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 the economic growth. For this purpose, we constructed a dynamic general equilibrium model with a search and matching structure in the labor market. The higher fiscal spending to attend immigration negatively impacts the government's budget in the short term, which is reversed positively on output, consumption, and employment level, increasing the government's revenues mainly through indirect tax collection. The labor market's effect differs between 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. This changes in the labor market affect the government's direct revenue, resulting, in the long term, in positive fiscal dividends of migration*

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1. Introduction

International migration has grown and transformed in the last decades due to increased globalization, armed conflicts, and socioeconomic conditions at the international level, which has brought economic, social, and cultural implications both in the countries of origin and arrival. The economic and sociological literature has thoroughly referred to the aftermath of migration: its short, medium, and long-term effects, as well as the public policy determinations that should be considered to tackle this issue. Beyond the complex social and cultural impacts of migration, one of the aspects that have been addressed in previous studies has been the fiscal effects on the host countries' economies. However, there has been a considerable debate due to the capacity of immigrants to generate tax revenues. This issue requires further studies, for migration leads to sharp increases in the demand for social services in host countries and allocating specific expenses to attend the immigrant population.

Empirical evidence has found that this fiscal asymmetry (an 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 and that the individual decision to emigrate plays an important role. The literature on migration has identified two types of migrants: voluntary migrants and forced migrants. While the first type involves decisions taken over a longer time spectrum and entails investment decisions and long-term consumption in the host country, the second one occurs when the expelling country's conditions lead to a forced departure of its inhabitants.

Due to the reasons mentioned above, empirical evidence has shown that the flow of voluntary migration has been directed to advanced countries –unlike those who forcibly migrate, which tend to settle in neighboring countries– and that a positive fiscal effect has a positive correlation with the migrant's skill level. For example, Storesletten (2003) provides evidence for Sweden that immigrants generate a fiscal positive net effect, for the labor market absorbs the shock with higher vacancies and participation rates. In France, Chojnicki et al. (2011) show positive impacts because migration flows of younger labor force reduce the fiscal pressures in the social security system. Dustmann & Frattini (2014) study as well the fiscal impact of immigration in the United Kingdom and find a positive net effect for immigrants from the European Economic Area (EEA) and a negative net effect for non-EEA immigrants. For the Colombian case, the Colombian Ministry of Finance and Public Credit (2019) find that the Venezuelan migration has had a considerable shock in the unemployment rate and a fiscal impact due to the provision of public goods associated with the phenomenon. Using a DSGE model, the Ministry of Finance finds that migration makes the overall unemployment rate increase while fostering economic growth due to an increasing demand generated by the immigrants and the government expenditure in response to attending the social requirements of migration. However, this analysis does not conclude the impact in wages that the migration causes to the skilled and unskilled labor markets. Furthermore, Tribin-Uribe et al. (2020) show that the aggregate macroeconomic impacts of the Venezuelan migration in Colombia are small and, therefore, there should not be a monetary policy response to it. However, they do display changes in the unemployment rate and the aggregate participation rate.

Conversely, forced migration processes are usually carried out towards neighboring countries, such as the Syrian, Lebanese, Jordan, and Venezuelan population exodus episodes. Moreover, the sudden exogenous arrival shocks are very different from the voluntary migration events due to the socioeconomic similarities among the recipient countries and the countries of origin. In such economies, fiscal capacity is limited, and the shock increases demands for public goods and services in recipient countries. Although the literature has previously addressed the fiscal effects of migration flows in advanced economies –which broadly corresponds to voluntary migration– there is an unexplored field regarding the fiscal effects of host emerging countries in which forced migration has prevailed. Thus, this document seeks to contribute to the scarce literature of the migratory shocks' fiscal impact in emerging economies and enrich migration studies by analyzing the economic effects of forced migration.

The purpose of this paper is to analyze the fiscal dividend of the Venezuelan migration shock in Colombia, which is measured as the difference between the fiscal contributions and public spending from the migration shock. 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. On the one hand, the model considers agent heterogeneity by type of qualification and residence. In equilibrium, unemployment rates are heterogeneous and endogenously determined, capturing the labor market's migration flows dynamics. On the other hand, the

model includes fiscal variables such as government expenditure allocated to attend the migrant population and fiscal contributions. We also incorporate distortionary taxation – direct and indirect– into the model to evaluate the endogenous response in terms of revenues.

The paper's main findings show that the migration shock generates positive effects on aggregate variables such as output, consumption, and investment, however, in a small magnitude. The aggregate unemployment rate is persistent in the medium-term. Moreover, we simulate the potential path of government spending on migrant care for the medium-term and compute tax revenue's transitional dynamics. We found a large deficit in the initial periods but decreasing over time. Consequently, our simulations suggest that indirect tax revenues can rise around 1% of GDP per year, reducing the deficit over time.

Such fiscal contribution is possible due to the labor market's recomposition. Authors such as Hum & Simpson (2004) find that immigrants enter the labor market and replace part of the local supply, but with lower average wages than natives. In the same way, Tribin-Uribe et al. (2020) show that the Venezuelan migration to Colombia impacted immigrants' unemployment and has effects on the global participation rate. Consistent with this finding, 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[5]. One of the reasons for this is the complexity of finding an immigrant employee by the employer; in this sense, Beladi & Kar (2015) argue that information asymmetries do not allow employers to find employees within the migrant population. Likewise, immigrants have constraints on getting into the health system and public services, which, in turn, affect the immigrant

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

population's adaptation process and leads to a predominant vulnerability (Somerville & Sumption, 2009).

