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# The Two Sides of Migration in Central America

## Distributional Impacts in Guatemala

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**Abstract**

International migration has become a defining force shaping Guatemala's economy, with both outflows and return inflows generating diverse impacts across economic sectors, labor markets, and household welfare. This study quantifies the economy-wide and distributional impacts of these migration dynamics using a modeling framework that integrates detailed microdata on migration profiles. Three scenarios are considered: a reference case reflecting recent-historical migration patterns (MIG-0), moderately restricted migration (MIG-1), and net return migration (MIG-2), capturing newly emerging shifts in emigration and return flows by skill level within the country. Results reveal trade-offs between aggregate economic performance and distributional impacts across households. Compared to a baseline economy with no mobility, Gross Domestic Product (GDP) rises modestly under the reference scenario (+0.2%) and by an additional 0.3-0.5 percentage points under the more restrictive cases, driven by higher labor availability from returnees and currency depreciation. Non-agro-processing manufacturing shows the largest expansion (up to 1.8%), reflecting its strong labor-absorption potential. Household welfare, however, is highly sensitive to remittance flows, with income and consumption declining under the restrictive scenarios. These findings underscore the need for policies that facilitate returnee reintegration and strengthen social protection for remittance-dependent households, ensuring that the macroeconomic gains from migration adjustments translate into equitable welfare improvements.

**Keywords:** International migration, return migration, economy-wide model, macroeconomic impact, labor markets, household welfare, Guatemala

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## 1. Introduction

International migration is a recurrent and multidimensional socioeconomic phenomenon in Central America. In Guatemala, it has played a pivotal role in shaping patterns of labor mobility, demographic change, and external financing. Between 2002 and 2021, Guatemala recorded an estimated net emigration of about 856,000 people (United Nations, 2024), while remittance inflows from migrant workers account for around 20% of Gross Domestic Product (GDP) (Bank of Guatemala, 2023), placing the country among the fifteen most remittance-dependent economies in the world (IOM, 2022).[1]

Prior work shows that migration and remittance flows can influence macroeconomic performance, household welfare, and community development through multiple and interrelated channels. At the macro level, remittances have the potential to stimulate demand and output, though they may also induce real exchange-rate appreciation and reduce competitiveness in tradable sectors, with evidence highlighting the importance of sectoral linkages in shaping these aggregate effects (Chami et al., 2008; Pérez-Saiz et al., 2019). Bahadir et al. (2018) further shows that the macroeconomic effects of remittances depend critically on how they are absorbed in the economy—being expansionary when directed toward credit-constrained entrepreneurs but potentially contractionary when mainly received by hand-to-mouth (non-saving) households. Similarly, Carare et al. (2024) find that while remittances can offset some of the contractionary effects of emigration, their overall impact on growth and labor participation remains modest when underlying structural constraints persist. From a microeconomic perspective, remittances can smooth consumption, relax credit constraints, and reduce poverty, but may also weaken labor-supply incentives, foster dependency among recipient households, and influence production and investment decisions in complex ways—sometimes facilitating a shift out of agriculture rather than strengthening on-farm productivity (Amuedo-Dorantes & Pozo, 2006; Woodruff & Zenteno, 2007; Davis et al., 2010; Adams & Cuecuecha, 2013).[2] At the community level, remittances can

[1] Remittances increased considerably after the pandemic in Guatemala, but they had already more than doubled over the previous decade (Santos-Lozada & Cuxil, 2025).

[2] Other empirical studies examining the relationship between remittances and household welfare include Ecer & Tompkins (2013); Ajaero et al. (2018); Aguayo-Téllez et al. (2020); Mora-Rivera & van Gameren (2021); Nanziri & Mwale (2023); Wong et al. (2024); Barkat et al. (2024); and Sritharan & Jothishankar (2025), which collectively document the heterogeneous effects of remittances on welfare, financial inclusion, and institutional outcomes across diverse contexts.

influence collective investment, local institutions, and social capital formation (Taylor et al., 1996), while Durand et al. (1996) and Bussolo et al. (2011) emphasize the heterogeneity in their use across households and the potential spillovers for local development. Synthesizing this broad evidence, Page and Plaza (2006) highlight the pivotal role of remittances in shaping development trajectories in sending countries, while Yang (2025) emphasizes that international migration generates substantial economic benefits not only for migrants themselves but also for their origin communities.

Despite this extensive evidence, most analyses treat macroeconomic and household-level effects in isolation, leaving two important dimensions underexplored: the economy-wide and distributional effects of migration across sectors and households, and the implications of return migration. This study addresses these gaps by integrating detailed microdata on migration profiles into a Computable General Equilibrium (CGE) model for Guatemala, enabling a joint assessment of macroeconomic adjustments, sectoral dynamics, and welfare distribution across households under alternative migration scenarios.

The first gap lies in the limited understanding of the economy-wide consequences of migration and their distributional implications across households. Most related research has focused on remittances and household-level outcomes (Adams, 2004; Edwards & Ureta, 2003; Mishra et al., 2022), while paying comparatively less attention to how migration reshapes sectoral dynamics, labor markets, and the broader structure of the economy. Economic theory suggests that the emigration of low-skilled labor may increase wages for stayers (Bhagwati & Hamada, 1974; Borjas, 2003; Elsner, 2013; Lim et al., 2023), whereas skilled emigration could create productivity bottlenecks and deepen inequality. Empirical studies in Mexico (Chiquiar & Hanson, 2005; Mishra, 2006; Hanson, 2007; Moraga, 2011; Escamilla-Guerrero et al., 2025) and Puerto Rico (Aydemir & Borjas, 2007) provide valuable micro-evidence of these mechanisms, but they stop short of capturing economy-wide interactions. In Guatemala and much of Central America, such perspectives remain absent, despite migration having coincided with a structural shift toward services and prolonged stagnation in the tradables sector since the 2000s (Ulku & Zaourak, 2021; IFC, 2023). Overcoming this limitation requires economy-wide and general equilibrium approaches that can capture interactions across markets and sectors, while also allowing for the assessment of broader policy implications.

The second gap concerns return migration, an increasingly relevant yet insufficiently understood phenomenon. The quantitative literature on this topic remains limited, though it has been expanding in recent years. Return migration is commonly framed in two ways: as the planned completion of a migration episode, or as an unplanned process, often triggered by deportation or economic shocks abroad. Planned return can enhance human capital (Wahba, 2014; Diodato et al., 2023; Sheftel, 2023) and generate financial assets that promote entrepreneurship and business stability (McCormick & Wahba, 2001; Marchetta, 2012). By contrast, unplanned return often leaves migrants without resources and places additional pressure on local labor markets, contributing to unemployment and lower household incomes (see Bohnet et al., 2022, 2025).[3] As with the first gap, little is known about the broader economy-wide impacts of return migration—particularly in the case of deportations and other forms of involuntary return—making it an area that remains understudied.

In the case of Guatemala (and more broadly Central America), rising numbers of returnees—driven by policy shifts abroad, deportations, or voluntary returns —pose both challenges and opportunities for the economy. In scenarios of large-scale return, reintegration can be uneven, particularly for those returning involuntarily or with limited resources. Deportations from the United States have surged in recent years, with thousands of individuals—often young in urban areas—returning annually. Despite these substantial flows, the mechanisms through which returnees can integrate into local labor markets, contribute to sectoral development, or influence structural transformation have received limited attention, leaving a critical gap in understanding their economy-wide and welfare impacts.

A key feature of our approach is the construction of distinct migration profiles by skill level and origin, capturing the heterogeneity of both emigrants and returnees. The model incorporates these profiles to simulate alternative scenarios of emigration and return migration across skill groups, tracing their economy-wide implications through adjustments in factor markets, remittance flows, household welfare, and sectoral production.

