opción

Revista de Antropología, Ciencias de la Comunicación y de la Información, Filosofía, Lingüística y Semiótica, Problemas del Desarrollo, la Ciencia y la Tecnología

Año 34, 2018, Especial N° 14

Revista de Ciencias Humanas y Sociales

ISSN 1012-1587/ ISSNe: 2477-9385

Depósito Legal pp 198402ZU45

Universidad del Zulia

Facultad Experimental de Ciencias

Departamento de Ciencias Humanas

Maracaibo - Venezuela

Opción, Año 34, Especial No.14 (2018):1549-1574
ISSN 1012-1587/ISSNe: 2477-9385

Investor-expert interaction model in the innovation investment system with knowledge asymmetry

Alim O. Gurtuev[1]
[1]Candidate of Economic Sciences, Department of Economics of Innovation, Institute for Computer Science and Problems of Regional Management of Kabardino-Balkarian Research Center of RAS, Nalchik, Russia
viscart@mail.ru

Zaur Z. Ivanov[2]
[2]Candidate of Economic Sciences, Department of Economics of Innovation, Institute for Computer Science and Problems of Regional Management of Kabardino-Balkarian Research Center of RAS, Nalchik, Russia
ivanovzayr@mail.ru

Elena G. Derkach[3]
[3]Researcher, Department of Economics of Innovation, Institute for Computer Science and Problems of Regional Management of Kabardino-Balkarian Research Center of RAS, Nalchik, Russia
derkazh19@mail.ru

Halimat K. Kazancheva[4]
[4]Doctor of Economic Sciences, Department of Economics of Innovation, Institute for Computer Science and Problems of Regional Management of Kabardino-Balkarian Research Center of RAS, Nalchik, Russia
kazancheva456@yandex.ru

Aminat Kh. Dumanova[5]
[5]Candidate of Economic Sciences, Department of Economics of Innovation, Institute for Computer Science and Problems of Regional Management of Kabardino-Balkarian Research Center of RAS, Nalchik, Russia
dumanaminat23@mail.ru

Abstract

The mechanisms of investing in innovation projects, when an objective evaluation of a project is impossible due to inherent uncertainty are subjects of increasing interest. As a method, the toolkit of non-cooperative games with communication is widely used in economics to model situations of information asymmetry. We propose a model of investor-expert interaction in the system of innovation investment. The model is a recurring game with imperfect information, deferred revenues and Bayesian re-evaluation of players' own type.Different equilibria for some qualitatively different configurations of initial values of budgets, risk attitude, and distribution of player types are found.

Keywords: innovation, investment, information, asymmetry, opportunism.

Recibido: 19-11-2017 •Aceptado: 13-02-2018

Modelo de interacción inversor-experto en el sistema de inversión de innovación con asimetría de conocimiento

Resumen

Los mecanismos de inversión en proyectos de innovación, cuando una evaluación objetiva de un proyecto es imposible debido a la incertidumbre inherente son temas de interés creciente. Como método, el conjunto de herramientas de juegos no cooperativos con comunicación se usa ampliamente en economía para modelar situaciones de asimetría de información. Proponemos un modelo de interacción inversor-experto en el sistema de inversión en innovación. El modelo es un juego recurrente con información imperfecta, ingresos diferidos y reevaluación bayesiana del tipo de jugador. Se encuentran diferentes equilibrios para algunas configuraciones cualitativamente diferentes de los valores iniciales de los presupuestos, la actitud de riesgo y la distribución de los tipos de jugador.

Palabras clave: innovación, inversión, información, asimetría, oportunismo.

