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Do Immigrants Bring Fiscal Dividends? The Case of Venezuelan Immigration in Colombia

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Abstract[*]

This paper analyzes the effects of recent Venezuelan immigration to Colombia on the fiscal balance, the labor market, and economic growth. For this purpose, we built a dynamic general equilibrium model with a search and matching structure in the labor market. The higher fiscal spending to address immigration negatively impacts the government's budget in the short term, which is offset by higher output, consumption, and employment level, increasing the government's revenues mainly through indirect tax collection. The effect on the labor market is different for unskilled workers–whose higher supply generates a negative effect on wages and an increase in the unemployment rate–and skilled workers, who benefit from higher wages and lower unemployment. These changes in the labor market affect the government's revenue, resulting, in the long term, in positive fiscal dividends of migration.

JEL Codes: E62,J61,H24
Keywords: fiscal policy, labor market, migration, unemployment

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1. Introduction

International migration has grown and transformed in recent decades due to globalization, armed conflicts, and socioeconomic conditions at the international level, which have had economic, social, and cultural implications in countries of origin and destination alike. There is a vast body of literature on the economic and sociological aftermath of migration—its short, medium, and long-term effects, as well as the public policy aspects that should be considered to tackle this issue. While previous studies have addressed the fiscal effects of migration on host countries' economies, there has been considerable debate about the capacity of immigrants to generate tax revenues. This issue merits further study, because migration leads to sharp increases in the demand for social services and the allocation of expenditures to address the needs of the immigrant population in host countries.

Empirical evidence has found that this fiscal asymmetry, that is, the increase in the demand for social services and reduced tax revenue coming from immigrants, does not occur in the same way in all migration flows. Furthermore, the individual decision to emigrate plays an important role. The literature on migration identifies two types: voluntary and forced. While voluntary migration is the result of decisions taken over a longer period and entails investment decisions and long-term consumption in the host country, forced migration occurs when conditions in the expelling country leave inhabitants no choice but to depart.

For the reasons mentioned above, empirical evidence shows that voluntary migration tends to flow to advanced countries, whereas those who forcibly migrate tend to settle in neighboring countries, and that a positive fiscal effect is positively correlated with migrants' skill level. For example, Storesletten (2003) provides evidence for Sweden that immigrants generate a net positive fiscal effect because the labor market absorbs the shock with higher vacancies and participation rates. Chojnicki, Docquier, and Ragot (2011) show positive impacts in France because migration flows of younger workers reduce fiscal pressures on the social security system. Dustmann and Frattini (2014) study the fiscal impact of immigration in the United Kingdom and find a net positive effect for immigrants from the European Economic Area (EEA) and a net negative effect for non-EEA immigrants.

In the case of Colombia, the Colombian Ministry of Finance and Public Credit (2019) found that Venezuelan migration is a considerable fiscal shock because of its impact on the unemployment rate and the need to provide additional public goods associated with migrants flows. Migration increases the overall unemployment rate while fostering economic growth due to an increasing demand generated by immigrants and government expenditure in response to the social requirements of migrants. However, this analysis does not

differentiate the impact of migration on wages of skilled versus unskilled labor. Furthermore, Tribin-Uribe et al. (2020) show that the aggregate macroeconomic impacts of Venezuelan migration in Colombia are small in terms of inflation and, therefore, they do not require a monetary policy response. However, they do cause changes in the unemployment rate and the aggregate participation rate.

Conversely, forced migration usually flows to neighboring countries, as exemplified by the exodus of segments of the Syrian, Lebanese, Jordanian, and Venezuelan populations. Moreover, the sudden exogenous shocks created by forced migration are different from the voluntary migration events due to the socioeconomic similarities among the destination countries and the countries of origin. In such economies, fiscal capacity is limited, and the shock increases demand for public goods and services in destination countries. Although the literature has previously addressed the fiscal effects of migration flows in advanced economies, which tend to be voluntary, the fiscal effects of forced migration on emerging destination economies is unexplored. This paper seeks to contribute to the literature on the fiscal impact of migration shocks in emerging economies and to enrich migration studies by analyzing the economic effects of forced migration.

Specifically, this paper analyzes the fiscal dividend of the Venezuelan migration shock in Colombia, measured as the difference between the fiscal contributions of migrants and public spending on them. The model shows direct and indirect effects from the shock captured in general equilibrium and the direct fiscal impact generated by increased public expenditure. Furthermore, it shows the impact on fiscal revenues due to the demographic effect on the economy and the indirect effect created by the labor market's recomposition, investment, and output after the shock.

To achieve this, we build a dynamic general equilibrium model that contains two main features. First, the model considers agent heterogeneity by type of skill and residence. In equilibrium, unemployment rates are heterogeneous and endogenously determined, capturing the labor market's migratory flow dynamics. Second, it includes fiscal variables such as government expenditure allocated to meet the needs of the migrant population and fiscal contributions. It also incorporates distortionary taxation—direct and indirect–into the model to evaluate the endogenous response in terms of revenues.

The findings show that that the migration shock generates positive albeit small effects on aggregate variables such as output, consumption, and investment. The aggregate unemployment rate is persistent in the medium term. Moreover, the model simulates the potential path of government spending on migrant needs in the medium term and computes

the transitional dynamics of tax revenues. The paper finds that the economy initially experiences a large deficit which decreases over time. Consequently, the simulations suggest that indirect tax revenues can rise around 1 percent of GDP per year, reducing the deficit over time.

This fiscal contribution is possible due to the recomposition of the labor market. Hum and Simpson (2004) find that immigrants enter the labor market and replace part of the local supply, but with lower average wages than native-born workers. Similarly, Tribin-Uribe et al. (2020) show that Venezuelan migration to Colombia impacted immigrants' unemployment and has effects on the global participation rate. Consistent with this finding, the literature has shown that these lower salaries are explained to a large extent by the self-employment assumed by many of the immigrants when they enter the labor market.[4] One of the reasons for this is the complexity of finding an immigrant employee by the employer. As Beladi and Kar (2015) argue, information asymmetries do not allow employers to find employees within the migrant population. Likewise, immigrants face constraints in accessing the health system and public services, which, in turn, affect their adaptation and lead to a predominant vulnerability (Somerville and Sumption, 2009).

However, these results differ depending on the skill level of the migrant population. When immigrants are highly skilled, the local labor market is less affected than when migrants are unskilled (Vargas-Vila, 2014). In addition, unemployment for unskilled labor is more volatile than for the skilled labor market (Dustman, Glitz, and Vogel, 2010). This effect depends directly on the elasticity of substitution between migrant and local workers and the between skilled and unskilled workers. This paper follows a similar approach by adding skilled and unskilled labor but analyzing how taxation affects labor participation rates. Our findings show an increase in tax collection due to migration.

In our model, labor frictions and taxes enable an analysis of the how the migration shock and the marginal effect of distortionary taxation affect equilibrium unemployment rates. This yields a more accurate analysis than Storesletten (2003) and Dustmann and Frattini (2014), where relative prices are constant and in partial equilibrium.

Unlike Chojnicki, Docquier, and Ragot (2011) and Tribin-Uribe et al. (2020), which do not differentiate between skilled and unskilled workers, we evaluate the unskilled migrant population shock. We find that there are medium-term benefits for skilled immigrants and

[4] Some papers related to this perspective are Andersson and Hammarstedt (2010), Bates (1997), Clark and Drinkwater (2000), Constant and Zimmermann (2006), Fairlie and Meyer (1996), Kidd (1993), Razin, (1992), Robson (1998), and Yuengert (1995).

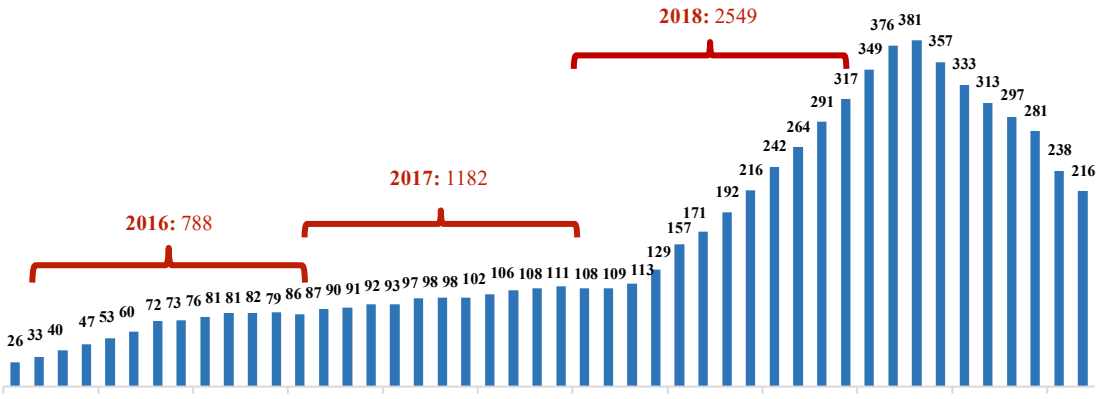
native-born workers in terms of higher wages and lower unemployment rates. Given its structure, our model cannot highlight the positive demographic effect on fiscal balance, as do those of Storesletten (2003) and Chojnicki, Docquier, and Ragot (2011).

