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Contents

RESOURCES, INSTITUTIONS AND TECHNOLOGIES:
GAME MODELING OF DUAL RELATIONS[*]

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Abstract

A new approach is proposed revealing duality relations between a physical side of economy (resources and technologies) and its institutional side (distributional relations between social groups). Production function is modeled not as a primal object but rather as a secondary one defined in a dual way by the institutional side. Differential games of bargaining are proposed to model a behavior of workers and capital-owners in process of prices or weights formation. These games result, correspondingly, in a price curve and in a weight curve – structures dual to a production function. Ultimately, under constant bargaining powers of the participants, the Cobb-Douglas production function is generated.

Key words: *Production function, Production factors, Choice of technology, Bargaining, Differential games, Duality*

1. Introduction

Can institutions be a primal reason of using definite technologies in the economy? The paper studies this question in relation to the problem of micro foundations of production function. Acceptance of concrete types of production functions in economics, such as Cobb-Douglas and CES, was rather occasional and since now not enough attempts have been made to explain and justify the widely used types of production function – see Acemoglu, 2003, Jones, 2005, Lagos, 2007, Nakamura, 2009, Matveenko, 2010, Dupuy, 2012. In the paper models resulting in the Cobb-Douglas production function are constructed on base of dual relations between production and institutional sides of the economy, by use of differential games of bargaining.

Duality is being considered both in general economics texts (e.g. Jehle and Reny, 2001) and in more specialized ones (e.g. Cornes, 1992). Diewert (1982) reviews numerous professional publications enlightening on the role of economic duality. An interesting historical note on duality in the production theory is provided by Jorgenson and Lau (1974). Knowledge of any one of a pair of dual objects is enough for restoring the other one. The spreading of duality in economics is connected with the mathematical fact that closed convex sets (which are often found in economic systems) can be described in two ways: by enumerating their elements (a primal description) and by enumerating closed subspaces containing the set (a dual description).

One way to exploit the dual relations is to use them as a basis for studying relations between a physical side and an institutional side of production process. These two sides of the economic system are in some duality relations; and it is a widespread view in the literature that institutions play equally important role in production as physical resources and physical technologies do. Jorgenson and Lau (1974) study an equivalence of technological and behavioral approaches as a basis of the production theory. Stern (1991), Hall and Jones (1999), Acemoglu et al. (2005), Acemoglu and Robinson (2010) consider social infrastructure and other institutions as determinants of economic growth and show that differences in incomes between countries are in a con-

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siderable measure explained by differences in social infrastructure. Nelson and Sampat (2001) and Nelson (2008) relate institutions to social technologies which are used in production symmetrically to physical technologies. Papandreou (2003) argues that "Though it is often difficult to distinguish institutional and physical constraints impinging on production and consumption sets, it is important to do so, as it provides a starting point for what can and cannot be controlled by human agency". However, an idea of duality of resources and institutions, physical and social technologies is still at a stage of formation.

In the paper a simple differential game of price bargaining is introduced as a benchmark and then is modified to a differential game of formation of prices of capital and labor and to a differential game of formation of weights (assessments) of the factor-owners. Each of these three differential games exploits one or another of duality relations existing in economies. The price curve and the wage curve are dual object in relation with the factor curve. Their formation is modeled by use of differential bargaining games. Ultimately, under constant bargaining powers of the participants, the Cobb-Douglas production function is generated.

The paper is organized as follows. Section 2 describes basic duality relation to be used in the paper. In Section 3 a benchmark differential game of price bargaining is introduced. In Section 4 a differential game of factor price formation is considered resulting in a price curve which leads to the Cobb-Douglas production function. In Section 5 a differential game of weight curve formation is studied and its relation to the production function is shown. Section 6 concludes.

2. Some dual relations

One of the duality relations used in the paper is usually represented as the duality between the production function, $Y = F(K,L)$, and the cost function, $C(p_K, p_L, Y)$; here Y is output, K is capital, L is labor, p_K and p_L are the factor prices. The first of these two functions shows the maximal output in dependence on the production factors while the second one shows the minimal cost given factor prices and an output. We propose a model of a process of the factor prices formation which is based on the institutional side of production and is independent on the physical side. To do this we use a duality correspondence between the production function and a set of the factor prices.

The following representation of the production function by use of the Euler theorem is often used in the economic growth theory:

$$F(K,L) = \frac{\partial F}{\partial K} K + \frac{\partial F}{\partial L} L = p(x)x \,,$$

where $x = (K,L)'$ is the vector of production factors and $p(x) = \left(\dfrac{\partial F}{\partial K}, \dfrac{\partial F}{\partial L} \right)$ is the corresponding price vector (the vector of marginal productivities). There exists a set Π of the price vectors corresponding the production function, such that the Euler theorem can be written in an 'extremal' form:

$$F(K,L) = \min_{p \in \Pi} px, \quad \textbf{(1)}$$

which means that the production function represents a result of a choice of a price vector from the set Π. The set Π is referred to as a *price curve*.

Let $M = \{x : F(x) = 1\}$ be the unit level line of the production function *F*; it will be referred as a *factor curve*. A conjugate problem for (1) is the problem of a choice of a bundle of production factors $x = (K,L)$ from the factor curve to provide a unit output with minimal cost:

$$F^*(p) = \min_{x \in M} px \,.$$

Rubinov (Rubinov and Glover, 1998, Rubinov, 2000) was the first to study new types of duality using, instead of the usual inner product, $px = \sum_{i=1,...,n} p_i x_i$, its analogues such as the Leontief function, $\min_{i=1,...,n} l_i x_i$. Notably, the latter is similar to the inner product but uses an 'idempotent summation' operation $\oplus = \min$. Matveenko (1997, 2010) and Jones (2005) found for neoclassical production functions a representation which reminds (1) but uses the Leontief function:

$$F(K,L) = \max_{\lambda \in \Psi} \min \{l_K K, l_L L\}.$$

Here Ψ is a *technological menu* which corresponds the production function *F*.

In the present paper both the usual and the generalized types of duality are used. The ordinary duality allows us to construct a microfoundation of production functions on base of the price curve. The generalized duality introduced by Rubinov and Glover, 1998, Rubinov, 2000 and Matveenko, 1997 is used to make the microfoundation more precise by specifying in what way the income distribution and a corresponding choice of technology can depend on formation of a set of moral-ethical assessments (weights) by the owners of the resources in dependence on their bargaining powers; this set will be referred as a *wage curve*.

3. Benchmark differential game of price bargaining

The term *bargain* relates both to a process of bargaining and to a result of this process. Both sides of bargaining are being studied in the bargaining theory – a special chapter of the game theory. However, traditionally, the bargaining theory deals more with results of bargains rather than with processes of bargaining. Nash (1950) proposed a system of axioms leading to a so called symmetric Nash bargaining solution; later an asymmetric solution was found and axiomatized[2]. For the reviews of the axiomatic approach in the bargaining see Roth, 1979, Thomson and Lendsberg, 1989, Thomson, 1994, Serrano, 2008.

The models of processes of bargaining are usually based on assumptions concerning economic benefits gained by participants under one or other running of the process of bargaining (see Muthoo, 1999). For example, a participant can bear some costs connected with the duration of the bargaining process. In practice, however, in many cases the course of a bargaining process depends in much not on expectations of economic benefits by participants but on their skills to bargain[3]. These skills can be associated with *bargaining powers* of the participants. The notion of bargaining power is often used in game theory, though, different authors put different sense into this notion[4].

In this Section we propose a simple differential game as a model of a bargaining process. In different versions of the game the bargaining powers of the players are either given exogenously or are defined endogenously in the game itself.

In the benchmark example of bargaining (Muthoo, 1999) an object is on sale (e.g. a house). A seller (player **S**) wishes to sell the house for a price exceeding $\bar{p}_S^0$ (the latter is the minimal price acceptable for player **S**). A buyer (player **B**) is ready to purchase the house for a price not exceeding $\bar{p}_B^0$ (the maximal acceptable price for player **B**). Here $\bar{p}_B^0 > \bar{p}_S^0$, what ensures the possibility

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[2] An asymmetric Nash bargaining solution satisfies axioms of Pareto optimality, independence on irrelevant alternatives, and independence on a linear transformation.

[3] In fiction we can find descriptions of bargaining processes where bargaining powers of players are of the first importance and these powers are not related directly to any economic benefits as in the following example. *"I went to look after a piece of old brocade in Wardour Street and had to bargain for hours for it. Nowadays people know the price of everything and the value of nothing".* Oscar Wilde. The Picture of Dorian Gray.

[4] Ways of behavior of bargainers are being studied in a so called *tactical approach* initiated by Schelling (1956). In the present paper the bargaining models are very schematic; but it can be expected that detailed tactical models applied in a similar would provide interesting results.

of the bargain. The seller starts from a start price, $p_S(0) > \overline{p}_S^0$, and then decreases her price, while the buyer simultaneously starts from a price $p_B(0) < \overline{p}_B^0$ and then increases her price. It is assumed, naturally, that $p_B(0) < p_S(0)$. A price trajectory $(p_B(t), p_S(t))$ formed in continuous time stops at a moment **T** when $p_B(T) = p_S(T)$. It follows that $p_B(t) < p_S(t)$ for $t \in [0, T)$. The selling price will be referred as p^*.

A surplus of the selling price over (under) the minimal (maximal) admissible price of a player can be considered as the player's utility:

$$u_S = p^* - \overline{p}_0^S, \; u_B = \overline{p}_0^B - p^*. \;\; (2)$$

A set Ω of all possible pairs of utilities on plane (u_B, u_S) is

$$\{(u_B, u_S): \; u_B + u_S = \overline{p}_0^B - \overline{p}_0^S, \; u_B, u_S \geq 0\}.$$

A simplest model of price bargaining appears under an assumption that each player $i = B, S$ changes her price with a constant velocity equal to the bargaining power of her opponent, b_j:

$$p_i(t) = p_i(0) + \dot{p}_i t, \quad i = B, S,$$
$$\dot{p}_S = -b_B, \; \dot{p}_B = b_S.$$

A strong opponent forces the player to change her price faster[5]. Hence,

$$p_S(t) = p_S(0) - b_B t, \;\; p_B(t) = p_B(0) + b_S t.$$

The game stops at the moment **T** which is found from equation:

$$p_0^S - b_B T = p_B^0 + b_S T,$$

i.e. at the moment

$$T = \frac{p_S(0) - p_B(0)}{b_S + b_B}$$

when the selling price is:

$$p^* = p_S(T) = p_B(T) = \frac{b_S}{b_S + b_B} p_S(0) + \frac{b_B}{b_S + b_B} p_B(0). \;\; (3)$$

So, the selling price is the convex combination of the start prices proposed by the players summed with weights equal to their relative bargaining powers.

Now let each player *i* know the minimal (maximal) price $\overline{p}_j^0$ accessible for the opponent and establish this as her start price: $p_S(0) = \overline{p}_B^0$, $p_B(0) = \overline{p}_S^0$. Then the play stops at the moment:

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[5] Similar results would be received if it is assumed that the velocity of changing the price by player *i* is inversely proportional to her own bargaining power: a high bargaining power means that the player agrees only to small abatement in bargaining.

$$T = \frac{\overline{p}_B^0 - \overline{p}_S^0}{b_S + b_B}$$

with the selling price

$$p^* = \frac{b_S}{b_S + b_B}\overline{p}_B^0 + \frac{b_B}{b_S + b_B}\overline{p}_S^0$$

And with the utilities of the players equal to

$$u_S = \frac{b_S}{b_S + b_B}(\overline{p}_B^0 - \overline{p}_S^0), \quad u_B = \frac{b_B}{b_S + b_B}(\overline{p}_B^0 - \overline{p}_S^0). \quad (4)$$

PROPOSITION 1. *Price* p^* *corresponds the asymmetric Nash bargaining solution of the bargaining problem under utilities* (2) *and bargaining powers* b_S, b_B.

Proof. The asymmetric Nash bargaining solution is here a solution of the problem of maximization of the function $u_B^{b_B} u_S^{b_S}$ on the set Ω. The first order optimality condition and the constraint form the system:

$$\begin{cases} b_B u_S = b_S u_B \\ u_B + u_S = \overline{p}_B^0 - \overline{p}_S^0 \end{cases},$$

from which the asymmetric Nash bargaining solution is found:

$$u_i = \frac{b_i}{b_S + b_B}(\overline{p}_B^0 - \overline{p}_S^0), \quad i = B, S,$$

which coincides with (4). Q.E.D.

The case when the players change prices under constant growth rates (rather than constant velocities) equal to their bargaining powers is similar. Since the growth rate g_i of price $p_i(t)$ $(i = B, S)$ is the velocity of changing the logarithm of the price, $\ln p_i(t)$, an equation similar to (3) is fulfilled, and the bargaining stops under a price p^{**} the logarithm of which is equal to the convex combination of the logarithms of the start prices with weights equal to the relative bargaining powers of the players:

$$\ln p^{**} = \frac{b_S}{b_S + b_B}\ln p_S(0) + \frac{b_B}{b_S + b_B}\ln p_B(0).$$

In a more complex case the velocity of changing price by a player depends on the actions of her opponent. If the seller decreases her price slowly then the buyer also increases her price slowly because she does not want the game to stop on a too high price. Similarly, if the buyer increases her price slowly then the seller decreases her price slowly. The following system of equations can serve as a model:

$$v_S = -\dot{p}_S = f_S(v_B), \quad v_B = \dot{p}_B = f_B(v_S), \quad (5)$$

where it is natural to assume that

$$f_S(0) = f_B(0) = 0$$

– a player changes her price only if the opponent changes hers; moreover,

$$f_S'(0) = f_B'(0) = 0,$$

and the functions $f_S(.) = f_B(.)$ are increasing and strictly convex: velocity of any player increases when the opponent changes her price faster.

Under the present conditions there exists a unique equilibrium pair of velocities (v_S, v_B) satisfying the system of equations (5). This pair is a Nash equilibrium: no one player alone wishes to change her velocity of price change.

EXAMPLE. Let

$$v_S = a_S v_B^2, \quad v_B = a_B v_S^2,$$

then

$$v_S = a_S^{-1/3} a_B^{-2/3}, \quad v_B = a_S^{-2/3} a_B^{-1/3}.$$

The game stops at the moment

$$T = \frac{\overline{p}_B^0 - \overline{p}_S^0}{a_S^{-1/3} a_B^{-2/3} + a_B^{-2/3} a_S^{-1/3}}$$

under the selling price

$$p^* = \frac{a_S^{-1/3}}{a_S^{-1/3} + a_B^{-1/3}} \overline{p}_S^0 + \frac{a_B^{-1/3}}{a_B^{-1/3} + a_S^{-1/3}} \overline{p}_B^0.$$

The coefficients $a_S^{-1/3}$, $a_B^{-1/3}$ can be interpreted as the players' bargaining powers: the smaller the bargaining power is the stronger the player's reaction to her opponent's price change is.

Let the growth rates of price change, $g_i = \dfrac{\dot{p}_i}{p_i}$, $i = B, S$, be constant. The bargaining power of player i can be defined as the value inverse to $|g_i|$:

$$b_B = \frac{1}{g_B}, \quad b_S = -\frac{1}{g_S}.$$

Then

$$\frac{g_B}{g_S} = -\frac{b_S}{b_B}, \quad (6)$$

i.e.

$$\frac{dp_B}{dp_S} \frac{p_S}{p_B} = -\frac{b_B}{b_S} = const,$$

The game interpretation of this differential equation is the following. Each player i chooses a control g_i, and the controls are connected by the relation:

$$g_B \geq |g_S| \frac{b_S}{b_B}, \quad (7)$$

which means that in the bargaining process the faster the seller decreases her price the faster the buyer increases hers. Moreover, a high bargaining power of the buyer relaxes this constraint (this means a lower degree of reaction to the opponent's actions), and a high bargaining power of the seller reinforces the constraint.

At the same time the seller is limited by the opposite constraint:

$$|g_S| \geq g_B \frac{b_B}{b_S}, \quad (8)$$

which means that the faster the buyer increases her price the faster the seller decreases hers. An increased bargaining power of the buyer forces the seller to diminish her price faster, and an increased own bargaining power allows the seller to diminish her price slower.

Simultaneous fulfillment of inequalities (7) and (8) implies the Equation (6).

4. Bargaining for production factor prices and corresponding choice of technologies

In the just described benchmark differential game the players change their proposals concerning the same price. Now we turn to differential games in which the interests of the players relate to different prices. At each moment of time one of the players *attacks*, another one *defends*. Only the attacker is satisfied by the direction of her price change while the defender hinders changes in her price.

In the present Section the following pair of dual objects will be under consideration:

(i) a neoclassical production function $F(K, L)$ which is characterized by its factor curve: $M = \{(K, L): F(K, L) = 1\}$ i.e. the set of bundles of resources allowing the unit output, and

(ii) the price curve $\Pi = \{(p_K, p_L)\}$ i.e. the set of such bundles of prices under which the unit output under unit costs is possible.

4.1 Usual causality

Given production function $F(K, L)$ the price curve Π can be found from the following system of equations:

$$F(K, L) = 1, \qquad (9)$$

$$p_K K + p_L L = 1, \quad (10)$$

$$\frac{\partial F / \partial K}{\partial F / \partial L} = \frac{p_K}{p_L}, \quad (11)$$

Equations (9) and (10) are conditions of the unit output under unit costs. Equation (11) is a condition of efficiency of production; it can be interpreted as a condition of maximization of output under given costs.

The system (9)-(11) establishes a one-to-one correspondence between points of the factor curve, *M*, and points of the price curve, Π. Indeed, by the Euler theorem, the Equation (9) can be written as

$$\frac{\partial F}{\partial K} K + \frac{\partial F}{\partial L} L = 1, \quad (12)$$

then the Equations (10)-(12) imply:

$$\frac{\partial F}{\partial K} = p_K, \quad \frac{\partial F}{\partial L} = p_L. \quad (13)$$

In particular, for the Cobb-Douglas production function, $F(K, L) = AK^\alpha L^{1-\alpha}$, the system (13) takes the form:

$$\alpha AK^{\alpha-1} L^{1-\alpha} = p_K,$$

$$(1-\alpha)AK^\alpha L^{-\alpha} = p_L.$$

Excluding the ratio K / L from these two equations we find the price curve Π:

$$\left(\frac{p_K}{\alpha A}\right)^{\frac{1}{\alpha-1}} = \left(\frac{p_L}{(1-\alpha)A}\right)^{\frac{1}{\alpha}}.$$

After raising both sizes of the equation to power $\alpha(\alpha-1)$, the price curve takes the form:

$$Bp_K^\alpha p_L^{1-\alpha} = 1,$$

where $B = A^{-1}\alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}$.

For the CES function $F(K,L) = A(\alpha(A_K K)^p + (1-\alpha)(A_L L)^p)^{1/p}$ where $p \in (-\infty, 0) \cup (0,1)$ the system (13) has the form:

$$\begin{cases} \alpha A_K^p \left(\alpha A_K^p + (1-\alpha)K^{-p}(A_L L)^p\right)^{\frac{1}{p}-1} = p_K \\ (1-\alpha)A_L^p \left(\alpha(A_K K)^p L^{-p} + (1-\alpha)A_L^p\right)^{\frac{1}{p}-1} = p_L \end{cases}.$$

Excluding $K^{-p}L^p$ from these equations we receive:

$$\frac{\left(\dfrac{p_K}{\alpha A_K^p}\right)^{\frac{p}{1-p}} - \alpha A_K^p}{(1-\alpha)A_L^p} = \frac{\alpha A_K^p}{\left(\dfrac{p_L}{A_L^p(1-\alpha)}\right)^{\frac{p}{1-p}} - (1-\alpha)A_L^p}.$$

From here, after some transformations, the following equation of the price curve is received:

$$\alpha^{\frac{1}{1-p}}\left(A_K p_K\right)^{\frac{p}{p-1}} + (1-\alpha)^{\frac{1}{1-p}}\left(A_L p_L\right)^{\frac{p}{p-1}} = 1,$$

which can be written in form of the CES function:

$$B\left(\beta\left(\frac{p_K}{A_K}\right)^q + (1-\beta)\left(\frac{p_L}{A_L}\right)^q\right)^{1/q} = 1,$$

where $B = \left(\alpha^{\frac{1}{1-p}} + (1-\alpha)^{\frac{1}{1-p}}\right)^{\frac{p-1}{p}}$, $\beta = \dfrac{\alpha^{\frac{1}{1-p}}}{\alpha^{\frac{1}{1-p}} + (1-\alpha)^{\frac{1}{1-p}}}$, $q = \dfrac{p}{p-1}$.

Here $\widetilde{p}_K = \dfrac{p_K}{A_K}$, $\widetilde{p}_L = \dfrac{p_L}{A_L}$ are prices of the effective capital, $A_K K$, and the effective labor, $A_L L$; the expenditures can be calculated both using the production factors themselves or the effective factors:

$$p_K K = \widetilde{p}_K \cdot A_K K, \quad p_L L = \widetilde{p}_L \cdot A_L L.$$

Notice that $q \in (-\infty, 0) \cup (0,1)$ and, in the same way as under the Cobb-Douglas production function, the price curve is concave (convex down). However under a low elasticity of substitution

of the CES production function (to be precise, under $p \in (-\infty, 0)$ and, correspondingly, $q \in (0,1)$) the prices of factors are boarded, whereas under a high elasticity of substitution (under $p \in (0,1)$ and $q < 0$) an arbitrarily high price of one of the factors is possible.

4.2 Reversed causality

Usually it is supposed that the prices are primarily determined by the physical side of production – physical technologies and existing bundles of production resources. However, another direction of causality is possible: institutions reflected by the prices can define which products will be produced and by use of which technologies[6].