1. INTRODUCTION

The behavior of economic agents in the innovation process can generally be reduced to the task of making decisions under conditions of uncertainty. The initial problem here is the problem of cognitive limitations of real economic agents. Thus, agents can manifest opportunistic behavior to seek deception or distortion of information, mostly indirectly. The limitations of cognitive possibilities and opportunism, taken together, give rise to the problem of asymmetry of knowledge, in which even if the information concerning the essential aspects of the transaction is available to all its participants, competences that are absent from one of the parties are needed to process this information (Gurtuev et al., 2017).Asymmetry of knowledge in the system of innovative investment leads to disruptions in the efficiency of resource allocation, market failures associated with the effects of adverse selection and post-contract opportunism. An important factor determining the parameters (and very existence) of market equilibrium in such a system is the nature of the distortions in the preferences of economic agents.

Most of the modern research on the behavior of economic agents in markets with imperfect information can be divided into two main classes of problems – problemswith unobservable characteristics (adverse selection) and with unobservable actions (moral hazard). The inefficiency of resource allocation under information asymmetry of both types is already proved by early papers in the field (Akerlof, 1978; Laffont and Martimort, 2009). As classic examplesof such marketswe can point to credit and insurance markets (Chiappori et al., 2006). The main subject of the analysis is the possible reaction of the market to asymmetric information, as well as the prerequisites for government intervention in the economy with the aim of correcting information market failures.

With unobservable characteristics, the possibility of a partial or complete collapse of the market (models of adverse selection) is usually investigated. There are a large number of papers that study the equilibrium in the labor market in conditions of non-observable types of workers, including the possibility of multiple equilibria and the problem of coordination. These studies led to the development of the information theory of discrimination in the labor marke tLaffontand Martimort (2009), Handel (2013), A significant number of works are also devoted to discussing the problem of unobservable characteristics in the credit and insurance markets, and the possibility of disequilibrium and rationing as a reaction of the market to information asymmetry (Chiappori et al., 2006; Finkelstein and McGarry, 2006).

Another significant part of the research body is devoted to the study of the actions of market agents under information asymmetry, to overcome its undesirable consequences. In the early 90's in the economic literature, the concept of signaling was widely introduced and well developed(Laffont and Martimort, 2009; Hackmann et al., 2015). The signaling mechanisms were developed for a vast number of markets including labor markets, commodity markets, as well as signaling in economic policy. Principles of reliable signaling are refined, and classification of equilibria in signaling problems is already given. In a number of works, a prescriptive analysis of the signaling is carried out. The concept and methods of screening in conditions of asymmetric information, including exclusive and competitive screening, have been developed.Another modern research direction focuses on the problem of unobservable actions and the resulting market failures. It is usual here to interpret the problem in terms of incomplete contracts when the "principal-agent" task is formulated, and an optimal contract is constructed under conditions of no-observability of the agent's actions (Laffont and Martimort, 2009; Handel et al., 2015; Guiso and Parigi, 1999).

Currently, with the development of the post-industrial economy, a structural transformation of the economy takes place, the output of industries that produce intangible assets, especially knowledge greatly increasing. The high mobility of capital and highly skilled labor has led to a new type of international division of labor, with the shift of industrial production to developing countries and knowledge production – to Organisation for Economic Co-operation and Development(OECD) countries.In this regard, the functioning of the system of innovative investment, when an objective evaluation of the subject of the transaction (an investment project possibly containing new knowledge) on both the investor and the innovator is impossible because of the uncertain future becomes the subject of greatly increased interest. The essence of this problem is that although the inherent property of any investment process is the need to quantify future (hence, uncertain) financial flows, for traditional industries, a satisfactory solution is to transfer the subject of the assessment from the category of uncertainty to the category of risk based on statistics on past similar projects and market research. For innovative investment, such a method is not applicable due to the natural absence of an appropriate statistical base. The practice of the investment process in the OECD countries shows that many of the mechanisms common in innovative investment (multi-stage investment, investor pools, blurred ownership packages, mentors, etc.) are not commonly used for investing in traditional industries and vice versa.

