STATISTICAL-ECONOMETRIC MODELS USED IN ANALYSIS OF THE IMPACT OF REMITES IN ECONOMIC DEVELOPMENT

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Abstract

The remittances are those sums earned outside the country by economic migrants in the first place. Remittances are a germ of economic migration. The hypotheses of the statistical and econometric models used in the migration analysis give a complete picture of the degree and complexity of migration in each country. Also, in these models, which are described in detail in the article, the correlation between emigration and remittances is also highlighted. Certainly remittances as they know have an impact on economic growth in each country, but to arrive at clear conclusions on which to provide national and international programs in this field, we must use methods, statistical and econometric analytical models primarily of migration. This is the neoclassical model that addresses the essence and motives of migration at a macroeconomic level. On the other hand, there is also a neoclassical model that maintains the microeconomic approach. This model represents a deepening of the neoclassical macroeconomic model. The main condition of the model is the fact that a migrant, before taking the decision to leave his own country, clearly analyzes the costs, income, cost-benefit relationship and the social and technological conditions he / she will meet in that country. In this way he draws his own conclusion and chooses his emigration model or not. This neoclassical model at micro- or macroeconomic level was also envisaged in Romania, when after 1990 an increasing number of people registered in the economic emigration, ie those who left the country because the living conditions were insufficient or minimal and from individual analyzes and groups have realized that they can acquire other conditions in other countries. Of course this has an effect on the labor force in our country but also in other countries, but it is a possibility for those who have resorted to this way to leave Romania. We can still talk about the new economic theory of migration that starts from the neoclassical economic model, but instills in the equation a new element that the decision to leave the country is not entirely a migrant but a decision influenced by the level of households, social-economic life and others. From this we can assume that a level of estimation of the determinants of migration

is a good tool to know the realities and to determine whether or not something can be done to stop this migration process. Significant economists spoke and grounded the gravitational model and, more recently, the gravitational modified model that provides superior net elements for carrying out the study of migration and its effects. We can analyze at the level of the European Union that this phenomenon of migration is stimulated by the Directive itself, which provides for the free movement of persons. Structuring upward, we can talk about the human capital model, the spatial model of job search, the modeling of migration with aggregate data, the modeling of migration with micro-data, and thus the statistical and econometric models used in the remittance analysis. At the macroeconomic level, the remittance analysis should be based on the volume of regular migrant transfers to the family or other groups in the country to identify the effectiveness of these transfers in order to then study the effect of migration on the level of population incomes as well as on economic growth. Fleming has established the Mundell model that shows the consequences of migration on remittances and entrepreneurship. We say entrepreneurship because many who return from this migration not only bring microeconomic macroeconomic remittances but develop business, ensure new jobs and can be a positive phenomenon.

Keywords: *statistical-econometric model, remittances, gravitational model, migration, economic growth*

JEL Classification: C10, F22, O15

Introduction

In this article, the authors have considered to base some of these models that can be used in such studies. First of all, those models used in the migration analysis and the impact of this migration on the population in a country or region should be established. The neoclassical model is approached at a macroeconomic level, then the neoclassical model as a microeconomic approach, considering here and taking into account the new economic theory of migration, that this process is favorable to economic development, but at the same time it can create labor displacements in one space in another, the workforce, ie the individual looking for better working conditions, better social conditions, and last but not least, better financial conditions. Several aspects of the gravitational model, the human capital model, the spatial search model of the jobs, or the modeling used to determine them are analyzed. The statistical and econometric models used in the remittance analysis are used in close co-ordination with the statistical and econometric models of migration and economic development. The article also talks about remittances and entrepreneurship in the context in which a number of emigrants return

to their countries with greater experience, higher financial income, engaging in job creation through their investment. Remittances are an important factor contributing to overall economic growth.

