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Analysis of Ineffectiveness Arising in "Investor-government" Relations

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Abstract

Purpose: This article deals with the problem of forming Pareto non-optimal norms of mutual behavior of investors and government in the process of decision-making related to financing designed to reduce risks in investment activity.

Methodology: Considering the interdependent type (nature) of interactions between related parties, game theory tools were used to model such interactions. Much attention was directed to search for parameters of interaction leading to certain Nash equilibriums in pure strategies. The formal results obtained with the model were verified by statistical analysis.

Findings: Analysis showed that the rational behavior of related parties can lead to unexpected results. Powerful investors will aim to work in socially-oriented economies, whereas primarily small investors will operate in most liberal economies with a minimum tax burden but with a higher level of risk. As for governments' behaviors, the images are the same: small economies tend to liberalize their tax systems and to secure investment faster than powerful ones. Empirical verification based on statistical data of groups of countries generally confirmed the conclusions. These formal and logical conclusions were from statistical analysis of 124 countries divided into 5 groups: OECD countries, post-socialist countries, Latin American countries, APAC countries and ACP countries. Provided that the more powerful ones are covered economies, there was stronger interdependence between the size of economies and tax burden and also between total investment and tax burden, where this dependence is positive.

Originality: The results obtained used Nash equilibriums in pure strategies as models of behavioral norms to define behaviors of related parties and also to explain assumptions concerning the behaviors of investors and government.

Keywords: investors, government, economic behavior; modeling; game theory, Nash equilibrium, Pareto-optimality

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Introduction

This article deals with one aspect of interaction between investors, operating (or intending to operate) in certain countries and their governments. In detail, this refers to the making of behavioral decisions by interacting parties concerning the additional financing to reduce risk in investors' activity: individually by investors themselves and, in the framework of the whole economy, by government.

The question at issue is (as practice has shown) that the norms of interaction between investors and government, arising in the process of evolution, are occasionally inefficient, i.e., they are Pareto non-optimal. The goal of the study was to answer the questions of how much such inefficiency results from coincidence, and how much it results from quite rational economic behavior of interacting parties.

Considering the interdependent type (nature) of interactions between related parties, the study used game theory tools to model such interactions. Much attention was directed to search for parameters of interaction leading to certain Nash equilibriums in pure strategies.

The formal results obtained with the model were verified by statistical analysis.

Literature review

There were problems of interaction between economic agents in the process of financing and ineffective states occurred as a consequence of such interaction, notably market failures. Terms of government intervention in market economies were investigated in different studies.

W. Tapia and H. Yermo (2007) classified the behavioral economics literature on investment choice. According to them, much of the discussion concerning the implementation of investment choice assumes that individuals are both exceptionally good decision makers and are able to carry out their investment decisions. Behavioral economists, on the other side, have shown that in reality several obstacles and behavioral challenges compromise good investment decision-making, i.e., the individuals do not follow the traditional assumptions about rational economic decision-making. Specifically they separated some behavioral factors influencing investment choices.

More detailed analysis of those factors was found in Kahneman and Tversky (1979), who emphasized that the decision-making process is not a strictly rational one, where all relevant information is collected and objectively evaluated. Rather, the decision maker takes mental "short cuts." Analysis of the impact of individual and psychological factors, as well as nonfinancial ones, on investment decisions is represented in Agnew (2002); Anand et al. (1993); Cassar and Friedman (2007); Dittrich et al. (2005); Iyengar and Kamenica (2010); Kent et al. (2002); de Miguel et al. (2009) and Pflug et al. (2012).

However, those authors entertained the hypothesis of rational behavior, taking into account that decision makers in that case are aggregated and they represent large groups of investors. That's why their individual behavioral characteristics were cancelled out.

Different kinds of market failures accompanying investment activities or financial markets were studied by the staff in international financial organizations as well as theorists. There was resulting evidence on barriers to inward investment as a kind of market failure, which constrain the ability of the private sector to achieve the full potential economic benefits from inward investment and give rise to a need for government action, as examined by experts of Department for Business Innovation & Skills of the UK government (BIS, 2011). They concluded that the incidence of these barriers across firms is not explained by firm size, and is not limited to new exporters. They also found that innovative and high growth firms experience a greater incidence and intensity of barriers.

World Bank experts studied grants as a one-time subsidy for a concrete investment activity to address market failures, often mentioned as obstacles for market and private--sector development. Their study focused on the use of grants for overcoming market failure and related design issues in lending. The authors proposed a framework for assessing and designing grant schemes, which would enhance the staff's capabilities for preparing grant schemes (Meer and Noordam, 2004).

K. Gillingham and J. Sweeney (2010) delved into the economic motivation for renewable energy policies by articulating the classes of market failures relevant to renewable energy. They described how these market failures may vary atemporally or intertemporally, and why the temporal structure and the extent of the market failures are the critical considerations in the development of renewable energy investment decisions. This was to provide motivation for more carefully designed renewable energy investment decisions focusing on correcting for particular market failures.

