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# ANALYSIS OF PRODUCT DEMAND AND SUPPLY IN CONDITIONS OF MARKET INSTABILITY

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**Abstract:**
The article analyzes the situation when, due to inflation, market unevenness occurs, and market entities offer different prices for their goods and services. An algorithm has been developed to determine the coordinates of the supply and demand line based on data from marketing experts and the direction of the angular coefficient of the supply and demand line. Based on certain coordinates, a simplified scheme for calculating the equilibrium prices of products and a numerical example are given.

**Keywords**: Demand, supply, relative price, absolute price, initial price, forecast price.

## Introduction

In today's market conditions, including market instability due to inflation, there is a need to analyze situations where entities offering goods and services offer different prices. In such cases, it is necessary to develop an algorithm for determining the coordinates of the demand and supply lines, taking into account the data of marketing experts and the directions of the angular coefficients of the demand and supply lines. Based on the determined coordinates, it becomes possible to use a simplified method for calculating the stable price of the product.

## LITERATURE ANALYSIS

Algorithms for analyzing the state of product demand and supply have been studied by various authors, including A. Abdugafarov, T. Abduvakhitov, N. Mardiev, and others. In particular, algorithms for analyzing the state of product demand and supply are presented in the literature "Models of equilibrium solutions of the system of equations of demand and supply lines passing through one or two given

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points" [1], "Forecast equilibrium solutions of the system of equations of demand and supply for products" [2], "Models of evaluation of financial processes and methods for solving practical problems" [3], "Innovative systems of product demand and supply and algorithms for their solution" [4,5].

## RESEARCH METHODOLOGY

The study used scientific abstraction, grouping, comparison, empirical analysis and other methods. The article analyzes the situation when entities offering goods and services offer different prices when there is instability in the market due to inflation. An algorithm for determining the coordinates of the demand and supply lines is presented, taking into account the data of marketing experts and the directions of the angular coefficients of the demand and supply lines. Based on the determined coordinates, a simplified method and a numerical example of calculating the stable price of a product are presented, and relevant conclusions are drawn.

## PROBLEM STATEMENT

Let us consider the table and graphical representation of the system of equations of the supply and demand lines passing through one given point $D_1(q_1,p_1)$ and $S_4(q_4,p_4)$ in the given direction of the angular coefficients $k_1^D = tg\gamma_1$ on demand and $k_4^S = tg\gamma_4$ on supply [1,2,3]:

$$\left.\begin{aligned} p^D - p_1 &= k_1(q^D - q_1), \\ p^S - p_4 &= k_4(q^s - q_4). \end{aligned}\right\} \qquad (1)$$

Naturally, consumers/buyers (demand) are always given the (predicted) minimum price $p_1$ at which they want to buy a product, and producers/sellers (supply) are always given the (predicted) maximum price $p_4$ at which they want to sell it. If there are several buyers and the same number of minimum prices are called, then the average value of the minimum prices of the product is taken. The task is to find the scientifically justified equilibrium price p* for selling goods, which consists of these min $p_1$ and max $p_4$, and is acceptable to both parties, while observing the law of supply and demand.

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## RESULTS OF ANALYSIS AND RESEARCH

We present the results obtained based on the above problem. Let the annual (quarterly, monthly) inflation for product/service A be expected (forecasted) I=7% or $i_1$=1.07, the initial (base) $i_0$=1.00; for product/service B I=4% or $i_1$=1.04 and for product/service C I=15% or $i_1$=1.15.

If the minimum forecast price for product A is $p_1$=1.01 (i.e. 1% more) and the expected inflation (money depreciation) is $i_1$=1.07, all other things being equal, the maximum forecast price $p_2$ is also equal to the demand of 1.07; similarly, for product B and $i_1$=1.04, max $p_2$, and for product C and $i_1$=1.15, max $p_2$=1.15.

If the maximum forecast price for the supply of product A is set to $p_2$ = 1.10 (i.e., $p_0$ = 1.00, 10% more than the initial one) and the inflation forecast is $i_1$ = 1.07, then the forecast min price is $p_3$ = 1.07; if the manufacturer of product B sets max $p_4$ = 1.06 with inflation $i_1$ = 1.04, then min $p_3$ = 1.04, and the seller of product C sets max $p_4$ = 1.20 (i.e., 20% more expensive than the previous one) with inflation $i_1$ = 1.15, then min $p_3$ = 1.15.

All of the above information can be obtained through surveys and marketing: forecast min $p_1 = \frac{P_1}{P^0}$ and max $p_4 = \frac{P_4}{P^0}$, max $p_2 = \frac{P_2}{P^0}$ and min $p_3 = \frac{P_3}{P^0}$, where the numerator and denominator are the absolute prices of goods and services.

Now, using the table, we find all the values of the quantities $q_1$ and $q_2$ for demand and $q_3$, $q_4$ for supply.

