ALGORITHMS FOR THE PROCESSES OF ESTABLISHING PRICES AND BALANCED BANK INTERESTS

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ABSTRACT: *The paper proposed economic and mathematical models of processes for sale, purchase of resources, including financial ones, are analyzed (in mathematical language) economic indicators, financial industries preferred income, financial resources at the end of production are analyzed cases possible deployment of productive processes with and without recourse to bank loans, are useful to constructive conclusions national economy branches, including National Bank.*

KEY WORD: *market economy; banking interest; cost of resources; economic system*

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1. INTRODUCTION

In market economy conditions unless monopolists, monopsony-ists, under perfect competition equilibrium prices are set by the "intersection" of APPLICATION and OFFER (Mankiw, 2008). Quality and quantity of resources involved in the productive sphere, under the impact of technological and scientific progress is evolving. Here in productive processes, and banks involved, which can significantly influence APPLICATION? Prices in the national economy can not achieve an equilibrium level under the banks agreed to continue to increase (or reduce) interest bank and vice versa.

2. NEED DETERMINING OPTIMAL VARIANT OF THE ECONOMIC POTENTIAL

Economic system can achieve balance and price level of resources involved in productive processes and bank interest. But this, at the discretion of supply and

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demand, has several variants-solutions. Of the many variants it is necessary to determine pricing option to resources of interest to the economic potential will be maximized. Pricing process analysis, banking interest equilibrium can be simulated using a mathematical economic model (Keynes, 2006, pp.231-282). To this end assume that the system is composed of m economic subjects $1,2,...,i,...,m$, each of which has the resources $1,2,...,j,...,n$: the volume of $x_i = (x_{i1}, x_{i2}, ..., x_{ij}, ..., x_{in})$, Φ_i, $i = 1,2,...,m$ own financial resources, which do not exceed the available resources summary financial-banking Φ.

If the economic subject i, $i = 1,2,...,m$, $\Phi_i^{(1)}$ takes loans from banks, then it has returned to the bank $(1+\alpha)\Phi_i^{(1)}$ monetary units, where a $\alpha > 0$ - bank interest, whether financial resources are made by the subject at the bank, then $\alpha < 0$. Each participant in the process of sharing resources is able to procure resources at the expense of their own financial resources in the amount of $x_i^{(1)} = \left(x_{i1}^{(1)}, x_{i2}^{(1)}, ..., x_{ij}^{(1)}, ..., x_{in}^{(1)}\right)$, $i = 1,2,...,m$. Exchange of resources between economic subjects of economic processes required for production needs. Resource requirements is represented by the vector $x_i^2 = \left(x_{i1}^{(2)}, x_{i2}^{(2)}, ..., x_{ij}^{(2)}, ..., x_{in}^{(2)}\right)$.

Resources to be purchased at prices $P = (P_1, P_2, ..., P_j, ..., P_n)$ are determined by the balance

$$\left(x_i^{(2)} - x_i\right) = \left(\left(x_{i1}^{(2)} - x_{i1}\right), \left(x_{i2}^{(2)} - x_{i2}\right), ..., \left(x_{ij}^{(2)} - x_{ij}\right), ..., \left(x_{in}^{(2)} - x_{in}\right)\right)$$

3. COST OF TRADE RESOURCES

In these circumstances the cost borne trade in resources each topic depends on the cost of resources (the vector P), the balance between resource availability and needs (the vector $\left(x_i^{(2)} - x_i\right)$), the amount of resources that can be purchased by each subject from their own (the vector $x_i^{(1)}$) can be expressed by the function $K_i\left(P, \left(x_i^{(2)} - x_i\right), x_i^{(1)}\right)$. Economic subjects, using the banking, financial resources have $\Phi_i + \Phi_i^{(1)}$.