This paper is organized as follows. Section 2 presents the main stylized facts of the immigration process in Colombia. Section 3 presents the model, and Section 4 explains its main parameters and calibration of the variables. Section 5 presents the results of the immigration shock simulation and the impact on the fiscal variables. Sections 6 concludes.

2. Stylized Facts about Venezuelan Immigration and the Labor Market in Colombia

In emerging economies, the Venezuelan exodus has been one of the most significant migration shocks. According to the UN Refugee Agency (UNHCR), Colombia is currently the second-largest (1.8 million) destination country in the world after Turkey (3.6 million) (UNHCR, 2019). Venezuelan immigrant flow has increased by 330 percent in less than four years (Figure 1).

Figure 1. Total Arrivals of People from Venezuela to Colombia *(in thousands)*



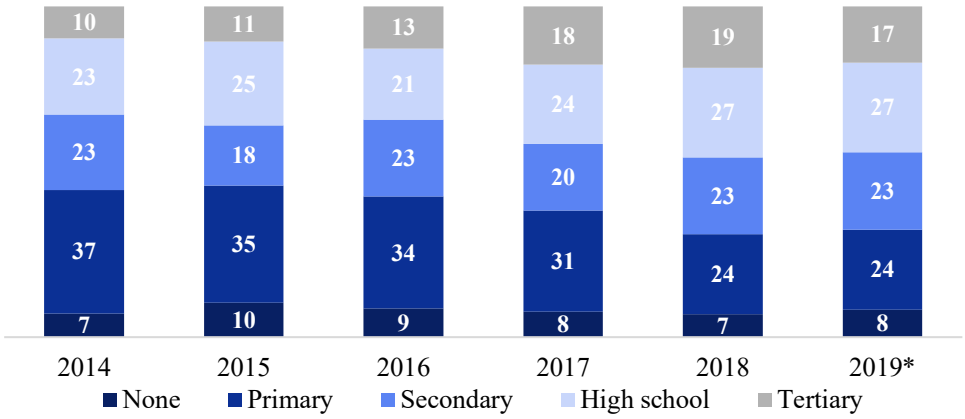
Source: Migración Colombia (2020).

2.1. Skill Level of Immigrants

Leading labor indicators show that the skill level of immigrants has changed in recent years. In 2018, the percentage of workers without education more than doubled compared to the previous year, and the percentage of immigrants who had completed tertiary education fell by 5 percent. Moreover, most immigrants have completed high school (Figure 2).

Figure 2. Venezuelan Immigrants that Arrived One Year Ago by Highest Education Level Achieved

(as a share of the total population)

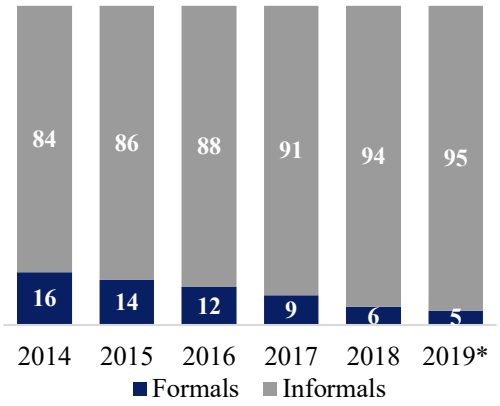


Source: GEIH-DANE. Migration module. *12-month moving average until September 2019.

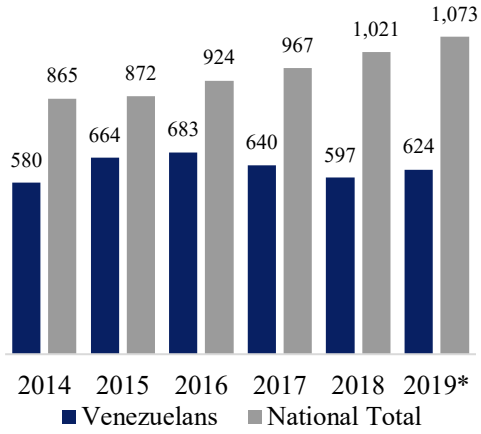
Immigrants are concentrated in the informal sector. On average, 80 percent of the Venezuelan workforce is informal, and their average wages were 34 percent below the average wage of Colombian workers between 2014 and 2018 (Figure 3).

Figure 3. Immigrants' Formality and Income

Panel A. Share of Venezuelans in the Formal or Informal Sector (share of employed population)



Panel B. Average Labor Income (current $COP X 1000)



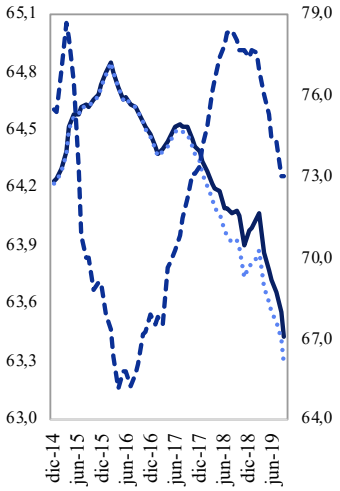
Source: GEIH-DANE. Migration module. *12-month moving average until September 2019.

2.2. Share of Immigrants in the Labor Supply

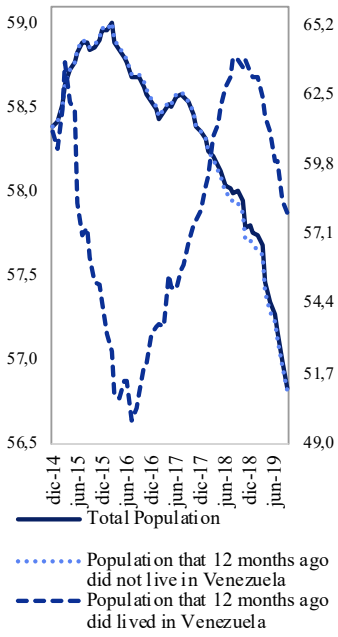
The share of immigrants in the labor supply has steadily increased, surpassing Colombians nationally. The number of employed Venezuelan workers is growing, while that of Colombians is falling. Additionally, the unemployment rate for foreigners remains at 19 percent, while locals are around 9.5 percent. In general, both the overall labor participation rate and the unemployment rate are U-shaped, which corresponds with the fall in oil prices and an exacerbation of the crisis in Venezuela, increasing the inflow of immigrants (Figure 4).

Figure 4. Labor Market Dynamics of Immigrants and Non-immigrants

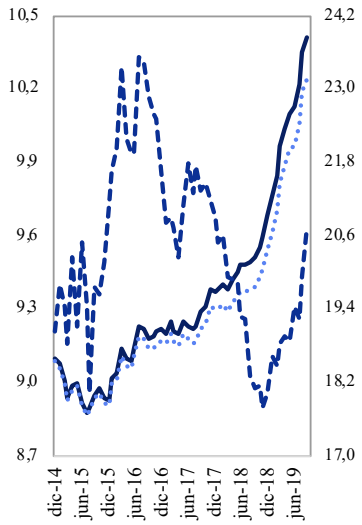
Global participation rate
(percentage)



Employment rate
(percentage)



Unemployment rate
(percentage)



Source: GEIH-DANE. Migration module. *12-month moving average until September 2019

2.3. Fiscal Response to Migration

The arrival of the vulnerable immigrant population exerted significant fiscal pressures on the national government. On the one hand, it allocated nearly US$426 million to immediate assistance: US$143 million for humanitarian aid to meet the immigrants' basic needs and US$291 million for family assistance, according to the Colombian Ministry of Finance and Public Credit (2019). On the other hand, there was an increase in public spending of US$1.583 billion allocated to the health system (US$639 million), education (US$787 million), and housing ($157 million). Thus, the government designated a total of US$2.171 billion for assistance and provision of services to the migrant, representing an additional expenditure of about 0.6 percent of GDP.

3. The Model

3.1. The Economy

The economy counts two types of households: local and foreign, and each household has individuals that can be skilled or unskilled. A representative firm uses capital, skilled labor,

and unskilled labor to produce output. Finally, the government uses tax revenues and public debt to finance its expenditures. This model follows the search and matching structure of Diamond-Mortensen-Pissarides (DMP), with two additional features: immigration flows and fiscal policy.

