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The effect of the Romanian pension market concentration on the magnitude of pension revenues

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Abstract. *Pension valuation allows for the estimation of the pension revenue that employees are entitled to receive after retirement. The high level of concentration on the Romanian pension market affects the pension revenue employees are entitled to receive after retirement in that, on a long run, 20 – 30 years, the higher pension revenue is provided by the bigger pension funds (with a market share over 30%). This study explores the effect of pension market concentration on the magnitude of the pension revenue by employing an agent based simulation technique.*

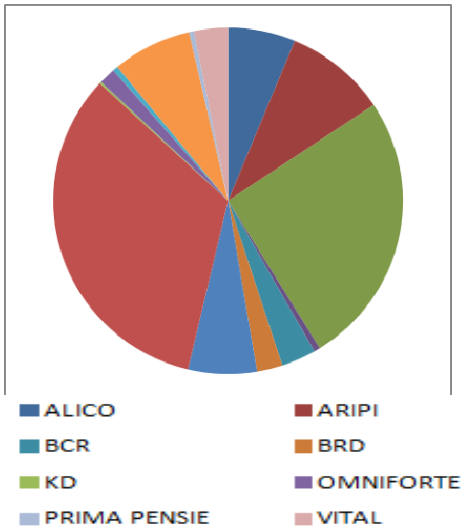
Keywords: private pensions; valuation; agent based simulations; Romania.

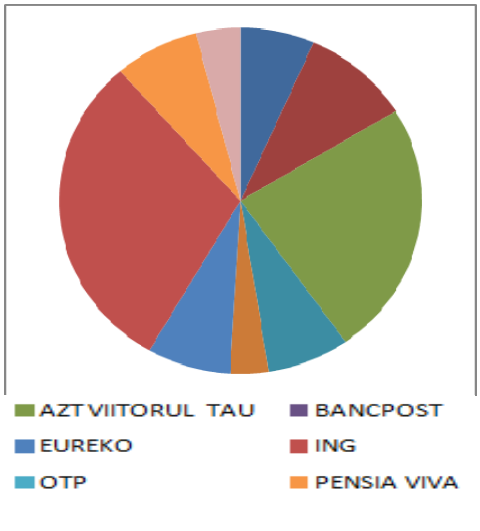
JEL Codes: C6, C63, G2, G23.
REL Code: 12I.

Competition on the Romanian pension market

Pension valuation allows for the estimation of the pension revenue that employees are entitled to receive after retirement. The pension revenue that employees are entitled to receive after retirement is dependent on, amongst others (e.g., level of pension contributions), on the number of participants of a privately managed pension fund. Many participants can pull together more contributions and, this way, generate higher returns. On the other hand, many participants may lead to higher administrative costs which can diminish the pension revenue that employees are entitled to receive after retirement. That is why, the number of participants and the way in which they are dividend amongst pension funds is relevant for pension valuation, namely, for the determination of the pension revenue that employees are entitled to receive after retirement.

The year 2008 was the year in which the Romanian pension reform started by extending the pay-as-you-go system with a second pillar of individual pension accounts. The number of privately administered pension plans decreased from 14 in 2008 to 9 in 2012. Combined, the private pension funds have under management assets worth over 2 billion euro, around 1.60% of the 2012 Romanian GDP. The body responsible with regulating the activities of the Romanian pension funds is the Romanian Private Pensions Supervisory Commission (CSSPP). Recently(1), representatives of CSSPP stated that "the number of players, the volume and the size of the pension funds allow for competition in pension market". Nonetheless, the way in which participants are allocated across pension funds (figures 1a and 1b) shows the fact that two of the pension funds have more than 50% of the total number of participants. The same result is obtained if the total value of assets is used instead of the number of participants. As figures 1a and 1b show, the concentration level on the pension market is high and was accentuated in time due to the fact that the participants of the disappearing funds were absorbed by the surviving funds.