The costs of trade must not exceed the available resources of finance, namely

$$K_i\left(P, \left(x_i^{(2)} - x_i\right), x_i^{(1)}\right) \leq \Phi_i + \Phi_i^{(1)}, \qquad i = 1,2,...,m ;$$

algebraic sum of loans by the bank should not exceed the available financial resources bank, namely

$$\sum_{i=1}^{m} \Phi_i^{(1)} \leq \Phi .$$

Economic Indicators — *Table no. 1*

Economic subject	Availability of resources to initiate exchanges					Vector availabilities	The available financial	Sourced from its own resources	Resource requirements						Resources to be purchased					Resources that can be purchased at the expense of their own financial resources					Bank loans	Cost function of resource exchanges	Availability of finance
	1	2	...	j	... n				1	2	...	j	...	n	1	2	...	j	... N	1	2	...	j	... n			
1	x_{11}	x_{12}	...	x_{1j}	... x_{1n}	x_1	Φ_1	$x_1^{(1)}$	$x_{11}^{(2)}$	$x_{12}^{(2)}$	...	$x_{1j}^{(2)}$	...	$x_{1n}^{(2)}$	$x_{11}^{(2)}-x_{11}$	$x_{12}^{(2)}-x_{12}$	...	$x_{1j}^{(2)}-x_{1j}$	... $x_{1n}^{(2)}-x_{1n}$	$x_{11}^{(1)}$	$x_{12}^{(1)}$	...	$x_{1j}^{(1)}$	... $x_{1n}^{(1)}$	$(1+\alpha)\Phi_1^{(1)}$	$K_1\left(P,\left(x_1^{(2)}-x_1\right),x_1^{(1)}\right)$	$\Phi_1+\Phi_1^{(1)}$
2	x_{21}	x_{22}	...	x_{2j}	... x_{2n}	x_2	Φ_2	$x_2^{(1)}$	$x_{21}^{(2)}$	$x_{22}^{(2)}$	...	$x_{2j}^{(2)}$	...	$x_{2n}^{(2)}$	$x_{21}^{(2)}-x_{21}$	$x_{22}^{(2)}-x_{22}$	...	$x_{2j}^{(2)}-x_{2j}$	... $x_{2n}^{(2)}-x_{2n}$	$x_{21}^{(1)}$	$x_{22}^{(1)}$	...	$x_{2j}^{(1)}$	... $x_{2n}^{(1)}$	$(1+\alpha)\Phi_2^{(1)}$	$K_2\left(P,\left(x_2^{(2)}-x_2\right),x_2^{(1)}\right)$	$\Phi_2+\Phi_2^{(1)}$
⋮	⋮	⋮	...	⋮	... ⋮	⋮	⋮	⋮	⋮	⋮	...	⋮	...	⋮	⋮	⋮	...	⋮	... ⋮	⋮	⋮	...	⋮	... ⋮	⋮	⋮	⋮
i	x_{i1}	x_{i2}	...	x_{ij}	... x_{in}	x_i	Φ_i	$x_i^{(1)}$	$x_{i1}^{(2)}$	$x_{i2}^{(2)}$	...	$x_{ij}^{(2)}$	...	$x_{in}^{(2)}$	$x_{i1}^{(2)}-x_{i1}$	$x_{i2}^{(2)}-x_{i2}$	...	$x_{ij}^{(2)}-x_{ij}$	... $x_{in}^{(2)}-x_{in}$	$x_{i1}^{(1)}$	$x_{i2}^{(1)}$	...	$x_{ij}^{(1)}$	... $x_{in}^{(1)}$	$(1+\alpha)\Phi_i^{(1)}$	$K_i\left(P,\left(x_i^{(2)}-x_i\right),x_i^{(1)}\right)$	$\Phi_i+\Phi_i^{(1)}$
⋮	⋮	⋮	...	⋮	... ⋮	⋮	⋮	⋮	⋮	⋮	...	⋮	...	⋮	⋮	⋮	...	⋮	... ⋮	⋮	⋮	...	⋮	... ⋮	⋮	⋮	⋮
m	x_{m1}	x_{m2}	...	x_{mj}	... x_{mn}	x_m	Φ_m	$x_m^{(1)}$	$x_{m1}^{(2)}$	$x_{m2}^{(2)}$	...	$x_{mj}^{(2)}$	...	$x_{mn}^{(2)}$	$x_{m1}^{(2)}-x_{m1}$	$x_{m2}^{(2)}-x_{m2}$	...	$x_{mj}^{(2)}-x_{mj}$	... $x_{mn}^{(2)}-x_{mn}$	$x_{m1}^{(1)}$	$x_{m2}^{(1)}$	...	$x_{mj}^{(1)}$	... $x_{mn}^{(1)}$	$(1+\alpha)\Phi_m^{(1)}$	$K_m\left(P,\left(x_m^{(2)}-x_m\right),x_m^{(1)}\right)$	$\Phi_m+\Phi_m^{(1)}$

