

**PRICE FORMATION MECHANISM AND TARIFF PROTECTION
IN A DYNAMIC MODEL OF A SMALL OPEN
ECONOMY IN TRANSITION**

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This paper examines the importance and dynamics of prices in a small open economy in transition. Several main features of this process outline the behavior of the mathematical model. The model examines four factors that affect prices after the liberalization of the domestic market: the domestic producer price, the cost price of inefficiency, the hyperinflation price, and the world market price, which includes the dynamics of the exchange rate. The numeric simulation of the price dynamics for the cheese segment of Ukrainian food market was made.

INTRODUCTION

The problem of transition to market has occupied the attention of policy makers and economists alike. The dynamics of the transition are multivariate and complex. They are difficult to capture because, during the transition, new market institutions emerge and new social interactions and behaviors need to be learned. The consequences of adjustment for economic agents in transition are not precisely described by the Rational Expectations terminology. The pricing mechanism seems to underlie the path of behavior in the initial stages of the economic transformation [1].

This paper examines the importance and dynamics of prices in a small open economy in transition. Several main features of this process outline the behavior of the model. The four factors that impact prices after the liberalization of the domestic market include the domestic producer price, the cost price of inefficiency, the hyperinflation price, and the world market price, which, in turn, includes the dynamics of the exchange rate that are also considered. The flow of information in the new economic and political environment allows economic agents to form expectations that are not completely rational. The model's set-up shows the interactions between consumers, new state-owned enterprises and the government; each contributes to price formation with available resources. For instance, the consumer has real balances that help determine demand on goods and services. The domestic producer, on the other hand, behaves as a monopolist with little regard to market forces, while the government controls the interest rates and tariff policies. This system of interactions defines «subjective» price expectations that exogenously influence the emerging market institutions and foreign trade. This specific behavior is characterized by several aspects of transition to market economy.

The first aspect is the basic transformation of the domestic economy into a market economy, which deals with the establishment of basic market institutions.

Since centrally planned economies have been administratively governed, and devoid of foreign influences, new rules of behavior and new institutions have come into being in order to challenge the existing order. In this framework, government intervention ceases to be direct, and so, more subtle ways of control begin to play the important role. The domestic producers become exposed to import price competition, and demand certain levels of protection. The consumers gain access to a wide variety of high quality imported goods and services.

At the same time, macroeconomic stabilization proves to challenge the new role of the government in transition. This second aspect consists of the establishment of equilibrium on product markets, reducing government budget deficit, cutting subsidies in different sectors of the economy, changing inefficient credit policies, enforcing strict tax laws, curbing inflation, and achieving an export-sensitive, sustainable exchange rate.

As part of this process, the restructuring of old production is extremely important because it changes the behavior of domestic producers and induces systemic changes to economic agents determined by the external impacts and collapse of former dominating CMEA «markets».

Privatization, both small and large-scale, transforms the form of property from state-owned to private-owned. Moreover, it establishes private property rights, disciplines domestic producers, and sets market «rules of the game».

The third aspect is trade liberalization, which introduces foreign influences to the previously closed domestic economy. Trade liberalization, also, symbolizes a movement from direct government regulation by use of restrictions towards a market price mechanism. Furthermore, it brings innovation and foreign competition to the country.

PROBLEM STATEMENT

The liberalization of trade is an integral part of the transition to market economy. The previous, artificial isolation from world markets now placed the domestic producers, consumers, and the government in a completely new environment. The domestic producers were thoroughly exposed to foreign competition, higher quality, and more efficient production from abroad. On the other hand, the consumers gained access to a variety of new goods and services, and experienced manifold increases in prices at home and decreases in real wages. In order to guide the process and to alleviate society's adjustment costs, the government had to shoulder social responsibility.

The proposition is to investigate the role and behavior of the above-described three agents in the period of transition. The proposed model examines two schemes of interaction of economic agents. First, the global market system includes the model of «objective» expectations, the emerging domestic market, and the influence of world markets on the open economy. In the proposed situation, economic agents use the model to predict the market price and plan their future actions. The new price on the domestic market and the influences of the world market conditions subsequently check on these expectations and change the course of action for the following period. This, also, allows the economic agents to improve their expectations within the constraints of the model.

