ESTIMATION OF DEMAND ELASTICITIES FOR CHOCOLATE TABLETS IN UKRAINE

by

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Abstract

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by Yuriy Bezpalyy

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This research is devoted to development of the procedures of demand and its elasticities' estimation for chocolate tablets market in Ukraine on macro and micro-levels. To estimate the demand for chocolate tablet as an aggregate product of different brands, ECM (Error Correction Mechanism) and GMM procedure with instrumental variables were applied. Also, following Eagle and Ambler (2002) there were estimated the determinants market growth rate. We found that seasonality has the most significant influence on chocolate consumption. Demand appeared to be price elastic: -1.99% and income inelastic: 0.12 % with quit low significance, however advertising clearly adds explanatory power to the model, but its elasticity is low too: 0.04%. The price, income and advertising growth by 1 unit will lead the growth of market to change by -1.38%, 0.054% and 0.003% respectively. But necessary to be cautious with the results which concern the growth of market size as they were obtained from the model with some drawbacks in order to have commensurability with results of Eagle & Ambler (2002).

VARX model was constructed in order to estimate the elasticities of demand for one particular brand (luxury one). Impulse Response Functions were used to find dynamic elasticities with respect to endogenous variables: own price elasticity, and

two cross-price elasticities are 0.4%, 0.4%, 0.25% respectively. The effect of permanent change in own price on demand was determined about 3.3% with the help of forecasting and simulation from the obtained model.

TABLE OF CONTENTS

LIST OF FIGURES

Number *Page*

LIST OF TABLES

Number *Page*

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Chapter 1

INTRODUCTION

Possession of relevant information is a key issue for the producer to be able to successfully compete on a market. Talking about marketing, it is impossible to conduct an effective policy without exact knowledge about the demand for the product. Moreover, this information is to be used further in the planning of production and other processes. The question is not only about the quantity that could be sold. Determinants of the demand for the product are also of major interest.

That is why this work is mostly devoted to the factors which influence demand and the extent of their impact, that is, we examine demand elasticities with respect to these factors.

The exact knowledge of at least (in the most common case) price, income and advertising elasticities will allow producers to carry out the most effective production, pricing and advertisement policies targeting either profit or market share (sales) maximization.

Because of economic instability and lack of managers' understanding of statistical analysis power, Ukrainian producers still apply only simple intuition approach to elasticity "estimation." For others, the appropriate data is out of reach.

We have got the data for chocolate tablets market in Ukraine (monthly time series for the period from 2001 to 2004 aggregated at the national level). So, in this paper we present the procedures for demand estimation and the results of their application based on the mentioned figures, though proposed methodology could be also used for other markets.

This is the first time for Ukraine when research in chocolate tablets' elasticities estimation is conducted. Studies connected to the demand for chocolate in other countries are not published in academic literature due to the proprietary data (one exception is mentioned below).

Sociologists and policy makers are interested in the aggregate consumption of the good, producers and economists worry about the market size of the product, information about the determinants of these values are crucial for all of them. So, **the first issue we are going to explore is *the aggregate demand for chocolate tablets***, factors that influence it, the magnitude of their effects, i.e. estimation the values of elasticities of Ukrainian demand for chocolate tablets with respect to price, income, advertisement, seasons and other parameters – **macro-level analysis**.

The authors of the only study we found, which concerns chocolate Eagle & Ambler (2002) argue that in Western Europe market size of this product doesn't not depend on advertising. Applying the same procedure, using OLS, we will check this evidence for Ukraine.

In order to receive robust estimates of elasticities, the demand for chocolate tablets will be estimated with more sophisticated procedure applying Error Correction Mechanism and Instrumental Variables approach.

Ukrainian chocolate tablets market in Ukraine is presented with five main producers (nine brands, three of which cover more then 75% of all sales). So, we have a deal with oligopoly. According to the economic theory, price competition is to prevail among these firms. To perform an optimal marketing (pricing and advertising) strategy the competitor should ***estimate the demands for chocolate tablets which are produced by all of them***, their own and cross short-run and long-run elasticities, i.e. to determine the interdependence of producers' competitive behavior (market-response functions) – **micro-level analysis**.

To investigate this **second issue** VARX (Vector Autoregressive Model with Exogenous Variables) will be constructed connecting sales, advertisement, prices and income of the main competitors. The reaction of the demand for one of the brands on the different prices changes will be investigated. This model will allow to estimate:

- the effect of price discount (temporary changes in these value) with the help of IRFs (Impulse Response Functions);

- the effect of permanent change in price (change in strategies) on the demand for particular brand with the help of simulations and forecasting.

The structure of the thesis is as follows. Chapter II reviews the related literature. Chapter III describes the Ukrainian chocolate tablets market. Chapter IV provides information about the data and theoretical model construction. Chapter

V presents empirical results. Conclusions and possible ways to improve the research on current topic are drawn in Chapter VI.

Chapter 2

LITERATURE REVIEW

The estimation of demand elasticity for such products as chocolate tablets is of producers' business interest, and often involves analysis of proprietary data. So, most existing studies are not published in the academic literature. Yet, scholarly journals do publish policy papers (e.g., Eagle and Ambler (2002)), which include estimation of influence of certain factors on demand and/or supply. Since methods which have been applied to other products for solving this problem can be used for our purposes as well, we present here a survey of approaches to estimation of demand elasticity. (Un)fortunately, similar studies for Ukraine or other transition economies have not been reported. It can be explained by the lack of reliable data or managers' distrust in econometric estimation. Yet, we have no reason to believe that techniques applied to data from developed countries will not be applicable to transition economies.

Calculating demand elasticity once we have estimated the parameters of demand function is a trivial issue; whereas specifying and estimating the demand functions themselves is not, and demands our attention. We begin by describing the problems and methods related to such different estimation procedures. This will be followed by review of literature, illustrating demand estimation from the data of purchases. Afterwards, we consider studies which use utility functions to derive demand. Then we describe models that were used specifically for micro-level demand estimation.