We propose now a model in which the price curve, Π, is defined in a pure institutional way. This model belongs to a class of island models – such where partially independent segments of a market are considered.

There are two types of agents: workers and entrepreneurs. A single product is produced in a continuum set of segments – *islands*; some of them are "inhabited" by the agents of both types. On each of the inhabited islands in each moment of time there are definite prices (payment rates) of labor and capital in terms of the product. In random moments of time from randomly chosen islands either a part of workers or a part of entrepreneurs moves to an uninhabited island. At this moment the prices in the inhabited island are fixed. After that a part of the other social group also moves from the "old" island to the "new" one and there the groups start bargaining about the factor prices. Those who have come first possess an advantage and try to increase their factor price – they *attack*. Those who have come later try not to allow their factor price to fall too much – they *defend*. As starting prices in the bargaining process the groups use the prices which they had had in the "old" island at the moment when the first group left. It is assumed that the social groups always have constant bargaining powers, b_K, b_L. Weakening this assumption is left for a future research.

Opposed to the case of the selling/purchasing bargaining game considered in Section 2, now the prices relate to different goods (labor and capital). The attacker, *a*, is interested in maximizing the growth rate of her factor price while the defender, *d*, is interested in minimizing (the module of) the growth rate of her factor price.

In the simplest case, similarly to the case considered in Section 2, it can be assumed that players have constant growth rates of their factor prices, $g_i = \dfrac{\dot{p}_i}{p_i}$; $g_a > 0$ for the attacker; $g_d < 0$ for the defender; and the price growth rates are linked with the bargaining powers by the equation:

$$|g_d| = \frac{b_a}{b_d} g_a. \quad (14)$$

According to this equation, a higher relative bargaining power b_d / b_a of the defender allows her to reach a slower decline in her factor price, i.e. a smaller $|g_d|$. Vice versa, an increase in the bargaining power of the attacker forces the defender to agree to a larger decline in her factor price.

Equation (14) describing the price change process turns into:

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[6] This reminds a situation in a famous discussion about a relation between geographic factors and institutions (see e.g. Acemoglu et al., 2005): it is usually supposed that historically geographic conditions define technologies and the latter define institutions; but it is possible that vice versa institutions define a choice of places of settling as well as products to be produced and technologies to be used.

$$\frac{dp_a}{dp_d}\frac{p_d}{p_a} = -\frac{b_d}{b_a} = const, \quad \textbf{(15)}$$

which can be written as

$$\frac{dp_K}{p_K}b_K = -\frac{dp_L}{p_L}b_L$$

Solving this differential equation we receive

$$\ln p_K{}^{b_K} = -\ln p_L{}^{b_L} + const,$$

and, hence,

$$p_K{}^{b_K} p_L{}^{b_L} = C. \quad \textbf{(16)}$$

Thus, the price curve Π is described. If initially the price vector belongs the curve Π given a constant *C* then the vector stays in the same curve further.

To describe the strategic behavior of the players in more details, let the attacker's problem be to maximize her price growth rate, g_a, under the following constraint:

$$|g_d| \geq g_a \frac{b_a}{b_d}, \quad \textbf{(17)}$$

and, correspondingly, let the defender's problem be to minimize the module of her price growth rate, $|g_d|$, under (**17**). The inequality (**17**) means that the attacker forces the defender to increase her price reduction rate. An increased bargaining power of the attacker reinforces this constraint while an increase in the bargaining power of the defender relaxes it.

In Figure **1** a solution of the maximizing player (attacker) under a fixed strategy of the defender is shown, and Figure **2** shows the solution of the defender under a fixed strategy of the attacker.

There exists a continuum of Nash equilibria, (g_a, g_d), and all of them satisfy the equation

$$\frac{g_a}{|g_d|} = \frac{b_d}{b_f}.$$

This equation, independently on which player (**K** or **L**) is the attacker, reduces to (**15**) and we come to the price curve (**16**).

Now let us show in what way the price curve (**16**) leads to the Cobb-Douglas type of production function.

We will use the representation of neoclassical production function by use of a menu of Leontief technologies (Matveenko, 1998, 2010, Jones, 2005). Matveenko (2010) has shown that to each neoclassical production function $F(K,L)$ a unique technological menu $\Psi = \{l = (l_K, l_L)\}$ corresponds which consists of effectiveness coefficients of the Leontief function and is such that

$$F(K,L) = \max_{l \in \Psi} \min\{l_K K, l_L L\}. \quad \textbf{(18)}$$

Figure 1: Solution of the attacker under a fixed strategy of the defender
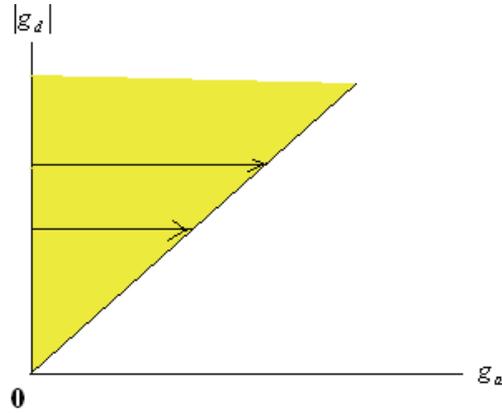
Figure 2: Solution of the defender under a fixed strategy of the attacker
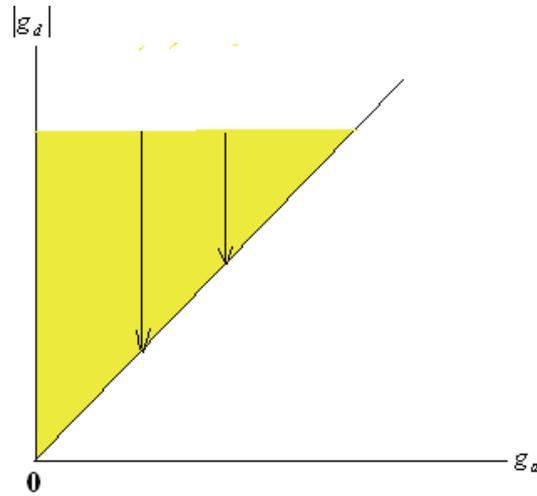
Moreover, there exists a simple one-to-one correspondence between the points $(K, L) \in M$ of the factor curve and the points $l \in \Psi$ of the technological menu:

$$(l_K, l_L) \in \Psi \leftrightarrow \left(\frac{1}{l_K}, \frac{1}{l_L} \right) = (\tilde{K}, \tilde{L}) \in M .$$

The function

$$F^{\circ}(l_K, l_L) = \frac{1}{F\left(\dfrac{1}{l_K}, \dfrac{1}{l_L} \right)}$$

is referred to as a *conjugate function*. Representation (18) follows from the following Lemma .

   LEMMA 1. *Let* $F(x_1, x_2, ..., x_n)$ *be an increasing positively homogeneous of 1ˢᵗ power (i.e. CRS) function of n positive variables,* M – *its unit level set, and* Ψ – *the unit level set of the conjugate function:*

$$M = \{x : F(x_1, x_2, ..., x_n) = 1\} ,$$

$$\Psi = \{l : F\left(\frac{1}{l_1}, \frac{1}{l_2}, ..., \frac{1}{l_n}\right) = 1\}.$$

Then

$$F(x_1, x_2, ..., x_n) = \max_{l \in \Psi} \min\{l_1 x_1, l_2 x_2, ..., l_n x_n\}. \quad \textbf{(19)}$$

Proof. For any $\tilde{x} \in (x_1, x_2, ..., x_n) \in M$ **and any** $l = (l_1, l_2, ..., l_n) \in \Psi$ **equation**

$$\min\{l_1 \tilde{x}_1, l_2 \tilde{x}_2, ..., l_n \tilde{x}_n\} = 1 \quad \textbf{(20)}$$

holds if $l = \left(\frac{1}{\tilde{x}_1}, \frac{1}{\tilde{x}_2}, ..., \frac{1}{\tilde{x}_n}\right)$, and inequality

$$\min\{l_1 \tilde{x}_1, l_2 \tilde{x}_2, ..., l_n \tilde{x}_n\} < 1$$

holds if $l \neq \left(\frac{1}{\tilde{x}_1}, \frac{1}{\tilde{x}_2}, ..., \frac{1}{\tilde{x}_n}\right)$. **Hence,**

$$F(\tilde{x}) = 1 = \max_{l \in \Psi} \min\{l_1 \tilde{x}_1, l_2 \tilde{x}_2, ..., l_n \tilde{x}_n\} \quad \textbf{(21)}$$

for each $\tilde{x} \in M$. Any vector $x = (x_1, x_2, ..., x_n)$ with positive components can be written as $x = \mu \tilde{x}$, where $\tilde{x} \in M$ (evidently, $\mu = F(x)$). By virtue of homogeneity, **(21)** implies **(19)** for each positive vector. **Q.E.D.**

When a pair of prices is defined on an island, the island chooses a suitable technology on base of one or another pure economic criterion (efficiency) or an institutional criterion (fairness). We assume that the whole set ("cloud") of available Leontief technologies is extensive enough to include all those technologies which any islands would choose to use. The technological menu Ψ is narrower and consists of those technologies which can be chosen.

Below three mechanisms of choice are identified resulting in the same technological menu Ψ and the factor curve *M*.

Mechanism A. Given factor prices $\left(p_K^0, p_L^0\right)$, an island chooses such Leontief technology (l_K, l_L) which guarantees receiving factor shares equal to the relative bargaining powers of the social groups[7]: $\alpha = \dfrac{b_K}{b_K + b_L}$ for the capital and $1 - \alpha = \dfrac{b_L}{b_K + b_L}$ for the labor.

For this technology, such volumes of factors $\tilde{K}, \tilde{L}$ for which:

$$l_K \tilde{K} = l_L \tilde{L} = 1,$$
$$p_K^0 \tilde{K} = \alpha, \ p_L^0 \tilde{L} = 1 - \alpha.$$

This choice of the Leontief technologies by the islands results in the following factor curve:

$$M = \{(K, L) : p_K K = \alpha, \ p_L L = 1 - \alpha, \ (p_K, p_L) \in \Pi\} =$$
$$= \left\{(K, L) = \left(\frac{\alpha}{p_K}, \frac{1 - \alpha}{p_L}\right), \ (p_K, p_L) \in \Pi\right\} =$$

---

[7] A support for this assumption is provided in Section 4.

$$= \left\{ (K,L) : \left(\frac{\alpha}{K} \right)^{\alpha} \left(\frac{1-\alpha}{L} \right)^{1-\alpha} = C \right\},$$

i.e.

$$M = \{(K,L) : AK^{\alpha}L^{1-\alpha} = 1\},$$

where $A = \dfrac{C}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}$.

Thus, the Leontief technologies chosen by the islands define the Cobb-Douglas production function:

$$F(K,L) = AK^{\alpha}L^{1-\alpha}.$$

Mechanism B. Given factor prices $\left(p_K^0, p_L^0 \right)$, an island chooses such Leontief technology $(l_K, l_L) = \left(\dfrac{1}{K^0}, \dfrac{1}{L^0} \right)$ which is *competitive* in the sense that, under this technology, the cost of the unit production on the island is equal to 1 while the cost on any other island is greater than 1. So, the usage of this technology is profitable only on the present island. In other words,

$$p_K^0 K^0 + p_L^0 L^0 = 1 < p_K K^0 + p_L L^0$$

for any bundle of prices $(p_K, p_L) \in \Pi$, $(p_K, p_L) \neq (p_K^0, p_L^0)$.

It follows that (p_K^0, p_L^0) is a solution of the problem

$$\min_{(p_K, p_L) \in \Pi} \{ p_K^0 K^0 + p_L^0 L^0 \}.$$

The first order optimality condition for this problem is:

$$\frac{p_L^0}{p_K^0} = \frac{1-\alpha}{\alpha} \frac{K^0}{L^0},$$

hence the factor shares ratio is

$$\frac{p_L^0 L^0}{p_K^0 K^0} = \frac{1-\alpha}{\alpha},$$

and we come to the Mechanism A.

Mechanism C. Given factor prices $\left(p_K^0, p_L^0 \right)$, an island chooses a Leontief technology $(l_K, l_L) \in \Psi$ (or, what is equivalent, $(K, L) \in M$) ensuring fulfillment of a fairness principle:

$$\max_{(K,L) \in M} \min \left\{ \frac{p_K^0 K}{b_K}, \frac{p_L^0 L}{b_L} \right\},$$

which is analogous to the *Rawlsian maximin principle*: a gain of the most hurt agent has to be maximized. Here the gain of an agent is her revenue but with account of her bargaining power: a participant's gain increases if her relative bargaining power increases.

The solution is characterized by the equation:

$$\frac{p_K^0 \widetilde{K}}{b_K} = \frac{p_L^0 \widetilde{L}}{b_L}.$$

Hence,

$$\frac{p_K^0 \widetilde{K}}{p_L^0 \widetilde{L}} = \frac{\alpha}{1-\alpha},$$

and again we come to the Mechanism A.

5. Differential game of weights formation

In this Section we provide a microfoundation for the Mechanism A decribed in Section 4. We propose a differential game in which the players (workers and capital-owners) form a weight curve – a set of possible assessments (weights); the curve is used by an arbiter to choose a vector of weights in a concrete bargain[8].

Three common features present in many real bargains and negotiations. Firstly, it is a presence of an arbiter in which role often a community acts, in a framework of which the bargainers interact. Examples are so called 'international community', including governments and elites of countries, and different international organizations; a 'collective' or a union in a firm; a local community; a "scientific community", etc. The community acts as an arbiter realizing a control for bargains in such way that unfair, from the point of view of the arbiter, bargains are less possible, at least as routine ones. An outcome of an unfair bargain can be, with a help of the arbiter, revised, if not formally than through a conflict. Such conflicts rather often arise, both on a local and on a national levels, as well as in international relations.

Secondly, bargains inside a fixed set of participants are often not 'one-shot' but represent a routine repeated process in which a 'public opinion' of the community is important; and the latter is being formed along with the bargains. Usually it is unknown in advance what concrete bargains will take place and in what time, and the process of formation of the public opinion processes uninterruptedly to prepare it for future bargains. The public opinion can be modeled as a set of the vectors of weights – the moral-ethical assessments which can be used by the arbiter as coefficients for the participants' utilities[9]. Possibilities of formation of public opinion are limited both by possibilities of access to media and by image-making abilities of the participants.

Thirdly, the moral-ethical assessments formed by participants are usually not univalent, but allow a variance: the public opinion practically always can stress both positive and negative features of a participant; concrete weights differ in different concrete bargains depending on obstacles. Thus, it is often useful to speak not about a single vector of weights but rather about a curve (in case of two participants) or a surface of admissible assessments.

Thus, the public opinion can be modeled as a weight curve (or a weight surface). In its approval or disapproval of a possible result of a concrete bargain the arbiter acts in accordance with a Rawlsian-type maximin principle, paying attention to the most infringed participant, but taking into account admissible vectors of weights for utilities; the set of admissible weights is formed in advance by the participants.

Let us consider a two stage game. On the first stage two players (workers and capital-owners) form a curve $\Lambda = \{(\lambda_K, \lambda_L)\}$ consisting of vectors of admissible reputational assessments (*weights*). On the second stage, for a concrete bargain, an arbiter (community) chooses an ad-

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[8] The weights of personal utilities are actively used in the bargaining theory (e.g. Shapley, 1969, Yaari, 1981) however there were almost no studies on the origin of the weights and on their relation to bargaining powers.
[9] Examples of reputational assessments of labor and capital are alternative opinions formed in the society on a special role of top-management in a modern production and on a decrease in the labor share as a result of globalization.

missible pair of weights from the weight curve Λ and divides the product Y among the players ($Y = Y_K + Y_L$) to achieve the maximin[10]

$$\max_{y \in \Omega} \max_{\lambda \in \Lambda} \min\{\lambda_K Y_K, \lambda_L Y_L\}. \quad \textbf{(22)}$$

Here

$$\Omega = \{y = (Y_K, Y_L) : Y = Y_K + Y_L\}$$

is the set of outputs.

Let us describe the first stage of the game in detail. The *i*-th player's gain depends negatively on her weight λ_i and depends positively on the opponent's weight λ_j, $j \neq i$. Hence, each player i is interested in decreasing her weight, λ_i, and in increasing the opponent's weight λ_j. However, in the process of the weight curve formation, the player *i* would agree to a decrease in the opponent's weight in some part of Λ at the expense of an increase in her own weight, as far as the opponent similarly temporizes in another part of Λ.

Since the system of weights is essential only to within a multiplicative constant, the players can start the formation of the weight curve Λ from an arbitrary pair of weights and then construct parts of the curve Λ to the left and to the right of the initial point.

The player who *attacks* decreases her weight while the *defender* does not allow her weight to increase too much. At each moment of time the attacker maximizes the module $|g_a|$ of her weight's growth rate and the defender minimizes the growth rate of her weight g_d under the following constraint:

$$|g_a| \leq g_d \frac{b_a}{b_d}, \quad \textbf{(23)}$$

which means that a higher bargaining power of the attacker helps her to enlarge the constraint, while an increase in the bargaining power of the defender makes the constraint stricter[11].

In equilibrium (23) is fulfilled as an equality. Thus, the constancy of the bargaining powers of the participants implies:

$$\frac{d\lambda_L}{dl_K} \frac{\lambda_K}{\lambda_L} = -\frac{b_K}{b_L} = const. \quad \textbf{(24)}$$

It means that the workers agree to a 1% decrease in the entrepreneurs' weight just as they agree only to a $\frac{b_K}{b_L}$% increase in their own weight. The more the bargaining power of a player is the better the reputational assessment she gains for herself is.

Solving the differential equation (24) we receive the weight curve Λ:

$$\ln \lambda_L^{b_L} = -\ln \lambda_K^{b_K} + const,$$

which can be rewritten in the form:

$$\lambda_K^{b_K} \lambda_L^{b_L} = C = const.$$

---

[10] According to the common Rawlsian maximin criterion the most restrained participant has to receive maximum utility. Notice, that when using the weighted maximin criterion the arbiter "plays into a hand" of the wealthier player by increasing the weight of the restrained player.

[11] In the same way as in Section 3, it is assumed that only the inequality directly related to the actions of the most active player (the attacker) is important as a constraint.

5.1 Properties of the weight curves

Let us see how the position of the weight curve depends on the relative bargaining power. Let the players start formation of the weight curve from a point $(\hat{\lambda}_K, \hat{\lambda}_L)$. Then the equation of the weight curve is:

$$\lambda_K{}^{b_K} \lambda_L{}^{b_L} = C = \hat{\lambda}_K{}^{b_K} \hat{\lambda}_L{}^{b_L},$$

or, in an explicit form,

$$\lambda_i = \left(\frac{\hat{\lambda}_j}{\lambda_j} \right)^{\frac{b_j}{b_i}} \hat{\lambda}_i. \qquad (25)$$

Under $\lambda_j < \lambda_j$ player *j* attacks (i.e. diminishes her weight) and player *i* defends (prevents increasing her weight). In this situation an increase in the relative bargaining power of player *i* (i.e. a decrease in b_j / b_i) would provide, according to (25), a decrease in her weight λ_i when λ_j is fixed. In other words, the defender achieves the more success in defense (i.e. a lower weight) the higher her relative bargaining power is. This is illustrated in Fig. 3.

Evidently, the attacker also gains from her higher bargaining power, as far as the opponent's weight becomes higher.

Figure 3: Comparison of weight curves corresponding different relative bargaining powers. For the dashed (green) weight curve the relative bargaining power of player *i* is higher than for the solid (red) weight curve. When player *j* attacks (moves down), the dashed curve is preferable for the defender (player *i*); correspondingly, the solid curve is preferable for the attacker (player *j*).
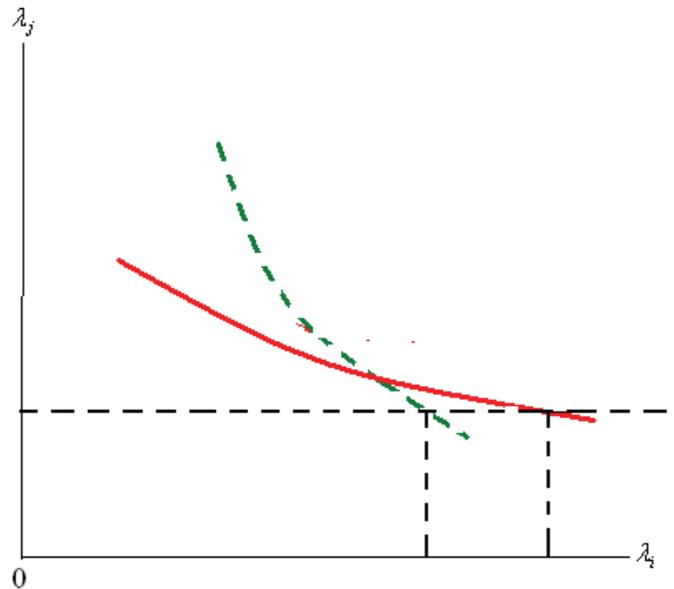
If the relative bargaining power of player *i* goes to infinity, i.e. $\dfrac{b_j}{b_i} \to 0$, then, according to (25), $\lambda_i \to \hat{\lambda}_i$. It means that if player *j* attacks but player *i* possesses a very high bargaining power then the weight of player *i* increases only negligibly (see Fig. 4). But if player *i* attacks then, with an increase in $\hat{\lambda}_i / \lambda_i$, the weight of player *j* increases significantly.

