

THE IMPACT OF PRODUCTION DECISIONS ON THE BALANCE PERFECT MARKET. AN INTERACTIVE STUDY

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Abstract: *Given that the market equilibrium at a given time t is the result of ratio of product demand, at the same moment of time t , and the supply launched at an earlier time $t - \Delta t$, and given that the product remains on the market until the sale was full, rationality of supply decision, by future sizing anticipating of demand, has a fundamental influence on the stability and equilibrium of product market. This paper provides an interactive version for study of sizing impact on offer, based from three dynamic models of perfect markets, derived from Kaldor's cobweb model. Using the same values of marginal demand, marginal supply and incompressible demand and supply are presented interactively the influences of the producer decision on the stability of the product market. IT produs, dezvoltat pentru acest scop poate fi utilizat, de asemenea, în cereri și cursuri practice în microeconomie, dinamica economică, luarea deciziilor și altele.*

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1. Approaches of supply foundation in dynamic models of the market adjustment through price

In this chapter we stop to three ways for the supply sizing by the manufacturer: taking as a base price of the product in the current period, starting at a price considered normal by the manufacturer and, respectively, taking into account the prices that occurred in two consecutive periods prior.

1.1. Supply substantiation considering the price next period will be equal to the price of current period

In this case we use Kaldor's model of market adjustment through price pattern called a cobweb. The model is:

$$D_t = a + b \cdot p_t \quad (1)$$

$$S_t = a_1 + b_1 \cdot p_{t-1} \quad (2)$$

$$S_t = D_t \quad (3)$$

Market demand is modeled by function (1), where a is incompressible demand, b is demand elasticity relative to product price and p_t is the product's price when the current time. Under conditions normal demand we have $b < 0$.

Supply product market is modeled by function (2), where a_1 is incompressible supply, b_1 is supply elasticity relative to product price (under normal supply $b_1 > 0$) and p_{t-1} is the market price at the time of the previous time (the product price when the manufacturer decided to produce the product).

Relationship (3) is the condition of equilibrium and it results from the assumption that market mechanisms provide price level each period according to excess demand. From static equilibrium condition $D = S$ we get the expression of equilibrium price $\hat{p} = \frac{a_1 - a}{b - b_1}$ where $a_1 - a$ is excess demand autonomous. The conditions of

existence of \hat{p} are $b - b_1 \neq 0$ and $\hat{p} > 0$. Substituting (1) and (2) in (3) obtain price dynamics equation:

$$p_t = \frac{b_1}{b} \cdot p_{t-1} + \frac{a_1 - a}{b} \quad (4)$$

Equation (4) is an inhomogeneous equation with first order finite differences. The solution to this has the form $p_t = c \cdot \lambda^t + \hat{p}$. Given the initial condition $p_{t=0} = p_0$, the trajectory of the evolution of prices is:

$$p_t = (p_0 - \hat{p}) \cdot \left(\frac{b_1}{b}\right)^t + \hat{p} \quad (5)$$

The stability condition is $\left|\frac{b_1}{b}\right| < 1$. Even $\varepsilon > 0$ infinitely small, and $\left|p_0 - \hat{p}\right| > \varepsilon$:

- If $\left|\frac{b_1}{b}\right| < 1$, p_t will oscillate around \hat{p} with amplitudes $\left|p_t - \hat{p}\right|$ increasingly smaller so that $(\forall t > T), \left|p_t - \hat{p}\right| < \varepsilon$.
- If $\left|\frac{b_1}{b}\right| > 1$, the own component $\left(p_0 - \hat{p}\right) \cdot \left(\frac{b_1}{b}\right)^t \rightarrow \pm\infty$, the price p_t will have a divergent evolution of improper oscillations whether $\frac{b_1}{b} < -1$ or monotonous divergent evolution if $\frac{b_1}{b} > 1$.
- If $\frac{b_1}{b} = -1$, the price will have a oscillating trajectory of the evolution, with constant amplitude, around of equilibrium price \hat{p} .

1.2. Supply substantiation considering that the price of the next period will tend to a price considered normal

In this case we will use the Kaldor's model with rational anticipation of prices. Unlike the cobweb that market regulation is left to fully realize its mechanisms, rational expectations model assumes that the producer can base its market for the next period taking into account, to some extent, a market price which he considered normal (P_N).