However, these results depend on the skills of the migrant population; when immigrants are highly skilled workers, the local labor market is less affected than in the case of migration flows composed of unskilled workers (Vargas-Vila, 2014). In addition, unemployment for unskilled labor is more volatile than the skilled labor market (Dustmann et al., 2010). This effect depends directly on substitution elasticity between migrant and local workers and the elasticity between skilled and unskilled workers. Our paper follows a similar approach by adding skill and unskilled labor but analyzing how taxation affects labor participation rates. Our findings show an increase in tax collection due to migration, resembling the results found in empirical approaches made by Tribin-Uribe et al. (2020).

In our model, labor frictions and taxes enables to analyze how equilibrium unemployment rates are affected by the migration shock and the marginal effect of distortionary taxation, which allows a more accurate analysis than Storesletten (2003) and Dustmann & Frattini (2014), where relative prices are constant and in partial equilibrium.

Unlike Chojnicki et al. (2011) and Tribin-Uribe et al. (2020)., that does 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 natives in terms of higher wages and lower unemployment rates. Given our model's structure, we cannot highlight the benefits of a positive demographic effect on fiscal balance, as it is considered in Storesletten (2003) and Chojnicki et al. (2011).

This paper is structured as follows. Initially, in Section 2, we present the main stylized facts of the immigration process in Colombia. In Section 3, we study the model, and in Section 4,

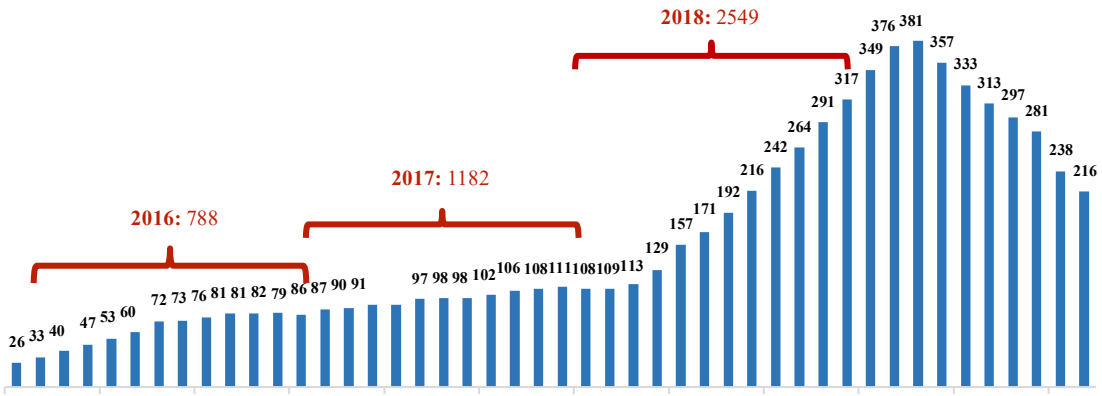
we explain its main parameters and the variables' calibration. Section 5 analyzes the main results of the immigration shock simulation and the impact on the fiscal variables, followed by the conclusions and final remarks in Section 6.

1. Stylized facts about Venezuelan immigration and the labor market in Colombia

In emerging economies, one of the most significant migration shocks has been the Venezuelan exodus. Colombia is currently the second-largest (1.8 million) recipient country in the world after Turkey (3.6 million), according to UNHCR (2019). As presented in Figure 1, Venezuelan immigrants' flow has increased by 330% in less than four years.

Figure 1. Total arrival of people from Venezuela to Colombia

(thousands)

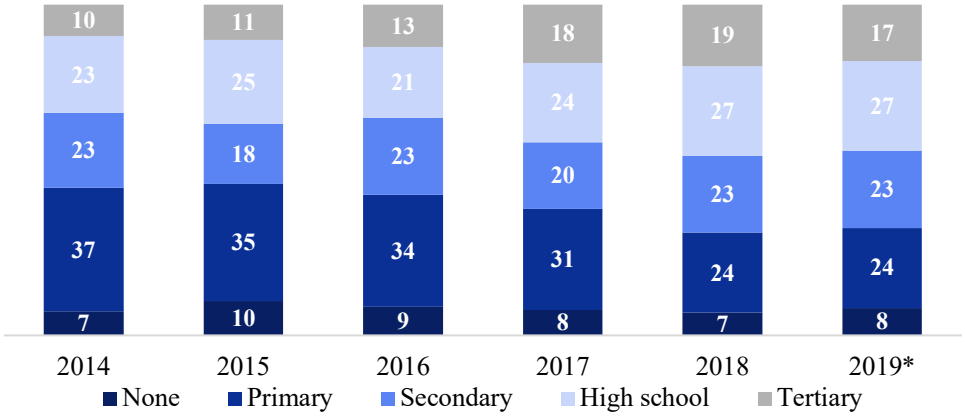


Source: Migración Colombia (2019)

Skill level of immigrants:

Leading labor indicators show that immigrants' qualification has changed in recent years. In 2018, the percentage of workers without education increased more than twice as much compared to the previous year, and the percentage of immigrants who completed tertiary education was reduced by 5%. Besides, there is a predominance of high school completion among immigrants, as Figure 2 shows.