Overall, while many of these dimensions have been studied in isolation—through micro studies of household level effects, macro models of remittances, or case studies of returnees—few analyses

[3] See also Dustmann & Gorlach (2016) for a comprehensive discussion of the key aspects of temporary migration that shape economic outcomes.

have sought to integrate them within a single quantitative setting. A CGE model offers this advantage by simultaneously tracking how migration shocks affect labor markets, household incomes (with or without remittances), production, and prices across the economy. By linking both emigration and return migration within a unified framework, this study provides new insights into how migration shapes Guatemala's development trajectory. In particular, it examines how changes in the composition of the labor force affect the structure of the economy as well as the welfare distribution across Guatemalan households.

The remainder of the paper is organized as follows. Section 2 provides a brief overview of recent migration trends in Guatemala, with a focus on the skill composition and origin of both emigrants and returnees. Section 3 describes the methodology and main data sources, including the design of the simulation scenarios. Section 4 presents the model results, analyzing the economy-wide and distributional impacts of migration shocks. Finally, section 5 concludes with policy implications.

## 2. Recent Migration Patterns in Guatemala

Over the past two decades, Guatemala has experienced sustained emigration, primarily from rural areas to the United States, with an important share of skilled individuals among emigrants (Britos et al., 2025). By 2020, approximately 1.4 million Guatemalans were estimated to reside abroad (UNDESA, 2020). Return migration, although less documented, has also intensified: between 2015 and 2023, more than 50,000 deportations occurred annually, largely involving young adults returning from the United States (IOM, 2024).[4] Recent reports by the Guatemalan Migration Institute show that more than 79,000 people returned in 2023 and approximately 76,000 in 2024, particularly men aged 15-59 years (IGM, 2025). These movements underscore the central role of the United States in shaping Guatemala's migration flows.

Amid these inflows, reintegration into the domestic labor market can pose significant challenges. To better understand these dynamics, we use microdata from the 2018 Population and Housing Census (INE, 2018), which includes detailed information on whether household members currently live abroad or have returned within the past five years. This allows us to construct

[4] Border apprehensions of Guatemalans in the United States increased from 17,338 in 2007 to 265,129 in 2019 and 228,220 in 2022—second only to Mexicans (CRS 2022; 2023). After the pandemic-related dip in 2020, crossings rebounded and then fell sharply in early 2025 amid tighter U.S. border enforcement.

migrant and returnee profiles across a wide range of socioeconomic variables, encompassing both demographic characteristics and migration-specific factors linked to experience and reintegration potential.

As shown in Table 1, the skill composition of migration flows exhibits a notable shift between emigrants and returnees. Among rural migrants, outflows are overwhelmingly concentrated among individuals with primary education, whereas inflows display a more diversified profile. The share of individuals among returnees with only primary education drops drastically in both rural and urban areas, while there is a marked increase in those with secondary and tertiary education, especially in urban areas. These patterns suggest that returnees are, on average, relatively more educated—many having completed secondary or tertiary education abroad. This is consistent with international evidence showing that return migration can be a channel for "brain gain" when migrants acquire skills overseas before returning home (Beine et al., 2008; Dustmann & Gorlach, 2016).

Table 1: Skill distribution for inflows and outflows by area

| | | **No education** | **Primary education** | **Secondary education** | **Tertiary education** | **Total** |
|---|---|---|---|---|---|---|
| Outflows distribution | Rural | 0.0 | 99.9 | 0.1 | 0.0 | 100.0 |
| | Urban | 0.2 | 81.2 | 18.6 | 0.0 | 100.0 |
| Inflows distribution | Rural | 9.9 | 59.9 | 27.4 | 2.7 | 100.0 |
| | Urban | 4.2 | 31.4 | 46.2 | 18.2 | 100.0 |

Source: Estimates based on 2018 Census microdata (INE, 2018). Years of schooling for emigrants (outflows) are projected using a regression model controlling for age, gender, rural/urban status, and municipal fixed effects.

Nevertheless, improved education levels do not automatically translate into better labor market integration. Analysis based on the same census microdata shows that inactivity rates remain high—50.3% in rural areas and 45.7% in urban areas—while employment rates hover around half of the returnee population (48.6% rural, 52.5% urban). The coexistence of higher educational attainment and limited employment suggests structural constraints, including the scarcity of high-productivity jobs and mismatches between skills acquired abroad and domestic demand. These findings are critical for our subsequent analysis: any assumptions about the potential economic impact of returnees must be consistent with the fact that a substantial share of this population remains outside

the labor force, and that even those with higher education may end up in jobs below their skill level. This dynamic is particularly acute in rural areas, where economic opportunities remain narrowly concentrated and structural barriers to productive employment persist.

The sectoral distribution of employed returnees reveals a clear rural-urban divide (see Table 2). Rural returnees are concentrated in traditional low-productivity sectors such as agriculture, forestry, and fishing (over half of rural employment), while urban returnees are engaged in more diversified activities, including wholesale and retail trade (22.5%), manufacturing (10.9%), accommodation and food services (6.4%), education (5.2%), and professional services (4.7%). These patterns suggest that the skills accumulated abroad are more likely to be applied in urban labor markets, while rural economies offer fewer pathways for the productive use of medium- and high-skill labor.

Table 2: Sectoral Employment of Guatemalan Returnees by Area

| **Sector** | **Rural (N)** | **Rural (%)** | **Urban (N)** | **Urban (%)** |
|---|---|---|---|---|
| Agriculture, forestry, and fishing | 1834 | 51.2 | 753 | 7.8 |
| Wholesale and retail trade | 429 | 12.0 | 2162 | 22.5 |
| Construction | 349 | 9.7 | 710 | 7.4 |
| Manufacturing | 244 | 6.8 | 1046 | 10.9 |
| Accommodation and food services | 113 | 3.2 | 615 | 6.4 |
| Education | 42 | 1.2 | 501 | 5.2 |
| Professional, scientific, and technical activities | 24 | 0.7 | 456 | 4.7 |
| Other sectors | 550 | 15.3 | 3378 | 35.1 |
| **Total** | **3585** | **100.0** | **9621** | **100.0** |

Source: Estimates based on 2018 Census microdata (INE, 2018).

Demographically, returnees are predominantly young adults aged 15-59, who account for approximately 79% of returnees in both rural and urban areas. Children and older adults constitute smaller proportions. Economically, average monthly household income is higher in urban areas (4,925 Quetzales or USD 642) than in rural areas (3,066 Quetzales or USD 400), while remittance

income remains relatively similar across areas, averaging around 1,655 Quetzales (USD 216) per month or approximately USD 2,600 on an annual basis. Remittances represent a significant source of income for many households.

In sum, understanding these patterns is essential for the modeling exercise presented in the next section, as assumptions on unemployment, sectoral allocation, and consumption must reflect them. While the higher education levels observed among returnees (Table 1) supports above-average productivity in certain sectors, reintegration barriers can limit these gains, especially for lower-skilled returnees. Overall, Guatemala's migration dynamics combine a persistent outflow of low-skilled rural workers with a gradual rise in better-educated urban returnees. Although return migration contributes to a broader domestic skill base—especially in urban areas—sectoral mismatches and limited labor absorption may constrain its economic impact.

## 3. Method of Analysis

### 3.1. RIAPA CGE Model

We use the Rural Investment and Policy Analysis (RIAPA) model tailored to the Guatemala economy. RIAPA is a structural, economy-wide model that has been extensively applied in low- and middle-income countries to analyze how policy reforms and labor shocks affect production, incomes, and welfare through interconnected markets. The model is grounded in a Walrasian general equilibrium framework and standard neoclassical behavior, and incorporates a Computable General Equilibrium (CGE) structure. In this section, we briefly describe the main features of the model and the key assumptions adopted in this study (see IFPRI (2023), for additional technical details).

CGE models are versatile tools for conducting ex ante impact analysis. In this study, we employ a static variant of the standard RIAPA model, which is well suited to capturing short- to medium-run adjustments to migration and return-migration shocks. The static framework allows us to transparently track changes in resource allocation, prices, and household incomes, while explicitly incorporating migration and return flows, remittances, and sector-specific productivity spillovers. This approach captures the key economic and distributional effects of migration without requiring the strong assumptions about expectations formation, capital accumulation, and intertemporal linkages that dynamic models impose, making it both simpler and more robust for policy analysis in the short to medium term.

