Demand models for direct mail and periodicals delivery services: results for a transition economy

Beko, Jani; Jagric, Timotej

DEMAND MODELS FOR DIRECT MAIL AND PERIODICALS DELIVERY SERVICES: RESULTS FOR A TRANSITION ECONOMY

Journal:	*Applied Economics*
Manuscript ID:	APE-07-0518.R1
Journal Selection:	Applied Economics
Date Submitted by the Author:	26-May-2008
Complete List of Authors:	Beko, Jani; Faculty of Economics and Business, Department for political economy Jagric, Timotej; Faculty of Economics and Business, Department for quantitative economic analysis
JEL Code:	C22 - Time-Series Models < C2 - Econometric Methods: Single Equation Models < C - Mathematical and Quantitative Methods, D42 - Monopoly < D4 - Market Structure and Pricing < D - Microeconomics, L80 - General < L8 - Industry Studies: Services < L - Industrial Organization, L87 - Postal and Delivery Services < L8 - Industry Studies: Services < L - Industrial Organization
Keywords:	elasticity of demand, direct mail and periodicals market, demand factors, estimation

DEMAND MODELS FOR DIRECT MAIL AND PERIODICALS DELIVERY SERVICES: RESULTS FOR A TRANSITION ECONOMY

Jani Beko, Department for political economy, Faculty of Economics and Business, University of Maribor, Razlagova 14, 2001 Maribor, Slovenia

Timotej Jagric[1], Departmet for quantitative economic analysis, Faculty of Economics and Business, University of Maribor, Razlagova 14, 2001 Maribor, Slovenia

DEMAND MODELS FOR DIRECT MAIL AND PERIODICALS DELIVERY SERVICES

ABSTRACT: This paper examines the demand for services of the Slovenian national postal operator for the direct mail and periodicals market and separately for the direct mail market. The main factors of the demand are found to be various price indicators with respect to individual market, two income series and the variable of economic environment. The results of our empirical analysis suggest that the price elasticity of demand on both markets is below zero. The autonomy in price increases is limited due to positive cross-price elasticity of demand for direct mail with regard to price fluctuations for TV commercials. Substitution effects on the direct mail market are even more evident with regard to price fluctuations for advertisements in magazines and daily papers. An additional finding is that the demand on both markets varies seasonally in all models estimated by us. Finally, coefficients of income elasticity of demand for direct mail services show that the total number of mail deliveries on the direct mail market increases faster than the retail revenue in real terms.

[1] Corresponding author: Timotej Jagric, Department for quantitative economic analysis, Faculty of Economics and Business, University of Maribor, Razlagova 14, 2001 Maribor, Slovenia. Phone: +386-2-2290343; fax: +386-2-2516141; e-mail: timotej.jagric@uni-mb.si.

1. INTRODUCTION

Although national postal operators possess the attributes of a natural monopoly and are subject to state control, they are exposed to increasing competition pressure as a result of the current process of mail market deregulation and the liberalisation of network industries (see, for example, WIK, 2006; Jung et al., 2008). Competition between mail service providers is increasingly more pronounced as far as the price and the quality (timeliness, reliability and adaptability) of the existing services are concerned (Albon, 1989; Filippini and Zola, 2005; Franses, 2007) and is even increased through the emergence of new modes of communication that are frequently very attractive alternatives to traditional mail services supplied by the national postal operators (Goel et al., 2006).

Bearing in mind the dynamics of national (and international) mail markets, it is understandable that there is a need for as precise as possible knowledge of demand factors. Extensive efforts have been invested in estimations of demand functions for mail. Collected empirical evidence is thus considerable, but rather fragmented according to market segments and limited to mail markets of developed economies. Valid estimations of demand functions exist separately for first and second class inland letter traffic for Great Britain (Cuthbertson and Richards, 1990; Nankervis et al., 2002), Finland (Nikali, 1997) and France (Rycke et al., 2001), for inland letter traffic for Great Britain (Nankervis and Rodriguez, 1995; Nankervis et al., 1999) and Portugal (Pimenta and Ferreira, 1999), for direct mail services for Portugal (Santos and Lagao, 2001), for four groups of addressed mail, without separately considering direct mail, for France (Florens et al., 2002), for postal delivery services at the household level in the United States (Wolak, 1997), and estimation of demand functions for parcel services in the United States (Nissen and Lago, 1975). Results of empirical studies depend not only on differences in definitions of estimated market segments but also on whether the studies concern applications of dynamic models based on aggregate time series or microeconomic models applied to cross-section data (see Cazals and Florens, 2002). Being aware of the risks of generalizing empirical findings, we can nevertheless

claim that estimations of functions of mail demand indicate at least three facts. First, price elasticity of mail demand is normally inelastic (or limited), whereby demand sensitivity to changes in (relative) prices increases across time. Second, substitution effects are often identified on mail markets but vary in significance and duration. Third, the impact of income on change in demand for various types of mail services cannot be neglected.

The present paper is part of research conducted during the proceedings of the Competition Protection Office of the Republic of Slovenia against the Slovenian national postal operator, Posta Slovenije d.o.o. (Post of Slovenia), for alleged abuse of its dominant position on the unaddressed direct mail market. The aim of this paper is to present estimations of demand functions for mail services of the Post of Slovenia in inland postal traffic by analyzing time series applied to the direct mail and periodicals market segment and the direct mail market segment. To the best of our knowledge there are no studies on elasticities of demand for mail services for (advanced) transition economies. Furthermore, as the overview of literature above testifies, even studies focusing on the demand factors of direct mail services in individual developed country are rather rare.

Post of Slovenia first offered the delivery of unaddressed direct mail in 1997, while the delivery of printed matter and other types of addressed mail had been offered already before that. In 2002, the direct mail and periodicals services were officially declassified as reserved postal services in Slovenia. Delivery of direct mail and other related matter have become the most dynamic component of postal services provided by the Slovenian postal operator in recent years. In 2005, revenues from direct mail, periodicals and inserts (which amount to a good fifth of revenues from postal services of Post of Slovenia) increased by 16% compared to the year before and were higher than revenues from letter and parcel services as well as express mail. In the same period, an above-average increase in the number of services related to the delivery of addressed and partially addressed direct mail (a 58% increase), unaddressed periodicals and inserts (a 28% increase), and unaddressed direct mail (a 10% increase) was recorded. As a

consequence, in 2005 the share of unaddressed direct mail, unaddressed periodicals and inserts in the total number of all postal services of Post of Slovenia increased by three percentage points in comparison with the previous year and reached 51% (Post of Slovenia, 2006). The above described boost in the volume of direct mail services benefited significantly from favorable economic trends (for example, in the 2000-2005 period the average annual real growth rate of Slovenia's GDP amounted to 3.6%) triggering advertising and marketing activities, and in particular from bustling trade activities. Thus, in the 2000-2005 period, the average annual real growth rate of value added in wholesale and retail trade, and in maintenance and repair of motor vehicles amounted to 3.1%. According to the estimations of Post of Slovenia, in the same period 95% of clients for direct mail and periodicals delivery services were in the trade sector. The rest of businesses demanding those services were in the financial intermediation, industry, and transport, warehousing and distribution sectors.

