International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

Peculiarities of Some Pricing Processes in the Transition Period

Mikhalevich, M.V.

IIASA Working Paper

WP-93-066

December 1993

Working Paper

Peculiarities of Some Pricing Processes in the Transition Period

Mikhail V. Mikhalevich

WP-93-66

December 1993

IIASA

International Institute for Applied Systems Analysis □ A-2361 Laxenburg □ Austria

Telephone: +43 2236 715210 □ Telex: 079 137 iiasa a □ Telefax: +43 2236 71313

Peculiarities of Some Pricing Processes in the Transition Period

Mikhail V. Mikhalevich

WP-93-66

December 1993

IIASA International Institute for Applied Systems Analysis □ A-2361 Laxenburg □ Austria

Telephone: +43 2236 715210 □ Telex: 079 137 iiasa a □ Telefax: +43 2236 71313

Abstract

Several essential aspects of pricing in the conditions of unsaturated market and monopoly impact are considererd. The analysis shows the existence of conditions under which the initial supply–demand disbalance may even be intensified by market pricing. Some inflation scenarios based on these conditions and necessary stabilization counter–measures are discussed. The importance of fast decentralization of economy is stressed. Results of investigations are illustrated by examples from the Ukrainian economy.

Acknowledgments

I want to express my gratitude to the members of the projects on Risk Analysis and Policy and Economic Transition and Integration. The fruitful discussions, which we had during my stay at IIASA, were very helpful and important for the completion of this paper.

Contents

Peculiarities of Some Pricing Processes in the Transition Period

*Mikhail V. Mikhalevich**

1 Introduction

In the present transition period, the economic situation in the former USSR countries (and, perhaps to a lesser degree, in Eastern Europe as a whole) does not correspond to either a centrally-planned or market economy. Centralized state control is being eliminated as a first reform, and market mechanisms, such as free pricing, are being established. However, monopoly structures typical for planned economies are still influencing production. An unsaturated market for goods and services makes monopoly forces even stronger because the producers can dictate prices and quality of deficit goods. Methods of direct control, which are more typical for planned than for market economies, are therefore necessary for a large number of enterprises dependent on state financial support. Whole branches of the economy, including the military complex, need this control.

Lack of a market infrastructure causes serious problems. The activities of the newly-formed banks and foundations, which give their money almost exclusively for non-productive operations, (including the "black market" trade), is only one example. Hyperinflation (approximately 1,500 – 13,000 % per year), a decline of production and investment, and chaotic financial activity are typical for nearly all the post-communist countries [4]. Many different phenomena, therefore, must be analyzed in detail in order to make recommendations for economic policy development. The goals of this policy are to minimize the risk of economic failures, to decrease the social instability and to provide the market transition with minimal costs.

Inflation and financial instability belong to the most important properties of the transition processes. In this paper, we analyze some cases of the present inflation which we refer to as the **Demand Crisis** and the **Structural Hyperinflation Crisis**. It should be noted that, in reality, these crises may be two consequent stages of the same inflation development, and they may be associated with other types of inflation processes. "Artificial" inflation of monopolies

*Professor of the Cybernetics Department at the Kiev State University. This paper was written during a visit at IIASA in October/November 1993.

may be one such example. Without being comprehensive, we try to detect the main features of the present inflation crisis and to shed some light on economic and political choices.

Inflation and market disbalance processes belong to the most typical and the most serious problems of the transition period. Their investigation is rather complex and needs the simultaneous consideration of differenct economic levels (microeconomics; intermediate level: branches, regions; macroeconomics). The inherent economic uncertainties dictate a systems approach combining economic and social factors. A model can help us to make general interpretations of phenomena. It is important because some policy variables such as taxes can rapidly change and this produces difficulties for detailed studies. Of course, any study requires numerically sound approaches and real-data illustrations. The dynamic aspects of models are essential as far as dynamic and unstable processes are concerned. Modelling inflation is far from complete even for market economics [1] – [2]. Some results in this area have mainly asymptotical values [3]. Despite this, a great deal of experience for decision-making has been collected [15] – [17]. The application of this experience for the economic transition is examined in this paper.

The sources of inflation are found both in the spheres of production and goods exchange which is reflected in this paper. In Section 2, we consider the macroeconomic processes connected with market disbalances and disproportions between money and goods with the purpose of understanding how the market pricing mechnism may work in such conditions. Theoretical results are illustrated by examples of the current Ukrainian economic situation: They show that the root of inflation is connected with production. The connection between structural disproportions in the industry and hyperinflation processes is analyzed in Section 3. The behavior of monopolies under conditions of inflation is investigated in Section 4.

Decentralization and privatization are crucial aspects of the economic transition. Yet, the private enterprise may be constrained from the beginning by hyperinflation. Therefore, some components of risk for such enterprises are discussed in Section 5, along with recommendations for decentralizing policies. A generalized view of privatization, which includes its political, economic and social aspects, is presented in Section 6, and tentative conclusions are suggested.

2 Inflation and the Demand Crisis

Under certain conditions, market pricing will not lead to a balance between supply and demand, particularly for transfer economies. Supply-demand inequalities may even be intensified by market pricing. A scenario for this disequilibrium is described as follows:

Consider a closed economic system, which can be described in terms of aggregated indicators. Insofar as it is a dynamic system, all its indicators will be continuous functions of time, t.

Let the gross national product (GNP) be denoted as x and its national income (NI) denoted as y. Assume that $y = (1 - a)x$ where a is a given constant (total expenditures per unit GNP). The NI of the system is distributed in three parts: accumulation for future production I, consumption R, and other components (governmental programs, for example). Such distribution is determined by the values of the coefficients W, $\tilde{W}$, 1 - W - $\tilde{W}$, so I = Wy, R = $\tilde{W}$y.