The RIAPA CGE model incorporates standard flexible behavioral equations, including nested production functions, imperfect substitution between domestic and traded goods, and linear expenditure systems to represent consumer demand. Consumers and producers are modeled as utility and profit maximizers, respectively, while prices in factor and product markets adjust endogenously to ensure market equilibrium. In particular, each activity combines value added and intermediate inputs to produce output. Intermediate demand is determined by fixed input-output coefficients under a Leontief structure, reflecting sector-specific cost compositions.

The Guatemala model includes eight labor categories, defined as the combination of area of residence (rural versus urban) and four skill levels (no education, primary complete, secondary complete, and tertiary complete). The model also includes agricultural land, crop-sector capital, livestock capital, and non-agricultural capital factors of production.

International trade is modeled using the Armington assumption, where domestic and imported goods are imperfect substitutes combined through a constant elasticity of substitution (CES) function, while a constant elasticity of transformation (CET) function allocates output between domestic sales and exports. Household income is derived from factor remuneration, transfers, and remittances, and consumption behavior is modeled through a Linear Expenditure System (LES) distinguishing between subsistence and discretionary spending. Savings from households, along with government and foreign savings, finance domestic investment.

In the model, a sector's contribution to national growth is influenced by both its share in GDP and the strength of its linkages with other sectors in the economy. Sectors that rely on domestic inputs, stimulate local consumption through income generation, or supply intermediate goods to other industries tend to produce positive spillover effects. For instance, agriculture is often considered to have strong growth spillovers due to its forward linkages (providing raw materials to downstream sectors), backward linkages (demanding local trade and transport services), and consumption effects (generating income for rural households that spend disproportionately on domestic goods). Overall, these linkages are determined by the country's production structure and consumption patterns.

To operationalize the shocks, we assume labor is mobile across sectors, while land and capital remain sector-specific, capturing short- to medium-term rigidities. Moreover, unemployment is assumed for unskilled labor across all scenarios to reflect frictions in job matching and labor

absorption, while skilled labor is assumed to be fully employed. This assumption is considered realistic, particularly in the context of return migration. Indeed, skilled returnees reintegrate more easily, as their human capital is better valued at home, while unskilled returnees face higher risks of unemployment and informal work, even if they have gained experience abroad, because this experience is not fully transferable or recognized locally (Hagan et al., 2014). In Central America, these challenges are further exacerbated by social stigma and employment discrimination (Ruiz et al., 2019).

### 3.2.Data

The analysis relies primarily on the 2021 Social Accounting Matrix (SAM) for Guatemala (IFPRI, 2024), which follows the IFPRI NEXUS format.[5] A SAM is a consistent, economy-wide database that records all income and expenditure flows among productive activities, factors of production, and institutions within an economy for a given year. The Guatemalan SAM captures detailed transactions across production sectors, households, government, and the rest of the world, including intermediate input use, factor payments, household income and expenditure, taxes, and trade flows. Its high level of disaggregation allows us to represent linkages between agriculture, industry, and services, as well as the distribution of value added across labor categories.

Households in the Guatemala SAM are also disaggregated into 20 groups defined by location (rural/urban) and income level deciles, reflecting Guatemala's diverse socio-economic structure. Each household category receives income from different combinations of factors (labor, land, capital), government transfers, and remittances, and allocates its spending across a detailed set of commodities. This granular representation allows us to trace how migration-induced changes in wages, employment, and remittance flows translate into differentiated welfare impacts across household types.

Overall, the 2021 Guatemala SAM provides a rich and coherent representation of the country's economic structure and supports the integration of thematic extensions, including migration modules. In particular, to characterize migration patterns, we use microdata from the 2018 Population and Housing Census of Guatemala (INE, 2018). This data allows us to disaggregate

[5] The Nexus Project is a collaboration between IFPRI and its partners, including national statistical agencies and research institutions. This project aims to improve the quality of social accounting matrices (SAMs) used for computable general equilibrium (CGE) modeling.

migrants by demographic characteristics and skill groups. We complement the census with administrative, survey-based, and online data on remittances and international and return migration flows from the Bank of Guatemala and Chi et al. (2025). All datasets are harmonized and scaled to national totals and disaggregated by region (rural/urban) and education level, providing a solid empirical foundation for model calibration.

### 3.3. Migration scenarios

To analyze the impacts of migration outflows and inflows in Guatemala, we consider three migration scenarios that reflect both recent-historical and ongoing changes in cross-border mobility with the United States, which remains by far the main destination: (i) a reference migration scenario (MIG-0), (ii) a moderately low migration scenario (MIG-1), and (iii) a severely restricted migration scenario (MIG-2). Table 3 summarizes each scenario in terms of outflows and inflows of labor and the resulting change in remittances.

These flows feed into a "Net Migration Shock" which triggers two main domestic channels: migrant outflows reduce the labor force, while migrant inflows augment it. These changes lead to labor market adjustments that propagate to output and sectoral production, ultimately affecting factor incomes. In parallel, remittance inflows—an external source of income that varies with the skill composition of migrants—directly affect household income. Appendix A provides additional details on the construction of the migration scenarios, while Appendix B presents a schematic overview of the transmission channels and the operationalization of these scenarios in the model.

Table 3: Outflows and inflows across migration scenarios, %

| | **MIG-0** Reference (recent-historical) migration patterns | **MIG-1** Outflows halved, inflows doubled (reduced flow) | **MIG-2** Outflows one-third down, inflows tripled (severely limited) |
|---|---|---|---|
| Outflows | -7.6% | -3.8% | -2.5% |
| Inflows | +1.4% | +2.8% | +4.2% |
| Net migration flow | -6.2% | -1.0% | +1.7% |
| Remittance change | +5.5% | +0.6% | -2.0% |

Source: Authors' assumptions based on Chi et al. (2025) and the Guatemala 2021 SAM (IFPRI, 2024).

*Reference migration scenario (MIG-0)*

This scenario mirrors recent-historical migration rates and patterns out of and into Guatemala. Over the 2019-2022 period, it is estimated that around 550,000 Guatemalans migrated to the United States (Chi et al., 2025). Accordingly, for simulation purposes, we assume a comparable level of outmigration from the country, equivalent to an outflow of 7.6 percent of the labor force. The rural-urban composition and skill distribution are consistent with the empirical patterns observed in the country (see Table 1). In addition, this scenario includes an inflow of Guatemalans equivalent to 1.4 percent of the labor force, representing the 102,000 returnees from the United States observed during the same 2019-2022 period. In sum, this migration scenario considers a net outflow of 6.2 percent of the labor force.

*Moderately restricted or low migration scenario (MIG-1)*

Compared with MIG-0, this scenario imposes a more restrictive outmigration regime, halving the rate of outflow and doubling that of inflow. This amounts to an outflow rate of 3.8 percent and an inflow rate of 2.8 percent, resulting in a net outflow of 1 percent of the labor force. This scenario represents a plausible policy or economic environment in which barriers to emigration are moderately increased, while return migration is encouraged or facilitated, reflecting potential shifts in migration incentives, labor demand abroad, or reintegration programs. It allows us to explore

how a moderate reduction in net outmigration and a higher inflow of returnees would affect labor markets, output, and household welfare in Guatemala.

*Severely restricted or net-return scenario (MIG-2)*

MIG-2 represents the most restrictive migration regime, featuring an outflow rate two-thirds lower than the recent-historical migration patterns (MIG-0) and an inflow three times higher (rising from 1.4 to 4.2 percent). This configuration results in a net inflow of about 1.7 percent of the labor force. The MIG-2 scenario captures a strong restriction on emigration and allows us to explore the effects of a substantial reversal in net migration on the labor market, sectoral output, and household welfare.

