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GENESIS OF MARKET FAILURE OF ADVERSE-SELECTION-TYPE IN PROBLEM OF EFFECTIVE CAPITAL ALLOCATION

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Summary

The paper investigates the problem of possibility of investment allocation by economies according to adverse pattern, which can ultimately imply the rise of situation of market failure. We consider the transformation of "ideal" capital allocation into allocation of adverse-selection-type, which occurs as a result of migration of agents of different types. We conclude that the uncontrolled agents' behavior, due to their bounded rationality, can lead to adverse selection state, when the less effective agents are investors in economies with most favorable investment climate, and vice versa.

Keywords: capital allocation, adverse selection, market failure, behavior of agents, maximizes, satisfiers

JEL Codes: D03, E22

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Introduction

The present paper considers the possibility of existence of non-effective capital allocation in conditions of rational and bounded rational behavior of agents. The problem is that the bounded rational behavior can lead to investment allocation according the adverse selection pattern, which ultimately implies the rise of situation of market failure. The additional problem is that the government nonintervention is entirely possible, in spite of obvious expedience of such intervention. Hereafter, we will try to uncover the reasons of mentioned agents' behavior and conditions of appearance of mentioned situations; henceforth it can facilitate the incentive of government intervention in economy aiming to prevent the market failure and to improve its efficiency.

Literature Review

In economic theory the various aspects of adverse selection problem of is discussed over time. Akerlof (1970) first considered the genesis of adverse selection. D'Aspremont and Gérard-Varet (1979), studying the optimal public design mechanisms, for the first time used the linear inequality methods to handle adverse selection. Stiglitz and Weiss (1981) showed that in equilibrium a loan market may be characterized by credit rationing. According to them the interest rate a bank charges may itself affect the riskiness of the pool of loans by sorting potential borrowers (the adverse selection effect) or affecting the actions of borrowers (the incentive effect). Both effects are caused by imperfect information in loan markets. Different borrowers have different probabilities of repaying their loan. This leads to adverse selection aspect of interest rates. Boyd and Smith (1993) considered credit rationing in an environment with adverse selection. They studied the equilibrium allocation of investment capital in an environment with some features, concerning the investment activity. Philippony and Skretaz (2012) study the design of interventions to stabilize financial markets plagued by adverse selection. They have shown that the efficiency of an intervention can be assessed by its impact on the market interest rate. The presence of an outside market determines the nature of optimal interventions and the choice of financial instruments, but it does not affect implementation costs.

There is a line of research concerning the modeling of adverse selection in entrepreneurship (Huberman and Kandel (1993), Heinkel and Stoughton (1994), Martin (2009)). Huberman and Kandel (1993) consider the two-asset signaling model (with elements of adverse selection) of money managers. As a result, they find that the asset allocation strategy of low and high quality managers can be distorted by reason of different portfolio weights, which may be considered as a signal of the managers' ability. Heinkel and Stoughton (1994) consider the two-period relationship between a client and a portfolio manager and the resulting problem o f motivating a manager of unknown ability to acquire valuable information. In their model they consider the situation with both adverse selection and moral hazard. They conclude that the possibility of multiple periods can enhance portfolio management

performance in the initial stages of a client-manager relationship and work to the mutual benefit of both agents. Martin (2009) considered the relationship between entrepreneurial wealth and aggregate investment under adverse selection, concentration on pooling and separating equilibria.

More specifically, the adverse selection as consequence of incomplete information have been discussed in Besley (1994), Tirole (2006, 2011), Kirabaeva (2011). Besley (1994) studied market failure, emphasizing the need to consider the full array of constraints that combine to make a market work imperfectly. He discussed various reasons for market failure and considered the problems that may be cited as failures of the market justifying intervention (enforcement; imperfect information, especially adverse selection and moral hazard; the risk of bank runs and so on). Besley (1994) concluded that there may be good arguments for intervention, and some may be based on market failure. Tirole (2006) in his "Theory of Corporate Finance" introduced asymmetric information between insiders and outsiders at the financing stage. The presented models are based on model of adverse selection in capital allocation and on model of moral hazard in capital allocation. Tirole (2006) defined some limitation of model: absence of asymmetric information about investors; absence of informational advantages over issuers for investors and so on.