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The government behavior in regulated investment markets of the national economy, aiming particularly to prevent inefficient states of the economy, was studied by Besley (1994) and Tirole (2006, 2012). Besley 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). He concluded that there may be good arguments for intervention and some may be based on market failure.

In his "Theory of Corporate Finance," Tirole introduced asymmetric information between insiders and outsiders at the financing stage. The presented models were based on a model of adverse selection in capital allocation and a model of moral hazard in capital allocation. He also defined some limitation of models: absence of asymmetric information about investors; absence of informational advantages over issuers for investors; etc.

Different patterns of government behavior when choosing different types of economic climate (paternalistic or liberal) were investigated by experts of the World Bank and UNCTAD (UNCTAD, 2012). Their studies deal with creating new and reforming existing investment legislation in developing and transition economies aimed to promote private investment (domestic and foreign) in those economies. Experts examined the universe of national and international policies through the lens of today's key investment policy challenges to strengthen the development dimension of investment policies.

The theoretical approaches regarding the effects of foreign direct investment (FDI) according to (caused by) government policy, particularly the neo-liberal, Keynesian, "dependency" and "new dependency" schools, were examined by Žilinskė (2010).

B. Carlin et al. (2013) developed a theoretical model to analyze the effects of libertarian paternalism on information production and financial decision making. They characterized situations in which libertarian paternalism improves welfare and contrasted them with scenarios in which this policy is suboptimal because of its negative effect.

Government behavior oriented to attracting investment, particularly by reducing the tax burden, was studied in OECD Working Papers (OECD, 2007; OECD, 2008). They provided reviews of empirical studies on the effects of taxation on FDI flows and developed approaches for incorporating commonly employed cross-border tax planning strategies in effective tax rate models used to identify tax distortions to investment.

Similar problems were analyzed by James (2009) and van Parys and James (2010). They examined the effects of tax incentives on investments and provided econometric evidence about affecting the investment climate and the effectiveness of such incentives.

Interaction of government and investors can be modeled by different methods: econometrical methods (Country Policy and Institutional Assessment – CPIA) (Gayle and Martinez, 2008), dynamic stochastic general equilibrium – DSGE) (Algozhina, 2012), real options approach (Barbosa et al., 2013), etc.

Since one issue is to take into account that the interests (objectives) of parties do not often coincide and can even contradict each other, it was expedient in this study to use game theory tools for modeling the interaction of parties. For studying the interaction of financial agents (notably government and investors), a number of other authors also felt it necessary to use game theory tools. In most cases, they investigated the interactions of such agents in different industries.

Thus F. Medda (2007) analyzed the process of risk allocation between public and private sectors in transport infrastructure agreements as a bargaining process between these two agents. They showed that when guarantees have a higher value than financial losses, one is confronted with strategic behavior and potential moral hazard problems.

Game theory was applied to analyze the optimal fiscal policy of the government and the optimal decision of the participating enterprises in (Cao et al., 2014) to evaluate the government's environmental regulation.

V. Vivoda (2011) established a model for analyzing the bargaining dynamics between host states, oil companies and other stakeholders in the oil industry, aimed at helping actors choose strategies more systematically, leading to higher relative bargaining power.

However it should be noted that studies of situations when investors' decisions depend on the degree of sociality/liberality of government policy related to investment protection, notably the logical and statistical analysis of possibilities and regularities of formation of non-optimal states in consequence of the rational behavior of related parties, have received little attention in the literature.

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Model of interaction between investors and government

One should consider the strategic choices that can be used by government on one side and by investors from another.

Investor's choice. Consider two types of investors: risk-loving and risk-averse. The process of earning investment income is not well defined, and investors faces the choice: to secure themselves and to allocate some funds to improve reliability of their operating results; or to risk trying to maximize the profit due to cost minimization. From this perspective, the actions of risk-averse investors improving the safety of operating results due to reduction of payoff (return) can be treat as a satisfactory behavior. Conversely, the risk actions aimed to receive the maximum payoff can be treated as a maximizing behavior.

Government's choice. The government also has two alternatives of behavior: so-called "social" and "liberal". In a simplified form, the social behavior can be treated as total investment "insurance" (similar to individual insurance as noted), i.e., improving the safety of doing business in a country. The government allocates some funds to improve safety, while simultaneously increasing the taxes. Similarly, the liberal behavior is related to minimization of expenses for improving safety. Consequently, the added component for "business insurance" in the tax rate is absent.

Since the decision-making process concerning the financing of risk reduction in investment activity can be presented as a process of interaction between investors and government, it is suitable to model that process using game theory tools.

Assume that expenses related to risk reduction in their investment activities are added by investors; they influence the amount of expected income by increasing it. At the same time, the amount of investment remains unchanged. The same additional expenses related to increasing the profitability of investment activity are assumed for the government in the case of choosing the "social" strategy.