Assume a linear dependence between the rate of growth (decline) of GNP and the value of accumulation, or

$$\frac{dx(t)}{dt} = b_1(W - W_o)y(t) = b_1(1 - a)(W - W_o)x(t)\,, \tag{1}$$

where b_1 and W_o are known parameters; $W_o y$ can be interpreted as the least amount of accumulation which is necessary to prevent GNP decline; b_1 can be interpreted as the rate of GNP growth/decline per unit of accumulation.

In (1) GNP is described in constant (conditional) prices, but prices can change. Therefore the price level is denoted as p and its relation to total consumer demand, S, and supply, R, are assumed to follow the equation:

$$\frac{dp(t)}{dt} = m\,(S(t) - R(t))\,, \tag{2}$$

where m is a given constant.

We assume that the value of demand S consists of two parts: constant demand for necessary goods and services, C, and payable value of demand, D/p, where D is the value of the money stock of the consumers. Therefore

$$S = C + \frac{D}{p}\,, \qquad \text{and}$$

$$\frac{dS(t)}{dt} = \frac{d}{dt}\left(\frac{D(t)}{p(t)}\right)\,. \tag{3}$$

If we denote as q the ratio of consumer income to national income y, the value of D (in current prices) satisfies the equation:

$$\frac{dD(t)}{dt} = q(t)p(t)y(t) - p(t)min\,(S(t), R(t))\,. \tag{4}$$

The system of differential equations (1) - (4) complete the expressions:

$$y(t) = (1 - a)x(t)\,;\; R(t) = \tilde{W}y(t)\,, \tag{5}$$

and the initial conditions:

$$x(o) = x^o,\ p(o) = p^o,\ S(o) = S^o,\ D(o) = D^o\ ,$$
$$C = S^o - \frac{D^o}{p^o}$$

are the model for further investigation.

This system may be transformed into:

$$\frac{dp(t)}{dt} = m(S(t) - R(t))$$
$$\frac{dR(t)}{dt} = b(W - W_o)R(t)$$
$$\frac{dS(t)}{dt} = \frac{qR(t)}{\tilde{W}} - min(S(t), R(t)) - m\left(\frac{S(t)}{p(t)} + C\right)(S(t) - R(t))\ , \qquad (6)$$

where $p(o) = p^o, S(o) = S^o, C = S^o - \dfrac{D^o}{p^o}, b = b_1(1-a)$ and $R(o) = \tilde{W}(1-a)x^o$.

The system (6) is non-linear and non-smooth. We don't know its analytical solution, but we may analyze its properties using methods of qualitative theory [7].

Consider the projection of the system (6) solution at S0R plane (see Figure 1 – 3). Line S = R corresponds to the market equilibrium and is denoted here as Γ. Quality analysis of the solution's behavior begins with a critical point search. Consider the system of equations:

$$m(S - R) = 0$$
$$b(W - W_o)R = 0$$
$$\frac{qR}{\tilde{W}} - min(S, R) - m\left(\frac{S}{p} + C\right)(S - R) = 0\ , \qquad (7)$$

$S = 0,\ R = 0,\ p \neq 0$ being the critical point of (6), will be its solution for the case of $W \neq W_o, \tilde{W} \neq 0$.

Further analysis shows this point to be unstable both in the areas above and below Γ [6]. It is a quite predictable result since the absence of production and consumption is not a normal situation for an economic system.

An analysis of the phase portrait of the initial non-linear system (6) is based on this result and the usage of the method of isoclines [7]. Consider the system (6) and note the following peculiarities: a) the zero point is the unique fixed point; б) isocline $\dfrac{dR}{dt} = 0$ will be the S axis and for every $S \neq 0$ $S' = mS^2/p < 0$ holds. Therefore, a trajectory exists which coincides with the S axis and is directed to the zero point. This makes it possible to construct the equations for isoclines.