3.2. Population Dynamics

The total population of the economy is N_t composed of local and foreign agents, so that $N_t = N_{H,t} + N_{F,t}$, where the subscript H and F denote whether the population is local or foreign, respectively. Each household has a skilled and unskilled population so that, $N_t = N_t^s + N_t^u$ where the superscripts s and u denote the skilled and unskilled population, respectively. The fraction $\Omega_t = N_{H,t}/N_t$ represents the share of local agents in the total, while $(1 - \Omega_t) = N_{F,t}/N_t$ is the share of foreign agents in the economy's population. In addition, the variable $\emptyset_{j,t} = N_{j,t}^s/N_{j,t}$ denotes the proportion of skilled labor within each household j and therefore $(1 - \emptyset_{j,t}) = N_{j,t}^u/N_{j,t}$ denotes the proportion of unskilled labor. It is assumed that there is no population growth within the local population, implying that the growth rate $(g_{H,t} = N_{H,t}/N_{H,t-1})$ is constant over time $g_{H,t} = g_H = 1$. The term g_t refers to the rate of total population growth that can change over time, as the foreign population may vary due to migration. Thus, population growth is defined by:

$$g_t = g_{H,t}\,\Omega_t + g_{F,t}(1 - \Omega_t)$$

In any period, the economy could receive a transitory migration shock; we describe the population behavior as follows:

$$N_{F,t}^u = \rho\overline{N_F^u} + (1 - \rho)N_{F,t-1}^u + mig_t$$

where $\overline{N_F^u}$ is the steady state of the unskilled foreign population. Besides, immigration is defined as:

$$mig_t = \rho_{mig}\overline{mig} + (1 - \rho_{mig})mig_{t-1} + \varepsilon_{mig,t}$$

where $\overline{mig}$ is stationary state migration. In particular, it is defined as $\overline{mig} = 1$.

3.3. Matching Technologies

Following the DMP structure, the model displays frictions in the labor market. This implies that not all vacancies opened by firms are filled by workers who are willing to work for the equilibrium wage or that all workers willing to work for the established wage find a job. Thus, the equations that define the matching functions are:

$$P_{j,t}^{i} = \overline{\mu_j^{i}}(\theta_{j,t}^{i})^{1-\eta}$$
$$\mu_{j,t}^{i} = \overline{\mu_j^{i}}(\theta_{j,t}^{i})^{-\eta}$$

$P_{j,t}^{i}$ is the probability that an unemployed person in household j according to skill i will find employment in the period t. Let $\mu_{j,t}^{i}$ the probability that the firm will fill a vacancy for the specific sector (j,i). $\overline{\mu_j^{i}}$ is efficiency parameter in the matchmaking process for each type of i worker within each j household. Additionally, these functions depend on $\theta_{j,t}^{i} ji$, which defines each type of workers' market slackness. The slackness condition is defined by:

$$\theta_{j,t}^{i} = \frac{V_{j,t}^{i}}{\left(N_{j,t}^{i} - H_{j,t}^{i}\right)}$$

This implies that, if $\theta_{j,t}^{i}$ increases, the market is less flexible, and therefore an unemployed person is more likely to find work; on the contrary, if $\theta_{j,t}^{i}$ decreases, a firm is more likely to be able to fill one of the open vacancies.

3.4. Households

As previously mentioned, there are two types of households: local and foreign, and each household has skilled and unskilled members. Households obtain utility from consumption $C_{j,t}$, and disutility by offering labor $H_{j,t}$ where $j = (H, F)$. The locals are the firms' owners and receive its benefits, while foreigners receive a government transfer only when they enter the country. Both households can invest in government bonds $B_{j,t}$, which are used to transfer consumption over time. The following lifetime utility represents the preferences:

$$U_t = E_0 \sum_{t=0}^{\infty} \beta^t \left[ln\left(C_{j,t}\right) - \frac{\varphi H_{j,t}^{1+\gamma}}{1+\gamma} \right] \quad (1)$$

where $\beta\epsilon(0,1)$ is the subjective discount factor and φ is a constant that represents the weight of labor's disutility, which is the same for both households. The total local labor is given by:

$$H_{j,t} = H_{j,t}^{s} + H_{j,t}^{u}\,; \quad j = (H,F)$$

where $H_{j,t}^{s}$, and $H_{j,t}^{u}$ denotes the skilled and unskilled labor supply.

Households have a symmetrical utility function. However, their budget constraints vary across households. The intertemporal budget for local households is:

$$C_{H,t}(1+\tau^{c}) + B_{H,t+1} \leq w_{H,t}^{s}H_{H,t}^{s}(1-\tau_{H}^{s}) + w_{H,t}^{u}H_{H,t}^{u}(1-\tau_{H}^{u}) + \Pi_{t} + r_{H,t}B_{H,t} + G_{H} \quad (2)$$

where τ^{c} is the consumption tax, and τ_{H}^{i} is the labor tax of each type of worker $i = (s,u)$. We define $w_{H,t}^{i}$ as the corresponding salary, Π_{t} are the firms' profits, $r_{H,t}$ is the interest rate on government bonds, and G_{H} is a government's lump-sum transfer to local households. The budget constraint for foreign households is given by:

$$C_{F,t}(1+\tau^{c}) + B_{F,t+1} \leq w_{F,t}^{s}H_{F,t}^{s}(1-\tau_{F}^{s}) + w_{F,t}^{u}H_{F,t}^{u}(1-\tau_{F}^{u}) + r_{F,t}B_{F,t} + G_{F} + S_{mig,t} \quad (3)$$

where $S_{mig,t}\ is$ the government's transfer to the migrant household in period t. The employment dynamics for both types of households are as follows:

$$H_{j,t+1}^{i} = (1-\chi)H_{j,t}^{i} + P_{j,t}^{i}\left(N_{j,t}^{i} - H_{j,t}^{i}\right), \qquad i = (s,u); j = (H,F)$$

where $\chi\epsilon(0,1)$ is the labor separation rate, which corresponds to the share of employees who lose their jobs from one period to another. Hence, the employed workers of household j, of type i, in the period $t+1$ were those workers who did not lose their jobs in the preceding period, plus the unemployed workers $\left(N_{j,t}^{i} - H_{j,t}^{i}\right)$ who manage to get employment with a probability $P_{j,t}^{i}$.

Household's problem

The household optimization problem is to choose $\{c_{j,t}, b_{j,t}, h^i_{j,t+1}\}^{\infty}_{t=0}$ for $i = (s,u)$ and $j = (H,F)$ such that it maximizes its intertemporal utility per capita, taking the prices of factors $\{w^i_{j,t}, r_{j,t}\}^{\infty}_{t=0}$, the benefits of the firms $\{\Pi_t\}^{\infty}_{t=0}$, the probabilities of finding employment $\{p^i_{j,t}\}^{\infty}_{t=0}$, and the initial conditions on $\{h^i_{j,0}\}$ given for $i = (s,u)$ and $j = (H,F)$. Consider that the equation of employment evolution implies that the household chooses the consumption, bonds, and working individuals that offer labor in *t*+1, taking the current labor as a state variable. Let us define $V_j(.)$ as the household value function. The recursive representation of the household problem in per capita terms is:

$$V_j\left(b_{j,t}, h^s_{j,t}, h^u_{j,t}\right) = \max_{\{c_{j,t}, b_{j,t}, h^i_{j,t+1}\}^{\infty}_{t=0}} \left\{u_t + \beta E_t V_j\left(b_{j,t+1}, h^s_{j,t+1}, h^u_{j,t+1}\right)\right\} \tag{4}$$

subject to

$$c_{H,t}(1+\tau^c) + b_{H,t+1} \leq w^s_{H,t} h^s_{H,t}(1-\tau^s_H) + w^u_{H,t} h^u_{H,t}(1-\tau^u_H) + \pi_t + r_{H,t} b_{H,t} \tag{5}$$

and for the immigrants:

$$c_{F,t}(1+\tau^c) + b_{F,t+1} \leq w^s_{F,t} h^s_{F,t}(1-\tau^s_F) + w^u_{F,t} h^u_{F,t}(1-\tau^u_F) + r_{F,t} b_{F,t} + s_{mig,t} \tag{6}$$

Moreover, the law of motion for the skilled employment is given by:

$$h^s_{j,t+1} g_{j,t+1} = (1-\chi) h^s_{j,t} + P^s_{j,t}\left[\emptyset_{j,t} - h^s_{j,t}\right] \qquad j = (H,F) \tag{7}$$

Symmetrically, the law motion for unskilled employment is:

$$h^u_{j,t+1} g_{j,t+1} = (1-\chi) h^u_{j,t} + P^u_{j,t}\left[(1-\emptyset_{j,t}) - h^s_{j,t}\right] \qquad j = (H,F) \tag{8}$$

where $c_{j,t} = C_{j,t}/N_{j,t}$, $h^i_{j,t} = H^i_{j,t}/N_{j,t}$, $b_{j,t} = B_{j,t}/N_{j,t}$, $\pi_t = \Pi_t/N_{H,t}$, $s_{mig,t} = S_{mig,t}/N_{F,t}$ denotes percapita variables for each type of households j. $g_{j,t} = N_{j,t}/N_{j,t-1}$ is the population growth rate for each type of household.