As the model parameters, defining the cost of various strategies, the following basic economic indicators will be used:

- R is the expected investor's income $(R>0)$;
- τ is the aggregate tax burden $(\tau>0)$;
- θ is the tax rate for government's assistance for safety of investment activity $(\theta\geq 0)$;

- λ, μ is the government's and investor's expenses, respectively, aimed to reduce risks in investment activity($\lambda \geq 0, \mu \geq 0$);
- p_0 is the initial probability of loss of expected income ($0 \leq p_0 \leq 1$); the general function of probability p of receiving insufficient income (proceeded from expenses).

In general, the probability p of receiving insufficient income depends on the amount of funds allocated to reduce risk in investment activity. The type of this dependence can be determined based on its behavioral properties: limited values with monotonicity.

Obviously, the absence of expenses means that probability is on the p_0 level; increasing expenses reduce p. It is assumed that p reduces according to the law of diminishing returns. It should also be considered that the probability at any amount of expenses cannot be less than zero. Therefore, the dependence function between income and investment will decrease monotonically. Those considerations allow supposing that the determined dependence is exponential with a negative value of the index, which should consider the amount of expenses related to risk reduction in investment activity (λ or μ). It is also obvious that the same expenses will lead to greater outcomes for investors with humble income, i.e., λ should be R-scaled. Hence, one obtains the

$e^{-\alpha\frac{\lambda}{R}}$ dependence of the or $e^{-\beta\frac{\mu}{R}}$ type.

α, β – coefficients of parameterization;

At that rate, the model of principal-agent interaction can be described as game (1-5):

$$\Gamma = \left(Gov,\ Inv,\ G\left(Gov,\ Inv\right), H\left(Gov,\ Inv\right)\right), \tag{1}$$

where

$$Gov = \begin{pmatrix} gov_0 \\ gov_1 \end{pmatrix} \tag{2}$$

– a set of government strategies: gov_0 is the "liberal strategy", i.e., the government does not use funds to improve the safety of investment activity in country; gov_1 is the "social" strategy, i.e., the government allocates some funds for improving the safety of investment activity, which provides the achievement of marginal utility;

$$Inv = \left(inv_0;\ inv_1\right) \tag{3}$$

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– a set of investor's strategies: inv_0 denotes the investor, who does not allocate funds to improve the safety of their own activity; inv_1 denotes the investor, who allocates some funds with this view, which provides the achievement of marginal utility;

$$G(Gov,Inv)=(g_{ij})=\begin{pmatrix} \tau R(1-p_0); & \tau R\left(1-p_0e^{-\beta\frac{\mu}{R}}\right) \\ (\tau+\theta)R\left(1-p_0e^{-\alpha\frac{\lambda}{R}}\right)-\lambda; & (\tau+\theta)R\left(1-p_0e^{-\alpha\frac{\lambda}{R}-\beta\frac{\mu}{R}}\right)-\lambda \end{pmatrix} \quad (4)$$

– government's payoff matrix;

$$H(Gov,Inv)=(h_{ij})=\begin{pmatrix} (1-\tau)R(1-p_0); & (1-\tau)R\left(1-p_0e^{-\beta\frac{\mu}{R}}\right)-\mu \\ (1-\tau-\theta)R\left(1-p_0e^{-\alpha\frac{\lambda}{R}}\right); & (1-\tau-\theta)R\left(1-p_0e^{-\alpha\frac{\lambda}{R}-\beta\frac{\mu}{R}}\right)-\mu \end{pmatrix} \quad (5)$$

– investor's payoff matrix.

Thus, the games (1–5) describe the interaction between *2* agents: government and investor; each of them has *2* pure strategies of behavior. The variables of the games are divided into the control parameters of government (τ, θ, λ), the control parameter of taxpayers (μ) and the parameters (and functions) of the environment (R, p_0, α, β).

Analysis of games (1–5) allows one to determine conditions leading to one or another behavioral tendency of government and investors.

One can now find the conditions of Nash equilibrium in pure strategies relative to:

$$E_{00}:\left(\tau R<\frac{\lambda-\theta R\left(1-p_0e^{-\alpha\frac{\lambda}{R}}\right)}{p_0\left(1-e^{-\alpha\frac{\lambda}{R}}\right)}\right)\wedge\left((1-\tau)R<\frac{\mu}{p_0\left(1-e^{-\beta\frac{\mu}{R}}\right)}\right); \quad (6)$$

$$E_{01}: \left(\tau R < \frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R} - \beta\frac{\mu}{R}}\right)}{p_0 e^{-\beta\frac{\mu}{R}}\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)} \right) \wedge \left((1-\tau)R > \frac{\mu}{p_0\left(1 - e^{-\beta\frac{\mu}{R}}\right)} \right); \quad (7)$$

$$E_{10}: \left(\tau R > \frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R}}\right)}{p_0\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)} \right) \wedge \left((1-\tau-\theta)R < \frac{\mu}{p_0 e^{-\alpha\frac{\lambda}{R}}\left(1 - e^{-\beta\frac{\mu}{R}}\right)} \right); \quad (8)$$