In the area $S < R$ they have the form

$$R = S - (A - B) + \frac{A(A - B)}{S + A}\ , \qquad (8)$$

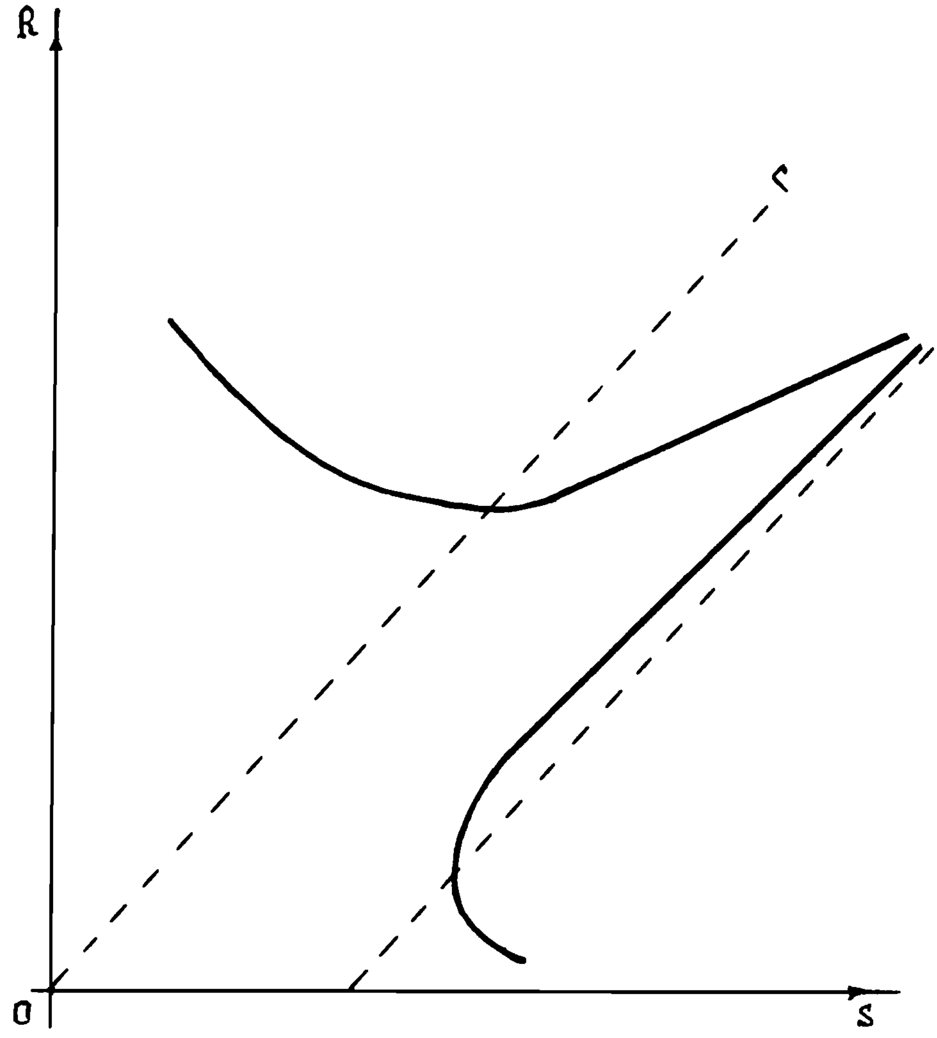

Figure 1: Demand crisis

where $B = \frac{p}{m}$, $A = \left(\frac{q}{\tilde{W}} - (W - W_o)b\right) H$ and H is the tangent for the isocline.

In $R < S$ this equation is

$$R = S - (A - B) + \frac{(A - B)^2}{S + (A - B)} \ . \tag{9}$$

The different forms of the phase portrait for the three following cases implies from (8) – (9).

$$I. \ (W - W_o)b < \frac{q}{\tilde{W}} - 1 \, .$$

The supply-demand dependence for this case is described in Figure 1. The equilibrium, demand is greater than supply, is observed. Prices grow, but the nominal (not real!) value of the consumer money stock D increases at a higher rate. Thus the market pricing mechanism produces a constant supply-demand imbalance and the price level p according to (2) increases at the rate of

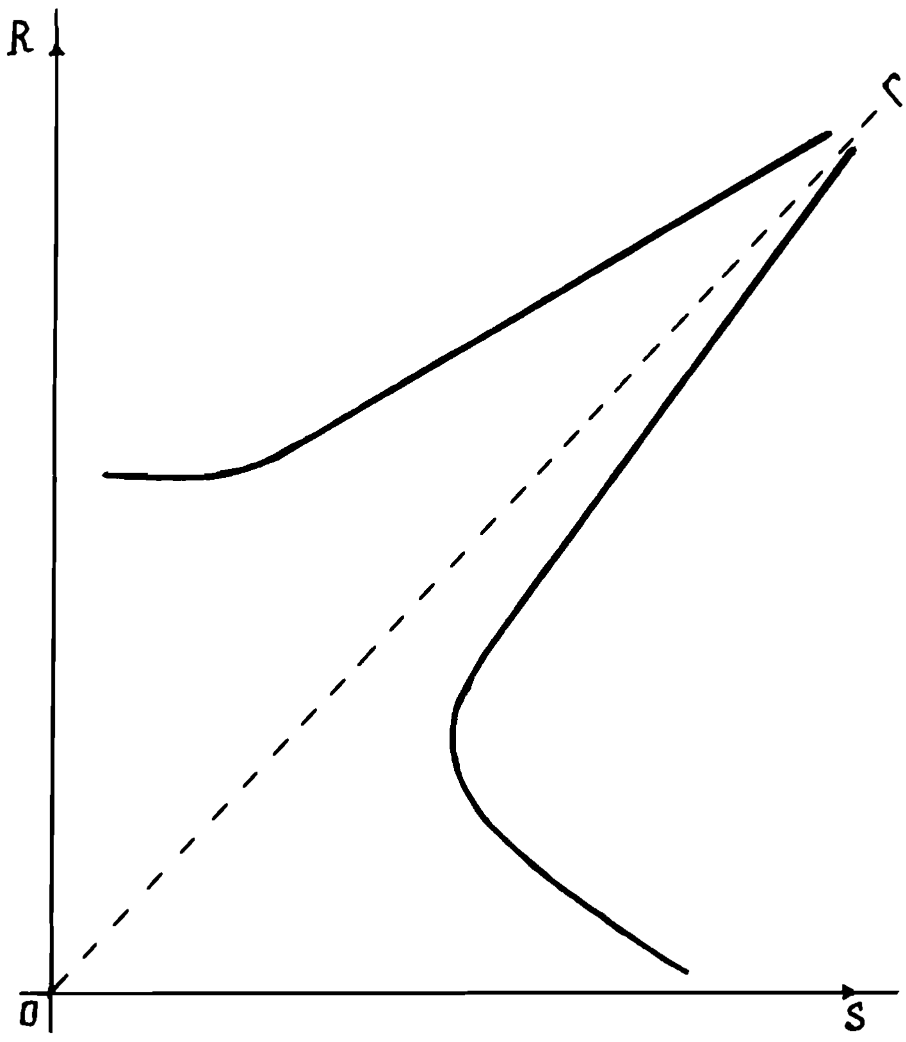

Figure 2: Well-balanced development.

$$p' = V = p(1 - \frac{q}{\bar{W}} + (W - W_o)\,b)\,.$$

High inflation and a constant deficit are typical for this scenario of economic development.

This case is called a "demand crisis". It is rather typical for the situation when the economic growth is in decline. The crisis is especially dangerous if the high ratio of consumer income to national income (q) is achieved by an accumulation of profits of a limited group of the population. The majority of consumers may have no money to survive in such conditions, but the prices continue to grow because this group buys goods to protect their money from inflation. It may be the trigger for irreversable social changes which are out of the scope of the model.

$$II.\ \frac{q}{\bar{W}} - 1 \leq (W - W_o)\,b \leq \frac{q}{\bar{W}}\,. \tag{10}$$

This case is described in Figure 2. It is a scenario for a well-balanced development. The market pricing mechanism can eliminate the supply-demand disproportions in this case. Prices will grow for this case, too, but the rate of their growth will be higher than the rate of money stock growth. "Superfluous" money will be "eaten" by prices and the inflation process will be stopped. But it is necessary to achieve the inequality (10), which means that the ratio of consumer income to NI and to the part of NI used for consumption must be greater than rates of NI growth/decline, but the difference between them cannot be greater than 1.

