

High Skilled Emigration and Wealth Distribution

Nuno Trindade Magessi , Luis Antunes
Universidade de Lisboa
LabMAG
nmaggessi@hotmail.com; xarax@di.fc.ul.pt

Abstract— Emigration is a social movement associated to the demand of better life conditions in different countries from those where one was born. In the specific case of skilled workers, this phenomenon is typically characterised in a negative way, due to the country's loss of highly skilled resources, in whose education significant investment was done. While the impact of immigration on labour markets is widely studied and developed, the same is not true in what respects the impact of emigration at emigrant's home countries. This article aims to analyse the effects of high skilled emigration from developed countries on wealth distribution at origin countries. For such purpose, an agent model was developed, and simulations are proposed to depict this phenomenon and discuss the inherent impacts.

I. INTRODUCTION

The recent flows of emigration occurred in Europe affected by the sovereign debt crisis have sparked debates in origin countries about the inability of these to offer employment to its citizens. This fundamentally happens when labour force is young and highly qualified and where the dominant discourse is the impoverishment of the country. The questions that arise are: is this social movement positive or negative to the origin countries, in terms of wealth distribution? What is the role of the employee's wealth expectations during labour activity? The rising of the phenomenon of emigration always has an impact on the demographic structure of a country as well as in family relationships. However, and although the phenomenon carries a negative connotation in people's common sense and removes qualified work force from labour market, the reality is that there may be other factors that transform emigration in a positive issue for the labour markets at origin countries.

Migratory movements are an important mechanism because they give people access to better income levels comparing with what they have in their home countries [1]. This empirical evidence is found when emigrants increase their earned wages in host countries. Currently, there is considerable literature about the effects of immigration on wages in host countries. This literature is striking to note that negative impacts are small and statistically irrelevant. However, the literature is limited in what concerns highly qualified young people. This is

surprising, because overall migration causes more impact on origin countries than in the host countries, taking into account the massive exodus over several countries. In this sense, we will study the effect of highly skilled emigration on origin countries regarding the distribution of wealth concept. For this, we opted to use a multi-agents methodology to develop a model that replicates this reality, allowing us to make some remarks about this subject.

This article is organised as follows: in the next section, we review the scanty literature about the effects of emigration on wealth distribution. On section 3, we present and describe our multi-agent model. Section 4 outputs the obtained results in what concerns the scope of this research. Finally, on section 5, we establish our conclusions and introduce future steps to this research.

II. REVIEWING RELEVANT LITERATURE ABOUT EMIGRATION

The return of intensive international migration in the last 5 years is one of the main reasons for the growing interest about the relations among emigration, labour market and wealth distribution. In 1962, [2] had already alerted to the question: "how effective is the inter-regional migration in the income fairness of comparable work?" Since then, migration has been linked to the economic development.

In 1993, [3] launched a theoretical basis, with some empirical evidence, where migration serves as an important driver for economic convergence between rich and poor countries. This impact is rarely mentioned and where wages act as a convergence mechanism. The debate over highly skilled brain drain and emigration, for example, derives indirectly from this argument that was covered extensively in the literature. However, the impact on the labour market as well as on the wealth distribution of the origin country is rarely mentioned.

The relation between supply and demand of labour establishes that a decline in labour supply in the origin country should raise wages, because immigration determines the return into equilibrium of labour markets. Migration is also attractive to move out people from poverty, providing economic alternatives to families outside the local market. Its influence extends to the labour at the household level [4], often in addition to

[□]This work was not supported by any organization

other families [5]. The simplified neoclassical model motivates us to verify if it makes sense not increase wages after a migration flow. Given the above argument, the law of supply and demand have clear implications, where the effect can theoretically range from zero to very large. For example, [6] remarked that the free movement of workers helped relieve the pressure on the domestic labour market, reducing unemployment and boosting growth in wages, although this has caused great labour shortages, in certain sectors. In 2007, [7] found that in fast-growing economies, the incompatibility of simultaneous exit of workers in the middle of a growing demand requires a country to resort immigration in order to offset the gap.