$$E_{11}: \left(\tau R > \frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R} - \beta\frac{\mu}{R}}\right)}{p_0 e^{-\beta\frac{\mu}{R}}\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)} \right) \wedge \left((1-\tau-\theta)R > \frac{\mu}{p_0 e^{-\alpha\frac{\lambda}{R}}\left(1 - e^{-\beta\frac{\mu}{R}}\right)} \right). \quad (9)$$

or

$$E_{00}: R + \frac{\mu}{p_0\left(1 - e^{-\beta\frac{\mu}{R}}\right)} < \tau R < \frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R}}\right)}{p_0\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)}; \quad (10)$$

$$E_{01}: \tau R < \min\left(\frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R} - \beta\frac{\mu}{R}}\right)}{p_0 e^{-\beta\frac{\mu}{R}}\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)};\ R + \frac{\mu}{p_0\left(1 - e^{-\beta\frac{\mu}{R}}\right)} \right); \quad (11)$$

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$$E_{10}: \tau R > \max\left(\frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R}}\right)}{p_0\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)};\ (1-\theta)R + \frac{\mu}{p_0 e^{-\alpha\frac{\lambda}{R}}\left(1 - e^{-\beta\frac{\mu}{R}}\right)} \right); \quad (12)$$

$$E_{11}: \left(\frac{\lambda - \theta R\left(1 - p_0 e^{-\alpha\frac{\lambda}{R} - \beta\frac{\mu}{R}}\right)}{p_0 e^{-\beta\frac{\mu}{R}}\left(1 - e^{-\alpha\frac{\lambda}{R}}\right)} < \tau R < (1-\theta)R + \frac{\mu}{p_0 e^{-\alpha\frac{\lambda}{R}}\left(1 - e^{-\beta\frac{\mu}{R}}\right)} \right). \quad (13)$$

It is evident that the sequence of occurrence of Nash equilibriums with τR moving higher is the following: E_{01}, E_{00} or E_{11},E_{10}.

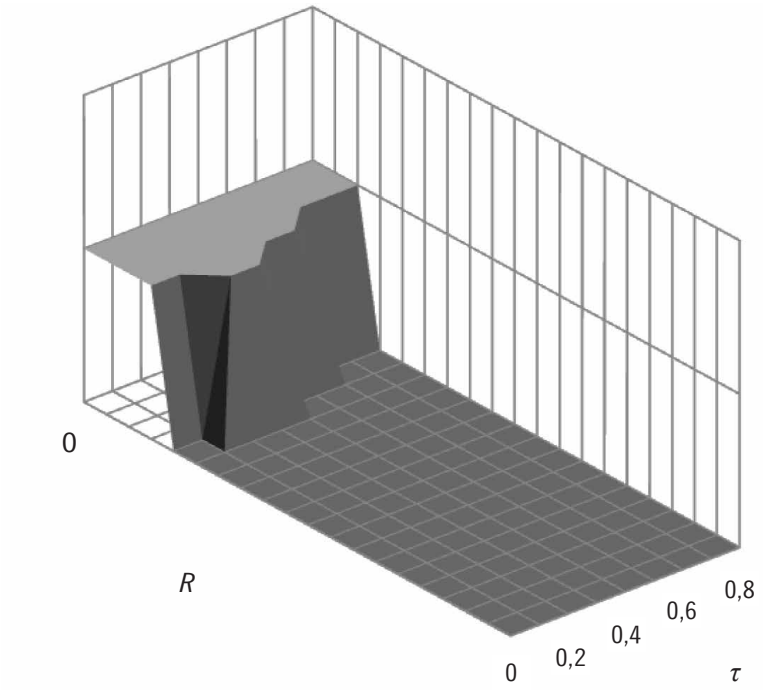
Results and Discussion

Therefore, the analysis of interaction between investors and government using game theory tools highlighted the set of patterns of their behavior, which can be suitably characterized for each interaction parameter separately.

Power of investors (*R*). If one investigates the interactions between government and a single investor, the parameter R will denote the amount of investment of such investor. However, at the macro level when the government faces an aggregated investor (i.e., all investors together, operating in the economy of a given country), R denotes the aggregate amount of investment in the economy as well, i.e., the capacity of a country's economy. The set of definitions of R is expressed by an additional semi axis.

It can be seen from equations (10)–(13) that a gradual increase of R leads to a certain evolution of investors' and government's priorities. A relatively small economy with low powered investors requires the maximum liberalization both on the part of government, which does not desire to allocate additional funds (or there are no such funds at all) to improve the safety of business activity; and on the part of investors, who prefer to risk rather than to allocate their own additional funds to reduce risks of their own activity (Figure 1).

Figure 1. Values of R and τ for the Nash equilibrium E_{00}



Source: author's calculations.