In addition to the introduction, the paper consists of four further chapters. Chapter two presents a range of available data sets belonging to potentially relevant explanatory variables in models of demand in terms of content criteria and the selection procedure for series actually used in this estimation. Chapter three explains the specifications of functions of demand for direct mail and periodicals delivery services and for direct mail delivery services. Chapter four includes testing of selected demand models and an explanation of results obtained. The paper ends with a presentation of key findings.

2. FACTORS AFFECTING DEMAND FOR DIRECT MAIL AND PERIODICALS DELIVERY SERVICES IN SLOVENIA

As a rule, five groups of explanatory variables, which can be divided into two sets in terms of content, are included in the design of demand functions for postal services in various segments and at various levels of the aggregation. The selection and grouping of variables were guided by similar studies for developed economies (Cuthbertson and Richards, 1990; Nankervis and

Rodriguez, 1995; Nikali, 1997; Nankervis et al., 1999; Pimenta and Ferreira, 1999; Santos and Lagao, 2001; Florens et al., 2002; Nankervis et al., 2002).

In terms of content, the first set includes variables trying to encompass socio-economic demand factors. Five groups of variables can be identified: (1) price variables; (2) income variables; (3) economic environment variables; (4) seasonal factors; and (5) other socio-economic factors. The other set in terms of content includes two groups of variables expressing quality components of demand factors: (1) timeliness (speed) of mail transport or delivery, and (2) range of services complementing the base service (mail transport).

The actual selection of explanatory variables used from among the range of those recommended in terms of content and theory depends on the selected methodological procedure for the estimation of parameters in the demand equation for postal services, determination of markets or postal services observed, level of aggregation of demand functions, and actually available statistics.

Estimated demand equations are based on aggregate data sets, since the dependent variable captures the total number of mail deliveries received in two service segments. The first segment, hereinafter called the direct mail and periodicals market (DMP), consists of direct mail (addressed, partially addressed and unaddressed mail) together with periodicals and respective inserts (addressed, partially addressed and unaddressed periodicals and inserts in periodicals). The other, narrower segment referred to as the direct mail market (DM) consists of addressed direct mail, unaddressed direct mail not including unaddressed periodicals, and inserts in periodicals. The definition of only two types of dependent variables is unavoidable because a more detailed disaggregation along the above mentioned mail segments, which should of course be methodologically comparable to reference calculations of price variables, is not available, in particular not for the generation of sufficiently long minimum required data sets. Namely, Post

of Slovenia possesses only disaggregated annual data on direct mail and periodicals subsegments from 1997 onwards.

The introduction of qualitative variables requires a possibility to monitor (empirically noted) impact of non-price competition factors on the structure of the market as a unit, that is on the volume of deliveries by individual mail subgroups. Direct mail customers place much impact on the availability (accessibility) of mail recipients in addition to reliable mail services. Thus companies or postal operators with the largest distribution and data networks enjoy comparative advantage in attracting customers. For the direct mail and periodicals segment and the direct mail segment, the Slovenian postal operator normally performs delivery within the time required by customers or within two days after the day of mailing. In addition, direct mail delivery is an upgrade of the basic mail service. Thus all variables included in the second content-related set in Chapter 2 are excluded from the range of theoretically appropriate (direct) explanatory variables.

In conducting econometric assessment of variables we can rely on socio-economic variables, having a possibility to choose among various time series (Table 1).

<TABLE 1 ABOUT HERE>

In generating average nominal prices for direct mail and periodicals services, we used sampling data on mailed items (direct mail and periodicals and separately direct mail) to calculate the average weight, which was then multiplied by the rate from the price list for the particular weight valid in a particular period. For the calculation of discount prices, their amount was deducted from financial statements on revenues from services concerned.

Communication with users through postal network channels competes, or at least can compete, with other marketing communication forms and media. Research on direct mail markets (Santos

and Lagao, 2001) indicates, for example, that businesses base their customer communication strategies on a wide media portfolio. In technologically developed societies, electronic advertising media could be a competitor to direct mail, yet often their relationship can be complementary. Complementarity or substitutionality between various media depends to a large degree (at least at the level of customers) on content-related and technical characteristics of advertising messages sent to consumers. In addition to two pairs of price variables for direct mail and periodicals and for direct mail, three price variables for alternative media can be included. In all cases they have been converted to the number of advertising messages communicated, that is the average nominal price for TV commercials as listed in TV operators' price lists, the average nominal price for advertisements in magazines as listed in publishers' price lists, and the average nominal price for advertisements in daily papers as listed in publishers' price lists. Average prices of marketing messages in all three media were also calculated according to the number of seconds for commercial broadcasts on TV or square meters in printed media, respectively, but thus defined variables did not prove as statistically significant during testing.

It should be underlined that comparable price series for other advertising media, e.g. billboards, cinema, Internet, and radio, were not available. Series allowing for the exact amount of discounts to be contained in data on advertising prices were also unavailable.

Because all price series are expressed in nominal terms it is appropriate to convert them into a real category. We can choose from among three deflators: consumer price index (CPI), communications price index (PC), and services price index (PS). Content-wise, the latter is placed between CPI, which is the widest category, and PC, which is the most narrow price category (regarding the content of the paper). The communications price index covers price fluctuations in prices for mail and telephone services and related products.

The importance of purchasing power for explaining the dynamics of direct mail (and periodicals) delivery services is expectedly different from its importance in the case of traditional letter mail services. Direct mail is a service targeted at the business sector; therefore it involves derived demand. The demand does not directly reflect consumers' preferences for this particular service, but is dependent on preferences of end users, that is buyers of products produced by the direct mail customer (direct user). We thus differentiate between the impact of service users' income (the demand of companies for direct mail services is dependent on the dynamics of sales, available advertising and marketing budgets, maturity of sales markets, etc.) and the income impact resulting from the secondary demand chain. Between January 2000 and September 2006, 95.7% of all direct mail was delivered to households and the rest to companies according to the estimation of Post of Slovenia. The same is true for periodicals.

The set of income variables offers a choice between domestic consumption in real terms representing the real gross domestic product excluding the net exports of goods and services, registered real household income, real net wages paid, domestic revenue in mining (C) and manufacturing (D) in real terms, domestic revenue in manufacturing (D) in real terms, and revenue in retail trade (excluding motor fuel sales) in real terms. The registered real household income variable includes real net wages, non-wage employment-related benefits in real terms and real transfer receipts. Data on net revenue, in real terms, from sales to 50 largest customers of direct mail services of Post of Slovenia are available at annual level only.

Four indicators are given for economic environment variables: gross domestic product in real terms, economic activity in the mining sector (C), manufacturing (D) and electricity, gas and water supply (E), economic activity in manufacturing industries (D), and the number of existing and new housing units. Consumer price index was used for deflating all nominal income series and nominal economic environment series. An a priori choice between the stated income indices and economic environment indices is not possible, thus the final choice of variables will be made on the basis of objective criteria of the econometric analysis.