Available sales data effectively describes some equilibrium points – intersections of demand and supply curves. Correct estimation of demand for a good may therefore require supply-demand simultaneous equations, because of their interdependence. This was understood as far back as in early 20-th century, at the time when empirical research was at its inception (e.g. Working, 1926). Exceptions refer to cases where variables are exogenous, for example if price is regulated by the government. If the system is at least exactly identified, we can estimate the needed parameters. Thurman (1986) describes endogeneity testing in supply and demand framework.

Because of the correlation between dependent variables and disturbances (for example prices are endogenously determined and correlated with disturbances) OLS estimators are biased and inconsistent. In spite of this Waugh (1961) defends least squares because in some cases they make analysis more consistent with theory: "Hog farmers would be interested in knowing the expected price given a year's output". Different approaches to solving the problem of simultaneity were proposed in early studies of supply-demand framework (Haavelmo (1943), Tintner (1946), etc.). There is no merit in describing their works because there are many modern instruments, which are broadly known and used. So, according to Greene (2000), there are single-equation and system methods of simultaneous equations estimation. Because of their simplicity the former (ILS, instrumental variables (IV), TSLS, LIML (Limited Information Maximum Likelihood)) are widely used. But the laster (3SLS, FIML (full-information maximum likelihood), GMM) give more robust results and are also applied in demand elasticity applications. To have more information about the subject of research authors usually use different estimates:

FIML and TSLS by Marquez (1994), 3SLS and GMM by Hetemaki & Kuuluvainen (1992), etc.

The models under consideration are divided into static (capturing only contemporaneous effects) and dynamic models (reflect influences in dynamics). An example of static demand estimation is Bartlett (1948). He estimated simultaneous equations for cotton yarn, where demand either was dependent on income or on price of the same period; supply was depended on costs and price of the same period. Hetemaki & Kuuluvainen (1992) also estimated roundwood supply and demand simultaneously. Demand was linearly explained with export price for final product, stumpage price and price of capital. OLS, TSLS and 3SLS were employed.

Another step in developing elasticity estimation techniques was constructing dynamic models of demand (consumption), which gave opportunity to compute not only short-run but also long-run elasticity. For instance, Johnson and Oksanen (1974) used a partial adjustment model with panel data and Johnson et al (1992) applied ECM (error correction mechanism) using aggregated data in estimating demand and its elasticity for alcoholic beverages in Canada. Lagged explanatory variables were included into specifications to allow for current values of factors influencing future demand. The authors estimated only demand equation. That is why in the first case they use GLS. In the second case tests allowed using OLS. In the latter research it was necessary to use ECM because of order one income and price integration in the long run.

Another way of specifying demand is deriving it from consumer theory using utility function, as it was first done by Stone (1954). This approach was further developed with the Rotterdam model by Barnett (1979), the translog model by Christensen et al. (1975), the almost ideal demand system (AIDS) by

Deaton & Muellbauer (1980) and others. Every mentioned structure is a system of demand equations for the groups of commodities (e.g. food, fuel, clothing, and other goods) consumed in the country. So, together these groups make up all the purchased goods. All consumers are assumed to be homogeneous. Every equation relates the share of disposable income or budget share spent on each group to average sample price and income by means of utility function or its approximation. Each paper proposes its own restrictions and method of utility approximation. Such kind of research has been conducted for policy purposes because models describe demand at the aggregated, and not at the individual good level. However, this approach can be somewhat modified to obtain more detailed results as Duffy (1991), Xiao et al. (1999) and others did. For example, Xiao et al. (1999), estimating non-alcoholic beverage demand with the help of the Rotterdam model posited two-step budgeting process. At the first step the consumer distributes his disposable income among two commodity groups, one of which is non-alcoholic beverages, and the second one includes everything else. At the second stage the consumer allocates beverage budget to individual drinks. Among independent variables are advertising expenses. Equations are estimated jointly using the iterative Jointly Unrelated Regression. Marquez (1994) estimated international trade elasticity with the help of the Rotterdam model. It is necessary to mention that utility specified dynamic demand models are also used (Anderson and Blundell (1982, 1984)).

Johnson et al. (1992) wrote about the estimation of demand derived from utility function: "…this approach would be necessary if the research goal were to provide evidence for the confirmation or disconfirmation of utility theory or to conduct utility-based welfare analysis". Despite it, this technique is widely used not only for mentioned purposes.

Estimating demands and their elasticities on the micro-level research works consider models which connect competitive brands behavior in sales, prices and advertising settings. So, they are assumed to act interdependently. With the help of elasticities we can model the reaction in all mentioned variables of one firm on, say, price cut or advertising activity of another. Having these assumptions VAR models are used in this case. For example, Dekimpe & Hanssens (2003) proposes to use purely VAR model with own sales, own marketing spending and competitors' marketing spending as dependent variables. Steenkamp et. al (2004) uses VARX model. Describing the market of four brands of consumer goods they run proposed regressions for every two brands simultaneously. The first differences of prices, sales and advertisement are dependent variables; display activity, feature activity, new product introduction - independent. VARX models are also used by Srinivasan et. al (2000), Nijs et. al and others. Most of these works use panel data. Impulse response functions analysis is applied for modeling competitors' reactions on the temporary changes of depended variables and structural brake approach in the case of permanent changes. Obtained results are different and there is no a single answer to the question what factors have the most powerful influence on the demand of each producer of consumer goods. Moreover, nothing is written about chocolate tablets.

All of those variables, which are measured in monetary terms, are usually deflated by CPI. In this case to make components of the model commensurable they are used in logs rather than in real terms. Estimated coefficients are already elasticities. Obtaining responses on factors of demand from dynamic models is a well-known procedure.