Investors are naturally concerned by the prospect of buying into a firm with poor prospects. Such adverse selection in general makes it more difficult for insiders to raise funds. Kirabaeva (2011) studied financial crises in emerging markets. She concluded that asymmetric information between domestic investors (borrowers) and foreign investors (lenders) can lead to adverse-selection problems in a country that finances its domestic investment and consumption through foreign debt or foreign equity. Tirole (2011) provided analysis of market jumpstarting and its two-way interaction between mechanism design and participation constraints. He fined that the government can reduce adverse selection enough to let the market rebound, but not too much, so as to limit the cost of intervention.

Capital Allocation Model

The functioning of group of the bounded economies can be analyzed in the context of their association on the one side and of some single economy inside this group – from another side. The efficient economic activity in mentioned cases bases on different criteria: while we consider the efficiency as the welfare maximization, but in the first instance it is aggregate welfare of all economies, and in the latter case it is welfare of a single economy.

Here the problem of optimization of capital allocation is to find the optimal allocation of economic agents by jurisdictions, i.e. to find allocation, which maximizes welfare both of all economies and a single one.

To analyze the mentioned problem we developed a formal model of capital allocation, considering the interaction between economic agents in the system of capital employment, which describes the investment and its returns, received by investors.

Two types of agents can be distinguished in the system of investment activity: investors and government; the last establishes rules for "the game", determines the tax level, collects taxes and, perhaps, spends some collected revenues on improving of investment climate.

It can be kindly assumed that the revenue of *i*-th investor in the economy r_i depends on

amount of capital employment, invested by him in economy;

efficiency of application of these funds, i.e. the acquisition other things equal of maximum return per unit of investment;

investment climate in economy.

The parameter of "investor's efficiency" illustrates how efficiently the investors other things equal are capable to invest, i.e. their investment skills. It is obvious that there is no procedure to its direct measurement both for the group of agents and the separate ones. In applications only the indirect estimation of mentioned parameter is possible.

The parameter of "investment climate's efficiency", as well as the previous one, can be estimated only indirectly, by expertise. It demonstrates, how easy (and, therefore, efficiently) one can carry on investment activity in some economy. The size of this parameter depends on legislation transparency, level of risks, corruption, economic and financial development and so on. The amount of transaction costs in some economy can be regarded to some extent as the estimation of efficiency of investment climate (although this amount also is difficult to be estimated).

We should note that the mentioned factors someway are ephemeral. Simultaneously, their impact on investment profitability is sufficiently obvious.

Comparing these factors, we can observe that the investor's efficiency characterizes the competency of economic agents (of only in aggregated form), whereas the efficiency of investment climate refers to parameters of function of economic system.

It is not easy for investor to improve its investment skills, but he can quickly change the amount of invested capital. The change of investment climate also is long-time process, so let's consider hereafter the amount of invested capital as controlled parameter, and investment efficiency and favorability of investment climate as uncontrolled parameters – the environment parameters.

Hence, the capital allocation model operates the following parameters, appropriate to investors:

amount of investment;

characteristics of investors' efficiency

and the parameter, appropriate to government –

characteristics of investment climate.

Let us formalize the parameters of capital allocation model for single economy.

$I_i\ t\ \big|_{i=1\ldots m}$ is the set of investors, acting in economy at time *t*;

$Y_j\big|_{j=1\ldots n}$ is the set of economies;

$x_i(t)$ is the investment of *i*-th investor at time *t*;

$y_j(t)$ is the investment of i-th investor destined for improving its skills at time t;

$z_i(t)$ is the investment of i-th investor destined for improving the investment climate in economy at time t;

$x_i\ t\ ; y_i\ t\ ; z_i\ t$ is the allocation of investment of i-th investor at time t, besides

$x_i\ t\ + y_i\ t\ + z_i\ t\ \le u + y_i\ t\ + z_i\ t\ \le U_i\ t\ ,$

where $U_i\ t\ \big|_{i=1\ldots m}$ is the active capital of i-th investor at time t:

$$U_i\ t\ = U_{i-1}\ t\ + x_i\ t\ ;$$

$r_i\ t\ = r\ x_i, t; a_i, \alpha_i, b_j, \beta_j$ is the revenue of i-th investor proceeded from its investment at time t, besides a_i and α_i characterize the investor's skills, and b_j and β_j characterize the investment climate of j-th economy, moreover

$$\forall i : i = \ 1, N\ \ , \ \forall j : j = \ 1, N\ \ : a_i > 0,\ b_j > 0,\ \ \alpha_i > 0,\ \beta_j > 0\,.$$