FigURE 4: The weight curve under a very high relative bargaining power of player *i*.
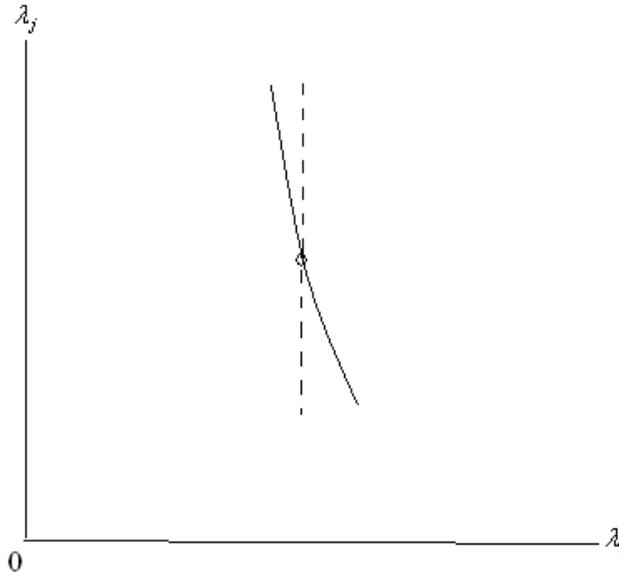
5.2 Generation of the asymmetric Nash bargaining solution

Now we turn to the second stage of the game.

LEMMA 2 *For each outcome* $y \in \Omega$, *the following equality is valid:*

$$\max_{\lambda \in \Lambda} \min\{\lambda_K Y_K, \lambda_L Y_L\} = A Y_K^{\frac{b_K}{b_K + b_L}} Y_L^{\frac{b_L}{b_K + b_L}}, \quad (26)$$

where $A = const$.

Proof. Applying Lemma 1 to the set Λ we receive:

$$\max_{\lambda \in \Lambda} \min\{\lambda_K Y_K, \lambda_L Y_L\} = A Y_K^{\beta_K} Y_L^{\beta_L}$$

for any point (Y_K, Y_L); here $A = C^{-\frac{1}{b_K + b_L}}$. **Q.E.D.**

According to (26), the arbiter's problem (22) reduces to:

$$\max Y_K^{b_K} Y_L^{b_L} \quad (27)$$

s. t.

$$y \in \Omega. \quad (28)$$

The solution of this problem is none other than the *asymmetric Nash bargaining solution.*

For any outcome $y \in \Omega$ there exists a unique vector of weights $\overline{\lambda} \in \Lambda$, such that $\overline{\lambda}_K Y_{K1} = \overline{\lambda}_L Y_L$, namely,

$$\overline{\lambda}_i = C^{\frac{1}{b_K + b_L}} \left(\frac{Y_j}{Y_i}\right)^{\frac{b_i}{b_1 K b_L}}, \quad i, j = K, L, \ i \neq j.$$

The number

$$v(y) = \overline{\lambda}_1 Y_1 = \overline{\lambda}_2 Y_2$$

will be referred as a *utility of outcome.*

PROPOSITION 2. $v(y) = \max_{\lambda \in \Lambda} \min\{\lambda_K Y_K, \lambda_L Y_L\}.$

Proof. Let $\lambda \in \Lambda$ be an arbitrary vector of weights, $\lambda \neq \overline{\lambda}$. Then

$$\min\{\lambda_K Y_K,\ \lambda_L Y_L\} < \min\{\overline{\lambda}_K Y_K,\ \overline{\lambda}_L Y_L\} = v(y).$$

Q.E.D.

Thus, the arbiter's problem (22) is equivalent also to:

$$\max_{y\in\Omega} v(y).$$

5.3 Some other equivalent criteria

Similarly to Lemma 1 and Lemma 2 it can be proved that

$$\min_{\lambda\in\Lambda}\max\{\lambda_K Y_K,\ \lambda_L Y_L\} = A Y_K^{\beta_K} Y_L^{\beta_L}.$$

It means that the "Pharisaical just" society (see footnote 9) for which the criterion is (22) does not differ, by its outcome, from a society searching for $\max_{y\in\Omega}\min_{\lambda\in\Lambda}\max\{\lambda_K Y_K,\ \lambda_L Y_L\}$ and, thus, openly acting in favor of the wealthier player by improving (i.e. decreasing) her weight[12].

The following proposition means that the same outcome can be received also as a *utilitarian solution*.

PROPOSITION 3. *Solution of the problem*

$$\max_{y\in\Omega}\min_{\lambda\in\Lambda}\left(b_K \lambda_K Y_K + b_L \lambda_L Y_L\right)$$

coincides with the solution of the problem (22).

Proof. For the sub-problem $\min_{\lambda\in\Lambda}\left(b_K \lambda_K Y_K + b_L \lambda_L Y_L\right)$ with a fixed *y*, maximization of the Lagrange function,

$$b_K \lambda_K K + b_L \lambda_L L - \mu\left(\lambda_K^{b_K}\lambda_L^{b_L} - C\right),$$

leads to the first order optimality conditions:

$$b_K Y_K - \mu b_K \lambda_K^{b_K-1}\lambda_L^{b_L} = 0,$$

$$b_L Y_L - \mu b_L \lambda_K^{b_K}\lambda_L^{b_L-1} = 0.$$

It follows that

$$\lambda_K Y_K = \lambda_L Y_L$$

The rest follows from Proposition 2. Q.E.D

5.4 Moral-ethical assessments as a mechanism

Earlier we supposed that the weight curve Λ is constructed in advance and then the arbiter (community) uses it in any concrete bargain. Now let us consider another version of the model: in a concrete bargain the participants change weights under a control of the arbiter, and the latter does not allow the value of outcome to diminish.

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[12] The model thus demonstrates that societies with different political mechanisms can have no considerable differences in their economic characteristics such as income distribution.

If at a current moment of time the value of outcome decreases in λ_i then player *i* can attack decreasing her weight, λ_i, and increasing the opponent's weight, λ_j. Player *j* in this situation can only defend, because her attack would decrease $v(y)$ what is not allowed by the arbiter. The attack of player *i* can continue only as long as the value of outcome, $v(y)$, increases. The dynamics of the weights is described by the differential game introduced above in this Section. The process stops as soon as the value of outcome reaches its maximum (Fig. 5).

Figure 5: Directions of changes under a control by the arbiter. The value of outcome achieves its maximum in point *m*. The arbiter allows the capital-owners to attack if $\lambda_1 > m\lambda_2$; the workers are allowed to attack if $\lambda_1 < m\lambda_2$.
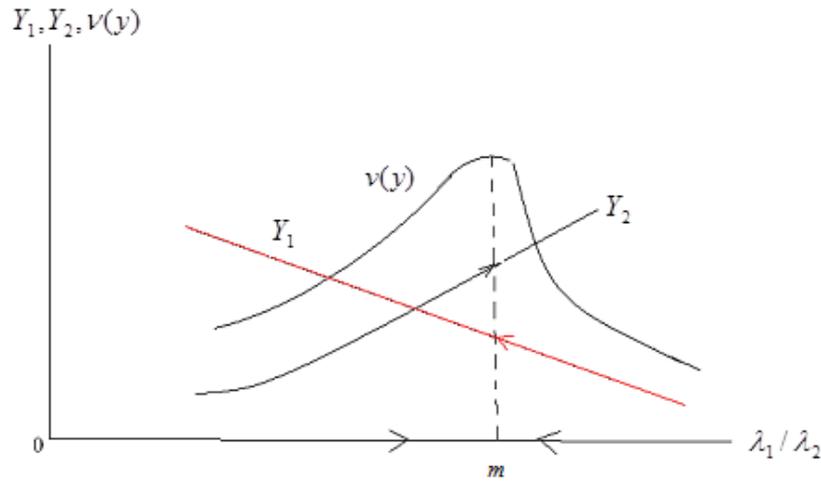
5. 5 Generation of the Cobb-Douglas production function

Reduction to the Mechanism A. It is easily seen that in the solution of the problem (27)-(28) the players receive shares proportional to their bargaining powers: $\dfrac{Y_K}{Y_L} = \dfrac{b_K}{b_L}$. Proposition 2 implies

$$\frac{Y_K}{Y_L} = \frac{\lambda_L}{\lambda_K}.$$

Hence, the pair of the weights (λ_K, λ_L) for which $\dfrac{\lambda_L}{\lambda_K} = \dfrac{b_K}{b_L}$ will be chosen by the arbiter (community). In such way, the social groups have to receive shares of the product proportional to their bargaining powers.

This provides a support to the Mechanism A described in Section 3. This mechanism, as we have seen, generates the Cobb-Douglas production function.

Notice, that a constancy of bargaining powers can explain a constancy of factor shares in some countries on a definite stage of their development – a validity of the corresponding Kaldor's stylized fact of economic growth.

Alternative way. There is a different way to explain the formation of the Cobb-Douglas production function in the context of weight curve. Let us assume that an economy consists of segments (islands) *i* combining inputs (labor and capital) in different proportions. For each bundle of inputs $(K(i), L(i))$ a pair of weights $(\lambda_K, \lambda_L) \in \Lambda$ is selected by the participants and by the arbiter in such way that a parity condition takes place:

$$\frac{K(i)}{\lambda_K(i)} = \frac{L(i)}{\lambda_L(i)}.$$

This can be interpreted as a demand of "equal" efforts of two participants, when a better reputation (a lower weight) allows a participant to include less efforts. At the same time, there is a demand for "equal" distribution of efforts for a unit production in the whole economy:

$$\frac{K(i)}{\lambda_K(i)} = \frac{L(i)}{\lambda_L(i)} = E = const. \quad (29)$$

To satisfy the institutional such a technology has to be chosen for which (29) is true. From the equation of the weight curve it follows that

$$\left(\frac{K(i)}{E}\right)^{b_K} \left(\frac{L(i)}{E}\right)^{b_l} = C.$$

In such way the unit production will be received under

$$AK^\alpha L^{1-\alpha} = 1,$$

where $A = \dfrac{1}{C^{\frac{1}{b_K+b_L}} E}$, $\alpha = \dfrac{b_K}{b_K+b_L}, 1-\alpha = \dfrac{b_L}{b_K+b_L}$. Thus we come to the Cobb-Douglas production function again.

6. Conclusion

In this paper a new approach is proposed for understanding a relation between a physical side of economy (resources and technologies) and its institutional side (distributional relations between social groups). The idea of the models presented here is that the distributional behavior can be described by a differential game of bargaining. A dual relation between the institutional and the physical sides of the economy allows to achieving an independent description of production function on base of a differential game in the institutional side. Thus, institutions can be a primal reason of a choice of technologies and, ultimately, define a production function.

Three differential games are proposed to describe a behavior of economic agents in processes of prices and weights formation. In the benchmark model of price bargaining players are interested in changing the same price in opposite directions. It is shown that under some conditions this game leads to the Nash bargaining solution. This benchmark game is modified to games in which players change (different) prices of their owned resources or change weights (moral-ethical assessments). One of these games describes bargaining of workers and capital-owners for their factor prices. In another game the same players bargain for weights (moral-ethical assessments); these weights enter a Rawlsian-type criterion which is used by an arbiter (community) in concrete bargains.

These games result in construction of structures – a price curve in one case and a weight curve in another – which are dual to the production function. Ultimately, under constant bargaining powers of the participants, these games lead to the Cobb-Douglas form of production function.

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EXPORTS AND DEVELOPMENT MONTENEGRO 2006-2012

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Abstract
This paper analyses the patterns of Montenegrin specialization and trade since its independence in 2006. The paper answers the questions how Montenegrin trade patterns have changed since its newly acquired independence. How were these changes affected by, and in turn how did they affect the overall level of economic development in Montenegro? The global financial crisis had a significant negative impact on the Montenegrin economy, due to the ongoing credit crunch, a decline in the real estate sector, and a fall in aluminum exports. In 2012, real GDP growth slipped to 0.5%, reflecting the general downturn in most of Europe.

Key words: Trade Specialization Indices; Concentration Ratios; Herfindahl-Hirshman Index; Coefficient of Variation; Machinery Exports and Imports; Montenegro

I. Introduction

After World War I, during which Montenegro fought on the side of the Allies, Montenegro was absorbed by the Kingdom of Serbs, Croats, and Slovenes, which became the Kingdom of Yugoslavia in 1929. At the conclusion of World War II, Montenegro became a constituent republic of the Socialist Federal Republic of Yugoslavia. When the Socialist Federal Republic of Yugoslavia dissolved in 1992, Montenegro federated with Serbia, first as the Federal Republic of Yugoslavia and, after 2003, in a looser State Union of Serbia and Montenegro. In May 2006, Montenegro invoked its right under the Constitutional Charter of Serbia and Montenegro to hold a referendum on independence from the state union. The vote for severing ties with Serbia barely exceeded fifty-five percent - the threshold set by the European Union (EU) - allowing Montenegro to formally restore its independence on 3 June 2006 (CIA FactBook, 2013).

Montenegro, newly independent since 2006 saw its commodity exports collapse in the worldwide financial crisis of 2008. It took three years for the volume of its exports to recover (see Figure I.1). For more details on the effects of the financial crises see the edited book by Bakker and Klingen (2012) and the papers by Buturac and Teodorovic (2012), Fabris and Mitrovic (2012), and Knollmayer, (2012A, 2012B).

During the period 2006 not only the total volume of its exports changes drastically, tracking the world trends, but also the composition of its exports underwent drastic shifts. The patterns of specialization likewise shifted, both globally, and within individual product sectors. These will be described below. How were these changes affected by, and in turn how did they affect the overall level of economic development in Montenegro? This will be described below.

The reminder of the paper is organized as follows. Section II details the specialization patterns of Montenegro's exports. Section III analyses both overall and sectoral levels of Montenegrin Export specialization. Section IV provides graphical description of temporal shifts of Montenegro exports by individual product sectors for the period 2006-2012. Section V presents the Overall dollar value of Montenegrin exports at the individual product level. Section VI briefly concludes.

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Figure I.1: Total Export of Montenegro 2006 - 2012
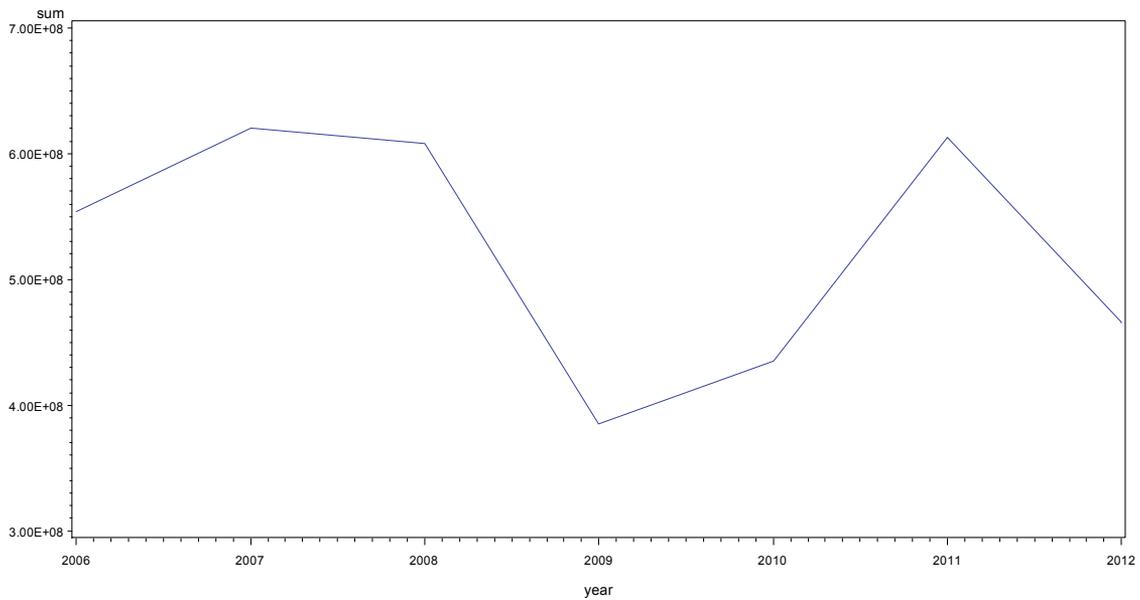
Source: UN Statistical Office Compustat.

II. Specialization Patterns of Montenegro's Exports

Since its independence, Montenegro's trade patterns have consistently demonstrated a trend of declining specialization. This is clearly demonstrated in Table II.1 and Figure II.1 below. The metric Trade Specialization Index (TSI) measures the degree of specialization (for a description and derivation of this index, see Kellman and Shachmurove 2011 and 2012). The Trade Specialization Index (TSI) rises as the degree of specialization increases. The relationship between specialization and economic development has a long history from Adam Smith's pin factory through the Classical and Neoclassical models, both the 2X2 models of the 18th Century and the more recent N X N models (see Kellman and Shachmurove Ibid for a description of the literature and for the presentation of the TSI index).

Table II.1   Trade Specialization Index of Montenegro Exports

Year	Year	Year	Year	Year	Year	Year
2006	2007	2008	2009	2010	2011	2012
TSI	TSI	TSI	TSI	TSI	TSI	TSI
5604.46	5608.55	4965.12	3461.63	2761.34	3001.39	2414.65

The Specialization index, TSI, measuring the degree of specialization of Montenegro's commodity exports was at a relatively high level of 5,064 in 2006. TSI's of a level of 5,000 or higher are typical of oil exporters such as Iran, and are rarely found in relatively highly developed industrial (or post-industrial) countries (see Kellman and Shachmurove, 2014, forthcoming), for comparable specialization measures of several Middle East countries (which like Montenegro had been part of the Ottoman empire until the early 20th Century). During the 6 years since independence, Montenegrin TSI clearly trended downward. By 2012, its value was roughly one half of its 2006 value. This marks a shift from a relatively highly specialized export composition to an increasingly diversified set of products exported.

The following Section III examines the export compositions of the entire set of Montenegrin exports, as well as the export details at a lower level of aggregation, at a more detailed level of product definition of various exported product sectors. This enables us to determine the extent

to which the observed growing diversification of the country's export diversification marks a shift from more to less specialized product sectors, or to intra-sectorial systematic declines of intra-sectorial specialization levels (see Chow, Kellman and Shachmurove, 1994, 1999).

Figure II.1: Trade Specialization Index of Montenegro Exports
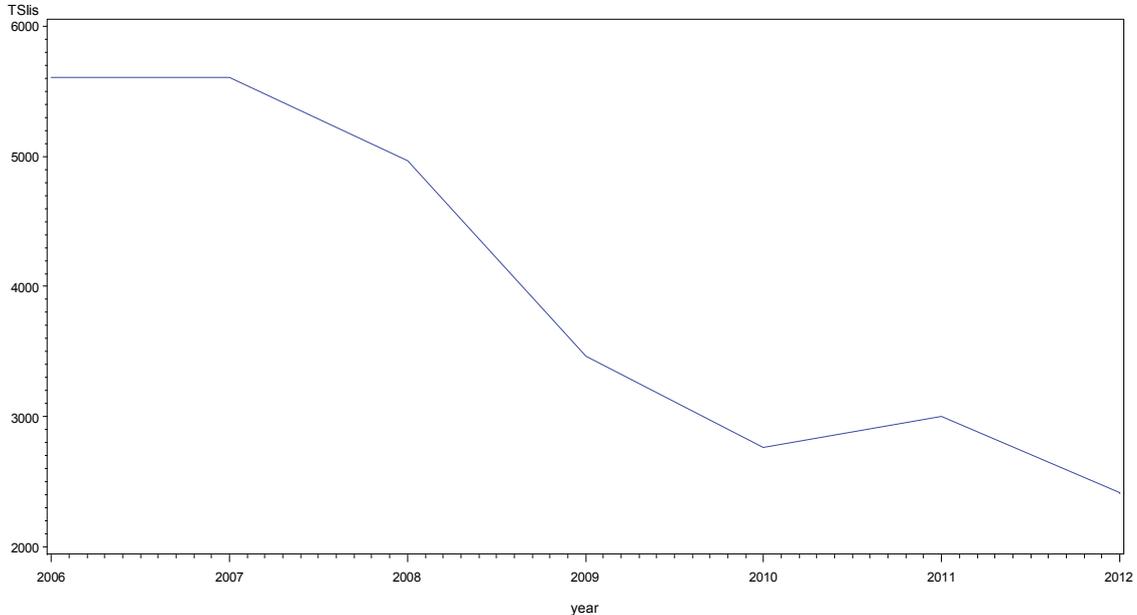
III. Overall, and Individual Sectoral Levels of Montenegrin Export Specialization

Table III.1 below indicates the percent distribution of commodity exports of Montenegrin exports for each year from 2006 to 2012. The table is organized by Product Groupings defined at the single digit Standard Industrial Trade Classification (SITC). Included are all those exports that are classified (that is, including SITC 0 through 8, but excluding the non-classified products of SITC 9). Hence, the first group in the table "Food and Animals" is SITC 0, "Chemicals" is SITC 5 etc. Generally, the product categories are organized by the level of sophistication, from homogenous basic primary products to increasingly complex diversified and sophisticated manufactures of SITC 7, and part of SITC 8, that includes scientific and medical instrumentation.

In 2006, the largest single product group is Basic Manufactures (SITC 6). These include products, generally undifferentiated, that are generally defined by the raw material content, such as products of iron, or products of rubber. In addition, SITC 6 includes non-ferrous metal alloys. The next largest single category is "Crude Materials" (SITC 2). These two categories accounted for close to 80% of all commodity exports of Montenegro in 2006.

Clearly, the shift to greater diversification noted in Section I above, reflects the shift away from Basic Manufactures that accounted for three quarters of all exports in 2006. By 2012, this percent fell to 42%. Which product groups took up the slack? In other words, the shift of declining specialization must ipso facto indicate a growing relative weight of some other product sectors other than SITC 6. Where was this growing revealed specialization? Table III.3 indicates that the dominance of the single product-group "Basic Manufactures" was largely replaced by a shift to the relatively more sophisticated SITC 7 (Machinery and Transport Equipment). This critical export sector (see Lipsey (1971), Kravis and Lipsey (1982), and Kellman and Shachmurove, 2011, 2012) constituted 5% of all exports in 2006, and by 2009 included roughly 10%.