Second, the model shows the «subjective» expectations that result from the interaction of the above-mentioned pricing scenarios. The domestic producer determines own price by considering two major factors. One of the factors is the demand-supply disequilibrium on the domestic market and the export-import disparity. The second factor is the cost price of old, inefficient technologies. This factor represents, to a certain extent, the cost of transfer to better and more advanced ways of production that arise from the introduction of foreign competition. On the other hand, the consumer determines the demand for goods and services on the domestic market, thus implicitly affecting the price. The government regulates interest rate and tariff policies in an attempt to curb inflation; the hyperinflation price is based on price expectations determined by the model and the money supply. The government also allocates a portion of tariff revenues as a subsidy to consumer's money stock. The world market price is not influenced by the domestic economy and works as a countervailing factor on the domestic price formation.

Several main features of transition economies that motivate the price formation model can be described as following [2].

Inflation. Despite the existence of market distortions, the pressure of international competition turned out to be the driving force of enterprise reform and encouragement of firms to adjust their costs, reallocate resources, and bring prices to competitive levels. As a result, and as a «rationalization» of domestic prices, inflation has become one of the main problems in transition economies. The sudden liberalization of prices has released enormous inflationary pressures onto the economy.

The «new» state-owned enterprises. The dominance of state-owned enterprises and strong monopoly (these should be sharply contrasted to the fledgling private sector) is strongly connected to this problem. Full mass-privatization has not been achieved; therefore, the existence of «rent-seeking» behavior, divergent price-setting, irrational structure and dislocation of resources should be expected. The strong «vested interests» in control and ownership of these «new» enterprises have shifted the «consensus» in their favor, and continued subsidies and price supports of various kinds.

Trade liberalization and its impacts. Trade liberalization would bring about prevalence of the world market conditions in the country. The mechanism by which this will come about is the downward pressure on the exchange rate. The repressed demand of the past would now be consumed in imports, which would further deteriorate the terms of trade and worsen the trade deficit. This subsequently would severely increase the pressure on restricting imports.

The government's role in transition. The government's role in transition remains very important as a catalyst of reforms. However, now the government should use non-direct market controls for providing all main components of transition. The fields of government actions in transition comprise of tariff measures that affect exports and imports, management of enterprise restructuring and privatization, credits and subsidies, and monetary policy.

Uncertainty. The processes in a transition economy have an impact of uncertainty, including uncertainty in the behavior of consumers and producers, connected to exposure to a new economic environment and learning. As a future goal of this investigation, the consumer learning in the form of changing-over-time

probabilities on selecting prices on the internal market should be considered. This would make the consumer more sensitive to the choice of goods and services.

Objectives to be achieved through the solution of the proposed model help define the price formation mechanism based on the general attributes of a small open economy in transition in order to recognize the specific behavior of the government, big state-owned enterprise, and consumer in different conditions of the reforming economy, specifically, to develop the dynamic mathematical model of such behavior, and to apply some optimization methods for determining the optimal interest rates and optimal tariffs as market control tools in the reforming process.

MATHEMATICAL MODEL

The model is based on several simplifying assumptions: it applies to a small open economy in transition; it assumes single commodity with no intermediate imports, no currency substitution, and with only one mode of production and no productivity gains; capital changes or transaction costs are ignored, and no difference exists between base money and government credit. Other assumptions will be explained later. This is a dynamic model described by a system of nonlinear differential equations. The numerical methods were used to solve equations simultaneously, and to find varied values of system's parameters. These methods are based on finite-difference approximation for time-valued derivatives. In equation form, the second sign usually signifies time derivatives. The solution of the system is a time vector of prices, the exchange rate, demand-supply, exports-imports, etc.

The price formation mechanism is determined in the following way. Let's consider four factors that affect prices of one type of good on the domestic market of a small open economy in transition.

The first factor is the affect of the domestic producer, which is described as follows:

- domestic producer price P_d^m dynamics are determined by demand-supply disequilibrium and by foreign trade balance of one good as

$$P_d^m = 1/\varepsilon_1(S(t) - u(t)) + 1/\varepsilon_2(\exp(t) - \text{imp}(t)), \quad (1)$$

where $S(t)$ is a demand on the market for this kind of good; $u(t)$ is the production capacity of domestic producer; $\exp(t)$ is the volume of exports for this good; $\text{imp}(t)$ is the volume of imports for this good; $\varepsilon_1, \varepsilon_2$ — elasticities.

The second one is the affect of inefficient domestic production [3], which is described as follows:

- the cost price of inefficiency $\hat{P}(t)$ is determined by the ratio of exports to imports (including production):

$$\hat{P}(t) = \hat{P}_0 e^{\{1 - \exp(t)/(u(t) + \text{imp}(t))\}t}, \quad (2)$$

where \hat{P}_0 is the cost price of innovation (when exports equal imports).