A simple analogy can be made with a bath with two tubes. Water flows in through one tube and out through the other. If one tube (money income) has the greater volume than the other (amount of goods for consumption) the bath will overflow (demand crisis). But if the tubes are approximately of the same size, the level of water can be controlled with a small cup, either by adding water or taking it away. The supply-demand pricing is analogous to the "small cup" for a market economy. It can eliminate disproportions but only if they are not large and quickly changed.

$$III. \ (W - W_o)\,b > \frac{q}{\tilde{W}} \, .$$

This case is presented in Figure 3. It is a "mirror reflection" of the first case to the side of supply. This superproduction crisis is well-known as the first stage of depression [1] and its consideration is out of the scope of this paper.

Returning to the demand crisis we will discuss the conception of price "freezing" (or state controlled prices) as a measure to thwart the crisis. We will analyze its possible consequences in such conditions.

Consider the system (6) with the assumptions that $m = 0$ (prices are frozen) and $S^o > R^o$ (demand crisis exists).

Such a system can be transformed into:

$$\frac{dp(t)}{dt} = 0 \, ,$$
$$\frac{dR(t)}{dt} = b(W - W_o)\,R(t) \, ,$$
$$\frac{dS(t)}{dt} = \frac{q}{\tilde{W}} R(t) - R(t) \, .$$

The latter has the analytical solution:

$$p \equiv p^o, \ R(t) = R^o e^{b(W-W_o)t}$$

$$S(t) = R^o \left(\frac{\frac{q}{\tilde{W}} - 1}{b(W - W_o)} \right) e^{b(W-W_o)t} + (S^o - R^o)$$

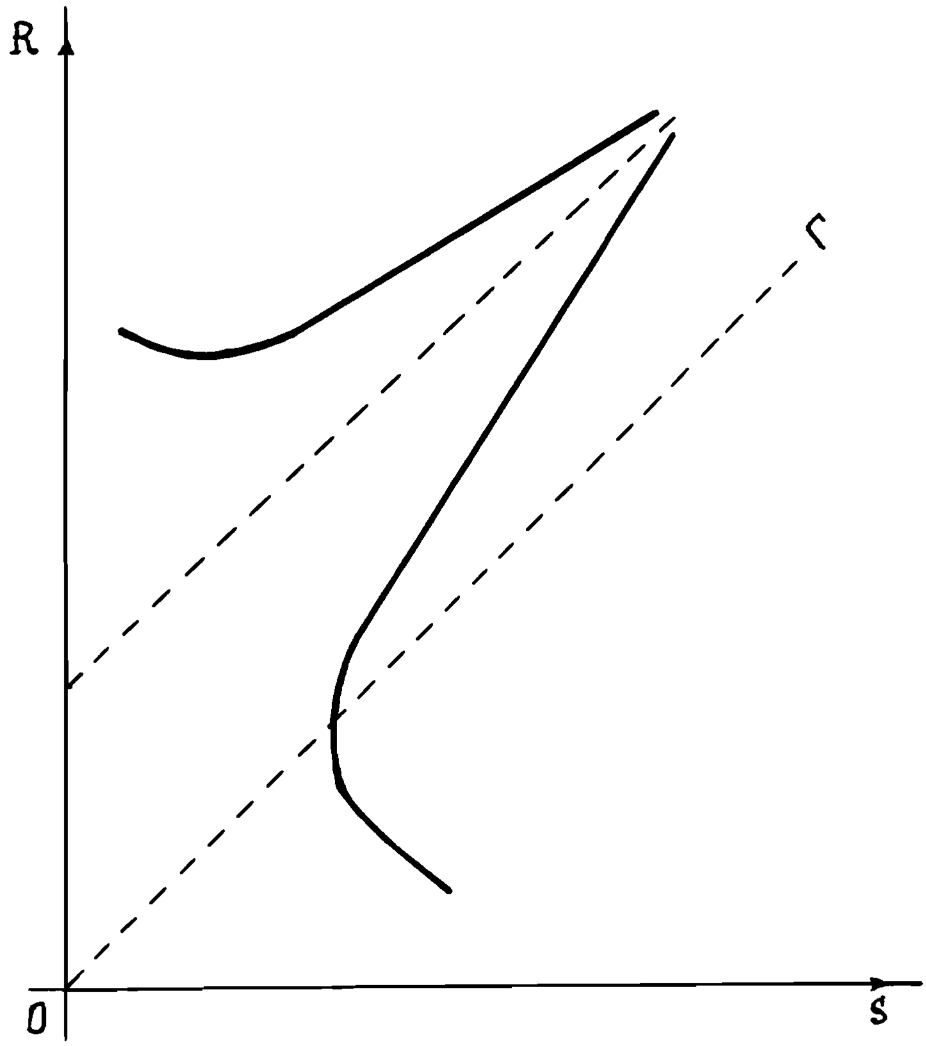

Figure 3: Superproduction crisis.

and

$$S(t) - R(t) = R^o \left(\frac{\frac{q}{\tilde{W}} - 1}{b(W - W_o)} - 1 \right) e^{b(W-W_o)t} + (S^o - R^o)\,.$$

As far as $\dfrac{\frac{q}{\tilde{W}} - 1}{b(W - W_o)} - 1 > 0$ (this implies from conditions of demand crisis), $S(t) - R(t) > 0$ for every t and $S(t) - R(t) \sim e^{b(W-W_o)t}$.

The continuous deficit, which is proportional to the rate of economic growth is the payment for constant prices. Therefore, such a policy cannot eliminate the consequences of the demand crisis. The satisfaction of the inequality (10) is the only realistic policy for such a case.