Thus, the study of the behavior of economic agents in the innovative investment system with emphasis on the inherent asymmetry of knowledge is a field of great interest. Our goal is developing a very basic model of interaction between economic agents within such a system, taking no unrealistic assumptions of possibility to measure uncertainty as risk.For that kind of markets currently, the main work is focused on studying the process of making individual decisions and on modeling individual markets. One of the main areas of application of simulation models in the economy is the study of the process of making individual decisions under conditions of risk and uncertainty. A modern study of problems related to risk and uncertainty relies to a large extent on the approach from the point of view of the theory of expected utility (Machina, 1995;Raiffa, 1996). This approach is based on several postulates that individually and jointly provide a sufficient basis for making a rational decision. The universality and normative attractiveness of this method have established it as a "generally accepted theory". The theory of expected utility in many respects is an ideal object of experimental research. This theory makes several clear predictions regarding the adoption of individual solutions. These predictions can be easily verified. If the discrepancies between facts and theory become apparent, one can check whether these discrepancies are the result of random errors or they should be considered as manifestations of certain specific and stable patterns of behavior that are different from those predicted. In such a case, theorists should modify the theory of expected utility or create new models corresponding to the results obtained. If these new models are capable of giving clear and potentially refutable predictions, they also need to undergo testing. Studies of recent times followed precisely this scheme. They stimulated the development of alternative models, which, in turn, are subjected to further testing.The literature devoted to the analysis of "principal-agent" situations is extensive and the list of important works – from the pioneering article of Ross (1973) to modern models can take dozens of pages. A good review of the state of the art at the beginning of the 21st century is given in (Laffont and Martimort, 2009).

Concluding all the above, the uncertainty inherent in innovative projects both in relation to the efficiency of a technological solution on which the project is based and about quantitative parameters of demand leads to the impossibility of efficient usage of the currently well-developed and validated methods for evaluating investment projects. Although some individual approaches to measuring uncertainty have been developed in the scientific literature GuisoandParigi (1999),Sommer and Loch (2004),Perminova et al. (2008),Jurado and Ludvigson (2015),Arve and Martimort(2016),Shmaya and Yariv (2016), an effective methodology for evaluating innovation projects has not been developed yet. In practice, there are a small number of simple empirical screening mechanisms (phased financing, co-financing, mentoring, expertise, presentations etc.) based on approaches to reducing pre- and post-contract opportunism, described in particular inFinkelsteinand McGarry(2006),Hackmann et al. (2015),Seitzand Watzinger(2017),Edmans et al.(2015),Fuchs and Skrzypacz(2015),Arve and Martimort (2016) and allowing to filter out only a small part of obviously unrealizable projects.The "principal-agent" models consider the situation when some agents have significant information that other agents do not have. Most often, situations are considered when agents have hidden information about the scope of possible solutions or about certain characteristics of the subject matter of the contract. For example, a similar situation is considered in signaling models Spence (1973), when the agent has information hidden from the principal about his future performance (his skills).Such a market can be simulated by a game with incomplete information. In this case, the hidden information determines the so-called “type” of a player. In the pioneering works of Harsanyi (1968) the game-theoretic representation of a game with incomplete information was first developed, which was later called the game in Harsanyi (1967) form (or the Bayesian game).

Let N be the set of players. Each player i of N has a set of actions (strategies) S_i. The hidden information that a player can have from the very beginning can be represented as a set of T_i for each player i of N. Thus, the Cartesian product $S \times T$ defines all possible player profiles.Next, let's introduce the probability function p_i, and call it the belief which is the mapping of T into Δ (T_{-i}), where Δ (T_{-i}) is the probability distribution set over all combinations of possible types different from i. This function formally describes the nature of the hidden information in this game. If player $i$is of type t_i, p_i is the conditional probability that the rest of the players have types that are components of the vector t_{-i}. For example, $p\ (t_{-I} \mid t_i)$ is the conditional probability that the real type distribution will be t_{-i} if player i is of type t_i.The preferences of each player i of N relative to the results are usually modeled by an utility function (of von Neumann-Morgenstern type or perspective theory type) which is a mapping of S × T to a set of real numbers R. Denoting this function as u_i (s, t), we can interpret its value as the utility for the player i at possible actions s and the players profile t. Let's call it the payoff i.