Surely, they can aim to get not only into a liberal economy, but also into a social one

(depending on the sign of expression $(1-\tau)p_0\left(1-e^{-\alpha\frac{\lambda}{R}}\right)-\theta\left(1-p_0e^{-\alpha\frac{\lambda}{R}}\right)$:

where "+" means the investor's intention to get into a social economy; and "–" means the investor's intention to get into a liberal economy. However, beginning with a certain value of "socialization" coefficient λ, the allocation of funds aimed to improve the safety of business activity becomes unprofitable for government. It either curtails this process and shifts to a liberal strategy or by some means tries to dispose of low powered investors.

Conversely, the more powerful are the investors, the more efforts they make to reduce risks of own activities regardless of the level of liberality of government policy. Formally, investors change their risk-loving behavior to a risk-averse one when their profitability

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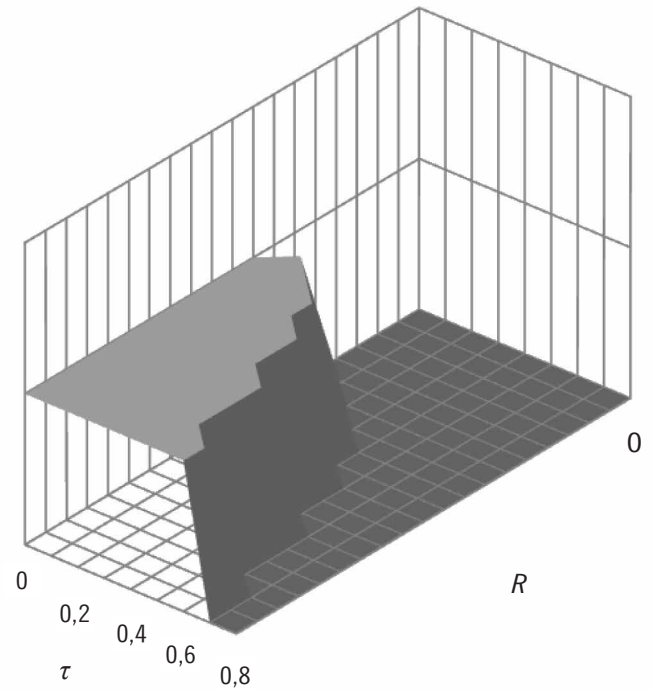
increase so that ratio μ becomes fewer than $(1-\tau-\theta)p_0 e^{-\alpha\frac{\lambda}{R}}\left(1-e^{-\beta\frac{\mu}{R}}\right)$.

Concerning the government's behavior, one can observe a similar situation for low powered investors: beginning with a certain value of λ, allocation of funds to improve the safety of business activity in a jurisdiction becomes unprofitable for government. Although it may be caused by other reasons, for example, the investors' efforts necessary to secure their own activities, virtually set the ratio of "expenses – safety of activity" on the level of marginal utility. Therefore, the additional government expenditures in that process are unprofitable (Figure 2).

Figure 2. Values of R and τ for the Nash equilibrium E_{11}



Source: author's calculations.

Generally it can be concluded that the vector of evolution for interaction between investors and government is directed from a mutual strategy of reciprocal absence of financing for safety of investment activity until the maximum possible financing, realized both by every investor (with regard to their own activity) and by government

(with regard to all investment activity in the economy). One can call this vector "policy of mutual support" or "bilateral behavior".

Total tax burden (τ). This study investigates the tax level τ on the macro level that can be described either as the major "budget-generating" tax or as the most important tax for corporations (but not for individuals, since the investment activity is considered as the activity of corporations), for example, the corporate income tax. But most reasonable, in the author's opinion, is to consider τ as the aggregate tax burden on corporations. Obviously, the set of determinations for τ is closed interval $[0; 1]$.

The aggregate investor's and government's behavior, as well as for the case for R, can be determined from analysis of equations (10)–(13). However as opposed to the case for R, the interaction between investors and government evolves from financing for the safety of investment activity (due to liberal government strategy) by each investor independently towards the government social strategy. The consequence of this is investors curtail their individual expenses, relying entirely on centrally-controlled measures.

The small tax burden permits investors to allocate some funds to improve the safety of their own businesses. Another factor favorable to financing for safety is the relatively large after-tax profit, and thus the larger efficiency of own safety financing. Concerning smaller tax revenues, they are unprofitably for government for the same reason to allocate additional funds to reduce risks of investor's activity (Figure 3).

The gradual increase of τ leads to changes in government's and investors' behaviors. Finally, the high tax level and the high tax revenues make the additional financing for safety of investors' activity is economically advantageous for government. However, the amount of unallocated funds of investors (who in this case pay heavy general taxes and also the additional tax for improving the safety of business activity) reduces considerably. Therefore, the investors tend to rely on government's activity and in addition they do not reduce individually the risk of their own activities (Figure 4).

Such evolution can be called a "policy of complement" or "compensatory behavior".