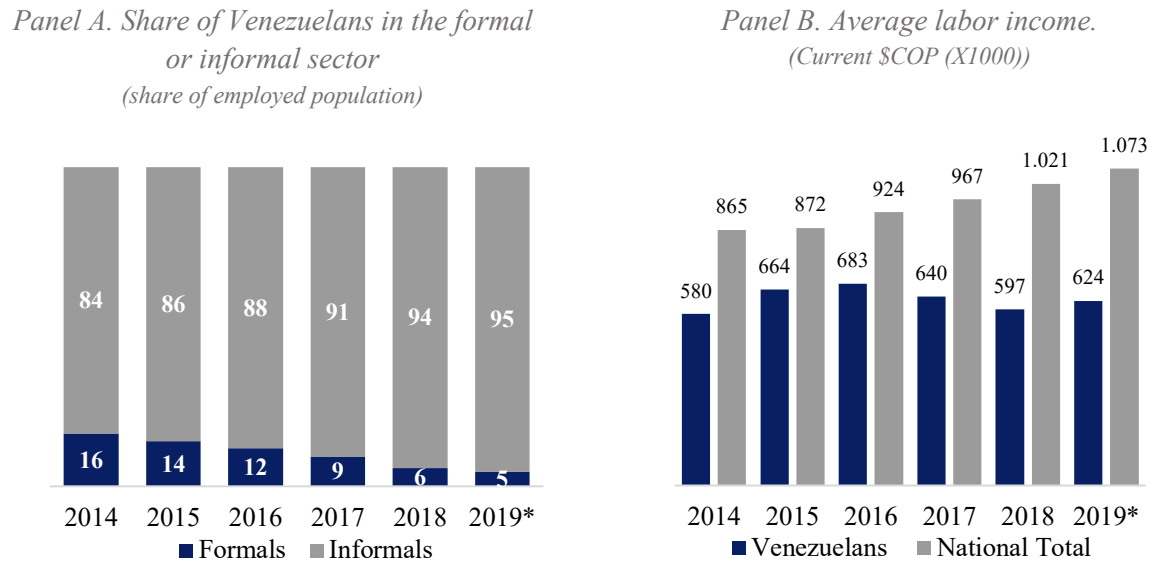
Figure 2. Venezuelan immigrants that arrived one year ago by highest education level achieved
(share of the total population)



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

Regarding the labor occupation of immigrants, the labor share concentrates in the informal sector. On average, 80% of the Venezuelan workforce is informal, and wages are 34% below Colombian workers' average between 2014 and 2018 (Figure 3).

Figure 3. Immigrants' formality and their income.



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

Labor share of immigrants:

There is a persistent increase in immigrant labor supply, which is greater than even Colombia's national level. There is a growing trend for Venezuelans and a falling trend for the locals' employment rate. Also, the unemployment rate for foreigners remains at 19%, while locals are around 9.5%. In general, we note that both the overall participation rate and the unemployment rate are U-like shaped, which corresponds with the fall in oil prices and an upsurge in Venezuela's crisis, increasing immigrants' influx (Figure 4).

Figure 4. Labor market dynamics of immigrants and non-immigrants

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

Fiscal response to migration:

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

2. The Model

3.1 The economy

The economy has 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, there is a government that uses taxes and public debt to finance the 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 qualified 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 concerning 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 $\left(1 - \emptyset_{j,t}\right) = N_{j,t}^u/N_{j,t}$ 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:

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

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, which imply that not all vacancies opened by firms are filled by workers who are willing to work for the equilibrium wages 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 of the household j according to the 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 we previously mentioned, there are two types of households: local and foreign, and each household has a skilled and unskilled population. 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 then receive their benefits, while foreigners receive a transfer made by the government only in the period in which 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 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 of 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 the period t.

The employment dynamics for both 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 the household j, of type i, in the period $t+1$ conformed those workers who did not lose their jobs a period before, plus the unemployed workers $\left(N_{j,t}^{i} - H_{j,t}^{i}\right)$ who manage to get employment with a probability $P_{j,t}^{i}$.

3.4.1 Household's problem

The household optimization problem is to choose $\left\{c_{j,t}, b_{j,t}, h_{j,t+1}^{i}\right\}_{t=0}^{\infty}$ for $i = (s,u)$ and $j = (H,F)$ such that it maximizes its intertemporal utility per capita, taking the prices of the factors $\left\{w_{j,t}^{i}, r_{j,t}\right\}_{t=0}^{\infty}$, the benefits of the firms $\{\Pi_{t}\}_{t=0}^{\infty}$, the probabilities of finding employment $\left\{p_{j,t}^{i}\right\}_{t=0}^{\infty}$, and the initial conditions on $\left\{h_{j,0}^{i}\right\}$ 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:

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

Subject to

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

And for the immigrants:

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

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

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

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. $g_{j,t} = N_{j,t}/N_{j,t-1}$ 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 according to each 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. In the first place, a static margin where direct and indirect taxation and compensation reduce incentives to offer labor supply. In the second place,

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)):

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

Where $A > 0$ and $A^k > 0$ are the total factor productivity and capital-augmenting technology. Meanwhile, α and ν are the elasticity of substitution 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_t^s and H_t^u are the skilled and unskilled labor that the firm uses as inputs.

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

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

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 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's (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:

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

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

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

$$L^i_{j,t+1}g_{t+1} = (1-\chi)L^i_{j,t} + \mu^i_{j,t}v^i_{j,t}; \qquad i = (s,u), j = (H,F) \tag{16}$$

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

Where, $y_t = \frac{Y_t}{N_t}, v^i_{j,t} = \frac{V^i_{j,t}}{N_t}, i_t = \frac{I_t}{N_t} k_t = \frac{K_t}{N_t} L^i_{j,t} = \frac{H^i_{j,t}}{N_t}$, denote the variables per capita and q^i_j is the cost of opening a vacancy for household-type i, j.