In analyzing factors of demand for mail services it is appropriate to assume the influence of seasonal factors. In estimating elasticity, the selected methodological procedure can be used to include seasonal influence in two ways: (1) by introducing dummy variables or (2) by seasonally adjusting the time series (multiplicative method X-12).

Other socio-economic factors are included by the following data: number of households in houses and multiunit buildings, number of “No Unaddressed Direct Mail" stickers, number of P.O. Box holders and users, number of P.O. Boxes for distribution, and number of work days in a certain time period. Because full evidence for the first four data series is available at the annual level only, nothing but the last series from the above listed other socio-economic variables can be used due to the selected methodology for estimating functional relationships.

Taking into account content-related relevance and constraints resulting from the method for elasticity estimations used, a selection from among available time series was performed. The entire set of available data series can be narrowed to the set of usable series (Table 2). The series of this set meet content-related and methodological criteria, in addition to which the following technical characteristics of the usable series must be met: (1) number of observations; (2) frequency of the time series (monthly, quarterly); and (3) structural breaks in recording data for individual series.

<TABLE 2 ABOUT HERE>

Because of structural breaks in average discount direct mail prices in real terms and the length of the registered real household income series and the real net wages paid series, a new data period has been defined to balance the data base. Consequently, 81 observations at the monthly level and 26 at the quarterly level are available for the 1999M8–2006M4 period. In the continuation we based the estimation of functions on monthly data series for several reasons.

First, with the exception of the interpolation of the total number of housing units generated from quarterly data, all data series have originally been obtained at monthly intervals. Second, it is recommendable to operate with the largest possible data sample, as there are five groups of explanatory variables: two types of price variables, income variables, economic environment variables, and other economic factors variables. If we used quarterly data, only three or four observations for each group of variables, respectively, would be available. This would cause the effect of memorizing the data in the model instead of model learning. And third, many tests used in this research are asymptotic in nature, which means that the reliability of statistic inference increases with the size of the sample. The requirement that time series must not contain structural breaks is coupled with the requirement that time series should be stationary, which prevents the possibility for spurious regression.

Taking into account the above mentioned criteria, we can perform the selection of time series on the basis of data from Table 2. Such time series meet content-related and methodological criteria as well as technical characteristics and are thus appropriate for the estimation of demand functions for direct mail and periodicals delivery services and direct mail delivery services. The string of time series appropriate for econometric estimation available at the monthly level without structural breaks and identified as I(0) (at the 5% significance level at least) is defined in the form of base coefficients (1999M8=1; in this way the influence of the unit of measure was at least partly removed) and marked in Table 2 with sign "*".

3. SPECIFICATION OF DEMAND FUNCTIONS FOR DIRECT MAIL AND PERIODICALS DELIVERY SERVICES

It is particularly important to assure sufficient model sensitivity in estimating functions. Thus a model will be sufficiently sensitive to demand analysis if the economic mechanism characteristics that influence demand for mail services of interest in the actual economic process will be explicitly present in the model structure specification. The sensitivity of the model is

further dependent on the extent to which the aggregation of economic variables is such that variations in demand for mail services concerned are sufficiently clearly pronounced in statistical data on individual economic variables. In addition, the length of the period during which the model is estimated also influences the accuracy of the model, because the characteristics of the economic and technical structure and norms of behavior contributing to the shaping of demand for direct mail and periodicals services and direct mail services, respectively, must be significantly present in the period concerned.

Many sophisticated econometric techniques like co-integration analysis have been applied to the analysis of demand functions in different areas (see, for example, the electricity demand forecasting in Engle et al., 1989). The technique of co-integration (see Engle and Granger, 1987) and error correction (see Hendry et al., 1984, among others) in the process of estimating demand functions avoids problems of spurious relationships that can bias the results and provides a convenient and rigorous way to discern between short-run and long-run effects of pricing policies. There are, however, some important limitations if one chooses such an approach. One important drawback of this methodology is the lack of power of the unit root tests needed to construct the co-integrating regressions. But more important in our case is that the time series should be tested for seasonal unit roots in order to correctly apply co-integration analysis. Since we use monthly time series, the seasonally component is probably present and significant. If we would ignore this fact the results of unit root test would be misleading.

A number of seasonal unit root tests have been proposed for the case of monthly data (Franses, 1991; Beaulieu and Miron, 1993) as an extension to the one suggested by Hylleberg et al. (1990). A characteristic of seasonal unit root tests is that they exhibit poor power performance in small samples and that the power deteriorates as the number of unit roots under examination increases. For example, in a simple test regression with no deterministic variables, the HEGY test procedure (Hylleberg et al., 1990) in the quarterly context requires the estimation of four parameters, whereas in a monthly context this number increases to twelve. In addition, the

algebra underlying monthly seasonal unit root tests is more involved than in the quarterly case and the associated computational burden non-negligible. In special cases these problems can be partially avoided by applying method proposed by Rodrigues and Franses (2003). In our case the sample is small even if we use monthly data (data is available for less then seven years, 1999M8–2006M4). If we would be forced to use quarterly data, the results of unit root test would definitely exhibit poor power performance.

Considering the limitations presented above, we decided to use standard ordinary least square regression (OLS) and to support the estimated functions by a battery of specification tests. Following the empirical analyses (Nikali, 1997; Pimenta and Ferreira, 1999; Nankervis et al., 2002) we employed the exponential specification of the population function of demand for direct mail and periodicals delivery services and separately for the demand for direct mail delivery services. Due to the fact that we decided to use OLS for the estimation of the parameters, all exponential functions are formulated in double-log form. Theoretical specifications of population regression equations in four versions are given in the continuation.

Equation 1: Model of demand for the direct mail and periodicals market using dummy variables

$$\ln(Q_t^{DMP}) = \ln(\beta_1) + \beta_2 \ln(P_{a,t}^{DMP}) + \beta_3 \ln(P_{b,t}) + \beta_4 \ln(P_{c,t}) + \beta_5 \ln(P_{d,t}) + \beta_6 \ln(I_{3,t}) + \beta_7 \ln(I_{6,t}) + \beta_8 \ln(EE_{2,t}) + \beta_9 \ln(O_{1,t}) + \sum_{j=2}^{12} \beta_j^D \cdot D_{j,t} + u_t$$

Symbols: Q_t^{DMP} – number of pieces mailed on the direct mail and periodicals market,

$P_{a,t}^{DMP}$ – ath price variable for the direct mail and periodicals market in period t where a=1, 2, 3.

$P_{b,t}$ – bth price variable for TV commercials in period t where b=2, 3.

$P_{c,t}$ – cth price variable for magazine advertisements in period t where c=4, 5, 6.

$P_{d,t}$ – dth price variable for advertisements in daily papers in period t where d=7, 8, 9.

$I_{3,t}$ – real net wages paid in period t,

$I_{6,t}$ – retail revenue in real terms in period t,

$EE_{2,t}$ – industrial production in period t,

$O_{1,t}$ – number of work days in period t,

$D_{j,t}$ – dummy variable to cover jth seasonal component in period t where

$j = \{2,...,12\}$,

$\ln(\beta_1)$ – regression constant,

$\beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_j^D$ – partial regression coefficients where

$j = \{2,...,12\}$,

u_t – random variable in period t.