Statistical analysis. The study analyzed four groups of economies: OECD countries, post-socialist countries (there is an overlap with OECD countries), Latin American countries, APAC countries and ACP countries to determine the dependence of GDP and total investment from the CIT rate. Average indicators were used for 2007–2012 (Table 1) to hedge against externalities of 2008–2009 (crisis and post-crisis periods).

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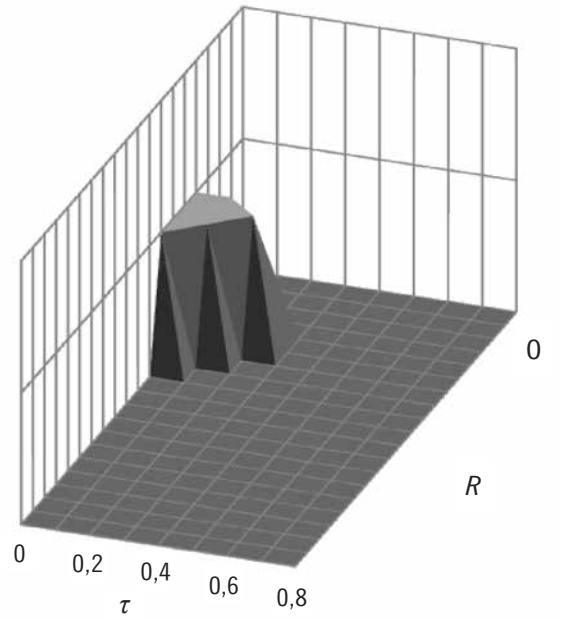
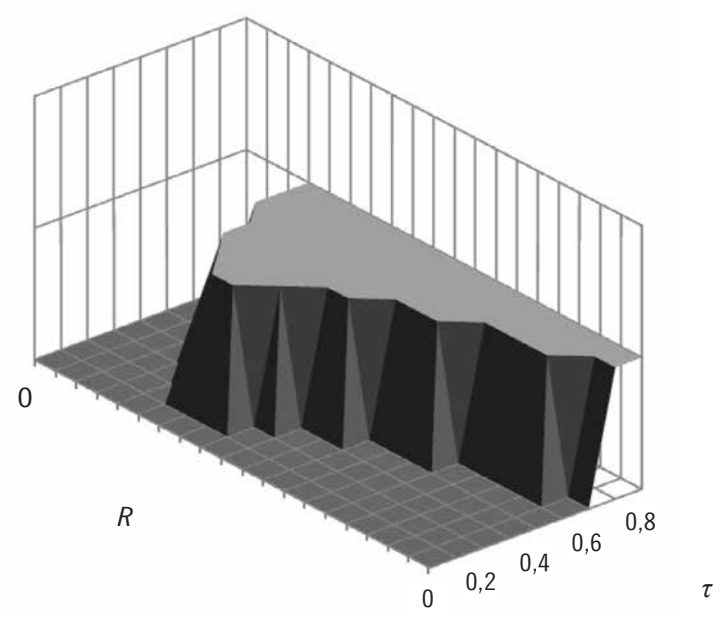
Figure 3. Values of R and τ for the Nash equilibrium E_{01}



Source: author's calculations.

Figure 4. Values of R and τ for the Nash equilibrium E_{10}



Source: author's calculations.

Table 1. CIT rates, GDP and total investment by group of countries, 2007–2012

Country	CIT rate, %	GDP, $ billions	Total investment, $ millions
OECD countries			
Australia	30	1,457,643	44,124
Austria	25	396,041	4,338
Belgium	33,99	489,771	87,060
Canada	28,33	1,738,050	30,844
Chile	18,5	245,687	17,064
Czech Republic	19	203,667	3,746
Denmark	25	320,575	1,755
Estonia	21	21,321	1,480
Finland	25,5	248,795	-0,869
France	33,33	2,652,824	35,581
Germany	29,42	3,452,835	35,727
Greece	21,33	277,684	1,463
Hungary	19	129,851	-4,853
Iceland	19,33	13,397	0,476
Ireland	12,5	215,354	38,455
Israel	24,67	234,138	6,904
Italy	31,4	2,088,576	21,023
Japan	39,80	5,783,931	5,548
Korea	23,47	1,086,320	2,727
Luxembourg	28,73	55,069	25,622
Mexico	30	1,134,825	20,907
Netherlands	25,17	793,327	15,628
New Zealand	28,67	159,300	1,421
Norway	28	470,425	13,635

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Table 1 (Continued)

Poland	19	491,805	16,273
Portugal	25	226,322	7,795
Slovak Republic	19	91,503	2,460
Slovenia	19,33	47,543	0,366
Spain	30	1,387,168	32,338
Sweden	26,3	507,622	4,623
Switzerland	18,37	613,052	29,847
Turkey	20	764,740	11,249
United Kingdom	26	2,409,869	33,876
United States	40	15,578,900	221,889
Post-socialist countries			
Albania	10	12,172	1,267
Armenia	20	9,784	0,670
Belarus	22	59,405	2,424
Bosnia and Herzegovina	10	17,446	0,350
Bulgaria	10	50,748	2,629
Croatia	20	59,042	1,825
Czech Republic	19	203,667	3,746
Estonia	21	21,321	1,480
Hungary	19	129,851	-4,852
Kazakhstan	20	180,013	12,006
Latvia	15	26,986	0,630
Lithuania	15	40,710	0,775
Macedonia	10	9,770	0,352
Montenegro	9	4,217	0,955
Poland	19	491,805	16,273
Romania	16	172,266	3,562