3.5.1 Firm's optimality conditions

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

The Euler condition for employment is:

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

Where the marginal product for skilled and unskilled workers is:

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

$$Pmg_t^u = A^{\alpha} y_t^{1-\alpha}\sigma(L_t^u)^{\alpha-1}$$

The equation (21) entails that the cost of and effective vacancy must be equal to the net surplus of hiring a worker $Pmg_{t+1}^i - w_{j,t+1}^i$ plus equals the savings of not having to open a vacancy in the future $\frac{q_j^i}{\mu_{j,t+1}^i}(1-\chi)$.

Also, the Euler condition for the investment evolves:

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

Where

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

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

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 from a Nash

negotiation. In particular, the wage established in such a way that maximizes Nash's surplus:

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

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 the household i for the worker j - type relative to the firm. Symmetrically, $(1 - \lambda_j^i)$ is the bargaining power of the firms relative to each household.

3.6.1 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 each worker. Each agent's weight is determined by its bargaining power (λ_i^j).

3.7 Government

The government obtains resources from, consumption labor taxes and bonds that the household buys from it. 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 markets 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 the total bonds demanded by the 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. 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 from a Nash bargaining and the 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. Parameters were calibrated according to match the relevant steady-state variables for Colombia in 2018, and others are taken directly from the related literature for the Colombian economy.

4.1.1. Depreciation rate and intertemporal discounting factor

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

4.1.2. Production

The substitution elasticities between skilled labor and capital and unskilled labor and capital were estimated by Krusell et al. (2000). We assume that unskilled capital and labor are net complements, and we fix the parameter to $\alpha = -0{,}2$. The assumption of gross complementarity between capital and skilled workers is drawn from Grossman (1982) and then $\nu = -0{,}2$. The parameters ρ and σ were calibrated consistently with data on the participation of the factors in the economy (DANE, 2019) at 73% and 40%,

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%. Once the economy's unemployment rate is calibrated, we determined that workers' separation rate is 0.11. This data is consistent with Dustmann et al. (2010) for non-OECD countries.

4.2. Labor market parameters

4.2.1. Matching technologies and bargaining power

On the one hand, 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 & Pissarides (2001). On the other hand, the bargaining power for locals and foreigners was set at 0.85 and 0.5, respectively, coinciding with Hosios (1990), who states 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.

4.2.2. Opening vacancies cost

The costs of opening a new vacancy were calibrated to obtain steady-state unemployment rates of 9.5% for the 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), stating that skilled workers' opening vacancies have higher costs than unskilled workers. Furthermore, since

immigrants face a higher transaction cost (i.e., verification, work permits), the cost of opening a vacancy for foreigners is higher than it would be for nationals.

4.2.3. 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 qualified population than for the non-qualified population, which corresponds with Krause and Lubik (2006 and 2010).

4.3. Fiscal parameters

The magnitude of the consumption tax was calibrated to be consistent with the consumption collection level as a percentage of GDP observed in Colombia of 6% 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% of GDP for 2018 in Colombia. Conversely, spending on immigrants was calibrated to be consistent with the Ministry of Finance and Public Credit estimates, which calculates that the spending percentage is between 0.4% and 0.8% of GDP.

4.4. Shock

4.4.1. Migration shock persistence

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

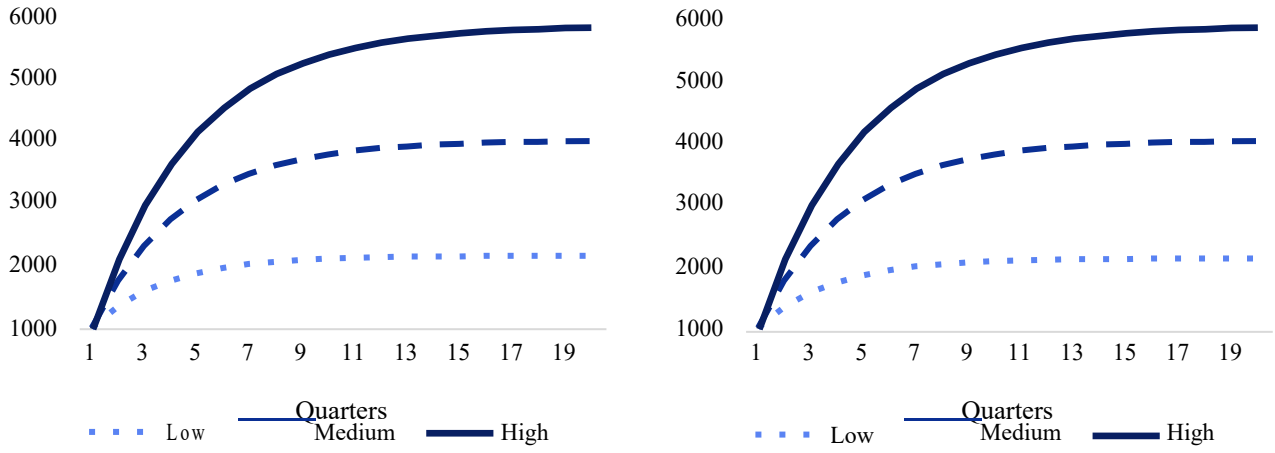
The Venezuelan immigrants' arrival to Colombia was characterized as an exogenous shock in the number of unskilled foreigners. In particular, we built three scenarios consistent with the immigrants' flows projected by the Ministry of Finance and Public Credit, the International Monetary Fund, and the World Bank.