In Europe, research shows that emigration has contributed to the convergence of real wages by reducing the growth of the labour force [3]. Borjas inspired another branch of research focusing on the impact of national migration, instead of smaller geographical segments [8]. As such, the major determinant of immigration impact on wages is the range of skills distribution within groups, over time. In addition to identifying replaceable workers, two additional factors influence whether and how a change in the workforce will change the labour market. The first is a direct change in the composition of skills of the labour force, an effect through the labour supply. In this sense, an impact on the labour market should be migrant's skills, which is composed differently from the native labour force. A second factor is an indirect effect affecting the demand for labour. The production mix of tradable goods and the degree of international openness of a country economy will determine whether and how quickly the labour market of this country adjusts to its long-run equilibrium. For instance, the labour market in a relatively closed economy, with little variety in the merchandise exported will likely experience long-term changes in its own equilibrium, when it faces a change in its workforce. A relatively open economy, with a mixture of high power will return to the original equilibrium if the adjustment occurs [9].

There are few studies that have measured empirically, the impact of emigration. The majority explores the variation in skill sets over the time. In 2007, [10] and [11] in Mexico, [12] one year after in Puerto Rico and [13] two years later on Moldova, they all conclude that emigration increases wages with elasticity's ranging from 2% to 6%. In 2012, [14] have used a stylized growth model to analyze the various channels through which a "brain drain" affects the sending countries. They conclude that high-skilled emigration not deplete a country's human capital stock, generating some positive network externalities.

Although some micro-level studies allowed us to verify that shocks of income on migration choice varies

according to the wealth. However, this reduction was not convincingly to establish relations for a theory. Meanwhile, several studies relate macro-level measures of average income inequality and migration using cross-country data, but do not use the income distribution to identify the prevalence of financial constraints in the population for potential migrants [15]. This article fills those gaps by deriving a generalized mapping between wealth distribution, income shocks, and the rate of migration flow. It was identified a constrained choice in migration liquidity based on randomized money transfers to the poorest families in Mexico and Bangladesh.

The remittances are a major economic component on developing countries, reaching 20 % of GDP in many developing countries [16]. The most relevant literature discusses the effects of remittances on poverty and wealth distribution. There are many studies that support poverty reduction [17], [18] and initiate a dynamic development marked by reduced production and constraints to the existing investment in the economy [20]. This happens because it provides opportunities for revenue growth, helping origin countries to create small business [22] or by creating a path for risk diversification [23].

Studies also suggest that remittances can produce a cycle of dependency and stunting the development of origin countries. More specifically if the funds are spent on consumption, rather on savings. Or when these funds generate employment in low-productivity activities, contributing to an unsustainable lifestyle, in the long term [24]. More recently, studies have shown that remittances used for consumption generates strong multiplier effects on the origin countries economy [19]. Literature had also considered the impact of migration and consequent remittances on economic disparities in the origin countries. Many studies have found that the flow of remittances reduce income inequality and wealth [20], while others observed the opposite pattern [18]. Recent studies serve to reconcile these patterns showing how the impact of remittances on inequality depends on the cost or the level of migration [24], [25].

III. MULTI-AGENTS' MODEL

The proposed model, named SEWD, Simulates the impact of Emigration on the Wealth Distribution in society. The intent is to reflect the labour market of a society by using a multi-agent methodology. The market is composed by companies and workers. The workers demand for the work supplied by companies in order to generate wealth.

A. SEWD Model Parameters

The multi-agent model is composed by a group of parameters with impact on wealth distribution and con-

trolled by the researcher. The parameter named best companies performers (ϕ) determines the initial quantity of companies (patches) that have the capacity to pay a high level of salaries (ω). As more companies exist in society with capacity to pay high salaries, the greater is the possibility for workers to increase their wealth and avoid the decision to emigrate.