Equation 2: Model of demand for the direct mail and periodicals market using seasonally adjusted series

$$\ln(QSA_t^{DMP}) = \ln(\beta_1) + \beta_2 \ln(PSA_{a,t}^{DMP}) + \beta_3 \ln(PSA_{b,t}) + \beta_4 \ln(PSA_{c,t}) + \beta_5 \ln(PSA_{d,t}) + \beta_6 \ln(ISA_{3,t}) + \beta_7 \ln(ISA_{6,t}) + \beta_8 \ln(EESA_{2,t}) + \beta_9 \ln(OSA_{1,t}) + u_t$$

Symbols: QSA_t^{DMP} – number of pieces mailed on the direct mail and periodicals market (seasonally adjusted),

$PSA_{a,t}^{DMP}$ – ath price variable for the direct mail and periodicals market in period t where a=1, 2, 3; (seasonally adjusted),

$PSA_{b,t}$ – bth price variable for TV commercials in period t where b=2, 3; (seasonally adjusted),

$PSA_{c,t}$ – cth price variable for magazine advertisements in period t where c=4, 5, 6; (seasonally adjusted),

$PSA_{d,t}$ – dth price variable for advertisements in daily papers in period t where d=7, 8, 9; (seasonally adjusted),

$ISA_{3,t}$ – real net wages paid in period t (seasonally adjusted),

$ISA_{6,t}$ – retail revenue in real terms in period t (seasonally adjusted),

$EESA_{2,t}$ – industrial production in period t (seasonally adjusted),

$OSA_{1,t}$ – number of work days in period t (seasonally adjusted),

$\ln(\beta_1)$ – regression constant,

$\beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9$ – partial regression coefficients,

u_t – random variable in period t.

Equation 3: Model of demand for the direct mail market using dummy variables

$$\ln(Q_t^{DM}) = \ln(\beta_1) + \beta_2 \ln(P_{a,t}^{DM}) + \beta_3 \ln(P_{b,t}) + \beta_4 \ln(P_{c,t}) + \beta_5 \ln(P_{d,t}) + \beta_6 \ln(I_{3,t}) + \beta_7 \ln(I_{6,t}) + \beta_8 \ln(EE_{2,t}) + \beta_9 \ln(O_{1,t}) + \sum_{j=2}^{12} \beta_j^D \cdot D_{j,t} + u_t$$

Symbols: Q_t^{DM} – number of pieces mailed on the direct mail market,

$P_{a,t}^{DM}$ – ath price variable for the direct mail market in period t where a=1, 2, 3.

$P_{b,t}$ – bth price variable for TV commercials in period t where b=2, 3.

$P_{c,t}$ – cth price variable for magazine advertisements in period t where c=4, 5, 6.

$P_{d,t}$ – dth price variable for advertisements in daily papers in period t where d=7, 8, 9.

$I_{3,t}$ – real net wages paid in period t,

$I_{6,t}$ – retail revenue in real terms in period t,

$EE_{2,t}$ – industrial production in period t,

$O_{1,t}$ – number of work days in period t,

$D_{j,t}$ – dummy variable to cover *j*th seasonal component in period t where

$j = \{2,...,12\}$,

$\ln(\beta_1)$ – regression constant,

$\beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_j^D$ – partial regression coefficients where

$j = \{2,...,12\}$,

u_t – random variable in period t.

Equation 4: Model of demand for the direct mail market using seasonally adjusted series

$$\ln(QSA_t^{DM}) = \ln(\beta_1) + \beta_2 \ln(PSA_{a,t}^{DM}) + \beta_3 \ln(PSA_{b,t}) + \beta_4 \ln(PSA_{c,t}) + \beta_5 \ln(PSA_{d,t}) + \beta_6 \ln(ISA_{3,t}) + \beta_7 \ln(ISA_{6,t}) + \beta_8 \ln(EESA_{2,t}) + \beta_9 \ln(OSA_{1,t}) + u_t$$

Symbols: QSA_t^{DM} – number of pieces mailed on the direct mail market (seasonally adjusted),

$PSA_{a,t}^{DM}$ – *a*th price variable for the direct mail market in period t where a=1, 2, 3; (seasonally adjusted),

$PSA_{b,t}$ – *b*th price variable for TV commercials in period t where b=2, 3; (seasonally adjusted),

$PSA_{c,t}$ – *c*th price variable for magazine advertisements in period t where c=4, 5, 6; (seasonally adjusted),

$PSA_{d,t}$ – *d*th price variable for advertisements in daily papers in period t where d=7, 8, 9; (seasonally adjusted),

$ISA_{3,t}$ – real net wages paid in period t (seasonally adjusted),

$ISA_{6,t}$ – retail revenue in real terms in period t (seasonally adjusted),

$EESA_{2,t}$ – industrial production in period t (seasonally adjusted),

$OSA_{1,t}$ – number of work days in period t (seasonally adjusted),

$\ln(\beta_1)$ – regression constant,

$\beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9$ – partial regression coefficients,

u_t – random variable in period t.

4. ESTIMATION RESULTS

To estimate the parameters of population functions specified in Chapter 3 we used the OLS method. In order to meet the assumptions of this method, we run a series of test on each regression model. We tested the stationarity of time series (ADF test with intercept and trend, time lag selection based on the Schwarz information riterion – SIC), distribution of residuals (JB test of normality), autocorrelation (Q-statistics from first to twelfth order, DW-statistics), significance of coefficients (t-statistics), stability/specification of regression equations (inclusion of different deflators, Cusum and Cusum Q test, White test), and the explanatory power (adj. R^2 and F test). All calculations and tests of models were performed with the aid of Eviews 4.0 software package.

When parallel estimations of the direct mail and periodicals market and separately of the direct mail market, number of time series versions in a particular group of variables, and two base approaches to including the seasonal component are considered, the total number of regression equation versions that can be estimated is one hundred sixty-four. Estimated regression equations with seasonally adjusted data show statistically insignificant parameters and low explanatory power (adjusted coefficients of determination, information criteria), (forty-six versions). Research in the field of time series analysis also indicates that seasonal adjustment

methods can negatively impact characteristics of time series (Stock and Watson, 1989; Jagric, 2003) and can cause a change of a phase in the spectrum, which is known as phase delay (Jagric, 2003; Castro and Osborn, 2004; Mir and Osborn, 2004). In the continuation of the analysis we therefore decided for a more conservative approach based on the identification of seasonal influences within the basic regression model using dummy varibles. Further, the verification of characteristics of dummy variables showed that the eleventh month was always statistically significant and robust (eliminating sixty-six versions). Eighteen versions of regression equations can be removed because the number of work days series could not be included as an additional explanatory variable into any of the specifications defined (atypical parameter), while further twelve versions of equations can be excluded because the real net wages paid variable is not statistically significant in specified models without delayed effect.