Literature review

Anghelache et al (2007) is a reference work for the macroeconomic field. Anghelache, Mitruţ and Voineagu (2013) analyzed the statistical indicators used in economic studies. Anghelache, Niţă and Badiu (2015) conducted a study on financial inclusion and impact on Romanian migrants and their families. Anghelache, Partachi, Anghel and Niţă (2017) analyzed the positive effect of remittances on poverty reduction. Giuliano and Ruiz-Arranz (2009) studied the correlation between remittances, financial development and economic growth. Goschin, Popa, and Roman (2010) investigated the macroeconomic impact of remittances. Goschin and Roman (2012) studied the determinants of the behavior of Romanian emigrants in the context of the economic crisis. Haller, Butnaru and Butnaru (2018) addressed a number of issues concerning the remittances of international migrants. Jouini (2015) studied the correlation between remittances and economic growth. A similar theme is analyzed by Niţă (2015). Taylor (1992) studied the direct and indirect effects of remittances. A similar theme is studied by Ustubici and Irdam (2011) who also analyzed the political implications of remittances. Zheng and Musteen (2018) investigated the impact of remittances on entrepreneurial activities.

Methodology, data, results and discussions

• Statistical and econometric models used in migration analysis

The neoclassical model - a macroeconomic approach, was originally developed to describe the impact of international migration on economic development. The model hypotheses take into account the fact that: international migration is determined by the wage differences between the country of origin and the country of destination; it is assumed that the elimination of these differences would lead to the cessation of international migration; the differences between the inflow of qualified and unqualified human capital could result in a different pattern of migration; the main mechanism by which international labor flows are generated is the labor market, other markets do not have the same impact as the labor market; how governments control and influence the international labor market through regulations both in the source and destination countries of migrants.

Assuming we have two locations, a home country from which the migrant leaves and the destination country, where the migrant chooses to live.

The current assessment of the migrant when choosing to live in the home country can be mathematically written as follows:

$$VA_o = \sum_{t=o}^{T} \frac{U_o(t)}{(1+p)^t} \quad (1)$$

where VA- represents the present value, $U_o(t)$ - represents the expected utility as a result of the migrant's decision to stay in the country of origin, T- the lifetime, and p - represents the preference rate of time, $p = 0$ suggests that the migrant is indifferent if he receives the payment today or future, so a positive value of p it indicates the individual's preference to receive payment today and not in the future.

This relationship can also determine the current value when the migrant chooses to live in the destination country, *d*. The equation becomes:

$$VA_d = \sum_{t=0}^{T} \frac{U_d(t)}{(1+p)^t} - \tilde{C}_{od} \quad (2)$$

In this equation, the element introduced in addition is that of the migrant's cost of moving from country o to d and is represented by $\tilde{C}_{od}$.

The migrant will make the decision to move from one country to another only if the chosen location will maximize its utility over the life span.

Todaro and Harris (1970) developed the economic model for international migration based on the Todaro model for internal migration from rural to urban. The internal migration model considers the wage balance between the rural and the urban ones that can be written:

$$E(S_u) = E(S_r) \quad (3)$$

where S_u and S_r - represents the wage levels in the urban environment and the rural area, and $E(S_u)$ and $E(S_r)$ shows the expected urban income, ie the rural income expected. Thus, the Harris-Todaro model predicts a first equilibrium approximation of the unemployment rate in the urban environment through the relationship:

$$1 - \frac{E_u}{L_u} = 1 - \frac{S_r}{S_u} \quad (4)$$

where E_u, represents the number of jobs in the urban area.

For the analysis of international migration, the Harris-Todaro (1970) model is transformed as follows: rural income is the income the migrant earns in the country of origin and the urban income becomes the income the migrant expects to receive in the country of destination. The mathematical equation becomes:

$$V_o^E < V_d^E - C_{od} \quad (5)$$

Where $V_o^E = f(Prob(LMP_o), V_o)$ and $V_d^E = f(Prob(LMP_d), V_d)$

V_o^E the expected income in the country of origin is a function that depends on the salary rate and V_o - income from this country. $Prob(LMP_o)$, is the likelihood that the migrant will find a job in the country of origin. Also, for the comparative analysis of the wage that can be obtained in the country of origin compared to the one in the country of destination, the same variables are considered for the country of destination, namely: V_d^E - the expected income in the country of destination, which also depends on the salary rate and income in the country of destination V_d and the likelihood that the migrant will find a job in this country $Prob(LMP_d)$.