The Euler equation for each type of household is given by:

$$E_t\left[\frac{c_{j,t+1}}{c_{j,t}}\right] = \beta E_t\left[\frac{r_{j,t+1}}{g_{j,t+1}}\right]; \qquad j = (H, F) \tag{9}$$

Equation 10 is the standard smoothing condition for the household. Equation 11 is the first-order condition for the labor supply by type of labor and household $i = (s, u) j = (H, F)$:

$$V_{h^i_{j,t}} = -\varphi h^{\gamma}_{j,t} + \frac{w^i_{j,t}\left(1-\tau^i_j\right)}{c_{j,t}(1+\tau^c)} + \beta E_t\left\{\left(\frac{1}{g_{j,t+1}}\right) V_{h^i_{j,t+1}}\left[(1-\chi) - P^i_j\right]\right\}; \quad i = (s, u), j = (H, F) \tag{10}$$

We highlighted two effects. The first is a static margin where direct and indirect taxation and compensation reduce incentives to offer labor supply. Second, there is a dynamic margin in which there is a positive effect on the labor supply of finding a job or maintaining the current job.

3.5. Firms

There is a representative firm that uses capital, skilled, and unskilled workers to produce a single consumer good (see Krusell et al. (2000)):

$$Y_t = A\left\{\sigma(H^u_t)^{\alpha} + (1-\sigma)[\rho(A^k K_t)^{\nu} + (1-\rho)(H^s_t)^{\nu}]^{\frac{\alpha}{\nu}}\right\}^{\frac{1}{\alpha}} \tag{11}$$

where $A > 0$ and $A^k > 0$ are the total factor productivity and capital-augmenting technology. Meanwhile, α and ν are the substitution elasticity between factors and $\sigma > 0, \rho < 1$ are the factor shares within the production function. K_t is the amount of capital used by the firm, while H^s_t and H^u_t are the skilled and unskilled labor that the firm uses as inputs.

The total unskilled and skilled labor is a simple aggregation between local and foreign workers:

$$H^u_t = H^u_{H,t} + H^u_{F,t}\,; \quad H^s_t = H^s_{H,t} + H^s_{F,t}$$

This implies that, for the firm, local and foreign workers are perfect substitutes. Therefore, the firm would only discriminate in terms of productivity between skilled and unskilled workers.

To employ any type of worker, the firm can open any vacancies $V_{j,t}^{i}$ at a specific cost q_j^i for each type of worker. The number of employed workers evolves as:

$$H_{j,t+1}^{i} = (1-\chi)H_{j,t}^{i} + \mu_{j,t}^{i}V_{j,t}^{i}; \qquad i = (s,u), j = (H,F) \tag{12}$$

For the total number of workers employed in $t+1$ for each household type i, j is equivalent to the mass of workers who keep their jobs plus the vacancies filled in period t. The firm owns the capital, and hence there is an adjustment cost. We follow the standard quadratic specification form (see Hayashi, 1982). Then, the law motion of capital is given by:

$$K_{t+1} = I_t - \frac{\kappa}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t + (1-\delta)K_t \tag{13}$$

By transforming the problem to per capita terms, dividing each variable into the total population of the economy (N_t), the firm's problem is:

$$\max_{\left\{k_{t+1}, v_{j,t}^{i}\right\}} \quad E_0 \sum_{t=0}^{\infty} \left(\frac{1}{1+r_t}\right)^t [\pi_t]$$

where

$$\pi_t = y_t - w_{H,t}^{s}L_{H,t}^{s} - w_{H,t}^{u}L_{H,t}^{u} - w_{F,t}^{s}L_{F,t}^{s} - w_{F,t}^{u}L_{F,t}^{u} - v_{H,t}^{s}q_H^{s} - v_{H,t}^{u}q_H^{u} - v_{F,t}^{s}q_F^{s} - v_{F,t}^{u}q_F^{u} - I_t \tag{14}$$

subject to

$$k_{t+1}g_{t+1} = i_t - \frac{\kappa}{2}\left(\frac{i_t}{k_t} - \delta\right)^2 k_t + (1-\delta)k_t \tag{15}$$

$$L_{j,t+1}^{i}g_{t+1} = (1-\chi)L_{j,t}^{i} + \mu_{j,t}^{i}v_{j,t}^{i}; \qquad i = (s,u), j = (H,F) \tag{16}$$

$$y_t = A\left\{\sigma(L_t^u)^{\alpha} + (1-\sigma)[\rho(A^k k_t)^{\nu} + (1-\rho)(L_t^s)^{\nu}]^{\frac{\alpha}{\nu}}\right\}^{\frac{1}{\alpha}} \tag{17}$$

where $y_t = \frac{Y_t}{N_t}, v_{j,t}^{i} = \frac{V_{j,t}^{i}}{N_t}, i_t = \frac{I_t}{N_t} k_t = \frac{K_t}{N_t} L_{j,t}^{i} = \frac{H_{j,t}^{i}}{N_t}$, denote the variables per capita and q_j^i is the cost of opening a vacancy for household type i, j.

Firm's optimality conditions

The problem of the representative firm is to choose $\{k_{t+1}, L^i_{j,t}, v^i_{j,t}, i_t\}^{\infty}_{t=0}$ such that it maximizes the present value of its lifetime profits, taking as given the factor prices $\{w^i_{j,t}, r_{j,t}\}^{\infty}_{t=0}$, the probabilities of filling a vacancy $\{\mu^i_{j,t}\}^{\infty}_{t=0}$ and the initial conditions $\{h^i_{j,0}\}$ and for $i = (s,u)\ j = (H,F)$.

The Euler condition for employment is:

$$\frac{q^i_j}{\mu^i_{j,t}} = \beta E_t \left\{ Pmg^i_{t+1} - w^i_{j,t+1} + \frac{q^i_j}{\mu^i_{j,t+1}} (1-\chi) \right\}; \qquad i = (s,u), j = (H,F) \qquad (18)$$

where the marginal product for skilled and unskilled workers is:

$$Pmg^s_t = A^{\alpha} y_t^{1-\alpha} (1-\sigma) \left[\rho (A^k k_t)^{\nu} + (1-\rho)(L^s_t)^{\nu}\right]^{\frac{\alpha}{\nu}-1} (1-\rho)(L^s_t)^{\nu-1}$$

$$Pmg^u_t = A^{\alpha} y_t^{1-\alpha} \sigma (L^u_t)^{\alpha-1}$$

Equation (21) shows that the cost of an effective vacancy must be equal to the net surplus of hiring a worker $Pmg^i_{t+1} - w^i_{j,t+1}$ plus the savings of not having to open a vacancy in the future $\frac{q^i_j}{\mu^i_{j,t+1}} (1-\chi)$.

Also, the Euler condition for the investment evolves:

$$E_t \left[\frac{M_{t+1}}{M_t}\right] = \beta E_t \left\{ \left(\frac{1}{g_{t+1}}\right) \left[Pmg_{k,t+1} M_{t+1} + (1-\delta) + \kappa \left(\frac{i_{t+1}}{k_{t+1}} - \delta\right) \frac{i_{t+1}}{k_{t+1}} - \frac{\kappa}{2} \left(\frac{i_{t+1}}{k_{t+1}} - \delta\right)^2 \right] \right\} \qquad (19)$$

where

$$M_t \equiv \left[1 - \kappa \left(\frac{i_t}{k_t} - \delta\right)\right]$$

$$Pmg_{k,t} = A^{\alpha} y_t^{1-\alpha} (1-\sigma) \left[\rho (A^k k_t)^{\nu} + (1-\rho)(L^s_t)^{\nu}\right]^{\frac{\alpha}{\nu}-1} \rho (A^k k_t)^{\nu-1} A^k$$

3.6. Wages: Nash Bargaining

Once the matching process occurs and each worker is assigned to a firm's vacancy, there is a bargaining process to set the wage. The wage equilibrium is determined by a Nash negotiation. In particular, the wage is established in such a way that maximizes Nash's surplus:

$$w_{j,t}^{i} = \underset{\widetilde{w}_{j,t}^{i}}{\operatorname{argmax}} \left\{ \left[\widehat{V}_{h_j^i}(\widetilde{w}_{j,t}^{i}) \right]^{\lambda_j^i} \left[\widehat{J_{L_j^u}}(\widetilde{w}_{j,t}^{u}) \right]^{1-\lambda_j^i} \right\} \tag{20}$$

Thus, the equilibrium wage is one that maximizes the marginal value of offering and demanding an additional unit of employment, weighted by the bargaining power of each agent. Where λ_j^i is the bargaining power of household i for worker j - type relative to the firm. Symmetrically, $(1-\lambda_j^i)$ is the bargaining power of firms relative to each household.