All of the above fully defines the Bayesian game with consistent preferences, which can be written in the following form:

$G^h=(N, (S_i)_{i\epsilon N}, (T_i)_{i\epsilon N}, (p_i)_{i\epsilon N}, (u_i)_{i\epsilon N})$

where:

N – a set of players (in our case there are 2 players – investor and innovator);

$(S_i)_{i\epsilon N}$ – a set of possible strategies (for the innovator, there are only two strategies – participate or non-participate, and for the investor

– a set of strategies that differ in the size and structure of investment, from non-participation, to full upfront financing);

$(T_i)_{i\epsilon N}$ – is the set of possible player types. In our case, for an investor this is one type, with some risk tolerance unknown for the innovator (hence hidden utility function), for an innovator – two types, *H* and *L*, determined depending on the future success of the project. At the beginning of the game these types are unknown, and the players themselves have *a priori*estimate of their types. Note that the division of "risk-seeking" and "risk-neutral" / "risk-averse" is not important for our case because risk-seeking investors are willing to pay a premium for risk, and, accordingly, in the innovation market, offer better conditions than risk-averse ones, taking all “perspective” (with high *a priori* probability of success) projects. The existence of risk-neutral or risk-averse investors in the market of innovative investment is possible only if the supply of projects exceeds the demand of risk-seeking investors. In this case, we can set a minimum level of risk-taking in the model, without changing anything else. The change in the form of the utility function of the investor will not affect the nature of the game. The solution found for a situation where all investors are risk-seeking, thus, will be fair for all cases (Gurtuev et al., 2017);

$(p_i)_{i\epsilon N}$ – beliefs about the types of other players. All players have the same beliefs of the distribution of types of other players. This assumption reflects the fact that all players have access to the same information about the world as a whole (technology, economy, science) and other players, and proceed from the premise of the rationality of other players;

$(u_i)_{i \in N}$ – players' payouts (their utility functions). What is important here is that in the case of the type of innovator is *L*, the payouts for both the innovator and the investor are negative;

As N, S_i, T_i are all finite, then the game is finite.

2. THE MODEL

Usually, in order to analyze the game of the aforementioned kind, it is necessary to make the assumption that each participant knows his own type and the matrix of game payouts. However, in our case, the participant does not know his type exactly, but only has an *a priori* evaluation of his type, which differs from *a priori*estimate of his type by other players. Note that a player's *a priori* evaluation of his type is likely to differ in the direction of increasing the probability *H* in comparison with the evaluation of his type by other players.

If the player knew exactly his type, then the choice of strategy in such a game would depend on his type and on the belief of the types of other players, and for such a game there always exists Nash equilibrium in mixed strategies. There is no difference in a single game, whether the player knows his type precisely or has the estimation, which differs from the common knowledge, but for the repeated game with communication, thissituation affects both the player strategy and the resulting equilibrium.

The toolkit of non-cooperative games with communication is widely used in economics to model situations of information asymmetry, in particular, systems of the "principal-agent" type.

We use this approach to model the relationship between investor and expert, presenting them as a repetitive game with imperfect information, deferred gains and Bayesian recalculation of its type estimation.

The game has the following form:

Two kinds of players:

Investors – always of the same type, profit-maximizers, risk-seekers, have two options – to send the project to the expert for evaluation or to reject the project without giving it to the expert.Experts – two types, “optimistic” and “pessimistic”, with Bayesian recalculation of the evaluation of their competence. They have two options – togive a positive or negative conclusion about the project (table 1).