Function of investment yield for i-th agent on its qualification, and also on investment climate of j-th economy, conceptually can take various forms, but it should correspond to principle of interdependence of mentioned parameters. Notably, the behavior of S-shape function (for example, the logistic function – the Pearl-Read function, the Gompertz function etc.) and of exponential function corresponds to this principle. We get for exponential:

$$\forall i : i = \ 1, N\ \ , \ \forall j : j = \ 1, N\ \ : r(x_{ij}) = a_i b_j \left(1 - e^{-\ \alpha_i + \beta_j\ x_{ij}} \right);$$

and for S-shape function:

$$\forall i : i = \ 1, N\ \ , \ \forall j : j = \ 1, N\ \ : r(x_{ij}) = a_i b_j \left(1 - \frac{1}{1 + e^{\ \alpha_i + \beta_j\ - x_{ij}}} \right).$$

Besides, the agents differ by their cognitive abilities; in the context of our study it means that there are two groups of agents: "maximizers", aiming to maximize their own profit $r\ x_i, t; a_i, \alpha_i, b_j, \beta_j\ \to \max$, and "satisfiers" (see, for example, the Simon's definition of "satisfiers" in (Simon, (1955)), who are satisfied by getting a profit $r\ x_i, t; a_i, \alpha_i, b_j, \beta_j\ \ge 0$.

"Ideal" capital allocation

Let us consider preliminarily the optimal allocation in ideal conditions. It can be shown that in this case the allocation, when the most effective agents act inside of economies with the most congenial climate; the most effective agents among the remainders act inside of economies etc., will be an optimal allocation of agents' equity (Sokolovskyi and Luk'yanenko (2011)).

Assume that exactly one investor can act in a single economy. Then for any two investors (i_1, i_2) and any two economies (j_1, j_2), for which the following conditions

$$r\ x_{i_1}, t; a_{i_1}, \alpha_{i_1}, b_j, \beta_j\ > r\ x_{i_2}, t; a_{i_2}, \alpha_{i_2}, b_j, \beta_j\ ;$$

$$r\ x_i, t; a_i, \alpha_i, b_{j_1}, \beta_{j_1}\ > r\ x_i, t; a_i, \alpha_i, b_{j_2}, \beta_{j_2}$$

hold, the proposition

$$\begin{aligned} & r\ x_{i_1}, t; a_{i_1}, \alpha_{i_1}, b_{j_1}, \beta_{j_1}\ + r\ x_{i_2}, t; a_{i_2}, \alpha_{i_2}, b_{j_2}, \beta_{j_2}\ > \\ > & r\ x_{i_1}, t; a_{i_1}, \alpha_{i_1}, b_{j_2}, \beta_{j_2}\ + r\ x_{i_2}, t; a_{i_2}, \alpha_{i_2}, b_{j_1}, \beta_{j_1} \end{aligned} \qquad (3)$$

holds.

Obviously, it is equally true for any number of economies and of investors. I.e., the optimal allocation (in terms of efficiency) will be the following: in the most favorable economic environment the most efficient agents act individually and their number is necessary and sufficient to satiate the investment demand inside of given economy. The most effective agents among the remainders act in the less favorable environment etc. The least favorable environment remains for least effective investors (Fig. 1).

