Centre of Excellence for Science and Innovation Studies

CESIS Electronic Working Paper Series

Paper No. 198

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A. Khalik Salman*, Leif Arnesson*, Anna Sörensson* and Ghazi Shukur**

(*Mid Sweden University, **JIBS and CAFO, Växjö University)

September 2009

The Royal Institute of Technology
Centre of Excellence for Science and Innovation Studies (CESIS)
http://www.cesis

Estimating the Swedish and Norwegian international tourism demand using (ISUR) technique

By

A. Khalik Salman[1], Leif Arnesson[2], Anna Sörensson[3], and Ghazi Shukur[4]

[1, 2&3] Department of Social Sciences, Mid Sweden University, Sweden.

[4] Departments of Economics and Statistics, Jönköping University and Centre of Labour Market Policy Research (CAFO), Växjö University, Sweden.

Abstract

This paper estimates the demand for tourism to Sweden and Norway for five countries: Denmark, the United Kingdom, Switzerland, Japan, and the United States. For each visiting country, and for Sweden and Norway, we specify separate equations by including relative information. We then estimate these equations using Zellner's Iterative Seemingly Unrelated Regressions (ISUR). The benefit of this model is that the ISUR estimators utilize the information present in the error correlation of the cross regressions (or equations) and hence are more efficient than single equation estimation methods such as ordinary least squares. Monthly time series data from 1993:01 to 2006:12 are used. The results show that the consumer price index, some lagged dependent variables, and several monthly dummies (representing seasonal effects) have a significant impact on the number of visitors to the SW6 region in Sweden and Tröndelag in Norway. We also find that, in at least some cases, relative prices and exchange rates have a significant effect on international tourism demand.

Keywords: tourism demand, significant factors, Iterative Seemingly Unrelated Regressions (ISUR)

1. Introduction

The theory of demand constitutes a central topic in economics, and modern formalized economic theory has dealt with consumer demand for some time. This has led the way towards econometric applications and statistical evaluations, and their application to tourism demand is the theme of this paper. A common deficiency in many applied econometric studies is the absence of statistical diagnostic testing. This is important because a model is only as good as the assumptions used, and if these assumptions are incorrect then the model can be worthless. Nowadays we pay increasing attention to model selection and specification procedures, especially in modeling dynamic relationships, with numerous test statistics and diagnostic checks suggested as tools in model selection strategies.

During the past decade or so, the tourism literature includes a number of different econometric models used to identify the relationships between tourist arrivals in a particular country and the factors that influence these arrivals. In international tourism demand modeling, most previous studies have used a demand function approach to identify the quantitative relationships. However, in econometric modeling, a trend term is often included to capture those factors considered to cause upward or downward trends in the demand variable, and this does not take into account any possible correlations between the residuals from the different equations.

Many external and internal factors influence tourism demand. In turn, tourism generates physical and financial flows that have potentially strong economic and environmental impacts. Consequently, there is a broad group of stakeholders in tourism arising from both the private and public sector. From these has emerged a widely felt need for tourism analysis in the wider context of the national account that is nationally and internationally comparable with measures of other economic activities. Importantly, in existing econometric studies of tourism in Scandinavia (particularly Sweden and Norway), factors such as relative income and relative/substitute price have not been important determinates in international tourism demand models (Hultkrantz, 1995; Jorgensen and Solvoll, 1996; Hultkrantz and Olsson, 1997), with relatively more emphasis on seasonal effects.

The aim of this paper is to estimate international tourism demand to Sweden and Norway for five countries: namely, Denmark, the United Kingdom (UK), Switzerland, Japan, and the United States (US). For each visiting country, and Sweden and Norway, we specify a separate equation with the relative information included in each equation. Previous Scandinavian studies have not compared tourism demand for Sweden and Norway. Further, previous studies of Norwegian tourism demand have not considered the relative price and substitution effect, the real and nominal exchange rate, and personal income. Yet other factors that influence demand for tourism include climate, cultural values, natural attractions, and government travel regulations, many of which are difficult to quantify.

The purpose of this paper is to use Iterative Seemingly Unrelated Regressions (ISUR) to estimate the relationship between monthly tourist arrivals to Sweden and Norway from Denmark, the UK, Switzerland, Japan, and the US and the factors that influence arrivals. To this end, we employ a demand function approach to tourism flow modeling. There is no previous application of this technique to tourism demand modeling. With the ISUR technique, we estimate the entire system of equations by taking into account any possible correlations between the residuals from the different equations. Moreover, the ISUR technique provides parameter estimates that converge to unique maximum likelihood parameter estimates.

The remainder of the paper is organized as follows. Section 2 discusses tourism demand for Nordic countries and the data used. Section 3 presents the estimation and testing methodology. Section 4 provides the results. The paper concludes with a brief summary and conclusion in Section 5.

2. Background and Data

The objective of this section is to analyze how the following macroeconomic and microeconomic variables and seasonal (monthly) conditions influence the demand for tourism for the Objective 6 region in Sweden (SW6)[1] and Tröndelag in Norway[2]:

1. The Swedish Consumer Price Index (CPI) represents the inflation rate and cost of living in Sweden and is in natural logarithms. The CPI has several advantages for this purpose: it is familiar to the public and is the most widely used measure of inflation in Sweden (Andersson and Berg, 1995). We adjust the CPI for any changes in indirect taxes and subsidies.
2. We use dummy variables for January to November to proxy for seasonal effects (December is the base category).
3. The exchange rate (*EX*) between the Swedish/Norwegian currencies and the visitors' country of origin currency are included in natural logarithms.
4. The relative price (*Pr*) reflects opportunity cost. This represents the cost of living in relative terms for Norway and Sweden and a substitute price for an origin country tourist. These are also in natural logarithms.

The north of Sweden is a major tourist destination worldwide, with the yearly demand for tourism in this part of Sweden and Norway consistently following an upward trend. However, interruption to these trends has taken place on a number of occasions due to economic conditions and/or international events. For example, September 11 and the Gulf War had a detrimental effect on tourism demand in both Sweden and Norway.

A common model used in tourism demand studies is a single equation with demand explained by the tourist's income in their country of origin, the cost of tourism in their chosen and alternative destinations, and a substitute price (Witt and Martin, 1987). To start with, the demand for tourism can be expressed in a variety of ways. The most appropriate variable to represent demand explained by economic factors is consumer expenditure or receipts (Grouch, 1992). Other measures of demand are potentially the nights spent by the tourist or their length of stay. However, due to the lack of data on

[1] The Objective 6 region is the lightly shadowed area at the top and top-left of the map of Sweden in the Appendix.

[2] The Tröndelag region in Norway is the lightly shadowed part on the top right of the map of Norway in the Appendix (Complete Appendix!).

monthly GDP, personal income (GDP/Population) is not included in this analysis.