In addition to the shift in outflows and inflows, these scenarios incorporate associated changes in remittances, reflecting the close link between migration patterns and external income flows. Orozco and Klaas (2021) tracked annual remittance inflows per sender among migrants from Latin America and Caribbean (LAC) during the 2022-2021 period and estimated an average remittance of just over USD 2,600, sent by about half of the respondents. In this context, we assume that remittances vary by the sender's skill level, ranging from USD 1,800 for the least educated to USD 3,000 for the highly educated. Given annual remittance inflows to Guatemala exceeding USD 15 billion (IFPRI, 2024) and the change in net outflows of people as established in the respective migration scenarios, we calibrate the model such that each migration scenario entails a proportional remittance shock: a 5.5 percent increase under MIG-0, a 0.6 percent increase under MIG-1, and a 2.0 percent decline under MIG-2. These changes in remittances are incorporated into the simulations together with the shifts in outflows and inflows, ensuring that the model captures both the domestic labor market effects of migration and the external income shocks transmitted through remittances.

Further, we account for population changes associated with net labor migration. This is done in two steps. First, net labor migration is calculated separately for rural and urban labor types. Then, using data from the National Survey of Living Conditions (INE, 2023) on the distribution of remittance-receiving households across income groups in Guatemala, we proxy the resulting population adjustments by household type.

In the static economy-wide model used in this study, the outcomes of these migration scenarios are compared both to the baseline economy (prior to any additional mobility), and to one another.

### 3.4. Outcome indicators

The model produces a comprehensive set of outcome indicators that capture economic and distributional effects under the alternative migration scenarios. These indicators are derived from the simulated changes in production, trade, and household behavior generated by the CGE model, and they operate at multiple levels of analysis—macroeconomic, sectoral, factor-market, and household welfare.

*Macroeconomic and sectoral indicators*

These variables capture the overall performance of the economy under each scenario. They include gross domestic product (GDP) at factor cost, aggregate private and public consumption, total exports and imports, the real exchange rate, and net inflows of international remittances. Movements in these aggregate variables reflect the combined effect of changes in domestic production, terms of trade, and external transfers, providing a first-order measure of the scale and direction of the simulated shock.

The model also reports GDP disaggregated into major sectors—agriculture, manufacturing, and services—and into finer subsectors such as cash crops, food crops, agro-processing, and other manufacturing. This breakdown allows identification of more granular structural shifts in the economy, for example, whether migration-induced changes in factor availability or demand patterns cause expansion or contraction of particular industries.

*Factor market indicators*

These indicators capture changes in the incomes accruing to the primary factors of production—labor, capital, and land. In this study, the focus is placed on labor incomes, which are disaggregated by skill level and by rural and urban location. Tracking these outcomes enables an assessment of how migration influences the functional distribution of labor income, as well as relative returns across specific factors (that is, the allocation of earnings across production factors). In addition,

the model reports changes in the total demand for each factor, shedding light on sector-specific adjustments in labor and capital utilization.

*Household welfare indicators*

At the distributional level, the analysis focuses on changes in household incomes and consumption patterns. Specifically, we report total household income, which comprises factor income, remittance income, and other transfer income. Real consumption expenditure measures the purchasing power of households after accounting for price changes, while disaggregated consumption captures expenditure across specific commodity groups (e.g., food, non-food). These indicators are calculated for representative households, constructed by grouping survey households with similar socioeconomic characteristics. As indicated in Section 3.1, the model distinguishes 20 representative households, classified by area of residence and income decile. This structure enables a differentiated assessment of how migration-related shocks affect households across income distribution.

Taken together, this set of indicators provides a multi-dimensional picture of the economic and welfare consequences of migration-related shocks, from aggregate macroeconomic performance to the heterogeneity of impacts across sectors, factors, and household groups.

## 4. Discussion of Results

Next, we present model results for the three migration scenarios (MIG-0, MIG-1, and MIG-2) described in Section 3.3. All results are reported as percentage changes relative to the counterfactual baseline economy without migration flows. Therefore, changes in macroeconomic and sectoral variables are expected in all scenarios—including MIG-0, which represents the reference scenario with recent-historical migration patterns. For MIG-1 and MIG-2, we additionally report percentage-point deviations from MIG-0, enabling a clear comparison across alternative migration scenarios.

### 4.1.Macroeconomic effects

We first discuss changes in selected macroeconomic indicators. In the reference migration scenario (MIG-0), where the magnitudes of outmigration and return migration are maintained at 7.6 percent and 1.4 percent of the labor force, respectively, GDP increases modestly at 0.2 percent (Table 4). This leads to an even larger rise in private and investment demand by 1.1 and 1.9 percent, showing the economic gains associated with net outmigration in Guatemala. Meanwhile, the results show a considerable reduction in exports (by 2.0 percent) that is associated with a decline in the performance of tradable sectors, including agriculture and manufacturing (see Table 5). By contrast, there is a 1.9 percent increase in imports to compensate for poor agricultural and manufacturing sector performance. International remittances, which are tied to the migration pattern, increase by 5.5 percent due to the 6.2 net outmigration rate. As remittance inflows rise, the current account balance improves, and despite declines in exports and increases in imports, the exchange rate appreciates by about 0.8 percent.

Contemporary changes in migration patterns and the country's stance on international migration suggest a fundamental shift in cross-border mobility. Table 4 also shows the macroeconomic impacts under scenarios representing moderately (MIG-1) and highly (MIG-2) restricted migration flows, which entail reductions in outmigration but increases in return migration. Model results indicate further gains in GDP growth by rates of 0.3 and 0.5 percentage points (pp) under the moderate and highly restricted migration scenarios, respectively, relative to the GDP performance under the reference scenario, such that GDP growth accelerates to 0.5 and 0.8 percent. This growth acceleration is due to an increase in domestic supply of cheap labor. Conversely, growth in private consumption declines compared to MIG-0, driven by the contraction in remittances as

outmigration falls and return migration rises. For example, remittance inflows decline by an additional 7.5 pp under the most restrictive MIG-2 scenario, relative to the reference migration scenario (MIG-0). Additionally, since we adopt a savings-driven investment closure—where investment responds to changes in savings and remittances directly affect savings—investment growth slows, although its growth remains positive. This is more evident under the stricter migration scenario MIG-2, where investment growth falls by 0.9 pp compared to MIG-0.

However, the alternative migration scenarios (MIG-1 and MIG-2) help improve the current account balance as exports increase and imports decrease compared to MIG-0. Specifically, export revenue increases by up to 2.4 percent under the restrictive MIG-2 scenario characterized by net immigration; compared with the export performance under MIG-0, this scenario results in a 4.3 pp larger growth. On the other hand, import growth slows to 0.7 and 0.2 percent under the MIG-1 and MIG-2 scenarios relative to the baseline economy, representing a total reduction of up to 1.7 pp compared with MIG-0. The movements in remittances, exports, and imports lead to a depreciation of the local currency, particularly under MIG-2, indicating that the net gains in foreign exchange from higher exports and lower imports fall short of the losses associated with declining remittances.

Table 4: Changes in selected macroeconomic indicators

| | Percentage change from baseline | | | Point deviations from MIG-0 | |
|---|---|---|---|---|---|
| | MIG-0 | MIG-1 | MIG-2 | MIG-1 | MIG-2 |
| GDP at factor cost | 0.2% | 0.5% | 0.8% | 0.3 pp | 0.5 pp |
| Private consumption | 1.1% | 0.5% | 0.3% | -0.6 pp | -0.8 pp |
| Investment demand | 1.9% | 1.2% | 1.0% | -0.7 pp | -0.9 pp |
| Export | -2.0% | 0.7% | 2.4% | 2.7 pp | 4.3 pp |
| Import | 1.9% | 0.7% | 0.2% | -1.2 pp | -1.7 pp |
| Exchange rate (LCU/US$) | -0.8% | 0.0% | 0.5% | 0.8 pp | 1.2 pp |
| Remittance inflow | 5.5% | 0.6% | -2.0% | -4.9 pp | -7.5 pp |

Source: Guatemala CGE model results. LCU = Local Currency Units.