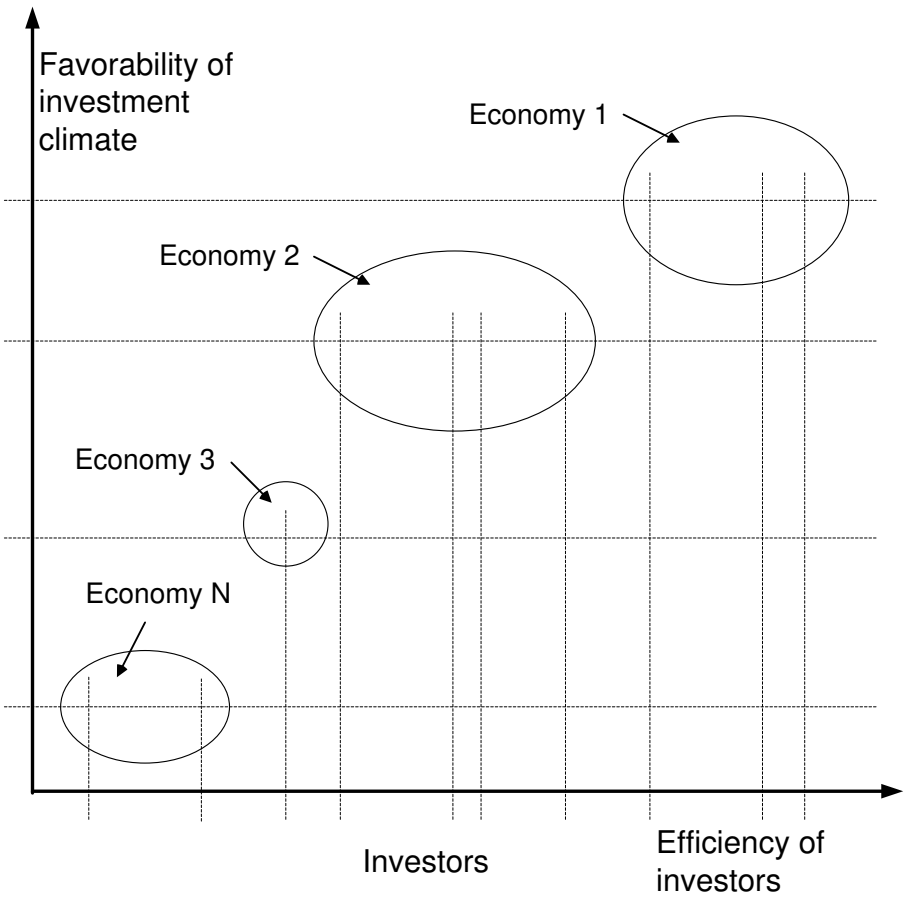

Figure *1*. Optimal allocation of investors in economies

Formally it can be written by considering the decision-making (behavior) of investors, depend upon the parameters of economic environment, in which the investors act. Assume for *i=1,2,…n:*

X_i is the amount of investment assets of agents, acting in different economies;

Y_i is the market potential of each economy;

$\psi(i)$ is the function of distribution of investment assets, belonging to agents of *i*-th economy:

$$\forall i : i = 1,2,\ldots,M : \psi\ i\ \in\ 1,2,\ldots,n\ ;$$

$\varphi(i)$ is the function of ordering the agents, possessing the following properties:

$$\text{assume that } r\ \ x,t,a_{i_1},\alpha_{i_1},b_j,\beta_j\ > r\ \ x,t,a_{i_2},\alpha_{i_2},b_j,\beta_j\ \ ,$$

$$\text{then } \varphi_{i_1} < \varphi_{i_2}\ ;$$

$$\forall i : i = 1,2,\ldots,M : \varphi\ i\ \in\ 1,2,\ldots,M\ \ .$$

It is obvious that

$$\forall j : j = 1,2,\ldots,n :\ \exists i_j : i_j \in\ 1,2,\ldots,M\ \ :$$

$$\left(\sum_{\varphi^{-1}\ i\ \le i_j} x_{\varphi^{-1}\ i}\ \le \sum_{jj=1}^{j} Y_{jj} \right) \wedge \left(\sum_{\varphi^{-1}\ i\ \le i_j+1} x_{\varphi^{-1}\ i}\ > \sum_{jj=1}^{j} Y_{jj} \right). \quad (1)$$

Then, the following allocation will be the most effective:

$$\psi\ \ i : \varphi^{-1}\ \ i\ \ \le i_1\ \ = 1;\quad \forall j = 2,\ldots,M :\ \varphi\ \ i : i_{j-1} < \varphi^{-1}\ \ i\ \ \le i_j\ \ = j. \qquad (2)$$

Adverse selection as a result of agents' migration

It should be noted that we used the model to estimate the following:

the favorable conditions for agents of different groups for shifting into the economy with better investment climate;

the agents' attitude towards appearance in economy of another agents';

the agents' will to invest into improvement of economic environment in which they act;

the government's will to invest into improvement of national economy.

Despite the fact that in classical case of homo oeconomicus all "maximizers" seek to act in the economy with most favorable investment climate, the presence of competition in absence of entry/exit barriers in the non-tax world leads to displacement of less effective investors by more effective ones in worst economic environment.

More strictly this means that if at time *t* the agents i_1 and i_2 fight for place in *j*-th economy, besides $r\ \ x,t,a_{i_1},\alpha_{i_1},b_j,\beta_j\ > r\ \ x,t,a_{i_2},\alpha_{i_2},b_j,\beta_j\ \ $, then agent i_1 wins and agent i_2 is displaced to less effective economy (with index *j+1, j+2 …*).

As a consequence of that process, some time it can be observed the effective allocation of agents by economies, illustrated on Fig. 1.

I.e., agreeing with *(2)* in some economy there will be "maximizers", whose skills are insufficient to act in more effective economy.