Table 1.Payouts for the investor-expert game

		Expert	
		Negative conclusion	Positive conclusion
Inv	Send to expert	-1, 1+(*Enl*-*Enh*)*XNP	-1+*P*-*C*, 1+(*Eph*-*Epl*)*XNP
	Reject	0, -	-, -

Where:

P –Investor’s share of the projects future profits

C –Total cost of project development

Enh–shift of the expert’s reputation value in the case of rejection of a successful project (implemented in the future, if the project was still implemented and was successful)

Enl–shift of the expert’s reputation value in the case of rejection of an unsuccessful project (implemented in the future, if the project was still implemented and was not successful)

Eph–shift of the expert’s reputation value in the case of supporting a successful project (implemented in the future if the project was successful)

Epl – shift of the expert's reputation value in the case of supporting an unsuccessful project (implemented in the future, if the project was not successful)

$$Enh = Eph = Epl*(C/P)$$

$$Enh>>Enl$$

XNP – the expected number of projects that will be submitted for expert's evaluation prior to the planning horizon (discounted)

All payments are measured in monetary units.

All these variables get values in some rounds after the round of the game, when players make decisions. Accordingly, decisions are made on the basis of estimates of the values of these variables, which are also subjects of Bayesian recalculation after the first data received.

Thus the game is played as follows:

1. The investor's move – she either rejects the project, or gives it to the expert, taking into account the expert's XNP;

2. The expert's move – she gives a conclusion about the project sent.

…

n-2. The investor’s move

n-1. The expert's move

n. The project revelation move (nature’s move) – the funded project is finished and reveals its type (either *H* or *L*)

n+1. The investor’s move – she recalculates expert’s XNP values and either rejects the next project, or gives it to the expert;

n+2. The expert's move – she recalculates own XNP value and gives a conclusion about the next project sent.

...

The game is repetitious; players of the same kind make the corresponding moves simultaneously. Each individual player (both the investor and the expert) can go bankrupt and drop out from the game.

3.THE RESULT

When simulated, after a number of moves, the game comes to equilibrium. We analyzed the game variant without generation of new investors and experts. As a result, we found that the five following kinds of stable equilibria are possible:

1. XNP ≈ 0, projects are not funding at all (with optimistic experts and wealthy investors)

2. Investors go bankrupt (when investors are not wealthy and experts are optimistic)

3. XNP is high, projects are funded very rarely (under pessimistic experts and overvaluation of *Enl*)

4. XNP ≈ 0, projects are funded very rarely (under pessimistic experts and an underestimation of *Enl*)

5. XNP is high, projects are funded often (with optimistic experts, wealthy investors and undervaluation of *Enl*)

And one kind of an unstable equilibrium, when the *Enl* estimate reflects the true share of projects of *L* type in the whole flow of innovation projects.

On the basis of the obtained results we can formulate hypotheses about the existence of the following problems specific for the system of innovative investment:

1. Pre-contract opportunism of pseudo-innovators.

For an innovation, investment system we need some mechanism that would be able to distinguish between projects with a low *a priori* probability of type *H* (pessimistic innovators) and projects that are of type *L* from the very start (pseudo innovators). Existing models proceed from the fact that agents clearly know their type, and the formation of the contract menu is based on the disadvantage for the agent of a low type to pretend to be high type and signal accordingly. In the system of innovative investment, such a menu will cut not only pseudo-innovators, but also pessimistic innovators.

The situation of post-contract opportunism, on the other hand, for innovative products is modeled and solved in the same way as for conventional products, because the unobservability of efforts has the same character, the agent knows exactly his type with reference to the situation of unobservable efforts, the principal experiences the same problems of observing efforts. All the developed apparatus of signaling and screening mechanisms in this aspect works exactly the same as for any other market.

2. Inefficient project filter.

The current situation with innovative financing, when less than 10% of innovative projects are successfully implemented, indicates that modern system, based on a variety of empirically developed selection mechanisms is inefficient, and many projects of a low type pass the filters and being funded. It still remains unclear if it is possible to construct the optimal mechanism or significantly increase the effectiveness of existing empirical mechanisms. But it is important that not the uncertainty of the future is the only source of information incompleteness here, but also the biases of *a priori*beliefs by innovators (about their projects) and the asymmetry of knowledge in the innovator-investor-expert triad.