The pattern of change in Montenegro's specialization was not as simple as described above. Clearly, there is evidence of a shift up the spectrum from the less sophisticated Basic Manufactures (SITC 6) to the more highly sophisticated Machinery (SITC 7). However, at the same time there was a clear shift down the spectrum to Crude Materials (SITC 2). This product group includes

exports such as leather and scrap metal. This involves a lower degree of value added from the original "gifts of nature" than most of those included in SITC 6. Hence, diversification is a good term that well describes shift in Montenegro's revealed international competitiveness. Section V below examines these patterns at a more detailed, disaggregated product level.

Table III.1: Composition of Montenegro Commodity Exports

Year	2006	2007	2008	2009	2010	2011	2012
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Product Sectors							
Food and Animals	2.75	2.48	3.92	6.69	7.27	6.26	7.64
Tobacco and Beverages	5.56	5.75	6	7.91	6.42	5.23	7.02
Crude Materials	8.21	8.6	7.97	9.13	13.6	14.56	15.48
Mineral Fuels	0.83	1.75	3.05	3.05	10.12	14.28	13.91
Animal Based Products	0.07	0.02	0.05	0.11	0.39	0.33	0.9
Chemicals	2.36	2.16	2.59	4.29	3.92	2.73	3.29
Basic Manufactures	73.93	73.98	69.29	55.98	47.88	49.8	42.51
Machinery	5.05	3.36	5.54	10.07	8.21	5.42	7.1
Misc Manufactures	1.23	1.9	1.59	2.77	2.2	1.4	2.15

IV. Graphical Description of Temporal Shifts of Montenegro Exports by Individual Product Sectors

Composition of Montenegro Commodity Exports
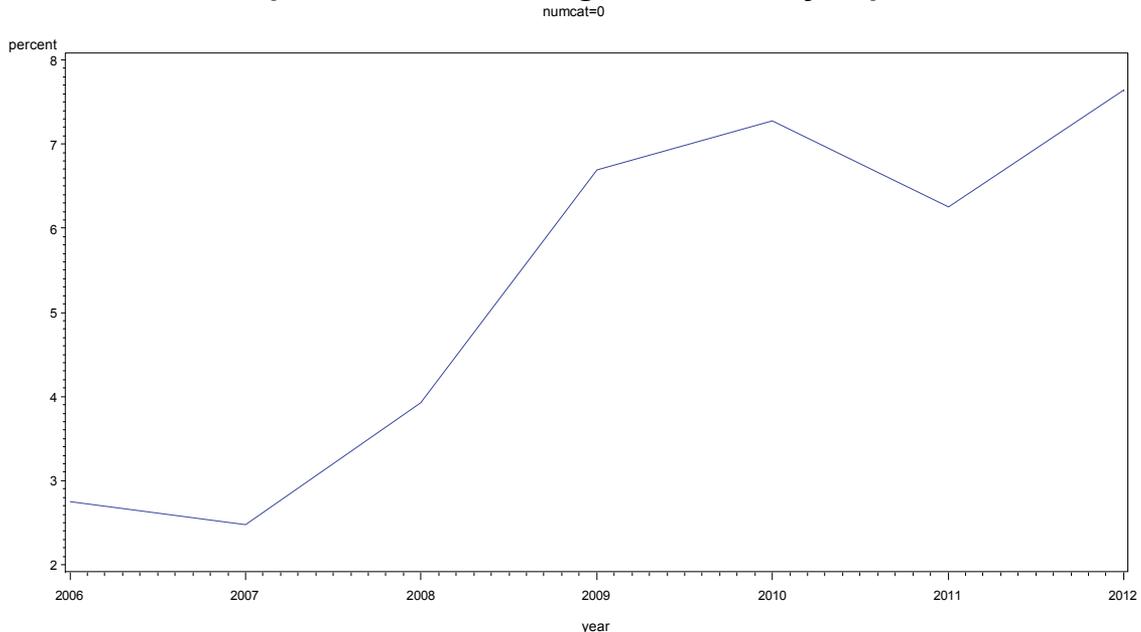
As noted above, over the period studied, 2006 to 2012, Montenegro's export pattern became less specialized. Here we note that the percent of all commodity exports accounted for by SITC 0, Food and Live Animals, increased from 2.75% in 2006 to 7.64% in 2012.

Composition of Montenegro Commodity Exports
numcat=1
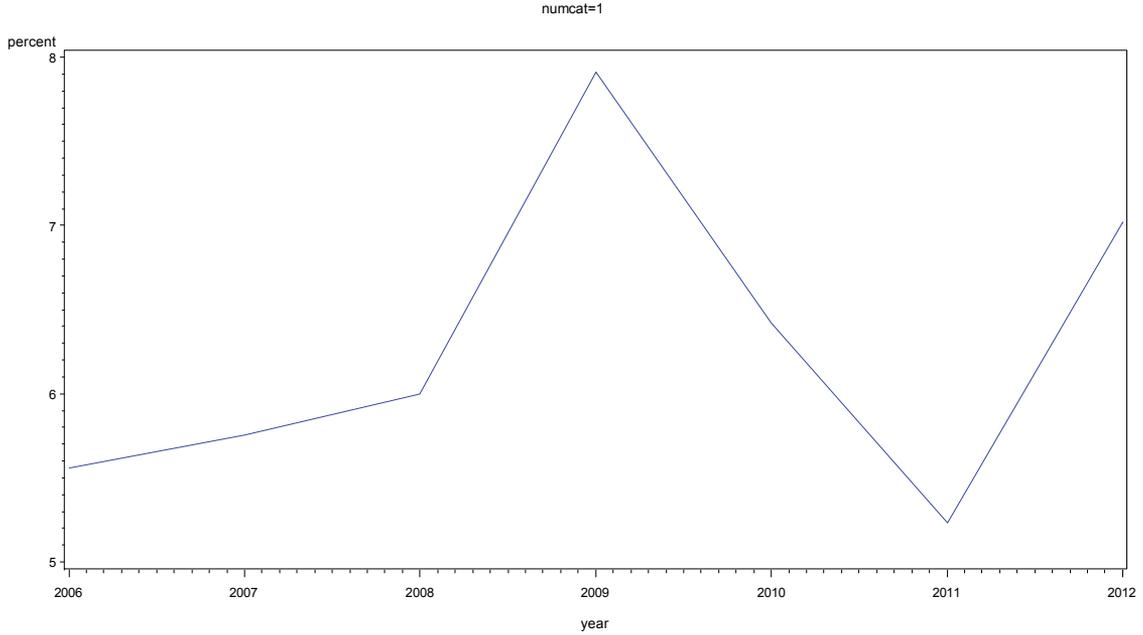
SITC 1, Tobacco and Beverages was a small portion of Montenegro's exports in 2006, and remained at roughly the same relative level over the period examined here.

Composition of Montenegro Commodity Exports
numcat=2
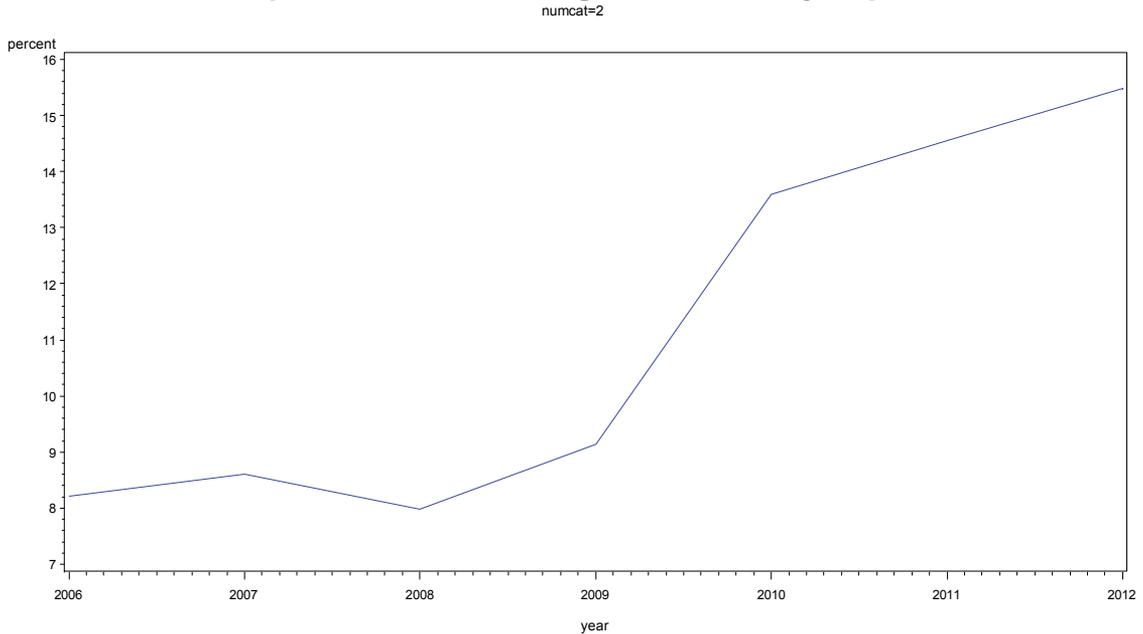
As noted above, SITC 2, Crude Materials while constituting a small percentage (less than 9%) of all commodity exports in 2006, increased steadily over the period, roughly doubling its relative weight by 2012.

Composition of Montenegro Commodity Exports
numcat=3
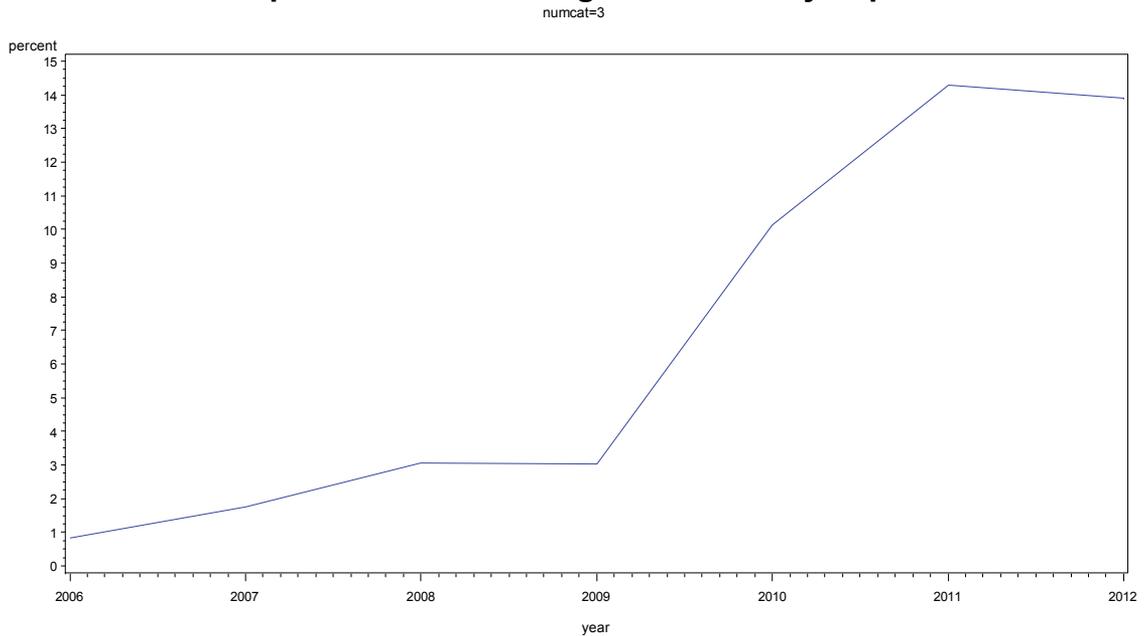
SITC 3, Mineral Fuels shows the greatest relative growth in relative weight. While constituting less than 1% of all exports in 2006, it contributed roughly 14% of all exports in 2012.

Composition of Montenegro Commodity Exports
numcat=4
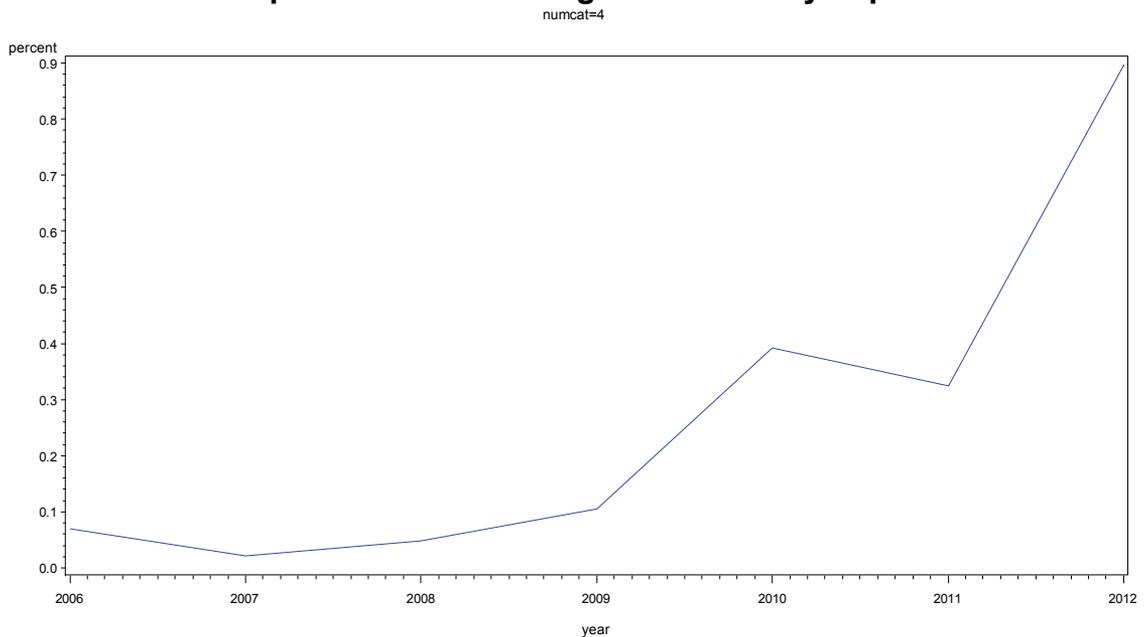
SITC 4 Animal Based Products was and remained a miniscule portion of all exports, never reaching even 1% of all commodity exports.

Composition of Montenegro Commodity Exports
numcat=5
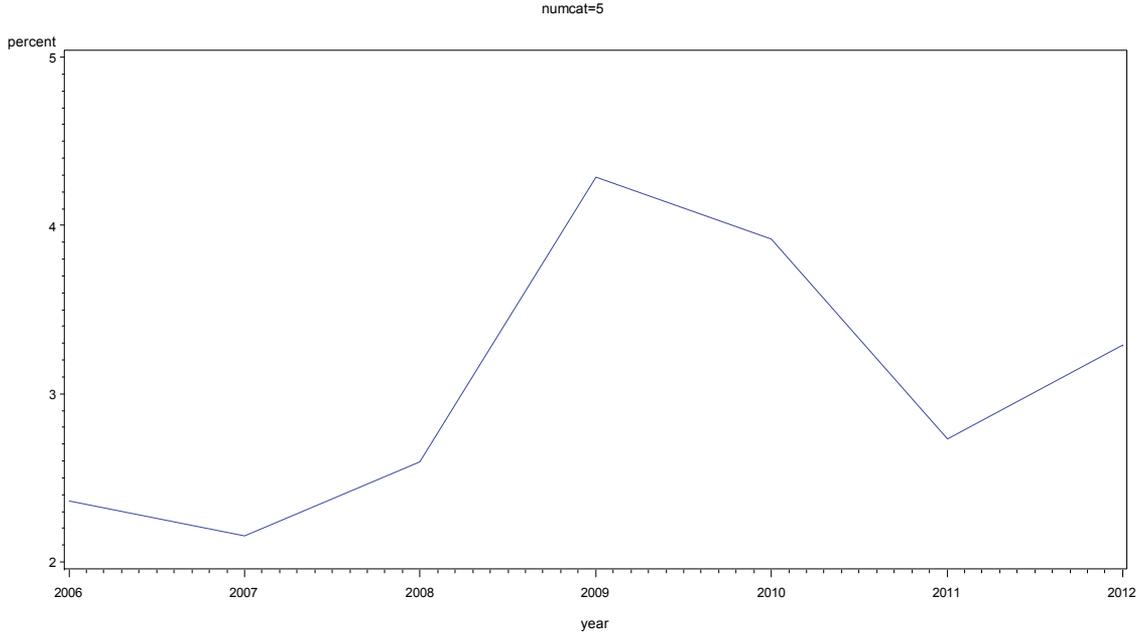
SITC 5, Chemicals fluctuated between 2% and 4%, basically maintaining a relatively miniscule proportion of all exports.

Composition of Montenegro Commodity Exports
numcat=6
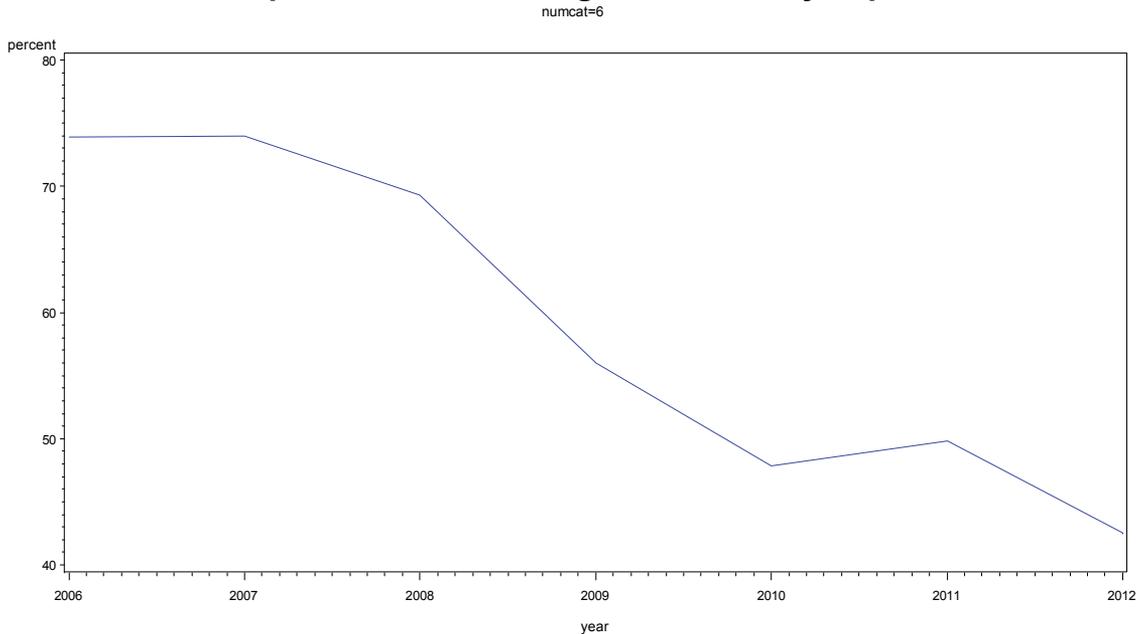
SITC 6, Basic Manufactures was the dominant export group throughout the period studied. In 2006 it constituted ¾ of all Montenegro's exports, and continually dropped to a lower, but still relatively high percent somewhat less than ½ of all exports.

Composition of Montenegro Commodity Exports

numcat=7
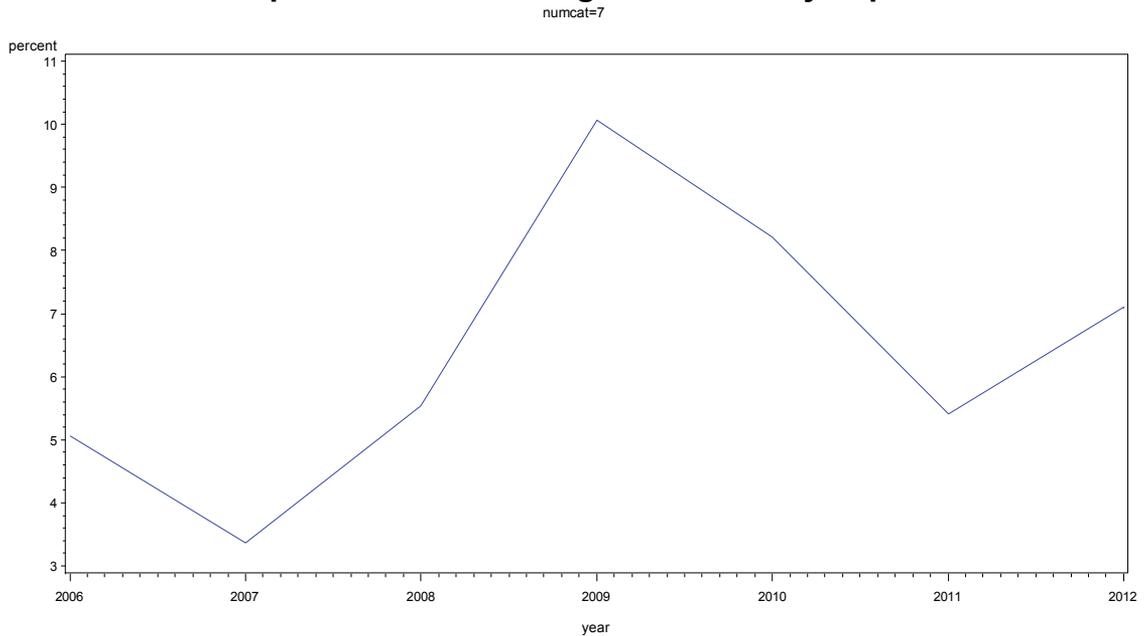
SITC 7, Machinery and Transport Equipment rapidly rose from 5% to 10% of all exports from 2006 to 2009. As the volume of all exports rose following the great financial crises of 2008, the percent of Machinery in all exports trended generally downward, ending around 7% of all exports in 2012.