Vector resource needs → $\begin{matrix} x_1^{(2)} \\ x_2^{(2)} \\ \vdots \\ x_i^{(2)} \\ \vdots \\ x_m^{(2)} \end{matrix}$

Array to resources to be purchased → $\begin{matrix} x_1^{(2)}-x_1 \\ x_2^{(2)}-x_2 \\ \vdots \\ x_i^{(2)}-x_i \\ \vdots \\ x_m^{(2)}-x_m \end{matrix}$

Source: Elaborated by the authors.

Economic system, is considered relatively closed, only redistribute resources exchange resources, namely total redistribution of resources is equal to one after redistribution, namely

$$\sum_{i=1}^{m} x_i = \sum_{i=1}^{m} x_i^{(2)}$$

Resource cost trade consists of costs of business operations, performed with and without bank loans. Denote by $K_i^{(1)}, K_i^{(2)}$ trade costs that resources under their own financial resources, based on bank loans, namely, $K_i = K_i^{(1)} + K_i^{(2)}$ where

$$K_i^{(2)} = \left(P_1, P_2, ..., P_j, ..., P_n\right) \begin{pmatrix} x_{i1}^{(1)} \\ x_{i2}^{(1)} \\ \vdots \\ x_{ij}^{(1)} \\ \vdots \\ x_{in}^{(1)} \end{pmatrix} = \left(P, x_i^{(1)}\right) = \sum_{j=1}^{n} P_j x_{ij}^{(1)}$$

$$K_i^{(1)} = \left(P_1^{(1)}, P_2^{(1)}, ..., P_j^{(1)}, ..., P_n^{(1)}\right) \begin{pmatrix} \left(x_{i1}^{(2)} - x_{i1}\right) \\ \left(x_{i2}^{(2)} - x_{i2}\right) \\ \vdots \\ \left(x_{ij}^{(2)} - x_{ij}\right) \\ \vdots \\ \left(x_{in}^{(2)} - x_{in}\right) \end{pmatrix} = \left(P^{(1)}, \left(x_i^{(2)} - x_i\right)\right) = \sum_{j=1}^{n} P_j^{(1)} \left(x_{ij}^{(2)} - x_{ij}\right)$$

The total costs of each topic is

$$K_i = \sum_{j=1}^{n} P_j x_{ij}^{(1)} + \sum_{j=1}^{n} P_j^{(1)} \left(x_{ij}^{(2)} - x_{ij}\right), \quad i = 1, 2, ..., m$$

The costs listed above are related to redistribution of resources between economic subjects for the operation scope and production costs of productive processes. Subject economically i, $i = 1, 2, ..., m$, with its resources $x_i^{(2)}$ and $x_i^{(1)}$ supports production costs $K_i^{(3)}\left(x_i^{(2)}, x_i^{(1)}\right)$. Economic subject participating in the redistribution of resources, if he fails to recover all costs: banking, trade, production, or if

$$\underbrace{K_i^{(3)}\left(x_i^{(2)}, x_i^{(1)}\right) + \sum_{j=1}^{n} P_j^{(1)}\left(x_{ij}^{(2)} - x_{ij}\right) + \alpha \Phi_i^{(1)}}_{\substack{\text{Costs, if the economic subject} \\ \text{participating in the processes of} \\ \text{redistribution and production,} \\ \text{using its own resources and} \\ \text{bank.}}} \leq \underbrace{K_i^{(3)}\left(x_i, 0\right)}_{\substack{\text{The subject does not} \\ \text{participate in the economic} \\ \text{redistribution of resources,} \\ \text{does not use credit, not} \\ \text{procure resources of their} \\ \text{own.}}}$$

Costs, if the economic subject participating in the processes of redistribution and production, using its own resources and bank.	The subject does not participate in the economic redistribution of resources, does not use credit, not procure resources of their own.