4.2. Sectoral effects

Despite the overall increase in GDP under the reference migration scenario (MIG-0), various sectors of the economy are affected differently. Table 5 shows a reduction in agricultural and manufacturing GDP by 0.3 percent, compared to baseline levels. Within agriculture, cash crops decline strongly (0.6 percent), while manufacturing sectors other than agro-processing contract significantly (by 0.6 percent). Meanwhile, the service sector—both private and public—expands slightly under the reference migration scenario.

Relative to these MIG-0 outcomes, the MIG-1 and MIG-2 scenarios significantly alter sectoral responses (Table 5). On the whole, all sub-sectors of the economy exhibit improved performance under these alternative migration patterns. For example, unlike the 0.3 percent contraction in agricultural GDP observed under the MIG-0 scenario relative to the baseline economy, the sector expands by 0.2 and 0.4 percent under the moderate (MIG-1) and highly (MIG-2) restrictive migration scenarios, respectively. This is equivalent to a 0.4-0.7 pp higher growth in agriculture relative to the reference migration scenario as labor becomes relatively more abundant owing to the decline in net outmigration. Within agriculture, cash crops, which experienced the largest declines in GDP under MIG-0, show the strongest recovery under the restrictive migration regimes, growing by 0.8-1.3 pp faster than in the reference scenario.

Manufacturing GDP also reverses its decline observed under MIG-0, increasing by 0.7-1.4 percent under MIG-1 and MIG-2 compared to the baseline—equivalent to 1.0-1.7 pp faster growth relative to MIG-0. These results indicate that the manufacturing sector benefits significantly from the increase in labor supply as outmigration decreases and migrants return. Notably, non-agro-processing manufacturing experiences substantially higher growth under the restrictive migration regimes, with gains of 0.8 to 1.8% relative to the baseline. Similarly, the service sector continues registering robust growth throughout the different migration scenarios considered in this study, performing strongly as outmigration significantly declines.

Table 5: Changes in sectoral GDP

| | Percentage change from baseline | | | Point deviations from MIG-0 | |
|---|---|---|---|---|---|
| | MIG-0 | MIG-1 | MIG-2 | MIG-1 | MIG-2 |
| Total | 0.2% | 0.5% | 0.8% | 0.3 pp | 0.5 pp |
| Agriculture | -0.3% | 0.2% | 0.4% | 0.4 pp | 0.7 pp |
| Food crops | -0.3% | 0.2% | 0.5% | 0.5 pp | 0.8 pp |
| Cash crops | -0.6% | 0.2% | 0.6% | 0.8 pp | 1.3 pp |
| Livestock and others | -0.1% | 0.1% | 0.3% | 0.2 pp | 0.3 pp |
| Mining | 0.1% | 0.2% | 0.2% | 0.1 pp | 0.2 pp |
| Manufacturing | -0.3% | 0.7% | 1.4% | 1.0 pp | 1.7 pp |
| Agro-processing | -0.1% | 0.4% | 0.8% | 0.5 pp | 0.9 pp |
| Other manufacturing | -0.6% | 0.8% | 1.8% | 1.4 pp | 2.4 pp |
| Services | 0.3% | 0.5% | 0.7% | 0.2 pp | 0.4 pp |
| Government services | 0.3% | 0.4% | 0.5% | 0.0 pp | 0.1 pp |
| Other services | 0.3% | 0.5% | 0.8% | 0.2 pp | 0.5 pp |

Source: Guatemala CGE model results.

### 4.3. Factor maker effects

Table 6 reports factor market responses from the various international migration scenarios. First, we discuss changes in factor-returns, i.e., factor incomes, and then we revert to the simulated changes in factor demand at the economy-wide level. We observe that the recent-historical migration patterns increase labor income in both rural and urban areas and irrespective of skill levels. However, the income gains are slightly stronger in urban areas mainly due to the growth in the service sector, while agriculture–which is predominantly a rural activity–contracts slightly. By skill level, more-skilled labor exhibits stronger increase in income in both rural and urban areas. Yet unlike the larger increase in total labor income observed in urban areas, the rise in skilled labor income is greater in rural areas—0.7 percent compared to 0.4 percent in urban areas. This pattern reflects the fact that rural outmigration is largely dominated by unskilled labor (see Table 1), which raises the demand for skilled labor through the substitution effect.

Table 6 further shows that factor income increases further under the moderate and more restrictive migration scenarios, showing limited risks to the factor market in Guatemala. Labor income in rural and urban areas is likely to increase by an additional 0.5 and 0.3 pp under the MIG-2 scenario compared with the MIG-0 scenario, mainly driven by a larger income increase in skilled labor. In fact, unskilled labor in urban areas may experience a decline in income (compared to MIG-0) as it is substituted by skilled labor, which becomes cheaper due to the increase in its supply. As the skill composition of returnees in Guatemala is skewed towards more skilled, the net inflow can alter the labor composition in the country. We also observe a more pronounced increase in income for factor of production in agriculture (land and agricultural capital) under the alternative migration scenarios. This occurs because demand for these factors rises to support the modest performance of the agricultural sector in these scenarios, as shown in Table 5, where demand for rural labor grows more slowly than demand for urban labor.

The changes in factor incomes discussed above are driven by shifts in factor demand and payments (wages and rents). Table 6 further reports the change in demand for factors of production under the three migration scenarios. Although the demand for labor increases in both rural and urban areas under the recent-historical migration patterns, the change in demand for skilled and unskilled labor in these two regions remains contrasting. Whereas the demand for skilled labor increases by 2.9 in rural areas, the demand for such labor declines by 0.2 percent in urban areas. In contrast, the demand for unskilled labor declines in rural areas whereas the demand increases in urban areas. This difference arises from variations in the relative scarcity of unskilled labor across regions, reflecting their differing contributions to outmigration. Nevertheless, at the national level, labor demand increases across all skill types, contributing to an overall but marginal increase in GDP.

The possible reduction in outmigration and increase in return migration (under MIG-1 and MIG-2) suppresses wages and increases the demand for labor. The increase in demand is particularly substantial for skilled labor classes, further expanding by 3.0 and 5.9 pp in rural areas and 3.0 and 5.4 pp in urban areas under MIG-1 and MIG-2, compared with the reference migration scenario (MIG-0). This significant increase in demand for skilled labor is due to an even further reduction in relative wages as more skilled Guatemalans return.

Table 6: Changes in factor income and factor demand

| | Change in factor income | | | | | Change in factor demand | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Percentage change from baseline | | | Point deviations from MIG-0 | | Percentage change from baseline | | | Point deviations from MIG-0 | |
| | MIG-0 | MIG-1 | MIG-2 | MIG-1 | MIG-2 | MIG-0 | MIG-1 | MIG-2 | MIG-1 | MIG-2 |
| **Labor income and demand** | | | | | | | | | | |
| Rural | 0.3% | 0.6% | 0.9% | 0.3 pp | 0.5 pp | 0.2% | 1.1% | 1.9% | 0.9 pp | 1.6 pp |
| Unskilled | 0.1% | 0.4% | 0.6% | 0.2 pp | 0.5 pp | -0.2% | 0.3% | 0.7% | 0.5 pp | 0.9 pp |
| Skilled | 0.7% | 1.0% | 1.4% | 0.3 pp | 0.7 pp | 2.9% | 5.8% | 8.8% | 3.0 pp | 5.9 pp |
| Urban | 0.4% | 0.6% | 0.8% | 0.1 pp | 0.3 pp | 0.2% | 1.5% | 2.5% | 1.2 pp | 2.3 pp |
| Unskilled | 0.6% | 0.4% | 0.3% | -0.2 pp | -0.3 pp | 0.5% | 0.3% | 0.3% | -0.2 pp | -0.2 pp |
| Skilled | 0.4% | 0.7% | 1.0% | 0.3 pp | 0.6 pp | -0.2% | 2.9% | 5.2% | 3.0 pp | 5.4 pp |
| National | 0.4% | 0.6% | 0.8% | 0.2 pp | 0.4 pp | 0.2% | 1.3% | 2.2% | 1.1 pp | 2.0 pp |
| Unskilled | 0.4% | 0.4% | 0.4% | 0.0 pp | 0.0 pp | 0.1% | 0.3% | 0.5% | 0.2 pp | 0.4 pp |
| Skilled | 0.4% | 0.7% | 1.0% | 0.3 pp | 0.6 pp | 0.4% | 3.4% | 5.9% | 3.0 pp | 5.5 pp |
| **Other factors' income** | | | | | | | | | | |
| Land and agric. capital | -0.7% | 0.9% | 2.1% | 1.7 pp | 2.8 pp | - | - | - | - | - |
| Other capital | 0.4% | 0.3% | 0.3% | -0.1 pp | -0.1 pp | - | - | - | - | - |

Source: Guatemala CGE model results. Since the scenarios are run under full-employment assumptions for land and capital, there are no changes in factor quantities at the economy-wide level.

