INE, 2020). The Census asks whether the individual resided in a different place five years prior. Among those who did, we identify internal migrants who crossed development regions using the department codes and the classification in Table B2. Observed internal flows in Guatemala are very low: Table B19 reports the flows and rates. Both directions are similar in magnitude, at roughly 0.6% of the origin population over five years.

Table B19: Internal migration rates by development region (cross-regional, past 5 years)

Flow	Migrants	Origin population	Rate (%)
Low → High	50,723	8,928,649	0.57
High → Low	32,567	5,972,637	0.55

Remittances and network intensity. We measure remittances at the departmental and regional level. We use 2018 and 2019 municipal-level data from FUNDESA (2018; 2020). For each municipality, we observe GDP per capita and remittances as a share of GDP. We compute remittances per capita as the product of the two. We aggregate to the departmental level as population-weighted arithmetic means using municipal population from the 2018 Census (INE, 2020). We aggregate to the regional level as population-weighted means across departments, following the development region classification in Table B2. For 2018 and 2019, remittances are higher in the low-development region, both in GDP per

capita and as a share of GDP (Table B20). The diaspora network intensity n_j is the 2018 remittances share of GDP: $n_L = 0.175$ and $n_H = 0.073$.

Table B20: Remittances by development region

	Per capita (USD)		Share of GDP (%)	
Region	2018	2019	2018	2019
High-development	429.0	484.7	7.3	8.6
Low-development	606.0	729.8	17.5	20.1

B.8 Amenities Regressions

We estimate the elasticity of the quality of life index with respect to public expenditure. We run a reduced-form log regression of ln(QoL index) (Section B.2) on ln(total public expenditure per capita) with region fixed effects; both the departmental cross-section (22 departments) and the municipal cross-section (327 municipalities) use 2013–2023 averages. The departmental estimate identifies α_u used in the model; the municipal regression is reported as a robustness check.

Calibration regression for α_u. Table B21 reports the reduced-form regression. Column (1) is the departmental cross-section averaged over 2013–2023 (22 departments), identifying $\alpha_u = 0.076$ used in the model calibration despite being not statistically significant given the small N. Column (2) is the municipal cross-section over the same window (327 municipalities) with standard errors clustered by department, as a robustness check. The municipal-level coefficient is similar in magnitude and statistically significant at 5%.

B.9 Value Added Regressions

We estimate the elasticity of tradable value added with respect to public expenditure. We run a reduced-form log regression of ln(tradable VA per capita) on ln(total public expenditure per capita) with region and year fixed effects. The departmental panel 2013–2023 identifies the TFP elasticity α_p used in the model; the municipal panel 2018–2019 is reported as a robustness check. The descriptive inputs are reported elsewhere in the appendix: per capita public expenditure in Section B.3 (Table B8) and per capita value added in Section B.5

Table B21: Calibration regression: ln QoL index on ln total public expenditure per capita

	(1) Departments Avg 2013–2023	(2) Municipalities Avg 2013–2023
ln(Total expenditure pc)	0.076	0.053**
	(0.067)	(0.021)
Region FE	Yes	Yes
Observations	22	327
R-squared	0.198	0.069

Note: Standard errors in parentheses; column (2) clustered by department. Total expenditure = current expenditure + public investment. Dependent variable: ln(QoL index). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

(Table B12). Value added is converted from Guatemalan Quetzales to US dollars using annual average exchange rates from the Banco de Guatemala.

Calibration regression for α_p. Table B22 reports the reduced-form regression. Column (1) is the departmental panel 2013–2023 (22 departments × 11 years) and identifies $\alpha_p = 0.334$, used in the model calibration. Column (2) is the municipal panel 2018–2019 (340 municipalities × 2 years) with standard errors clustered by department, as a robustness check. The municipal-level coefficient is smaller, consistent with municipal tradable GDP being imputed from departmental GDP by sectoral share.