Under these conditions the supply function is:

$$S_t = a_1 + b_1 \cdot [p_{t-1} + \alpha \cdot (P_N - p_{t-1})] \quad (6)$$

Demand function (1) and equilibrium condition (3) remain unchanged. Proceeding similarly from (1), (6) and (3) obtain $\hat{p} = \frac{a_1 - a}{(b - b_1) + b_1 \cdot \alpha} + \frac{b_1 \cdot \alpha}{(b - b_1) + b_1 \cdot \alpha} \cdot P_N$ where $\frac{1}{(b - b_1) + b_1 \cdot \alpha}$ is excess demand autonomous multiplier, and $\frac{b_1 \cdot \alpha}{(b - b_1) + b_1 \cdot \alpha}$ is nominal price multiplier. Living conditions of \hat{p} are $(b_1 - b) + b_1 \cdot \alpha \neq 0$ and $\hat{p} > 0$. Trajectory of price evolution, in this case is:

$$p_t = (p_0 - \hat{p}) \cdot \left(\frac{b_1 \cdot (1 - \alpha)}{b}\right)^t + \hat{p} \quad (7)$$

The stability condition is $\left|\frac{b_1 \cdot (1 - \alpha)}{b}\right| < 1$. Even $\varepsilon > 0$ infinitely small, and $\left|p_0 - \hat{p}\right| > \varepsilon$:

- If $\left|\frac{b_1 \cdot (1 - \alpha)}{b}\right| < 1$, p_t will oscillate around \hat{p} with amplitudes $\left|p_t - \hat{p}\right|$ increasingly smaller so that $(\forall t > T), \left|p_t - \hat{p}\right| < \varepsilon$.

- If $\left| \frac{b_1 \cdot (1 - \alpha)}{b} \right| > 1$ the own component $\left(p_0 - \hat{p} \right) \cdot \left(\frac{b_1 \cdot (1 - \alpha)}{b} \right)^t \rightarrow \pm \infty$, the price p_t will have a divergent evolution of improper oscillations whether $\frac{b_1}{b} < -1$ or monotonous divergent evolution if $\frac{b_1}{b} > 1$
- If $\frac{b_1 \cdot (1 - \alpha)}{b} = -1$, the price will have a oscillating trajectory of the evolution, with constant amplitude, around of equilibrium price \hat{p} .

Analyzing the stability conditions presented above, it follows that Kaldor's model with rational anticipation of prices provides a wider range and greater stabilization speed than the cobweb model. If $1 - \alpha < 1$, then convergent evolution of the price range given by the condition of stability $\left| \frac{b_1 \cdot (1 - \alpha)}{b} \right| < 1$ is larger than that given the condition of stability $\left| \frac{b_1}{b} \right| < 1$. Thus if $\left| \frac{b_1}{b} \right| > 1 \ (\exists) \alpha \in (0, 1)$ such that $\left| \frac{b_1 \cdot (1 - \alpha)}{b} \right| < 1$

1.3. Supply substantiation taking into account the prices of the product in two previous successive periods

Now, we will use the Kaldor's model with anticipation prices of Goodwin type. It is a second variant of the cobweb model. Unlike the other variants considered above, it assumes that the producer can base its market supply for the next period taking into account, to some extent, the difference between product prices in two previous periods $(p_{t-1} - p_{t-2})$. Here, the supply function is:

$$S_t = a_1 + b_1 \cdot [p_{t-1} + \rho \cdot (p_{t-1} - p_{t-2})] \quad (8)$$

As in previous cases, the relations (1) and (3) remain the same. Equilibrium price is $\hat{p} = \frac{a_1 - a}{b - b_1}$, and the

conditions of existence are $b_1 - b \neq 0$ and $\hat{p} > 0$. From (1), (8) and (3) results:

$$p_t = \frac{b_1 \cdot (1 + \rho)}{b} \cdot p_{t-1} - \frac{b_1 \cdot \rho}{b} \cdot p_{t-2} + \frac{a_1 - a}{b} \quad (9)$$

The characteristic equation attached to it is $\lambda^2 - \frac{b_1 \cdot (1 + \rho)}{b} \cdot \lambda + \frac{b_1 \cdot \rho}{b} = 0$, with the solutions $\lambda_{1,2} = \frac{b_1}{2b} \cdot (1 + \rho) \pm \frac{1}{2b} \cdot \sqrt{\Delta}$ where $\Delta = \frac{b_1}{b} \cdot \left[\frac{b_1}{b} \cdot (1 + \rho)^2 - 4\rho \right]$. In function of Δ values, the price dynamics has one of the forms:

$$\text{if } \Delta > 0 \wedge \lambda_1 \neq \lambda_2 \Rightarrow p_t = c_1 \cdot \lambda_1^t + c_2 \cdot \lambda_2^t + \hat{p} \quad (10)$$

$$\text{if } \Delta = 0 \Rightarrow \lambda_1 = \lambda_2 \Rightarrow p_t = (c_1 + c_2 \cdot t) \cdot \lambda^t + \hat{p} \quad (11)$$

$$\text{if } \Delta < 0 \quad \lambda_1 \lambda_2 \in \mathbb{C} \Rightarrow p_t = 2 \cdot k \cdot r^t \cdot \cos(\omega \cdot t + \theta) + \hat{p} \quad (12)$$

$$r = \sqrt{(\operatorname{Re} \lambda)^2 + (\operatorname{Im} \lambda)^2}, \omega = \operatorname{arctg} \frac{\operatorname{Im} \lambda}{\operatorname{Re} \lambda}$$