From that point of view it is obvious, that their current position is optimal for them. This implies that "maximizers" will not seek either to pass into the more effective economy, or to improve the investment climate of economy, in which they act ("maximizers" fear, that in this situation they will be displaced by more efficient investors). In other words, for "maximizers" the allocation *(2)* is equilibrium. This implies that they have no sustainable incentives for migration.

As for "satisfiers" it should be noted that when the condition $r\ x_i,t;a_i,\alpha_i,b_j,\beta_j \geq 0$ holds (this means, that their activity in some economy is profitable), "satisfiers" will do nothing to improve the favorability of investment climate, since they are satisfies by their current position. When the "satisfiers" skills are insufficient to provide the profitable activity in given economy, they will seek to leave this economy and enter to the one with more favorable investment climate, which will allow them to gain a profit. It is clear that such seeking looks like "despair gesture", since in ideal static conditions of perfect market, they had to bankrupt. But indeed the new markets appear and the entry barriers can thwart certain effective investors, therefore an opportunity to achieve a success arises for ineffective ones (Fig. 2).

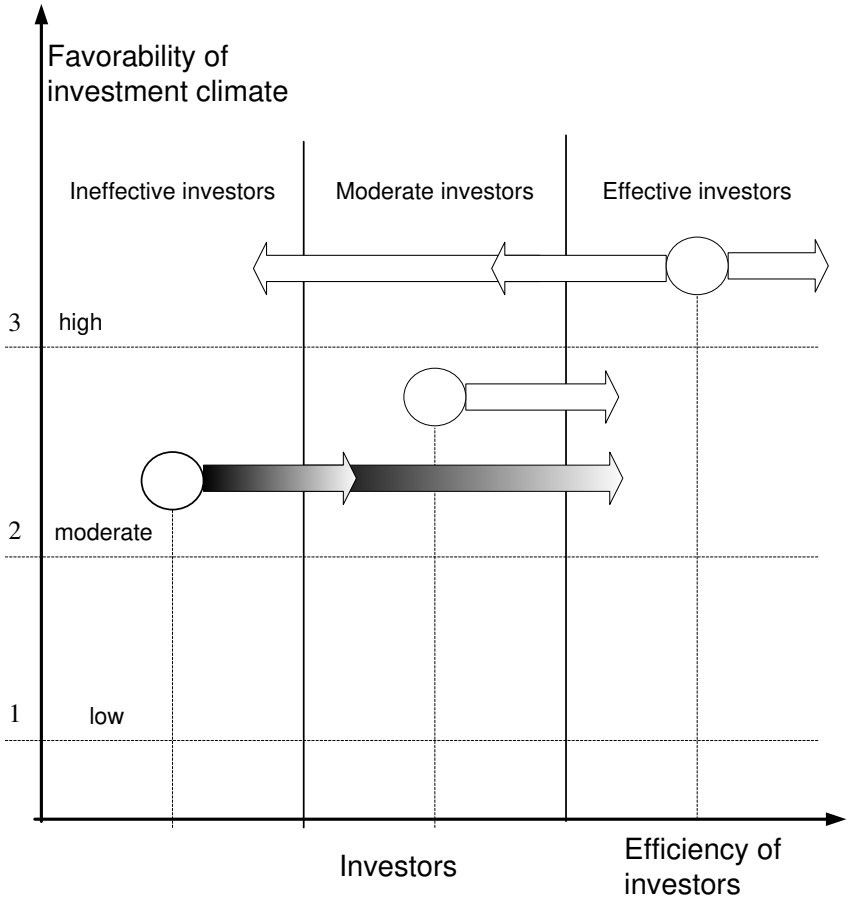

Figure. *2*. Tendencies of agents' migration

The logical analysis allows confirming the following.

In certain economies the investors-satisfiers aim to be sufficiently effective and do not become a bankrupt, because they are completely satisfied by their current position. Coincidently the less effective investors, primarily, will try to change the less effective economies on more effective ones, and after them the effective investors-maximizers will try to do so.

Entering of additional investors into economy can lead to deterioration of investment climate (due to glut of economy by equity) and also to strengthening of competition between new agents and existing ones. Thus it is obvious that the rationally acting existing agents will resist to appearance of new ones, moreover, the more the new agents are effective, the stronger will be the resistance, because their appearance will create the stronger competition. As a consequence, the tendencies of agents' migration lead to the case, contrary to situation, illustrated on Fig. 1: the less effective investors are in the economy with more favorable climate, and their "seats" in less favorable economy are occupied by most effective ones.