Russian Federation	20	1,817,938	44,945
Serbia	10	39,774	1,992
Slovak Republic	19	91,503	2,460
Slovenia	19,33	47,543	0,366
Ukraine	23,67	158,717	6,142
Latin American countries			
Argentina	35	431,819	7,528
Aruba	28	2,495	0,198
Bahamas	0	7,867	0,710
Barbados	25	4,364	0,553
Bermuda	0	5,636	0,088
Bolivia	25	23,545	0,635
Brazil	34	2,291,265	52,121
Cayman Islands	0	3,324	18,712
Chile	18,5	245,687	17,064
Colombia	33	331,059	9,098
Costa Rica	30	40,812	1,656
Dominican Republic	27,67	55,104	1,995
Ecuador	24	78,943	0,376
El Salvador	30,00	22,807	0,308
Guatemala	31	46,469	0,919
Honduras	31,67	17,371	0,674
Jamaica	33,33	14,153	0,281
Mexico	30,00	1,134,825	20,907
Panama	25,83	31,540	2,168
Paraguay	10	23,980	0,180
Peru	30	180,959	7,706
Trinidad and Tobago	25,00	22,448	0,825

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Table 1 (Continued)

Uruguay	25,00	45,067	2,172
Venezuela	34	364,238	1,080
APAC countries			
Afghanistan	20	18,593	0,127
Bahrain	0	28,373	0,398
Bangladesh	27,5	120,296	0,930
Cambodia	20,00	12,703	0,741
China	25	7207,543	218,278
Hong Kong SAR, China	16,5	246,894	77,707
India	32,96	1,834,351	33,159
Indonesia	25	811,192	12,630
Israel	24,67	234,138	6,904
Japan	39,80	5,783,931	5,548
Jordan	14	28,734	1,846
Korea, Republic of	23,47	1,086,320	2,727
Kuwait	15	154,580	0,808
Macao SAR, China	12,00	36,246	1,724
Malaysia	25	280,432	8,707
Malta	35,00	8,811	0,860
Oman	12	68,965	1,146
Pakistan	35,00	200,465	1,888
Philippines	30,00	224,623	2,054
Qatar	10	163,000	4,236
Saudi Arabia	20	635,789	27,333
Singapore	17,00	257,946	44,828
Sri Lanka	30,33	56,058	0,612
Syrian Arab Republic	28	57,092	2,019

Thailand	27,67	362,800	7,654
United Arab Emirates	55	339,939	5,727
Vietnam	25	135,764	7,677
Yemen	25	31,802	-0,226
ACP countries			
Angola	35	100,979	-1,349
Botswana	23	14,483	0,179
Egypt	21,67	233,508	4,205
Kenya	30	35,736	0,210
Libya	26,67	72,444	1,578
Malawi	30	6,565	0,092
Mauritius	15	10,804	0,320
Mozambique	32	12,149	1,668
Namibia	34	12,106	0,735
Nigeria	30	245,912	7,815
South Africa	34,55	383,119	5,152
Sudan	28,33	53,814	4,765
Tanzania	30	25,776	1,341
Tunisia	30	45,144	1,097
Uganda	30	19,041	0,760
Zambia	35	18,962	1,177
Zimbabwe	25,75	8,700	0,219

Source: author's calculations.

It should be noted that in any group, there is no sufficient linear dependence (correlation index > 0,7). This can be explained by sufficiently random distribution of values of GDP and total investment for low rates of CIT.

However, each group was tested for statistical assumptions about the independence of values of GDP from CIT, values of total investment from CIT, and also taking into

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account the previously mentioned dependences (if they occur), to demonstrate the interdependence between GDP and total investment.

The test was as follows. To confirm the assumption about independence between variables, the number of economies for which the value of each variable is higher than a certain threshold value should be within a fixed interval. The results are presented in Table 2.