Figure 5-Panel A shows the migrant population's growth rate. The low scenario is consistent with an increase of one million additional people, who stop arriving after approximately three years. The medium scenario calculates that, after four years, there will be about three million more people than there were in the economy before the shock. Finally, the high scenario shows the arrival of about five million additional people over four and a half years.

Figure 5. Immigration shock scenarios

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

Panel B. Migration growth rate.



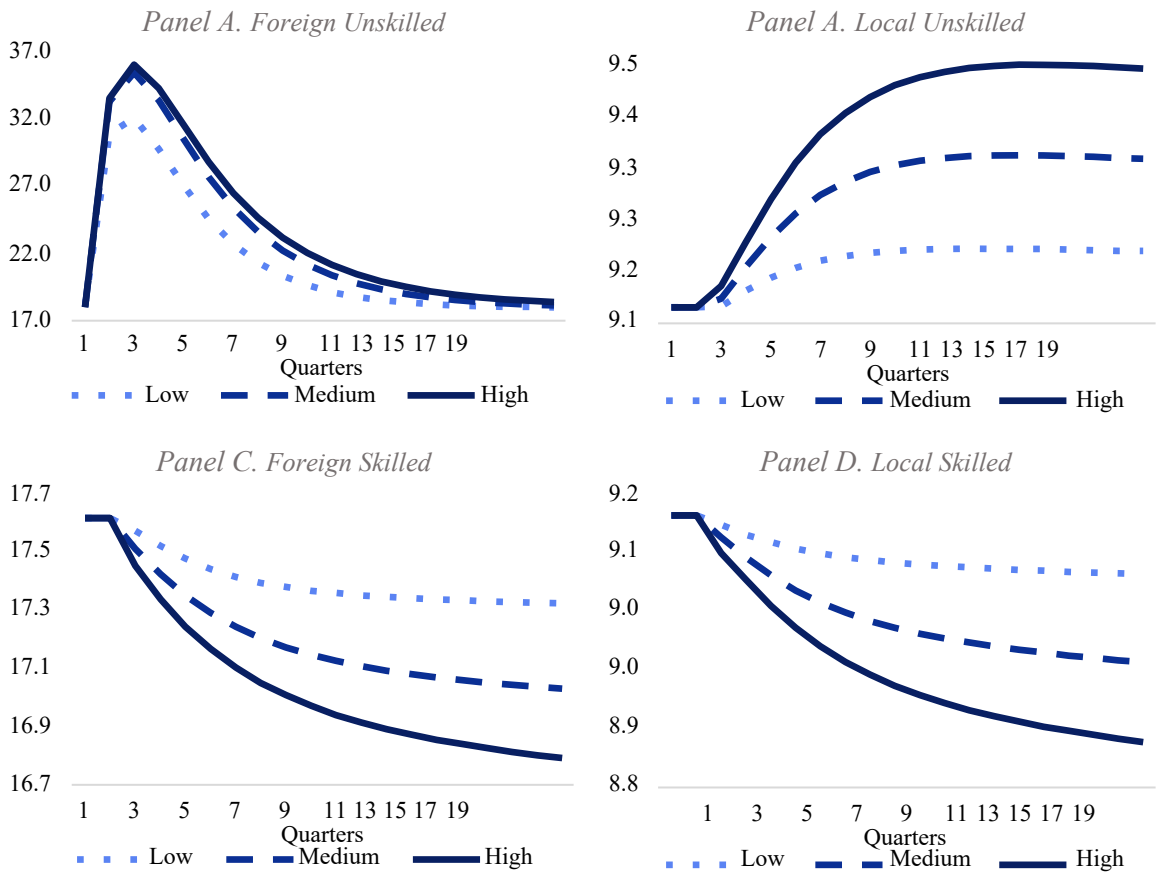
Source: Authors' calculation.