The tourism price index (the price of the holiday) is also an important determinant of the decision a potential tourist makes. We can divide this into two components: (i) the cost of living for the tourist at the destination, and (ii) the cost of travel or transport to the destination. We divide the cost of living into two components: (i) the CPI in relative price form assuming that tourists have the option of spending their vacation in either SW6 or Tröndelag, and (ii) tourist consumer expenditure, real consumer expenditure, real income, and per capita income (Salman, 2003)[3]. In this paper, CPI represents the cost of living. However, we measure transport costs by the weighted mean prices according to the transport mode used by tourists to reach the destination. Changes in travel costs, particularly airfares, can have a major impact on tourism demand. Unfortunately, data on economy class airfares between Stockholm and the capital cities of the countries of origin were not consistently available, so we could not use these in construction of the variables. Moreover, one should also take into account the small proportion of tourists who arrive in Sweden using charter flights destined for regional airports closer to the main tourist resorts, as the airfares for these may differ considerably from those to the capital city's airport. Therefore, in the absence of a suitable proxy, we exclude travel costs from our demand system (Lathiras and Siriopoulos, 1998).

Following previous research, we can specify the price of tourism at the destination in a variety of ways. For instance, we can represent prices in either absolute or relative terms. In this study, we employ the relative price as an opportunity cost. We define this as the ratio of the CPI of the host country (CPI_{SW}) to the country of origin adjusted by the relative exchange rate (R_{it}) to obtain a proxy for the real cost of living (Salman, 2004). Therefore, the real cost of tourism in Sweden and Norway are the relative CPIs given by:

$$Rp_{jt} = \frac{\frac{\mathrm{CPI}_{it}}{EX_{ijt}}}{\mathrm{CPI}_{jt}}, \tag{1}$$

Where, i is the host country (Sweden or Norway), j is the visiting (or foreign) country, and t is time. Rp_{it} is the relative CPI for country i in time t, CPI_{it} is the CPI for Sweden or Norway, CPI_{jt} is the CPI for the foreign country, and EX_{ijt} is the exchange rate between the Swedish krona/Norwegian krone and the foreign currency.

In addition to the price variable, the exchange rate is a relevant factor in determining tourism demand. The rationale behind incorporation of the exchange rate as a separate explanatory variable is that tourists may be more aware of the relative exchange rate than the specific cost of tourism at the destination. A question that arises is whether the exchange rate should be included in our model system as an explanatory variable together with the price variable. In an attempt to find a variable to represent a tourist's cost of living, Salman, Shukur, and Bergmann-Winberg (2007) concluded that the CPI (either alone or with the exchange rate) is a reasonable proxy of the cost of tourism. We define the exchange rate variable as the foreign exchange rate of the Swedish krona or Norwegian krone to the currency of the origin country. This variable represents the relationship between tourism demand and the international money market and international economic events (including recessions and financial crises).

As microeconomic theory suggests, the price of other goods influences the demand for a particular good. In the case of tourism, the identification and separation of substitute products is very difficult to achieve on an a priori basis. In our case, tourists consider Tröndelag (in the north of Norway) an alternative destination to the Objective 6 region (in the north of Sweden). These destinations are among the most popular destinations in Scandinavia, at least in terms of arrivals, for tourists from the origin countries under consideration.

In this paper, we attempt to explain international flows to SW6 and Tröndelag from Denmark, the UK, Switzerland, Japan, and the US. Therefore, we define the substitute and opportunity cost effects as the ratio of the CPI of the host country (CPI_{SW} and CPI_{Nor}) to the country of origin (CPI) adjusted by the relative exchange rate (R_{it}). This provides a proxy for the real cost of living. We define the real cost of tourism in

[3] We use the value of industrial output as a proxy for monthly GDP.

Sweden and Norway by relative CPI_{SW} and CPI_{Nor} as follows along with the cost of living or substitute effect (in relative prices):

Relative price of tourism for Denmark $= \dfrac{CPI_{SW} / EX_{Sek/Den}}{CPI_{Nor} / EX_{Nor/Den}}$, (2)

Relative price of tourism for the UK $= \dfrac{CPI_{SW} / EX_{Sek/UK}}{CPI_{Nor} / EX_{Nor/UK}}$, (3)

Relative price of tourism for Switzerland $= \dfrac{CPI_{SW} / EX_{Sek/Swi}}{CPI_{Nor} / EX_{Nor/Swi}}$, (4)

Relative price of tourism for Japan $= \dfrac{CPI_{SW} / EX_{Sek/Yen}}{CPI_{Nor} / EX_{Nor/Yen}}$, (5)

Relative price of tourism for the US $= \dfrac{CPI_{SW} / EX_{Sek/US}}{CPI_{Nor} / EX_{Nor/US}}$, (6)

where:

CPI_{SW}: CPI in Sweden (1998 = 100).

CPI_{Nor}: CPI in Norway (1998 = 100).

$EX_{Sek/Den}$: An index of the Swedish krona per unit of Danish krone (1998 = 100).

$EX_{Sek/£}$: An index of the Swedish krona per unit of British pound (1998 = 100).

$EX_{Sek/Swi}$: An index of the Swedish krona per unit of Swiss franc (1998 = 100).

$EX_{Sek/Yen}$: An index of the Swedish krona per unit of Japanese yen (1998 = 100).

$EX_{Sek/\$}$: An index of the Swedish krona per unit of US dollar (1998 = 100).

A lagged dependent variable may also be included to account for habit persistence and supply constraints. As for the signs of the explanatory variables, we expect a negative sign for the relative price variable and a positive sign for the exchange rate variable. In this study, monthly dummies represent seasonal effects on the number of arrivals from the origin countries. All variables are in natural logarithms, and the data are in index form (1998 = 100). All economic data employed in this study are from Statistics Sweden (Statistiska Centralbyrån) and Statistics Norway. Estimation is with the STATA Ver. 10 and EViews Ver. 5.1 statistical program packages. We examine monthly time series data from 1993:01 to 2006:12.

3. Methodology

3.1. Statistical Assumptions and the Problem of Misspecification

In the common stochastic specification of econometric models, the error terms are assumed to be normally distributed with mean zero, to have constant variance, and to be serially uncorrelated. These assumptions must be tested and verified before we can have any confidence in the estimation results or conduct any specification tests, including standard *t* tests of parameter significance or tests of theoretical restrictions. Because misspecification testing is a vast area of statistical/econometric methodology, we confine ourselves to a brief description of the methods used in this study (in the Appendix) with additional details in the cited references.

The methodology used for misspecification testing in this paper follows Godfrey (1988) and Shukur (2002). To test for autocorrelation, we apply the F-version of the Breusch (1978) and Godfrey (1978) test. We use White's (1980) test (including cross products of the explanatory variables) to test for heteroscedasticity and Ramsey's (1969) RESET test to test for functional misspecification (Ramsey, 1969). We also apply the Engle (1980) Lagrange Multiplier (LM) test for the possible presence of Autoregressive Conditional Heteroscedasticity (ARCH) in the residuals. Finally, we apply the Jarque–Bera (1987) LM test of nonnormality to the residuals in model (4).
When building an econometric model, the assumption of parameter consistency is widely used because of the resulting simplicity in estimation and ease of interpretation. However, in situations where a structural change may have occurred in the generation of the observations, this assumption is obviously inappropriate. Particularly in the field of econometrics where data are not generated under controlled conditions, the problem of ascertaining whether the underlying parameter structure is constant is of paramount interest. However, to test for the stability of the parameters in the models, and in the absence of any prior information regarding possible structural changes, we conduct a cumulative sum (CUSUM) test following Brown, Durbin, and Evans (1975). The CUSUM test is in the form of a graph and is based on the cumulative sum of the recursive residuals. Movement in these recursive residuals outside the critical lines is

suggestive of coefficient instability (see the figures in the Appendix).