Source: Romanian Private Pensions Supervisory Commission statistics http://www.csspp.ro/evolutie-indicatori/

Figure 1a. *Allocation of pension fund participants across pension funds for year 2008*

Figure 1b. *Allocation of pension fund participants across pension funds for year 2012*

Impavido et al. (2009, p. 33), define a competitive pension market as one where the participants react to administrative costs levels and rates of return in that they chose to be transferred from a pension fund with high administrative costs or/and low returns on investments to a pension fund with low administrative costs or/and high returns on investments. Nonetheless, the number of participants transferring from one pension fund to another is reduced for the Romanian pension market(2). The reduced number of transfers is motivated by participants' inertia and lack of understanding with respect to the pension related decisions that have to be made (Impavido et al., 2009, p. 14). Inertia is also to blame when new employees that enter the labor market do not opt into which pension fund to become participants. This state of inertia can lead to high operational costs for pension funds that can splurge when it comes to marketing expenses. To avoid high marketing expenses, the Romanian pensions' regulatory body imposed the automatic enrollment for employees entering the labor market. According to recent legislation(3), the auto – enrollment is done by the CSSPP that considers the effort of pension fund administrators in attracting and informing participants and the concentration level of the pension market. Additionally, the Romanian pension market has entry barriers that relate to the minimum required capital level imposed on

those who want to become pension fund administrators. That is, in order to manage a pension fund, those that wish to do so must provide proof of having at their disposal the amount of four billion Euro(4).

Due to participants' inertia, the regulations related to the accepted asset allocation of the pension funds, the regulations related to the maximum level of administrative fees and the entry barriers, the Romanian private pensions market is not one which is characterized by competition. In order to reproduce in time and space the competition level observed on the Romanian market, agent-based simulations can be employed. Pension valuation allows for the estimation of the pension revenue that employees can receive after the moment of retirement from a specific pension fund. Pension valuation in a market with low competition can be done by using agent-based simulations.

Role of simulations in pension valuation

Pension valuation allows for the estimation of the pension revenue employees are entitled to receive after retirement. Due to the fact that the pension revenue is received after a long period of time in which pension contributions are paid (e.g., if the employee enters the labor market at the age of 25 and retires at the age of 65, then the period during which he pays pension contributions is 40 years), pension valuation requires a look into the future. A possible future can be sketched by employing simulations techniques. By making use of simulation techniques the future can be represented in multiple scenarios and values for variables of interest can be obtained in each scenario. For a high number of variables values, the mean of these values can be reasonably assumed to be the expected value of the variable.

In order to generate future scenarios, the system that is simulated is described through a model. Although describing a pension system through a model does takes away the fine realistic features of the system, there are advantages in that a model allows for an in depth analysis that eases the understanding of the complex mechanisms that govern the pension reality. Therefore, a pension system can be described through variables and mathematical equations between these variables and the modeler can easily make *ceteris paribus* analysis by varying variables and seeing the effect of that variation in the results. These types of analyses are more difficult when using real data and econometric models due to the fact that important independent variables can be omitted. By using simulation techniques causalities can be identified and not just influences as it is the case when incomplete econometric models are being used. The simulations can accommodate the reproduction of the model for more time periods and this way the system modeled can be viewed as it evolves in time. For a pension system the simulation of the model

offers insights with respect to the pension revenue that employees are entitled to after retirement.

As all methodologies, the simulation methodology evolved in time and nowadays, due to the increased computational power of computers, the new forms facilitate the modeling of behavior for individual agents which, through interaction, offer an aggregate result. As an example, these types of simulations incorporate the individual behavior of buyers and sellers on a market so that the equilibrium price can be retrieved from their interaction. These types of simulations are agent-based simulations. For the pension environment, agent-based simulations can be employed where the model mimics the behavior of participants when choosing a pension fund. This gives insights into the level of financial knowledge of participants as high concentration on the pension market (i.e., many participants in few pension funds) can signify low financial education. If this result is identified in the real pension market, such research can guide regulators to take measures with respect to the form in which pension related information is communicated to participants with a heterogeneous financial education.