The salary growth interval (φ) determines how often the salaries grow in the market. It represents the output of negotiations among government, labour unions and the employers association, in a context of social agreement. If this cycle is long it means that the labour market may be closed to full employment. This happens because all the agents are satisfied with the conditions they have. This parameter affects the stability of salaries over time and consequently the accumulated wealth. Another parameter is the growth of salaries (g) and it determines how much money is incremented in the salaries practiced in the labour market. The wages growth is established by the decisions occurred in each round of negotiations among agents.

The parameter number of employees (η) determines the initial number of workforce susceptible to do their activities in this market. The age at onset of labour activity (m) represents the shortest age that an employee can start working on this market according to the law against child labour. On the other hand, the maximum expected age activity (M) is the longest age that an employee can work on this market according to the law that establishes the age for retirement. As higher is the gap between both parameters the greater is the possibility of a worker accumulate high wealth at the end of his labour life. The maximum salary (ζ) parameter sets the highest amount of income that an employee demands on the labour market. The maximum mobility parameter (π) gives the range of possible companies that an employee could be interested in working on. The justification for this parameter is the fact that some attractive jobs are far from their houses, which is a constraint that affects their expectations about their way of life. Normally, employees are reluctant to change from their region to work. Employees have a consumer pattern defined by consumer percentage parameter, that interferes in savings and consequently on the accumulation of wealth. The “wage capacity” parameter represents the maximum amount of money that employers can offer to employees. For each income level a proportional tax rate is applied. Another parameter is the “maximum wealth expectancy” representing the employee’s expectations regarding the wealth that they can accumulate during their working life. Finally, the parameter “salary multiplier” settles the salaries increment that immigrants or emigrants will require to enter or return to this labour market. When there is shortage of highly qualified workers, companies have to increase salary rates in order to attract and recruit them abroad.

B. SEWD Model Description

This model is intended to demonstrate the effect of emigration in wealth distribution. It represents a society with the respective labour market, composed by companies representing employers and where employees demand for a job opportunity. Employees will try to maximise their wealth by looking for better salaries in order to match their wealth expectations. In our simulation, we use NetLogo patches [26] to represent employers who are offering a job. A dark patch represents a company in difficulties, without projects in its portfolio and consequently not recruiting new workers and without attractive salaries. On the contrary, a light yellow patch symbolises a very dynamic and competitive company with many projects in its portfolio and looking for high qualified workers in the market (see Fig.1). This process works dynamically. This means that an excellent company (yellow patch) could become in bad situation (black patch) if paid wages beyond their means. When a patch change from black to yellow means that a new company have replaced the position of a bankrupt company.

So, the colour variation depends of the competitiveness in the market and respective success of companies. If a employee salary is more than company capacity ($\zeta > \omega$) each patch changes dynamically from yellow to dark and vice versa, revealing the high or low competitive environment among companies.

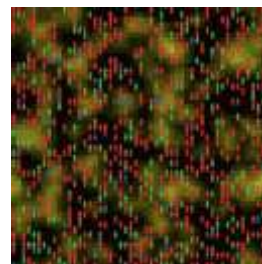


Fig1. Labour market environment

Each healthy company has some projects where can invest in order to create more value to their stockholders and consequently to the market. Through the implementation of these projects, companies have a number of available jobs in order to increment the value (v) of labour market. So, v is the value generated by the business and depends on the company’s budgeted investment for each year and it is expressed in net cash flows. This investment is settled randomly and has ω as an upper limit ($v < \omega$). In this sense, the jobs added to the market comes as a function of the number of best companies’ performers and the maximum investment capacity (1).

$$p = f(\phi, \omega) \quad (1)$$

$$v_t = v_{t-1}(1+g)^i \quad (2)$$

Additionally, the amount of resources and consequent value creation can grow on each company, which translates into the hypothesis of market value growth (2). Employees receive their salaries from the value they helped to generate in companies. The individual salary (γ) is obtained from companies, where each employee works in each time period generating his/her own wealth. A salary is used by employees to consume where the remaining amount is allocated to savings, in order to increase their wealth. Consumption value is established randomly, lower than consumer parameter (δ) and is less than maximum salary ($\delta < \zeta$).