Table B22: Calibration regression: ln tradable VA per capita on ln total public expenditure per capita

	(1) Departments 2013–2023	(2) Municipalities 2018–2019
ln(Total expenditure pc)	0.334***	0.109***
	(0.025)	(0.013)
Region FE	Yes	Yes
Year FE	Yes	Yes
Observations	242	673
R-squared	0.604	0.324

Note: Standard errors in parentheses; column (2) clustered by department. Total expenditure = current expenditure + public investment. Dependent variable: ln(tradable VA per capita) at the departmental level, ln(tradable GDP per capita) at the municipal level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.10 Baseline TFP and Amenity Derivations

Baseline TFP. We normalize $\bar{A}_L^T = 1$ and recover $\bar{A}_H^T$ as a residual. The endogenous TFP equation implies, in logs:

$$\ln \frac{\bar{A}_H^T}{\bar{A}_L^T} \;=\; \ln \frac{A_H^T}{A_L^T} \;-\; \alpha_p \ln \frac{(1-\delta_H)}{(1-\delta_L)} \;-\; \alpha_p \ln \frac{g_H}{g_L},$$

where δ_j and g_j are from Table B8. The effective TFP ratio A_H^T/A_L^T is recovered from the production function:

$$\frac{A_H^T}{A_L^T} \;=\; \frac{Y_H^T}{Y_L^T} \cdot \frac{L_L^T}{L_H^T} \cdot \frac{\bar{s}_L^T}{\bar{s}_H^T},$$

where Y_j^T is tradable value added (Table B11), L_j^T is weighted tradable employment (Table B9), and $\bar{s}_j^T$ is average tradable skill (Table B5). Using 2013–2023 averages:

1. VA ratio: $Y_H^T/Y_L^T = 125.64/73.10 = 1.719$.
2. Employment ratio: $L_L^T/L_H^T = 1{,}889{,}836/1{,}145{,}082 = 1.650$.
3. Skill ratio: $\bar{s}_L^T/\bar{s}_H^T = 0.699/0.722 = 0.968$.

$\Rightarrow$ Effective TFP ratio: $1.719 \times 1.650 \times 0.968 = 2.746$.

4. Investment share ratio: $(1-\delta_H)/(1-\delta_L) = 0.059/0.085 = 0.694$.
5. Expenditure p.c. ratio: $g_H/g_L = 465.0/50.7 = 9.17$.

$\Rightarrow$ Productive spending p.c. ratio: $0.694 \times 9.17 = 6.36$.

Result: $\ln(\bar{A}_H^T/\bar{A}_L^T) = \ln(2.746) - 0.334 \times \ln(6.36) = 1.010 - 0.618 = 0.392$, so $\bar{A}_H^T = e^{0.392} \approx 1.48$.

Baseline amenities. Unlike TFP, amenities enter utility additively, so absolute levels matter and we calibrate each $\bar{\gamma}_j$ individually. The endogenous amenity equation implies:

$$\bar{\gamma}_j \;=\; \frac{\gamma_j}{\left(\delta_j \, g_j/\bar{g}\right)^{\alpha_u}},$$

where the observed amenity level γ_j is the quality-of-life index (Table B7), and δ_j, g_j are from Table B8. Using 2013–2023 averages and $\bar{g} =$ USD 217.4:

1. Amenity spending intensity, L: $\delta_L \, g_L/\bar{g} = 0.915 \times 50.7/217.4 = 0.213$.

2. Fiscal multiplier, L: $0.213^{0.076} = 0.889$.

$\Rightarrow \bar{\gamma}_L = 0.222/0.889 = 0.250$.

3. Amenity spending intensity, H: $\delta_H \, g_H/\bar{g} = 0.941 \times 465.0/217.4 = 2.013$.

4. Fiscal multiplier, H: $2.013^{0.076} = 1.055$.

$\Rightarrow \bar{\gamma}_H = 0.342/1.055 = 0.324$.

B.11 Robustness of the Emigration Cost $\bar{\kappa}$

Table B23 reports the data-implied $\bar{\kappa}$ = coyote fee$/PV$ across alternative data sources, household weighting schemes, and annual discount factors. The calibrated baseline ($\bar{\kappa}_{data} \approx 0.177$) uses ENCOVI 2014 with Factor3 person weights and $\beta = 0.96$. Across all 20 combinations, $\bar{\kappa}_{data}$ stays within $[0.10, 0.33]$, confirming that the emigration cost represents a substantial but bounded fraction of lifetime income regardless of the data source or discounting assumption.

Comparison to Bazzi (2017). In Bazzi's (2017) Indonesian setting, migration fees of USD 800–1,200 (2005) are 0.6–0.9× annual GDP per capita of USD 1,300 (Bank Indonesia 2009). The Guatemala–US coyote fee of USD 12,500 (2023) is 2.26× Guatemalan value added per capita of USD 5,542 (Banguat × INE; 2013–2023 average USD 4,280, Table B12), roughly 3–4× the Indonesian ratio. The gap reflects corridor type: Bazzi's setting involves formal recruitment-agency outflows on 2–3 year contracts to (South)East Asia and the Middle East, while the Guatemala–US flow largely involves undocumented migration facilitated by coyotes.