3.2. Systemwise Estimation

In this paper, we aim to estimate the number of visitors to Sweden and Norway from five countries (Denmark, the UK, Switzerland, Japan, and the US). For each visiting country, we specify a separate equation with the relative information included in each equation. We do this for both Sweden and Norway. For this purpose, we follow a simple strategy on how to select an appropriate model by successively examining the adequacy of a properly chosen sequence of models for each country separately using diagnostic tests with known good properties. The methodology used for misspecification testing in this paper follows Godfrey (1988) and Shukur (2002). We apply their line of reasoning to the problem of autocorrelation, and then extend it to other forms of misspecification. If we subject a model to several specification tests, one or more of the test statistics may be so large (or the p-values so small) that the model is clearly unsatisfactory. At that point, one has either to modify the model or search for an entirely new model.

Our aim is to find a well-behaved model that satisfies the underlying statistical assumptions, which at the same time agrees with aspects of economic theory. Given these models or equations, we estimate the whole system using Zellner's ISUR. The ISUR technique provides parameter estimates that converge to unique maximum likelihood parameter estimates. Note that conventional seemingly unrelated regressions (SUR) does not have this property if the numbers of variables differ between the equations, even though it is one of the most successful and efficient methods for estimating SUR. The resulting model has stimulated countless theoretical and empirical results in econometrics and other areas (see Zellner, 1962; Srivastava and Giles, 1987; Chib and Greenberg, 1995). The benefit of this model for us is that the SUR estimators utilize the information present in the cross regression (or equations) error correlation and hence it is more efficient than other estimation methods such as ordinary least squares (OLS).

Consider a general system of *m* stochastic equations given by:

$$\mathbf{Y}_i = \mathbf{X}_i B_i + e_i \text{, } i = 1, 2, \ldots \mathrm{M}, \tag{7}$$

where $\boldsymbol{Y_i}$ is a $(T \times 1)$ vector of dependent variables, e_i is a $(T \times 1)$ vector of random errors with $E(e_i) = 0$, $\boldsymbol{X_i}$ is a $(T \times n_i)$ matrix of observations on n_i exogenous and lagged dependent variables including a constant term, B_i is a $(n_i \times 1)$ dimensional vector of coefficients to be estimated, M is the number of equations in the system, T is the number of observations per equation, and n_i is the number of rows in the vector B_i. The *m* system of equations can be written separately as:

$$Y_1 = X_1 \beta_1 + e_1,$$
$$Y_2 = X_2 \beta_2 + e_2, \quad .$$
$$Y_m = X_m \beta_m + e_m,$$

and then combined into a larger model written as:

$$\begin{pmatrix} Y_1 \\ Y_2 \\ \ldots \\ Y_m \end{pmatrix} = \begin{pmatrix} X_1 & 0 & 0 & 0 \\ 0 & X_2 & 0 & 0 \\ 0 & 0 & \ldots & 0 \\ 0 & 0 & 0 & X_m \end{pmatrix} \cdot \begin{pmatrix} \beta_1 \\ \beta_2 \\ \ldots \\ \beta_m \end{pmatrix} + \begin{pmatrix} e_1 \\ e_2 \\ \ldots \\ e_m \end{pmatrix}. \tag{8}$$

This model can be rewritten compactly as:

$$\mathbf{Y} = \mathbf{X}B + e, \tag{9}$$

where *Y* and *e* are of dimension $(TM \times 1)$, *X* is of dimension $(TM \times n)$, $n = \sum_{i=1}^{M} n_i$, and *B* is of dimension $(K \times 1)$.

At this stage, we make the following assumptions:

a) X_i is fixed with rank n_i.

b) $P\ \lim \frac{1}{T}(X_i^{'}X_i) = Q_{ii}$ is nonsingular with finite and fixed elements, i.e. invertible.

c) In addition, we assume that $P\ \lim \frac{1}{T}(X_i^{'}X_j) = Q_{ij}$ is also nonsingular with finite and fixed elements.

d) $E(e_i e_i^{'}) = \sigma_{ij} I_T$, where σ_{ij} designates the covariance between the i^{th} and j^{th} equations for each observation in the sample.

The above expression can be written as:

$E(e) = 0$ and $E(ee^{'}) = \Sigma \otimes I_T = \Psi$, where $\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1M} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2M} \\ \vdots & & \ddots & \\ \sigma_{M1} & \sigma_{M2} & \cdots & \sigma_{MM} \end{bmatrix}$ is an $M \times M$

positive

definite symmetric matrix and $\otimes$ represents the Kronecker product. Thus, the errors at each equation are assumed homoscedastic and not autocorrelated, but there is contemporaneous correlation between corresponding errors in different equations.

The OLS estimator of B in (9) is:

$\hat{\beta}_{OLS} = \left(X'X\right)^{-1} X'Y$, with the variance

$Var(\hat{\beta}_{OLS}) = \left(X'X\right)^{-1} X'\Psi X(X'X)^{-1}$.

The SUR Generalized Least Squares (GLS) estimator of B is given by:

$\hat{\beta}_{GLS} = \left(X'(\Sigma^{-1} \otimes I_T)X\right)^{-1} X'(\Sigma^{-1} \otimes I_T)Y$, and the variance is given by:

$$V\left(\hat{\beta}_{GLS}\right)=\left(X'(\Sigma^{-1}\otimes I_T)X\right)^{-1}.$$

However, the system of the five equations for Sweden and Norway are as follows:

$$Y_{it}=\alpha_i+S_i+X_{it}B_i+Y_{it-q}\Phi_{iq}+e_{it},\ i=1,2,\ldots 5;\ q=1,2,\ldots 12, \qquad (10)$$

where $\boldsymbol{Y_{it}}$ is a $T\times 1$ vector of observations on the dependent variable, e_{it} is a $T\times 1$ vector of random errors with $E(e_t)=0$, and S_i are monthly dummy variables that take values between 1 and 11 (the twelfth month is the base). X_{it} is a $T\times n_i$ matrix of observations on n_i nonstochastic explanatory variables, and B_i is an $n_i\times 1$ dimensional vector of unknown location parameters. T is the number of observations per equation, and n_i is the number of rows in the vector B_i. Φ_{iq} is a parameter vector associated with the lagged dependent variable for the respective equation.

The dependent variables $\boldsymbol{Y_i}$ are the natural logarithms of the number of monthly visitors from Denmark, the UK, Switzerland, Japan, and the US to either Sweden or Norway. The matrix X_i is the natural logarithm of three vectors that contains monthly information about the CPI in Sweden (or Norway), the exchange rate (*Ex*) in Sweden (or Norway), and relative price (*Rp*) for Sweden (or Norway) with respect to each of the abovementioned countries.

Another objective of this study is to test for the existence of any contemporaneous correlation between the three generations' equations. If such correlation exists and is statistically significant, then least squares applied separately to each equation are not efficient and there is need to employ another estimation method that is more efficient.