The parameters c_1, c_2 respectively k, θ resulting from the initial conditions $p_{t=0} = p_0$ and $p_{t=-1} = p_{-1}$. From (10) - (12) resulting stability conditions:

$$\text{if } \Delta > 0 \wedge \lambda_1 \neq \lambda_2 \Rightarrow |\lambda_1| \wedge |\lambda_2| < 1 \quad (13)$$

$$\text{if } \Delta = 0 \Rightarrow \lambda_1 = \lambda_2 \Rightarrow |\lambda| < 1 \quad (14)$$

$$\text{if } \Delta < 0 \quad \lambda_1 \lambda_2 \in C \Rightarrow (\operatorname{Re} \lambda)^2 + (\operatorname{Im} \lambda)^2 < 1. \quad (15)$$

IT application for study of the adjustment mechanisms through price on a perfect market

Study based on solving manually of theoretical models presented in the previous chapter, in addition to being laborious, may make some problems especially when the complex solutions are obtained. To remove these inconveniences, and not only, present briefly a interactive application which, besides exempt of the manually solving of models, provides intuitive graphics that would facilitate analysis.

We believe further that the marginal demand is normal and has $b = -2.7$ value, marginal supply is also normal with $b_1 = 3.2$ value, and supply and demand incompressible have values $a = 100$ and $a_1 = -20$ respectively. Product price at time $t = 0$ is $p_0 = 22u.m.$

The application contains three windows for the study of the three models presented.

The first window is for the study of spider blade model (Figure 1). For the study of market dynamics is necessary to introduce the values of parameters whose significance were presented in the previous chapter and the market price of the product baseline. The application automatically determines the equilibrium price (\hat{p}) and shows the evolution of the price (chart left) and product supply and demand trends (chart, right). As you can see, the model name comes from the form of the graph.

Figure 1 shows a divergent dynamic. Since $\left| \frac{b_1}{b} \right| > 1$, in absolute terms, the marginal supply is higher than the marginal demand, market mechanisms can not stabilize the market price.

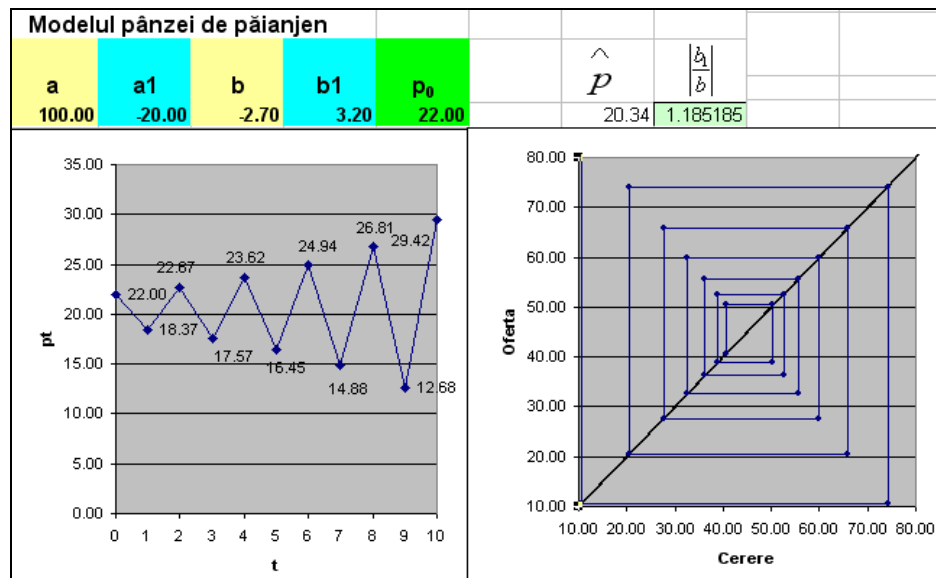


Figure 1 Market price dynamics with divergent improper fluctuations

To emphasize the importance of rationality of producer in substantiation of his supply, the user has available the second application window (Figure 2). As can be seen, although the elasticity of demand and supply remain the same, the new way of substantiating the supply, the market price stabilizes.