Eagle & Ambler (2002) is the only study we discovered, which is more or less connected to the chocolate demand elasticities. It investigates the influence of advertising on the demand for chocolate confectionery, i.e. its market size in Belgium, France, Germany, the Netherlands and the UK. They found no significant relationship between the weight of advertising and market growth, but there was negative correlation between market size and price. Dependent variable was annual percentage growth in the chocolate market, which was regressed on changes of price, changes of total advertisement expenditures, per capita income, time and country dummies with OLS.

Chapter 3

DESCRIPTION OF CHOCOLATE TABLETS MARKET IN UKRAINE

During the deep stagflation after the USSR collapse either chocolate production or other industries experienced negative growth. But beginning with 1994 – 1995 years, when economy became more or less stable and open for foreign investors, the rebirth began. The enterprise, whose present name is Kraft Foods Ukraine, bought Trostyanets confectionery factory "Ukrajina.", Nestle began its production on the Lviv factory "Svitich", Western NIS Enterprise Fund, Sigma Bleizer and other multinational corporations also made investments in this industry. However, "Roshen" – one of the leading national producers, was created with own funds. Annual market growth for recent years was 4-5%.

As a result now chocolate tablets industry in Ukraine is presented with[1] (Table 3.1):

- 5 main competitors, three of which occupy more than 80% of the market (42%, 26%, 13%);
- 10 brands, three of which cover 70% of the market (38%, 22%, 10%).

[1] The data was made available on condition that market players' identity couldn't be directly inferred from description of either data or results. So, from now we will refer to brand 1, brand 2, etc.

Table 3.1: *Chocolate tablets market players in Ukraine*

Producers	Brands
Nestle	Svitoch
	Svitoch 1882
	Aero
Ukrprominvest	Zodiak
Kraft Foods Ukraina	Korona
	Spokusa
	Milka
Malbi	Millenium
	Lyubimov
Russkiy Chocolate	Russkiy Chocolate

Foreign products' share is about 7% with leading representative from Russia "Russkiy Chocolate".

As it can be seen, we have a deal with oligopoly, where under economic theory price competition is to be the main instrument of producers' interactions.

Main features of chocolate tablets market:

- seasonality: chocolate consumption almost always experiences significant growth during autumn and winter, whereupon recession in spring and summer except for February and March. It gives more utility to eat chocolate with a cup of coffee when it is raining or snowing outdoors then drink cold water with thawed chocolate tablet on the beach. "February effect" can be explained with reasonable dropping of sales after the abnormally increased consumption during the Christmas and New Year holidays. "March effect" incorporates International Women's Day and the first month of spring – the time of falling in love (chocolate is a great present for every woman).

- high correlation between prices of chocolate and cocoa beans: cocoa is its main ingredient.

Chapter 4

DATA DESCRIPTION AND METHODOLOGY

The data, which is used in the estimation of Ukrainian demand elasticities for chocolate tablets in this research, is time-series and monthly. It covers the period from 2001 to 2004 (48 observations for each variable) and is aggregated at the national level. Desegregation to the oblast level may not even give more information, as prices and competition not vary across regions and advertising is mostly at the national level too. All figures were taken from the confidential source except Salary, CPI, USD/UAH Exchange Rate (National Bank of Ukraine), Population (State Committee of Statistics), the Price of Cocoa Beans (New York Board of Trade). December' 2000 was taken as a base period for CPI. So, we will use (for descriptive statistics see Appendix A, Table A.1, Figure A.1):

Salary – Official real average salary in Ukraine, UAH ($Salary = Salary_{nominal} / CPI$);

P – Average real retail price per 1 kg of chocolate tablets, UAH ($P = P_{nominal} / CPI$);

P1, P2, P3 - Real retail prices per 1 kg of chocolate tablets of 3 leading brands , UAH;

S – Market Size (Retail Sales), kg per capita (Total volume of sales/Ukrainian population);

S1 – Retail Sales of Brand1, kg per capita

A – Advertising (GRPs), number of times per month (Average number of times a typical household has been exposed to an advertisement of chocolate tablets in a month);

A1, A2, A3 – Advertising (GRPs) of 3 leading brands, number of times per month;

COCOA – Price of cocoa beans at New York Board of Trade expressed in UAH. Though most of companies buy this product in Europe, prices of cocoa beans are correlated all over the world. This data was taken with lag 10 taken into account the time for transportation stock time and forward feature of contracts.

All the series have growing pattern, moreover Sales and Advertising highly depend on seasons of the year, and they vary a lot. In summer, for example, the probability not to see any advertising is rather high, however, in December one will be exposed to it 2681 times. Every Ukrainian gets a salary of UAH 389 and eats 0.027 kg of chocolate tablets in average per month. All the prices behave similarly depending on the prices of cocoa beans. However Brand 3 represents luxury good on the market, so its price is rather higher (UAH 29.64) than average one (UAH 22.82). P1 and P2 seem to copy each other, but the first one is a little bit higher (for UAH 1.98). In order to buy one standard tablet of Chocolate (0.1 kg) a representative Ukrainian should pay for that 0.6% of his income. All the further analysis will be provided further as variables appear in the analysis.

The research is subdivided into two parts:

1. Estimation of Ukrainian demand for chocolate tablets and its elasticities at **macro-level**
2. Estimation of demands for chocolate tablets which are produced by different firms (brands) and their own and cross elasticities – **micro-level**.

Macro Level

Model 1:

As we have only one paper, which concerns chocolate market – Eagle & Ambler (2002)[2], it seems reasonable to follow its methodology of demand exploring. In such a way we would be able to compare the obtained results for Ukrainian and Western Europe chocolate markets. Though this investigation doesn't give us any information about the demand elasticities, with its help we would be able to bring insight into the growth of market size and its determinants. The percentage growth of market (gS) is going to be linearly related to price of chocolate, "the amount of advertising," consumer wealth and dummies for changes in variables during time, which is not related to any of parameters in the model:

$$GS(t) = C(1) + C(2)*P(t) + C(3)*A(t) + C(4)*Salary(t) + u(t), \qquad (4.1)$$

Also we are going to include trend and dummies for all possible months and then exclude those of them, which are insignificant. OLS will be used in estimation.

