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Інформація про автора

Смачило Ірина Ігорівна – викладач кафедри менеджменту Тернопільського національного економічного університету (46020, м. Тернопіль, вул. Львівська, 11, e-mail: sm_iryna@ukr.net).

Информация об авторе

Смачило Ирина Игоревна – преподаватель кафедры менеджмента Тернопольского национального экономического университета (46020, г. Тернополь, ул. Львовская, 11, e-mail: sm_iryna@ukr.net).

Information about the author

Iryna Smachylo – teacher of management department Ternopil National Economic University (11, Lvivska str., Ternopil, 46020, e-mail: sm_iryna@ukr.net).

Рецензент
канд. екон. наук,
професор Афанасьєв М. В.

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GOVERNMENT-MARKET RELATIONSHIPS AS AN EVOLUTIONARY GAME

UDC 338.242:330.33

A. Zanegin

The role of the state in market economy has been studied regarding evolutionary game theory which enables to differenciate stable and unstable equilibrium patterns between market and government economic institutions. The idea of two different unstable equilibrium situations has been put forward. Stable equilibrium (homeostasis) possibility in economic system has been studied. Regulation in general hes been considered as the stable eguilibvium condition which facilitates market development and protects the economy.

Key words: evolutionary game, attractor, repeller, crisis, stable equilibrium, unstable equilibrium, homeostasis, sub prime mortgage.

ДЕРЖАВНО-РИНКОВІ ВІДНОСИНИ ЯК ЕВОЛЮЦІЙНІ ІГРИ

УДК 338.242:330.33

Занегін А. Г.

Роль держави в ринковій економіці розглядається з позицій еволюційної теорії ігор, яка надає можливість розділити стійкі і нестійкі типи рівноваги між ринковими і державними економічними структурами. Висувається думка про дві різні ситуації нестійкої рівноваги. Розглядається можливість стійкої рівноваги (гомеостазиса) в економіці. Умовою стійкої рівноваги є регулювання, взяте широко як сприяюче розвитку ринку, так і оберігаюче від його ексцесів.

Ключові слова: еволюційна теорія ігор, нестійка рівновага, стійка рівновага, репелер, атрактор, ринок, держава, регулювання.

ГОСУДАРСТВЕННО-РЫНОЧНЫЕ ОТНОШЕНИЯ КАК ЭВОЛЮЦИОННЫЕ ИГРЫ

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Занегин А. Г.

Роль государства в рыночной экономике рассматривается с позиций эволюционной теории игр, которая позволяет разграничить устойчивые и неустойчивые типы равновесия между рыночными и государственными экономическими структурами. Выдвигается идея о двух различных ситуациях неустойчивого равновесия. Изучается возможность устойчивого равновесия (гомеостазиса) в экономических системах. Условием устойчивого равновесия является регулирование в широком смысле, как способствующее развитию рынка, так и оберегающее экономику от его эксцессов.

Ключевые слова: эволюционная теория игр, неустойчивое равновесие, устойчивое равновесие, репеллер, аттрактор, рынок, правительство, кризис, регулирование.

Political statements on the government size aside, could science say anything about the issue? Could it be Economics, for example? Unfortunately, Economics just talks about government role in the economy. The well-known mixed economy notion is essentially empty: it says nothing specific about the mix.

It says nothing about the equilibrium in the Government-Market system either. What conditions could it be stable under? Maybe there is no stable equilibrium at all?

Are there any tipping points when small changes push the system to one state or another? Which states of the system are attainable?

Given these questions, the subject under study is not market equilibrium (classical approach), but equilibrium in the combined Government-Market system.

There exists a very good tool to deal with the above questions. This tool is evolutionary game theory (Saari, 2010).

Even the simplest, most general evolutionary game theory ideas and models provide an amazingly new and fresh insight into the relationships between Market and Government.

The term "evolutionary" speaks for itself. Government-Market system has a dynamic structure. It changes. What is big now could be small tomorrow, in a new historical situation.

Structural system evolution may be regarded as a result of a game. Market and Government are the participants of the game. The outcome of the game is the change in market economic size and power in relation to the government economic size and power.

Two extreme outcomes of the game are obvious: absolute power government (non-market economy) or unbridled market system with zero government power.

But what is the path of the system from one extreme to another, how does the evolution work?

To figure that out, and to make the use of graphs possible, we are going to define a parameter namely "market power differential" or MD, which is simply the difference between market economic power and government economic power.

If MD<0 economic power of the government is dominant with various degrees of dominance which, of course, depend on the absolute value of MD.

This describes the centrally planned economy with various degrees of centralization.