B.12 Outer-Pinned SMM Parameters

Table B24 reports the two parameters that sit outside the SMM estimation loop. The emigration cost level $\bar{\kappa}$ and the lump-sum tax T are outer-pinned: they are set to fixed multiples of equilibrium income objects and updated via a fixed-point recursion until the targets are met to within 10^{-3}.

Table B23: $\bar{\kappa}$ across data source, weighting, and discount factor

		y (USD/yr)	annual discount factor β				
Source	Weighting	per worker	0.92	0.94	0.96	0.98	1.00
Panel A: Present value of period-2 income, $PV = y \times (1-\beta^T)/(1-\beta)$ (USD)							
ENCOVI 2014	Factor3 (person)	3,435	37,603	45,067	54,934	68,114	85,887
ENCOVI 2014	unweighted (HH)	3,904	42,734	51,217	62,430	77,409	97,607
ENEI 2025	FACTOR (worker)	3,678	40,259	48,251	58,814	72,926	91,954
ENEI 2025	unweighted (worker)	4,112	45,012	53,947	65,757	81,535	102,810
Panel B: Data-implied $\bar{\kappa}$ = coyote/PV							
ENCOVI 2014	Factor3 (person)	3,435	0.258	0.215	**0.177**	0.143	0.113
ENCOVI 2014	unweighted (HH)	3,904	0.227	0.190	0.156	0.125	0.099
ENEI 2025	FACTOR (worker)	3,678	0.327	0.272	0.224	0.180	0.143
ENEI 2025	unweighted (worker)	4,112	0.292	0.244	0.200	0.161	0.128

Note: $T = 25$. Coyote fee USD 12,500 (2023, Denton via CID Gallup), CPI-adjusted to the year of each y. Construction of y for each source follows the main text; PV and coyote are in the same year's USD, so $\bar{\kappa}$ is unit-free. Bold = calibrated value.

Table B24: Outer-pinned parameters

Parameter	Symbol	Value	Determination
Emigration cost level	$\bar{\kappa}$	0.0744	$0.247 \cdot \text{median}(Y_1^{\text{stay}})$
Lump-sum tax	T	0.0204	$0.046 \cdot \text{mean}(Y_0)$

Note: Y_1^{stay} is median period-1 income among stayers and Y_0 mean period-0 income; both are equilibrium objects updated within the fixed-point recursion. Both targets are met to within 10^{-3}.

C Robustness: Domestic credit market

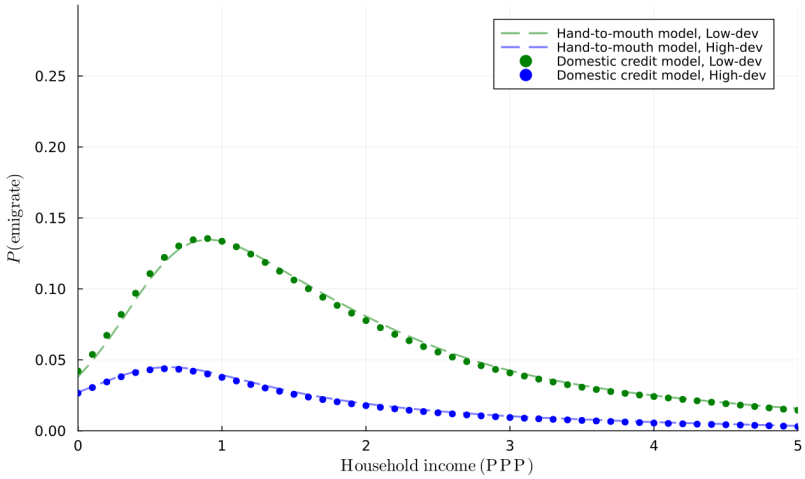
The baseline model assumes hand-to-mouth households, so that a temporary transfer can affect migration only through the period-0 budget. This appendix examines the robustness of the model under a domestic credit market in two ways. First, we assess whether the inverted-U relationship between income and emigration continues to hold when households have access to domestic credit. Second, we rerun the temporary transfers of Experiments 1 and 2 under the credit market to assess how their emigration and welfare effects change.