To be results fully comparable with the outcome of Eagle & Ambler (2002) we will use the same specification and method of estimation as they proposed. But, necessary to mention that, it doesn't take into account several problems among which endogenous nature of price. In order to receive more correct demand estimation and get elasticities from it, we will construct another model.

Model 2:

The demand for chocolate tablets in Ukraine (S) is also supposed to be explained with Price (P), Advertising(A), Income (Salary) and dummies for different

[2] See Chapter II for details

periods. Constructing our own specification we are to identify problems, which are to be overcome.

First of all, in order to to obtain elasticities we will use series in logarithms (denoted as a prefix "L" before the variable). Price determines sales and sales influences price. So, residuals are to be correlated with price. To get rid of it we will use instrumental variable – the price of cocoa beans ("cocoa"). It is not influenced by sales and correlation between these series is 0,796. This is not strange because cocoa beans are the main ingredient of chocolate.

According to the Augmented Dickey-Fuller test all of the variables (without dummies) are I(1), besides they are cointegrated according to Johansen test, which indicates one cointagration equation (Tables B.1, B.2). So, not to obtain spurious regression we will apply unrestricted Error Correction Mechanism similar to those, which was applied by Johnson et al (1992) estimating consumption elasticities of alcoholic beverages in Canada.

The model will look like:

$$\begin{aligned} D(LS(t)) = {} & C(1) + C(2) * (LS(t-1) + C(3) * LP(t-1) + C(4) * LA(t-1) + \\ & C(5) * Lsalary(-1)) + C(6) * D(LS(t-i)) + C(7) * D(lP(t-i)) + \\ & C(8) * D(LA(t-i)) + C(9) * D(Lsalary(t-i)) + u(t) \end{aligned} \quad (4.2)$$

where i = 0… - lag length. Also, there will be included dummies for all of the months, whereupon we will leave only significant variables. The coefficients near the first differences of dependent variables with i=0 will indicate the demand elasticities with respect to those variables. To incorporate the instrument for price we will use GMM as according to Greene (2000), it is one of the most efficient implements in this case. Besides, this procedure will take into account the possible problem of autocorrelation.

MICRO LEVEL

Effect of temporary changes in prices (promotion actions):

As chocolate tablets market in Ukraine is presented with 3 main producers (brands), each of them would be interested in the estimation of either the effect of his and competitors' temporary marketing actions or permanent change in pricing policies on own demand. We will construct a model which will connect all of the brands' Prices with Sales of one of them to estimate demand with its short-run and long-run price elasticities. As far as estimation procedure is the same for every competitor, it will be presented for brand 3 only. This product is luxury one – porous chocolate, and, as it can be seen from Figure A.1, its price is higher than competitors' prices. So, demand for this chocolate tablet is expected to be not elastic.

We have exogenous and interdependent variables. To obtain dynamic elasticities (IRFs) and ideally describe the market we need to construct VARX model (Vector Auto-Regressive Model with exogenous variables) using all the Prices and sales of brand 3 as endogenous; and real salary, each brand's advertising with dummies for different seasons as exogenous. It would be also interesting to modify model and include advertising as endogenous variables, but we are lack of degrees of freedom and most of demand exploring papers are assumed them to be independent.

We will modify the model proposed by Dekimpe & Hanssens (1999) and construct:

$$\begin{bmatrix} LS1_t \\ LP1_t \\ LP2_t \\ LP3_t \end{bmatrix} = \begin{bmatrix} a_{1,0} \\ a_{2,0} \\ a_{3,0} \\ a_{4,0} \end{bmatrix} + \sum_{i=1}^{N} \begin{bmatrix} a_{11}^i a_{12}^i a_{13}^i a_{14}^i \\ a_{21}^i a_{22}^i a_{23}^i a_{24}^i \\ a_{31}^i a_{32}^i a_{33}^i a_{34}^i \\ a_{41}^i a_{42}^i a_{43}^i a_{44}^i \end{bmatrix} \begin{bmatrix} LS1_{t-i} \\ LP1_{t-i} \\ LP2_{t-i} \\ LP3_{t-i} \end{bmatrix}$$
$$+ \sum_{i=1}^{N} \begin{bmatrix} a_{11}^A a_{12}^A a_{13}^A \\ a_{21}^A a_{22}^A a_{23}^A \\ a_{31}^A a_{32}^A a_{33}^A \\ a_{41}^A a_{42}^A a_{43}^A \end{bmatrix} \begin{bmatrix} LA_{1,t-i} \\ LA_{2,t-i} \\ LA_{3,t-i} \end{bmatrix} + \begin{bmatrix} a_{11}^{Salary} \\ a_{21}^{Salary} \\ a_{31}^{Salary} \\ a_{41}^{Salary} \end{bmatrix} LSalary_t + \begin{bmatrix} a_{11}^D \\ a_{21}^D \\ a_{31}^D \\ a_{41}^D \end{bmatrix} D_t + \begin{bmatrix} e_{1,t} \\ e_{2,t} \\ e_{3,t} \\ e_{4,t} \end{bmatrix} \quad (4.3)$$

where ɨ lag length, D – dummy for seasonality. All variables are taken in logarithms with the purpose of easily obtaining elasticities from the outcome and get the effect of constant elasticity.

One could argue against the reasonability of applying model with so many coefficients having only 48 observations, but we are doing it mostly with descriptive purposes of applying such a methodology to estimation the demand elasticities of a particular brand.