4. PROCESS MODELING OF ESTABLISHMENT PRICING

Every economic subject by minimizing total costs involved determining in prices, banking interest equilibrium. Subject i, $i = 1,2,...,m$, do not solve the problem which could cause the minimum function:

$$K_i^{(3)}\left(x_i^{(2)}, x_i^{(1)}\right) + \sum_{j=1}^{n} P_j^{(1)}\left(x_{ij}^{(2)} - x_{ij}\right) + \alpha \Phi_i^{(1)} \tag{1}$$

with

$$K_i\left(P,\left(x_i^{(2)} - x_i\right), x_i^{(1)}\right) \le \Phi_i + \Phi_i^{(1)}, \qquad i = 1,2,...,m \tag{2}$$

$$x_i^{(2)} \ge 0, \qquad i = 1,2,...,m \tag{3}$$

$$x_i^{(1)} \ge 0, \qquad i = 1,2,...,m \tag{4}$$

$$\sum_{i=1}^{m} x_i^{(2)} = \sum_{i=1}^{m} x_i \tag{5}$$

$$\sum_{i=1}^{m} \Phi_i^{(1)} \le \Phi \tag{6}$$

Resource prices, loans are set by economic subjects, unjustified increase interest bank contribute to a significant reduction of productive activities of economic subjects. Low bank interest but contribute to the productive activities and reduce potential bank to grant loans, higher interest rates help increase bank potential, but also reduce productive activities. So there are optimal banking interest in earning both parties and economic subjects, and the bank.

Analysis of pricing, interest balance may be made on a system to imitate the functioning of the national economy (de la Fuente, 2000, pp.379-384). Starting from a range of bank interest rate change can be simulated variants can be determined the optimal bank interest.

Economic and mathematical model (1) - (6) may have a number of interpretations, applications can be generalized, can be found and models of processes for particular cases. In determining the equilibrium price of money can also be taken into account and social insurance funds, private (Stegăroiu & Ţâu, 2008). Typically, algorithms economic processes contribute to the calculations (Toader, 2008, pp.96-98). When examined algorithms are assigned to the concepts.

Let us examine a case of the processes determining the optimal amount of bank interest. To this end, assume that the national economy consists of m branches.

Branch i, $i = 1,2,...,m$, has:
- funds production Φ_i;
- including funding of productive performance $\overline{\Phi}_i$;

- operational support costs per unit of fund performance $\overline{C}_i$;
- bad production funds C_i ;
- operation cost fund performance $\overline{C}_i\,\overline{\Phi}_i$;
- cost of funds underperforming operation $C_i\left(\Phi_i - \overline{\Phi}_i\right)$ (Table 2).

Costs of production in industry funding of i, $i = 1,2,...,m$, are depending on the structure of funds by level of economic performance. Namely

$$f_i\left(\Phi_i\right) = \begin{cases} \overline{C}_i\overline{\Phi}_1 + C_i\left(\Phi_i - \overline{\Phi}_i\right), \text{ if the national economy operating funds} \\ \qquad\qquad\qquad\qquad \text{and funds bad performance} \\ \\ \overline{C}_i\overline{\Phi}_i, \text{ if all funds are performing productive national} \\ \qquad\quad \text{economy} \end{cases}$$

Productive funds underperforming operation is more expensive compared to similar costs of production funds performance, namely

$$C_i > \overline{C}_i, \qquad i = 1,2,...,m$$

Table 2. Economic indicators in the profile branches

Branches of national economy / Economic indicators	1	2	...	i	...	m
Productive funds	Φ_1	Φ_2	...	Φ_i	...	Φ_m
Including funding of productive performance	$\overline{\Phi}_1$	$\overline{\Phi}_2$	...	$\overline{\Phi}_i$	...	$\overline{\Phi}_m$
Operating costs per unit of productive funds performance	$\overline{C}_1$	$\overline{C}_2$	...	$\overline{C}_i$	...	$\overline{C}_m$
Operating costs per unit of production funds underperforming	C_1	C_2	...	C_i	...	C_m
Cost of operation of productive funds performance	$\overline{C}_1\overline{\Phi}_1$	$\overline{C}_2\overline{\Phi}_2$	...	$\overline{C}_i\overline{\Phi}_i$	...	$\overline{C}_m\overline{\Phi}_m$
Bad productive operation cost funds	$C_1\left(\Phi_1 - \overline{\Phi}_1\right)$	$C_1\left(\Phi_1 - \overline{\Phi}_1\right)$	...	$C_1\left(\Phi_1 - \overline{\Phi}_1\right)$	...	$C_1\left(\Phi_1 - \overline{\Phi}_1\right)$

Source: Elaborated by the authors.