Composition of Montenegro Commodity Exports

numcat=8
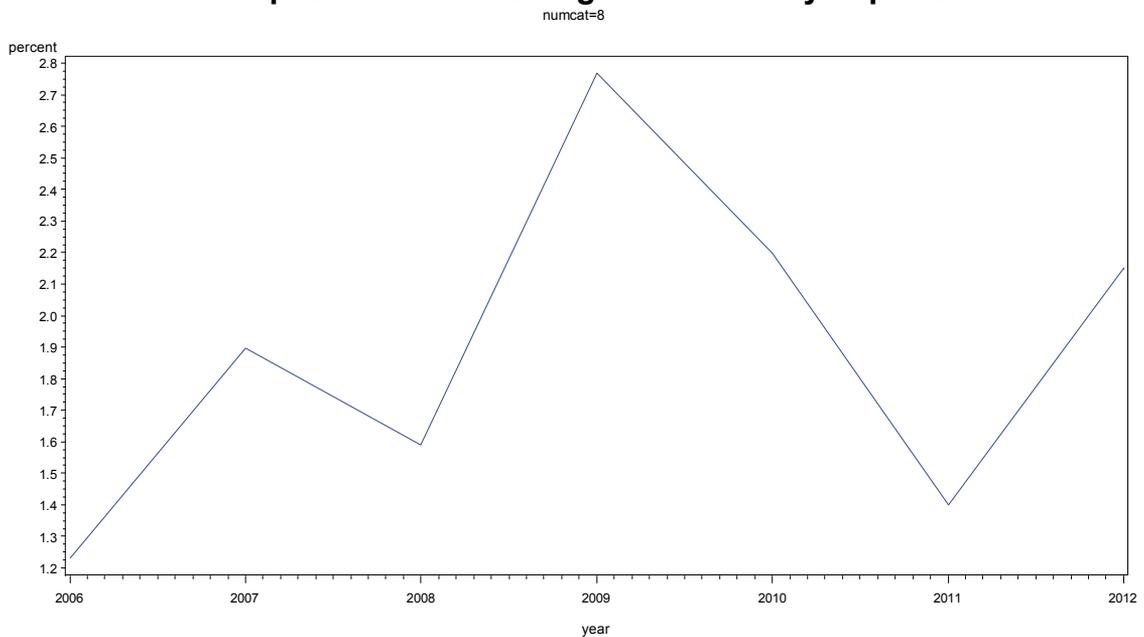
SITC 8, Miscellaneous Manufactures, remained relatively unimportant, ranging from roughly 1% to a high less than 3% of all exports.

Intra-Sectoral Product Export Specialization 2006 – 2012

Trade Specialization Index of Montenegro Basic Manufactures Exports (SITC 6)

2006	2007	2008	2009	2010	2011	2012
TSIis	TSIis	TSIis	TSIis	TSIis	TSIis	TSIis
6169.3	5827.42	4180.85	5461.77	6878.83	6964.87	6942.22

Composition of Montenegro Basic Manufactures Exports

	Year						
	2006	2007	2008	2009	2010	2011	2012
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Products							
Iron or Steel Bars	.	.	6.15	.	.	.	.
Steel Rods	10.37	6.86	5.36	.	.	.	.
Steel Bars	.	.	12.15	7.67	.	8.61	.
Aluminum Alloys	77.73	75.71	62.62	73.17	82.67	82.96	83.09

Trade Specialization Index of Montenegro Food and Animals Exports (SITC 0)

	Year					
2006	2007	2008	2009	2010	2011	2012
TSIis	TSIis	TSIis	TSIis	TSIis	TSIis	TSIis
847.29	753.46	888.72	784.53	746.1	789.82	722.17

Composition of Montenegro Food and Animals Exports

	Year						
	2006	2007	2008	2009	2010	2011	2012
numcat	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Bacon	12.63	13.93	14.76	14.07	10.34	7	10.39
Sausages	.	.	.	.	6.1	6.69	8.7
Prepared Meat	.	9.16	13.55	13.39	.	.	.
Flour	.	.	.	7.03	.	.	6.36
Pastry	13.19	8.4	6.7	5.19	7.75	11.11	11.98
Vegetables	6.7	19.14	13.74	12.01	9.52	10.45	7.57
Dried Vegetables	6	5.66	6.78	.	.	.	.
Grapes	.	.	5.46	.	.	.	.
Fruit nes	6.38	5.92	9.75	.	8.56	6.79	8
Frozen Fruit	17.4	9.34	.	5.83	5.97	6.25	.
Chocolate	.	.	.	.	11.7	7.84	9.9
Edible Products nes	.	.	6.08	7.38	12.3	16.46	8.69

Trade Specialization Index of Montenegro Crude Materials Exports (SITC 2)

	Year						
	2006	2007	2008	2009	2010	2011	2012
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Products							
Calf Skins	8.46	6.47	.	.	7.19	.	6.9
Logs	.	.	5.8	6.36	6.91	.	.
Wood Coniferous	29.72	26.91	23.83	33.11	19.09	15.96	14.68
Wood nes	10.51	12.96	8.1	9.98	6.63	5.52	5.83
Ferrous Scrap Metal	.	8.14	9.7	11.05	16.63	27.94	22.24
Alumina	7.58	7.23	10.97	.	.	5.14	.
Zinc Ores	.	.	.	.	.	5.42	7.66
Non-Ferrous Scrap	22.03	23.28	24.4	17.05	25	18.01	20.38

Composition of Crude Materials Exports

Year						
2006	2007	2008	2009	2010	2011	2012
TSIis	TSIis	TSIis	TSIis	TSIis	TSIis	TSIis
1660.94	1633.59	1530.95	1717.33	1452.62	1508.23	1336.2

The level of specialization for Crude Materials exceeded that of Food and animals. It was composed largely of metal scrap (roughly 44% of all Sectoral exports by 2012). The major shift was from Coniferous Wood exports, to exports of Ferrous Scrap Metal.

Trade Specialization Index of Montenegro Mineral Fuels Exports (SITC 3)

Year						
2006	2007	2008	2009	2010	2011	2012
TSIis	TSIis	TSIis	TSIis	TSIis	TSIis	TSIis
9970.53	9358.24	9002.38	9405.66	5966.21	9049.97	8752.97

Composition of Mineral Fuel and Energy Exports

	Year						
	2006	2007	2008	2009	2010	2011	2012
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Products							
Lignite	99.85	96.69	94.76	96.95	15.13	.	5.96
Petroleum Bitumin	.	.	.	.	9.73	.	.
Electric Current	.	.	.	.	75.12	95	93.37

Of all sectors, this was the most highly Specialized (or less Diversified). In the early period, or 2006 to 2009, it consisted of practically only Lignite (Coal). From 2010 to 2012, the shift was abrupt, from exports of Coal to exports of Electricity.

Trade Specialization Index of Montenegro Machinery Exports (SITC 7)

Year						
2006	2007	2008	2009	2010	2011	2012
TSIis	TSIis	TSIis	TSIis	TSIis	TSIis	TSIis
975.68	964.03	737.32	1031.17	776.68	1380.06	1848.41

Composition of Montenegro Machinery Exports

	Year						
	2006	2007	2008	2009	2010	2011	2012
Products	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Excavation Machines	.	6.27	.	7.71	7.64	6.66	.
Food Processing Machinery	5.11	.	.	.	.	.	.
Machine Tools	.	.	.	25.98	.	.	
Furnaces	.	.	.	5.4	.	.	.
Shaft or Crank	14.57	24.37	16.34	12.13	18.63	34.13	40.61
Domestic Refrigerators	12.84	14.07	7.78	6.94	9.13	6.9	.
Batteries	.	.	6.08	.	.	5.91	.
Trucks	5.95	.	5.31	.	5.72	.	.
Aircraft	.	.	.	.	7.86	.	.
Aircraft parts	.	5.21	.	.	11.13	.	8.5
Ships	22.01	7.07	.	.	.	.	.
Tugs	.	.	16.05	.	.	.	.

Exports of Machinery were characteristically not specialized in any single product category.

The relatively disaggregated and product–detailed tables in this section flesh out the Sectoral Trade Specialization Indices (TSI's). Of all 9 Product sectors, only two exhibited relatively high TSI values – Mineral Fuel and Energy (SITC 3), and Basic Manufactures (SITC 6). From the Tables in this section the interpretation of these high values become clear. In the case of SITC 3, one single product (Lignite) accounts for close to 99% of all exports of this Product-Sector in 2006, and remains above 90% until 2010.

In the last two years, 2011 and 2012, Lignite is replaced by, again a single Product (Electric Current) that accounts for over 95% of all exports in this Product Sector. Similarly, in the case of SITC 6 – Basic Manufactures, the Sector's exports are concentrated, or dominated by one single product, Aluminum Alloys, which alone constitute from between 60% to 80 % of all Sectoral exports. On vulnerability of an economy on specific industries, see for example, Kellman, Saadawi and Shachmurove, (1996). Hence, the high degrees of Sectoral specialization indicated by the high values of TSI are indications of the virtual dominance of each of these two Product Sectors by one single (respective) Product export.

V. Overall Dollar-Values of Exports at the Individual Product Level

Table V.1 below presents a ranked detailed product description, name and dollar-value for all those products (at the 4-digit level of SITC aggregation) that included (each) at least 1% of all commodity exports for each respective year.

Table V.1 Top Montenegro Exports for Each Year 2006-2012

——————————————————— year=2006 ———————————————————

year	SITC	Product Description	Exports	Percent
2006	6841	Aluminum Alloys	318302345	57.4923
2006	6731	Steel Rods	42469973	7.6710
2006	1121	Wine	18792784	3.3944
2006	2482	Wood Coniferous	13522502	2.4425
2006	6732	Steel Bars	12288814	2.2196
2006	5417	Medicaments	11276559	2.0368
2006	2882	Non-Ferrous Scrap	10026076	1.8109
2006	1123	Beer	9393589	1.6967
2006	6783	Iron Pipes	9030792	1.6312
2006	6725	Iron or Steel Bars	6312775	1.1402
2006	7932	Ships	6160730	1.1128

——————————————————— year=2007 ———————————————————

year	SITC	Product Description	Exports	Percent
2007	6841	Aluminum Alloys	347347761	56.6583
2007	6731	Steel Rods	31481173	5.1351
2007	1121	Wine	23244633	3.7916
2007	6732	Steel Bars	19569076	3.1920
2007	6725	Iron or Steel Bars	18321523	2.9885
2007	6783	Iron Pipes	14806704	2.4152
2007	2482	Wood Coniferous	14347487	2.3403
2007	2882	Non-Ferrous Scrap	12415362	2.0252
2007	5417	Medicaments	9683760	1.5796
2007	1123	Beer	8876332	1.4479
2007	6724	Puddled Bars of Iron or Steel	7106083	1.1591
2007	2483	Wood nes	6910821	1.1273

——————————————————— year=2008 ———————————————————

year	SITC	Product Description	Exports	Percent
2008	6841	Aluminum Alloys	263495668	44.4873
2008	6732	Steel Bars	51108421	8.6289
2008	6725	Iron or Steel Bars	25880518	4.3695
2008	1121	Wine	25658620	4.3321
2008	6731	Steel Rods	22556758	3.8084
2008	6783	Iron Pipes	19708244	3.3274
2008	6724	Puddled Bars of Iron or Steel	19690898	3.3245
2008	5417	Medicaments	12428378	2.0983
2008	2882	Non-Ferrous Scrap	11825417	1.9965
2008	2482	Wood Coniferous	11550565	1.9501
2008	1123	Beer	7710935	1.3019

——————————————————— year=2009 ———————————————————

year	SITC	Product Description	Exports	Percent
2009	6841	Aluminum Alloys	157509753	41.9163
2009	1121	Wine	23231992	6.1825
2009	6732	Steel Bars	16511065	4.3939
2009	5417	Medicaments	12535854	3.3360
2009	2482	Wood Coniferous	11635117	3.0963
2009	7362	Machine Tools	9803076	2.6088
2009	6731	Steel Rods	8499644	2.2619
2009	6724	Puddled Bars of Iron or Steel	8293606	2.2071
2009	6725	Iron or Steel Bars	6657352	1.7716
2009	2882	Non-Ferrous Scrap	5992222	1.5946
2009	6783	Iron Pipes	4828684	1.2850
2009	7493	Shaft or Crank	4577340	1.2181
2009	3223	Lignite	4171998	1.1102
2009	1123	Beer	4091388	1.0888
2009	2820	Ferrous Scrap Metal	3883664	1.0335

——————————————————————— year=2010 ———————————————————————

year	SITC	Product Description	Exports	Percent
2010	6841	Aluminum Alloys	172048782	40.9338
2010	3510	Electric Current	22512732	5.3562
2010	1121	Wine	22056342	5.2476
2010	2882	Non-Ferrous Scrap	14775940	3.5155
2010	2482	Wood Coniferous	11284324	2.6848
2010	2820	Ferrous Scrap Metal	9830153	2.3388
2010	6724	Puddled Bars of Iron or Steel	9460442	2.2508
2010	5417	Medicaments	8710390	2.0724
2010	6725	Iron or Steel Bars	7473068	1.7780
2010	7493	Shaft or Crank	6631547	1.5778
2010	6732	Steel Bars	6191795	1.4731
2010	3223	Lignite	4533308	1.0786
2010	2112	Calf Skins	4246691	1.0104

——————————————————————— year=2011 ———————————————————————

year	SITC	Product Description	Exports	Percent
2011	6841	Aluminum Alloys	253126305	42.4316
2011	3510	Electric Current	68221371	11.4360
2011	6732	Steel Bars	26260232	4.4020
2011	1121	Wine	25588197	4.2894
2011	2820	Ferrous Scrap Metal	24918182	4.1770
2011	2882	Non-Ferrous Scrap	16063130	2.6927
2011	2482	Wood Coniferous	14234380	2.3861
2011	7493	Shaft or Crank	11248350	1.8856
2011	5417	Medicaments	10693866	1.7926
2011	6725	Iron or Steel Bars	6599397	1.1063
2011	980	Edible Products nes	6307875	1.0574

——————————————————————— year=2012 ———————————————————————

year	SITC	Product Description	Exports	Percent
2012	6841	Aluminum Alloys	164612746	36.2947
2012	3510	Electric Current	49163234	10.8398
2012	1121	Wine	23231886	5.1223
2012	2820	Ferrous Scrap Metal	16043073	3.5373
2012	2882	Non-Ferrous Scrap	14698915	3.2409
2012	7493	Shaft or Crank	13337781	2.9408
2012	5417	Medicaments	12099440	2.6677
2012	2482	Wood Coniferous	10586315	2.3341
2012	6732	Steel Bars	9202995	2.0291
2012	6725	Iron or Steel Bars	5596694	1.2339
2012	2875	Zinc Ores	5526482	1.2185
2012	2112	Calf Skins	4975675	1.0970
2012	6724	Puddled Bars of Iron	4779295	1.0537

The gradual shift in the composition of Montenegrin exports may be seen in these detailed lists.

The one single largest product accounted for 57.5% of all exports in 2006, and fell steadily to 36.3 in 2012. Similarly, the top 4 products accounted for 65.2% in 2006 and declined in relative weight steadily to 47.1% in 2012.

This characteristic of a declining degree of concentration in fewer products, or as we termed it a decline in the degree of specialization, was noted in the earlier section of this paper, and is depicted graphically in Graph II.2. Note that the this phenomenon of a gradually increased variety in its export composition noted in Section V was based on detailed product data analyzed at the 4 digit SITC level of aggregation, whereas the same phenomena summarized in Graph II.2 was calculated using aggregated product-sectors, at the 1- digit SITC level. Furthermore, the metric used in the earlier part of the paper is the Trade Specialization Index (TSI), whereas that used in Section V is the Top 1 or top 4 product level of concentration of the top 1 and top 4 (similar to measures utilized by the Federal Trade Commission (FTC) in analyzing levels and changes in degrees of

industry concentration). The TSI metric utilizes all of the information, and avoids the subjectivity of choosing cutoff point for the top -n analysis.

In short, the gradual shift away from a very highly specialized export composition to one with a higher degree of representation from a wider spectrum of production levels and varieties is a robust finding, regardless of the metric chosen, or the level of aggregation of the observations. This finding is supported in section V by the constant change in the products that appear in the top 1% samples. Some, such as Beer and Ships drop out of the list, while other are newly added to the list, such as Electricity.

While the time period is perforce limited, one may note that this tendency to shift from a smaller universe of relatively dominant products to a wider and more varied export product composition is universally observed in the process of economic development, be it in the case of the dramatic compositional shifts that accompanied the East Asian Industrial revolution of the 1960s – 1980s, or the changes from mono-crop dependence of various African countries.

VI. Conclusion

The relatively short time period for which pertinent data are available for this relatively new country give a guardedly optimistic view of its growth or development prospects. On the one hand, Montenegro' commo-dity exports reveal a relatively high level of vulnerability in its high level of dependence on a small number of products, notably Aluminum. Another negative indicator is the failure of the economy to promote a clear shift to exports of the critical Machinery product group.

On the other hand, a typical correlate of economic growth is indicated in the trends revealed in the da-ta. This is the growing degree of product diversification. This is found at all levels of aggregation examined. It is most clearly seen in the fact that the dependence on one single product (Aluminum Alloys)) consisten-tly declined from a dependence of over half of all commodity exports in 2006 (57%). to still a relatively high, but yet a lower level of mono-product dependency, or 36 % in 2012.

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A SIMPLE POST KEYNESIAN MODEL OF INVESTOR MYOPIA AND ECONOMIC GROWTH

IVAN V. ROZMAINSKY [1]

Abstract

The paper contains attempt to develop investor myopia theory of economic growth. Investor myopia takes place when agents do not take long-term outcomes of their activity into account. This phenomenon, can, of course, lead to underinvestment. The outcome is negative rates of economic growth. Such negative growth, as it known, had hit Russia, Ukraine and some other transitional economies in the 1990s. Investor myopia can be treated as the long-run phenomenon which is concerned with serious defects of institutional environment. The main practical conclusion is that the State is responsible for overcoming of investor myopia. This phenomenon can be considered as the key to many fundamental economic problems of developing and transitional economies.

Key words: *Investor Myopia; Economic Growth; Post Keynesian Economics; Institutional Environment; Forward Contracts; Opportunism, the State.*

1. Introduction

The idea that economic growth is driven by technical progress does not need any comments. The idea that technical progress is driven by capital accumulation generated by investment spending – which is independent on the savings behavior of households - is also true, according to my opinion. But, unfortunately, it is the main point of only the Post Keynesian approach to analysis of growth in the version of Thomas Palley (1996a, 1996b). He (Palley, 1996a) has created elegant model of growth which takes investment spending as the autonomous factor of both technical progress and growth into account.

But, unfortunately, his model contains a rather poor description of factors influencing on investment. According to this model, investments depend only on the growth of aggregate demand. The other Post Keynesian models emphasize – as the arguments in the investment – or investment-based capital accumulation – function – other macroeconomic variables such as capacity utilization rate, rate of profit, the profit share (Lavoie, 2006, ch. 5), productivity growth (Bhaduri, 2006). I think that there are more important factors influencing on the long-run evolution of investment; at that, as a rule, these factors have no purely macroeconomic nature.

The fundamental idea of this paper is that the very important factor limiting investment is *investor myopia*. This completely unexplored concept means that investors evaluate their performance only over a short-time horizon and therefore refuse to make long-term investment. It leads to investors' rejection of the majority of fixed capital investment projects because such projects can bear (high) return only in long period of time.

It is clear that investor myopia can stop economic growth and generate long economic decline. Therefore the question about factors of diffusion of this myopia among investing agents is the vital one. Why do investors constrain themselves to invest over only short-time period? The main goal of my paper is to give answer to this question and, hence, to approach an understanding of what why "standards of living differ among parts of the world by amounts that almost defy comprehension" (Romer, 1996, p. 1), and, hence, why can the real GDP fall during the long peri-

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ods of time: unfortunately, "fall models", unlike "growth models", are complete rarity. The paper will show that the answers depend on inclusion of interactions between different agents and institutional environment which has influence on these interactions.

The structure of the paper is the following. In the beginning, in the Section 1, I will shortly describe the basic content of Palley model. This model will serve as the starting point of the model presented by this paper. Then, in the Section 2, I will give detailed analysis of definition and forms of investor myopia as the very important factor decreasing investment level in the long run. The Section 3 will contain analysis of main formally institutional reason for potential investor myopia diffusion. This reason is the ineffectiveness of contracts enforcement system belonging to the State. The Section 4 will analyze informally institutional causes of investor myopia. These causes are features of agents' behavior; such features contribute to rapid diffusion of investor myopia among them and, according to my opinion, are especially important for both developing countries and countries with transition economies. The simple model of "negative growth" presented in the Section 5 will be constructed with the regard for these formally and informally institutional aspects. The final Section 6 will conclude the paper.

2. Palley model as the representative Post Keynesian model of growth induced by investment and technical progress

Strictly speaking, cited work of Palley (1996a) contains not only growth model, but several models. These models differ from each other depending on inclusion or exclusion of some components (excess demand, financial markets etc). I have chosen the model which gives the most essential reflection of basic elements of the Post Keynesian approach to growth modeling.

The model includes the following equations (Palley, 1996a, p. 125-128).