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

5.1. Labor market impact:

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

Figure 6. Unemployment Rates

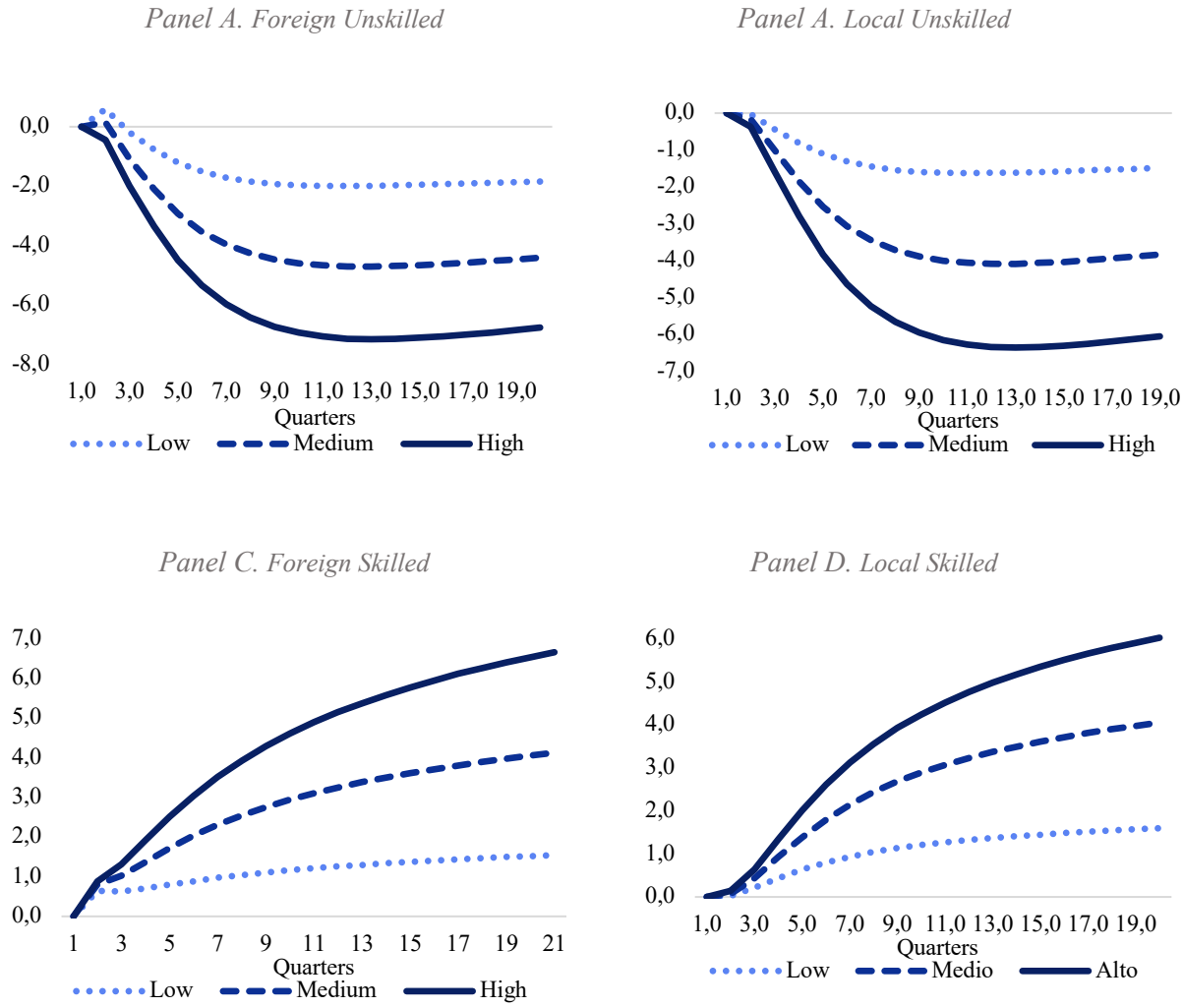


Source: Authors' calculation.

For skilled workers, the effect is the opposite: the unemployment rate after the shock is lower, both for foreign and local workers (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. It must be noted that this decrease is not immediate: during the first two quarters, the unemployment rate of the skilled workers is not affected. The labor market absorbs the supply of unskilled workers from the third quarter, and the unemployment of the skilled workers adjusts. In the medium term, unemployment among skilled foreigners is

between 0.3pp and 0.9pp lower, while locals' unemployment is 0.05pp and 0.4pp lower than before.

Figure 5. Wages
(percentage variation concerning steady-state)



Source: Authors' calculation.

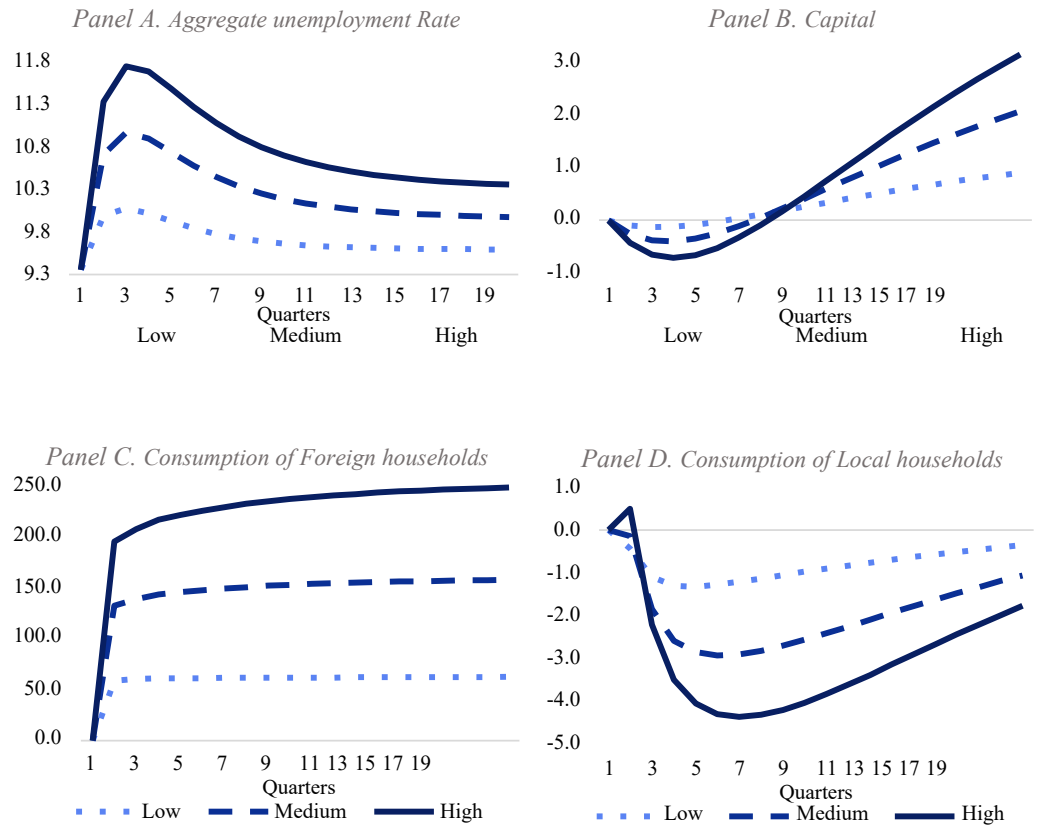
The wages that clear the labor market also adjust after the shock. Figure 7 shows the wages of each labor segment as variations for their steady-state level. For unskilled workers, wages fall as a response to the oversupply of work due to migration. This variation is similar for both locals and foreigners: two years after the shock, their wages are expected to drop