This implies that the average efficiency of economy will decrease with time rather than increase; that correspond to standard case of "adverse selection" (Akerlof (1980)) (Fig. 3).

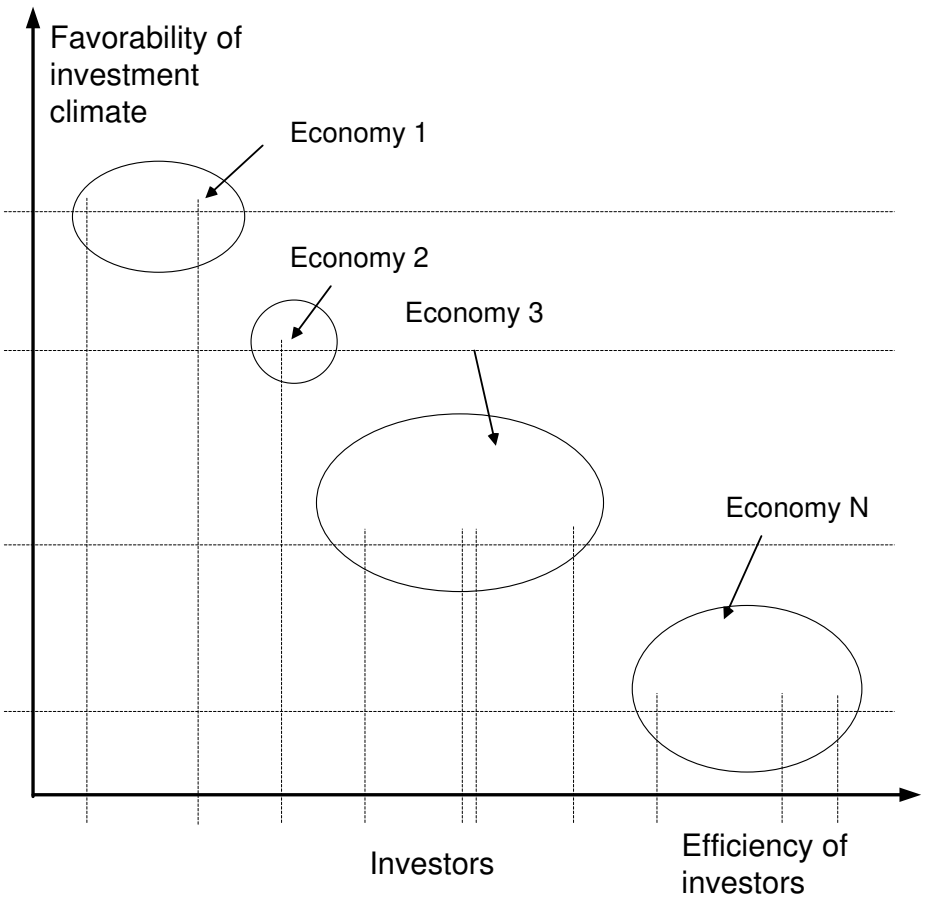

Figure *3*. Investors allocation in economies according to adverse selection principle

Finally it reasonable to consider that it can lead to “closure” of economy and to the appearance of incomplete market as a form of market failure (Bator (1958), Stiglitz (1989)).

Certainly, the described situation is the reason for government intervention, which can consist both in the administrative control of agents’ migration, setting of entry/exit barriers and in the economic measures (to our mind this is more interesting), in particular, in the investment into improving the investment climate of economy.

At that the government can both to involve the own public finance, to borrow the capital in financial markets and to incite the agents by some means for investment into improving the investment climate.

Conclusion

The analysis of model of investment allocation by economies allows concluding that the free (uncontrolled) agents’ behavior [under certain conditions], due to their bounded rationality, can lead to adverse selection state, when the less effective agents are investors in economies with most favorable investment climate, and vice versa.

The government administrative and/or economic intervention aimed both to non-admittance of ineffective investors and to improving of investment climate of appropriate economies, can be the way out.

The analysis of government’s and investors’ behavior within the frame of given issue is beyond the scope of present article; however it is in the scope of authors’ research.

Thus, further it is assumed to analyze the conditions, necessary for appearance (and disappearance) of incentives to invest into improving of investment climate. It is subject to both government and agents of different type: effective and ineffective “maximizers” and “satisfiers”. The similar models for production and insurance spheres were proposed in Sokolovskiy (2001, 2011).

Further formalization of mentioned behavioral and estimative characteristics and also the effectiveness parameters will allow forecasting the appearance of hazard in such situation in real economy, and, therefore, will allow preventing the similar situation.

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