In case of MD>0 the market is a dominant force. Again, there could be different degrees of market dominance. The extreme situation may represent the system, close to the possibility described by Jacques Attali. He believes that some typical traits of such outcome could be: capture of all social protection networks by markets, dismantling nation-states, "devastating wars, pitting nations, religious groups, terrorist entities, and free-market pirates against one another" (Attali, 2009).

Let us build a graph, depicting a possible path from one extreme to another.

The X-axis will be the relative size of the market. Although sizes measurement and comparison are quite vague, it sounds reasonable to say that at some point the market makes 0.3 of the combined government and market size and at another point it constitutes 0.8 of the mentioned size. What matters here is that 0.8 represents significantly greater relative market size. Let us denote this as MS. If MS = 0, there is no market economy.

If MS=1 there are only market structures. If MS deals size, MD 'denates differential power and potential. Small issues, in principle, may be powerful. It is not accidental that evolutionary game theory suggests analogy of a terrain, a landscape with its hills and ravines, with mountain peaks and valleys. Mountain peaks have high potential energy, according to physics.

Let us put MD on Y-axis.

A possible evolutionary path from absolute government dominance to absolute market dominance (or vice-versa) is represented in Fig 1.

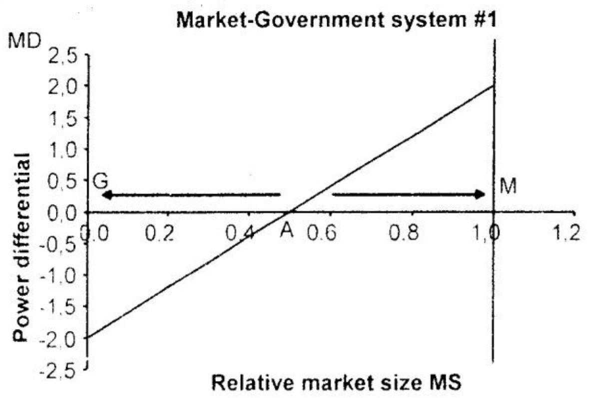

Fig. 1. **Evolutionary path #1**

At point G there is no market and market differential MD is negative with maximum absolute value. The government captures all economic activity. At point M government as an economic agent is nonexistent.

Suppose MS=0.2 (see Fig. 1). In what direction will the economy go? The power differential is negative, so the government dominates. To answer the question we need clear understanding of different economic entities dynamics.

Everybody knows that with a decrease in economic activity within recessions unemployment grows and demand for consumer goods drops, which depresses economic activity even more. The vicious cycle evolves. In good times this cycle may transform into a virtuous one. This is a manifestation of positive feedback loops. It is positive in the sense that the feedback signal aims at direction of the change. So whatever the change, the positive feedback enhances it. The negative changes (in pure mathematical sense) become even greater by absolute value, and so are the positive ones.

Positive feedback loops permeate all complex systems, economy included.

For our study it is important to underscore that government typically begets government, it feeds on itself, trying to enhance this particular element of the system. Yet it is true for market components, too. Markets usually beget markets. Positive feedback loops work in both entities.

So what happens at the point where MS=0.2 and MD<0? Owing to the positive dominating government power feedback nature the government domination will only grow. The market cannot prevent that at this point. Eventually the system reaches point G where government domination is absolute.

Now assume MS=0.8. (See again Fig. 1). In this area MD>0 and the market dominates. The positive feedback logic suggests that the market will be enhancing its position until the system reaches point M for absolute market domination. The arrows in Fig. 1 illustrate these movements to the extreme points.

What about point A? How will the system behave at this point, where power differential is 0? In fact this is the top of the hill, a tipping point. A small push will cause a precipitous move either to G or to M. Prof. Saari uses the term "repeller" for this kind of situation. This is unstable equilibrium. According to evolutionary game theory mathematics, unstable equilibrium point corresponds to positive slope of the evolutionary path. Indeed, at point A the slope is positive.

If the slope at the crossing is negative, it is a stable equilibrium. It is called "attractor". This is not shown in Fig. 1.

Mainstream economic science, to our mind, implicitly considers equilibrium as stable. Yet unstable economic situations are real. Thus, the notion of "repeller" is by no means empty. It is quite appropriate for economic and financial crises mechanics description. We remember pretty well how financial operations with sub-prime mortgage derivatives tipped the world economy into 2008 – 2009 crisis.

Yet the question arises: does Fig. 1 exceptionally depict Government-Market system behavior? Clearly, there may be room for criticism.