Equilibrium wages

From the value functions of the agents and replacing in equation 23, we obtain:

$$V_{h_j^i} = \frac{\lambda_j^i}{(1-\lambda_j^i)} \left[\frac{\left(1-\tau_j^i\right)}{c_{j,t}(1+\tau^c)} \right] J_{L_j^i} \tag{21}$$

Using equations (21) and (24)–(27) and solving for $w_{j,t}^{i}$ yields:

$$w_{j,t}^{i} = \lambda_j^i \left[Pmg_t^i + \frac{q_j^i}{\mu_{j,t}^i} P_{j,t}^i \right] + \left(1-\lambda_j^i\right) \left[\frac{\varphi(h_{j,t})^{\gamma} c_{j,t}(1+\tau^c)}{\left(1-\tau_j^i\right)} \right] \tag{22}$$

Wages are a weighted average between what firms can offer and what households demand for each worker. Each agent's weight is determined by its bargaining power (λ_i^j).

3.7. Government

The government obtains resources from taxes on consumption and labor and bonds that the household buys with its wages. These resources are used to pay the interest on bonds, a fixed-sum transfer to households, and transfers that are proportional to immigrants. Thus, the government's budget restriction is given by:

$$w_{H,t}^{s}h_{H,t}^{s}\tau_{H}^{s} + w_{H,t}^{u}h_{H,t}^{u}\tau_{H}^{u} + w_{F,t}^{s}h_{F,t}^{s}\tau_{F}^{s} + w_{F,t}^{u}h_{F,t}^{u}\tau_{F}^{u} + c_{H,t}\tau^{c} + c_{F,t}\tau^{c} + B_{H,t} + B_{F,t} = r_{H,t}B_{H,t-1} + r_{F,t}B_{F,t-1} + G + s_{mig,t} \quad (23)$$

where $G = G_H + G_F$ and spending on immigrants is defined as:

$$s_{mig,t} = \mu_{mig}(g_{F,t} - 1)$$

3.8. Market-clearing Conditions

In equilibrium, the following conditions must be satisfied:

Labor market clearance:

$$h_{j,t}^{i}\Omega = L_{j,t}^{i}; \qquad i = (s,u), j = (H,F)$$

Bond market clearance:

$$B_t = B_{t-1} = 0$$

Additionally, the aggregations are of the form:

$$C_t = C_{H,t} + C_{F,t}$$
$$c_t = \Omega c_{H,t} + (1-\Omega)c_{F,t}$$
$$B_t = B_{H,t} + B_{F,t}$$
$$B_{H,t} = \emptyset_B B_t$$
$$B_{H,t} = (1-\emptyset_B)B_t$$

Where $\emptyset_B$ is the share of total bonds demanded by local households, the resource constraint of the economy is given by:

$$Y_t = C_t + I_t + V_{H,t}^{s}q_H^{s} + V_{H,t}^{u}q_H^{u} + V_{F,t}^{s}q_F^{s} + V_{F,t}^{u}q_F^{u} \quad (24)$$

3.9. Model Solution

Given the initial conditions for $\{K_0, H_{H,0}^{s}, H_{H,0}^{u}, H_{F,0}^{s}, H_{F,0}^{u}\}$, decentralized equilibrium, it is defined by a series of prices, $\{r_H, r_F, w_{j,t}^{i}\}_{t=0}^{\infty}$ matching probabilities

$\{ P_{H,t}^{s}, \ P_{H,t}^{u}, \ P_{F,t}^{s}, \ P_{F,t}^{u}, \ \mu_{H,t}^{s}, \ \mu_{H,t}^{u}, \ \mu_{F,t}^{s}, \ \mu_{F,t}^{u} \}_{t=0}^{\infty}$ and allocations $\{C_H, C_F, \Pi_t, H_{H,t}^{s}, H_{H,t}^{u}, H_{F,t}^{s}, H_{F,t}^{u}, K_t, V_{H,t}^{s}, V_{H,t}^{u}, V_{F,t}^{s}, V_{F,t}^{u} \}_{t=0}^{\infty}$ such that households and firms optimize their decisions by taking into account labor market frictions. Wages are determined by a Nash bargaining where all budget constraints are satisfied and the markets are cleared.

4. Calibration

4.1 Structural Parameters

Table 1 reports the values of the structural parameters of the model based on quarterly calibration. We calibrated parameters to match the relevant steady-state variables for Colombia in 2018, and others are taken directly from the related literature.

Depreciation Rate and Intertemporal Discounting Factor

Following relevant literature, the intertemporal discount rate was set at 0.99, consistent with a real steady state interest rate of 2 percent. Similarly, the capital depreciation rate was set at 2.5 percent to obtain, at a steady state, the capital-output ratio of 9.7.

Production

Krusell et al. (2000) estimated the substitution elasticities between skilled labor and capital and unskilled labor and capital. We assume that unskilled capital and labor are net complements, and we fix the parameter at $\alpha = -0{,}2$. The assumption of gross complementarity between capital and skilled workers, drawn from Grossman (1982), is $\nu = -0{,}2$. Parameters ρ and σ were calibrated consistently with data on the participation of the factors in the economy (DANE, 2019) at 73 percent and 40 percent, respectively. Finally, parameters A and A^k were measured to calibrate the share of capital and consumption to output in a steady state. Additionally, parameters associated with the disutility of work were calibrated so that the equilibrium unemployment rate of the economy was 9.7 percent. Once the economy's unemployment rate is calibrated, we determined that workers' separation rate is 0.11. These data are consistent with Dustman, Glitz, and Vogel (2010) for non-OECD countries.

Table 1. Calibration of Parameters

Parameter	Value	Definition	Source
$0 < \beta < 1$	0.985	Intertemporal discount factor	Calibration
$\varphi > 0$	0.15	Labor disutility	Calibration
$0 \leq \delta \leq 1$	0.025	Capital depreciation rate	Calibration
$\frac{1}{1-\nu}$	-0.2	Capital-skilled labor substitution elasticity titution	Literature
$\frac{1}{1-\alpha}$	-0.2	Capital-unskilled labor substitution elasticity	Literature
$0 < \sigma < 1$	0.405	Share of unskilled labor in production	Calibration
$0 < \rho < 1$	0.733	Share of capital in production	Calibration
q_H^S	0.018	Vacancy cost for local skilled workers	Calibration
q_H^U	0.009	Vacancy cost for local unskilled workers	Calibration
q_F^S	0.361	Vacancy cost for foreign skilled workers	Calibration
q_F^U	0.199	Vacancy cost for unskilled foreign workers	Calibration
$\chi > 0$	0.11	Employment separation rate	Data
$0 \leq \eta \leq 1$	0.5	Employment search elasticity	Literature
$0 \leq \lambda_H \leq 1$	0.85	Relative negotiating power of local workers	Literature
$0 \leq \lambda_F \leq 1$	0.5	Relative negotiating power of foreign workers	Literature
$0 < \gamma < 1$	0.2	Frisch elasticity	Literature
$0 < \tau^C < 1$	0.08	Consumption tax rate	Calibration
$0 < \tau_H^S < 1$	0.04	Labor tax for local skilled workers	Calibration
$0 < \tau_H^U < 1$	0.04	Labor tax for local unskilled workers	Calibration
$0 < \tau_F^S < 1$	0.04	Labor tax for skilled foreign workers	Calibration
$0 < \tau_F^U < 1$	0.04	Labor tax for unskilled foreign workers	Calibration
A^k	0.3	Capital productivity	Calibration
A	0.6	Total factor productivity	Calibration
μ_H^S	0.6	Match efficiency for local skilled workers	Calibration
μ_H^U	0.6	Match efficiency for local unskilled workers	Calibration
μ_F^S	0.6	Match efficiency for skilled foreign workers	Calibration
μ_F^U	0.6	Match efficiency for unskilled foreign workers	Calibration
μ_{mig}	0.31	Public expenditure as share of migrant population	Calibration
ρ_{mig}	0.8	Migration shock persistence	Calibration

4.2. Labor Market Parameters

Matching Technologies and Bargaining Power

The values used for the new match's elasticity concerning the search time were set to 0.5, consistent with the empirical evidence found by Petrongolo and Pissarides (2001). The bargaining power for locals and foreigners was set at 0.85 and 0.5, respectively, coinciding with Hosios (1990), who finds that locals have more bargaining power than immigrants. Chassamboulli (2013) asserts that immigrants have a lower bargaining power than locals because, on average, immigrants have a lower reserve wage.