To be more precise with model specification we are to check the stationarity of the used series. Augmented Dickey-Fuller indicates that all of them are stationary in first differences, and Johansen Cointegration test didn't detect any cointegration relation at 1 lag (Tables C1, C2). Lag was determined with the help of Akaike Criteria (Table 4.1):

Table 4.1: *Akaike Criteria for VARX*:

	1 lag	2 lags	3 lags
Akaike Criteria	-18.754	-17.815	-16.890

So, according to the obtained results of the tests we will run Vector Autoregressive Model with exogenous variables (VARX) in differences.

Impulse response functions (IRFs) of Sales, constructed with the shock in 1 standard deviation of the variable will give us dynamic demand elasticity with respect to it or the effect of one month price change. Also, coefficients near the advertising and salary variables will give us elasticities with respect to them. As far as they are independent, won't be able to find dynamic elasticities for them.

Effect of permanent change in prices (change in pricing policy):

The problem of estimating the effect of permanent change in price is quite actual and can be raised when firm decides to change the positioning of the brand and increase (decrease) its price.

A soon as the model which describes the market for cocoa beans is estimated, it is possible to make the forecasts for every endogenous variable based on the obtained coefficients. Making restrictions on the behavior of some variables (for example, permanent increase in P3 per 1 percent) we will obtain the response of other components of the model including sales. Sorting out different scenarios it is possible to find the best one. Besides, it will be done through estimation of demand elasticities. Necessary to mention that P3 in this case is not endogenous any more, and it is not affected by other variables. EviewsIV allows to make any variable follow some scenario with the help of incorporating an add factor in the equation of this variable. For example, if we have an equation of $f(y_i) = f_i(y,x)$, than we can include an add factor "a" in it: $f(y_i - a) = f_i(y,x)$, and generate "a" in such a way, that endogenous variable takes the form of predetermined one.

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Chapter 5

EMPIRICAL PART

MACRO-LEVEL

All the computations were made in Eviews IV and Microsoft Excel.

Model1:

As it was mentioned in the previous part, the first step of empirical estimation will be duplication of the estimation procedure of Eagle & Ambler (2002) applying data for Ukrainian chocolate market in order to compare the obtained results.

After the excluding of all not significant variables OLS gave the outcome presented in Table 5.1.

Table 5.1 *The results of Model 1 (Macro-level)*

Dependent Variable: GS				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
A	0.003400	0.000865	3.931433	0.0003
SALARY	0.053661	0.023673	2.266807	0.0290
RP	-1.381451	0.460182	-3.001971	0.0047
MARCH	14.69119	4.678639	3.140056	0.0032
SEPTEMBER	17.44232	4.792033	3.639859	0.0008
OCTOBER	10.74111	4.552436	2.359421	0.0234
AUGUST	-6.521783	4.658402	-1.400004	0.1004
APRIL	-9.224506	4.501384	-2.049260	0.0472
R-squared	0.537577	Mean dependent var		0.820534
Adjusted R-squared	0.454578	S.D. dependent var		11.29113
S.E. of regression	8.338807	Akaike info criterion		7.233557
Sum squared resid	2711.892	Schwarz criterion		7.548476
Log likelihood	-161.9886	Durbin-Watson stat		2.165836
White Heteroskedasticity Test (H_0- no heteroscedasticity):				
F-statistic	0.368637	Probability		0.959885
Obs*R-squared	4.879921	Probability		0.936842

An explanatory power of the model (Adjusted R-squared = 0.45) is not very low and in two times exceeds the value of this indicator in the regression of Eagle & Ambler (2002). Durbin-Watson statistics indicates no autocorrelation, White test accepts hypothesis of no heteroscedasticity. Lagged Salary was excluded from the model due to high correlation with not lagged variable (correlation: 0.961726). Advertising does have an influence on the growth of Ukrainian chocolate market (for Western Europe countries this variable was not significant). If the number of times a typical household has been exposed to advertising increases by one time, the total sales will increase by 0.0034%. So, if a firm advertises its brand, then it doesn't only attract the consumers who bought other products, but also entices people, who didn't eat chocolate tablets before, or advertising just makes a consumer to eat this product in bigger amounts. People would like to buy more chocolate if they had more money – if the average salary increases by one hryvna, the market growth will rise by 0.05366% (however, in developed countries income coefficient is equal 0.5). Even taken into account that UAH1 is less worth than EUR 1, the gap in the effect is still big. The most significant effect, except for dummies has price – the decrease in price for one chocolate tablet by 10 kopiykas will lead to the market growth rising by 1.38%.

As it was expected, many seasonal dummies appeared to be significant; moreover, their effect is much bigger than influence of any other variable. Their signs correspond to the monthly changes of sales (see Figure A.1).

Despite the fact that all of the mentioned variables are strictly significant, it is necessary to be cautious about the results because of mentioned in the previous chapter drawbacks of the model.

Model 2

After the excluding variables with most insignificant coefficients GMM estimation of the second model with instrumental variable "the price of cocoa beans" for price of chocolate gave the outcome placed in Table B.3.

Comparing with the previous model Adjusted R-squared became higher: 0.636. Most of the coefficients incorporated in Error Correction Mechanism are significant. So, its use is appropriate in this case. As before using of dummies are crucial for explaining the demand. To save degrees of freedom it was decided to combine the months with growing pattern of sales in one dummy "winter" (January, March, September, October, November, December), however we also use them separately as they added explanatory power to the model.

As was expected, August and July has a negative WINTER is positive. Negative coefficients near the March and November say that in these periods growth was not as big as in WINTER. Income and price elasticities appeared to be insignificant. From this outcome we can make a conclusion that demand is inelastic to these variables and equals zero. But such a high p-value can be explained with a little number of observations and a great number of procedures which were used to overcome the difficulties with data. Taken into account the result of significant influence of price and income on the market growth from the first model, we hold an opinion that price elasticity is -1.99 and income 0.33. So, the increase in price by 1% will lead to the decrease in sales per 1.99% and increase in average salary per 1 percent will cause the rise in sales per 0.33%. So, the demand for chocolate tablets is rather price elastic. Talking about the advertising, we can say that, it is significant with lag 2, but doesn't meter with other lags. It can be explained with the fact that people need time to believe it and make a response. Elasticity with respect to this variable is 0.039.