The SUR estimators utilize the information present in the cross regression (or equations) error correlation. In this paper, we estimated our model in equation (4) by equation using the OLS method to achieve the best specification of each equation (the results are available in the Appendix). We estimate the whole system using ISUR.

Tables 1 and 3 present the results. The ISUR technique provides parameter estimates that converge to unique maximum likelihood parameter estimates.

To test whether the estimated correlation between these equations is statistically significant, we apply Breusch and Pagan's (1980) LM statistic. If we denote the covariances between the different equations as σ_{12}, $\sigma_{13} \ldots \sigma_{45}$, the null hypothesis is:

H_0: $\sigma_{12} = \sigma_{13} \ldots = \sigma_{45} = 0$, against the alternative hypothesis,
H_1: at least one covariance is nonzero.

In our three equations, the test statistic is:

$\lambda = N(r^2_{12} + r^2_{13} + \ldots r^2_{45})$, where r^2_{ij} is the squared correlation,
$r^2_{ij} = \sigma^2_{ij} / \sigma_{ii}\sigma_{jj}$.

Under H_0, λ has an asymptotic χ^2 distribution with five degrees of freedom. We may reject H_0 for a value of λ greater than the critical value from a $\chi^2_{(5)}$ distribution for a specified significance level. In this study, the calculated χ^2 value for Sweden is equal to 24.599 (p-value = 0.0062). For Norway, the calculated χ^2 value is 33.842 (p-value = 0.0002), and for both Sweden and Norway together (i.e. 10 equations in the SUR model), the calculated χ^2 value is 100.021.842 599 (p-value = 0.0000). These results, reported respectively in Tables 2 and 4 for Sweden and Norway, suggest rejection of H_0 at any conventional significance level. This implies that the residuals from each ISUR estimation are significantly "positively" or "negatively" correlated with each other that might stand for the relation between these equations and the countries thereafter. For the case of Norway, the results also suggest a rejection of H_0 at any conventional significance level and we interpret this in the same manner as Sweden.

4. Results

In this section, we present our most important results using ISUR to model international tourism demand to SW6 in Sweden and Tröndelag in Norway. We first conduct single equations estimation on model (10) for the five equations for Sweden and the five equations for Norway, separately. We specify these equations according to a battery of diagnostic tests (see the Appendix). We then select the five most appropriate equations for Sweden and Norway and include them separately in ISUR estimation to achieve the best possible efficiency. We first present the results for the three economic variables and then discuss the results for the seasonal dummy variables (with December as the base month), followed by the lagged dependent variables. Note that the macro variables are in logarithmic form and so we can interpret the estimated parameters as elasticities. The estimated coefficients are included even if they are not significant. For the dummy and lagged dependent variables, only coefficients significant at least at the 10% level in the single equation estimation are included in the ISUR estimation.

4.1. Results for Sweden

Table 1 shows that the CPI parameter for Denmark is negative and small in magnitude but not statistically significant, indicating Swedish CPI has no effect on the demand for tourism by Denmark. This could be due to low travel costs, whereas countries of origin that are more distant generally have higher price elasticity. The estimated CPI_{sw} elasticity is –6.283 and greater than that for Japan. This indicates that a 1% increase in CPI_{sw} results in a 6.3% decrease in tourist arrivals to SW6 from Japan. The low CPI_{sw} elasticity for the US could be a reflection of the depreciation of the Swedish krona against the US dollar.

The estimated elasticity of the relative (substitute) price ranges from 1.9% to 2.3% and is greater than one for Japan and Switzerland. This indicates that a 1% rise in the relative price level (price of tourism in Sweden relative to Norway) causes a more than 1% fall in tourist arrivals from Japan and Switzerland. These estimates indicate that tourist arrivals in Sweden from these countries are elastic with respect to the relative price variable. This implies that Sweden must maintain its international price competitiveness to maintain high growth in tourist inflow. The estimated relative price level elasticity ranges from 0.2% to 0.8% and is less than one for Denmark and the US. These suggest that a 1% increase in the relative price results in a 0.2% and 0.8% decrease in tourist arrivals to SW6 from Denmark and the US, respectively. The low exchange rate elasticity for Japan and the US may also be a reflection of the depreciation of the Swedish krona against the Japanese yen and US dollar. As expected, the estimated elasticities of CPI_{SW} for the UK, Switzerland, and the US are positive.

Table 1. ISUR estimation results for Sweden

Sweden	Equations				
Parameters	Denmark	UK	Switzerland	Japan	US
Constant	0.155 (0.940)	–6.726 (0.058)	–1.178 (0.802)	16.370 (0.00)	–0.222 (0.959)
CPI	–0.278 (0.730)	2.879 (0.037)	2.868 (0.047)	–6.283 (0.000)	0.432 (0.789)
EX	1.810 (0.027)	0.834 (0.035)	–1.200 (0.170)	0.216 (0.502)	0.248 (0.486)
Rp	–0.178 (0.271)	0.548 (0.380)	–1.912 (0.038)	–2.260 (0.004)	–0.769 (0.367)
D1	0.570 (0.000)	–0.377 (0.000)			
D2	0.610 (0.000)	–0.257 (0.000)		0.158 (0.004)	
D3	0.272 (0.076)	–0.411 (0.000)	0.224 (0.000)	0.083 (0.133)	0.138 (0.006)
D4	–0.363 (0.005)	–0.440 (0.000)		–0.197 (0.001)	–0.233 (0.000)
D5	–0.973 (0.000)	–0.707 (0.000)	–0.118 (0.047)	–0.141 (0.013)	–0.113 (0.027)
D6	–0.237 (0.000)	–0.090 (0.090)	0.477 (0.000)	0.113 (0.066)	0.354 (0.000)
D7	0.293 (0.001)	–0.304	0.806 (0.000)		

		(0.000)			
D8	–0.352 (0.004)	–0.399 (0.000)	0.483 (0.000)		
D9	– 0.738 (0.000)	–0.674 (0.000)			–0.243 (0.000)
D10	–0.794 (0.000)	–0.507 (0.000)	–0.363 (0.000)		–0.227 (0.000)
D11	–0.857 (0.000)	–0.328 (0.000)	0.297 (0.000)	0.282 (0.000)	–0.123 (0.028)
$Y_{(t-1)}$		0.592 (0.000)	0.095 (0.082)		0.561 (0.000)
$Y_{(t-3)}$					0.182 (0.005)
$Y_{(t-4)}$		–0.154 (0.000)			
$Y_{(t-11)}$	0.110 (0.144)				
$Y_{(t-12)}$	0.101 (0.159)	0.247 (0.000)	0.153 (0.006)	0.587 (0.000)	
R^2	0.941	0.902	0.825	0.854	0.743

Table 2. Matrix of correlations between the residuals for Sweden

	Denmark	UK	Switzerland	Japan	US
Denmark	1.0000				
UK	0.0538	1.0000			
Switzerland	0.2517	–0.1346	1.0000		
Japan	–0.0356	0.1454	0.0143	1.0000	
US	–0.1454	–0.0835	0.1433	0.0457	1.0000

Breusch–Pagan test of independence: Chi-square (10) = 24.599, p-value = 0.006

In the case of the UK, we find that all dummies are significant, indicating clear seasonality in the demand for tourism. The demand in December is the highest for the year. We also find lags 4 and 12 are statistically significant. Note that the sign of lag 4 is negative while it is larger and positive for lag 12. For Switzerland, only the summer dummies are large, positive, and statistically significant, meaning that the Swiss are relatively more interested in summer tourism. The remaining dummies are either insignificant or small in magnitude. The estimated parameters of lags 1 and 12 are positive and significant.