Cost of Opening Vacancies

The costs of opening a new vacancy were calibrated to obtain steady-state unemployment rates of 9.5 percent for locals. Thus, $q_H^S = 0.018$, $q_H^U = 0.009$, $q_F^S = 0.361$ y $q_F^U = 0.199$. This is consistent with Chassamboulli (2013), who found that skilled workers' opening vacancies have higher costs than those for unskilled workers. Furthermore, since immigrants face higher transaction costs (i.e., verification, work permits), the cost of opening a vacancy for foreigners is higher than for nationals.

Pairing Efficiency

Following Shimer (2010), pairing efficiency is established so that, in steady state, the probability of filling a vacancy is more significant for the skilled population than for the non-skilled population. This corresponds with Krause and Lubik (2006; 2010).

4.3. Fiscal Parameters

The size of the consumption tax was calibrated to be consistent with the consumption collection level as a percentage of GDP observed in Colombia of 6 percent of GDP in 2018. Similarly, the labor tax rate was calibrated to observe the same collection level generated by the labor tax, which was 2.7 percent of GDP for 2018 in Colombia. Conversely, spending on immigrants was calibrated to be consistent with estimates by the Ministry of Finance and Public Credit, which calculates that the spending percentage is between 0.4 and 0.8 percent of GDP.

4.4. Shock

Persistence of Migration Shock

The match's persistence was calibrated to replicate the Ministry of Finance and Public Credit scenarios in the Medium-Term Fiscal Framework (2019) on the migration flow's estimated saturation time.

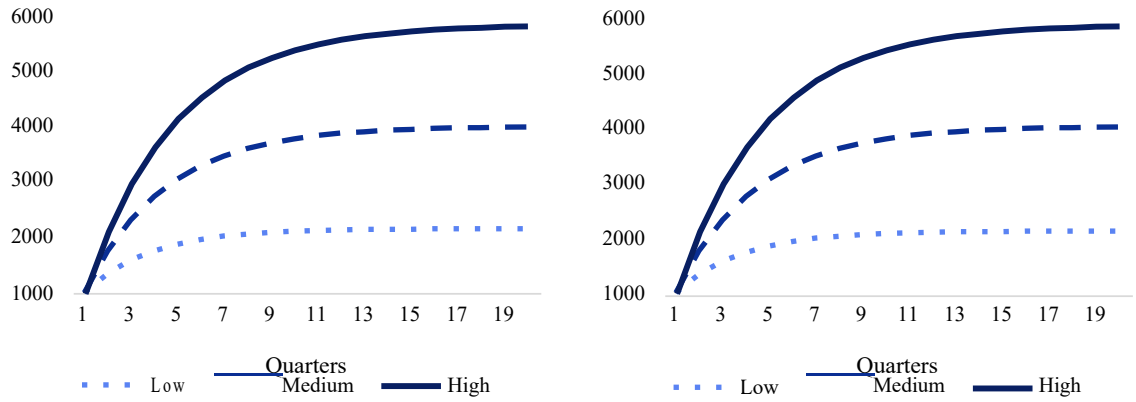
5. Results

The arrival of Venezuelan immigrants in Colombia was characterized as an exogenous shock because of the number of unskilled foreigners. This analysis constructed three scenarios consistent with the immigrant flows projected by the Ministry of Finance and Public Credit, the International Monetary Fund, and the World Bank. Panel A shows the growth rate of the migrant population. The low-case scenario is consistent with an increase of 1 million additional people, who stop arriving after approximately three years. The mid-case scenario calculates that, after four years, there will be about 3 million more people than there were in the economy before the shock. Finally, the high-case scenario shows the arrival of about 5 million additional people over four and a half years.

Figure 5. Migration Shock Scenarios

Panel A. Number of immigrants arriving in Colombia *(thousands of people)*

Panel B. Migration growth rate.



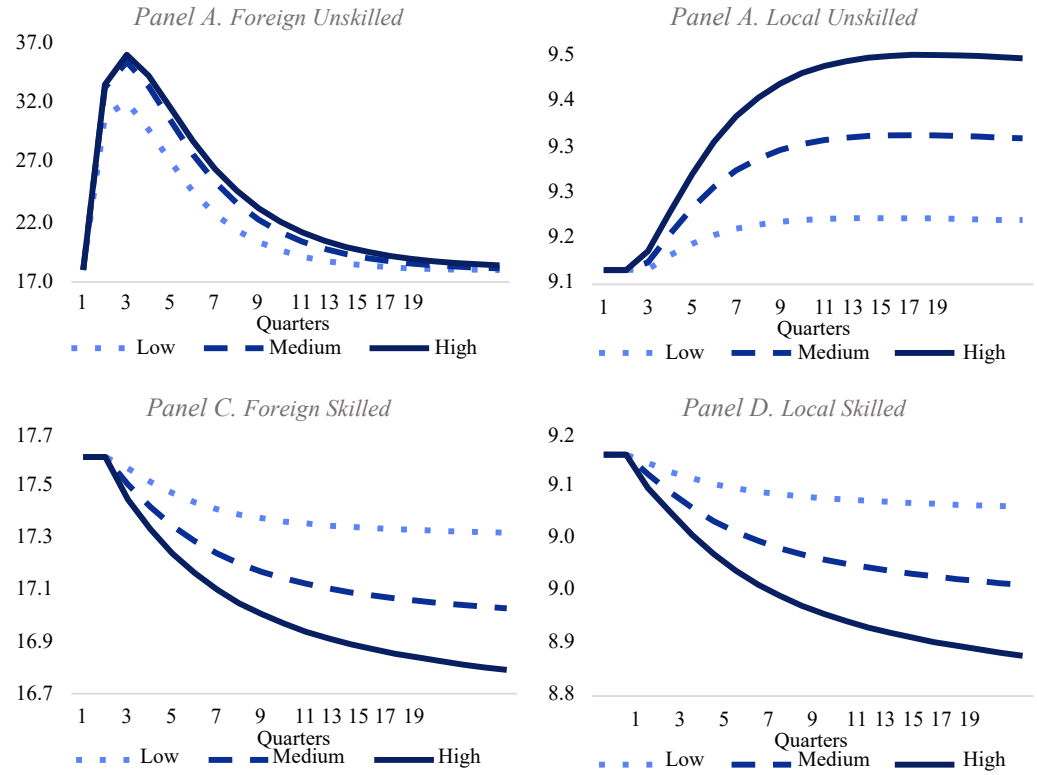
Source: Authors' elaboration.

We present the effects of the shock in three parts: first, the short and medium-term impacts of migration on the labor market. Mainly, we explain the effects on the unemployment rate and wages for each population subgroup. The results of the shock on the main macroeconomic variables—economic growth, consumption, and capital—are presented below. Finally, we show the effects of migration on fiscal variables.

5.1. Impacts on the Labor Market

The entry of an additional labor force into the labor market generates an increase in the employment rate. In particular, the employment rate of unskilled foreigners (Figure 6-Panel A) experiences an increase of 13 percentage points (pp) and 18 pp during the first two quarters of the year, respectively. Then, as immigrants enter the labor force, the unemployment rate decreases. In the medium term, this population segment's unemployment rate reaches levels close to those observed before the shock. The unemployment rate of unskilled locals (Panel B) also increased by between 0.05 pp and 0.35 pp. However, its behavior differs from that previously explained: this increase is gradual and due to local workers being displaced by foreign workers. In the medium term, the unemployment rate of unskilled locals does not return to the initial level. On the contrary, it reaches a stationary state level higher than the initial one. This result is explained by the fact that in equilibrium, local workers' wages are higher than those of foreigners.