### 4.4. Welfare and distributional effects

Welfare impacts are assessed through changes in household income and commodity consumption (food versus non-food). Examining how these indicators vary across household groups permits to approximate the distributional effects of the migration patterns under study.

Table 7 reports changes in household income. This change in income is largely driven by variations in international remittances discussed in Section 4.1 and changes in factor incomes discussed in Section 4.3. Under the reference migration scenario (MIG-0), remittances and factor returns increase considerably. In line with this, households experience significant income gains when migration occurs at recent-historical rates. This income increase is more pronounced for rural households (1.4 percent), resulting in a 1.1 percent increase at the national level. Between lower-income households (bottom 40% of income distribution) and higher-income households (upper 60%), the higher-income exhibit the largest income increase. This occurs for two main reasons. First, unlike domestic remittances or interhousehold transfers, international remittances are primarily received by higher-income households. Second, as shown in Table 6, skilled labor—predominantly owned by richer households—experiences the largest increases in income.

However, in contrast to the stronger economic performance (Table 5) and higher factor incomes (Table 6) observed under the more restrictive migration scenarios (MIG-1 and MIG-2), household incomes increase at significantly lower rates than those observed under the recent-historical migration patterns (MIG-0). For example, household incomes at the national level increase by only 0.5 and 0.2 percent under MIG-1 and MIG-2 compared to the 1.1 percent increase under MIG-0. This amounts to a 0.6-0.9 pp reduction in income growth relative to what can be achieved under the reference migration scenario. These declines in household incomes are mainly driven by the 4.9-7.5 pp reduction in remittances reported in Table 4. It is plausible that a significant weight of the decline in income is concentrated among richer households, given their considerable share in remittance receipts.

Our results further reveal important effects on consumption spending across the different migration situations. Although changes in consumption generally resemble those in income, they differ slightly due to household-level differences in savings behavior and income tax contributions.

Table 7: Changes in household income

| | Change in household income | | | | |
|---|---|---|---|---|---|
| | Percentage change from baseline | | | Point deviations from MIG-0 | |
| | MIG-0 | MIG-1 | MIG-2 | MIG-1 | MIG-2 |
| Rural | 1.4% | 0.6% | 0.2% | -0.8 pp | -1.2 pp |
| Lower income | 0.5% | 0.6% | 0.8% | 0.1 pp | 0.3 pp |
| Higher income | 1.7% | 0.6% | 0.0% | -1.2 pp | -1.7 pp |
| Urban | 1.0% | 0.4% | 0.2% | -0.5 pp | -0.8 pp |
| Lower income | 0.7% | 0.5% | 0.5% | -0.2 pp | -0.2 pp |
| Higher income | 1.0% | 0.4% | 0.2% | -0.6 pp | -0.8 pp |
| National | 1.1% | 0.5% | 0.2% | -0.6 pp | -0.9 pp |
| Lower income | 0.6% | 0.6% | 0.7% | 0.0 pp | 0.2 pp |
| Higher income | 1.1% | 0.5% | 0.2% | -0.7 pp | -1.0 pp |

Source: Guatemala CGE model results. Households are divided into two groups: lower-income households (bottom 40% of the income distribution, i.e., the bottom two quintiles) and higher-income households (top 60%, i.e., the upper three quintiles).

Table 8 decomposes the changes in consumption into changes in food and non-food components. The aggregate change in consumption at the household level resembles the change in income discussed earlier. There is, however, a notable distinction between the consumption responses for food and non-food products. Under MIG-0, remittance inflows and domestic economic adjustments associated with the reference migration pattern lead to larger gains in non-food consumption than in food consumption. This pattern reflects both the relative scarcity of food and agricultural products—as the agricultural sector stagnates due to substantial net outmigration (Table 5)—and the lower income elasticity of food products compared with non-food items as incomes rise.

Since non-food consumption expands most under the reference migration scenario, a slowdown in outmigration from Guatemala and an increase in return migration may lead to a significant reversal of these consumption gains, relative to the more stable response observed for food consumption. In the case of the severely restricted migration scenario (MIG-2), national non-food consumption increases by 1.2 pp less than in MIG-0. The decline in consumption growth in rural areas is roughly twice that observed in urban areas. This is because the forgone remittances resulting from reduced outmigration and rapid return migration in rural areas are not fully offset by the limited recovery of the agricultural sector, which grows by only 0.4-0.7 pp under the restrictive migration

scenarios—compared with a 1.0–1.7 percentage point increase in manufacturing growth, a largely urban sector—relative to the MIG-0 scenario.

Table 8: Changes in commodity consumption (food and non-food) by household group

| | Percentage change from baseline | | | Point deviations from MIG-0 | |
|---|---|---|---|---|---|
| | MIG-0 | MIG-1 | MIG-2 | MIG-1 | MIG-2 |
| Rural | 1.4% | 0.6% | 0.2% | -0.8 pp | -1.2 pp |
| Food commodities | 0.5% | 0.3% | 0.2% | -0.3 pp | -0.3 pp |
| Non-food commodities | 2.0% | 0.8% | 0.3% | -1.2 pp | -1.7 pp |
| Urban | 1.0% | 0.5% | 0.3% | -0.5 pp | -0.6 pp |
| Food commodities | 0.2% | 0.3% | 0.4% | 0.1 pp | 0.2 pp |
| Non-food commodities | 1.2% | 0.5% | 0.3% | -0.7 pp | -1.0 pp |
| National | 1.1% | 0.5% | 0.3% | -0.6 pp | -0.8 pp |
| Food commodities | 0.3% | 0.3% | 0.3% | 0.0 pp | 0.0 pp |
| Non-food commodities | 1.4% | 0.6% | 0.2% | -0.9 pp | -1.2 pp |

Source: Guatemala CGE model results.

## 5. Conclusion and Policy Implications

Migration is a central driver of Guatemala's economic, social, and demographic dynamics. Despite its significance, two critical dimensions remain underexplored: the economy-wide effects of migration on sectoral performance and factor markets, and the distributional consequences of both outward and return migration on household welfare. While prior studies have largely focused on remittances and household-level outcomes, the broader macroeconomic and structural implications, as well as the integration of returnees into the labor market, remain less understood. To address these gaps, this study uses detailed microdata on migrant profiles as inputs to calibrate a CGE model, capturing interactions across sectors, factor markets, and households under different migration scenarios. A key innovation is the construction of distinct migrant profiles by skill level and origin, allowing us to capture the heterogeneity of both emigrants and returnees. We simulate three scenarios—a reference migration pattern based on recent historical flows, moderately restricted migration, and severely restricted migration—to reflect both past and ongoing changes in emigration and return migration across skill groups. The analysis explores the resulting general

equilibrium effects on the macroeconomy, sectoral performance, factor markets, remittance flows, and household welfare.

Our results highlight a nuanced trade-off between economic performance and household well-being. The reference migration scenario contributes a modest 0.2 percent growth in GDP, whereas restrictive migration scenarios—net outmigration of 0.6 percent of the labor force (MIG-1) and net return migration of 2.0 percent (MIG-2)—increase GDP by an additional 0.3-0.5 pp. These gains are driven by higher domestic labor availability and a currency depreciation that enhances export competitiveness, offsetting moderate contractions in private consumption due to declining remittances. Sectoral outcomes mirror these dynamics: agriculture and manufacturing contract under the recent-historical migration pattern (MIG-0), while all sectors expand under the restrictive scenarios, particularly non-agro-processing manufacturing followed by cash crops.