3. A rather small number of H type funded projects.

The flow of new innovative projects consists mostly of projects of *L* type – it is an inherent characteristic of the innovation process. But in the same time, each successful project of H type has the potential to have strong multiplicative effect on the social welfare in the future (by creating new or even destroying existing forms of human activity). In this regard, it might be beneficial to increase the number of funded projects, even with some deterioration in the overall efficiency of the project filter.

A concomitant problem is to find some balance between solving issues 2 and 3. Of course, in an ideal world, with the complete elimination of issue 1 (pseudo-innovators) and unlimited funding, issue 2 is not important, however, such assumptions are very unrealistic, and we should continue to research for possible solutions in the situation with limited funding and opportunism.

4. DISCUSSION

The results obtained, despite the fact that many a priori assumptions are used in the model, allow us to draw several important conclusions.

First, we proposed a new formal approach, which can be applied to any markets with uncertainty, not only to the system of innovative investment. In the field of modeling markets with uncertainty, recent results are related either to the study of macroeconomic shocks Jurado andLudvigson (2015) or to the analysis of mechanisms for reducing uncertainty at the microeconomic level. As variants of such mechanisms, in particular, a tendency to stick to a known equilibrium (avoidance of deviations) Battigalli et al. (2015) and various procedures for choice randomization are considered (Saito, 2015). In this case, the behavior of the economic agent is also modeled using the apparatus of Bayesian games. Thus, our model gives direction for a significant expansion of the field of market research with uncertainty.

Second, a classification of the equilibria in the market of innovative projects has been obtained, which makes it possible to better understand the reasons for the ineffectiveness of particular empirical filters of innovation projects.

Third, unlike common "principal-agent" models, the game model presented in the paper based on the impossibility of replacing *a priori* estimate with a statistic-based probability, and this makes it well suited to the very nature of the simulated process.

It should be noted that the theoretical difference between the priori estimate and the statistical probability is extremely important – it manifests almost in any case of making judgments. The essential and specific feature of the innovation process lies in the fact that the conditions in which the participants make decisions are unique (it is impossible to find a sufficient number of similar examples so that by analyzing them in aggregate make any conclusions about the significance of the actual probability in the situation modeled). At the same time, it is certain that the participants in the innovation process make judgments about probability. Thus, when making decisions about investing in an innovative project, the methods used to estimate investments in traditional sectors are not applicable. The future state of the market, in this case, is connected with the dynamics of too many uncertain factors, so that on the basis of known techniques it would be possible to obtain the estimate applicable in the work.

In addition, situations of risk and uncertainty in decision-making differ significantly in the part of processing additional information. At risk, additional information leads to a refinement of estimates of the likelihood of occurrence of specific events and estimates of profit margins or damage from the onset of these events. In this case, information in the general case is characterized by a decreasing marginal utility and there is a certain limit of information saturation, after which it can be assumed that additional information does not influence the decision. But under uncertainty when making a decision, we can no longer use decreasing marginal utility assumption.Instead, another subjective factor comes into play – an evaluation of the completeness of the information picture. In the case of uncertainty, the information basis for the decision is formed differently–

additionalinformation either confirms a priori estimation and increases the completeness of the information picture or refutes it. In the latter case, new a priori estimates are constructed. A particular market decision is made when the information picture is considered quite complete, but this view has a completely different nature in situations of risk (information saturation) and uncertainty (confirmation of a priori assessment).

Thus, the most important features of the innovation investment system as an object for modeling are:

- Low probability of project success (much lower than in traditional industries) but very high potential gains (many times higher than in traditional sectors);

- There is no risk situation, there are no statistics to rely on, the most significant factors affecting the profitability of the project are uncertain;

- The Condorcet jury theorem is inapplicable - there are no experts with a probability of a correct positive verdict over 50%.

These important properties of decision making under conditions of uncertainty are reflected in the proposed model.