As with the internal migration model from rural to urban, the net migration model proposed by Harris-Todaro (1970) also takes into account other factors, such as: unemployment rate or migration costs from one country to another. The net migration model equation takes the form:

$$MN_{od} = f(V_o, V_d, U_o, U_d, X_o, X_d, C_{od}) \quad (6)$$

- The neoclassical model - microeconomic approach, this model represents a deepening of the neoclassical macroeconomic model. The main assumption of the model is that the migrant, ahead of his decision to leave his native country, looks very well at expected costs and revenue, cost-benefit, and social and technological conditions, and only when net expected earnings are higher than those in the native country choose to migrate. This model was developed by Borjas (1989, 1990) which considers the migrant's salary in the source country to be illustrated by the equation:

$$\ln(s_0) = v_0 + \varepsilon_0, \quad (7)$$

In the case of the destination country, the equation becomes:

$$\ln(s_d) = v_d + \varepsilon_d, \quad (8)$$

where v_0 and v_1 - represents the average income the migrant would receive in his / her home country, compared to the average income the migrant would receive if he / she would choose to leave his / her home country. ε_0 și ε_1 - random values are not related to average earnings.

Borjas introduces into the model and personal characteristics of migrants: the age or level of education, characteristics that have proven to influence international migration, so the model distinguishes between the composition and size of the effects of migration. By equation (9) Borjas clusters the value of the migrant's selectivity:

$$\left(\frac{\sigma_o \sigma_d}{\sigma(\varepsilon_d - \varepsilon_o)}\right)\left(\frac{\sigma_d}{\sigma_o} - \rho\right)\Omega = \mathbf{M\Omega} \tag{9}$$

where *M* represents for a group of migrants and the combination of income (which can only change if a change in the structure of the migrant's characteristics or income) or a combination of migrant characteristics. This term is presented by Borjas as being

$$\mathbf{M} \equiv \left(\frac{\sigma_o \sigma_d}{\sigma(\varepsilon_d - \varepsilon_o)}\right)\left(\frac{\sigma_d}{\sigma_o} - \rho\right) \tag{10}$$

Considering $\mathbf{B} = \mathbf{M\Omega}$, in the equation:

$$\frac{\partial B}{\partial k} = \Omega\frac{\partial \mathbf{M}}{\partial \mathbf{k}} + \Psi\frac{\partial \mathbf{\Omega}}{\partial \mathbf{k}} \tag{11}$$

the first term of the equation is defined by Borjas as the compositional effect and measures for the same sample of migrants the marginal effect of the combination of income and qualities of the migrant. The second term measures the dimensional effect, the marginal effect in the conditions in which the income and qualities of migrants remain constant, but their sample changes. Differentiating the two elements allows a clearer identification of the influence of the variables.

With this model Borjas obtained a series of conclusions:

- changing the distribution of earnings in the source country only results in a scale effect, the flow of migrants will be reduced when income sources are found in the country of origin.
- increasing or decreasing the costs associated with migration will increase or reduce the selectivity, Borja assumes that these costs do not vary according to the qualities of the migrant.
- an increase or decrease in earnings in the source country will decrease or increase the average earnings of migrants who are part of the chosen sample.

The new economic theory of migration starts from the neoclassical economic model, but introduces into the equation a new element, namely that the decision to leave the source country does not belong entirely to the migrant, an influence in this decision has the family or household to which it belongs migrant. Thus the condition of a better salary is not sufficient for the individual to leave the source country, cultural, social factors, capital market, insurance or credit markets to the destination country influences the migrant's decision. This model was developed by Stark (1991).

- The model for estimating the determinants of migration, the model was developed by Hatton (1995) and presents migration as an investment in human capital. The economic relationship is based on the concept encountered in other models that analyze migration, namely maximizing the usefulness of the migrant:

$$U_t = \ln(v_d)_t + \gamma(e_d)_t - \ln(v_o)_t - \mu(e_o)_t - c_t \quad (12)$$

Where w_d, w_h, e_d, e_h represents the income and probability of obtaining a job in the source or destination country. The model also takes into account the cost of migration c_t.