The model begins with a randomly-settled, unequal, wealth distribution. Workforce is divided according to their initial wealth, in three classes: rich, medium class and poor. Then, an employee wanders around a good company performer gathering as much salary as he/she can (3). This means that if an employee find another company inside of his/her maximum mobility (π) offering better salary, he/she will resign with his company and moves to the new company.

$$\gamma_i = \max (v_i, \pi_i) \quad (3)$$

where

$$\pi_i = f(\pi_{i-1}) \quad (4)$$

Employers attempt to move in the direction where most of the high salary companies (yellow patches) are, and up to where they are available to be reallocated qualifications to go. The maximum reallocation that employees are willing to commit themselves is given by the parameter that rules the maximum mobility that an employee could accept. (4). This means that employees could restrict their job search. In our model, the radius of maximum mobility varies between one company (patch) and fifteen companies (patches). Consequently, depending of their maximum mobility, employees will move in the direction of the company or group of companies offering better salaries.

As described above, in each time period, each employee consumes and saves part of his/her income. Consequently, in every run the wealth (w) is calculated as follows (5):

$$w_i = w_{i-1} + \gamma_i - t_i \gamma_i - \delta_i \gamma_i (1-t_i). \quad (5)$$

Employees also have an expectation about the period of labour activity, according to the wealth they want to achieve. This expected activity (ea) is given by (6):

$$ea = m + (M-m) \quad (6)$$

where the difference ($M-m$) is settled randomly.

When employees decide to retire ($i \geq M$), where i is the employee age, or when they are unemployed because $w_i < 0$, they simple get out of the labour market. The unemployed workers emigrate to other countries looking for a job opportunity. Emigration can also happen if employees don't match their wealth expectations (6). The expected wealth is based on maximum expected wealth (u) and calculated as follows (7):

$$\hat{e} = u / ea \quad (7)$$

If emigration happens, a company is forced to recruit a new employee to fill the vacancy left by the employee who emigrated. In Portugal, when high qualified workers emigrate they don't send remittances to its origin country. This is a phenomena occurring nowadays and goes contrary to what is explicit in [14]. High skilled workers don't send remittances to their origin countries only low skilled workers. We use this fact as assumption in our model in order to represent this new emigration profile.

However, companies can opt to offer a salary above the ones that were practiced in the market or to invest in recently graduated students. So, new employees enter the labour market with a salary randomly settled and ranging uniformly from the poorest to the richest agent in activity.

C. SEWD Model Lorenz Curve and Gini Coefficient

To analyse the fairness of the wealth distribution, we have drawn the Lorenz curve, a tool frequently used in these circumstances. We have ranked employees by their wealth and then we have plotted the percentage of them that owns each percentage of the wealth. We ranked the employees based on their wealth, from the greatest to the least: the poorest employee would have the lowest ranking of 1 and so forth. Then we have plotted the proportion of the rank of an employee on the y-axis and the portion of wealth owned by this particular employee and all the workers with lower rankings on the x-axis.

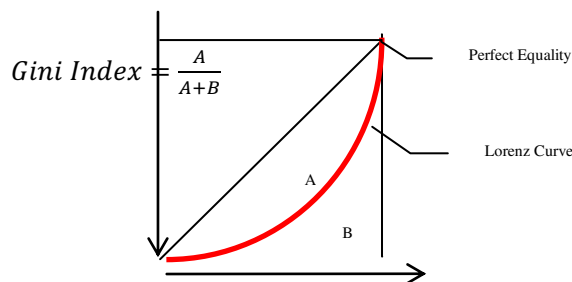


Fig.2 Computing Gini Coefficient Schema

For example, employee alpha with a ranking of 20 (20th poorest in society) would have a percentage ranking of 20% in a society of 100 agents. The corresponding plot

on the x-axis is the proportion of the wealth that this employee with ranking 20 owns along with the wealth owned by all workers with lower rankings, from 1 to 19.

A straight line with a 45 degree angle at the origin (or slope of 1) is a Lorenz curve that represents perfect equity meaning that everyone holds an equal share of the available wealth. On the other hand, should only one individual hold all of the wealth in the population (i.e. perfect inequity), and then the Lorenz curve will be a backwards “L” where 100% of the wealth is owned by the least possible percentage proportion of the population.