Hence eleven functions remain for each market segment. As we wish to estimate the influence of all time series by all types of deflators on both market segments separately but in a pair of comparable specifications on both segments, the following ten estimated specifications can be included in the final analysis, of which five specifications for the direct mail and periodicals market segment (E1–E5 represent notations of sample regression models - see Table 2 for the definition of variables):

$$E1: \ln(Q_t^{DMP}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{1,t}^{DMP}) + \hat{\beta}_4 \ln(P_{4,t}) + \hat{\beta}_5 \ln(P_{7,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E2: \ln(Q_t^{DMP}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{2,t}^{DMP}) + \hat{\beta}_3 \ln(P_{2,t}) + \hat{\beta}_4 \ln(P_{5,t}) + \hat{\beta}_5 \ln(P_{8,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E3: \ln(Q_t^{DMP}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{2,t}^{DMP}) + \hat{\beta}_4 \ln(P_{5,t}) + \hat{\beta}_5 \ln(P_{8,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E4: \ln(Q_t^{DMP}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{3,t}^{DMP}) + \hat{\beta}_3 \ln(P_{3,t}) + \hat{\beta}_4 \ln(P_{6,t}) + \hat{\beta}_5 \ln(P_{9,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_9 \cdot D_{11,t} + e_t,$$

$$E5: \ln(Q_t^{DMP}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{3,t}^{DMP}) + \hat{\beta}_4 \ln(P_{6,t}) + \hat{\beta}_5 \ln(P_{9,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t$$

and five specifications for the direct mail market segment (E6–E10 represent notations of sample regression models - see Table 2 for the definition of variables):

$$E6: \ln(Q_t^{DM}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{1,t}^{DM}) + \hat{\beta}_4 \ln(P_{4,t}) + \hat{\beta}_5 \ln(P_{7,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E7: \ln(Q_t^{DM}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{2,t}^{DM}) + \hat{\beta}_3 \ln(P_{2,t}) + \hat{\beta}_4 \ln(P_{5,t}) + \hat{\beta}_5 \ln(P_{8,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E8: \ln(Q_t^{DM}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{2,t}^{DM}) + \hat{\beta}_4 \ln(P_{5,t}) + \hat{\beta}_5 \ln(P_{8,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E9: \ln(Q_t^{DM}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{3,t}^{DM}) + \hat{\beta}_3 \ln(P_{3,t}) + \hat{\beta}_4 \ln(P_{6,t}) + \hat{\beta}_5 \ln(P_{9,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t,$$

$$E10: \ln(Q_t^{DM}) = \ln(\hat{\beta}_1) + \hat{\beta}_2 \ln(P_{3,t}^{DM}) + \hat{\beta}_4 \ln(P_{6,t}) + \hat{\beta}_5 \ln(P_{9,t}) + \hat{\beta}_6 \ln(I_{3,t-1}) + \hat{\beta}_7 \ln(I_{6,t}) + \hat{\beta}_8 \ln(EE_{2,t}) + \hat{\beta}_{11}^{D} \cdot D_{11,t} + e_t.$$

The results of parameter estimations derived from models E1–E10 are shown under heading A of Table 3 and Table 4. The following findings can be reported. Point estimates of price elasticity of demand on the direct mail and periodicals market amount to -0.9 (equations E1–E5). If the direct mail market only is taken into account, estimates of price elasticity of demand are slightly lower (in the absolute sense) yet highly synchronized again at -0.7 (equations E6–E10). It can be inferred from calculations that a one-percent increase in real prices of direct mail and periodicals and of direct mail, discounts taken into account, will lead to a 0.90 percent decrease in the volume of demand on the direct mail and periodicals market and a 0.7 percent decrease in the volume of demand on the direct mail market on the average.

<TABLE 3 ABOUT HERE>

In equations E2 and E4 partial regression coefficients expressing the impact of the average real price of TV commercials on the volume of demand on the direct mail and periodicals segment are statistically insignificant. From analogue estimates of specifications on the direct mail market segment (equations E7 and E9) it can be inferred that a 1 percent increase in the average real price of TV commercials results in a 0.2 percent increase in demand for direct mail delivery services.

<TABLE 4 ABOUT HERE>

With regard to changes in prices of magazine advertisements, estimates of cross-price elasticity of demand on the direct mail and periodicals market as well as on the direct mail market are reached at the 5 percent significance level at least, using all three kinds of price deflators. It can be inferred from the results that a 1 percent increase in average real prices of magazine advertisements will lead to a 0.4–0.5 percent increase in the volume of demand for services on the direct mail and periodicals market and on the direct mail market.

Regarding changes in prices of advertisements in daily papers, no significant deviations occur in connection with estimates of cross-price elasticity of demand when those estimates are compared according to various price deflators or both markets analyzed. The results can lead to a conclusion that the number of mail pieces on the direct mail and periodicals market and on the direct mail market will increase by 0.2–0.3 percent in case of a 1 percent increase in the average real price of advertisements in daily papers.

Estimates of dependence of service trends on the direct mail and periodicals market and on the direct mail market from changes in real net wages paid are given with at least 5 percent level of significance of the test. For this variable, partial regression coefficients in equations E1–E10 indicate that the total number of mail pieces on the direct mail and periodicals market and on the direct mail market will increase by 0.5 percent and 0.8 percent at the most, respectively, if real net wages paid increase by 1 percent, with other conditions unchanged.

In contrast to the estimates of the income parameter measured with retail revenue in real terms in equations E1–E5, it can be stated that the demand for services on the direct mail market is elastic with respect to income (equations E6–E10). Thus an increase in retail revenue in real terms by 1 percent will on the average lead to a 1.2 percent increase in the total number of mail pieces on the direct mail market. Estimates of partial regression coefficients are highly statistically significant in all ten functions.

In case of the parameter from the group of the economic environment variables it can be inferred that a 10 percent increase in industrial production will on the average increase activities on the direct mail and periodicals market segment and on the direct mail market segment by 9 percent (equations E1, E3, E5, E6, E8) or by 10 percent (equations E2, E4, E10), measured with the total number of mail pieces sent.

Conclusions on the explanatory power of estimated regression equations can be made on the basis of the value for adjusted coefficients of determination (heading B in Table 3 and Table 4). It shows that all estimated equations have a satisfactory explanatory power. 95 and 91 percent, respectively, of variance in changes in the number of pieces mailed on the direct mail and periodicals market segment and on the direct mail market segment can be explained by a combination of variables included in ten model specifications. On the basis of the results of the Durbin-Watson d-statistics it has also been stated (at the 1 percent significance level) that none of the estimated equations shows a problem of autocorrelation of residuals, which is also supported by the values of Ljung-Box Q-statistics (detailed test results for equations E1–E10 can be obtained from the authors). The list of econometric tests in Table 3 and Table 4 also displays a test of residuals distribution for equations selected. The results of the Jarque-Bera test performed lead to a conclusion on a normal distribution of residuals of all regression models. For all estimated elasticity coefficients from equations E1–E10 it has been stated that they are structurally stable at the satisfactory level of the test significance (α=0.05).