The income–emigration profile under credit. Figure C1 compares the income–emigration profile of the credit economy, before any transfer, with the hand-to-mouth baseline. The two profiles are nearly indistinguishable: the inverted-U in region L and the flatter profile in region H are preserved, with peaks at the same income levels. The only visible difference is a slightly higher emigration probability at the very bottom of the L distribution, as access to credit frees up some period-0 resources. The liquidity mechanism survives because the credit market is available to stayers and internal migrants but not to emigrants, so the upfront cost $p_0^T \kappa_L$ must still be met out of period-0 income. The share of liquidity-constrained households falls only from 4.4% to 3.8%, and emigration moves by +0.24 pp (Table C1), indicating that the constraint operating at the bottom of the distribution is not an artifact of the hand-to-mouth assumption. The opportunity-cost mechanism also remains operative: domestic income remains linear in skill while consumption abroad saturates.

Transfers under credit. In this exercise, stayers and internal migrants pool their two-period budgets at the world interest rate, while emigrants cannot. Variant A is the universal transfer and Variant B the targeted transfer, at the same total outlay. The transfers are paid from abroad, with no tax. We vary ζ over the Experiment 1 grid extended to 2.00, with the $\zeta = 0$ row showing the credit market alone.

A credit market adds a *consumption-smoothing channel* that is available to stayers but not to emigrants, so large transfers tilt the location choice toward staying. This exercise should be read as a mechanism illustration rather than a specific policy intervention: the credit economy is not re-estimated, and its conditional internal migration rates at $\zeta = 0$

Figure C1: Probability of emigration and household income: hand-to-mouth baseline and domestic credit market



Note: Probability of emigration as a function of household income, adjusted for regional purchasing power, for region L (green) and region H (blue). Dashed lines: hand-to-mouth baseline. Dots: domestic credit market with no transfer ($\zeta = 0$). The credit economy is not re-estimated. Values are smoothed for readability.

are 1.0% in L and 6.2% in H, against calibration targets of about 0.5%. It therefore shows how the transfer results of Experiments 1 and 2 would change if households could smooth resources across periods, not what those results would be under a re-calibrated credit economy.

The emigration response is non-monotonic in the transfer size. At low values of ζ, cash relaxes the liquidity constraint: the constrained share falls and emigration peaks at +3.90 pp at $\zeta = 0.33$ (Table C1). At high values of ζ, consumption smoothing becomes dominant: only stayers can spread the transfer across periods, so emigration crosses the baseline near $\zeta = 1.3$ and reaches −2.34 pp at $\zeta = 2.00$. The credit market alone barely moves emigration (+0.24 pp). Targeting deepens the reversal: each covered household's transfer is $1/\theta$ times as large, so Variant B peaks earlier and ends lower (−2.81 pp at $\theta = 0.33$, −3.66 at $\theta = 0.50$; Table C2). In welfare terms (Tables C3 and C4), the credit market alone is worth +4.7% to the poorest L tercile and −2.2% to the top. The transfer builds on these welfare effects, which increase with the transfer size: at $\zeta = 0.33$ the poorest tercile is at +51% under the universal transfer and +137% under targeting. Targeting also sharpens the split: the uncovered L top tercile slides to −8.6% at that transfer size, while under the universal

transfer every L tercile is positive at moderate and higher transfer values. H is essentially flat, drifting a few percent negative only at the largest transfer values.

Table C1: Transfers under a domestic credit market, Variant A: universal transfer

	Emig L (%)	ΔL (pp)	Constr. L (%)	Cost (% of GDP)
Baseline (hand-to-mouth)	10.02	—	4.4	0.00
Domestic credit, $\zeta = 0$	10.26	+0.24	3.8	0.00
$\zeta = 0.05$	11.24	+1.22	1.5	1.56
$\zeta = 0.10$	12.27	+2.26	0.3	3.13
$\zeta = 0.33$	13.92	+3.90	0.0	10.32
$\zeta = 1.00$	11.28	+1.27	0.0	31.27
$\zeta = 2.00$	7.68	-2.34	0.0	62.54

Note: ΔL is measured from the hand-to-mouth baseline. The transfer is paid from abroad (no tax). The credit economy is not re-estimated: its conditional internal migration rates at $\zeta = 0$ are 1.0% (L) and 6.2% (H) against calibration targets of about 0.5%, so the exercise illustrates the smoothing channel. Transfer values above $\zeta \approx 0.33$ exceed any plausible policy scale and are reported to trace the reversal of the emigration response. Columns as in Table 10.