In general, the lags of the dependent variable for the months of January and December are also significant, supporting the hypothesis of a habit-forming or word-of-mouth effect. Some of the monthly dummies as proxies for seasonal effects are also significant, including January, March, May, June, July, September, October, and November. Estimates of the Denmark dummy show a clear seasonal variation in the pattern of Danish tourism demand in Sweden, such that demand in January, February, March, and July is higher than in December, with lower demand in other months.

4.2. Results for Norway

Table 3 provides estimates of the monthly arrivals from Denmark, Japan, and the US to Tröndelag in Norway. The estimated Norwegian CPI (CPI_{Nor}) elasticity ranges from 0.5% to 0.8% and is lower than that for Denmark, Japan, and the US. The estimated CPI_{SW} coefficients suggest that a 1% increase in CPI_{Nor} results in 0.5%, 0.49%, and 0.8% decreases in tourist arrivals to Norway from Denmark, Japan, and the US, respectively. The low CPI_{Nor} elasticity for Japan and the US may be a reflection of the depreciation of the Norwegian krone against the Japanese yen and the American dollar.

The estimated elasticities of the relative price variable for Switzerland and the US are less than one (0.17% and 0.6%, respectively), indicating that a 1% rise in the relative price (price of tourism in Norway relative to Sweden) causes about a 1% fall in tourist arrivals from Switzerland and the US. The estimated elasticity of the relative price variable for the UK and Japan are greater than one, indicating that the arrival of tourists in Norway from these countries is elastic with respect to the relative price variable. This implies that Norway must also maintain its international price competitiveness to maintain high growth in tourist inflows. Yet again, the low exchange rate elasticity for Denmark, Japan, and the US can be a reflection of the depreciation of the Norwegian krone against the Danish krone, the Japanese yen, and the US dollar.

Table 3. ISUR estimation results for Norway

Parameters	Denmark	UK	Switzerland	Japan	US
Constant	1.949 (0.026)	–2.278 (0.088)	–0.013 (0.996)	–2.095 (0.232)	2.214 (0.136)
CPI	–0.532 (0.239)	2.324 (0.000)	2.681 (0.000)	–0.820 (0.275)	–0.487 (0.414)
Ex	0.233 (0.694)	–0.688 (0.041)	–1.200 (0.149)	– 0.462 (0.128)	0.0792 (0.719)
Rp	0.211 (0.721)	–1.387 (0.018)	–0.166 (0.011)	–1.127 (0.141)	–0.551 (0.349)
D1					0.112 (0.033)
D2		0.178 (0.000)			0.162 (0.008)
D3	0.158 (0.002)	0.216 (0.000)			0.177 (0.002)
D4				–0.473 (0.000)	
D5	–0.135 (0.027)		0.497 (0.000)	–0.150 (0.025)	0.374 (0.000)
D6	0.308 (0.000)	0.486 (0.000)	1.340 (0.000)	0.239 (0.000)	0.506 (0.000)
D7	0.265 (0.000)	0.446 (0.000)	1.346 (0.000)		0.441 (0.000)
D8		0.318 (0.000)	0.734 (0.000)		0.416 (0.000)
D9				–0.227 (0.000)	0.204 (0.002)
D10			–0.331 (0.000)	–0.269 (0.000)	0.171 (0.002)
D11			–0.221 (0.000)		
$Y_{(t-1)}$	0.212 (0.000)	0.025 (0.625)	0.167 (0.000)	0.451 (0.000)	0.364 (0.000)
$Y_{(t-2)}$					–0.143 (0.036)

$Y_{(t-3)}$	–0.135 (0.001)				
$Y_{(t-6)}$	–0.116 (0.004)		–0.188 (0.000)		
$Y_{(t-7)}$	0.144 (0.000)				
$Y_{(t-9)}$	–0.127 (0.005)				
$Y_{(t-10)}$			–0.135 (0.001)		
$Y_{(t-11)}$	0.278 (0.000)			0.199 (0.000)	
$Y_{(t-12)}$	0.363 (0.000)	0.292 (0.000)		0.263 (0.000)	0.244 (0.000)
R^2	0.924	0.794	0.950	0.808	0.850

Table 4. Matrix of correlations between the residuals for Norway

	Denmark	UK	Switzerland	Japan	US
Denmark	1.0000				
UK	–0.0220	1.0000			
Switzerland	0.0170	0.1060	1.0000		
Japan	0.1514	–0.0446	0.1531	1.0000	
US	–0.0091	0.3856	–0.0883	–0.0033	1.0000

Breusch–Pagan test of independence: Chi-square (10) = 33.842, p-value = 0.000

5. Summary and Conclusions

The main purpose of this paper is to estimate the demand for tourism to Sweden and Norway from five different countries: namely, Denmark, the UK, Switzerland, Japan, and the US. Monthly time series data from 1993:01 to 2006:12 is collected from Statistics Sweden for this purpose. For each visiting country, we specify a separate equation with the relative information included in each equation. We conduct several diagnostic tests in order to specify the five equations for Sweden and Norway. We then estimate these equations using Zellner's ISUR that takes into consideration any possible correlation between the equations and hence is more efficient than other single equations estimation methods such as OLS.

The results show that CPI, some lagged dependent variables, and several monthly dummy variables representing seasonal effects have a significant impact on the number of visitors to SW6 in Sweden and Tröndelag in Norway. The results also show that the relative price and exchange rate have a significant effect on international tourism demand for some countries. However, although we could view this conclusion as supporting a theoretical framework that describes tourism demand model variable relationships, our demand system lacks a travel cost variable. Nonetheless, our results could also have important implications for the decision-making process of government tourism agencies in both countries when considering influential factors in their long run planning.

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APPENDIX

Diagnostic Tests

The Cusum test

This test is used for time series and checks for structural changes. In the Cusum test Recursive Residuals (RR) calculated by the Kalman Filter are used.

We now describe the construction of recursive residuals and the Kalman filter technique. The recursive residuals can be computed by forward or backward recursion. Only forward recursion is described, backward recursion being analogous.

Given N observations, consider the linear model (2 . 2 . 1) but with the corresponding vector of coefficient β expressed as β_t, implying that the coefficients may vary over time t. The hypothesis to be tested is $\beta_1 = \beta_2 = , . . .,$ $= \beta_N = \beta$. The OLS estimator based on N observations is:

$$b = (X'X)^{-1} X'y ,$$

where X is a N by k matrix of observations on the regressors, and y is an N by 1 vector of observations for the dependent variable. Suppose that only r observations are used to estimate β. Then for $r > k$, where k is the number of independent variables,

$$b_r = (X_r'X_r)^{-1} X_r'y_r , \qquad r = k+1, . . ., N .$$

Using b_r, one may "forecast" y_r at sample point r, corresponding to the vector X_r of the explanatory variables at that point.