Financial indicators, in profile national economy branches, determine their operation restrictions (Helfert, 2001, pp.13-14). For branch i, $i = 1,2,...,m$ noted: M_i - needs financial resources, $\overline{M}_i$ - the available branch i of funding.

In these cases, industries need financial resources lending volume $\left(M_i - \overline{M}_i\right)$ the costs of bank loans will increase by $\alpha_i\left(M_i - \overline{M}_i\right)$, by borrowing from other economic subjects - $\beta_i\left(M_i - \overline{M}_i\right)$. Branch i, $i = 1,2,...,m$ financial resources have $\hat{M}_i$ (Table 3).

Table 3. Financial indicators in profile branches

Branches of national economy / Economic indicators	1	2	...	i	...	m
Financial resource requirements	M_1	M_2	...	M_i	...	M_m
Availability of financial resources	$\overline{M}_1$	$\overline{M}_2$	...	$\overline{M}_i$	...	$\overline{M}_m$
Loan resource finance	$M_1 - \overline{M}_1$	$M_2 - \overline{M}_2$	...	$M_i - \overline{M}_i$	...	$M_m - \overline{M}_m$
Costs related to bank loans	$\alpha_1\left(M_1 - \overline{M}_1\right)$	$\alpha_2\left(M_2 - \overline{M}_2\right)$	...	$\alpha_i\left(M_i - \overline{M}_i\right)$	...	$\alpha_m\left(M_m - \overline{M}_m\right)$
Costs of borrowing from other economic subjects	$\beta_1\left(M_1 - \overline{M}_1\right)$	$\beta_2\left(M_2 - \overline{M}_2\right)$	...	$\beta_i\left(M_i - \overline{M}_i\right)$	...	$\beta_m\left(M_m - \overline{M}_m\right)$
Availability of financial resources	$\hat{M}_1$	$\hat{M}_2$	...	$\hat{M}_i$	...	$\hat{M}_m$

Source: Elaborated by the authors.

Total costs, consisting of the operating costs of production funds $\left(f_i(\Phi_i)\right)$ and bank borrowing costs from other economic subjects, must not exceed the available financial resources $\left(\hat{M}_i\right)$, namely

$$f_i(\Phi_i) + \alpha_i\left(M_i - \overline{M}_i\right) + \beta_i\left(M_i - \overline{M}_i\right) \le \hat{M}_i, \quad i = 1,2,...,m$$

Prices of final products by made a unit of production funds is a likely size. Depending on a number of factors have a certain product prices change. Mathematical expectation of the price noted by W_i, $i = 1,2,...,m$.

Financial resources used to operate production processes ensure a final product volume growth. Return per unit of financial resources V_i end products. Products made of financial resources is $M_i V_i$; income based on financial resources - $M_i V_i W_i$; income earned in the operation of productive funds are $\Phi_i W_i$. Each branch is natural they ensure maximum revenue by minimizing costs. Preferred income by industry i, $i = 1,2,...,m$ will be $W_i \cdot \min\{M_i, V_i, \Phi\}$ (Table 4).

Table 4. Preferred income profile branches

Branches of national economy / Preferred income profile branches	1	2	...	i	...	m
Mathematics hope the price of final products made of a productive unit funds	W_1	W_2	...	W_i	...	W_m
Produced per unit of financial resources	V_1	V_2	...	V_i	...	V_m
Products made of financial resources	$M_1 V_1$	$M_2 V_2$	...	$M_i V_i$	...	$M_m V_m$
Income based on financial resources	$M_1 V_1 W_1$	$M_2 V_2 W_2$	...	$M_i V_i W_i$	...	$M_m V_m W_m$
Income funds in the productive	$\Phi_1 W_1$	$\Phi_2 W_2$	...	$\Phi_i W_i$	...	$\Phi_m W_m$
Preferred income $W_i \cdot \min\{M_i, V_i, \Phi_i\}$	$W_1 \cdot \min \{M_1, V_1, \Phi_1\}$	$W_2 \cdot \min \{M_2, V_2, \Phi_2\}$	...	$W_i \cdot \min \{M_i, V_i, \Phi_i\}$	...	$W_m \cdot \min \{M_m, V_m, \Phi_m\}$