The development of research in the field of decision-making in markets under uncertainty is currently developing in several areas. Some models have been developed for the currently used empirical mechanisms for screening innovative projects. In particular, the formal models of the crowd-fundingmechanism are considered in (Strausz, 2017;Chang, 2016). A few attempts to link the models of "wisdom of the crowd" with the distributed mechanisms of investment in innovative projects, which are already quite close to the systems for identifying tacit knowledge are presented in (Polzinet al., 2018). At the same time, the formal mechanisms proposed in these studies are in general reduced to screening mechanisms for the principal-agent system.

In view of the above, it’s clear that the synthesis of the concept of scattered tacit knowledge and the apparatus of Bayesian games (in particular – infinite non-cooperative repetitive games) is a promising direction for modeling decision-making under uncertainty, and it is necessary to abandon the premise of players knowing their types *ex-interim*.

5. CONCLUSION

We developed a model of “investor-expert” interaction within the innovation investment system in the form of a recurring game with imperfect information, deferred gains and Bayesian recalculation of player’s types. Player payouts and types of expert players are revealed during the game course. At the beginning of the game these types are unknown, and players have *a priori*belief of their types. Investors are all of the same type, because the division of "risk-seeking" and "risk-neutral" / "risk-averse" is unreasonable in the market of innovations, as it is shown in the paper.

Usually, in order to analyze such models it is necessary to make the assumption that each player knows his own type and game payouts *ex-interim*. However, in our case, the participant does not know his type for sure, but has only *a priori* belief of his type, which differs from *a priori* estimations of his type by other players. Note that a player's belief of his type is likely to be optimistic, increasing the probability H in comparison with the evaluation of his type by other players. If the player knew exactly his type, then the choice of strategy in such a game would depend on his type and on the idea of the types of other players, and for such a game there always exists a Nash equilibrium in mixed strategies. There is no difference in a single game, whether the player knows his type exactly or has a certain score different from the well-known one, but for a repeated game with communication this already significantly affects the strategy and the set of possible equilibria.

The results of the analysis of the model presented allowed us to construct a complete classification of the Bayes-Nash equilibria in this model, and we obtained estimates of the dependence of the equilibrium type on the initial conditions.

REFERENCES

AKERLOF, G.1978. **The market for lemons: Quality uncertainty and the market mechanism.** In Uncertainty in Economics. pp. 235-251.US.

ARVE, M., and MARTIMORT, D. 2016.**Dynamic procurement under uncertainty: Optimal design and implications for incomplete contracts**. American Economic Review. Vol. 106. N° 11: 3238-74.US.

BATTIGALLI, P., CERREIA, S., MACCHERONI, F., and MARINACCI, M. 2015.**Self-confirming equilibrium and model uncertainty**. American Economic Review. Vol. 105. N° 2: 646-77.US.

CHANG, J . 2016. **The Economics of Crowd funding**. Available at SSRN: https://ssrn.com/abstract=2827354.

CHIAPPORI, P., JULLIEN, B., SALANIÉ, B., and SALANIE, F. 2006. **Asymmetric information in insurance: General testable implications.** The RAND Journal of Economics. Vol. 37.N° 4: 783-798.US.

EDMANS, A., GOLDSTEIN, I., and JIANG, W. 2015**.Feedback effects, asymmetric trading, and the limits to arbitrage**. American Economic Review.Vol. 105. N°12: 3766-97. US.

FINKELSTEIN, A., and MCGARRY, K. 2006. **Multiple dimensions of private information: evidence from the long-term care insurance market**. American Economic Review.Vol. 96. N° 4: 938-958. US.

FUCHS, W., and SKRZYPACZ, A. 2015.**Government interventions in a dynamic market with adverse selection**. Journal of Economic Theory.Vol. 158. Pp. 371-406. US.

GUISO, L., and PARIGI, G. 1999. **Investment and demand uncertainty**. The Quarterly Journal of Economics. Vol. 114. N° 1: 185-227. US.