For a numerical measurement of the fairness of the distribution of wealth, the Gini coefficient is derived from the Lorenz curve. To calculate the Gini coefficient, we first have found the area between the 45-degree line of perfect equality and the Lorenz curve. Secondly, we divided this quantity by the total area under the 45-degree line of perfect equity, which is always 0.5. If the Lorenz curve is the 45-degree line then the Gini coefficient would be 0, meaning that there is no area between the Lorenz curve and the 45 degree line. If, however, the Lorenz curve is a backwards “L”, then the Gini coefficient would be 1. Hence, equity in the distribution of wealth is measured on a scale of 0 to 1.

IV. SIMULATION RESULTS

The results reported in this section were obtained conducting the described experiments using version 5.0.4 of the NetLogo framework [26]. NetLogo is a programmable modelling environment for simulating natural and social phenomena. It is particularly well suited for modelling complex systems developing over time.

At this stage of research, we are still doing more experiences and getting insights on how the several parameters impact the system dynamics. So, in this section we will only analyse the results under the scope of this article.

In terms of parameterization we used as reference indicators from Portuguese labour market in 2012 [Source: Eurostat]. It is an excellent example, according the long tradition of emigration in this country. In this sense, the number settled employees are 1000 and the percentage of best companies’ performers with condition to pay high salaries is 6%. The wage growth interval is established in 5 years. When it grows, the incremented value is about 8%. Companies have on average an offer limit of 25 thousand of euro and employees a demand average limit of 15 thousand euro. The minimum and the maximum expected activity are 22 and 66 years old. The maximum mobility parameter we assumed a value of 2 in a scale of 0 to15. Employees reveal a consumer pattern of 65% of their salary. The maximum wealth expected by employees during their labour activity is in average €20,000. We

decided to apply the current tax rates in Portugal. Portugal at this moment uses progressive tax rates. Consequently, we used the average rates for the first, second and third levels of income. The main reason to choose these values is to match the current values practiced in the Portuguese labour market (see table 1).

TABLE 1 - Normal and Average Portuguese Tax Rates [Source: Portuguese Tax Authority]

Income Level (in €)	Normal Rates (in %)	Average Rates (in %)
<=7000	14,5	14,5
>7,000 to <= 20,000	28,5	23,60
>20,000 to <= 40,000	37,0	30,3
>40,000 to <= 80,000	45,0	37,5
>80,000	48,0	-

After several runs, we verified that wealth expectations and the capacity of companies in recovering the human resources they have lost, through immigration, are key factors to retrieve some conclusions. So we built four scenarios. The first one was emigration with low value of expected wealth and without immigration. It means that companies didn’t succeed in finding new employees to replace the exit ones. If we take a look for simulated results, we verify that emigration does not have impact on wealth distribution, maintaining the Gini-Index relatively constant. (see Fig.3)

However, if we put a high expectation on employees’ wealth (>€22 thousand), the Gini-Index decreases as the number of employees emigrated, revealing an artificial increase on wealth distribution. We called artificial because in reality there is no improvement on the distribution of wealth.

What we have is an exit of workers with low salaries to other countries and the permanence of employees with good salaries. In other words emigration has an impact on this specific case, not in function of better redistribution of wealth, but due to massive exodus of underpaid and high qualified workers. The greater are the expectations to become rich, the greater is the number of emigrants and the lower is Gini-Index. (see Fig.4)

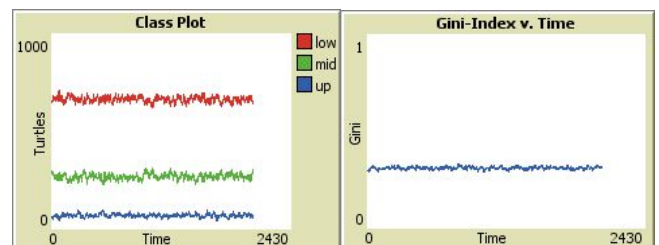


Fig.3 Simulation of emigration effect on wealth distribution with low expected wealth

Logically the society could improve wealth distribution, if emigrated employees transfer remittances to their relatives frequently. But as we saw earlier this is not the case for high skilled workers.