Simulating the competition on the Romanian pension market

The Romanian pension system is of the defined contribution type. One of the characteristics of this type of pension systems is that participants are at liberty to select the pension fund in which they want to place their monthly pension contributions. By introducing the second pillar of the Romanian pension system, the reform imposed mandatory participation to some employees, i.e., under the age of 35. By using agent-based simulations the choice of employees for a specific pension fund can be modeled. In this analysis the employees are governed by a behavior according to which the pension fund is chosen based on the "proximity" to the pension fund. Here, the term "proximity" is one that refers to the vicinity to information, that is, an employee can chose a pension fund after he requires a recommendation from a neighbor or if he is convinced by a marketing agent. Also, similar to the real situation, the pension funds increase in size (the size is given by the number of participants) with the passage of time and it is expected that a bigger pension fund will attract more employees than a smaller pension fund.

The programming language Netlogo[5] allows for the behavior of choosing a defined contribution pension fund to be simulated for individual employees. Figure 2 presents a part of the graphical interface of Netlogo. In Figure 2, the pension funds, represented by the geometrical figure of a square, increase in size with the number of participants that chose those specific funds (e.g., the orange square in the middle of Figure 2). As a pension fund becomes

more dominant on the market, more undecided employees that will "hear" of that pension fund will chose to become participants in that specific pension fund.

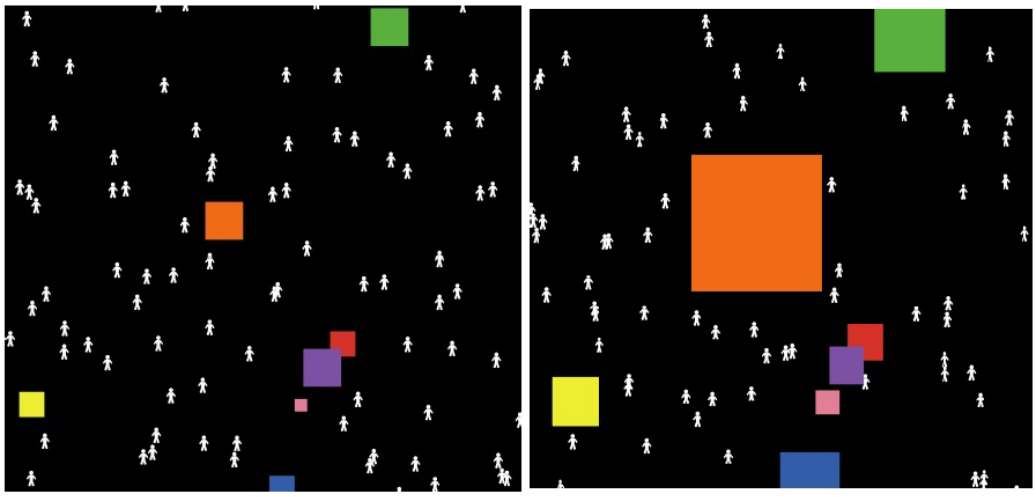


Figure 2. *Simulation of the Romanian private pension market*

The model developed in this paper accommodates seven pension funds(6) – represented by the geometrical figure of square, and 100 employees. The simulation follows the evolution of the pension system and allows for the estimation of the pension revenue for each pension fund.

Figure 3 presents the evolution of the number of participants of two pension funds: pension fund M, that belongs to the upper quintile of the size distribution, and pension fund m, that belongs to the lower quintile of the size distribution.