Table C2: Transfers under a domestic credit market, Variant B: targeted transfer

	$\theta = 0.33$		$\theta = 0.50$		
	Emig L (%)	ΔL (pp)	Emig L (%)	ΔL (pp)	Cost (% of GDP)
$\zeta = 0.05$	12.62	+2.60	12.14	+2.13	1.56
$\zeta = 0.10$	13.62	+3.60	13.44	+3.42	3.13
$\zeta = 0.33$	11.98	+1.96	13.21	+3.19	10.32
$\zeta = 1.00$	8.79	-1.23	8.97	-1.05	31.27
$\zeta = 2.00$	7.20	-2.81	6.36	-3.66	62.54

Note: The Variant-A transfer is directed to the bottom θ of L; at every ζ the total outlay and Cost match Table C1. Credit market and columns as in Table C1.

Table C3: Welfare effects: universal transfer under domestic credit

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Domestic credit, $\zeta = 0$	+1.2	+1.8	+0.5	+4.7	+3.2	-2.2	+0.3	+1.2	+1.2
$\zeta = 0.05$	+1.2	+6.0	+0.6	+11.9	+7.2	-1.2	+0.4	+1.2	+1.2
$\zeta = 0.10$	+1.2	+9.3	+0.7	+19.3	+10.9	-0.2	+0.4	+1.1	+1.1
$\zeta = 0.33$	+3.8	+25.0	+0.9	+51.4	+27.1	+4.4	+0.2	+0.9	+0.9
$\zeta = 1.00$	+15.8	+67.1	+0.3	+136.0	+68.3	+17.6	+0.3	+0.3	+0.2
$\zeta = 2.00$	+32.5	+117.7	-1.2	+243.0	+119.1	+36.5	+0.3	-1.3	-1.3

Note: Median consumption-equivalent EV in %, versus the hand-to-mouth no-policy baseline. The $\zeta = 0$ row is the credit regime alone; the transfer rows stack the policy on it. Nat, L, H: national and regional medians. L and H low/mid/high: medians within terciles of baseline period-0 income in each region. Scenarios and parameter values as in Table C1; the EVs at the largest transfer values reflect transfers well above any plausible policy scale.

Table C4: Welfare effects: targeted transfer under domestic credit

	Nat	L	H	L low	L mid	L high	H low	H mid	H high
Domestic credit, $\zeta = 0$	+1.2	+1.8	+0.5	+4.7	+3.2	-2.2	+0.3	+1.2	+1.2
$\theta = 0.33$, $\zeta = 0.10$	+1.1	+6.6	+0.7	+45.1	+6.7	-4.4	+0.4	+1.1	+1.1
$\theta = 0.33$, $\zeta = 0.33$	+1.0	+13.0	+0.9	+137.0	+13.0	-8.6	+0.3	+0.9	+0.9
$\theta = 0.33$, $\zeta = 1.00$	+0.6	+28.9	-0.3	+366.7	+28.9	-17.5	+0.1	-0.4	-0.4
$\theta = 0.33$, $\zeta = 2.00$	+4.4	+48.8	-3.0	+654.5	+48.9	-19.8	+2.6	-3.2	-3.2
$\theta = 0.50$, $\zeta = 0.10$	+1.2	+7.1	+0.7	+31.8	+7.2	-4.4	+0.4	+1.1	+1.1
$\theta = 0.50$, $\zeta = 0.33$	+1.0	+17.5	+0.9	+93.0	+13.8	-8.7	+0.3	+0.9	+0.9
$\theta = 0.50$, $\zeta = 1.00$	+0.4	+54.0	0.0	+251.1	+37.7	-17.8	+0.1	0.0	0.0
$\theta = 0.50$, $\zeta = 2.00$	+5.4	+98.6	-2.3	+449.8	+52.1	+9.7	+1.5	-2.5	-2.5

Note: Median consumption-equivalent EV in %, versus the hand-to-mouth no-policy baseline; the $\zeta = 0$ row is the credit regime alone. Columns as in Table C3. The reported parameter values are a subset of the Table C2 grid. Per-recipient transfers are ζ/θ times mean period-0 income, which is what the covered terciles receive; the EVs at the largest transfer values reflect transfers well above any plausible policy scale.

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