In conclusion, the market pricing mechanisms can result in a supply and demand equilibrium only if the inequality (10) holds. For other cases, the initial disequilibrium may even be intensified due to the imbalance between a nominal quantity of money (proportional to q), the amount of goods (depending on $\tilde{W}$) and the rates of economical growth/decline (proportional to $e^{b(W-W_o)}$). A further analysis shows that the account of such factors as externalities, large governmental expenditures which increase the value of q and decrease the value of $\tilde{W}$ (due to $1 - W - \tilde{W}$ increasing) cannot radically change the qualitative conclusions. But during the demand crisis they make the situation more difficult.

The verification of the model (6) with real economic data has considerable interest.

3 The Structural Hyperinflation Crisis

Such verification was attempted with the data from the Ukrainian economy for 1991-1993. The absence of accurate data on consumer income in the nongovernmental sector made it necessary to consider two separate cases corresponding to upper and quer bound estimates of the income, respectively. We denote these cases as **Variant 1** and **Variant 2**. The difference between them is essential. For example, according to variant 1 the ratio of consumers income to NI in the first half of 1993 is equal to 0.55. The same indicator (the value of q for the given time interval) is equal to 0.4 according to variant 2. The threshold $\hat{q}$, such that the existence of the demand crisis implies from $q > \tilde{q}$ is equal to 0.42 for this time interval. Therefore, the inequality (10) holds for variant 2, but not for variant 1.

Judgements of experts from the Ukrainian National Institute of Economic Programs (NIEP) were also used to estimate m and W_o.

Model (6) enables us to describe with sufficient accuracy changes of GNP (see Table 1) and money stocks (see Table 2). Figure 4, which shows price dynamics, is also realistic. However, in reality the values and the rates of price increases are rather higher than the model (6) predicts (see Table 3). The divergence is especially large in 1993. According to variant 1, a demand crisis

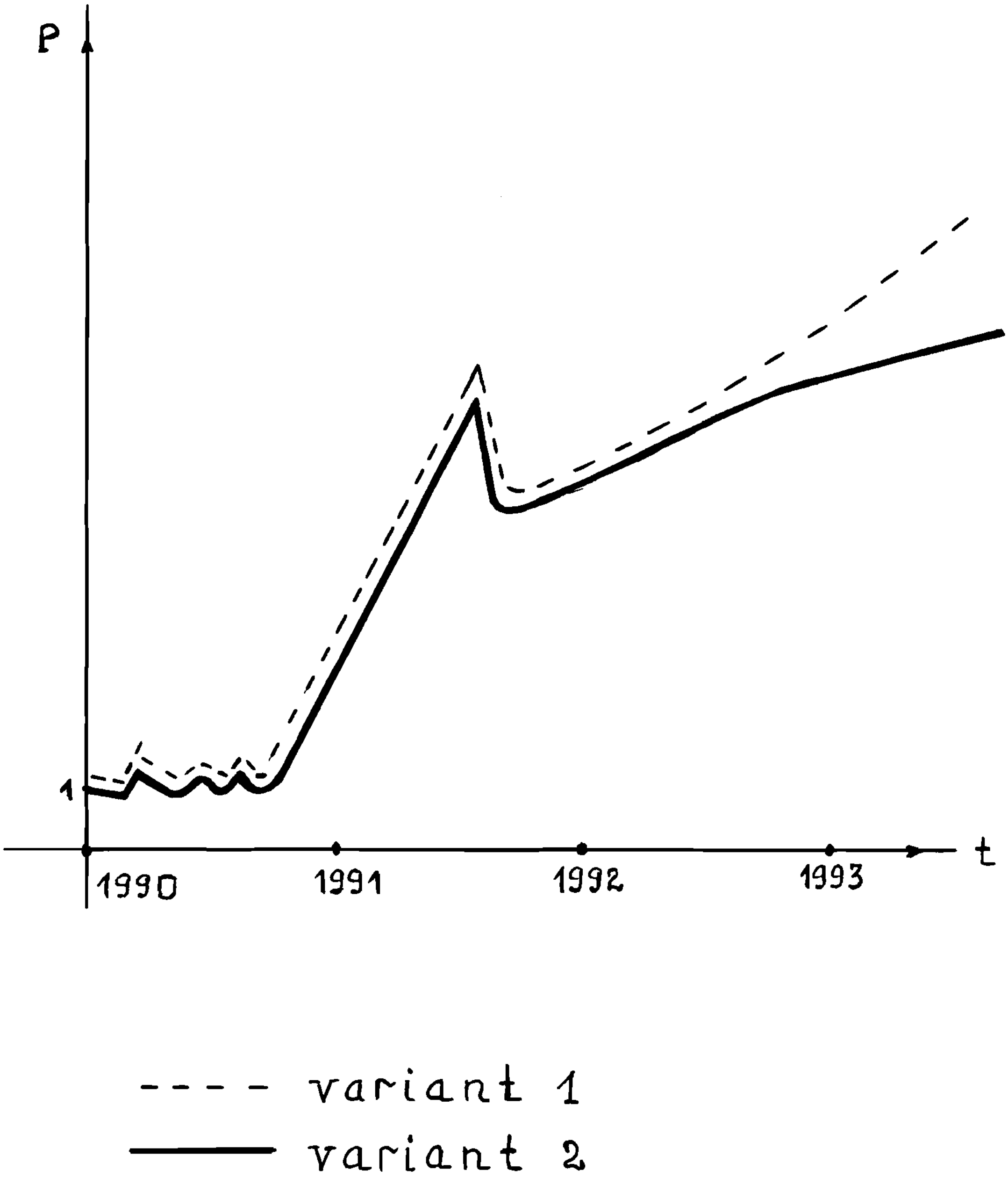

Figure 4: Predicted price level growth.