The identified own-price inelasticity of demand for both service segments makes it possible for the Slovenian postal operator to maintain a positive marginal revenue in spite of increases in prices for the delivery of direct mail and periodicals and prices for direct mail delivery. Such price response of demand reflects current advantages of the national postal operator, as its mail network already put in place and a wide data base enable a more competitive response to market needs in terms of costs and time. It is therefore not surprising that business success of (potential) direct mail customers (real revenue in retail trade) greatly influences the dynamics of those services of the national postal operator. Thus Post of Slovenia has a definite comparative advantage over specialized companies engaging in the transfer of unaddressed mail, newspaper publishers and publishing companies delivering unaddressed commercial inserts in their own publications, and companies themselves delivering their unaddressed mail.

On the other hand estimations of cross-price elasticity on both market segments show a distinctive importance of indirect competition (including, in the broadest sense of the word, all non-postal channels of marketing communication) that Post of Slovenia faces. TV commercials and advertisements in printed media (magazines and daily papers) compete with direct mail services offered by the Slovenian postal operator. There is substitution among various forms of accessing customers. On the basis of their business objectives and according to the prices of marketing communication services offered, companies optimize their marketing budgets.

In the light of a growing importance of marketing communications in business environments (influence of a wider economic environment) increased demand for all tools of marketing communication with final users, including direct mail delivery services, can be expected in the future. Technological factors (expansion of electronic communications), innovative marketing strategies of companies (sales promotion on the Internet and by electronic mail), and changes in relative prices will determine the share of individual communication channels on the market (Goel et al., 2006).

5. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The paper presents evidence on elasticities of demand for services of Post of Slovenia on the basis of a range of available variables separately for two market segments: the direct mail and periodicals market and the direct mail market. The outcomes of the analysis can be summarized in three conclusions. First, the value of price elasticity of demand is below zero for both markets. Taking into account estimates of demand functions, we can infer that in case of an increase in the average real price of direct mail and periodicals delivery as well as direct mail delivery the percentage of decrease in the number of mail pieces delivered on either of the market segments analyzed will be smaller than the percentage of the reference price increase on the markets. Reported inelasticity of demand suggests that the revenue of the Slovenian postal

operator increases on both market segments as a result of increases in the average real prices of direct mail and periodicals delivery and the average real price increases in direct mail delivery.

Second, autonomy in price increases is limited, since the analysis of demand functions for direct mail shows positive cross-price elasticity of demand with regard to price fluctuations for TV commercials. Substitution effects on the direct mail market are even more clearly expressed with regard to price fluctuations for advertisements in magazines and daily papers. Although this concerns exploratory results, they indicate competition pressures faced by the direct mail market segment. The efficiency of increases in prices for mail deliveries on the direct mail and periodicals market segment by the Slovenian postal operator is also limited, since the estimates of cross-price elasticity show that placements of advertisements in magazines and daily papers are competitive with direct mail and periodicals delivery services.

Third, coefficients of income elasticity of demand for direct mail services defined by retail revenue in real terms show that the total number of mail deliveries on the direct mail market increases faster than the real retail revenue. Of all explanatory variables, the latter most strongly influences changes in the quantity of direct mail.

Since the elasticity coefficients presented are a result of estimates of aggregate functions of demand, there are two potential avenues to expand the current analysis in the future. The range of time series presented in this article should be tested on the error correction model, whilst coefficients of own-price and cross-price elasticity obtained with time series should be compared with estimates of demand functions using cross-section data for a sample of companies that are customers of direct mail services of Post of Slovenia. Both empirical approaches would add additional insights in to the functioning of the Slovenian direct mail market, however more time is needed in order to have sufficient amount of data for the required estimation procedures.

REFERENCES

Albon, R. (1989) Some observations on the efficiency of British postal pricing, *Applied Economics*, **21**, 461–74.

Beaulieu, J. J. and Miron, J. A. (1993) Seasonal unit roots in aggregate U.S. data, *Journal of Econometrics*, **55**, 305–28.

Castro, D. B. T. and Osborn, R. D. (2004) The consequences of seasonal adjustment for periodic autoregressive processes, *The Econometrics Journal,* **7**, 307–21.

Cazals, C. and Florens, J. P. (2002) Econometrics of mail demand, a comparison between cross-section and dynamic data, in *Postal and Delivery Services: Delivering on Competition* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 119–40.

Cuthbertson, K. and Richards, P. (1990) An econometric study of the demand for first and second class inland letter services, *The Review of Economics and Statistics,* **72**, 640–48.

Engle, R. and Granger, C. W. J (1987) Cointegration and error correction: representation, estimation and testing, *Econometrica,* **55**, 251–76.

Engle, R. F., Granger, C. W. J. and Hallman, J. S. (1989) Merging short and long run forecasts: an application of seasonal cointegration to monthly electricity sales forecasting, *Journal of Econometrics*, **40**, 45–62.

Filippini, M. and Zola, M. (2005) Economies of scale and cost efficiency in the postal services: empirical evidence from Switzerland, *Applied Economics Letters*, **12**, 437–41.

Florens J. P., Marcy, S. and Toledano, J. (2002) Mail demand in the long and short term, in *Postal and Delivery Services: Pricing, Productivity, Regulation and Strategy* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 171–90.

Franses, P. H. (1991) Seasonality, nonstationarity and forecasting of monthly time series, *International Journal of Forecasting*, **7**, 199–208.

Franses, P. H. (2007) Estimating the stock of postwar Dutch postal stamps, *Applied Economics*, **39**, 943–46.

Goel, R. K., Hsieh, E. T., Nelson, M. A. and Ram, R. (2006) Demand elasticities for Internet services, *Applied Economics*, **38**, 975–80.

Hendry, D. F., Pagan, A. R. and Sargan, J. D. (1984) Dynamic specification, in *Handbook of Econometrics, Volume III* (Eds.) Z. Grilliches and M. D. Intrilligator, North-Holland, Amsterdam, pp. 1231–303.

Hylleberg, S., Engle, R. F., Granger C. W. J. and Yoo, B. S. (1990) Seasonal integration and cointegration, *Journal of Econometrics*, **44**, 215–38.

Jagric, T. (2003) A nonlinear approach to forecasting with leading economic indicators, *Studies in Nonlinear Dynamics and Econometrics,* **7**, Available at http://www.bepress.com/snde/vol7/iss2/art4/.

Jung, I., Gayle, P. G. and Lehman, D. E. (2008) Competition and investment in telecommunications, *Applied Economics*, **40**, 303–13.

Mir, M. A. and Osborn, R. D. (2004) Seasonal adjustment and the detection of business cycle phases, ECB Working Paper Series, 2004/357.

Nankervis, J. and Rodriguez, F. (1995) Aggregate letter traffic demand in the United Kingdom and the economy, in *Commercialization of Postal and Delivery Services: National and International Perspectives* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 269–84.

Nankervis, J., Carslake, I., and Rodriguez, F. (1999) How important have price and quality of services been to mail volume growth, in *Emerging Competition in Postal and Delivery Services* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 229–44.

Nankervis, J., Richard, S., Soteri, S. and Rodriguez, F. (2002) Disaggregated letter traffic demand in the UK, in *Postal and Delivery Services: Pricing, Productivity, Regulation and Strategy* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 203–18.