The calculations of the forecast minimum and maximum relative quantities for the demand and supply of goods and services (q=p/tgφ, where φ is the polar angle) are presented in Table 1.

Table 1

| Line No./items. | Product, hizmat | When φ>π/4, as required | | | | | | By suggestion when φ<π/4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | minP₁ | i₁=P₂ | φ | tgφ | Settlement q=P/ tgφ | | i₁=P₃ | maxP₄ | φ | tgφ | Settlement q=P/ tgφ | |
| | | | | | | maxq₁ | min q₂ | | | | | min q₃ | maxq₄ |
| 0/0 | 2/1 | 3/2 | 4/3 | 5/4 | 6/5 | 7/6 | 8/7 | 9/8 | 10/9 | 11/10 | 12/11 | 13/12 | 14/13 |
| 1 | A | 1,01 | | 46⁰ | 1,036 | 0,9749 | | 1,07 | | 44⁰ | 0,9657 | 1,1080 | |
| 2 | | | 1,07 | 50⁰ | 1,192 | | 0,8976 | | 1,10 | 40⁰ | 0,8391 | | 1,3109 |
| 3 | B | 1,01 | | 46⁰ | 1,036 | 0,97 | | 1,04 | | 44⁰ | 0,9657 | 1,08 | |
| 4 | | | 1,04 | 50⁰ | 1,192 | | 0,87 | | 1,06 | 40⁰ | 0,8391 | | 1,26 |
| 5 | C | 1,01 | | 46⁰ | 1,036 | 0,9749 | | 1,15 | | 44⁰ | 0,9657 | 1,1908 | |
| 6 | | | 1,15 | 50⁰ | 1,192 | | 0,9648 | | 1,20 | 40⁰ | 0,8391 | | 1,4301 |

Also, using surveys and marketing, it is possible to determine the forecast of max$q_1 = \frac{Q_1}{Q^0}$ and max$q_4 = \frac{Q_4}{Q^0}$, min $q_2 = \frac{Q_2}{Q^0}$ and min $q_3 = \frac{Q_3}{Q^0}$, where the ratios are the absolute quantities of goods and services.

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The task of the marketing department of the company (OJSC, enterprise) is to provide a formulary (statement) of the task; decode the initial/starting price; indicate the reasons for the increase in prices for food and non-food products, the range of goods and services, and the inflation forecast; forecast the minimum and maximum prices and quantities for D demand and S supply.

Based on the above, we substitute the found values of product A into the points D1(0.9749; 1.01) for demand and S4(1.3109; 1.10) for supply:

- for product B, D1(0.97; 1.01) and S4(1.26; 1.06);
- for product C, D1(0.9749; 1.01) and S4(1.4301; 1.20).

Now we construct a system of three separate supply and demand equations for each of the goods A, B and C with known coordinates of points D1 and S4 according to system (1). $k_1^D = tg\,\gamma_1$ and $k_1^S = tg\,\gamma_4$, and the angles $\gamma_1$=arctg$k_1$, $\gamma_4$=arctg$k_4$ remain unknown. We know from practice and the Law of Supply and Demand in which direction each straight line of demand D and supply S is directed.

For their visual representation and further calculation, we present the system of equations of the straight lines of demand and supply (1) in graphical form:

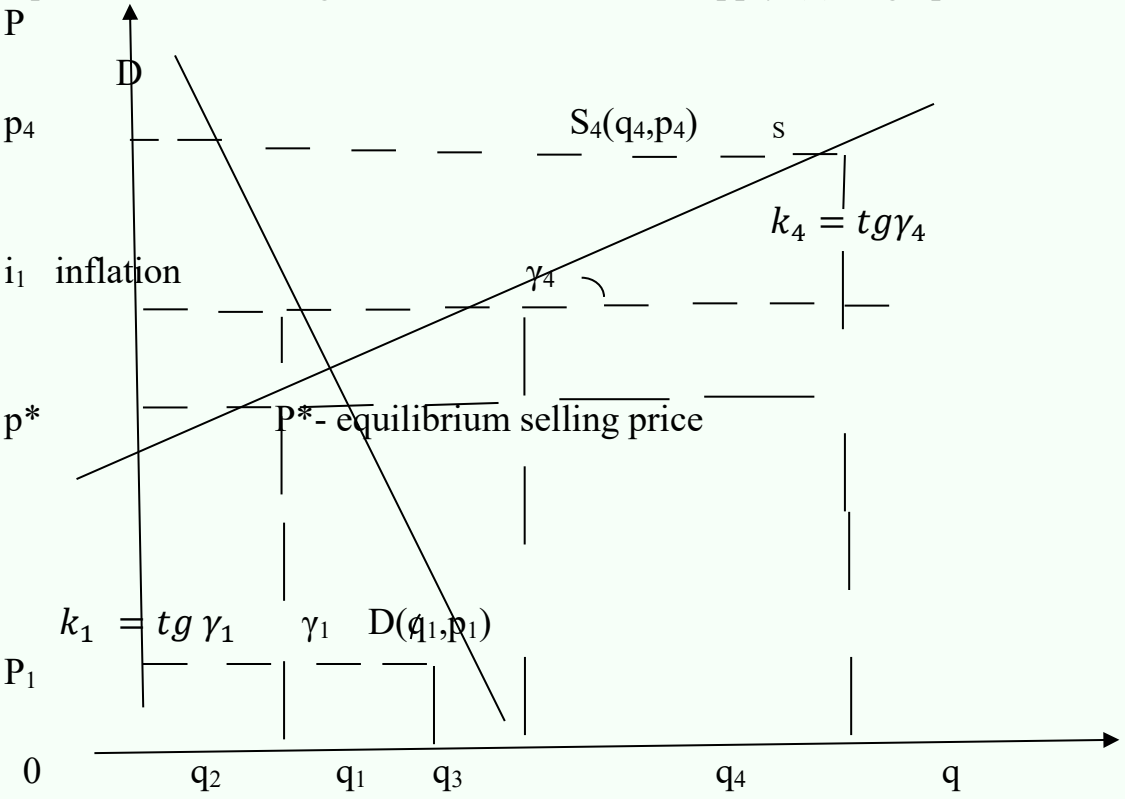


Figure 1. Graphical representation of the system and the solutions $k_1$,$\gamma_1$,$k_4$,$\gamma_4$ with respect to the equilibrium selling price of the product

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If you look closely at Figure 1, it is easy to understand

$$tg\gamma_1 = \frac{i_1 - P_1}{q_1 - q_2} \text{ and } tg\gamma_4 = \frac{P_4 - i_1}{q_4 - q_3}. \quad (2)$$

(2) formuladan foydalanib $k_1$ и $k_4$ burchak koeffitsientlari, va $\gamma_1$ и $\gamma_4$ burchaklarining qiymatlarini topamiz va 2 -jadvalni tuzamiz.
Using formula (2), we find the values of the angular coefficients $k_1$ and $k_4$, and the angles $\gamma_1$ and $\gamma_4$, and compile Table 2.

Table 2

| Count No. i/ row No. | Goods, services | Calculations | | | |
|---|---|---|---|---|---|
| | | On demand | | By invitation | |
| | | $tg\gamma_1 = \frac{i_1 - P_1}{q_1 - q_2}$ | $\gamma_1 = arctgk_1$ | $tg\gamma_4 = \frac{P_4 - i_1}{q_4 - q_3}$ | $\gamma_4 = arctgk_4$ |
| 0 | 1 | 2 | 3 | 4 | 5 |
| 1 | A | 0,7762 | $37^0 50^1$ | 0,1478 | $8^0 30^1$ |
| 2 | B | 0,3 | $16^0 50^1$ | 0,11 | $6^0 20^1$ |
| 3 | C | 13,8614 | $85^0 50^1$ | 0,2089 | $11^0 50^1$ |

Based on the numerical examples in Tables 1 and 2, it is possible to construct separate graphs for each of the goods A, B and C and construct a numerical system of supply and demand equations in accordance with (1), which are solved to maintain market equilibrium. In this case, for the interests of the consumer and the producer, the buyer and the seller, as well as for the coincidence of supply and demand, D=S, $p^D$=$P^S$, $q^D$=$q^S$ must be met, that is, the law of supply and demand is fulfilled.
Algorithm for calculating the forecasted scientifically based equilibrium price of a product (goods, services) between the producer (seller) and the consumer (buyer):

$$p^* = \frac{(p_1 - k_1 q_1)k_4 + (p_4 - k_4 q_{14})k_1}{k_4 - k_1}, \quad (3)$$

$$P^* = p^* \bullet P^0, \quad (4)$$

where $P_0$ is the initial (initial) absolute price of the product.
Using formulas (3) and (4) and tables 1 and 2, we construct general table 3.

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Table 3

| Count No. i/ Quantity No. i | Goods, services | Forecast | | | $P^0$ thousand com | Calculations | | |
|---|---|---|---|---|---|---|---|---|
| | | Inflation I | min D $P_1$ | maxS $P_4$ | | p* | $P^*=p^*\bullet P^0$ ming co'm | Exclusion +; - thousand com |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | A | 7% | 1,01 | 1,10 | 150 | 1,0598 | 158,97 | +8,97 |
| 2 | B | 4% | 1,01 | 1,06 | 100 | 1,0386 | 103,86 | +3,86 |
| 3 | C | 15% | 1,01 | 1,20 | 200 | 1,1064 | 221,28 | +21,28 |

## CONCLUSION

In conclusion, we note that in order to calculate the scientifically based balanced selling price of a product (goods, services) of an innovative supply and demand system, the following conditions must be met: compliance with the law of "Supply and Demand"; matching of supply and demand; maintaining market balance; matching of the interests of the consumer and the producer.

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