Temporary price changes (price discounts):

Following the methodological part we have estimated the described VARX model (Table C.3). To save degrees of freedom we performed a combined dummy "winter" in a way we did before. LSlary and LSalary(-1) are highly correlated, so we have taken the one, which was more significant – Lsalary(-1). Advertising variables we placed with lags 0, 1 and 2, further lags appeared highly insignificant. P-values of many coefficients are not really good, but it is acceptable for VARs. Besides, it easily can be explained with the lack of observations.

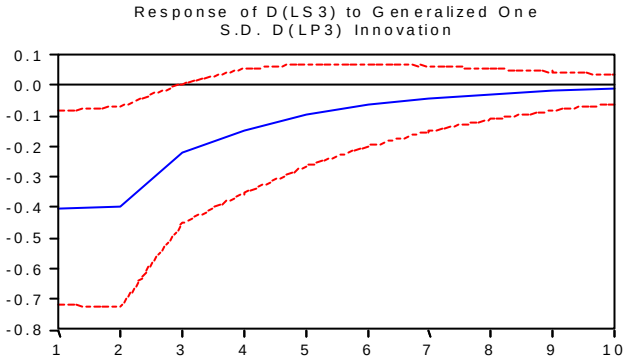
The advertising influence of all of the brands on the demand for the third one is quite low and doesn't exceed elasticity of 0.021%. Its greatest impact is observed at lag 1. Besides, this product is more sensitive to the outside promotion. People respond to the own advertising only in the second period with elasticity 0.016%, while the influence of other actions is significant in two periods with even grater magnitudes. It can be explained with the fact that Producer 3 covers relatively lower share of market, and of course, one percentage of its advertising is lower than the same unit of others. Interesting to mention that advertising of brand 1 has a positive impact on the consumption of our chocolate tablet. This outcome we could get from the qualitative characteristics of the promotion. The advertising of brand 1 is more devoted to the chocolate, than to the own product.

Salary is insignificant. Consumers of these chocolate tablets have strong preferences concerning them and they won't change their choice despite any income disturbances.

Applying generalized impulses to each of the price we have obtained dynamic price elasticities (Figures 5.1, 5.2). So, we constructed an orthogonal set of

innovations that don't depend on the VAR ordering (Cholesky decomposition doesn't allow for that). These responses to an innovation to the j-th variable were derived by applying variable specific Cholesky factor computed with the j-th variable at the top of the Cholesky ordering (EviewsIV gives such an option).

Figure 5.1: *Own-price elasticity*

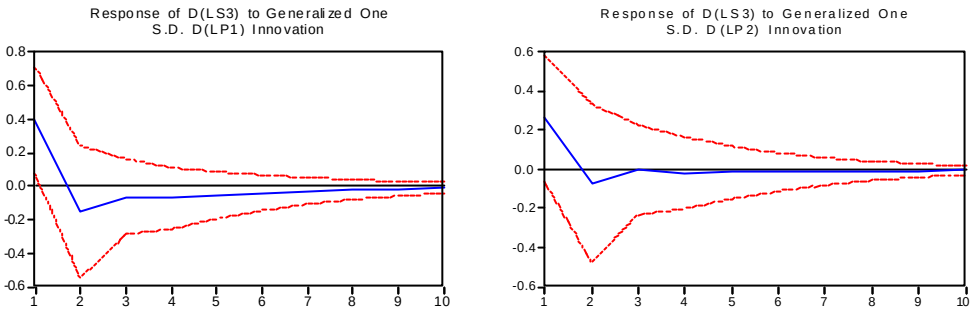


According to the Figure 5.1 and Table C.4, the demand for this tablet is not elastic: in the first period elasticity equals –0.4 and then it declines with time rather slow, till the end of the 10-th months effect already despaired. Brand 3 is a premium-class product, so such a behavior of demand is rather logical. Buyers of these tablets are wealthy people, for whom increase in price by one percent will lead the decrease of consumption only by 0.4%. According to this finding we can conclude that price discount for a short period of time is not in effective policy for sales enlargement.

Talking about the demand behavior of Brand 3 with respect to changes in competitors' prices, necessary to say that it reacts approximately in the same manner to each of them (Figure 5.2, Table C.3), but the magnitude of the response to change in P1 is bigger. It can be explained with the fact that brand 1

having bigger market share has bigger influence on the market and brand 3 as a component of this market.

Figure 5.2: *Cross-price elasticities*



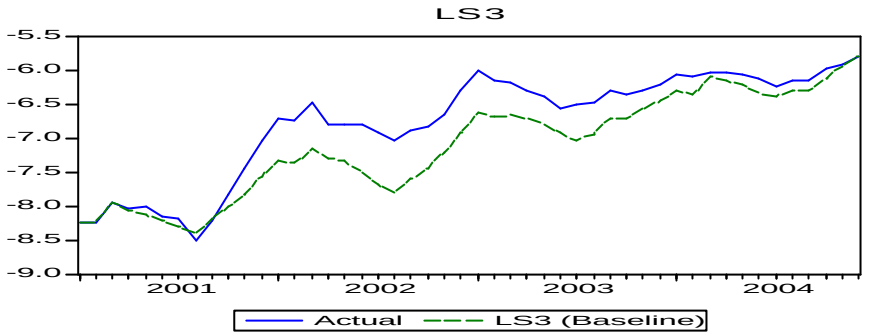
The cross-price elasticity with respect to first brand is 0.4, second brand: 0.25 in the first period. Then it goes in a little bit strange way decreasing till the negative sign of 0.15 for firm1 and 0.75 – for firm2, afterward decreasing to zero. When some firm increases price for the good it produces, it looses some consumers – that is why in period 1 sales of brand 3 have grown. But then, some loyal to firm 3 consumers will treat brand 1 as more or less luxury because its price became higher. So, it will lead to exchange of the consumers. The same explanation is applicable for the price discount because the problem lies in the borders of market segmentation. If someone has made the discount in price, he will attract some consumers from a segment of cheaper chocolate and scare away buyers from previous usual part of the market regardless the quality of product. But with time the effect of price promotion will come to zero.