Nikali, H. (1997) Demand models for letter mail and its substitutes: results from Finland, in *Managing Change in the Postal and Delivery Industries* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 133–61.

Nissen, H. D. and Lago, M. A. (1975) Price elasticity of the demand for parcel post mail, *The Journal of Industrial Economics,* **23**, 281–99.

Pimenta, A. A. and Ferreira, P. M. (1999) Demand for letters in Portugal, in *Emerging Competition in Postal and Delivery Services* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 265–80.

Post of Slovenia (2006) Letno poročilo 2005 (Annual report 2005), October, Maribor.

Rodrigues, P. M. M. and Franses, P. H. (2003) A sequential approach to testing seasonal unit roots in high frequency data. Institute Reports, Econometrics Department, Erasmus University Rotterdam. Available at http://www.eur.nl/WebDOC/doc/econometrie/feweco20030410140109.pdf.

Rycke, D. M., Marcy, S. and Florens, J. P. (2001) Mail use by firms, in *Future Directions in Postal Reform* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 213–32.

Santos, G. R. and Lagao, C. S. (2001) The demand for direct mail in Portugal, in *Future Directions in Postal Reform* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 233–53.

Stock, H. J. and Watson, W. M. (1989) New indexes of coincident and leading economic indicators, in *NBER Macroeconomics Annual* (Eds.) O. Blanchard and S. Fischer, MIT Press, Cambridge, pp. 351–409.

WIK (2006) Main developments in the postal sector (2004–2006), study for the European Commission, May, Bad Honnef.

Wolak, A. F. (1997) Changes in the household-level demand for postal delivery services from 1986 to 1994, in *Managing Change in the Postal and Delivery Industries* (Eds.) A. M. Crew and R. P. Kleindorfer, Kluwer Academic Publishers, Boston, pp. 162–91.

TABLE 1: AVAILABLE DATA SERIES FOR GROUPS OF EXPLANATORY VARIABLES

Price variables	Deflators	Income variables	Economic environment variables	Seasonal factors	Other socio-economic factors
-Average discount price for direct mail and periodicals delivery - Average price for direct mail and periodicals delivery, estimated for average weight, according to the price list of Post of Slovenia - Average discount price for direct mail delivery - Average price for direct mail delivery, estimated for average weight, according to the price list of Post of Slovenia - Average official list price for TV commercials - Average official list price for magazine advertisements - Average official list price for advertisements in daily papers	- Consumer price index (CPI) - Services price index (PS) - Communications price index (PC)	-Domestic consumption in real terms - Registered real household income - Real net wages paid - Revenue from industry in real terms (C+D) - Revenue in manufacturing in real terms (D) - Retail revenue in real terms - Net revenue, in real terms, from sales to 50 largest customers of direct mail services of Post of Slovenia	-Gross domestic product in real terms - Industrial production (C+D+E) - Manufacturing industries (D) - Total number of housing units	- Dummy variables	- Number of households - Number of "No Unaddressed Direct Mail" stickers - Number of P.O. Box holders and users - Number of P.O. Boxes for distribution - Number of work days

Note: The set of available data series has been compiled using the data of Post of Slovenia, Mediana, Statistical Office of the Republic of Slovenia, and the Bank of Slovenia.

TABLE 2: DEFINITION OF USABLE TIME SERIES

Desig-nation	Series name	N	S.b.	Time period
$*Q^{DMP}$	Number of pieces of direct mail and periodicals	105	. . .	1998M1–2006M9
$*Q^{DM}$	Number of direct mail pieces	105	. . .	1998M1–2006M9
$*P_1^{DMP}$	Average discount price, in real terms, for direct mail and periodicals (CPI deflator)	105	. . .	1998M1–2006M9
$*P_2^{DMP}$	Average discount price, in real terms, for direct mail and periodicals (PS deflator)	105	. . .	1998M1–2006M9
$*P_3^{DMP}$	Average discount price, in real terms, for direct mail and periodicals (PC deflator)	105	. . .	1998M1–2006M9
P_4^{DMP}	Average list price, in real terms, for direct mail and periodicals (CPI deflator)	105	2003M1	1998M1–2006M9
P_5^{DMP}	Average list price, in real terms, for direct mail and periodicals (PS deflator)	105	2003M1	1998M1–2006M9
P_6^{DMP}	Average list price, in real terms, for direct mail and periodicals (PC deflator)	105	2003M1	1998M1–2006M9
$*P_1^{DM}$	Average discount price, in real terms, for direct mail (CPI deflator)	105	1999M7	1998M1–2006M9
$*P_2^{DM}$	Average discount price, in real terms, for direct mail (PS deflator)	105	1999M7	1998M1–2006M9
$*P_3^{DM}$	Average discount price, in real terms, for direct mail (PC deflator)	105	1999M7	1998M1–2006M9
P_4^{DM}	Average list price, in real terms, for direct mail (CPI deflator)	105	2003M1	1998M1–2006M9
P_5^{DM}	Average list price, in real terms, for direct mail (PS deflator)	105	2003M1	1998M1–2006M9
P_6^{DM}	Average list price, in real terms, for direct mail (PC deflator)	105	2003M1	1998M1–2006M9
P_1	Average price, in real terms, for TV commercials (CPI deflator)	94	. . .	1999M1–2006M10
$*P_2$	Average price, in real terms, for TV commercials (PS deflator)	94	. . .	1999M1–2006M10
$*P_3$	Average price, in real terms, for TV commercials (PC deflator)	94	. . .	1999M1–2006M10
$*P_4$	Average price, in real terms, for magazine advertisements (CPI deflator)	94	. . .	1999M1–2006M10
$*P_5$	Average price, in real terms, for magazine advertisements (PS deflator)	94	. . .	1999M1–2006M10
$*P_6$	Average price, in real terms, for magazine advertisements (PC deflator)	94	. . .	1999M1–2006M10
$*P_7$	Average price, in real terms, for advertisements in daily papers (CPI deflator)	94	. . .	1999M1–2006M10
$*P_8$	Average price, in real terms, for advertisements in daily papers (PS deflator)	94	. . .	1999M1–2006M10
$*P_9$	Average price, in real terms, for advertisements in daily papers (PC deflator)	94	. . .	1999M1–2006M10
I_1	Domestic consumption in real terms	106	. . .	1998M1–2006M10
I_2	Registered household income in real terms	100	. . .	1998M1–2006M4
$*I_3$	Real net wages paid	100	. . .	1998M1–2006M4
I_4	Revenue from industry in real terms	105	. . .	1998M1–2006M9
I_5	Revenue in manufacturing in real terms	105	. . .	1998M1–2006M9
$*I_6$	Retail revenue in real terms	105	. . .	1998M1–2006M9
EE_1	Gross domestic product in real terms	106	. . .	1998M1–2006M10
$*EE_2$	Industrial production	105	. . .	1998M1–2006M9
EE_3	Manufacturing industries	105	. . .	1998M1–2006M9
EE_4	Total number of housing units	105	. . .	1998M1–2006M9
$*O_1$	Number of work days	105	. . .	1998M1–2006M9

Note: N – number of observations (all time series are on monthly frequency), S.b. – structural brake. For easier understanding of the specification of demand equations for direct mail and periodicals delivery services and direct mail delivery services, designations were ascribed to series used as functional variables. The following signs were used: Q^{DMP} – volume of demand on the direct mail and periodicals market, Q^{DM} – volume of demand on the direct mail market, P^{DMP} – price of direct mail and periodicals, P^{DM} – price of direct mail, P – price of advertisements and commercials, I – revenue, EE – economic environment and O – other socio-economic variables. Because several time series are available for certain variables, numerical designations were added. Sign "*" indicates variables, which are selected for final models. All time series marked with sign "*" include in final models 81 observations and cover the time period 1999M8–2006M4.