We also find noticeable differences in factor market outcomes across the different migration scenarios considered. In line with the GDP performance, both demand for and returns to factors of production rise markedly under the restrictive scenarios compared with the reference migration scenario (MIG-0), suggesting limited risks to factor market stability in Guatemala.

Despite the macroeconomic and sectoral gains observed in the most restrictive migration scenarios relative to the reference scenario, household welfare exhibits a contrasting pattern. Income and consumption growth under the restrictive migration scenarios are substantially lower than under the reference scenario, particularly among households' dependent on remittances, including both higher-income rural and urban households with significant remittance receipts. Nevertheless, total household income remains above the baseline level across all scenarios, indicating that even with reduced remittances, households experience net gains in welfare. This divergence underscores a critical policy challenge: reduced migration can stimulate domestic production and sectoral performance but may simultaneously constrain household welfare among those reliant on external income flows.

Importantly, the observed GDP and sectoral gains are contingent upon the assumption of full employment for high-skilled workers, which underpins the projected domestic productivity enhancements. Realizing such outcomes in practice requires well-designed policies and institutional frameworks that ensure the effective integration of returnees, thereby enabling their

productive contribution to the economy while mitigating potential welfare losses among vulnerable households.

The study findings underscore the need for targeted policy responses to translate the modeled gains into tangible and inclusive outcomes—in particular, to convert macroeconomic gains from migration adjustments into equitable improvements in household welfare—while also highlighting the broader relevance of Guatemala's experience for other remittance-dependent economies in Central America, where similar structural constraints shape the transmission of migration shocks. Effective integration of returnees into the labor market is essential, through skills recognition programs, targeted vocational training, and incentives for private sector absorption. Social protection mechanisms should be strengthened to buffer households against remittance volatility, particularly in rural areas. Finally, policies that promote domestic investment and productive employment can help reconcile the trade-off between macroeconomic growth and household welfare, ensuring that migration shocks—both emigration and return—contribute to sustainable and inclusive development.

In sum, this study demonstrates that migration in Guatemala operates as a double-edged sword, serving both as a catalyst for economic activity and as a source of household vulnerability. By capturing these complex interactions within a single economy-wide framework, the analysis provides actionable insights for policymakers seeking to harness the benefits of migration while mitigating its adverse effects on vulnerable populations.

Looking forward, several avenues for further research merit attention. Future analyses could refine labor market assumptions by disaggregating the workforce, including a distinct category for returnees, which would allow for more precise tracking of targeted interventions. Additionally, differentiated assumptions by age or gender—such as restricting full employment to younger cohorts—could improve model realism. Lastly, the static nature of the CGE framework constrains the evaluation of temporal policy interventions; a dynamic extension would facilitate assessment of transitional effects and the cumulative impact of migration policies over multiple periods.

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## Appendix A. Migration Scenarios and Model calibration

This appendix details the construction of the migration scenarios used in the simulations, including their calibration with recent historical data on flows, skills, and remittances.

### A.1 Empirical flows providing the benchmark for the Migration scenarios

Between 2019 and 2022, Guatemala experienced substantial cross-border mobility. Cumulative estimates suggest that 552,000 Guatemalans migrated to the United States, while 102,000 returnees re-entered the country (Chi et al., 2025). These flows amount to an outmigration of 7.6 percent of the labor force and an inflow of 1.4 percent, resulting in a net outflow of 6.2 percent (Table A.1).

Table A.1. Cumulative migration flows, 2019–2022

| Flow type | Number of persons | Share of labor force (%) |
|---|---|---|
| Outmigration | 552,000 | 7.6 |
| Returnees | 102,000 | 1.4 |
| **Net migration** | **–450,000** | **–6.2** |

Source: Authors' assumptions based on Chi et al. (2025) Guatemala-US flows for 2019-2022 using online data.

Migration patterns exhibit heterogeneity across groups. Using microdata from the 2018 Population and Housing Census of Guatemala (INE, 2018), in combination with regression-based projections, we disaggregate migrants by skill level and area of residence. Empirical analysis indicates that outmigration is predominantly rural and concentrated among low- and medium-skilled workers, whereas return migration is primarily urban and skewed toward individuals with secondary and tertiary education (over 50%). Table 1 in the main manuscript reports the distributional parameters applied in the simulation scenarios to operationalize migration flows.

Finally, based on these cumulative migration flows under the reference scenario (MIG-0), we derive scenarios MIG-1 and MIG-2, in which adjustments to migration volumes are assumed. In MIG-1, outflows are halved and inflows are doubled, whereas in MIG-2, outflows decrease by one-third and inflows triple (see Table A.3 for final net migration flows). MIG-1 is referred to as

the moderately restrictive or low migration scenario and MIG-2 as the severely restricted or net-return scenario.

### A.2. Remittance calibration providing the benchmark for the Migration scenarios

Migration dynamics are closely intertwined with remittance flows, a critical income source for Guatemalan households. Orozco and Klaas (2021) estimate that migrants from Latin America and the Caribbean region remit on average just over USD 2,600 annually, with around 50 percent of migrants sending remittances. In addition, returnees generally bring new skills, while out-migrants, especially high skilled migrants are consumers that can boost local economies in their host countries (IADB, 2024). Building on this, we differentiate remittance levels by education: USD 1,800 for the least educated, between USD 2,000 and USD 2,500 for medium skill, and USD 3,000 for the highly educated (Table A.2). These assumptions are also consistent with a total inflow of over USD 15 billion in remittances received by Guatemala in 2022 (IFPRI, 2024).

Table A.2. Remittance assumptions by skill level

| Skill level | Annual remittance (USD) |
|---|---|
| No education | 1,800 |
| Primary education | 2,000 |
| Secondary education | 2,500 |
| Tertiary education | 3,000 |

Source: Authors' assumptions based on Orozco and Klaas (2021).

The integration of remittances ensures that migration shocks not only alter domestic labor supply but also external income transfers. Depending on the net balance of flows, total remittances shift by +5.5 percent under MIG-0, +0.6 percent under MIG-1, and –2.0 percent under MIG-2. These adjustments are embedded simultaneously with labor shocks, reinforcing the macro-micro transmission channels of the model (Table A.3).

Table A.3. Final migration scenarios: net flows and remittance shocks

| Scenario | Outflow (% labor force) | Inflow (% labor force) | Net migration (%) | Remittance change (%) |
|---|---|---|---|---|
| MIG-0 | 7.6 | 1.4 | –6.2 | +5.5 |
| MIG-1 | 3.8 | 2.8 | –1.0 | +0.6 |
| MIG-2 | 2.5 | 4.2 | +1.7 | –2.0 |

Source: Authors' assumptions.

## Appendix B. Operationalization of migration scenarios and model assumptions

The inflow and outflow estimates under scenarios MIG-0 to MIG-2 for Guatemala, combined with the assumed remittance levels, feed into a "Net Migration Shock" that triggers two main domestic channels: migrant outflows reduce the labor force, while migrant inflows augment it. These changes lead to labor market adjustments that propagate to output and sectoral production, ultimately affecting factor incomes. In parallel, remittance inflows—an external source of income that varies with the skill composition of migrants—directly affect household income.

Figure B.1 illustrates how our economy-wide modeling framework captures sectoral interlinkages by connecting production and consumption activities through economic interactions taking place in both factor and product markets, which operate following basic economic principles. In this study, the model is calibrated into Guatemala's economy using the 2021 Social Accounting Matrix (SAM) database adapted from IFPRI (2024). We disaggregate production activity into 66 economic sectors, comprising 19 in agriculture, 35 in industry, and 12 in services. Households are distinguished not only by rural and urban location but also by income level (deciles). The factor markets are disaggregated into three major factors—land, labor, and capital. Labor is further divided into eight categories, distinguishing between rural and urban areas and across four educational levels (uneducated, primary, secondary, and tertiary) (see Appendix C for the full model disaggregation). Labor supply and its allocation across different skill categories are the main levers used to design the simulation scenarios presented in Section 3 of the paper. Specifically, exogenous shocks to labor supply are introduced through migration flows —both inflows and outflows —altering the initial stocks of workers by skill type and location.