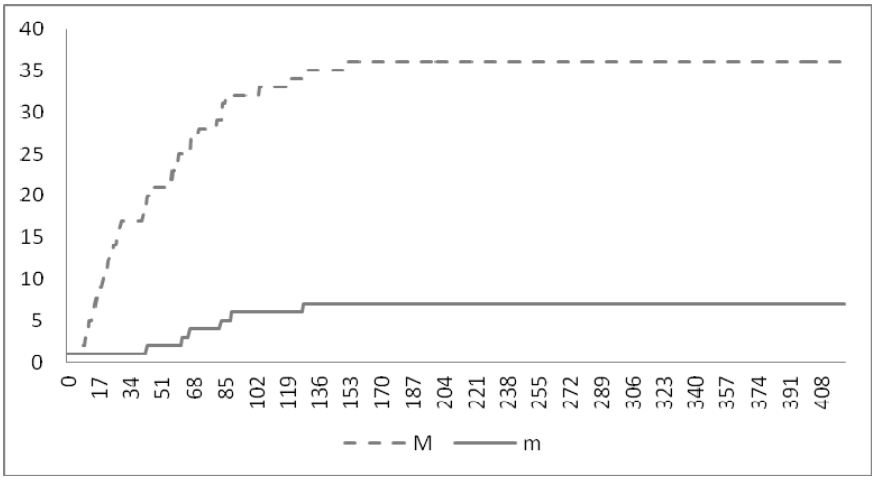


Figure 3. *Evolution of the number of participants*

In the model, the number of participants is normalized to 100. The analysis is repeated for different number of participants, the biggest being 100,000, but the results are maintained: one of the pension funds is the market leader with a number significantly higher that the number of participants of a small pension fund (similar to the situation in Romania). This result is obtained because the model is trying to replicate the reality in which an employee takes the decision to participate in a pension fund because of the "proximity" (e.g., receiving an advice from a neighbor) to the pension fund.

Simulating the activity of a pension fund

The management of a pension fund is also described by a model (Cui et al. 2011, pp. 1-29). The pension fund participants pay pension contributions c which are a percentage of the average salary $\bar{S}$. The total value of the gross pension contributions received by the pension fund i for time t, Cb_t^i, depends on the average salary, the pension contribution and the number of participants in the pension fund N_t^i (equation 1).

$$Cb_t^i = \bar{S} \times c \times N_t^i \quad (1)$$

The total value of the net pension contributions of the pension fund i for time t, Cn_t^i, is obtained by taking out the value of the administrative fee Ca (in percentage), which is the same for all pension funds, from the amount of the gross pension contributions (equation 2).

$$Cn_t^i = Cb_t^i \times (1 - Ca) \quad (2)$$

The total assets value of the pension fund *i* for time *t*, A_t^i, is increased with the new net contributions received Cn_t^i and with the rate of return obtained from the investments of the pension fund. The total assets value of the pension fund is decreased with the pension payments P_t^i made by the pension fund to its participants that have reached the age of retirement. The financial assets in which the pension fund invests (for simplicity it is considered that the pension fund invests in a single type of financial asset) follow a Brownian motion with drift μ and annual volatility σ (equation 3).

$$\frac{dA_t^i}{A_t^i} = \mu dt + \sigma dZ_t \quad (3)$$

where *dZt* is a Wiener process. For this simulation, the historical rate of return of Romanian pension funds of 12% is used as an expected annual rate of return and the historic volatility of the Romanian pension funds of 4% is used as an expected annual volatility.

The evolution of the pension fund' assets are given by equation 4.

$$A_t^i = \left(A_{t-1}^i + C_t^i - P_t^i\right)\exp\left([\mu - \tfrac{1}{2}\sigma^2]\Delta t + \sigma\sqrt{\Delta t}Zt\right) \quad (4)$$

The model allows for the estimation of the replacement rate (equation 5) which represents the ratio between the pension revenue for the first ten years of retirement and the average wage earned for the last ten years of employment before retirement.

$$R_t^i = \sum_{t=P}^{P+10} \beta^t Vp_t^i - \sum_{t=P-10}^{P} \beta^t S \quad (5)$$

where R_t^i is the replacement rate, *P* the age of retirement, β the discount factor obtained from a risk free rate of return, Vp_t^i the pension revenue that can be paid to participants out of the pension fund' assets for the first ten years of retirement and *S* the average wage for the last ten years before retirement.

Simulating the Romanian economic environment

The economic environment in which the pension funds exist can be modeled. All the values of the parameters used in the model are described in Table 1.