(1) $I = z(g_d)$; $z_{gd} > 0$,   [Investment function]

(2) $k^* = I - [d + n + a]k$,   [Capital deepening]

(3) $g_y = n + a + s_k k^*/k$,   [Output growth]

(4) $a = a(k, I) = a(k, g_d)$; $a_k > 0$, $a_{gd} > 0$,   [Technical progress function]

(5) $g^*_d = G(g_y - g_d)$; $G' > 0$,   [Demand growth adjustment]

where I = gross investment per worker, g_d = the rate of the aggregate demand (AD) growth, k = capital-labor ratio; k^* = the rate of the capital-labor ratio growth; d = rate of depreciation; n = rate of population growth; a = change of labor augmenting technical change; g_y = rate of the growth of aggregate output; s_k = capital's share of output; g_d = the change of the rate of the AD growth.

Equation (1) is the investment function and one of the most important distinctions of the Post Keynesian modeling of growth from neoclassical one. The presence of the investment function which is independent from the savings function implies that thriftiness of households cannot be the source of accumulation of physical (fixed) capital. More concretely, this specification of the investment function means that investment reacts positively on economic expansion. In other words, the growth of AD generates an increase in the investment level.

Equation (2) shows the factors which generate the dynamics of capital-labor ratio, and equation (3) determines how aggregate output grows. Equation (4) is the treatment of endogenous growth idea by means of the Post Keynesian methods. This equation demonstrates that labor augmenting technical progress (which is an intensive factor of growth itself) depends positively upon both capital stock per worker and flow of investment per worker. Finally, equation (5) illustrates dependency of changes in the AD growth on the dynamics of the output growth rate (Palley, 1996a, p. 126).

This system of equations is an example of dynamic process of "cumulative causation" (Setterfield, 2010), which can be potentially unstable. The acceleration of AD growth can generate -

through growing investment - increase of the growth of capital-labor ratio (i. e. capital deepening). The latter, in turn, increases rates of technical change and growth of aggregate output. But then the AD growth will be accelerated more strongly (Palley, 1996a, p. 127). This reasoning suggests that instability can also take the form of *negative growth* of output and technical change. It can be very important for many developing countries and countries with transition economies which during the long periods of time are characterized by decrease in the real GDP (for example, Sierra-Leone, Nicaragua, Haiti, Liberia, Russia, Ukraine, Albania, Romania etc). Naturally, the threat of instability is real when parameters of the above-described functions take on the large values.

My opinion is that in spite of all its merits, this model has one serious demerit. I imply poor specification of the investment function (which itself can be the key to instability). Investment depends upon the many various factors, and the AD growth is hardly the most important one. Here there are two considerations. Firstly, fixed capital investment is concerned with future expected returns, and therefore current macroeconomic dynamics may not play the leading role. This consideration goes back to Keynes (1936). For example, he (Keynes, 1939) criticized the idea of accelerator. Secondly, the AD growth (fall) alone can hardly be the sole cause of long expansion (contraction) of investment activity, which has been, for example, the feature of some transition economies in the 1990s (like Russia, Ukraine etc). It implies that the specification of the investment function needs to be elaborated more deeply. The paper will show that long-run investment dynamics is concerned with special behavioral norms of investors. These norms are determined in the course of interactions between heterogeneous agents who are guided by an institutional environment. All these aspects suggest that there is a necessity to go beyond purely macroeconomic analysis.

3. Investor myopia as the main factor limiting fixed capital investment in the long-run

I think that the promising explanation of (negative) long-run investment dynamics can be concerned with *short-termism*, which can be defined as the pessimistic under-weighting of expected future returns and/or the excessive discounting of expected future returns" (Juniper, 2000). It is clear that so defined short-termism leads to refusal from realization of some investment projects. Furthermore, as Juniper (2000) has pointed out, short-termism favors strategies of labor-shedding and asset-stripping instead of strategies of skills formation and asset-renewal (this aspect will be explored below).

Furthermore, short-termism can be represented in more extreme form, although this form is often treated as a something which differs from short-termism itself. I imply *investor myopia* which – as it already was mentioned above - means that *agents evaluate consequences of their decisions only over short-time horizon* (Juniper, 2000; italics added; see also Rozmainsky, 2011b). I believe that investor myopia is both really powerful cause of underinvestment and important determinant of portfolio (and real investment) decisions. Therefore it matters. But investor myopia is not concerned with cyclical fluctuations of macroeconomic activity. This myopia can be treated as the special institutional barrier to economic growth. Unfortunately, there are neither consistent theory of short-termism nor satisfactory analysis of investor myopia (as the most radical and important form of short-termism). The latter is an almost completely unexplored phenomenon.

The essence of investor myopia can be formulated in the following way. This phenomenon can exist whenever decision about purchase of durable asset(s) should be made. And always investor myopia shows itself to be a shift toward assets bearing short-term income across the whole spectrum of durable assets. If liquidity preference, according to quick-witted definition of Dequech (1999a, p. 426), is "an urge for inaction", then investor myopia can be defined as "an urge for action bearing only short-term outcomes".

Furthermore, investor myopia affects not only structure of stock market and choice between asset-renewal and asset-stripping, as Juniper (2000) and other researchers pointed out. In other words, investor myopia is not confined to equity market. In particular, this phenomenon can determine ratios between productive and non-productive activities, between skills formation and skills erosion, between health promotion and health loss, between technical-progress-inducing

industries and other ones, between legal and illegal activities, and so on. Put in more detail, investor myopia can exist in the following spheres of choice (see also Rozmainsky, 2011b).

The choice between productive and non-productive activities. In any economy there is some ratio between these types of activity. Other things being equal, productive activities bear income in more distant future than non-productive ones such as trade and speculatiions, including so-called "financial hoarding" (Binswanger, 1999). For instance, successful speculation can utterly enrich agent for the day unlike any agricultural or industrial production. Here investor myopia has been embodied in the form of shift to trade and speculations. It is clear that such shift seriously distorts a structure of the economy and leads to fall in productivity, technological degradation and also often to fall in the real GDP. It had been a scourge of many former socialist countries in the beginning of their transition to the market economic systems in the turn of the 1990s. Some countries like Bulgaria, Romania, Russia, Ukraine had suffered from this economic disease. The same problems grip some developing countries of Africa and Asia.

The choice between accumulation of human capital and erosion of skills. A role of investor myopia (more exactly, a role of short-termism as the excessive discounting of expected future returns) as the barrier to "skills formation" was mentioned in the literature (Juniper, 2000). But this aspect needs to be explored in detail. In order to accumulate human capital people should have long-term horizon planning, because more high skills generate gains only in the distant future. Diffusion of investor myopia among agents can lead to the erosion of skills, when people begin to make occupational choice in favor of activities which do not require high skills. The examples are jobs for common labor and various mediatory activities. Such shifts together with brain drain had contributed to technological degradation in many transitional economies in the 1990-2000s.

The choice between accumulation of health capital and health loss. This aspect, unfortunately, is totally ignored in economic analysis. In general, "health can be viewed as a durable capital stock that produces an output of healthy time" (Grossman, 1972, p. 223). In other words, health capital is the factor which increases period of use of human capital. The problem is that health investment can generate significant only in very distant future. Therefore investor myopia destroys inducements to invest in health capital (Rozmainsky, 2011a). Moreover, people characterized by such myopia often make choice which leads to health loss. I imply increasind demand for alcohol and drugs, and also just "unhealthy way of life". Agents do not believe in (distant) future and not care about their health. As a result, health capital decreases. It adversely affects both life expectancy and economic development. The examples are Russia (Rozmainsky, 2011a), Ukraine and some other transitional countries.

The choice between technical-progress-inducing industries and other ones. Broadly speaking, any investments can contribute to technical progress. Such assumption is valid in any very abstract growth model like Palley (1996a) model or the model in the Section 5. But if we make more detailed analysis then the conclusion must be made that some investments foster strongly technical progress, other investments are not. Usually embodiment of technical improvements is not only complex but also lengthy process. Therefore investments concerned with such embodiment bear profit later than other ones. Put differently, expansion of potentially technically-progressive industries is possible only when agents have long-term planning horizon. On the contrary, when agents evaluate their future performance over short-time horizon, such industries cannot develop, and new inventions do not embody. It is the serious issue of many countries with developing and transitional economies.

The choice between legal and illegal activities. The existence of more or less significant illegal sector in all developed, transitional and developing economies is at present time not secret for economists. But causes of agents' choice of illegal business, determinants of dynamics and structure of this sector, and also consequences of its expansion are up to now not satisfactorily explored. It is serious lacuna in modern economics. It seems to me that one of the most promising modes to fill it is use of concept of investor myopia. The point is that activity within the framework of illegal sector is almost always short-term (Oleynik, 2000, ch. 6). The point is that illegal business implies activity under conditions of high likelihood of applying legal sanctions by

the State. Therefore participants of illegal sector are guided by only short-term outcomes. It means that when some agent tries to choose between legal and illegal activities, if his (or her) behavior is characterized by investor myopia, then he (or she) will make decision in favor of "shadow economy". That is why rapid growth of illegal sector in almost all countries with transition economies (especially in Bulgaria, Russia, Ukraine) should not be surprising.

These are main forms of "embodiment" of investor myopia. In short, entrepreneurs with investor myopia aspire to make money (a) by means of trade or various (stock, forex, real estate) speculation, (b) in the industries bearing quick income, or (c) within the framework of illegal sector. Workers (employees) with investor myopia do not accumulate their human capital and rush for unskilled occupations, including activity within the framework of three just mentioned "spheres". The consequences regarding shareholders and other participants of financial markets were already explored (Dickerson et al, 1995; Juniper, 2000), and I will not touch upon this issue. The above analysis shows that *investor myopia changes fundamental decisions determining a structure of the economy and also dynamics of capital stock and its technologocal structure. It is clear that investor myopia can have enormous influence on economic growth, structural dynamics and technical progress*. But what factors generate investor myopia itself?

The point is that investor myopia is a *behavioral norm*, because often it is a long-run principle of human behavior. Therefore it can be treated as an *institutional phenomenon*. It means that investor myopia problem exceeds the limits of purely macroeconomic analysis. In order to fully comprehend this problem it is necessary to take institutional factors into account. As an *institutional phenomenon* and *behavioral norm,* investor myopia should be considered in connection with main elements of institutional environment. I suppose that this phenomenon is determined by some important both formal and informal institutions. So theory of investor myopia becomes new addition to the analysis of institutional boundaries to economic growth (North, 1990).

Below I start with the main formally institutional cause of investor myopia.

4. The main formally institutional cause of investor myopia

The importance of institutions, as is well known, is to reduce degree of uncertainty. This statement is shared not only by the Post Keynesians (Davidson, 1972, 1988, 1991; Dequech, 2000), but also by the New Institutionalists (North, 1990; 1991, 1995; Eggertsson, 1990). This goal can be attained by both types of institutions. I mean formal and informal "rules of games".

The most important formal institution which decreases uncertainty is the law of contracts. The point is that legal forward contracts make possible to assure many future outcomes and flows and, thereby, reduce degree of uncertainty. Such contracts give entrepreneurs possibility to determine at least level of future cost. Without it any long-term economic activity makes no sense. That is why *some Post-Keynesians consider legal forward contracts as the most fundamental institution of market "monetary" economy* (Davidson, 1972, 1988, 1991; Carvalho, 1992; Rozmainsky, 2011b). In particular, only forward contracts make investments with long gestation period possible. This feature as a rule characterizes fixed capital investments, including investments embodying technical progress.

But forward contracts must be legally enforceable. Only in such case this institution will be really able to reduce uncertainty and to create foundations for any long-term economic activity, including fixed capital investment. Such legal enforcement is provided by the State. The absence of the State protection of forward contracts in the form of legal enforcement creates broad possibilities for various violations of contractual obligations.

Broadly speaking, absolute absence of any legal enforcement of contracts means that explicit money forward contracts system cannot function. But enforcement is ordinal phenomenon. It can have different degrees. Thus, *degree of uncertainty surrounding economic agents is a positive function of degree of legal contracts enforcement provided by the State*. So, bad performance of the State in this sphere can increase degree of uncertainty (Rozmainsky, 2011b).

It is clear that the most of fixed capital investment cannot be realized without complex forward contracts. The low degree of legal enforcement of contracts, other things being equal, de-

creases general amount of forward contracts; hence, it lead to agents' refusal from some long gestation period real investment projects.

It is also clear that all these aspects are relevant to investor myopia problem. The great difficulties concerned with legal forward contracting impede to assure future costs and other important economic variables. Therefore evaluation of too distant performance becomes senseless. Hence investor myopia takes place. Agents begin to confine themselves only to short-term planning horizon. Only improvement of performance of the State in this sphere is able to solve investor myopia problem. It means that the more role of long gestation period investment in the economy, the better legal enforcement must be. Bad enforcement leads to adverse changes in both volume and structure of real investment and also to technological degradation. Here there is very important institutional barrier to economic growth. But this cause of investor myopia is not only. In order to understand deeply the process of *diffusion* of this myopia, one needs to turn to analysis of informally institutional reasons for investor myopia.

5. The basic informally institutional causes of investor myopia

I mean by "informal institutions" here "a style of relations" between agents and their "behavioral patterns". The former is determined mainly by the "degree of pursuit of self-interest" by separate agents. The high degree of such pursuit means *opportunism* (Williamson, 1985; Dunn, 2000). The phenomenon was extensively analyzed by Williamson and some other New Institutionalists. But this analysis had almost exclusively microeconomic character. However, opportunism should be considered also as an important factor influencing long-run macroeconomic variables.

The point is that opportunism always means low degree of mutual trust between agents. Each agent has low propensity to form any links with other agents. Therefore quantity of contracts in a society with high opportunism is less than quantity of ones in a society with low opportunism or without it. It is clear that diffusion of opportunism negatively affects both investment activity and inducement to work and to innovate. Needless to say, any complex and lengthy economic activity implies both links with different sides and confidence in predictability (and honesty) of their actions.

Increase in the degree of opportunism can be described through tools of standard macroeconomic analysis as a leftward shift in the aggregate supply curve, because this phenomenon acts as a strong disincentive to work, to invest, to innovate, etc. Producers will supply the same amount of real output only for higher prices. Here we can see that *opportunism is both high institutional barrier to growth and cause of cost inflation*. For example, accelerated inflation in all transition economies in the beginning of the 1990s can be explained, in particular, as an effect of increased degree of opportunism.

For our analysis it is important that *increasing opportunism narrows planning horizon*. If agents do not trust each other they will not put into practice of any lengthy (and complex) activities. Increased opportunism instills psychology of participants of illegal sector in "ordinary" people. They begin to strive for short-term gains. The calculations of long-term outcomes become an exception. (Rozmainsky, 2011b)

So absence or low degree of opportunism is not less important condition for high level of real investment than legal enforcement of forward contracts. Although, broadly speaking, high opportunism can be an effect of failure of the State as "a legal protector" of contracts. The point is that inability or reluctance of the State to enforce legally contracts induce people to behave in an opportunistic manner.

Here it should be noted, that diffusion of opportunism is not dependent entirely on contracts enforcement issue. The other important cause of such diffusion has roots in a sphere of moral norms. If people cease to follow moral norms or if these norms themselves degrade, that diffusion of opportunism is inevitable. All these aspects took place in the beginning of the transition of the former planned economies to the market system at the turn of the 1990s. The destruction of communistic ideology together with bad performance of the State as the "contracts protector" had led to diffusion of opportunism through imitation. It means that people took over investor myopia view. Here it is necessary to note that for the sake of simplicity, in the course of further

analysis, I will treat opportunism as a "variable" determined exclusively by ineffectiveness of contracts enforcement system, in spite of importance of moral norms as an autonomous factor.

It is the first possible cause of diffusion of investor myopia among agents (and this cause has become the reality in the 1990s in many transition economies). The other cause of it is concerned with special behavioral patterns of agents who live in the countries with no traditions of market economy. The matter concerns such behavioral pattern of people of various non-market (or not purely market) economies as *rationality aversion*: I believe that in the transition economies agents as a rule may not make fully rational choice at all.

The point is that the rational behavior implies "calculatedness" (Leibenstein, 1976, p. 72 – 82), i. e. detailed personal account of current and future benefits and costs which are concerned with the decision-making. Only politically, socially and psychologically independent people with deliberate objectives, personal responsibility and care for own material welfare will make rational decision in their economic life. That is why rationality is not universal feature of human behavior; it should be treated as the behavioral norm can be formed by religious, cultural and social factors. The most famous illustration of last sentence is Weber (1965) conception of the Protestant ethic influence on rise of capitalism. Western capitalistic society itself compels people to be rational, as it implicitly follows from the famous work of Leibenstein (1976, ch. 5). As Kregel (1995, p. 168) pointed out, "an economy based on exchange for private gain in the form of learned behavior, a particular form of human culture which cannot be expected to resurface unaided which more than 75 years in the Soviet Union, and over 40 in most of Eastern Europe have been spent trying to form 'New Socialist Man'".

In other words, the planned economy is the system which very strongly affects behavioral norms and features of its participants. The planned economy implies both political and social dependency of people and low level of personal responsibility. Many social-and-economic relations have been based on the State paternalism (Kornai, 1980). In the planned economies people usually had shifted the burden of individual decision-making responsibility to somebody's shoulders. As a rule, this "somebody" is the State or an enterprise of the State. The level of wage, consumption bundle and other important objects of economic choice had been determined by the State in exchange for guaranteeing of staple economic goods and social maintenance. People had been insured against starvation, homelessness, bankruptcy, misery, unemployment. Their personal efforts could not both make them bankrupt or unemployed and allow them to enrich. Needless to say, planned economy had led to very high degree of psychological personal dependence of people and their very low propensity to innovate in any spheres of economic life. Non-rational behavior of participants of the planned economy is a natural consequence of fundamental properties of such system (although, on the other hand, rise of this system itself can be treated as an effect of religious, cultural and social factors preventing rationality)

To overcome behavioral norms is time-consuming process (Sapir, 1999, p. 4). Therefore, for example, in the beginning of transition agents do not behave (fully) in the rational manner, because they have no appropriate habit!

It leads to the very high degree of consensus of opinion in the various markets for durable assets and to the phenomenon which was called by J. M. Keynes (1936) "conventional judgement" (see also Raines and Leathers, 2000; detailed analysis of different definitions of "conventions" is contained in Dequech, 1999b) and by Parenteau (1999) "herding". Each agent tries to follow the behavior of others and refuses from individual independent weighing of benefits and costs of own choice. So, high *rationality aversion* generates high *propensity to herd*, and the latter favors quick diffusion of other behavioral norms. One of such norms is already familiar investor myopia.

In short, diffusion of opportunism and high propensity to herd (caused by rationality aversion) can lead to very significant investor myopia which generates refusal to invest in physical capital and technical progress. The non-productive assets become rather more popular.

6. The simple model of investor myopia and "negative growth"

This process of *negative growth* can be presented in the form of the simple model. Its first three equations are taken from the growth model of Palley (1996a) with addition of time period index t:

(6) $k^*_t = I_t - (d + n + a_t)k_t,$ [Capital deepening]

(7) $g_{yt} = n + a_t + s_k k^*_t / k_t,$ [Output growth]

(8) $a_t = a(k_t, I_t);$ a'(k), a'(I) > 0.
[Technical progress function]

The investment function is specified in the following way.

(9) $I_t = I(M_t - S_{mt}M_t);$ I' > 0; $0 \leq S_m \leq 1,$ [Investment function]

where M = money supply; S_m = the share of money supply which contains in the hands of agents whose behavior is characterized by investor myopia. Such agents do not invest (in the fixed capital), unlike agents with "normal-termism", i. e. without investor myopia. The total money supply has distributed among agents belonging to these two different types of investors.

(10) $M_t = L_{mt}M_t + S_{mt}M_t;$ $0 \leq L_m \leq 1,$ [Distribution of money supply]

where L_m = the share of money supply which contains in the hands of agents with "normal-termism". It is clear that if money stock has distributed among investors not strongly unequally, that volume of investment depends negatively upon quantity of agents suffering from investor myopia. It leads to the question about factors determining quantity of such agents and change of this quantity. It is necessary to specify function which governs dynamics of S_m. The above reasoning suggests that first of all *S_m should depend on such non-quantifiable parameters as a ineffectiveness of contracts enforcement generating high propensity to behave in an opportunistic manner and a degree of rationality aversion generating high propensity to herd.* Besides, the analyzed variable can be concerned with changes in the real GDP (growth rates) and also with expected changes of prices of non-productive assets which are the object of demand of agents suffering from investor myopia. The examples of such assets are means of financial hoarding, Old Masters, and also capital used in the framework of illegal activity. I offer to formalize these aspects in the following way:

(11) $S^*_{mt} = S_{mo}F(HERD_t) + \eta ENF_t - \sigma g_{yt} + \mu(P_{et} - P_t);$ $\eta, \sigma, \mu, F' > 0,$
[Dynamics of share of myopic investors]

where S_{mo} = S_m in the some "initial" time period, HERD = parameter of the propensity to herd, F(HERD) = functional dependence upon this parameter, ENF = parameter of ineffectiveness of the State system of contracts enforcement, P = the price of non-productive assets which are attractive for agents suffering from investor myopia, P_e = the expected price of such assets, η, σ, μ = coefficients. The equation (11) is the key one in this model.

The first term in the right side of (11) implies that dynamics of S_m depends upon some initial share of "short-sighted" investors and agents propensity to herd. The more both these parameters are, the more S_m will grow. In other words, when the quantity of "short-sighted' investors is large, and each agent tries to follow the behavior of the other agents, then total quantity of investors "infected" by myopia can very quickly increase to the bound. On the other hand, when initial quantity of myopic investors is small, or propensity to herd is low, then increase of analyzed variable cannot be very great.