Of course and as it was referenced earlier, companies can recover the lost manpower by recruiting new employees in other countries with better remunerations or wait for students to finish they degree and pay them the same salary. So, if companies recruit outside the Gini-Index remains stable and ranges between 31,5% and 33%. (see Fig.5)

Instead, if companies decide by the option of investing in recent graduates, the distribution of wealth decreases slightly into a range between 28,9% and 30,3%. (sees Fig.6)

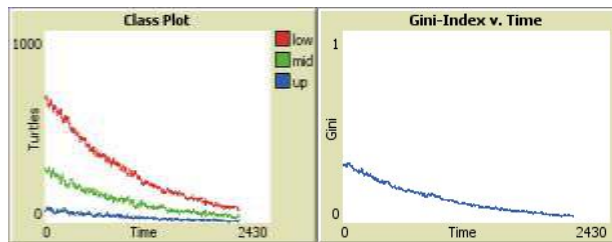


Fig.4 – Simulation of emigration effect on wealth distribution with high expected wealth

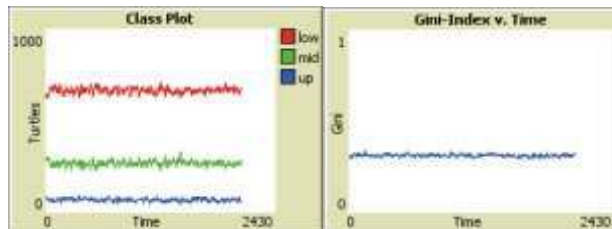


Fig.5 Simulation of emigration effect on wealth distribution with consequent immigration

Now if we compare figures we realize that Fig.5 and Fig.2 have similar patterns in what concerns wealth distribution.

This situation suggest that a market composed by employees with low wealth expectations have the same impact on wealth distribution as it have, if companies decide to invest in new and less experienced graduated

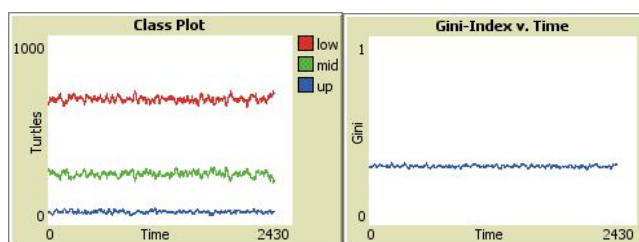


Fig.6 Simulation of emigration effect on wealth distribution with consequent immigration

students. In the case of high skilled workers where remittances transference doesn't happen, a better wealth distribution could be achieved, if companies can recruit high skilled workers in other markets, even if they have to

pay more money. This action will improve the price equilibrium in labour market of origin country. In our case, the increase in Gini-Index is not substantial because we have used current parameters of Portuguese Labour Market. For example the consumption rate and the proportion of taxes in salaries influence results. And obviously these parameters differ from country to country. We didn't contemplate the impact of these parameters because it was outside of article scope.

V. CONCLUSION AND FUTURE WORK

The main goal of this article was to study the impact of emigration in the distribution of wealth. After multiple runs, results suggest a small contribution of highly qualified emigration to a better wealth distribution. Results also demonstrated that highly skilled emigration could generate a better Gini-index and consequently a better distribution of wealth in origin country. This depends on the role of the employee's expectations. However, this is an artificial impact, because the index has not improved because of greater effectiveness on the allocation of wealth, but rather because of the population reduction. Workers with low salaries get out of country and consequently reduce the active population. Future steps involve the analysis of other situations that contribute to the oscillation of emigration and consequent effect on wealth distribution. For example, instead of assuming that all workers are highly qualified, we will divide the society in high and low skilled workers. With this procedure we want to include the effect of remittances sent by low skilled workers.

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