Permanent price changes:

On the base of estimated coefficients from VARX we have constructed a forecasting model with 4 endogenous and 5 exogenous variables (Table C. 5). The goodness of its historical simulation fit for LS3 is satisfactive (Figure 5.3) :

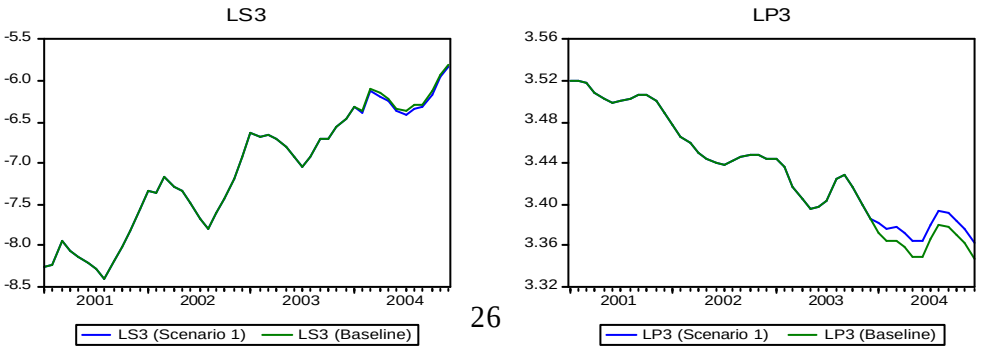
Mean Simulation Error = -0.32646; Mean percent error = 4.974604%.

Figure 5.3: *Simulation possibility of the model*



Now we can provide the effect of permanent change in some variable on the behavior of all the system (all endogenous variables). As an example, we will change lP3. Suppose, managers want to change the pricing policy concerning brand 3 and decide to permanently increase it by 1%. Unless they don't incorporate other strategies and don't react on the market changes (endogenous variables of the system), model will be able to predict the outcome of such an action. For simplicity, let's assume that now there is the first of January'2004 (of course it can be done for future periods too) and firm 3 decides to increase the price by one percent. We incorporate an add factor into the model, which makes LP3 to follow this pattern. The outcome can be seen in Figure 5.4.

Figure 5.4: *The effect of permanent increase in LP3 by 1 %:*



May be, it is not clear from the graph, but according to numerical values: sales decreased in average by 3.3% (Table C.6). This elasticity is much higher than those, which we obtained from the impulse response functions. It can be explained with the fact that now firm 2 doesn't adjust the behavior of the market.

We won't provide the analysis for other prices as it is hard to believe that competitors won't react the market in the forecast period.

Constructed model can be applied to real business market for optimizing price strategies.

Chapter 6

CONCLUSIONS

This work was devoted to the estimation elasticities of the demand for chocolate tablets in the Ukrainian oligipolistic market. We subdivided our research into two parts: macro and micro levels. Macro-level analysis investigated the demand's elasticities of chocolate tablet as an aggregated product of all of the brands in the market. Micro-level exploration scrutinized the demand for one of the leading brands.

The most significant chocolate consumption driver appeared to be seasonality, which leads to potent increase of market during autumn and winter, decrease in spring and autumn except for February and March.

Chocolate tablets' price also has a strong effect on the consumer behavior, and, as it was expected, – negative. In one of the models its coefficient appeared to be insignificant and equal -1.99. We could treat this fact as: "chocolate is inelastic good", but taking into account the problems with data and the lack of observation, this hypothesis was rejected. More over, chocolate the representative tablet is not a luxury good with respect to other products, and has many substitutes (sweats, bars, etc.). This conclusion is also supported with the outcome from another model, where price does influence the growth of market size with significant coefficient of – 1.38.

Income elasticity has the same problem. From one model it is about 0.13% and insignificant, from another income is a driver of market growth and is statistically

credible. Its increase by UAH1 will lead to 0.05% increase of the market growth. In Western Europe Countries under Eagle & Ambler (2002) both price and income are significant, but first one has lower magnitude and second – greater.

So, we are forced to conclude that income and price elasticities are equal to the mentioned values, but this topic needs further research.

We've found a strict dependence between chocolate market growth and advertising. This relation doesn't hold for Western Europe countries. So, the increase of competitors' advertising activity causes not only redistribution between their market shares but also leads to the increase of Ukrainian market size and its growth. Advertising elasticity was found to be 0.03968 at lag 2, and, if the number of times a typical household has been exposed to an advertising increases by one time, the total sales will go up by 0.0034%.

Micro-level investigation gave us an opportunity to explore the demand for brand of luxury porous chocolate, which is not the leader but has rather big share of market. The estimated market-response VARX model (with all of the prices and this brand's sales as endogenous variables) gave us an effect of temporary price changes on its demand (price discounts) with the help of IRFs. As it was expected for luxury good, it is not very price elastic: –0.4% for own price and 0.4%, 0.25% for competitors' temporary price promotions in the first period with decreasing pattern. All of the price shocks don't lead a model to other steady states of variables and die out after the tenth period. As other two brands have bigger shares of market than the brand under consideration, the impact of their price shocks are big compared to own price effect. So, according to these results, price promotions won't lead to far better performance in sales.