Table 1:

GNP Dynamics in the constant prices of 1991 *in billion roubles*			
		By Modelling Results	
Year	In fact	Variant 1	Variant 2
1990	637.0	637.0	637.0
1991	565.0	561.9	561.9
1992	485.0	493.5	493.5
1993 (5 months)	150.9	174.2	174.2

Table 2:

Dynamics of consumers money stocks at year end *in billion roubles*			
		By Modelling Results	
Year	In fact	Variant 1	Variant 2
1990	12.0	12.00	12.00
1991	43.5*	61.73*	61.70*
1992	606.0	855.06	855.06
1993 (5 months)	954.5	1,027.00	949.80

*Consumers money stocks before the first sharp price increase. By modelling it must take place in November – December 1991, in reality it took place in January 1992.

Table 3:

Price level dynamic (relatively to price level of 1990)			
		By Model Simulation	
Year	In fact	Variant 1	Variant 2
1990	1.00	1.00	1.00
1991	2.21	6.03	6.03
1992	25.9	16.87	16.87
1993 (5 months)	206.10	24.30	23.71

will still exist, but the inflation rates will be the same as in 1992. Variant 2 corresponds to the transition to a well-balanced development, and the inflation rates decrease. But in reality they rapidly increase. Therefore, another type of hyperinflation exists in the sphere of production. The modeling exercises allow us to prepare the following hypothesis about this hyperinflation.

Consider an economic system which consists of N branches. Direct sales from the production of the i-th branch for a unit of production of j-th branch is denoted as a_{ij}. Assume that the payment for labor and several other payments (taxes, rents, etc.) for the j-th branch are proportional to the price value of p_j with known coefficients q_j and $\hat{q}_j$, respectively. The rest of the payments are assumed to be constant; their value is equal to u_j. If each branch has a monopoly position, it establishes the price at every moment on the basis of its total sales. Therefore, at any point in time $(t+\Delta t)$, the price level $(p_j(t+\Delta t))$ for the j-th branch is equal to:

$$p_j(t+\Delta t) = a_{jj}p_j(t+\Delta t) + \sum_{\substack{k=1\\k\neq j}}^{N} a_{kj}p_k(t) + u_j + q_jp_j(t+\Delta t) + \hat{q}_jp_j(t+\Delta t)\,. \qquad (11)$$

This value may be increased above the value of (11), if the demand for the production of the j-th branch is greater than its supply.

From (11),

$$p_j(t+\Delta t) = \sum_{\substack{k=1\\k\neq j}}^{N} \frac{a_{kj}p_k(t)}{1-a_{jj}-q_j-\hat{q}_j} + \frac{u_j}{1-a_{jj}-q_j-\hat{q}_k}$$

or, in vector form

$$p(t+\Delta t) = \bar{A}p(t) + \bar{U} \tag{12}$$

where p is the price vector, $\bar{A} = \{\bar{a}_{ij}\}$ matrix, $\bar{U} = (\bar{u}_j)$ vector,

$$\bar{a}_{ij} = \begin{cases} \dfrac{a_{ij}}{1 - a_{jj} - q_j - \hat{q}_j}, & \text{if } i \neq j \\ 0, & \text{if } i = j\,, i,j = \overline{1,N} \end{cases}$$

$$\bar{u}_j = \frac{u_j}{1 - a_{jj} - q_j - \hat{q}_j}, \ j = \overline{1,N}\ .$$

Consider the system of equations:

$$p = \bar{A}p + \bar{U} \tag{13}$$

Then (12) expresses a procedure for its solution by the Gauss-Seidel method [8]. Therefore, the sufficient condition for its convergence to the solution of (13) is the productivity of matrix $\bar{A}$:

$$\sum_{j=1}^{N} \bar{a}_{ij} < 1 \text{ for every } i = \overline{1,N} \tag{14}$$

or

$$\sum_{i=1}^{N} \bar{a}_{ij} < 1 \text{ for every } j = \overline{1,N}$$

must hold.

If conditions (14) are not satisfied, the sequence $\{p(t)\}$ may have no limits, and does sometimes (13) not have a solution at all.

The estimates

$$\min_{j=\overline{1,N}} (p_j(t+\Delta t)) \geq Q \min_{k=\overline{1,N}} (p_k(t))\ ,$$

where

$$Q = \min_{j=\overline{1,N}} \left(\sum_{i=1}^{N} \bar{a}_{ij} \right)$$

follows from (12). If $Q > 1$, then the prices will rise exponentially.

In this case, the market prices would, sooner or later, be substituted by the price mechanism expressed in (12). Such a scenario of crisis development is called here a "structural hyperinflation crisis". The structural disproportion in the economy — large values of sales in its branches — is its source. A particular case of such process, when every branch has no more than one input from others, was considered in [19]. The conclusion was made there that the inflation rates will be accelerated in such conditions.

The data of the multibranch balances from 1990-1991 [9-10] were used to verify this hypothesis. According to these data the matrix $\bar{A}$ was not productive even for 1990. Its columns corresponding to coal, food and light industries, have their sum between 1.1 - 1.7. Several rows of the $\bar{A}$ matrix also have a sum greater then 1. High tax increase in 1992 accelerated the structural hyperinflation crisis in the Ukraine. A decrease in the values of q_j was the result of the government policy of "strong economy" leading to a severe decline in living standards of the population, but the increase of $\hat{q}_j$ values as a result of high taxes eliminated the anti-inflation effect of the "strong economy" measures.

The wave of resource thefts and their "black export" abroad also lead to an increase in sales. This may accelerate the structural hyperinflation crisis in 1993.

The best way to stop such development is to decrease sales at the level of the enterprises. Decentralization of economy is the way to stimulate such processes. The behavior of the producers in such conditions needs special analysis.

4 Crisis Behavior of Monopolists

The model of producer behavior under the conditions of a demand crisis is considered in this Section. We assume that the producer has a monopoly, and he (or she) can control prices for production. The value of goods to be produced is the tool of such control. Prices may be artificially increased as the result of a decrease in production. What policy will be optimal from the viewpoint of profit maximization? To answer this, consider the following dynamic micromodel of such a situation:

The producer can control the value $U(t)$ of his production at each point in time $t \epsilon [0;T]$. This value is determined by his production abilities:

$$0 \leq U(t) \leq \bar{U} \tag{15}$$

where $\bar{U}$ is the production capacity.