Recursive residuals are now derived by estimating equation (2 . 2 . 1) recursively in the same manner, that is by using the first k observations to get an initial estimate of β, and then gradually enlarging the sample, adding one observation at a time and re-estimating β at each step. In this way, it is possible to get (N-k) estimates of the vector β, and correspondingly (N-k-1) forecast errors of the type:

$$W_r = y_r - X_r b_{r-1} \quad , \qquad r = k+1, \ldots, N ,$$

where b_{r-1} is an estimate of β based on the first $r - 1$ observations. It can be shown that, under the null hypothesis, these forecast errors have mean zero and variance $\sigma^2 d_r^2$, where d_r is a scalar function of the explanatory variables, equal to $[1 + X_r'(X'_{r-1}X_{r-1})^{-1} X_r]^{1/2}$.

Then the quantity: $$W_r = \frac{y_r - X_r b_{r-1}}{[1 + X_r'(X'_{r-1}X_{r-1})X_r]^{1/2}} \quad , \qquad r = k+1, \ldots, N ,$$

gives a set of standardized prediction errors, called "recursive residuals". The recursive residuals are independently and normally distributed with mean zero and constant variance σ^2. As a result of a change in the structure over time, these recursive residuals will no longer have zero mean, and the CUSUM of these residuals can be used to test for structural change.

CUSUM involves the plot of the quantity:

$$V_r = \sum_{t=k+1}^{r} W_t \;/\; \sigma^*, \qquad r = k+1, \ldots, N,$$

where σ^* is the estimated standard deviation based on the full sample.

The test finds parameter instability if the cumulative sum goes outside the area between the two error bounds. Thus, movements of V_t outside the error bounds are a sign of parameter instability.

The Breusch-Godfrey-test

The Breusch-Godfrey test can be separated into several stages:

1. Run an OLS on:

   $y_t = \alpha + \beta X_t + \theta_i y_{t-i} + \varepsilon_t$

   This gives us $\hat{\varepsilon}_t$

2. Run an OLS on:

$$\hat{\varepsilon}_t = \alpha + \beta X_t + \theta_i y_{t-i} + \rho_1 \hat{\varepsilon}_{t-1} + \rho_2 \hat{\varepsilon}_{t-2} + ... + \rho_P \hat{\varepsilon}_{t-P} + u_t$$

This equation can be used for any AR(P) process. From this equation the unrestricted residual sum of squares (RSS_u).

The restricted residual sum of squares (RSS_R) is given from the following equation:

$$\hat{\varepsilon}_t = \alpha + \beta X_t + \theta y_{t-1} + \nu_t$$

The null hypothesis is:

$$H_0 : \rho_1 = \rho_2 = ... = \rho_P = 0$$

3. Run an F-test:

$F = ((RSS_R - RSS_U)/p) / (RSS_U/(T-k-P))$

This has a distribution: F(P,T-k-P) under the null hypothesis.

The Breusch-Godfrey test can be tested for AR(P) processes which gives this test a clear advantage over other available tests for autocorrelation.

The Ramsey RESET-test

RESET test stands for Regression Specification Error Test. The test is very general and can only tell you if you have a problem or not. It tests for omitted variables and incorrect functional forms or misspecified dynamics and also if there is a correlation between the error term and the independent variable. The null hypothesis is:

H_0: E (ε_i/X_i) = 0

H_1: E (ε_i/X_i) $\neq$ 0 (and an omitted variable effect is present)

Thus, by rejecting the null hypothesis indicates some type of misspecification. First a linear regression is specified:

$$y_i = \alpha + \beta X_i + \varepsilon_i$$

This gives the restricted residual sum of squares (RSSR). After the RSS_R has been found the unrestricted model is presented by adding variables (three fitted values):

$$y_t = \alpha + \beta X_i + \theta_1 \hat{y}_i^2 + \theta_2 \hat{y}_i^3 + u_t$$

This gives us the unrestricted residual sum of squares (RSS_U). In the third step the

RESET-test uses a F-test:

F= ((RSS$_R$ - RSS$_U$)/number of restrictions under H$_0$) / (RSS$_U$ / (N- number of parameters in unrestricted model))

The F-test checks if $\theta_1=\theta_2=0$, if $\theta_1=\theta_2\neq0$ we have an omitted variable or a misspecification in the model.

The White's test

This test is a general test where we do not need to make any specific assumptions regarding the nature of the heteroscedasticity, whether it is increasing, decreasing etc. The test only tells us if we have an indication of heteroscedasticity.

$$H_0 : \sigma_i^2 = \sigma^2 \qquad \forall i$$

The alternative hypothesis is not H$_0$, anything other than H$_0$.

The test can be divided into several steps:

1. Run an OLS on:

   $$y_i = \alpha + \beta_1 X_{1i} + ... + \beta_k X_{ki} + \varepsilon_i$$

   From this equation we get $\hat{\varepsilon}_i$ which is used as a proxy for the variance.

2. Run an OLS on:

   $$\hat{\varepsilon}_i^2 = \alpha_0 + \alpha_1 X_{1i} + ... + \alpha_k X_{ki} + \alpha_{k+1} X_{1i}^2 + ... + \alpha_{k+k} X_{k+k}^2 + \alpha_{k+k+1} X_{1i} X_k + \delta_i$$

   Where *k* is the number of parameters. The variance is considered to be a linear function of a number of independent variables, their quadratic and cross products. Thus, the X:s is used as a proxy for Z.

3. Calculate an F-test:

   Restricted model: $\hat{\varepsilon}_i^2 = \alpha_0^{'} + \delta_i^{'}$

   From this test the restricted residual sum of squares (RSS$_R$) is measured.

   The F-test is:

   F=((RSS$_R$-RSS$_U$)/k) / (RSS$_U$/(n-k-1))

   Where $H_0 : \alpha_i = 0 \quad \forall i = 1,2...k$

The ARCH Engel's LM test

This is a test for AutoRegressive Conditional Heteroscedasticity (ARCH). The ARCH process can be modeled as:

$$y_t = \alpha + \beta X_t + \varepsilon_t$$

where the Variance of ε_t conditioned on ε_{t-i} : Var($\varepsilon_t \backslash \varepsilon_{t-i}$) = $\alpha_0 + \alpha_1 \varepsilon_{t-i}^2$

1) Use OLS on the original model and get: $\hat{\varepsilon}_t$. Square it and use it in the folloing unrestricted model:

2) $$\hat{\varepsilon}_t^2 = \alpha_0 + \alpha_i \hat{\varepsilon}_{t-i}^2 + \delta_t$$

3) Test whether α_i = 0, for any i = 1, 2 , . . . By an F-test as before.

Test for Non-Normality

The test for non-normality is normally done before one test for heteroskedasticity and structural changes.

The test used here for testing for normal distribution is the Jarque-Bera test. The Jarque-Bera test is structured as follows:

$$T\left[1/6\hat{b}_1^2 + 1/24(\hat{b}_2 - 3)^2\right]$$

$$b_1 = \mu_3 / (\mu_2)^{3/2}$$

$$b_2 = \mu_4 / (\mu_2)^2$$

Where T is the total number of observations, b_1 is a measure for skewness and b_2 is a measure for kurtosis. The μ are different moments. The test has a chi-square distribution with two degrees of freedom under the null hypothesis of normal distribution. The two degrees of freedom comes from having one for skewness and one for kurtosis.