In reality, many market economies, at least for a short period of time, remain at stable equilibrium, however fleeting it could be. Otherwise we would have seen just two types of economic systems: 100 % planned economies and unfettered markets economies. The real picture is rather "motley".

There are, indeed, economies with more or less stable Government- Market mix within a certain time span.

Now the logic of evolutionary game theory comes to the fore. If we reject the path from G to M in Fig. 1 with one crossing of axis X as unrealistic, we can get to M by crossing X exactly 3 times. We cannot cross X just twice, actually, because the system at point M has a positive MD. Or, as the evolutionary game theory puts it, the global connecting curve slope must be positive. Yet, in the middle there is a negative slope. Thus, in order to have positive global slope there should be one positive slope + one negative slope + one positive slope, which, of course, equals a positive slope (+1-1+1=+1).

Fig. 2 shows the path with 3 crossings of axis X.

At Point A the slope is positive, so it is a repeller. MS to the left of A eventually leads to the absolute government power. Within A-H interval the power differential is positive, so the market dominates and the system moves to the right. Something new happens here, though. The curve slope turns negative, which means movement deceleration to the market domination. The system cannot go beyond point H, because beyond this point until point B the government power is overwhelming again.

So every market structure between H and B as well as between A and H gravitates to H. It is obvious that H is stable equilibrium. So it is an attractor.

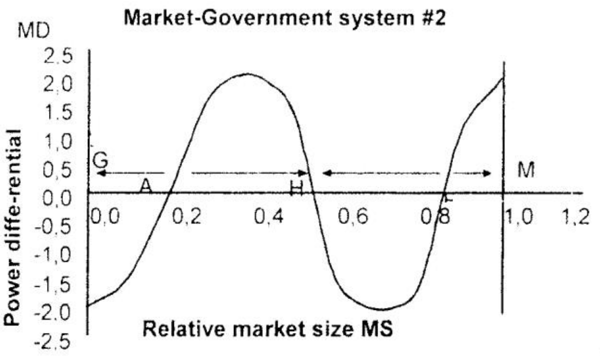

Fig. 2. **Evolutionary path #2**

What about the interval between B and M? Every structure within this interval due to economic entities positive feedback nature precipitates to M, the absolute market dominance.

Yet, the moves from A to H and from B to H need more explanation. Why is it that market domination power in A-H interval decreases? Why is there a decrease in government domination power within H-B interval? In case of precipitous positive feedback does not accelerating dynamics work?

Well, positive economic entities feedback nature remains intact, of course, yet it may be confronted by regulation.

This is why the system comes to the stable equilibrium point H.

It is interesting that Fig. 2 reveals two regulation types. Within A-H interval it is in favor of the market (the antitrust laws in the USA) and within interval H-B it is against market expansion or market failure (Glass-Steagall Act in the USA).

The notion of regulation, though, should be enlarged. To put it in a nutshell, each and every economic entity – households, companies, governments, should exercise some kind of regulation and self-regulation given the challenges of supposedly unsustainable (positive feedback loops at work!) life modes on our planet.

Regulation is a process characterized with a negative feedback loop. In a negative feedback loop the feedback signal works against the change in the system, leading to stable equilibrium, i. e. homeostasis. The notion of homeostasis is no stranger to biology. What is strange is that it has no place in economic theory, despite all signs of being absolutely adequate to the reality. Paradoxically, it may take evolutionary game theory to make it relevant to Economics.

Down to the economic interpretation of Fig. 2, given some factual evidence of existing stable equilibriums, attractors, it is inevitable that there are always unstable ones, repellers. There are two of them in our case.

Hence, repellers may represent crisis points. Point A may describe a transition to the market economy. Point B may well be adequate to the US situation before the recent crisis. The repeal of Glass-Steagall Act in the USA, among other things, intensified instability of the markets. Tipping the economy into reasonable regulation could have pushed it in the homeostasis direction. As with human body, it might have been temporary; the direction would still have been correct. Yet the economy was tipped by sub-prime mortgage mechanism in the direction of unfettered markets where market failures were more pronounced.

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Information about the author

Andrey Zanegin – PhD, Economics.

Інформація про автора

Занегін Андрій Георгійович – докт. екон. наук, професор.

Информация об авторе

Занегин Андрей Георгиевич – докт. экон. наук, профессор.

Рецензент
докт. екон. наук,
професор Лепейко Т. І.

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METHODICAL APPROACH TO ESTIMATION OF CORPORATE BONDS ISSUER DEFAULT RISK

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O. Slutska

The article is devoted to the development of methodical approach to corporate bonds issuers default risk estimation. Fuzzy logic rules have been laid down generated to determine default risk level, focusing on four financial indicator values and of market