- Gravitational Model and Modified Gravitational Model

Makeover, Marschak and Robinson economists have laid the foundation for this model. The hypothesis of the gravitational model is that there is a direct relationship between migration and the population of the source country of migration, namely the population of the destination country and a direct relationship between migration and the distance between the two countries. The gravitational model is described by the relationship:

$$M_{od} = \frac{C P_o^{\beta_1} P_d^{\beta_2}}{D_{od}^{\alpha}} \quad (13)$$

where C is the constant, P_o and P_d Represents the population of the country of origin or of the country of destination, D_{od} – represents the distance between the two countries and β_1 and β_2 are freely estimated and the hypothesis of their equality with 1 can be tested..

The modified gravitational model appeared in the 1960s and takes into account several variables for migration analysis, being an extension of the standard gravity model. The model equation becomes:

$$lnM_{od} = ln\beta_0 + \beta_1 lnD_{od} + \beta_2 lnP_o + \beta_3 lnP_d + \beta_4 lnV_o + \beta_5 lnY_d + \sum_{n=1}^{m} \beta_{on} lnX_{on} + \sum_{n=1}^{m} \beta_{dn} lnx_{dn} + e_{od} \quad (14)$$

where V represents the income, X includes the variables: unemployment rate, urbanization degree, public expenditure and / or taxes, migrant characterization variables: age, gender, education or variables describing the behavior of the migrant. These characteristics can be extrapolated to the population of the source country of the migrant.

- The human capital model is an economic model added from the perspective of imbalance; in this model, it is considered that the migrant maximizes utility according to two arguments: income and free time. The

migrant will work only if the marginal rate of substitution of his free time is equal to the salary rate, in other words, the migrant is willing to work only if the salary received will also cover the cost of his / her leisure time.

- The spatial model of job search is a consequence of the human capital model. The basic concept of this model is that before leaving the source country the migrant will look for a job and set a preferred salary threshold. It is only when the country of destination concerned finds a salary equal to or higher than the set threshold that they decide to migrate.

- Migration modeling with aggregate data - Migration analysis using aggregate data presents several disadvantages:

- In the migration of an individual in more than one country, only the first and last place of the migrant is included in the analysis, the intermediate locations are excluded and thus not all the nuances of migration are caught in the analysis;
- the reasons why a person or group of people choose to migrate from their country of origin are not counted;
- do not take into account the types of migration: periodic, permanent, seasonal or new;
- the consequences of migration are analyzed at regional level and not individually.

- Modeling migration with microdata: unlike aggregated data, data at the individual level have the following advantages: they allow for a more detailed understanding of the relationship between migration and employment opportunities; provides more concrete estimates of income from migrants; allow for a detailed analysis of the correlation between migration and the individual characteristics of the migrant; allow analysis of migration at every moment, whether periodic or not.

• Statistical and econometric models used in remittance analysis

At the macroeconomic level, the remittance analysis should consider not only the volume of regular migrant transfers to his / her home family, but also the amounts accumulated by the migrant for the entire period spent abroad. It is important to know whether these migrant-saved amounts return to their country of origin and whether they are used for investment or consumption here or return to the economy of the country of destination.

Taking into account that remittances represent an influx of capital in the home country can affect the country's economic equilibrium and macroeconomic variables such as the Gross National Product (GNP). The Keynesian model, one of the oldest macroeconomic models, attempts to

capture this impact of remittances on economic variables. A form of the model can be described by the equations:

$$C_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 C_{t-1} \quad (15)$$

$$I_t = \beta_0 + \beta_1 Y_t + \beta_2 K_{t-1} \quad (16)$$

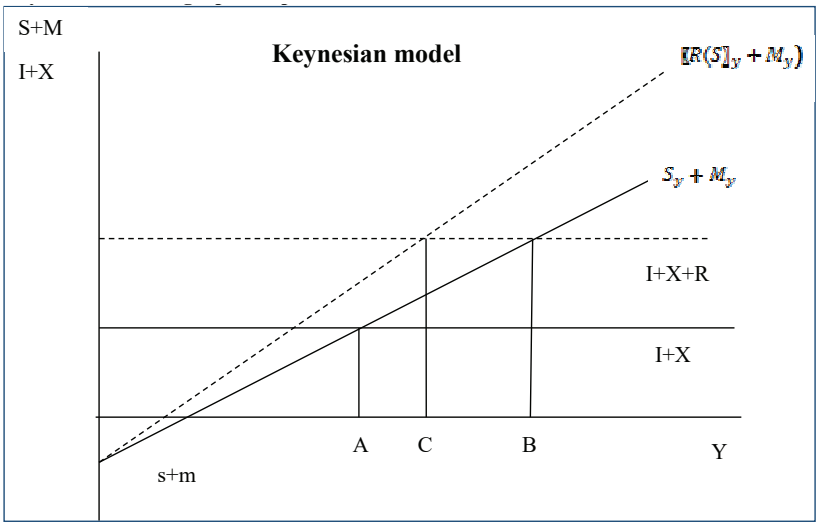
$$M_t = \gamma_0 + \gamma_1 Y_t + \gamma_2 K_{t-1} + \gamma_3 M_{t-1} \quad (17)$$

$$Y_t = C_t + I_t + G_t + X_t - M_t + R_t \quad (18)$$

where C - represents the private consumption expenditure, I - the gross domestic investment, M - the import of goods and services, Y - the national disposable income comprising the GDP and the volume of the migrant remittances, K - exogenous variable, - public consumption expenditure, X - exports of goods and services, R - remittances of deflated migrants to the consumer price index, and t - represents the analysis period..

Keynesian model - graphic representation

Figure 1

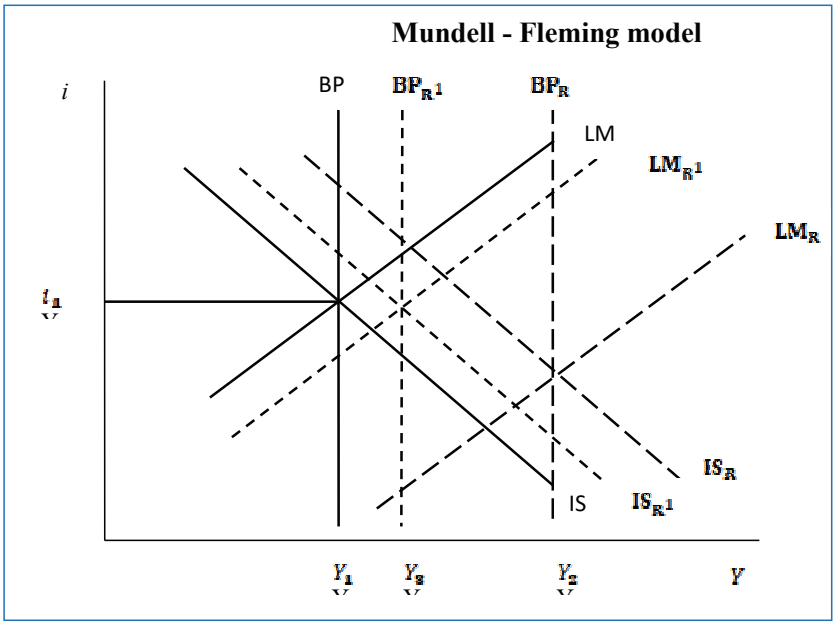


Source: International Monetary Fund

According to the Keynesian model, an increase in remittances will result in revenue growth, which will also lead to real GDP growth. This increase in remittances can also be interpreted as an increase in export earnings or as an additional investment. I - represents the investments, and the S - economies. The impact of remittances on marginal tilt to import (i) or savings (s) influences the balance.