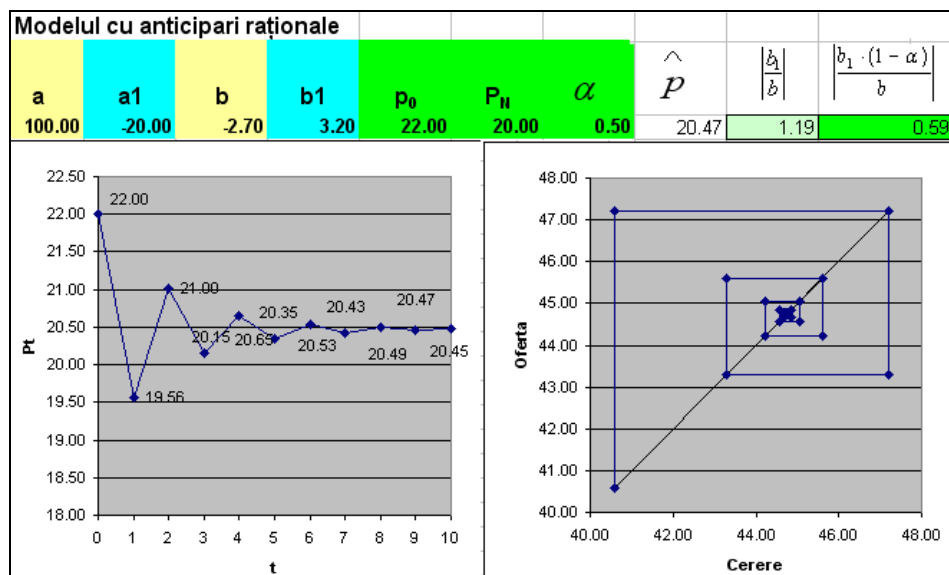


Figure 2 The price stabilization by its rational anticipating

Finally, a third window, allows the user to monitor the effects that different ways of conceiving of the supply, using Kaldor's model with prices anticipation by Goodwin type, t has on the dynamic stability of the analysis market.

In the example shown in Figure 3, knowing the values of prices in two previous periods $p_{-1} = 24u.m.$ and $p_0 = 22u.m.$, the producer makes the assumption that the price trend will change in the future (to move in reverse) in a 70% difference from the previously recorded.

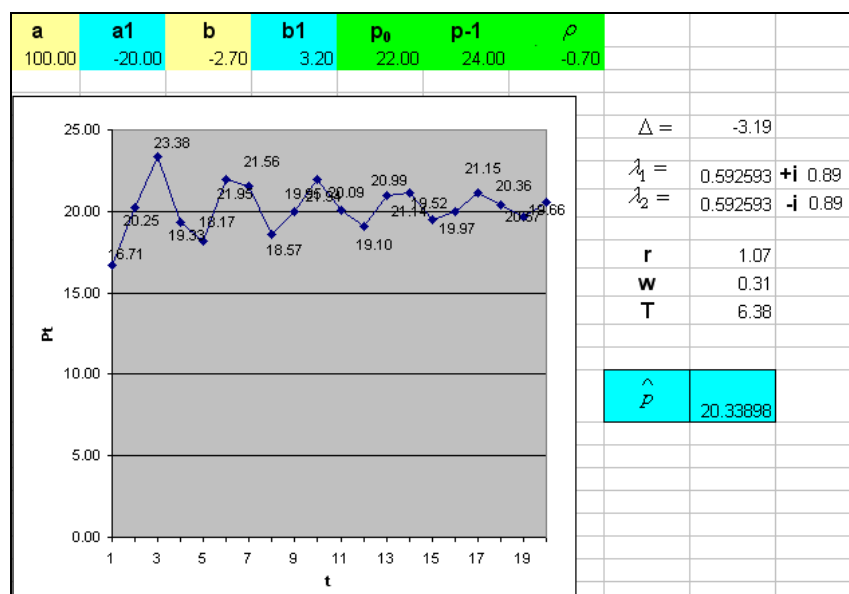


Figure 3 The market price stabilization by anticipating of Goodwin type of prices

The resulting evolution is convergent oscillating with a period of about 6.4 intervals. This evolution is given by the complex roots $\lambda_{1,2} = 0.59 \pm 0.89 \cdot i$ of characteristic equation.

Conclusions

Market stability and balance of the product producer's decision on its supply volume is essential. Of course, in the perfect market conditions, producers' atomicity makes the decision of a single producer to not have any influence on the market price of the product. But, what happen if several producers think the same? Definitely the thinking of producers depends of their level of training and experience on economic field and, as such, the market as a whole, at least in the transitional period, can reach to instability. In these circumstances, knowledge of different modes of action and their possible consequences are worthy of attention.

In support of the approached, the IT product presented is an easy and useful support to study price dynamics perfect markets and to highlight the importance of rational sizing of supply on the market. It offers the possibility to perform detailed studies on the models presented and implemented in it and, in so far as it has information on elasticity of supply and of demand to the price of a product, the possibility of such forecasts for the product markets.

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