The second term reflects an influence of formally institutional sphere. It hardly needs to be commented; here it is necessary to note only that ENF is not inevitably exogenous parameter. It can become endogenous through inclusion of very rapid institutional shifts (the examples are the transition from the planned economy to the market one or some systemic transformations in the "underdeveloped" economies), which weaken the State as the "contracts protector":

(12) $ENF_t = ENF(INST.SHIFTS_{t-n})$; $ENF' > 0$,
[Contracts enforcement ineffectiveness "function"]

where t-n implies that (adverse) institutional shifts decrease effectiveness of contracts enforcement system with some time lag.

The third term in the right side of (11) means that *negative growth* makes people less confident in the long-term future. Agents become more and more oriented themselves to the short-term outcomes. The last term is a reflection of very familiar "speculative bubbles" phenomenon. The dynamics of demand for non-productive assets - which are attractive for myopic investors - can be characterized by properties of standard speculative bubbles. Here the question about factors of price expectations emerges. According to the Post Keynesian tradition, any expectations can be hardly described by one simple algebraic formula. But it does not mean that expectations can be only exogenous. The general specification of non-productive assets price expectations is here the following:

(13) $P_{et} = P_e(g_{yt}, HERD_t, SS_t)$; $P_e'(g_{yt}) < 0$; $P_e'(HERD)$, $P_e'(SS) > 0$,
[Non-productive assets price expectations function]

where SS is the volume of purchases of non-productive assets. When demand for speculative assets (it should be noted that short-term, "myopic", income has very often speculative nature) increases, and this increase is accelerated through phenomenon of high propensity to herd, then jumps of expected prices are inevitable. On the other hand, long negative dynamics of the real GDP can depress expected price of any assets.
The purchases of "myopic" assets, in turn, are determined in the following way which does not require explanations:

(14) $SS_t = SS(P_{et} - P_t, S_{mt}M_t)$; $SS'(P_{et} - P_t)$, $SS'(S_{mt}M_t) > 0$.
[Purchases of non-productive assets function]

Finally, money supply should not treated as an exogenous variable. According to the Post Keynesian tradition, it can be specified as a variable depending on real activity:

(15) $M^*_t = M(g_{yt})$; $M' > 0$.
[Money supply function]

More concrete specification of this function depends upon the type of endogeneity (Pollin, 1994): if endogeneity is accomodative (structural), then dependence of money supply growth upon the real GDP growth will be high (low).
The presented model makes possible to emphasize macrodynamics which is concerned with interactions between different agents characterized by different "termisms". Because of weakening of the State (which can be induced my deep institutional transformations, as the equation (12) shows), bullish markets for non-productive assets sentiments or current slump investors become more myopic. This tendency can be intensified when investors averse to "calculatedness" and are characterized by high propensity to herd. All these considerations are reflected in the key equation (11). At that, *optimistic non-productive assets price expectations, purchases of such assets, high propensity to herd, diffusion of investor myopia and negative dynamics of the real GDP interact*, as the equations (13) and (14) demonstrate.

The diffusion of investor myopia, in turn, generates fixed capital investment decrease (9). Such decrease leads to fall in the capital-labor ratio (6), technical regress (8) and *negative growth* itself (7). Here, of course, it should not forget also about the interactions between (6), (7) and (8), i. e. between capital-labor ratio, dynamics of the real GDP and parameter of technical change.

The likelihood of emergence of the process of *negative growth* depends upon the likelihood of institutional shifts generating decrease in the degree of effectiveness of contracts enforcement system. The intensity of this process is determined by the character of interactions between heterogeneous agents: the more agents follow each other and imitate myopic behavior, the quicker quantity of myopic investors goes up and the quicker investment and the real GDP fall. The rapid monetary contraction in the course of *negative growth* (15) – which takes place especially when money supply endogeneity has accomodative forms – contributes to such adverse dynamics (9). This process can be hindered due to the collapses of some markets for non-productive assets; such collapses may be treated as the natural consequences of recent euphoria or fall in the real GDP (13).

7. The conclusive comments

The phenomena of long decreases of fixed capital investment and the real GDP have been the reality of many countries with developing and transition economies (for example, in Russia during the 1990s the real GDP has fallen more than twice; and the level of real fixed capital investment in the 1999 was equal approximately to 20 per cent of the 1990 level). Unfortunately, these phenomena hitherto were not explained by any mainstream growth models.

The present paper offers simple Post Keynesian growth model which explains long *negative growth*. There are three keys to explanation: account of inability or reluctance of the State to enforce legal forward contracts; speculative bubbles in the markets for non-productive assets; and high propensity to herd which generates rapid imitation of (adverse for the real economy) behavioral norms. In the center of these three aspects there is such "adverse" behavioral norm as investor myopia. This norm implies that investors evaluate their performance only over a short-time horizon and therefore refuse to make long-term investment. It leads to investors rejection of the majority of fixed capital investment projects because such projects can bear (high) return only in the long period of time. The lengthy fall in the real GDP is both an inevitable consequence and a cause of further diffusion of investor myopia.

The model makes possible to make sentences about modes of both prevention of and struggle with described process of *negative growth*. The prevention is concerned, first of all, with high effectiveness of the contracts enforcement system. Besides, such prevention can be treated as the negative function of "attractiveness" of various markets for non-productive assets. So here the State can play enormous role not only as the "contracts protector", but also as the "agent" which controls and restricts markets for those non-productive assets which can displace (different elements of) fixed capital as the object of investment (these considerations suggest that not only money itself can "crowd out" physical investment, as Keynes (1936, ch. 17) and some Post Keynesians (Davidson, 1969) believed).

The struggle is concerned, of course, to a considerable extent, with government investments which encourage both technical progress and economic growth. But the other "line" of such struggle should regard for creation of barriers to the diffusion of investor myopia. These barriers are effective when agents are not characterized by high propensity both to follow and to cheat each other, that is, by both high propensities to herd and to behave in an opportunistic manner. The former is determined by the degree of rationality aversion, the latter by effectiveness of contracts enforcement system and moral norms. That is why the degree of rationality of agents and its honesty are very important. But it is also sphere of an activity of the State. It must increase both rationality and honesty of its residents. On the contrary, if the State prevents rational and honest behavior – for example, by means of inconsistent and contradictory legislation (Lah and Sušjan, 1999, p. 592), that makes detailed economic calculations and responsibility, unlike cheating, senseless – then *negative growth* can be intensified. Here it is clear that the role of interac-

tions between different heterogeneous agents can be very important in the process of (positive and especially negative) growth.

All these considerations suggest that sustainable and high positive economic growth can be hardly take place irrespective of the prudential policy of the State.

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TESTING THE TRILEMMA HYPOTHESIS AND MEASURING THEIR EFFECTS ON INFLATION, GROWTH AND VOLATILITY FOR POLAND

YU HSING[1]

Abstract

This paper finds evidence of the trilemma for Poland. Exchange rate stability, monetary independence and financial integration have a tradeoff. Mainly because of its plan to join the ERM II and pursuing for inflation targeting, the policy combination of exchange rate stability and monetary independence has been prevalent since 1991. More exchange rate stability raises the growth rate but also increases output volatility. More financial integration reduces the inflation rate, inflation volatility and output volatility. More monetary independence does not affect inflation, growth and volatility. Hence, these impacts may be considered in reviewing and selecting a policy combination.
Keywords: trilemma, exchange rate stability, monetary policy independence, financial integration.

1. Introduction

Three macroeconomic policies - exchange rate stability, monetary autonomy and free capital mobility - have been considered and pursued by many countries in order to reduce exchange rate volatility, engage in monetary easing to improve a sluggish economy or monetary tightening to dampen an over-heated economy, and attract foreign investments. The trilemma of international economics and finance suggests that only two of these three policies can be achieved simultaneously (Ghosh, Gulde and Ostry, 1997; Edison, Klein, Ricci and Sløk, 2002; Prasad, Rogoff, Wei and Kose, 2003; Levy-Yeyati and Sturzenegger, 2003; Eichengreen and Leblang, 2003; Frankel, Schmukler and Serven, 2004; Shambaugh, 2004; Obstfeld, Shambaugh and Taylor, 2005, 2009, 2010; Henry, 2006; Kose, Prasad, Rogoff and Wei, 2006; Prasad and Rajan, 2008; Aizenman, Chinn and Ito, 2008b, 2011a; Aizenman and Ito, 2012; and others). Australia maintains monetary independence and free capital flows and permits the exchange rate to move freely. Hong Kong focuses on exchange rate stability and free capital mobility and allows the internal interest rate to follow the world interest rate. China pursues a stable exchange rate and independent monetary policy and places some capital controls.

This paper tests the trilemma hypothesis and examines potential effects of these three trilemma policies on inflation, economic growth, inflation volatility and output volatility for Poland. The study of this subject is significant. Because Poland is a member of the EU and plans to join the ERM II, it would be more inclined to pursue these three trilemma policies in order to stabilize the zloty/euro exchange rate, pursue price stability, and attract international capital. An analysis of previous studies indicates that none of the previous studies has used the latest data for financial integration (Chinn and Ito, 2006, 2008; Aizenman, Chinn and Ito, 2011b) to examine the relationships between inflation, economic growth, inflation volatility and output volatility and these three trilemma policies for Poland.

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Several recent studies have examined the related subjects. Based on a sample of 18 industrial countries including many EU countries and 28 developing countries, Frankel, Schmukler and Serven (2004) find that although several large advanced countries can select their own rates over the long run, most other countries with flexible exchange rates react fully to international interest rates in the long run. In the short run, countries with flexible exchange rates respond to international interest rates with slower speed, suggesting that they possess some degree of monetary autonomy.

Using a multi-country sample including Poland, Obstfeld, Shambaugh and Taylor (2005) show that the trilemma can be considered as a guide for macroeconomic policy framework. Countries without pegging exchange rates and capital controls would retain sufficient amount of monetary autonomy whereas countries pegging exchange rates and not having capital controls would lose significant monetary autonomy.

Using a large sample of 179 countries including Poland, Aizenman, Chinn and Ito (2008b) show that greater exchange rate stability leads to more inflation or output volatility and a lower inflation rate; greater monetary independence results in higher inflation; and more financial integration lowers the inflation rate. Aizenman, Chinn and Ito (2011a) reveal that those emerging market countries with more converged policies and relatively large foreign reserves would experience less output volatility whereas those countries with relatively low foreign reserves would suffer more output volatility. Aizenman and Ito (2012) find that the three macroeconomic policies in emerging economies are converging toward an intermediate ground as they pursue managed exchange rates backed up by large international reserves, some degree of monetary autonomy, and restrained financial integration. These emerging economies experience less output fluctuations whereas emerging economies with relatively low international reserves as a percent of GDP would suffer relatively high output fluctuations if they select policy divergence.

Based on a sample of eight new EU countries outside of the euro zone including Poland, Căpraru and Ihnatov (2011) study potential impacts of different exchange rate systems on monetary autonomy. They show that countries with the fixed or intermediate exchange rate system are less sensitive to ECB's interest rate than countries with the floating exchange rate system and that countries with the intermediate exchange rate system preserve more monetary independence. It suggests that countries with the flexible exchange rate system have less monetary independence than countries with the fixed or intermediate exchange rate system.

2. The Model

Extending Aizenman, Chinn and Ito (2008b, 2011a), Aizenman and Ito (2012) and other previous studies, we can express the trilemma equation as:

$$C = f(S_t, I_t, F_t) \qquad (1)$$

where

C   = a constant,
S   = exchange rate stability,
I   = monetary independence, and
F   = financial integration or free capital mobility.

If the goodness of fit in equation (1) is relatively high, it suggests that these tree policies are binding and constrained. An increase in the value of one of the trilemma policies will reduce the value of one or both of the other policies. Note that equation (1) is written in the general form because different functional forms such as the linear, log-log, log-linear and linear-log relationships will be considered and tested.

We can use equation (2) to test potential impacts of exchange rate stability, monetary independence and financial integration on the inflation rate, the growth rate of real GDP, inflation volatility and output volatility:

$$X_t = h(S_t, I_t, F_t) \qquad\qquad (2)$$

where X represents one of the following dependent variables

π = the inflation rate,
GR   = the growth rate of real GDP,
IV   = inflation volatility, and
YV   = output volatility.

More exchange rate stability is expected to stabilize the currency value and price level, reduce uncertainty, and help economic growth. On the other hand, more exchange rate stability may increase or reduce inflation or inflation volatility, depending upon whether the pegged anchor currency would appreciate, depreciate or be volatile. Depending upon monetary easing or tightening, the timing and the magnitude, more monetary independence may increase or reduce the inflation rate, the growth rate of real GDP, inflation volatility and output volatility. More capital inflows are expected to increase aggregate demand and the supply of funds, reduce lending rates, help economic growth, and may increase or reduce the inflation rate or inflation volatility. However, large amounts of abrupt capital outflows would reduce aggregate demand, destabilize an economy, cause currency depreciation, hurt economic growth, and may increase or reduce the inflation rate or inflation volatility (Chinn and Ito, 2008b; Aizenman, Chinn and Ito, 2011a; Aizenman and Ito, 2012).

3. Empirical Results

S, I and F are obtained from Aizenman, Chinn and Ito (2008b, 2010, 2011b) and Chinn and Ito (2006, 2008) and have values ranging from zero to one. A higher value of S, I or F indicates more exchange rate stability, monetary independence or financial integration. Exchange rate stability is represented by:

$$S = 0.01 / [0.01 + \sigma(\Delta \log(\varepsilon))], \qquad\qquad (3)$$

where σ and ε stand for the standard deviation and the nominal exchange rate. Monetary independence is measured by:

$$I = [1 - c(r, r^*)] / 2, \qquad\qquad (4)$$

where c, r and r* stand for the correlation coefficient, the money market rate in Poland and the money market rate in Germany. The index for financial integration is derived from the information regarding the requirement of the surrender of export proceeds, the presence of multiple exchange rates, and restrictions on current and capital account transactions, which are published by the International Monetary Fund. π is represented by the percent change in the consumer price index. IV is represented by the standard deviation of the inflation rate over a five-year period. GR is measured by the percent change in real GDP. YV is measured by the standard deviation of GR over a five-year period. The consumer price index and real GDP are obtained from the IMF. The sample period ranges from 1991 to 2010.

Table 1 presents empirical results for the trilemma test. Note that a value of 2 is assigned to the constant C and that a value of 2 is added to each of S, I and F in order to avoid a zero or negative value when a logarithmic scale is used. The Newey-West method is employed if consistent estimates of covariance and standard errors are needed. Four different functional forms are considered. As shown, the relatively high values of R-squared suggest that the goodness of fit is relatively high. All the coefficients are positive and significant at the 1% level. The log-linear regression has the smallest values of the mean absolute percent error or Akaike information criterion. Hence, the log-linear relationship yields smaller forecast errors than the conventional linear relationship. Based on the estimated coefficients, it appears that Poland places more emphasis on exchange rate stability and monetary independence than financial integration. Poland

plans to join the ERM II and will be required to maintain the zloty/euro exchange rate within an allowable range in order to adopt the euro in the future. Poland has adopted inflation targeting since 1999 and has set the current inflation target as 2.5%±1%. The National Bank of Poland sets the nominal money market rate consistent with its inflation target. Hence, Poland put more weights on exchange rate stability and monetary independence.

Based on the log-linear regression, Graph 1 presents different policy combinations and compares their weighted values. As shown in the graph, the policy combination of exchange rate stability and monetary independence has been dominant since 1991. The policy mix of exchange rate stability and financial integration ranks second, and the policy mix of monetary independence and financial integration ranks third.

Table 2 reports the impacts of these three trilemma variables on the inflation rate, the growth rate of real GDP, inflation volatility and output volatility. More exchange rate stability leads to a higher growth rate and more output volatility. More monetary independence does not have any impact on inflation, economic growth, inflation volatility and output volatility. More financial integration results in a lower inflation rate, less inflation volatility and less output volatility. These results suggest that more financial integration generates positive benefits whereas more exchange rate stability yields both positive and negative effects.

<p align="center">Table 1: Estimated regressions for the trilemma test</p>

	Exchange rate stability	Monetary independence	Financial integration	R^2	MAPE	AIC
Linear	0.500[a] (3.975)	0.241[a] (3.155)	0.132[c] (1.781)	0.9992	2.401	-2.579
Log-log	0.481[a] (4.013)	0.238[a] (3.215)	0.118 (1.686)	0.9988	2.008	-4.332
Log-linear	0.173[a] (3.975)	0.084[a] (3.155)	0.046[c] (1.781)	0.9992	1.668	-4.699
Linear-log	1.389[a] (4.013)	0.687[a] (3.215	0.341 (1.686)	0.9988	2.889	-2.213

Notes: Figures in the parenthesis are t-statistics. Superscript letter a or c indicates that a coefficient is significant at the 1% or 10% level. There is no intercept in the estimated regression. In the log-linear form, the dependent variable is transformed into the logarithmic scale. In the linear-log form, the independent variables are transformed into the logarithmic scale. Sample period: 1991-2010.

<p align="center">Graph 1: Analysis of different policy combinations</p>
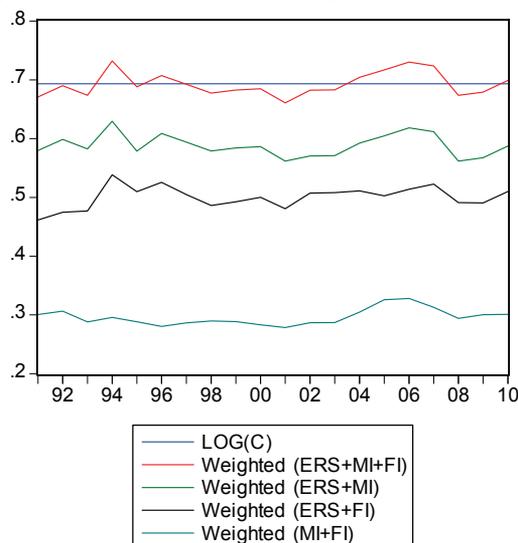
Notes:
C = a constant,
ERS = exchange rate stability,
MI = monetary independence, and
FI = financial integration.

Table 2: Estimated regressions for the inflation rate, the growth rate, inflation volatility and output volatility

Dependent variable	Exchange rate stability	Monetary independence	Financial integration	Constant	R^2
Inflation rate	-7.943 (-0.193)	27.045 (1.220)	-74.661[a] (-3.638)	30.911 (1.761)	0.567
Growth rate	19.562[b] (2.007)	-4.290 (-0.741)	5.981 (1.178)	-1.579 (-0.413)	0.329
Inflation volatility	83.290 (0.348)	184.261 (1.715)	-300.416[b] (-2.497)	54.717 (0.690)	0.526
Output volatility	7.337[b] (2.366)	0.212 (0.069)	-9.428[a] (-4.407)	4.312 (2.398)	0.467

Notes: Figures in the parenthesis are t-statistics. Superscript letter a or b indicates that a coefficient is significant at the 1% or 5% level, respectively. Sample period: 1991-2010.

4. Summary and Conclusions

This paper has found evidence of the trilemma for Poland, implying that there is a tradeoff among exchange rate stability, monetary independence and financial integration. The policy combination of exchange rate stability and monetary independence has been prevalent since 1991. The prevalent policy combination of exchange rate stability and monetary independence is mainly due to its plan to join the ERM II and adoption of inflation targeting. More exchange rate stability raises the growth rate and output volatility, and more financial integration reduces the inflation rate, inflation volatility and output volatility. In comparison, the findings of a positive effect of exchange rate stability on output volatility and a negative impact of financial integration on the inflation rate in this paper are similar to those found by Aizenman, Chinn and Ito (2008b), but other results in this paper are different from those reported by Aizenman, Chinn and Ito (2008b). Hence, the findings based on an individual country may be different from the results based on a pooled sample of many countries.

There are several policy implications. In studying the trilemma, nonlinear relationships need to be examined. The log-linear relationship is expected to yield smaller forecast errors than the widely used linear relationship. It would be beneficial for Poland to pursue more exchange rate stability in order to raise the growth rate of real GDP. However, it also causes more output volatility. Monetary policy may need to be evaluated as more monetary autonomy does not reduce inflation, increase growth, or reduce volatility. More financial integration benefits Poland as it reduces inflation and volatility. To determine whether the results are robust, regression parameters need to be re-estimated when the sample size increases in the future.

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CONSUMER ACCEPTANCE OF FUNCTIONAL FOODS IN MONTENEGRO

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Abstract

This study aimed to investigate determinants of acceptance of functional food in Montenegro and to analyze to what extent these factors affected individuals' consumption of food with health claims. The questionnaire was administered to 479 respondents in Montenegro. The stratified three-stage random sampling method was adopted. Several statistical techniques were employed for investigating data: regression, cluster analysis, independent-samples t test and chi-square.

The results indicate that individuals' education, standard of the household and level of knowledge on products with health claims and perception of some products attributes affect the frequency of functional food consumption. Functional food consumers in Montenegro differ from their global counterparts relative to their age, gender, presence of children in household and appraisal of healthiness of functional food. It is recommended that companies should provide consumers with more information on functional food and attempt to diminish the relevance of price through other product's attributes. Since this paper presents the first national assessment of factors that influence functional food consumption in Montenegro it will be a valuable benchmark for future studies in the field.

Keywords: functional food, Montenegro, cluster analysis, health claims, consumption.

1. Introduction

In the last decades market and academic research have reported a raising awareness and interest of consumers in health matters and functional foods in general (Urala and Ldhteenmdki, 2004; Ares and Gambaro, 2007). Several factors could be acknowledged as influencing agents for this trend: recognition of the role of the food in the preservation of health (Krystallis et al, 2008), increase in life expectancy and increasing cost of healthcare (Menrad, 2003). Even though the lack of an official definition of the functional food complicate and limit to some extent monitoring of functional food markets, there are clear evidence that this market has been in the rise in the previous period and it is expected that this trend will continue in the future also. This market was estimated to be $47.6 billion, whereas the United States were the largest market segment, followed by Europe and Japan (Sloan, 2002). It is projected that the market of functional food will exceed $130 billion by the year of 2015 (Functional Foods and Drinks: A Global Strategic Business Report). The same report argued that developing regions would be the prime growth engines, especially highlighting East Europe, Asia-Pacific, Latin America and Middle East. This is in line with Sibbel's (2007) assertion that functional foods are commercially relevant in many countries globally.