Income appeared to be not significant, which can be explained with the fact that consumers of this product have strong preferences concerning it. Most of them

are rich people and change in income doesn't effect their consumption of favorite good.

Advertising does have but not very strong impact on the sales in periods 1, 2 and 3 (not more than 0.021%). Besides, the competitors' promotion has bigger influence than own one. It can also be explained with differences in shares. We have found the positive influence of the advertising activity of outside brand on consumption of the luxury tablet. It says that advertising of outside brand is more devoted to the chocolate, than to the own product.

On the basis of VARX there was created a model, which can forecast the effect of permanent change in all the variables. It can be already used with business purposes. As an example of illustrating the procedure we have estimated the effect of permanent change in price for the brand under consideration. Own - price elasticity appeared to be higher than the value estimated earlier and was about 3.3%. It can be explained with the fact that the forecasting variable is not allowed to response to the market changes (deviation of other endogenous variables). So, these methods are to be applied with respect to different assumptions.

This research could be developed through:

- incorporating more variables in the regression for Macro-level (include the prices of substitutes and complements). Unfortunately we were scarce of this data;

- enlargement of micro-level model including the sales and advertising variables of the brands as endogenous;

- application the proposed procedure to another kind of data, which is irrelevant to seasonal influences – scanner data, daily data, yearly data; scanner and daily data will also solve the problem of evolving series;

- using more observations.

BIBLIOGRAPHY

Barnett, W. (1979), 'Theoretical Foundations for the Rotterdam Model,' The Review of Economic Studies, Vol. 46, nr. 1, p. 109-130

Bartlett, M.S. (1948), 'A Note on the Statistical Estimation of Supply and Demand Relations from Time Series', Econometrica, vol. 16, nr.4, p. 323-329

Blattberg, R. and E. George (1991), 'Shrinkage Estimation of price and Promotional Elasticities: Seemingly Unrelated Equations', Journal of the American Statistical Association, vol. 86, nr. 414, p. 304-315

Christense, L., D. Jorgenson, L. Lau (1975), 'Transcendental Logarithmic Utility Functions,' American Economic Review, nr.65, p. 367-383

Deaton, A, J. Muellbauer (1980), 'An Almost Ideal Demand System,' The American Economic Review, vol. 70, nr. 3, p. 312-326

Dekimpe, M., D. Hanssens, S. Silva-Risso (1999), 'Long-run effects of price promotions in scanner markets,' Journal of Econometrics, nr. 89, p. 269 - 291

Dekimpe, M., D. Hanssens, S. Silva-Risso (2003), Persistence Modelling for Assessing Marketing Strategy Perfomance,' Journal of Econometrics, nr. 65, p. 269 – 289

Duffy, H. (1991), 'Advertising in Demand Systems: Testing a Galbaraithian Hypothesis,' Applied Economics, nr. 3, p.485-496

Eagle, B., T. Ambler (2002), 'The influence of advertising on the demand for chocolate confectionery,' International Journal of Advertising, nr. 21, p. 437-454

Ghost, A., S. Neslin, R. Shoemaker (1984), 'A Comparison of Market Share Models and Estimation Procedures,' Journal of Marketing Research, Vol. 21, p. 202 – 210.

Greene, W. (2000), 'Econometric Analysis'-4th ed.

Haavelmo, T. (1943), 'The Statistical Implication of a System of Simultaneous Equations', Econometrica, vol. 11, nr. 1, p. 1-12

Hetemaki, L., J. Kuuluvainen (1992), 'Incorporating Data and Theory in Roundwood Supply and Demand Estimation', American Journal of Agriculture Economy, p. 1010-1018

Hsiao, C., D. Mountain (1985), 'Estimating the Short-Run Income Elasticity of Demand for Electricity by Using Cross-Sectional Categorized Data', Journal of American Statistical Association, vol. 80, nr. 390, p. 259-265

Johnson, J., E. Oksanen (2001), 'Estimation of Demand for Alcoholic Beverages in Canada from Pooled Time Series and Cross Sections', The Review of Economics and Ststistics, p. 113-118

Johnson, J., E.Oksanen, M.Veall, and D. Fretz (1992), 'Short-Run and Long-Run Elasticities for Canadian Consumption of Alcoholic Beverages: an Error-Correction Mechanism / Cointegration Approach', The Review of Economics and Statistics, vol. 74, nr. 1, p. 64-74

Marquez, J. (1994), 'The Econometrics of Elasticities or Elasticity of Econometrics: An empirical Analysis of the Behavior of U.S. Imports', The Review of Economics and Statistics, vol. 76, nr. 3, p. 471-481

Nijs, V., M.Dekimpe, J. Steenkamp, D. Hanssens (2001) , 'The Category-Demand Effects of Price Promotions,' Marketing Science, vol. 20, nr. 1, p.1-22

Srinivasan, S., T. Leszczyc, F. Bass (2000), 'Market share response and competitive interaction: The impact of temporary, evolving and structural changes in prices,' International Journal of Research in Marketing, nr. 17, p. 281 – 305

Stone, J. (1954), 'Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand ', Economic Journal, nr. 64, p. 511-527

Theil, H. (1965), 'The Information Approach to Demand Analysis', Econometrica, vol. 33, nr. 1, p. 67-87

Thurman, V. (1986), 'Endogeneity Testing in a Supply and Demand Framework', The Review of Economics and Statistics, vol. 68, nr. 4, p. 638-646

Waugh, F. (1961), 'The Place of Least Squares in Econometrics,' Econometrica, 29, p. 386-396

Working, E. (1926), 'What do Statistical "Demand Curves" Show?,' Quarterly Journal of Economics, vol. 41, nr. 2, p. 212-235

Xiao, H., W. Kinnukan, H. Kaiser (1999), 'Effects on Advertising on U.S. Non-Alcoholic Beverage Demand: Evidence from a Rotterdam Model,' Journal of Africultural and Resource Economic