GURTUEV, A., IVANOV, Z., and DERKACH, E. 2017.**Model investor-expert v sistemeinnovatsionnogoinvestirovaniya s asimmetrieyznaniy**. N^{o} 6. Pp. 45-50.US.

HACKMANN, M., KOLSTAD, J., and KOWALSKI, A. 2015.**Adverse selection and an individual mandate: When theory meets practice**. American Economic Review. Vol. 105. N^{o} 3: 1030-66. US.

HANDEL, B., HENDEL, I., and WHINSTON, M. 2015. **Equilibria in health exchanges: Adverse selection versus reclassification risk**. Econometrica. Vol. 83. N^{o} 4: 1261-1313. US.

HANDEL, B. 2013.**Adverse selection and inertia in health insurance markets: When nudging hurts**. American Economic Review.Vol. 103. N^{o} 7: 2643-82. US.

HARSANYI, J. 1967. **Games with incomplete information played by “Bayesian” players, I–III Part I. The basic model**. Management science. Vol. 14. N^{o} 3: 159-182. US.

HARSANYI, J. 1968. **Games with Incomplete Information Played by "Bayesian" Players.I-III. Part II. Bayesian Equilibrium Points**.Management Science.Vol. 14.N^{o} 5. US.

JURADO, K., and LUDVIGSON, S. 2015. **Measuring uncertainty**. *A*merican Economic Review. Vol. 105. N^{o} 3: 1177-1216. US.

LAFFONT, J., and MARTIMORT, D. 2009. **The theory of incentives: the principal-agent model**. Princeton university press.US.

MACHINA, M. 1995.**Non-Expected utility and the Robustness of the Classical Insurance Paradigm.The Geneva Papers on Risk and Insurance Theory**.Vol. 20. Pp. 9-40.US.

PERMINOVA, O., GUSTAFSSON, M., and WIKSTRÖM, K. 2008.**Defining uncertainty in projects–a new perspective**. International journal of project management.Vol. 26. N^{o} 1: 73-79.Finland.

POLZIN, F., TOXOPEUS, H., and STAM, E. 2018.**The wisdom of the crowd in funding: information heterogeneity and social**

networks of crowd funders. Small Business Economics.Vol. 50. Nº2: 251-273. US.

RAIFFA, H. 1996. **Lectures on negotiation analysis**.Program on Negotiation.US.

ROSS, S. 1973. **The economic theory of agency: The principal's problem**. The American Economic Review.Vol. 63. Nº 2: 134-139. US.

SAITO, K. 2015. **Preferences for flexibility and randomization under uncertainty**. American Economic Review.Vol. 105. Nº3: 1246-71.US.

SEITZ, M., and WATZINGER, M. 2017.**Contract enforcement and R&D investment**. Research Policy.Vol. 46. Nº1:182-195. US.

SHMAYA, E., and YARIV, L. 2016. **Experiments on decisions under uncertainty: A theoretical framework**. American Economic Review.Vol. 106. Nº7: 1775-1801. US.

SOMMER, S., and LOCH, C. 2004.**Selectionism and learning in projects with complexity and unforeseeable uncertainty**. Management science. Vol. 50. Nº10: 1334-1347.US.

SPENCE, M. 1973. **Job Market Signaling.**The Quarterly Journal of Economics.Vol. 87. Nº 3: 355-374. US.

STRAUSZ, R. 2017. **A theory of crowdfunding: A mechanism design approach with demand uncertainty and moral hazard**. American Economic Review. Vol. 107. Nº 6: 1430-76. US.

UNIVERSIDAD
DEL ZULIA

opción
Revista de Ciencias Humanas y Sociales

Año 34, Especial N° 14, 2018

Esta revista fue editada en formato digital por el personal de la Oficina de Publicaciones Científicas de la Facultad Experimental de Ciencias, Universidad del Zulia.
Maracaibo - Venezuela

o

www.luz.edu.ve

www.serbi.luz.edu.ve

produccioncientifica.luz.edu.ve