TABLE 3: RESULTS FOR THE DIRECT MAIL AND PERIODICALS MARKET SEGMENT

Variables	E1	E2	E3	E4	E5
	A				
$\ln(\beta_1)$	-0.175 (-3.948)*	-0.143 (-2.996)*	-0.163 (-3.615)*	-0.164 (-3.609)*	-0.177 (-4.026)*
$\ln(P_{1,t}^{DMP})$	-0.891 (-12.163)*	-	-	-	-
$\ln(P_{2,t}^{DMP})$	-	-0.900 (-13.091)*	-0.903 (-13.096)*	-	-
$\ln(P_{3,t}^{DMP})$	-	-	-	-0.902 (-12.532)*	-0.895 (-12.461)*
$\ln(P_{2,t})$	-	-0.090 (-1.190)	-	-	-
$\ln(P_{3,t})$	-	-	-	-0.095 (-1.113)	-
$\ln(P_{4,t})$	0.501 (4.082)*	-	-	-	-
$\ln(P_{5,t})$	-	0.439 (3.665)*	0.444 (3.693)*	-	-
$\ln(P_{6,t})$	-	-	-	0.476 (4.055)*	0.491 (4.204)*
$\ln(P_{7,t})$	0.284 (3.546)*	-	-	-	-
$\ln(P_{8,t})$	-	0.238 (2.932)*	0.258 (3.244)*	-	-
$\ln(P_{9,t})$	-	-	-	0.274 (3.630)*	0.289 (3.881)*
$\ln(I_{3,t-1})$	0.564 (2.812)*	0.486 (2.398)**	0.539 (2.717)*	0.554 (2.742)*	0.575 (2.857)*
$\ln(I_{6,t})$	0.780 (6.798)*	0.789 (6.869)*	0.768 (6.747)*	0.792 (6.835)*	0.772 (6.732)*
$\ln(EE_{2,t})$	0.871 (4.951)*	0.958 (5.336)*	0.904 (5.189)*	0.963 (5.050)*	0.887 (4.971)*
$D_{11,t}$	0.115 (2.613)**	0.114 (2.636)*	0.118 (2.709)*	0.111 (2.543)**	0.114 (2.621)**
	B				
Adj. R^2	0.945	0.946	0.946	0.945	0.945
F test	195.219 (0.000)	175.263 (0.000)	198.947 (0.000)	172.176 (0.000)	195.945 (0.000)
DW-statistics	1.753	1.761	1.772	1.758	1.760
SIC	-1.358	-1.341	-1.376	-1.324	-1.361
JB test	2.842 (0.241)	2.259 (0.323)	2.404 (0.301)	2.008 (0.366)	2.519 (0.284)
White test	0.718 (0.739)	0.885 (0.584)	0.725 (0.732)	0.821 (0.652)	0.763 (0.694)
Cusum, Cusum Q test	+	+	+	+	+

Note: Under point elasticities of estimated parameters, pertinent t-statistics are given in brackets marked by "*" for 1 per cent and by "**" for 5 per cent significance level. Exact levels of significance are given in brackets for the F test, the JB test and the White test. Values of F statistics are given for the White test. Results of Cusum and Cusum Q tests with the level of significance 0.05. Sign "+" denotes structural stability of estimated parameters.

TABLE 4: RESULTS FOR THE DIRECT MAIL MARKET SEGMENT

Variables	E6	E7	E8	E9	E10
	A				
$\ln(\beta_1)$	0.363 (4.780)*	0.345 (4.413)*	0.381 (4.919)*	0.364 (4.822)*	0.394 (5.305)*
$\ln(P_{1,t}^{DM})$	-0.689 (-8.024)*	-	-	-	-
$\ln(P_{2,t}^{DM})$	-	-0.733 (-8.883)*	-0.706 (-8.515)*	-	-
$\ln(P_{3,t}^{DM})$	-	-	-	-0.731 (-8.527)*	-0.727 (-8.393)*
$\ln(P_{2,t})$	-	0.226 (1.949)***	-	-	-
$\ln(P_{3,t})$	-	-	-	0.207 (1.625)***	-
$\ln(P_{4,t})$	0.521 (2.809)*	-	-	-	-
$\ln(P_{5,t})$	-	0.451 (2.499)**	0.435 (2.367)**	-	-
$\ln(P_{6,t})$	-	-	-	0.393 (2.236)**	0.359 (2.036)**
$\ln(P_{7,t})$	0.274 (2.265)**	-	-	-	-
$\ln(P_{8,t})$	-	0.292 (2.381)**	0.239 (1.959)***	-	-
$\ln(P_{9,t})$	-	-	-	0.253 (2.237)**	0.219 (1.950)***
$\ln(I_{3,t-1})$	0.659 (2.041)**	0.753 (2.369)**	0.674 (2.096)**	0.722 (2.263)**	0.702 (2.175)**
$\ln(I_{6,t})$	1.228 (7.252)*	1.178 (7.008)*	1.238 (7.354)*	1.183 (6.991)*	1.239 (7.387)*
$\ln(EE_{2,t})$	0.890 (3.336)*	0.789 (2.882)*	0.943 (3.534)*	0.828 (2.882)*	1.002 (3.718)*
$D_{11,t}$	0.168 (2.524)**	0.184 (2.809)*	0.174 (2.610)**	0.186 (2.836)*	0.178 (2.687)*
	B				
Adj. R^2	0.905	0.909	0.905	0.908	0.906
F test	108.933 (0.000)	99.221 (0.000)	108.628 (0.000)	98.293 (0.000)	109.462 (0.000)
DW-statistics	1.728	1.864	1.741	1.845	1.774
SIC	-0.531	-0.525	-0.528	-0.517	-0.535
JB test	2.074 (0.355)	2.921 (0.232)	2.135 (0.344)	2.759 (0.252)	2.067 (0.356)
White test	0.905 (0.552)	1.075 (0.397)	0.940 (0.518)	1.122 (0.356)	0.982 (0.478)
Cusum, Cusum Q test	+	+	+	+	+

Note: Under point elasticities of estimated parameters, pertinent t-statistics are given in brackets marked by "*" for 1 per cent, by "**" for 5 per cent and by "***" for 10 per cent significance level. Exact levels of significance are given in brackets for the F test, the JB test and the White test. Values of F statistics are given for the White test. Results of Cusum and Cusum Q tests with the level of significance 0.05. Sign "+" denotes structural stability of estimated parameters.