Mundell - Fleming model - graphic representation

Figure 2



Source: International Monetary Fund

In the Mundell-Fleming model, the simultaneous equilibrium for Y (income), i (real interest rate), IS (goods and services market), LM (money market) and BP (balance of payments) is made at the intersection Y_1 and i_1. The remittances under this model can be seen as an influx of money, which would result in a $\mathbf{LM_R}$ and the increase in real income, Y_2, which means availability higher domestic credit.

At the level of national accounts, the economic model can be described as such:

$$Y = (C + I)_p + (C + I)_g + (X + M + NY + NCT) \quad (19)$$

remittances are included in net income (NY) and net current transfers (NCT), and $X + M + NY + NCT$ are actually the balance of the current account.

The remittances in the country of origin economy can be used for investment, consumption or can be saved.

If remittances are transformed into savings, it should be taken into account that these savings can be kept outside the banking sector and thus there

are no monetary implications, or they can change in local currency and only when bank deposits are created, remittances can contribute to appreciation of the exchange rate.

The relationship (19) can be written in the form:

$$S = Y - C = I + CAB \quad (20)$$

If remittances are used only for consumption, the relationship (18) becomes:

$$C = Y - I + CAB \quad (21)$$

And when the remittances are invested, the economic relationship becomes:

$$I = Y - C - CAB \quad (22)$$

There is a deterioration in the current account when both consumption and investment grow at the same time.

Remittances and Entrepreneurship - In this context, the possibility of a migrant, in the long run, is reaching a balance in which he will use remittances to invest in his own business. Rapoport H. and Docquier F. (2005) propose an economic model based on the Mensard model (2001) and Roy (1998) to analyze the link between remittances and entrepreneurship, a model in which entrepreneurship is considered not to involve any risk and that there is only one type of internal firms. The hypotheses of the proposed model are the following: migrants can work in the subsistence sector, in which case they receive a fixed salary, marked with $\underline{s}$, or they can work in the industrial sector and receive the salary fixed on the labor market, w, or choose entrepreneurship. In the latter case, it is assumed that the individual has to pay an initial cost C_i , bigger than the migrant's savings so far, so he has to make a loan. Thus the migrant will have to pay an interest rate, r; to employ a number of workers, n; and the total value is denoted by q. The profit equation depends on all these indicators and can be written:

$$\pi = q - ns - C_i i \ (+r) \quad (23)$$

The authors of the model have also determined the wealth threshold that allows a migrant access to entrepreneurship while at the same time reassuring creditors in respecting their payment obligations. This condition is given by the equation:

$$\Omega > C_i - \frac{E(J)}{1+r} \equiv \Omega^* \quad (24)$$

Where Ω represents the wealth of the migrant, C_i (1+r) - the amount to be repaid, $\Omega(1+r)$ - represents the lost guarantee, and E(J) the expected value following a legal or social sanction.

Needs to study within this model is wage determination. Thus, in the case of a closed economy for migration, labor demand (MFF) is given by:

$$CFM = \begin{cases} [1 - G(\Omega^*)]m & daca\ s < \bar{s} \\ 0\ if\ s \geq \bar{s} \end{cases} \quad (25)$$

where $\bar{s} \equiv \frac{q-1}{1+m}$ calculates the salary rate for which a migrant is indifferent to becoming an entrepreneur or an employee and $G(\Omega^*)$ is the distribution of wealth.

Therefore, for a higher rate, the number of migrant entrepreneurs and labor demand would fall below 0, while for a lower rate the demand for labor is proportional to the number of entrepreneurs.

Job offer (OFM) is given by:

$$OFM = \begin{cases} 0, daca\ s < \underline{s} \\ G(\Omega^*)\ \textbf{daca}\ \underline{\mathbf{s}} \leq \mathbf{s} < \bar{s} \\ \mathbf{1}, daca\ \mathbf{s} \geq \bar{s} \end{cases} \quad (26)$$

With regard to human capital, the same authors present a two-period analysis, in the first period individuals earn a minimum wage (s_m)and receive a transfer (R) from the previous generation migrants, giving them the opportunity to invest in an education program at a given cost. The decision to make this investment in education, marked with e, is taken under the constraint of liquidity, because at the end of the period, their savings can not be negative.