The goal of the producer is profit maximization for the time interval $[0;T]$ after discounting:

$$\int_o^T e^{\nu t} p(t) \min(U(t), S(t))\, dt \rightarrow \max, \tag{16}$$

where ν is the coefficient of the discounting interest rates , $p(t)$ is the price value at t, and $S(t)$ is the value of the demand for the production. As discussed above, prices are controlled indirectly, through supply and demand. Therefore, the Samuelson – Walras equation [5] will be appropriate, or

$$\frac{dp(t)}{dt} = m(S(t) - U(t)), \tag{17}$$

where m is the same coefficient as in (2). The initial price level is assumed to be known:

$$p(o) = p_o . \tag{18}$$

Given the demand crisis, the exponential demand takes place:

$$S(t) = e^{\mu t} ,$$

where the μ coefficient can be found in the model (6) simulations. Assume that the producer has sufficient capacity, i.e, $\bar{U} \geq e^{\mu T} \geq S(t)$ and consider this model as the optimal control problem with objective function (15) and constraints (15), (17-18). It should be noted that under given assumptions, the constraint (15) is not essential. It is necessary only for proof of the following theorem.

Theorem 1. Let the equation

$$e^{-\nu\tau}\left(\frac{m}{\mu}e^{\mu\tau} + p_o - \frac{m}{\mu}\right) = \frac{e^{(\mu-\nu)T} - e^{(\mu-\nu)\tau}}{\mu - \nu} \tag{19}$$

have the solution $\tau \in [0; T]$. Then the solution $U^*(t)$ of the problem (15) - (18) is the following:

$$U^*(t) = 0, \text{if } t < \tau ,$$

and

$$U^*(t) = S(t), \text{if } t \geq \tau .$$

The proof of this theorem is given in [6]. It is based on the maximum principle.

It is important to note the economic interpretation of this result and conclusions which can be drawn from it. According to the theorem, the producers' interest (under certain assumption) during the demand crisis is to stop (or to decrease to a minimum) their production. Therefore the monopoly intensifies the inflation process and makes the crisis deeper. Indeed, curtailing of production is a typical feature of the demand crisis during the transition period.

But the State can influence the monopoly behavior. Consider the solution of equation (19) as the function from m and ν parameters and denote it as $\tau(m, \nu)$. Several numerical experiments show [6] that $\tau(m, \nu)$ increases with m increasing and decreases with ν increasing.

Therefore, higher interest rates can decrease such monopoly effects during the demand crisis. Of course, increasing rates leads to higher inflation. High interest rates make credits too expensive and the hyperinflation mechanisms connected with expenditure disproportions can begin. Such a situation was described in the previous Section. Thus the optimal value of interest rates can be determined such that its negative economic impact will be less than positive. In any case, the interest rates must be higher than the expected inflation rates μ.

It should be noted that the larger value of m implies a larger value of $\tau(m,\nu)$. Therefore, the measures which decrease inflation but are not directly connected with market pricing (nor state-controlled prices) can also stimulate the production. In contrast, "free" prices lead us to additional industrial decline.

5 Financial Risk for Enterprises

No doubt the fear of decentralization of the economy is the best way to struggle against monopoly. The presence of several independent enterprises makes the monopolistic effects quite impossible. But this way out of the crisis has two kinds of risk:

1. Decentralization may lead to the total destruction of the new-born independent enterprises; and
2. a limited group of monopolists may become the exclusive owners of enterprises as the result of a badly-organized privatization process.

Wide literature exists to examine both kinds of risk. Different aspects of the first kind of risk are investigated in [15]. In the present Section we discuss mainly the financial aspects of such risk. The analysis of the second will follow.

Consider the enterprise which becomes independent in the conditions of a structural hyperinflation crisis. The State can give financial support for the enterprise (i.e., can pay its debts), but such support is limited by money stocks. An extremely simplified model of financing enterprises is discussed below.

Assume that the expenditures of the enterprise are proportional to the price p of its production. Let $\bar{A}$ be the coefficient of proportionality. We also assume that the value of this production is equal to demand for the given price level p. This indicator is further denoted as $S(p)$ and it is equal to $\frac{\eta}{p}$, where η is a given constant.

Assume that the total tax payments are proportional to the value of the enterprise production in current prices, i.e., they are equal to $C_1 pS(p)$, where C_1 is a given coefficient. The enterprise also pays the fixed payments (rents, etc.) which are proportional to the price level p with a coefficient C_o which is assumed to be known.

As far as the structural hyperinflation crisis goes, prices increase according to the law:

$$\frac{dp(t)}{dt} = Qp\,, \tag{20}$$

where $Q = A + C_1 - 1 > 0$, and the initial value $p(o) = p_o$ is assumed to be known.

The value of the enterprise money stock at present is denoted as D, and it may be shown that under certain assumptions

$$\frac{dD(t)}{dt} = (p - (Q+1)p)S(p) - C_o p\,. \tag{21}$$

The above equation implies that

$$\frac{dD(t)}{dt} = -\eta Q - C_o p\,.$$

For constant values of expenditures, prices increase as e^{Qt}, $\frac{dD(t)}{dt} < 0$ holds and sooner or later the enterprise will be ruined. To decrease the expenditure such that $A + C < 1$ holds, i.e., to stop the price race is the only way to survive.

Assume that expenditure decreases can be described by the function $Q(t,\theta)$ which continuously depends on time t and some random parameters θ. $Q(t,\theta)$ is decreasing by t for every value of θ. The enterprise will survive if at time $\bar{\tau}$, (when direct governmental support is stopped) at least two conditions hold:

1. Price increases halt and, moreover, $\frac{dD(\bar{\tau})}{dt} > 0$ holds; and,

2. the initial money stock D_o and governmental money support $\bar{\Delta}$ are not totally spent before $\bar{\tau}$, i.e.,

$$D_o + \bar{\Delta} - \int_0^{\bar{\tau}} D'(t)\,dt \geq 0\,.$$

Due to the presence of random parameters θ (unpredictable circumstances), two enumerated events are random. Let us estimate the probability of their common appearance.