Source: Elaborated by the authors

After the production cycle branch will provide financial resources in volume $\hat{M}_i - f_i(\Phi_i) - \alpha_i(M_i - \overline{M}_i) - \beta_i(M_i - \overline{M}_i)$.

At the end production branch i, $i = 1,2,...,m$, will provide financial resources amounting to:

$$W_i \cdot \min\{M_i, V_i, \Phi_i\} + \left[\hat{M}_i - f_i(\Phi_i) - \alpha_i(M_i - \overline{M}_i) - \beta_i(M_i - \overline{M}_i)\right] \text{ (Table 5).}$$

If after the granting of credit, bank loans remained unsolicited M_0 unsolicited financial resources, then banking revenues are:

$$-k_0 M_0 - k_1(\overline{M}_0 - M_0) + \beta(\overline{M}_0 - M_0), \; 0 \le M_0 \le \overline{M}_0,$$

where: $\overline{M}_0$ - Availability of bank credit;

k_0 - Specific gain (per unit) missed by the bank;

k_1 - Specific costs related to banking operations.

Flows of financial resources will be balanced, so if a price (B), for which each economic subject of this process that can maximize the income provided:

$$\sum_{i=0}^{m} M_i = \sum_{i=0}^{m} \overline{M}_i$$

Note: model is not closed, as it admitted financial resources and other extra bank loans, the criteria for optimization may be other economic indicators, income may have the most diverse branches of growth forms: small, slow, increased.

Table 5. Financial resources to end period

Branches of national economy	1	2	...	i	...	M
Algebraic sum of financial resources to end period	$W_1 \cdot \min \{M_1, V_1, \Phi_1\} + $ $+ \left[\hat{M}_1 - f_1(\Phi_1) - \alpha_1 \right.$ $(M_1 - \overline{M}_1) - $ $\left. - \beta_1 (M_1 - \overline{M}_1) \right]$	$W_2 \cdot \min \{M_2, V_2, \Phi_2\} + $ $+ \left[\hat{M}_2 - f_2(\Phi_2) - \alpha_2 \right.$ $(M_2 - \overline{M}_2) - $ $\left. - \beta_2 (M_2 - \overline{M}_2) \right]$	...	$W_i \cdot \min \{M_i, V_i, \Phi_i\} + $ $+ \left[\hat{M}_i - f_i(\Phi_i) - \alpha_i \right.$ $(M_i - \overline{M}_i) - $ $\left. - \beta_i (M_i - \overline{M}_i) \right]$	...	$W_m \cdot \min \{M_m, V_m, \Phi_m\} + $ $+ \left[\hat{M}_m - f_m(\Phi_m) - \right.$ $\alpha_m (M_m - \overline{M}_m) - $ $\left. \beta_m (M_m - \overline{M}_m) \right]$
Expressions $(M_i - \overline{M}_i)$	$M_1 - \overline{M}_1 \gtrless 0$	$M_2 - \overline{M}_2 \gtrless 0$	...	$M_i - \overline{M}_i \gtrless 0$	...	$M_m - \overline{M}_m \gtrless 0$

Source: Elaborated by the authors

5. CONCLUSION

Supply and demand of resources, including finances, determines equilibrium price and resources, and money. But establishing equilibrium processes take place in a long time may create problems of all kinds, makes the economic potential of national economies. Banking interest, arbitrarily set significantly affects the structure of productive funds, and not a change in a positive direction.

Hence, equilibrium prices need to be /projected on a basis of economic-mathematical simulation of resource exchange, the buying and selling of money. National Bank must have a scientific and practical potential to make profound scientific research, to know the best selling price, the purchase of financial resources for each economic situation can be created.

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