Table 1

Economic parameters used in the analysis of the pension system of Romania

Name	Value
Average monthly wage	2,100 lei
Annual growth rate of the wage	2%
Monthly private pension contribution rate	3%
Annual growth rate of the pension contribution	2%
Annual risk free rate (for Romania)	6%
Monthly pension fund administration fee	3%

The parameters' values come from real data and estimations. The level of the average monthly wage, the level of the monthly private pension contribution and the level of the monthly pension fund administration fee are retrieved from actual data. Estimated values are used for the annual growth rate of the average wage, the annual growth rate of the private pension contribution and the risk – free rate of return. The model developed uses the parameters' values presented by the pension funds: the monthly pension fund administration fees for the year 2012 are 2.5% of the participants gross contributions and 0.05% of the pension fund asset; the estimated rate of return on a pension fund assets of 12% and the annual estimated volatility of 4% are calibrated for a period of 50 months of real data.

Results

In the simulation developed, an average private pension contribution rate of approximately 4.70% paid from an average wage of 3,286.98 lei for a period of 35 years(7) leads to a replacement rate of 9%. If the replacement rate offered by the public pension system which is agreed upon by the Romanian government is 45% and the private pension system offers a replacement rate of 9%, then the total pension revenue will be 54% of the average monthly wage. If the replacement rate wanted is 70%, then the average annual private pension contribution rate will be approximately 13% (for the calculation of this replacement rate both the public pension revenue and the private pension revenue are taken into account). So, if the public pension system offers a replacement of 45%, then the private pension system offers a replacement rate of 25% with a 13% average monthly contribution rate. If all the pension revenue comes from the private pension system and the replacement rate wanted is 45%, similar to the one meant to be offered by the Romanian public pension system then, keeping all other factors fixed, the average private pension contribution rate should be approximately 23% for the next 35 years. Currently, the public pension contribution rate is 35%, with 12% higher than what should

be paid if the private pensions system would offer the pension revenue integrally.

The simulation developed shows a situation in which for the first years the value of the gross asset is overtaken by the value of gross contributions because of the nature of the pension fund administration fees which are proportional to the size of the pension fund (Figure 4).

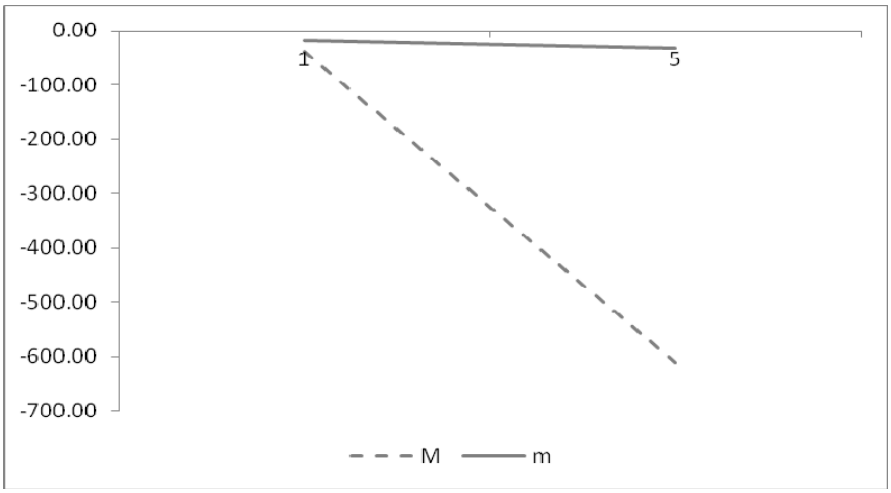


Figure 4. *Evolution of the pension fund net assets (gross asset minus gross contributions) for the short-run*

The analysis shows that for a short period of time (five years constitute a short period for the pension domain), participants that place their contributions into a private pension fund of a big size are in disadvantage compared to those that place their contributions into a small size pension fund. Thus, the small size pension fund has a net assets value close to zero which means that the participant receives pension revenue that covers the pension contribution made. Differently, the gross asset of the bigger pension fund does not cover the gross contribution of the pension fund participant.