Figure 6. Unemployment Rates

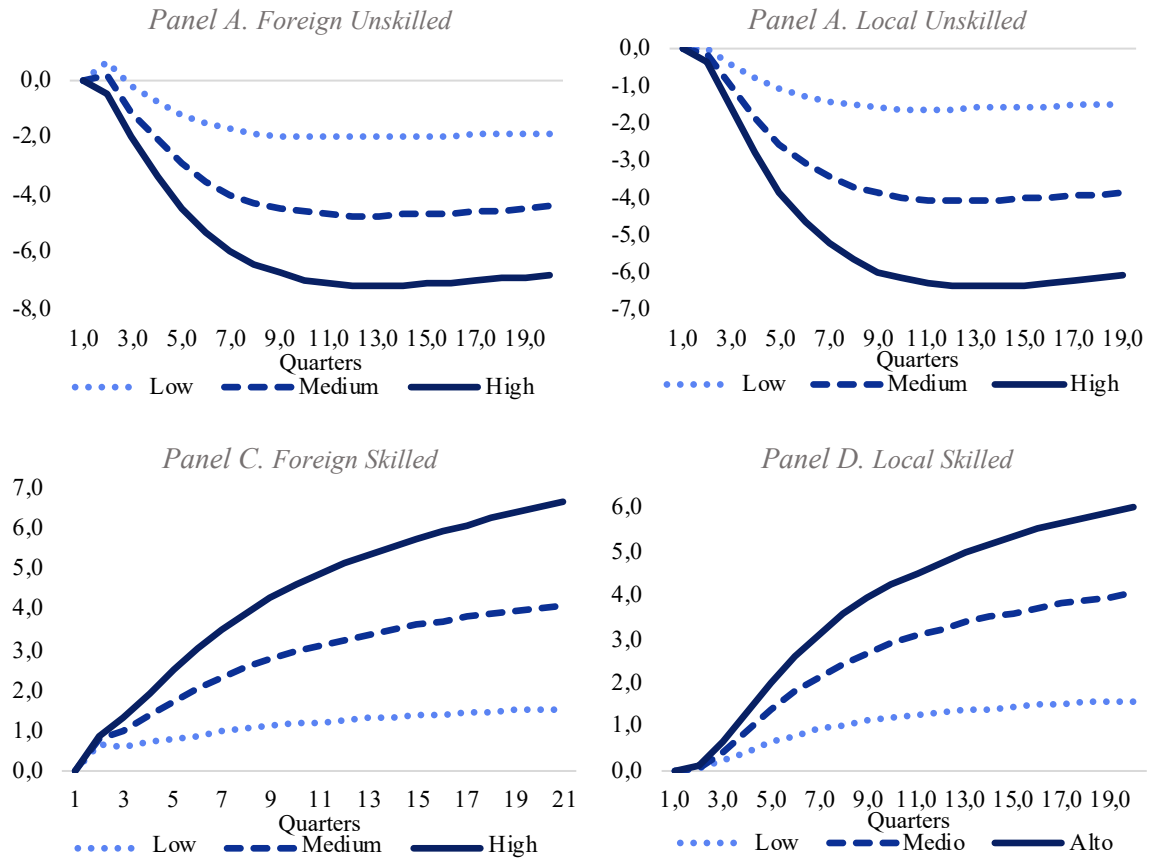


Source: Authors' calculation.

For skilled workers, the effect is the opposite: the unemployment rate is lower after the shock, both for foreign and local workers (Figure 6, Panels C and D). The lower number of skilled workers explains this decrease in relative terms and their complementarity with capital within the production function. This decrease is not immediate: during the first two quarters, the unemployment rate of skilled workers is not affected. The labor market absorbs the supply of unskilled workers starting in the third quarter, and the unemployment of skilled workers adjusts. In the medium term, unemployment among skilled foreigners is between 0.3 pp and 0.9 pp lower, while locals' unemployment is 0.05 pp and 0.4 pp lower than before.

Figure 7. Wages

(percentage variation with respect to steady state)



Source: Authors' calculation.

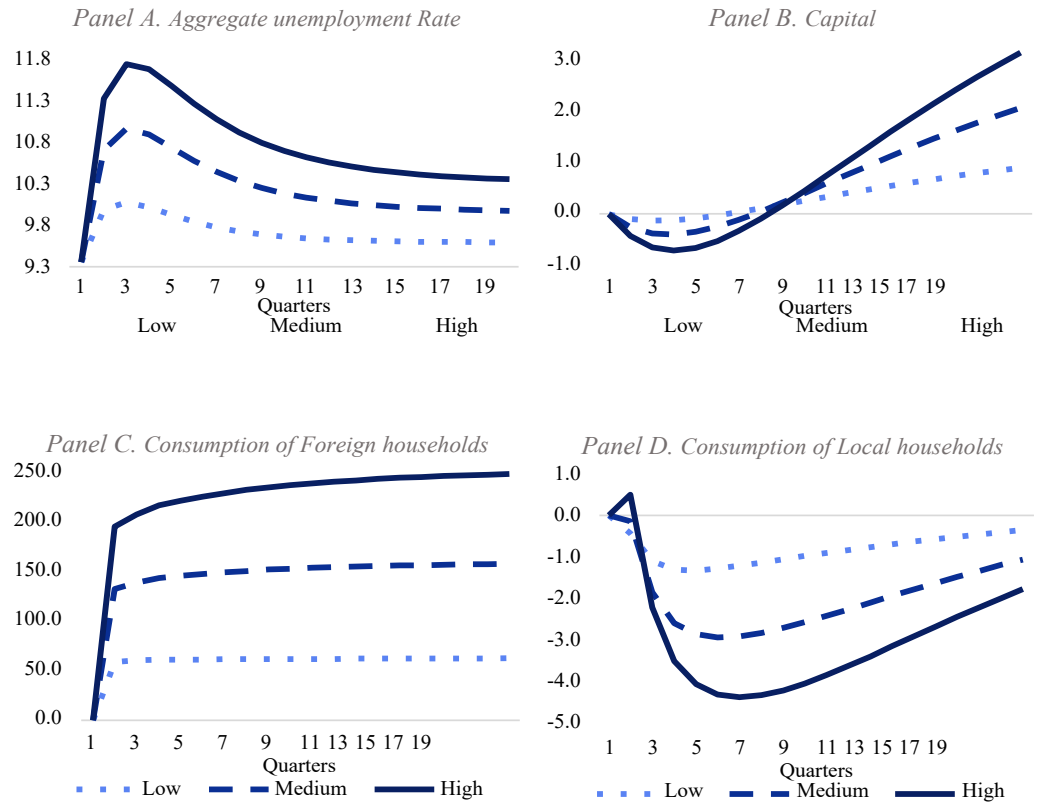
Wages that clear the labor market also adjust after the shock. Figure 7 shows the wages of each labor segment as variations of their steady state level. For unskilled workers, wages fall in response to the oversupply of work due to migration. This variation is similar for both locals and foreigners: two years after the shock, their wages are expected to drop between 2 and 7 percent. For skilled workers, a different response is expected: wages increase as the productivity of skilled labor increases due to more capital in the economy, greater demand for consumer goods, and fewer skilled workers relative to total workers. In the medium term, wages of skilled foreigners will be between 1 and 7 percent higher than before the shock, while for locals of the same skill level, this increase will be between 1.5 and 6.5 percent.

5.2. Impacts on Main Macroeconomic Variables

The previous section showed that the impacts on unemployment are different for each labor market segment. However, in the aggregate, total unemployment in the economy increases (Figure 8- Panel A) due to the unskilled population's greater weight within the total. However, this expansion is not permanent and decreases after the first three quarters. In the medium term, the unemployment rate stabilizes at levels slightly higher than those observed before the shock: between 9.8 and 10.5 percent.

Figure 8. Macroeconomic Variables

(percentage variation with respect to steady state, except for Panel A, presented as percentage)



Source: Authors' calculation.

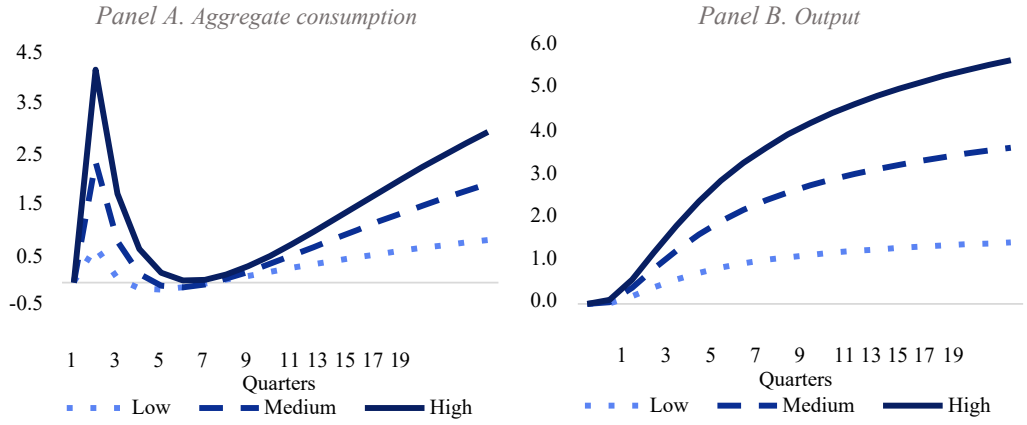
Capital (Figure 8, Panel B) shows a different dynamic: during the initial periods, when the wages of the unskilled fall sharply, firms substitute capital for labor, which generates a slight slowdown in investment. However, with higher consumer demand and increased skilled labor productivity, capital increases to levels observed before the migration shock (between

an additional 1.0 and 5.0 percent). Consumption grows with the arrival of immigrants to the economy. In particular, the foreign population's consumption rises and stabilizes in a new higher steady state (between 50 and 200 percent more than before the shock) (Figure 8, Panel C). For locals, the entry of immigrants lowers wages for the unskilled and raises unemployment rates. Thus, since the unskilled population represents the largest share of the Colombian population, consumption decreases between 1.0 and 5.0 percent. However, in the medium term, consumption recovers to converge to the same steady-state level (Figure 8, Panel D).