The equality:

$$p(t) = p_o e^{\int_0^t Q(x,\theta)dt}$$

implies from (21).

As far as value of $\frac{dD(t)}{dt}$ increase when Q decrease and is continuous function the first event takes place if and only if the second one is reached and $\hat{\tau}(\theta) < \bar{\tau}$ holds when $\hat{\tau}(\theta)$ is the solution of the equation

$$-\eta Q(\tau,\theta) - C_o p_o e^{\int_0^{\tau} Q(t,\theta)dt} = 0 \tag{22}$$

for given values of θ. Thus,

$$P\left\{\frac{dD(\bar{\tau})}{dt} > 0 \,/\, D_o + \bar{\Delta} - \int_0^{\bar{\tau}} D'(t)dt \geq 0\right\} = P\{\hat{\tau}(\theta) < \bar{\tau}\}\,.$$

On the other hand,

$$D_o + \bar{\Delta} - \int_0^{\bar{\tau}} D'(t)dt = D_o + \bar{\Delta} - D(\bar{\tau}) =$$
$$= D_o + \bar{\Delta} - \eta G(\bar{\tau}, \theta) - C_o p_o \int_0^{\bar{\tau}} e^{G(x,\theta)}\, dx \,,$$

where

$$G(x, \theta) = \int_0^x Q(t, \theta)dt \,.$$

According to the assumed properties of $Q(t, \theta)$, $D_o + \bar{\Delta} - D(\bar{\tau}) \geq 0$ occurs, if $\tilde{\tau}(\theta) < \bar{\tau}$, where $\tilde{\tau}(\theta)$ is the solution of the equation

$$D_o + \bar{\Delta} - \eta G(\tau, \theta)\, C_o p_o \int_0^{\tau} e^{G(x,\theta)}\, dx = 0 \,, \tag{23}$$

obtained for given values of θ.

Therefore, the probability of the enterprise's survival, $\bar{P}$, is

$$\bar{P} = F_{\hat{\tau}}(\bar{\tau}) \, . \, F_{\tilde{\tau}}(\bar{\tau}) \,,$$

where $F_{\hat{\tau}}(t)$ is the distribution function of $\hat{\tau}(\theta)$ random variable, and $F_{\tilde{\tau}}(t)$ is the distribution function of $\tilde{\tau}(\theta)$.

Equations (22) and (23) usually have no analytical solutions. But it is possible using the statistical modelling methods (i.e., Monte-Carlo method) to estimate the empirical distributions of these variables. This makes it possible to estimate the financial risk $1 - \bar{P}$ for each enterprise liberalization. The approach to decentralization must be quite different depending on the value of this risk. We can think that the medium value likely corresponds to the majority of enterprises to be privatized. Enterprises with a low level of risk may be rented. But high-risk economic units need strong state control.

6 Conclusions

1. The specifity of the intermediate economic, unsaturated market of goods and services, and the influence of monopolies, produces the special forms of pricing.

2. Market "free" pricing can eliminate supply–demand disequilibrium if it is not large and quickly changed.

3. High sales lead to cost growth. Sooner or later market pricing will be substituted by cost pricing at such conditions.

4. Decentralization of the economy is the way out of the crisis development. But the peculiarities of managers' behavior and aspects of risk must be accounted for.

References

[1] Jucas, R.E. (1987). Models of Business Cycles. Blackwell, Oxford.

[2] Christiano, L. (1987). Cagan's Model of Hyperinflation Under Rational Expectations. *International Economic Review*, **28**:33-49.

[3] Johansson, K.H.(1993). On Market Dependencies of Agents' Learning for a Hyperinflation Model. IIASA, WP-93-47.

[4] Bienkowski, W. (1992). The Bermuda Triangle: Why Self-Governed Firms Work For Their Own Destruction. *Journal of Comparative Economics*, **16**: 750-762.

[5] Nicaido, H. (1967). Convex Structures and Economic Theory. Academic Press, New York.

[6] Mikhalevich, M., A. Chizevskaya. (1993). Dynamical Macromodels of Unstable Processes of the Market Economical Transition. *Kibernetica*, **4**: 81-88. (In Russian).

[7] Handbook of Applicable Mathematics (1982). W. Ledermann, editor. Vol. IV. Analysis. J. Wiley and Sons.

[8] Marchuk,G.I.(1977). Methods of Computational Mathematics. Nauka, Moscow.(In Russian).

[9] Multibranchial Balance of Ukrainian Economy for 1990. (1992). Minstat, Kiev. (In Ukrainian).

[10] Multibranchial Balance of Ukrainian Economy for 1991. (1993). Minstat, Kiev. (In Ukrainian).

[11] Gandolfo, G. (1980). Economic Dynamic, Methods and Models. North-Holland.

[12] Truetl, L. (1987). Macroeconomics. McGraw Hill, New York.

[13] Hahn, F. (1985). Money, Growth and Stability. McGraw Hill, New York.

[14] Reynolds, L.S. (1988). Economics. McGraw Hill, New York.

[15] Bodily, S.E. (1993). Gaining the Rewards From Privatization Risks in Central and Eastern Europe. IIASA, WP-93-042.

[16] Näslund, B. (1978). Decision-Making Under Inflation. In: *Operational Research*. (Edited by K. Haley). North-Holland, pp. 849-859.

[17] Straffa P. (1993). Monetary Inflation in Italy During and After the War. Cambridge. *Journal of Economics*, **17**:7-26.

[18] Wyzan M.L. (1993). Monetary Independence and Macroeconomic Stabilization in Macedonia: An Initial Assessment. *Communist Economies and Economic Transformation*. v. 5, N3: 351-368.

[19] Moroney, J.R., A. L. Toevs. (1979). Input Prices, Substitution and Product Inflation. *Advances in the Economics of Energy and Resources* **1**: 27-50.