The general «monopoly» price is described as a weighted sum of P_d^m and \hat{P} :

$$\bar{P}_d^m(t) = (1 - \alpha_1) P_d^m(t) + \alpha_1 \hat{P}(t), \quad (3)$$

where α_1 is the index of openness.

So, if α_1 is equal to zero, then the fully closed economy is investigated. In this case, the «monopoly» price on the domestic market is formed only by the domestic producer price P_d^m . However, if α_1 is equal to one, then a fully open economy is investigated. In a fully open economy, the «monopoly» price on the domestic market is formed only by cost price of inefficiency \hat{P} .

The third factor that affects the prices on the domestic market is the influence of the money supply, which is described as the Cagan hyperinflation price P_2 :

$$P_2(t) = e^{Y(t)} \quad (4)$$

and

$$\alpha Y'(t) = \ln M_S - Y(t) + \gamma, \quad (5)$$

where $\alpha > 0$, γ are parameters of the model, M_S is the value of money supply.

The fourth factor examined in the model is the impact of the world market prices, described as projection of the world market prices into the domestic market [1], the so-called «projection» price P_d^W :

$$P_d^W(t) = P^W \varepsilon(t), \quad (6)$$

where P^W is the constant price on the world market, and $\varepsilon(t)$ is the exchange rate.

The dynamics of the «projection» price are completely determined by the dynamics of the exchange rate, which are described as follows:

$$\begin{aligned} \varepsilon'(t) = & c_1 \{P_d'(t) / P^W - P_d'^W / P^W\} + \\ & + c_2 \{(\exp(t) - \text{imp}(t)) / (\exp(t) + \text{imp}(t))\} + c_3 \{(M_S(t) - M_d(t)) / M_S(t)\}, \quad (7) \end{aligned}$$

where $M_d(t)$ is the value of money demand; c_1, c_2, c_3 — are parameters.

It is assumed, that the domestic price level $P_d(t)$ is determined at every time period t as follows:

$$\begin{aligned} P_d(t) = & \{(u(t) - \exp(t)) / S(t)\} \bar{P}_d^m(t) + \\ & + \{\text{imp}(t) / S(t)\} (1 + \tau) P_d^W(t) + \{M_S(t) / M_d(t)\} P_2(t), \quad (8) \end{aligned}$$

where τ is a tariff on imported goods.

To complete the system of equations, the dynamics of exports and imports for a good economy are determined as follows:

$$\begin{aligned} \exp'(t) = & \{(P_d^W(t) - P_d) / P^W\} \exp(t) + u'(t); \\ \text{imp}'(t) = & \{(P_d(t) - (1 + \tau) P_d^W) / P^W\} \text{imp}(t) + S'(t). \end{aligned}$$

Let's assume that it's impossible to import and export the same one good at the same time. Let's also assume that the volume of exports is always less than the production level.

The dynamics of money supply — money demand are described by the following equations:

$$M'_S(t) = M_S(t)i + \delta,$$

$$M'_d(t) = \bar{W} - iM_d(t),$$

where i is the interest rate, and \bar{W} is the growth of GDP.

The last block of equations describes the dynamics of the money available to consumer $D(t)$:

$$D'(t) = iD(t) + P_d(t)(\text{exp}(t) - \text{imp}(t)) + Q(t);$$

$S(t) = D(t)/P_d(t)$ — is the demand for the model's tradable good;

$Q(t) = q_1P_d(t)\text{imp}(t)$ — is the government subsidy to the consumer.

NUMERIC SIMULATION

The numeric simulation was made to evaluate the price trends in cheese segment of the food market in Ukraine that had a substantial amount of export-import operations. Here are some condensed notes from the analytical data regarding Ukrainian cheese market at the end of 2009.

The statistical information [4] shows that the wholesale prices for Ukrainian distributors to buy cheeses of popular brands («Dutch», «Russian») were 40–43 UAH/kg in December 2009. As a result, the Ukrainian products were comparable in price with the European analogues, because the raw price of the similar cheeses imported from Poland made about 42–43 UAH/kg taking into account all import tariffs (10%) and VAT (20%).

For the same time period the demand did not go down on cheeses in Ukraine, and during 2009 cheese consumption remained stable enough. During 11 months of 2009 domestic enterprises produced 215,9 thousands ton of hard cheeses. Ukraine remains the large exporter of cheeses, and the costs of internal market on these products are closely associated with tendencies at the world markets, especially in the countries of the CIS. For example, in the second half-year of 2009 an average monthly production was 17–18 thousands ton, and about 6–7 thousands ton were exported at the average wholesale price of 5000 US dollars per ton.