On the long run (after 10 years) the situation is reversed in that the big size pension fund manages to have the value of gross asset much higher than the value of the gross contributions (Figure 5) due to the transaction volume.

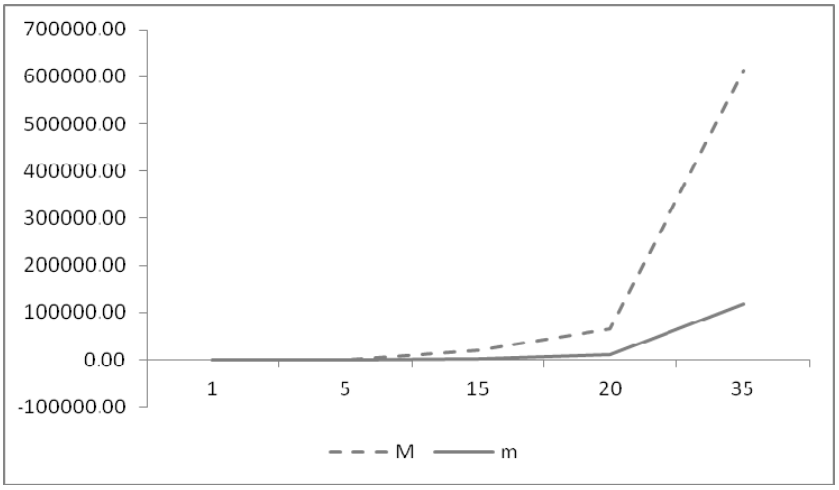


Figure 5. *Evolution of the pension fund net assets (gross asset minus gross contributions) for the long-run*

The difference between the gross assets value and the gross contributions value is directly connected to the number of participants in a pension fund and, implicitly, to the absolute value of the pension fund administration fee. On the short run, the unwanted difference between the value of the gross asset and the value of the gross contributions is much more pronounced in the case of the pension fund from the upper size quintile. Having an administrative fee proportional to the size of the pension fund leads to a situation in which a participant in a big size pension fund receives a pension revenue smaller than the pension contributions paid. In order to neutralize the negative effect of the pension fund administration fees, a big size pension fund has to have rates of return on investments higher than the small pension funds. On the long run, due to the volume of the assets, the big size pension fund has the value of the net assets higher than those of the small pension fund. Although pension fund M and pension fund m have different net asset value, the replacement rates of the two pension funds are not considerably different. Pension fund M, which belongs to the upper quintile of the size distribution, offers to its participants a replacement rate of 8.99%. Pension fund m, which belongs to the lower quintile of the size distribution, offers to its participants a replacement rate of 8.44%.

For a sensitivity analysis various variables can be varied: the pension contribution rate, the level of the pension administration fee, the estimated rate of return on the plan's assets, the discount factor etc. In the simulation the monthly private pension contribution rate is 5% on average for a period of 35 years. The rise of the monthly pension contribution rate to 8% leads to the replacement rate of 15%. For a replacement rate of 45%, the average monthly

pension contribution rate is 23%. In the base analysis the monthly pension fund administration fee is 3%. A decrease of the administration fee can lead to the increase of the replacement rate. Using a monthly pension fund administration fee of 2% leads to a replacement rate of 9.2%. The simulation uses in the base analysis an annual estimated rate of return on the pension fund assets of 12%. Considering the decreasing trend of the rates of return showed by the Romanian pension fund, by using a rate of return of 6% leads to a replacement rate of approximately 8%. In this scenario, pension fund M offers a replacement rate of 8.30% and pension fund m offers a replacement rate 7.82%.