Single Equation Estimation and Diagnostic Results

SWEDEN

Equation 1 (Denmark)

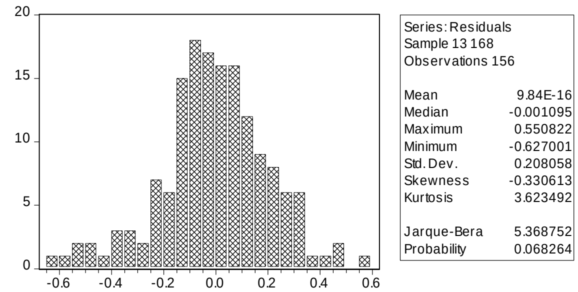
Equation 1

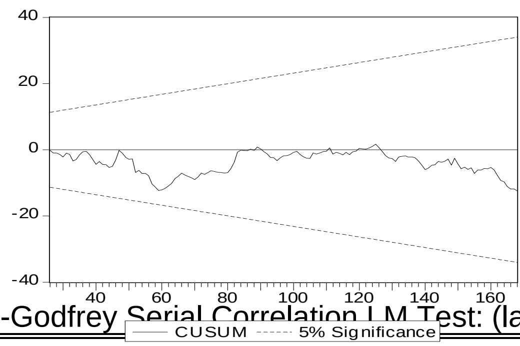
Dependent Variable: LY1S
Method: Least Squares
Date: 12/22/07 Time: 01:02
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.119869	2.177339	-0.055053	0.9562
CPI	-0.329812	0.859238	-0.383842	0.7017
EX	1.949515	0.879789	2.215890	0.0283
Rp	-0.174692	0.179727	-0.971984	0.3327
D1	0.535168	0.113648	4.708980	0.0000
D2	0.575040	0.164450	3.496738	0.0006
D3	0.193673	0.169505	1.142578	0.2552
D4	-0.441525	0.143971	-3.066755	0.0026
D5	-1.009611	0.125585	-8.039258	0.0000
D6	-0.232609	0.069912	-3.327157	0.0011
D7	0.258146	0.093145	2.771445	0.0063
D8	-0.408344	0.133995	-3.047455	0.0028
D9	-0.784962	0.111768	-7.023144	0.0000
D10	-0.803996	0.097960	-8.207415	0.0000
D11	-0.865023	0.102241	-8.460669	0.0000
LY1S(-1)	0.156265	0.083752	1.865806	0.0642
LY1S(-12)	0.092566	0.079332	1.166823	0.2453

R-squared	0.941591	Mean dependent var	3.766018
Adjusted R-squared	0.934867	S.D. dependent var	0.666149

S.E. of regression	0.170009	Akaike info criterion	-0.6033 69
Sum squared resid	4.017505	Schwarz criterion	-0.2710 13
Log likelihood	64.06280	F-statistic	140.047 2
Durbin-Watson stat	2.026049	Prob(F-statistic)	0.00000 0





Breusch-Godfrey Serial Correlation LM Test: (lag 1)

F-statistic	2.453516	Probability	0.11948 8

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	1.187923	Probability	0.29821 8

White Heteroskedasticity Test:

F-statistic	1.560470	Probability	0.08754 5

Ramsey RESET Test:

F-statistic	2.804172	Probability	0.06393 8

ARCH Test: (1 lag)

F-statistic	0.669005	Probability	0.41467 1

ARCH Test: (12 lag)

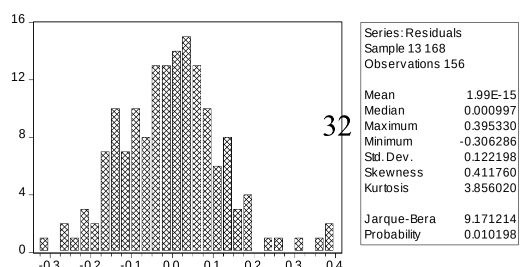
F-statistic	1.277820	Probability	0.23901 6

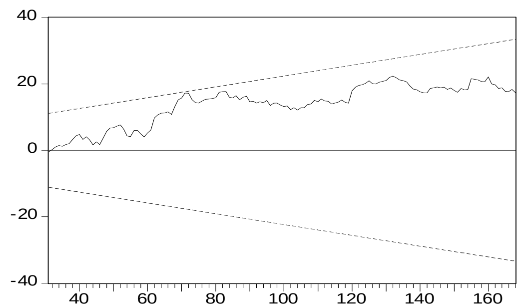
Equation 2. (UK)

Dependent Variable: LY2S
Method: Least Squares
Date: 12/22/07 Time: 01:15
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficie	Std. Error	t-Statistic	Prob.

	nt			
C	-7.638103	3.820955	-1.999004	0.0476
CPI	3.274332	1.484819	2.205207	0.0291
EX	0.885046	0.430066	2.057930	0.0415
Rp	0.557153	0.668809	0.833053	0.4063
D1	-0.356825	0.065210	-5.471938	0.0000
D2	-0.250278	0.066938	-3.738970	0.0003
D3	-0.395741	0.071868	-5.506512	0.0000
D4	-0.433470	0.065740	-6.593749	0.0000
D5	-0.722577	0.072784	-9.927690	0.0000
D6	-0.101814	0.057072	-1.783959	0.0766
D7	-0.311841	0.058173	-5.360573	0.0000
D8	-0.402540	0.058301	-6.904539	0.0000
D9	-0.676417	0.072282	-9.358021	0.0000
D10	-0.535941	0.065281	-8.209807	0.0000
D11	-0.348392	0.060646	-5.744678	0.0000
LY2S(-1)	0.579430	0.064477	8.986605	0.0000
LY2S(-4)	-0.143180	0.058915	-2.430272	0.0164
LY2S(-12)	0.214971	0.063376	3.391974	0.0009
R-squared	0.901984	Mean dependent var		3.132188
Adjusted R-squared	0.889909	S.D. dependent var		0.390316
S.E. of regression	0.129507	Akaike info criterion		-1.142004
Sum squared resid	2.314527	Schwarz criterion		-0.790098
Log likelihood	107.0763	F-statistic		74.70182
Durbin-Watson stat	1.976678	Prob(F-statistic)		0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	0.000310	Probability	0.985967

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.454242	Probability	0.937245

White Heteroskedasticity Test:

F-statistic	1.611124	Probability	0.050065

Ramsey RESET Test:

F-statistic	0.506977	Probability	0.603447

ARCH Test: (1 lag)

F-statistic	0.344502	Probability	0.558107

ARCH Test: (12)

F-statistic	0.372600	Probability	0.97102 2

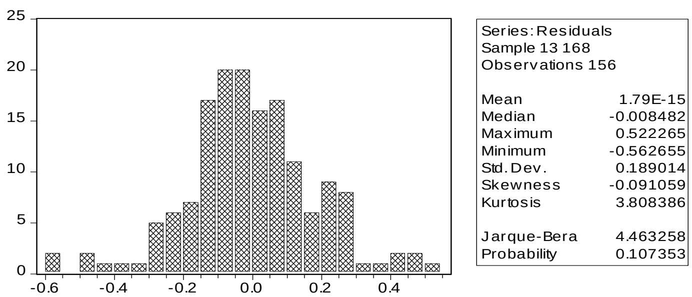
Equation 3 (Switzerland)