The analytical data for the cheese market in Ukraine was used to calculate the price trends at the internal market of Ukraine with a current import tariff of 10%, and for the hypothetical, high import tariff of 90%. The results of numeric simulation are presented on fig. 1–2.

The graphs on fig. 1–2 illustrate stable growth of the domestic prices reaching 44000 UAH/ton with 10% import tariff, and 47000 UAH/ton with artificially high 90% import tariff at the end of one year time period. These results also could be interpreted as relatively stable state of demand-supply and export-import equilibrium on cheese market of Ukraine. The graphs on fig. 3–5 illustrate insignificant impact of the National Bank APR variations on the annual prices trends in comparison with the impact of import tariffs variations.

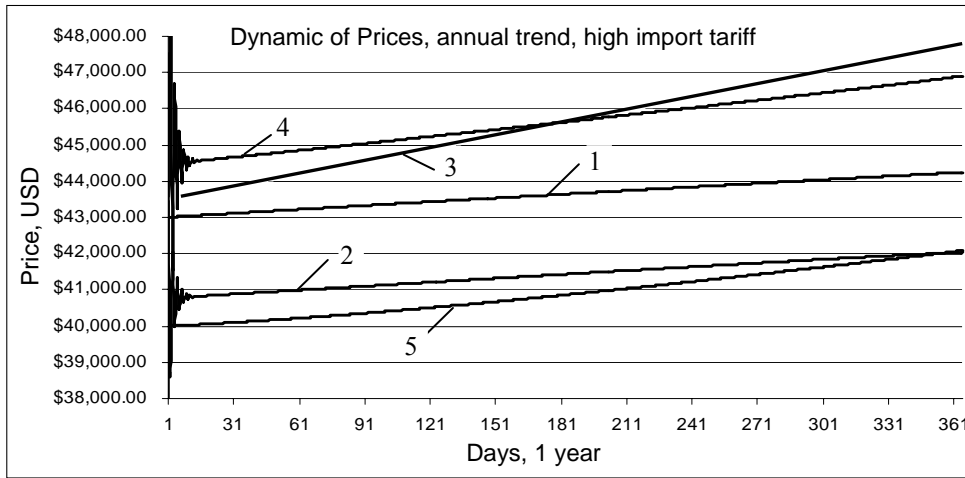


Fig. 1. Dynamics of prices, annual trend, and import tariff 90%; 1 — Domestic Manufacturer, 2 — Monopoly Price, 3 — Hyperinflation Price, 4 — Domestic Price, 5 — World Price

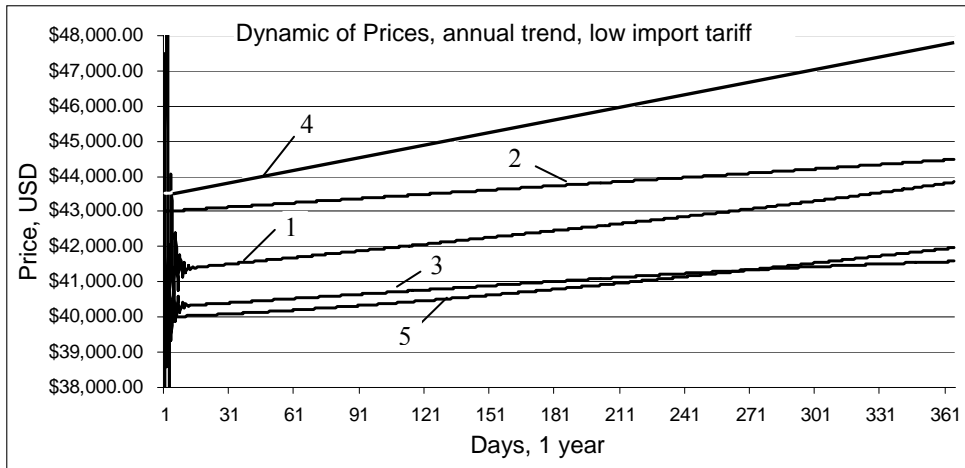


Fig. 2. Dynamics of prices, annual trend, and import tariff 10%; 1 — Domestic Price, 2 — Domestic Manufacturer Price, 3 — Monopoly Price, 4 — Hyperinflation Price, 5 — World Price