between 2% and 7%. On the other hand, for the skilled workers, a different response is expected: wages increase as the productivity of skilled labor increases due to more significant 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% higher than before the shock, while for locals of the same skill level, this increase will be between 1.5% and 6.5%.

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%.

Figure 8. Macroeconomic variables
(percentage variation with respect to steady state (except for panel A that is presented in percentual points))



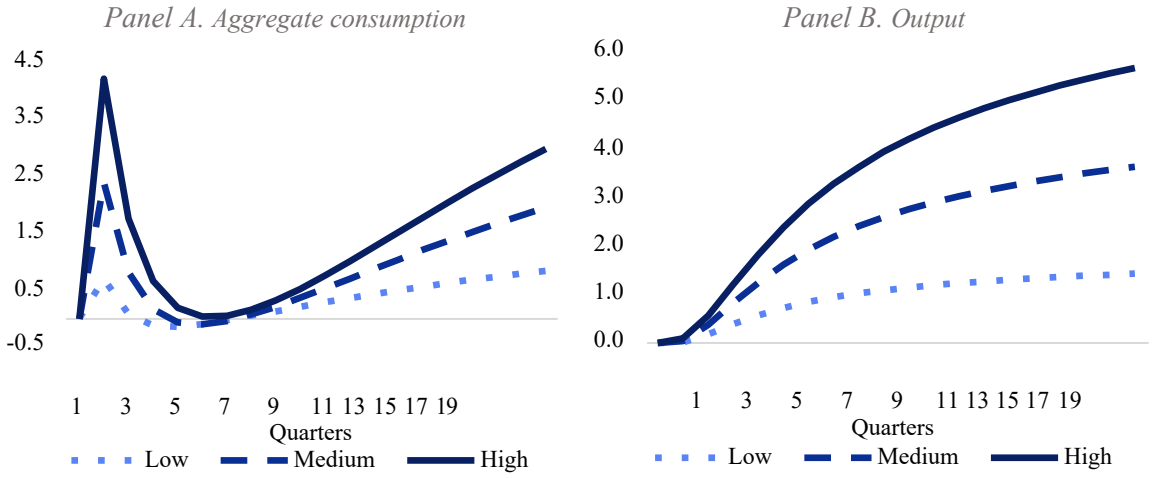
Source: Authors' calculation.

On the other hand (Figure 8-Panel B), capital shows a different dynamic: during the first periods, when the wages of the unskilled fall sharply, firms substitute capital for labor, which generates a slight slowdown in investment. However, with the 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%). 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% more than before the shock) (Figure 8- Panel C). For locals, the entry of immigrants produces lower wages for the unskilled and higher unemployment rates. Thus, as the unskilled population represents the

largest share of the Colombian population, consumption decreases between 1.0 and 5.0%. However, in the medium term, the consumption of premises recovers to converge to the same steady-state level (Figure 8- Panel D).

In the aggregate, consumption increases in the first 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% higher than those observed before the immigrants' arrival (Figure 9- Panel A). As a consequence of the higher demand for consumption and the higher level of capital, output increases. In the medium term, panel B shows how output stabilizes at a new steady-state level between 1.0% and 6.5% higher than that observed before the shock.

Figure 9. Total consumption and production
(percentage variation with respect to steady state)



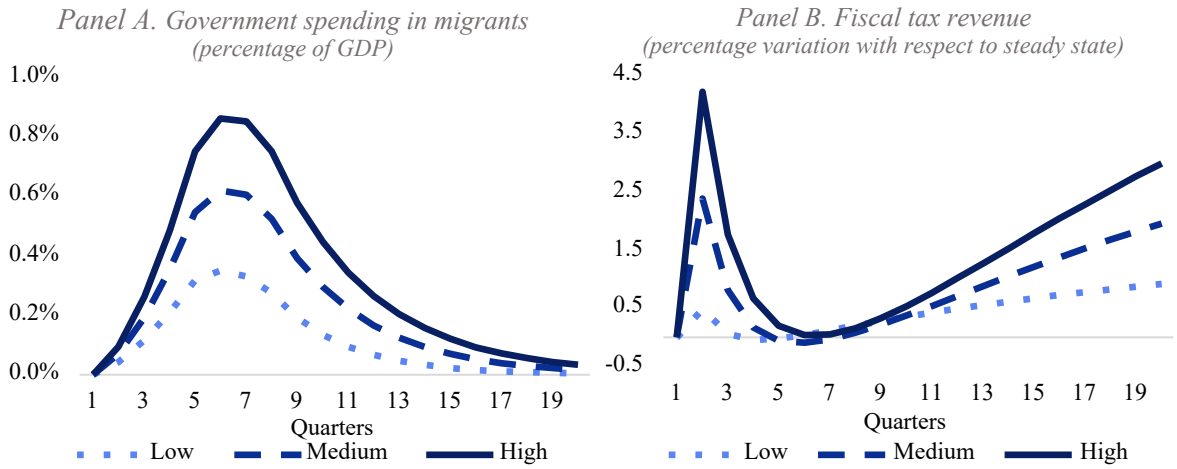
Source: Author's calculation.