Table 2. Results of testing of statistical hypotheses for interdependence between GDP, CIT and TI

Independent variable	Threshold value	Total number	Number in a sample	C.I. (5%)	Assumption about independence is confirmed
OECD countries (34 countries; 15 countries; GDP average – $1,347 trn)					
CIT	GDP > $1trn	11	10	[1,829;5,289]	No
CIT	TI > $20 bln	13	11	[2,409;6,003]	No
GDP	TI > $20 bln	13	10	[2,409; 6,003]	No
Post-socialist countries (21 countries; 11 countries; GDP average – $173 bln)					
CIT	GDP > $100 bln	7	6	[1,449;5,885]	No
CIT	TI > $5 bln	13	8	[4,525;9,094]	Yes
GDP	TI > $5 bln	6	6	[1,017;5,268]	No
Latin American countries (24 countries; 11 countries; GDP average– $226 bln)					
CIT	GDP > $100 bln	7	6	[1,208;5,209]	No
CIT	TI > $5 bln	7	5	[1,208; 5,209]	Yes
GDP	TI > $5 bln	7	6	[1,208; 5,209]	No
APAC countries (28 countries; 11 countries; GDP average – $730 bln)					
CIT	GDP > $100 bln	18	8	[4,188;7,383]	No
CIT	TI > $5 bln	12	5	[2,207;5,507]	Yes
GDP	TI > $5 bln	12	10	[2,207; 5,507]	No
ACP countries (17 countries; 8 countries; GDP average – $76 bln)					
CIT	GDP > $50 bln	8	4	[1,867;5,663]	Yes
CIT	TI > $1 bln	9	4	[2,337;6,133]	Yes
GDP	TI > $1 bln	9	6	[2,337; 6,133]	Yes

Source: author's calculations.

Analysis of Table 2 leads to making the following observations.

For OECD countries with a probability of 0.95, all assumptions about independence between values of GDP from CIT, TI from CIT and TI from GDP are rejected. Therein, two assumptions about independence from CIT are rejected with higher probability than the third one. This provides evidence of real influence of the CIT burden on GDP and TI instead of indirect appearance of the interdependence of GDP and TI. For post--socialist and Latin American countries, the assumptions are partially rejected (only GDP from CIT and TI from GDP). For APAC and ACP countries, all assumptions were confirmed, except for independence between TI and CIT. Comparing the average GDP in all groups allows one to observe the direct positive dependence between the size of economies and CIT burden. Likewise the more powerful are covered economies (excepting APAC countries), the more evident is this law. The most obvious is OECD countries, to a lesser extent for post-socialist, Latin American and APAC countries and almost absent for ACP countries. It can be explained by the more the country is developed, the more investors are confident on the effectiveness of additional taxes.

It can also be stated that in practice, the powerful investors tend to operate in secured "social" economies and the low powered investors primarily operate in economics with maximum liberalization, but also with minimum tax burden.

This situation seems not quite logical. It can be assumed that developed countries with a large volume of investments can increase the degree of liberalization of their economies and reduce the tax burden to create favorable conditions for attracting investment. Also, it is no wonder that powerful investors, capable of securing independently the reduction of risks of their own activities, would tend to operate in economies with small tax burdens that would allow increasing their profits.

Conversely, the government policy, consisting of centrally-controlled reduction of risk in investment activity while simultaneously increasing the tax burden, could attract the small investors who have no additional funds to secure independently the safety of their activities.

Finally, it would seem natural for the most powerful and investment-attractive economies to use the more liberal tax systems; by contrast in developing and LDC countries, the investment activity in them is accompanied by high risk.

Therefore the statistical analysis confirms the conclusions obtained during the model study. The identified relations between macroeconomic indices are non-casual and

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are perfectly related with the conditions of Nash equilibriums in a game, modeling the interactions between investors and government. Thus, the behavior of the parties is completely expected.

In addition, the aforementioned logic of behaviors of economic agents can lead to faster failures of most small investors (as compared to other conditions, for example, equal allocation of investors in economic systems). The powerful corporations would not fully use their capacities due to excessive precaution; the given norm of interaction will lead to Pareto non-optimal decision-making that enables identifying it as inefficient.

Conclusions

One of the important questions related to interactions between investors and government within a certain economy is the decision-making by both parties concerning the financing to improve safety of investment activity.

The analysis of relations between the parties with game theory tools affirmed that decisions made by parties often leads to the appearance of Pareto inefficient norms of mutual behavior, especially for the smallest and the biggest investors. It can be easily observed that in practice due to the impact of other factors, which were not taken into account in this study, results would be more vague. The study concludes for the behavioral tendency that for the Pareto inefficient norms, both investors and government simultaneously tend to either finance or not finance to ensure safety of investment activity.

In contrast with existing studies analyzing the behavior of economic agents in individual industries using game theory tools, this study obtained results in macroeconomic terms, allowing comparisons by country. One of the results of those comparisons is the high tax burden in powerful economies, i.e. economies with high GDP (but not necessarily in the developed countries) where the bulk of investment flows into those economies, despite the high taxes. The analysis of statistical data for OECD countries generally confirms this conclusion, especially with regard to the biggest investors.

The directions for future research of this problem are related with modeling of structures and categories for institutional economics: norms, institutes, routines, contracts, etc., aimed to avoid the appearance of ineffective norms.

The determination of influencing factors on forming norms of mutual investors' and government behaviors will encourage the development and realization of specific

management decisions, aiming to avoid and remedy such situations. This could lead to more rational allocation of available funds by investors and government, and consequently to more profitable investment activity.

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