In spite of this, it could be noted that there is a vast number of studies that tackled functional food market in developed countries (U.S. and EU mainly), while consumer behavior on this matter remained understudied in emerging markets (van Trijp and van der Lans, 2007; Verbeke et al., 2009; Dmitrovic et al., 2009). Several scholars (Frewer et al., 2003; Milosevic et al., 2012; Zezelj et al, 2012) called for attention in reference to this observation, emphasizing that consu-

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mer behavior related to functional food varied considerably cross-culturally, with regard to the diversity of specific socio-cultural environments. According to these authors European market is heterogeneous in terms of acceptance of functional food, appraisal of its characteristics and appreciation of different kinds of functional food and nutritive claims. Therefore, it can be concluded that it is necessary to conduct more research on this matter in developing countries and, thus help better understanding of functional food consumption patterns and market potentials in those regions. The research presented here aims to understanding of consumer acceptance of functional foods in emerging market based on a case study of Montenegro.

2. Literature review

One of the widely accepted definitions (Diplock et al., 1999) describes functional food as a food that "affects beneficially one or more target functions of the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease". In the simpler manner, it could be alleged that functional foods are those which can promote health and diminish the risk of illness (Christidis et al., 2011). Hence, European Union legislation (Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods) approves two types to be designated on the foodstuffs: nutrition claims and health claims (HC), whereas the latter are used, among others, to mark functional foods.

Elements that affect food choice, concerning the consumers, usually are: their socio-demographic characteristics and their attitudes and motivations to use functional foods. It can be argued that of numerous socio-demographic characteristics that have been examined in broad range of studies undertaken on the subject of functional food consumption, just few of them proved to be significant. Nevertheless, research consistently point out that socio-demographic features have certain power to explain differences in acceptability and intention to use functional food (Verbeke, 2005; Ares and Gambaro, 2007).

There is general consensus with respect to the gender of functional food's buyers – females demonstrate stronger purchase interest towards this kind of food (Childs, 1997; Poulsen, 1999). This outcome is quite salient, provided that females are persons who are responsible for food purchasing in the households. Moreover, functional food users in Europe are often more educated and of higher economic status (Hilliam, 1996; Anttolainen et al., 2001). However, in the domain of consumers' age there cannot be find such unanimity of opinions and findings. According to Poulsen (1999) and Urala (2005), elderly (older than 55 years) show more intention to buy functional food, which is adverse to the findings of Childs (1997). Another important socio-demographic attribute pertains to the presence of children in household (Xu and Wu, 2008; Verbeke et al., 2009). This finding may be explained in the way that families with children potentially have higher risk aversion, while also seek for fortification in their foods.

In the recent years, lifestyle factors appear to gain in the relevance for unfolding consumers' food selections. It is deemed that if person lives a healthy lifestyle, that will reflect to her/his food consumption (Villegas et al., 2008), while functional food can provide consumers with a modern way of leading a healthier life without changing their eating habits (Chen, 2011). Studies (Urala, 2005; Krystallis et al., 2008) consistently allege that one of the crucial motives for consumers to use functional food is the preservation of good health status and that one's health condition and the type of a product's health claim are highly correlated (van Kleef et al, 2005) with his/her acceptance of a certain functional food product. With regard to the HC, even though they are perceived to be useful (William, 2005), consumers are usually skeptical towards their trustworthiness (Verbeke et al., 2009). It should be noted, that knowledge of food and food ingredients contribute positively to the functional food consumption (Christidis et al., 2011) and that more informed (i.e. knowledgeable) consumers understand better (Grunert et al., 2011) benefits that they could gain from the balanced diet. Indeed, as Sun (2008) concluded, individuals' perception of their health status, their health concerns and nutritional knowledge would affect the formation of their healthy eating attitudes, and consequently, their habits related to functional food usage.

Furthermore, psychological factors determine to the very high extent what foods individual eats. Of these factors, the most prominent ones related to making food choice are: food preferences, food likes and dislikes and response to sensory attributes (Asp, 1999), which correspond to the attitudes. Attitudes can be defined "as a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour" (Urala and Ldhteenmdki, 2004). In other terms, "attitude is the sum of experiences and information about a product (cognition), which evokes positive or negative feelings towards it (affection) and drives the tendency to behave in a certain way (motivation to buy and eat it)" (Behrens et al., 2007).

With respect to the functional food consumers' attitudes are mostly focused on the healthiness, taste, convenience of use (Gray et al., 2003; Urala and Ldhteenmdki, 2007) and price. It is generally considered and established that belief in the health benefits of functional foods determined positively acceptance of this kind of food (Verbeke, 2005). Nonetheless, the way in which HC are being presented have very low impact on perceived overall healthiness and consumer appeal (van Trijp and van der Lans, 2007), which is in line with consumers' expressed skepticism towards HC. In addition, consumers are not willing to compromise taste for eventual health benefits (Gray et al., 2003; Ares et al., 2008), implying that sensory attributes are the essential in determining ultimate food choice. Correspondingly, certain findings (Asp, 1999) suggest that liked foods are those that are familiar and considered pleasant, while disliked foods are rejected either because they are perceived to be unpleasant or they have never been tasted. Concerning the perception of the price of the functional food, rather equivocal findings are encountered in the subject literature (Krystallis et al., 2008; Verbeke et al., 2009). One rational explanation could be the one proposed by Verbeke et al. (2009), citing that consumers may express the price argument in order to rationalize their reserves against functional foods, even though underlying reasons for this rejection is rather related to non-economic considerations.

Stemming from the subject literature and observed research gaps, this study aimed to explore determinants of acceptance of functional food in Montenegro and to analyze to what extent these factors affected individuals' consumption of food with HC.

3. Research methodology

3.1 Participants and sampling

The questionnaire was administered to 479 respondents in Montenegro, while stratified three-stage random sampling method was adopted, in order to ensure nationally representative samples. Primary sampling units were polling station territories, which encompassed about 200 households defined by street names. In the second stage specific households were chosen; and in the third phase sampling units were actual respondents. In order to optimize the sample plan and reduce sampling error, the stratification was done by region and type of settlement. The survey was undertaken in September 2010 and data collection was organized through face-to-face interviews at respondents' homes. Respondents' personal characteristics are provided in the Table 1.

3.2 Instrument

The questionnaire was developed in order to investigate broad range of research questions, regarding motives on food choice and consumption, attitudes, knowledge and social norms related to four product categories (fruit, traditional food, organic food and products with HC). In the last section of the survey, participant's socio-demographic data were gathered. The questionnaire was developed in English, translated in local language and then back-translated to English. The comprehensibility of the questionnaire was investigated by pilot study that comprised 60 respondents.

Given the research subject of this paper, only relevant part of the questionnaire, which concerns products with HC, will be described. In the introductory part of the survey it was explained to the respondents what it was meant by the term "products with HC" and some examples were given. We considered this to be important since some previous studies (van Trijp and van der

Lans, 2007; Christidis et al., 2011) identified that consumers in various European countries often do not know the term of "functional food" or related concepts (e.g. health claims). The formulation in the questionnaire was as following: "Health claims that we see on product packages are claims that link a nutrient to a normal functioning of the body or a specific disease. An example of a health claim – *High in calcium, Calcium helps build strong bones. Adequate calcium throughout life, as part of well-balanced diet, may reduce risk of the osteoporosis*". Some pictures with products with HC (e.g. probiotic yoghurts, milk enriched with vitamins) were provided also, ascertaining respondent's better apprehension of this kind of the food.

Table 1: Statistical features of respondents

Variant	Sample population	Percentage
Gender		
Male	197	41.1
Female	282	58.9
Age		
18-30	183	38.2
31-50	161	33.6
51-65	103	21.5
66 or above	32	6.7
Education		
Unfinished elementary school	56	11.7
Finished elementary school	8	1.7
Finished secondary	315	65.8
College or university degree	100	20.9
Standard of household		
Bad	61	12.7
Moderate	256	53.4
Good	162	33.8
Children in household		
Yes	140	29.2
No	339	70.8
State of health		
Very bad	5	1.0
Bad	31	6.5
Moderate	119	24.8
Good	212	44.3
Very good	112	23.4
Body Mass Index		
Underweight (<18.4)	17	3.5
Normal (18.5 to 24.9)	281	58.7
Overweight (25 to 29.9)	149	31.1
Obese (>= 30)	32	6.7
Level of information		
Not informed at all	41	8.6

Very poorly informed	129	26.9
Moderately informed	249	52.0
Very well informed	51	10.6
Fully informed	9	1.9
HC on products labels are useful		
Agree	346	72.2
Disagree	133	27.8

Self-reported assessment was applied in responses to questions about: a) frequency of consumption, b) respondent's level of information on food with HC, c) whether participant perceives HC made on product labels to be useful, d) his/her state of health, e) standard of his/her household. For evaluation of frequency of consumption 10-points scale was used, including subsequent items: more than 2 times a day, twice a day, once a day, once in 2-3 days, once a week, 2-3 times a month, once a month, several times a year, once a year or less, never. Attitudes were measured by 7-point semantic differential scales, ranging from -3 to 3, including 0, which represented neutral score. Answer modalities for the other questions can be observed in the Table 1.

3.3 Data analysis
Several statistical techniques were employed for investigating data: regression, cluster analysis, independent-samples t test and chi-square. Multiple linear regression was run aiming to establish whether certain respondent's features affect his/her frequency of purchasing of products with HC. These results are accompanied with descriptive statistics, which should help better understanding of obtained data in regression analysis.

In the second phase of the examination, hierarchical cluster analysis was performed. Respondents were segmented into the clusters based on their attitudes towards food with HC (i.e., their expressed level of evaluation of the following food attributes – bad/good; unpleasant/pleasant; unhealthy/healthy; inconvenient for consumption/convenient for consumption; tasteless/tasty; cheap/expensive). Ward's aggregation method and Euclidian distances were applied.

Clusters profiling through identifying distinctive characteristics of each of the clusters was obtained by chi-square test and independent-samples t test. In the case of categorical variables (e.g., gender, presence of the children in the household, etc.) chi-square test at the significance level of 5% was performed, while in the case of metric variables (e.g., frequency of consumption of products with HC and respondent's knowledge about products with HC), independent-samples t test was considered to be suitable, again at the significance level of 5%. All statistical procedures were conducted using PASW Statistics 18 for Windows (SPSS Inc, Chicago, IL, 2009).

4. Results and discussion
In order to assess the influencing factors on the frequency of consumption of products with HC, a multiple linear regression was performed. The complete list of the variables included in the model is presented in the Table 2. Five kinds of explanatory factors are considered: socio-demographic (e.g., gender, age, education, etc.), physiological (overall state of health and body mass index), level of information (knowledge) of products with HC, skepticism of products with HC and attitudes towards the products with HC (e.g., whether respondents perceive this kind of products to be good, healthy, tasty, etc.). The regression model explained 30.7% of the variance of the experimental data.

The results of the regression analysis are reported in the Table 3. Among socio-demographic explanatory variables affecting consumer's frequency of consumption of products with HC, education and economic standard of the household had significant influence. Consumers with higher educational level and higher income would buy products with HC more often, which supports some previously published data (Hilliam, 1996; Verbeke, 2005).

Table 2: Descriptive statistics

Variable	Mean	Std. Deviation
How often they consume products with HC	4.81	2.198
Gender	1.59	0.493
Age	1.97	0.930
Education	2.96	0.832
Standard of the household	2.21	0.650
Children in household	0.29	0.455
Overall current state of health	3.82	0.898
BMI	3.41	0.669
Level of information	2.70	0.841
HC on product labels are useful	1.28	0.448
Bad/Good	2.05	1.208
Unpleasant/Pleasant	1.90	1.188
Unhealthy/Healthy	2.04	1.209
Inconvenient for consumption/Convenient for consumption	2.71	1.232
Tasteless/Tasty	1.81	1.253
Cheap /Expensive	2.08	1.261

Physiological factors, overall state of health and body mass index, have not proved to be statistically significant in predicting consumers' frequency of buying HC products. Reason for this can be found in the fact that respondents estimated their generic health status, not concentrating on some particular health issue that they could be concerned of, while some preceding studies denoted that functional food use was associated with specific health problems (Verbeke et al., 2009), and thus, specific functional food types, as well as with the care about calories intake (Sun, 2008).

As expected, respondents who considered being better informed about this kind of food and consumers who agreed with the statement that HC made on product labels were useful in helping her/him to decide which product to consume, tended to buy products with HC more often. These outcomes corroborate conclusions drawn by Grunert et al. (2011) and by Sun (2008).

Table 3: Regression results for frequency of consumption

Variable	Beta
Gender	0.051
Age	0.060
Education	-0.066*
Standard of the household	-0.079*
Children in household	0.037
Overall current state of health	0.047
BMI	-0.015

Level of information	-0.350***
HC on product labels are useful	0.088**
Bad/Good	-0.136**
Unpleasant/Pleasant	-0.060
Unhealthy/Healthy	0.011
Inconvenient for consumption/Convenient for consumption	-0.064
Tasteless/Tasty	-0.061
Cheap /Expensive	0.099**

Asterisks indicate that estimated coefficients are significant at *10%, **5% or ***1% level of confidence

Two out of six investigated attitudes toward the products with HC are found to have significant influence on frequency of consumption of HC products. Results show that higher consumers' perception of the goodness of product lead to more frequent consumption of that product. On the other hand, if a product is perceived to be more expensive, consumers are less likely to buy it.

Hierarchical cluster analysis was run in order to establish whether consumers with different attitudes towards functional food differ in their consumption patterns concerning that kind of food. This criterion for clusters segmentation is in line with previous studies stating that the beliefs and attitudes outweigh the impact of socio-demographic determinants on functional food acceptance (Verbeke, 2005; Christidis et al., 2011; Grunert et al., 2011). Two clusters are identified: Cluster 1, including 330 respondents and Cluster 2, composed of 149 participants. Statistically significant differences between these two clusters are found in all six cases, as reported in Table 4.

Table 4: Items of the attitudinal questionnaire and average scores for each of the two identified clusters

Attitude scale items (*By your opinion products with HC are...*)	Cluster 1 – HC Enthusiasts (n=330)		Cluster 2 – HC Opponents (n=149)		Cluster 1 x Cluster 2
	Mean	Std. Deviation	Mean	Std. Deviation	
Bad/Good	2.67	0.553	0.68	1.129	*
Unpleasant/Pleasant	2.48	0.711	0.63	1.036	*
Unhealthy/Healthy	2.70	0.534	0.59	1.007	*
Inconvenient for consumption/ Convenient for consumption	2.21	0.960	0.61	1.038	*
Tasteless/Tasty	2.36	0.826	0.57	1.152	*
Cheap /Expensive	2.27	1.175	1.66	1.345	*

Asterisks indicate that average scores for clusters 1 and 2 are significantly different at 5% level of confidence according to t test

The majority of respondents were classified in the Cluster 1 and they exhibited very positive attitudes towards the products with HC – therefore this cluster was named HC Enthusiasts. However, they perceived functional food to be quite expensive (M=2.27) in contrast to participants of the Cluster 2 (M=1.66). Opposite to them, the participants of the Cluster 2, named HC Opponents, showed rather unfavourable attitudes towards functional food, considering it to be not very pleasant (M=0.63), nor tasty (M=0.57).

In clusters profiling several factors were distinguished as significant, according to chi-square statistics – education, age (at 10% level of confidence), person's opinion on whether HC on product labels help product choice for consumption and respondent's level of information about food with HC. Unexpectedly, gender, presence of children in a household, standard of the household and respondent's state of health have not significantly affected the segmentation. The HC Enthusiasts are younger, more educated and consider HC to be valid influential factor when making their decision about product purchase. Adversely, HC Opponents were less educated, perceived HC to be unimportant and were older than their counterparts from Cluster 1. The significance of the enumerated factors in the differentiation of various segments of consumers of the functional food have been recognized in previous literature (Anttolainen et al., 2001; Xu and Wu, 2008; Verbeke et al., 2009).

Highly significant differences were found among clusters for the respondent's appraisal of the how much he/she was informed about products with HC and frequency of consumption of the functional food. Results of the independent samples t-test revealed that HC Opponents thought to be less informed about products with HC than the HC Enthusiasts, which is confirmed by descriptive statistics also (M1=2.92, M2=2.23; means are given respectively for Cluster 1 and Cluster 2). Moreover, both clusters significantly varied with regard to the frequency of consumption of products with HC. In this case, inspection of the clusters' means could be also useful, in terms that it exhibits that HC Enthusiasts buy functional food often (M=4.23, in 2-3 days, on the average), while HC Opponents do the same very rarely (M=6.09, 2-3 times a month). These findings suggest that consumers' attitudes towards food characteristics have impact on the frequency of consumption of functional foods, which is underpinned by prior subject research (Gray et al., 2003; Grunert et al., 2011).

5. Conclusions and limitations

This paper presents the first assessment of factors that influence functional food consumption in Montenegro. Provided that estimates indicate raising significance of Eastern European market of foods with HC, gaining an insight and better knowledge of local consumers on this matter is of the crucial importance. This study revealed manifold differences between Montenegrin consumers of functional foods and their global counterparts.

Several variables established as highly relevant in previous subject research failed to demonstrate their significance in determining differences in level of consumption of products with HC in our case. Above all, these variables pertain to gender, presence of children in household and perceived state of health. The majority of previous studies ascertained that these three factors highly affect individuals' consumption of products with HC, however our regression model did not confirm the same. In addition, perceived healthiness of food, taste, pleasure and convenience of consumption have not appeared to influence frequency of consumption, which is opposite to findings of some prior research (Urala and Ldhteenmdki, 2007; Villegas et al., 2008; Chen, 2011). It may be concluded that the goodness and price represent prevailing elements in determining how often food with HC would be used, which has already been confirmed to be true for foods in general.

Cluster analysis indicated that companies should put more efforts in informing consumers about functional food and HC. Provided that respondents of the Cluster 2 (HC Opponents) demonstrated unfavourable attitudes toward functional food, but on the other hand they expressed to be poorly informed about products with HC, marketers could consider providing more information on this matter to them in order to influence their more positive attitudes in the future. Individuals recognized as HC Enthusiasts should be more investigated in terms of lifestyle in order to achieve their effective marketing targeting, since they represent driving force and the most lucrative segment of Montenegrin functional foods market. Moreover, with regard to the fact that they are very sensitive to the price and perceive functional food to be expensive, companies should try to communicate better to which extent prices of products with HC differ comparing to prices of conventional products, and what kind of benefits they provide their consumers with for these premium prices.

Finally, some limitations should be mentioned also. Firstly, self-reported measures as the indicators of consumption frequency and level of information on products with HC were applied, which could lead to somewhat inaccurate assessments. Secondly, since face-to-face interviews were conducted, that might imply sensitivity to socially desirable answers. In order to improve further studies in this field, utilization of diary method could be more reliable in investigating consumption and level of knowledge on functional food.

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RISK ASSESSMENT MODEL RESPECTING SEGMENTS OF THE PUBLIC

BORUT JEREB[1]

Abstract
The paper describes a broader and more detailed approach to the risk assessment model. The author's assumption is that risk is ultimately an attribute of human beings and not of things or concepts. Therefore, system processes (e.g. a model of business processes), as well as input and output and the public are divided into segments, reflecting the complexity of reality more accurately. The approach is described as sufficiently general to allow for its direct application in a large range of simulation approaches and tools.

The parameters can be used to define individual processes by using their states for representing the accumulated history of the past processes life cycles. The model includes the functions that calculate new values of parameters and output on the basis of the given input. Based on the provided tolerance levels for risks, impacts, and process parameters, the model determines whether these levels are acceptable for each defined segment of the public. The model assumes that parameters, functions and levels are non-deterministic, i.e. parameters, functions and levels may change in time.

Keywords: *Risk Management, Public, Modelling, Simulation, Business Process*

1. INTRODUCTION

Risks are an integral part of our lives and it appears that people have never devoted as much attention to the challenges of risks as we do today. Risks are addressed by numerous articles, comments, and conversations. Perhaps expectedly, there are virtually countless conceptions and definitions of the term "risk". Even if a particular community agrees upon a single definition of risk, it is still anything but certain that such a community will reach uniform opinions or answers to questions such as [3], [19], [20], [22], [25]: How to perceive risks? How to measure them? Which risks are we most exposed to in a given moment? What are the consequences of exposure to risks – what is the impact of risks? Which risks are acceptable and to which magnitude or extent? Who are the risks acceptable to and who are they not acceptable to? How do risks change in time? What is their impact when observed individually and when taken together? What is their mutual effect and what are the consequences of these interactions? How should risks be managed? How to assess the amount of assets required to reduce, or eliminate the risks? The myriad of questions that have remained unanswered to this day points to the complexity of the problem imposed when one contemplates on a quest to address and manage the risks in a comprehensive manner.

ISO 31000:2009 establishes a number of principles that need to be implemented to make the risk management efficient [14]. A risk assessment as the key activity of the risk management is the overall process of the risk identification, the risk analysis and the risk evaluation [15] (see Figure 1). It is the topic of this paper and it requires a multidisciplinary approach since risk may cover a wide range of causes and consequences.

Despite the decade-long history of contesting views on the relations between the terms risk, uncertainty, probability, risk exposure, and risk impacts, technical science, engineering, economics, etc., employ a simplified approach where risk models predominantly, or even exclusively, use the probability distributions of risk, while failing to account for their diverse dependence on the environment.

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