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 unemployment rate increased from 9,7% in 2018 to 10,5% in 2019, while the economic activity went from growing 2,7% in 2018 to 3,3% in 2019 (DANE, 2020).

5.3. Fiscal impacts:

Immigrants' arrival to the Colombian economy caused pressures on public spending due to the foreign population's needs related to health, education, 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 scenario, the additional spending at its maximum point (6 quarters after the shock) reaches 0.4% of GDP. In the high scenario, the additional spending is 0.9% 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.

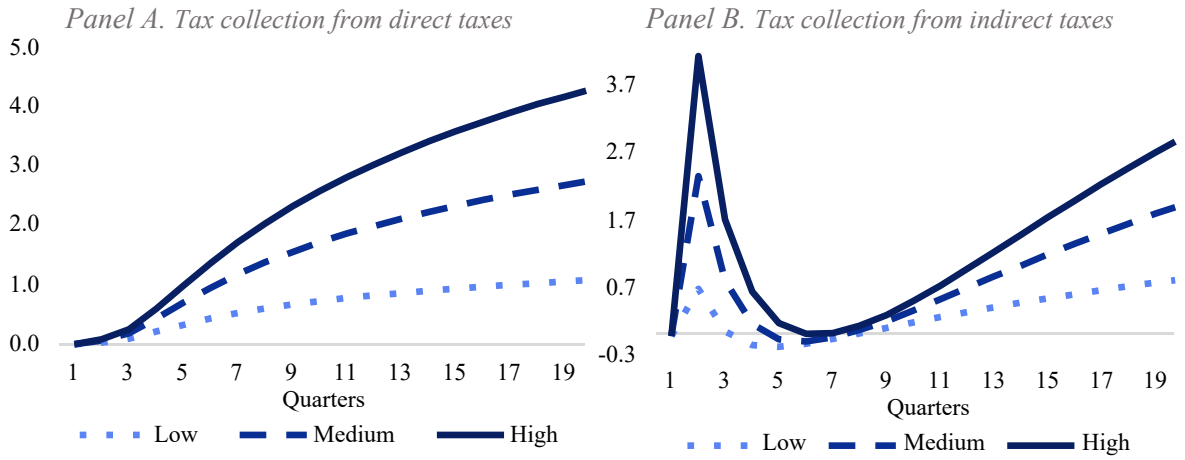
Figure 10. Public spending and income



Source: Authors' calculation.

After the shock, tax collection shows different dynamics among 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% -4% higher than the initial state. On the other side, when immigrants' consumption increases due to the population growth generated by migration, the VAT collection rises. As the labor market recovers and locals (displaced by immigrants) reduce their consumption level, the tax collection's expansion slows down. However, the total collection from indirect taxes reaches a new steady-state between 1% to 3% higher than the previous one in the medium term.

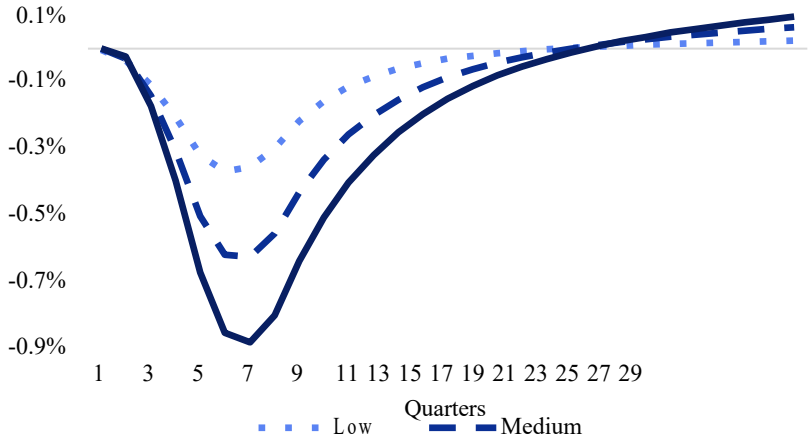
Figure 11. Tax collection
(percentage variation for steady-state)



Source: Authors' calculation

Consequently, the government's fiscal balance as a percentage of GDP is affected by the shock (Figure 12). In the short term, spending pressures lead to a 0.3% to 0.9% decrease in 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. Government Balance as a percentage of GDP (difference for steady-state)



Source: Authors' calculation.

Thus, the immigration shock impacts the labor market in the aggregate macroeconomic and fiscal variables. In particular, the fiscal effect is negative in the short term due to the public spending pressure and the labor market restructuring, which increases the 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 same 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. Concluding Remarks

This paper proposes a general equilibrium model with *search and matching* with qualified and unskilled work to evaluate Venezuelans' migratory effect in the labor market, fiscal balance, and growth in Colombia's case. It is found 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 informality rates (characteristic of emerging economies) in designing and creating institutions that allow increasing human capital and attracting 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 migratory shock generates a non-standard effect in the literature, in which the general unemployment rate of the economy increases even when the economy increases its growth.

Finally, the government incurs an expense to attend migration 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. Collection increases as a consequence of VAT, while direct collection falls in the short term. This results in a fiscal deficit during the first 4-5 years after immigrants' arrival, depending on the migratory flow. In the medium term, positive tax dividends are generated due to the gradual increase in income from economic activity.

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