The economy-wide model incorporates these shocks through two channels: (i) labor supply adjustments, and (ii) remittance flows.

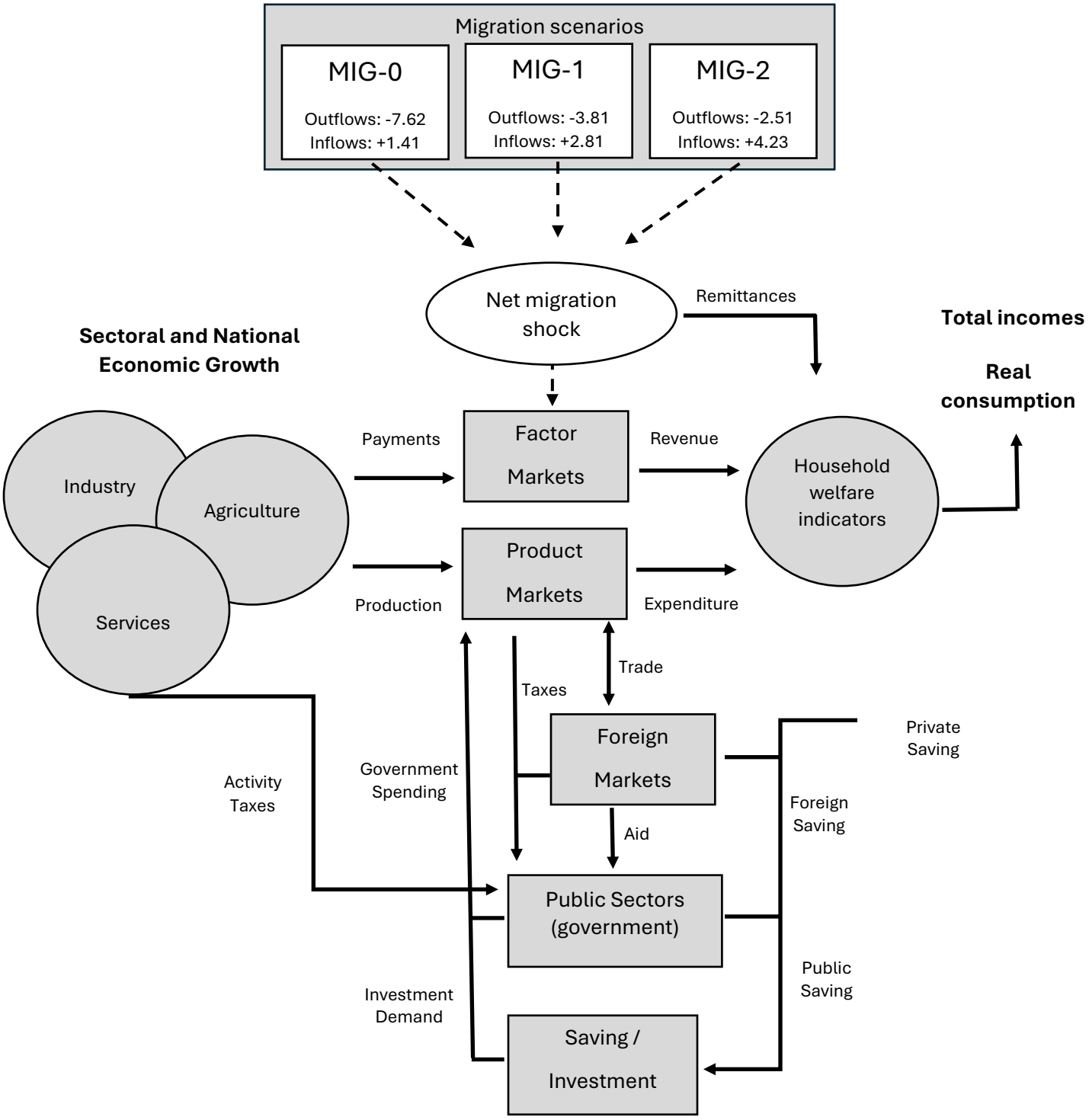
**Channel 1: Labor supply adjustments.** Migration outflows reduce the domestic labor force, while return inflows increase it. These changes primarily affect factor markets, especially labor, which in turn influence sectors with high labor intensity, such as agriculture and labor-intensive services. The adjustments in labor supply also directly impact households, particularly those receiving a larger share of their income from wages. As a result, changes in labor availability are transmitted to sectoral production levels, affecting total output, incomes, and ultimately household welfare indicators.

**Channel 2: Remittance flows.** Household transfers from abroad, capturing scenario-specific remittance changes, directly affect the disposable income of households. This additional income influences household consumption patterns, which in turn feed back into product markets, affecting demand for goods and services. In this way, changes in consumption can amplify the effects of labor supply shifts on sectoral output and generate broader impacts on aggregate economic activity.

Both channels ultimately transmit to the government, foreign, and saving/investment sectors, amplifying the effects of migration beyond the initial shock. Higher household incomes from remittances or increased labor supply can raise tax revenues, alter government expenditure, and influence private and public savings and investment, thereby generating economy-wide repercussions on sectoral output, household welfare, and aggregate growth.

Finally, both shocks—changes in labor supply and remittance inflows—are applied simultaneously to ensure internal consistency and to capture their joint impact on the economy. Model outcomes under scenarios MIG-0, MIG-1, and MIG-2 are compared both against the baseline economy (without additional mobility) and against one another. This dual comparison allows us to isolate the distributional and macroeconomic effects of alternative migration scenarios and to evaluate the extent to which migration flows shape household welfare and sectoral and national economic performance.

Figure B1: Transmission channels and operationalization of migration scenarios in the model




Source: Authors elaboration.

**Appendix C: Model disaggregation by input factors, households, and production sectors.**

**Input factors:**

| Code | Labor Description |
|---|---|
| flab-rn | Labor - rural uneducated |
| flab-rp | Labor - rural primary |
| flab-rs | Labor - rural secondary |
| flab-rt | Labor - rural tertiary |
| flab-un | Labor - urban uneducated |
| flab-up | Labor - urban primary |
| flab-us | Labor - urban secondary |
| flab-ut | Labor - urban tertiary |
| flnd | Land - agricultural crops |
| fcap-c | Capital - crops |
| fcap-l | Capital - livestock |
| fcap-m | Capital - mining |
| fcap-o | Capital - other |

**Economic sector aggregates:**

| No. | Code | Sector Description |
|---|---|---|
| 1 | acrop | Food crops |
| 2 | acash | Cash crops |
| 3 | alive | Livestock |
| 4 | amin | Mining |
| 5 | afood | Food processing |
| 6 | aman | Other manufacturing |
| 7 | apub | Government services |
| 8 | aser | Private services |

**Household types:**

| Code | Household Description |
|---|---|
| hhd-r1 | Rural – decile 1 |
| hhd-r2 | Rural – decile 2 |
| hhd-r3 | Rural – decile 3 |
| hhd-r4 | Rural – decile 4 |
| hhd-r5 | Rural – decile 5 |
| hhd-r6 | Rural – decile 6 |
| hhd-r7 | Rural – decile 7 |
| hhd-r8 | Rural – decile 8 |
| hhd-r9 | Rural – decile 9 |
| hhd-r10 | Rural – decile 10 |
| hhd-u1 | Urban – decile 1 |
| hhd-u2 | Urban – decile 2 |
| hhd-u3 | Urban – decile 3 |
| hhd-u4 | Urban – decile 4 |
| hhd-u5 | Urban – decile 5 |
| hhd-u6 | Urban – decile 6 |
| hhd-u7 | Urban – decile 7 |
| hhd-u8 | Urban – decile 8 |
| hhd-u9 | Urban – decile 9 |
| hhd-u10 | Urban – decile 10 |

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