$$e = \begin{cases} 1\ \ daca\ R \geq 1 - s_m \\ 0\ daca\ \ R < 1 - s_m \end{cases} \quad (27)$$

In the second period, the authors of the model assume that the agent transfers part of the income earned on his child, the value of this transfer is denoted by *t*. The dynamics of the transfers is described by:

$$R_{+1} = \begin{cases} ts_{+1}\ \ daca\ R < 1 - s_m \\ bs_{+1}(1+E) daca\ \ R > 1 - s_m \end{cases} \quad (28)$$

where s_{+1} is the wage rate, in the second period t + 1, E is the return to education.

Also, in order to study the determinants of remittances, the mathematical function can be estimated:

$$R = f(PIB, RS, PopG, OPN, IPC, AF, DYR, RRD, SVal) \quad (29)$$

a function that was developed following the economic models proposed by Adenuga (2008), Mitrovic and Jovicic (2006), Poola and Ruiz (2005).

The variables presented are: R - remittances, GDP - real GDP, RS - unemployment rate, PopG - population growth, OPN - openness measured as the share of exports and imports in GDP, CPI - consumer price index, - real interest rate, SVal - currency exchange. The logarithm variables are used in model estimation.

- **Reasons for remittances at microeconomic level**

Rapoport H. and Docquier F. (2005) analyzed the altruistic reasons that lead a migrant to send money to his family at home; the authors developed a model that measures altruism, starting with Stark's (1995) model. The degree of altruism is measured by $0 \leq \alpha^i \leq \frac{1}{2}$, and it can be migrant or household. Thus the usefulness of the migrant is described by the authors of the model through the relationship:

$$U^m(C^m, C^g) = (1 - \gamma^m)F(V^m - R) + \gamma^m F(V^g + R) \quad (30)$$

U is the utility, *V* - are household incomes before remittances, *C* - consumption, and *R* - is the amount of remittances sent by the migrant to the household - *g*, and F measures the emigration of the migrant derived from own consumption ($F(C^i)$).

γ^m is calculated by the formula

$$\gamma^m = \frac{\alpha^m(1 - \alpha^g)}{1 - \alpha^m\alpha^g} \quad (31)$$

The optimal remittances can be computed by:

$$R^{\dagger} * = Max\{\gamma^{\dagger}m\ V^{\dagger}m - (1 - \gamma^{\dagger}m\ )\ V^{\dagger}g, 0\} \quad (32)$$

cu $\frac{\partial T^*}{\partial I^m} > 0, \frac{\partial T^*}{\partial I^h} < 0$, $\frac{\partial T^*}{\partial \beta^m} > 0$, $\frac{\partial T^*}{\partial \beta^h} < 0$.

So when the income and degree of altruism of the migrant grow, there is an increase in the volume of remittances, but they do not increase when household income increases.

Other economic models that study the relationship between the volume of remittances and the degree of altruism of the migrant also aim at testing assumptions such as: higher income migrants remit larger volumes, low income households receive more remittances, remittances increase when the relationship migrant and household members is closer and decreases when other members of the same household migrate to other countries.

Conclusions

From the study, the authors sought to draw a series of conclusions. The first is that migration is the effect of an individual or group decision to leave a geographic space for economic, financial and social reasons, of course, going to go to those geographic areas that provide a range of net superior conditions. The second conclusion is that the migration process has been studied for a very long time, a context in which models of micro or macroeconomic approach were used, usable also under the current conditions to carry out a complete study on migration. Migration can not be separated from remittances because those people who work in a place other than where they emigrated create additional income that in high proportion brings them to the family, the social group they belong to in the country from which they left. There are a number of models such as gravity, gravity, human capital, or space search for jobs, which show that migration is closely linked to remittances and consequently determinant in a certain way, and on the level of development of one country or another. Another conclusion is that based on data, especially in long series, a complex analysis of migration, remittances and economic growth in each country can be made. It is not by accident that the European Union has issued a directive which ensures the free movement of persons in the European space.

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