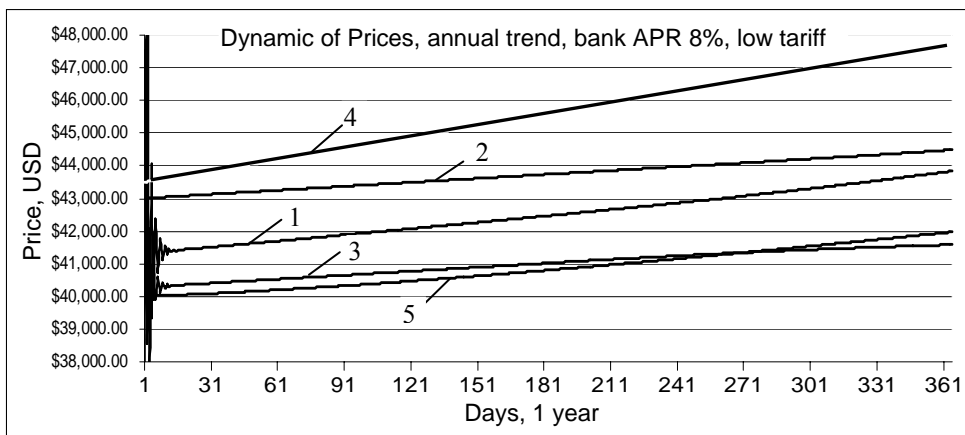


Fig. 3. Dynamics of prices, annual trend, and import tariff 10%, APR 8%; 1 — Domestic Price, 2 — Domestic Manufacturer Price, 3 — Monopoly Price, 4 — Hyperinflation Price, 5 — World Price

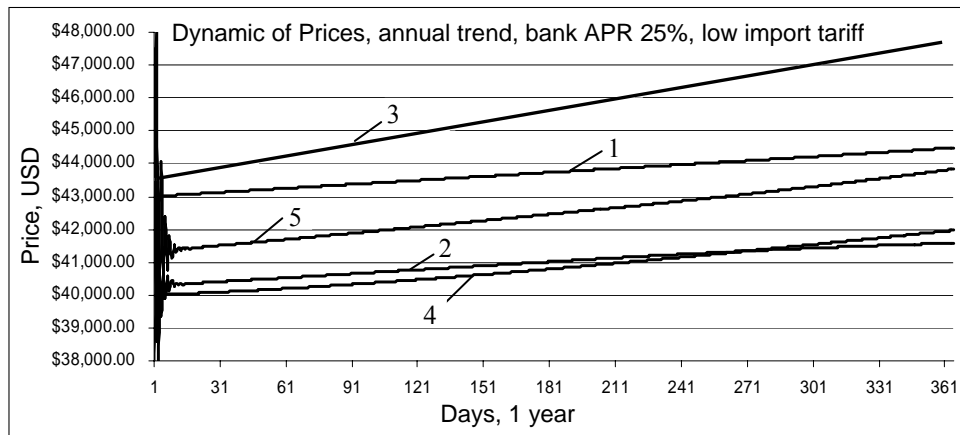


Fig. 4. Dynamics of prices, annual trend, and import tariff 10%, APR 25%; 1 — Domestic Manufacturer Price, 2 — Monopoly Price, 3 — Hyperinflation Price, 4 — World Price, 5 — Domestic Price

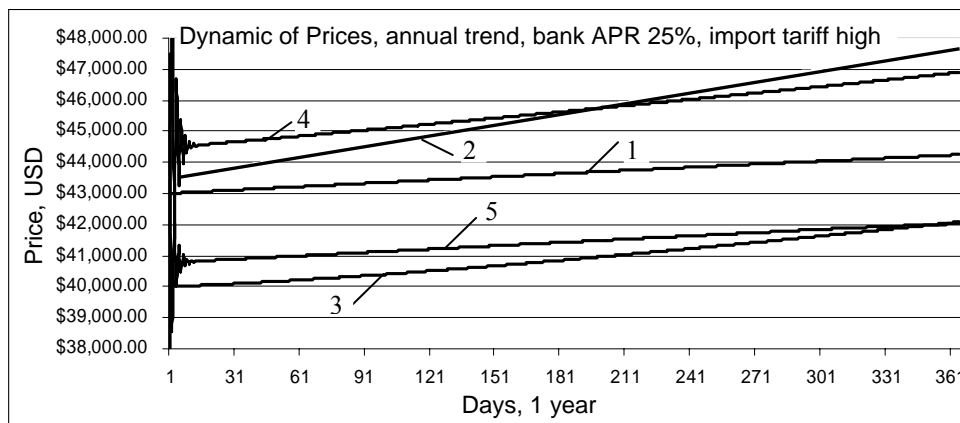


Fig. 5. Dynamics of prices, annual trend, and import tariff 90%, APR 25%; 1 — Domestic Manufacturer Price, 2 — Hyperinflation Price, 3 — World Price, 4 — Domestic Price, 5 — Monopoly Price

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