In the aggregate, consumption increases in the initial periods with a strong migration shock and decreases after two quarters. However, in the medium term, consumption increases and stabilizes at levels between 1.0 and 3.0 percent higher than those observed before the immigrants' arrival (Figure 9, Panel A). As a consequence of higher consumption and the higher demand for capital, output increases. In the medium term, panel B shows how output stabilizes at a new steady-state level between 1.0 percent and 6.5 percent higher than that observed before the shock.

Figure 9. Total Consumption and Production

(percentage variation with respect to steady state)



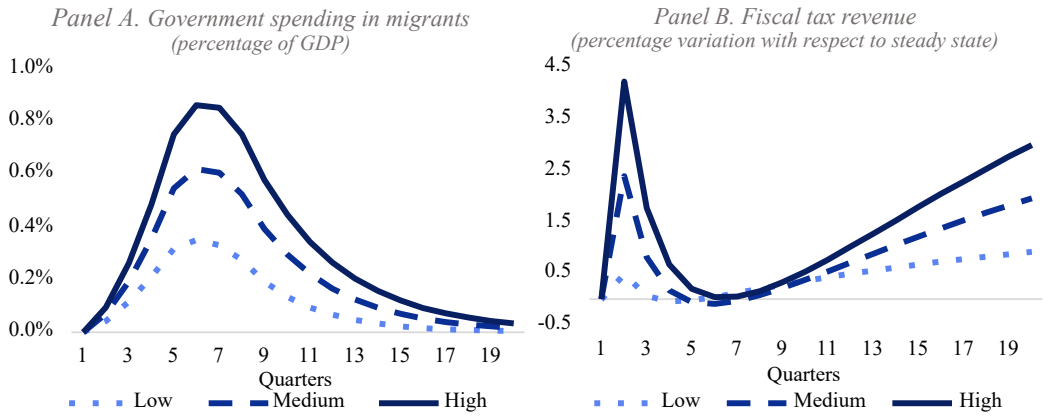
Source: Authors' elaboration.

It is crucial to notice that these results show higher economic growth with increases in unemployment. This dynamic is consistent with what was observed for Colombia, where the unemployment rate increased from 9.7 percent in 2018 to 10.5 percent in 2019, while the economic growth rate rose from 2.7 percent in 2018 to 3.3 percent in 2019 (DANE, 2020).

5.3. Fiscal Impacts

Immigrants' entry into the Colombian economy exerted pressure on public spending due to the foreign population's needs related to health, education, and humanitarian assistance, among others. Consequently, spending on immigrants as a percentage of GDP is expected to increase as the unskilled population arrives (Figure 10, Panel A). In the low-case scenario, additional spending at its maximum point (six quarters after the shock) reaches 0.4 percent of GDP. In the high-case scenario, additional spending is 0.9 percent of GDP, which is congruent with the estimates made by the Ministry of Finance and Public Credit (2019). In the medium term, as immigrants cease to enter the country, the pressure for additional public spending is reduced, returning to its initial steady-state level.

Figure 10. Public Spending and Income

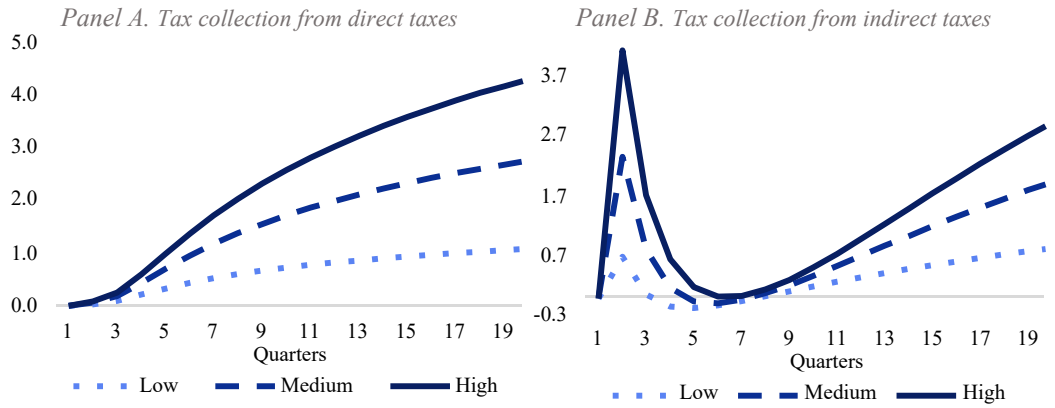


Source: Authors' calculations.

After the shock, tax collection shows different dynamics between direct and indirect taxes (Figure 11). As the immigrants enter the economy, more employees participate in the labor market, which implies higher labor tax collection. After the shock, Panel A shows that tax collection from direct taxes is 1 percent, or 4 percent higher than the initial state. On the other side, when immigrants' consumption increases due to the population growth generated by migration, value-added tax (VAT) collection rises. As the labor market recovers and locals (displaced by immigrants) reduce their consumption, the expansion of tax collection slows. However, total collection from indirect taxes reaches a new steady state of between 1 and 3 percent higher in the medium term.

Figure 11. Tax Collection

(percentage variation with respect to steady state)

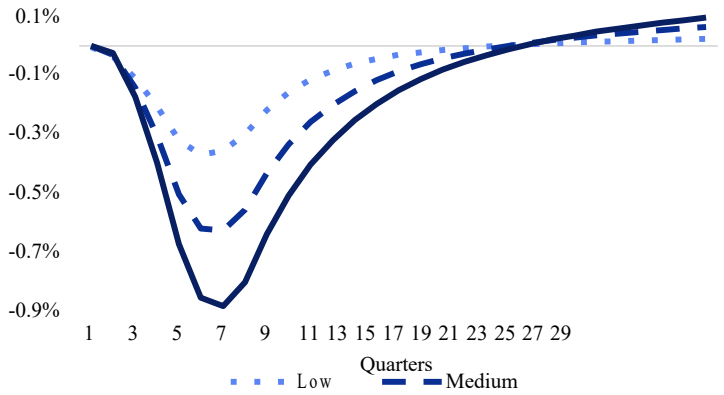


Source: Authors' calculations.

Consequently, the shock affects the government's fiscal balance as a percentage of GDP (Figure 12). In the short term, spending pressures lead to a 0.3 percent to 0.9 percent decrease in the GDP's primary fiscal balance. Later, as more people find employment and labor tax collection increases, the primary fiscal balance returns to the steady state. In the long term, surpluses are expected due to the higher level of tax collection.

Figure 12. Primary Fiscal Balance as a Percentage of GDP

(difference from steady state)



Source: Authors' calculations.

Thus, the immigration shock impacts the labor market in the aggregate macroeconomic and fiscal variables. The fiscal effect is negative in the short term due to the public spending pressure and labor market restructuring, which increases income tax collection. However, in the long term, migration brings fiscal dividends as fiscal revenue as a percentage of GDP converges to a steady-state level higher than that observed before the shock, while public spending returns to the previous level. Consequently, the fiscal balance as a percentage of GDP also reaches higher steady-state levels. Therefore, the preceding implies higher output levels in the long term, higher consumption, higher capital, and fair tax dividends caused by migration.

6. Conclusions

This paper proposes a general equilibrium model with *search and matching* with qualified and unskilled work to evaluate the effect of Venezuelan migration on the labor market, fiscal balance, and growth in Colombia. It finds that migration increases the labor supply, which initially generates a decrease in wages for both types of workers. However, in the medium term, skilled workers, both local and foreign, present higher labor returns thanks to the higher marginal productivity derived from immigrants' complementary work. These results highlight the challenge of economies with high rates of informality (characteristic of emerging economies) in designing and creating institutions that allow increasing human capital and attract skilled labor.

At the aggregate level, the model suggests that migration drives GDP growth in the short term due to an increase in the amount of labor employed. The model shows that the migration shock generates a non-standard effect in the literature, in which the general unemployment rate increases even as economic growth increases.

Finally, the government incurs an expense to address the needs of migrants proportional to new immigrants' arrival rates. At the same time, it receives income from increased economic activity, both due to higher demand for final consumption and employment growth performance. VAT tax collection increases, while direct collection falls in the short term. This results in a fiscal deficit during the first four to five years after the immigrants' arrival, depending on the migratory flow. In the medium term, immigration generates positive tax dividends due to the gradual increase in income from economic activity.

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