The risk-free rate of return used as a discount factor is very important in the pension domain because of the long time horizon between the moment when the contributions are paid and the moment when the pension revenue is received. Thus, a high risk-free rate of return leads to a smaller discounted value and a low risk-free rate leads to a high discounted value. The accounting standards impose that the term structure of interest rates (different interest rates for different time periods) is used for obtaining the discounted value of the pension liabilities (in the case of defined benefits pension funds). Low values of the risk-free rates in developed countries have determined the abrupt rise of pension liabilities and the pension funds are forced to show pension liabilities that are higher than the pension assets. In this simulation the risk-free rate of 6% is used for the discounted value of the wage and the pension revenue, providing the participants with a replacement rate of 9%. A risk-free rate of 4% determines a replacement rate of 10%.

Conclusions

Pension valuation allows for the estimation of the pension revenue that employees are entitled to receive after retirement. The high level of concentration on the Romanian pension market (over 30% of the participants belong to a single pension fund) impacts the pension revenue that employees are entitled to receive after retirement. On the short run, e.g., five years, the big pension funds (with a market share of over 30%) do not offer to their participants a pension revenue that covers the level of the pension contributions paid, while the small pension funds return to their participants in the form of pension revenue approximately all the contributions paid. On the long run, e.g., 20-30 years, the situation is reversed in that big pension funds have net assets much higher the net assets of the small pension funds. These results are motivated by the structure of the pension fund administration fees charged by Romanian pension funds. Pension administration fees are fixed monthly rates charged on the pension contributions value and the pension assets value. Implicitly, big pension funds will have an absolute level of administrative costs

which is higher than that of small pension funds. The negative effect that pension administration fees have of diminishing the pension revenue employees are entitled to receive after retirement can be neutralized by an efficient asset management that brings superior rates of return.

Using data from the Romanian pension market, the replacement rates of pension funds with different sizes are not majorly different. The pension fund belonging to the upper size quintile offers to its participants a replacement rate of 8.99% and the pension fund from the lower size quintile offers participants a replacement rate of 8.44%.

For valuating the pension revenue offered by pension funds that activate in a highly concentrated market like that of the Romanian pension funds, agent-based simulations can be used. This type of simulation allows for pension fund individual participant behavior to be modeled. From the interaction between participants and pension funds in an economic environment similar to the Romanian one, the pension revenue level can be retrieved. Agent-based simulation can also fulfill an educational role, allowing for a good understanding of the complex domain of pensions. The simulation methodology makes possible that the results of changing specific variables can be seen in a very short time interval (i.e., a few seconds). Making the connection between cause and effect is useful for a good understanding of a complex phenomenon as through the simulation methodology, the intuition is doubled by the experience.

Notes

(1) Capital, 15 January 2012, "Piaţa pensiilor private este lichidă şi aproape de consolidare", http://www.capital.ro/detalii-articole/stiri/piata-pensiilor-private-este-lichida-si-aproape-de-consolidare-159541.html.

(2) http://www.csspp.ro/evolutie-indicatori/.

(3) CSSPP. Norma nr. 4/2012 pentru modificarea şi completarea Normei nr. 22/2009 privind aderarea şi evidenţa participanţilor la fondurile de pensii administrate privat.

(4) CSSPP. Elemente de Siguranţă ale Sistemului Fondurilor de Pensii Administrate Privat - Pilon II.

(5) http://ccl.northwestern.edu/netlogo/.

(6) Currently, there are nine privately managed pension funds on the Romanian pension market. The estimations (estimations of the participants in the event "Cinci ani de pensii private" organized by Ziarul Financiar, 19 September 2012. http://www.zf.ro/analiza/politica-demografica-trebuie-sa-fie-o-prioritate-altfel-sistemul-public-de-pensii-va-sari-in-aer-10096528) are that in ten years the number of pension funds will decrease to 6.

(7) The private pension contribution is 3% initially and the annual growth rate of this contribution is of 2%. The average intitial wage is of 2.100 lei and the annual growth rate of the wage is 2%.

(8) In 2012 Germany registered negative risk – free rates of return.

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***CSSPP (2011). *Norma nr. 7 privind ratele de rentabilitate ale fondurilor de pensii administrate privat*