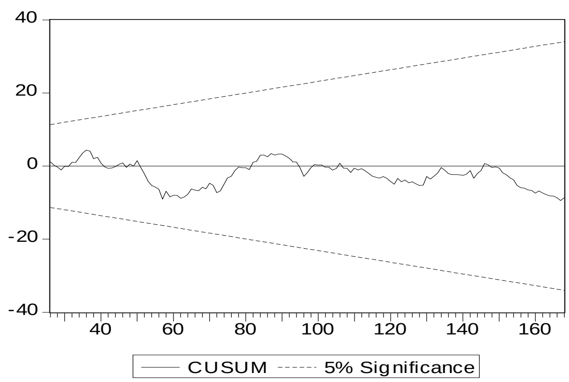
Dependent Variable: LY3S
Method: Least Squares
Date: 12/26/07 Time: 13:20
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficie nt	Std. Error	t-Statistic	Prob.
C	1.161667	5.066274	0.229294	0.8190
CPI	2.195696	1.541189	1.424677	0.1564
EX	-1.45546 2	0.946573	-1.537613	0.1264
Rp	-2.23077 5	1.000473	-2.229722	0.0273
D3	0.214337	0.064273	3.334782	0.0011
D5	-0.10823 8	0.062189	-1.740476	0.0839
D6	0.463586	0.075057	6.176465	0.0000
D7	0.778064	0.089632	8.680650	0.0000

D8	0.445411	0.085466	5.211553	0.0000
D10	-0.342893	0.066463	-5.159183	0.0000
D11	0.300770	0.073663	4.083063	0.0001
LY3S(-1)	0.108503	0.059123	1.835206	0.0686
LY3S(-12)	0.186613	0.061763	3.021441	0.0030

R-squared	0.825277	Mean dependent var	2.552475
Adjusted R-squared	0.810614	S.D. dependent var	0.452187
S.E. of regression	0.196785	Akaike info criterion	-0.333759
Sum squared resid	5.537558	Schwarz criterion	-0.079604
Log likelihood	39.03318	F-statistic	56.28637
Durbin-Watson stat	1.835514	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)			
F-statistic	1.736072	Probability	0.189759

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.631462	Probability	0.812301

White Heteroskedasticity Test:

F-statistic	1.254121	Probability	0.231790

Ramsey RESET Test:

F-statistic	4.581138	Probability	0.001663

ARCH Test: (1 lag)

F-statistic	4.51E-05	Probability	0.994649

ARCH Test: (12)

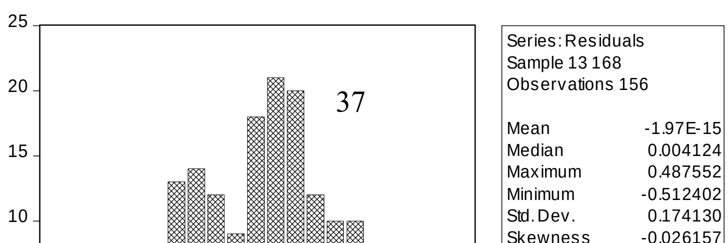
F-statistic	1.137238	Probability	0.335894

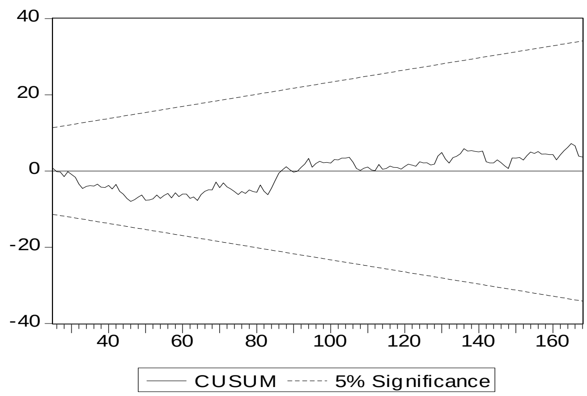
Equation 4 (Japan)

Dependent Variable: LY4S
Method: Least Squares
Date: 12/26/07 Time: 13:46
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.92918	4.042619	4.187677	0.0000
CPI	-6.459596	1.508936	-4.280895	0.0000
EX	0.097664	0.338176	0.288796	0.7732
Rp	-2.374048	0.815590	-2.910834	0.0042
D2	0.158504	0.057138	2.774067	0.0063
D3	0.081410	0.057596	1.413475	0.1597
D4	-0.203459	0.063137	-3.222509	0.0016
D5	-0.140453	0.059189	-2.372963	0.0190
D6	0.119331	0.064106	1.861454	0.0647
D11	0.291585	0.076227	3.825223	0.0002
LY4S(-1)	0.233591	0.058468	3.995189	0.0001
LY4S(-12)	0.580193	0.053634	10.81761	0.0000

R-squared	0.845582	Mean dependent var	2.684916
Adjusted R-squared	0.833786	S.D. dependent var	0.443123
S.E. of regression	0.180659	Akaike info criterion	-0.510612
Sum squared resid	4.699804	Schwarz criterion	-0.276008
Log likelihood	51.82774	F-statistic	71.68462
Durbin-Watson stat	2.090491	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	0.529381	Probability	0.468057

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.954636	Probability	0.495384

White Heteroskedasticity Test:

F-statistic	1.308870	Probability	0.199895

Ramsey RESET Test:

F-statistic	0.453596	Probability	0.636257

ARCH Test: (1 lag)

F-statistic	0.001458	Probability	0.969592

ARCH Test: (12)

F-statistic	0.903619	Probability	0.545306

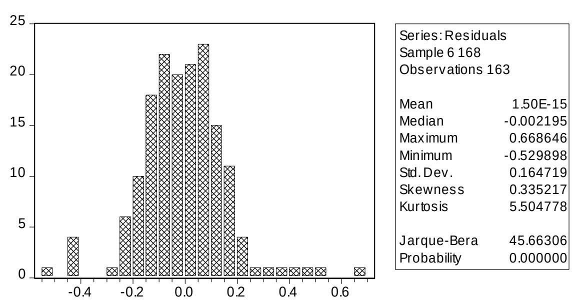
Equation 5 (USA)

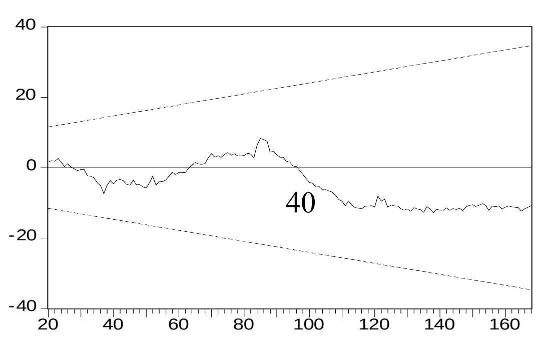
Dependent Variable: LY5S
Method: Least Squares
Date: 12/27/07 Time: 01:08
Sample(adjusted): 6 168
Included observations: 163 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.16260	4.368918	-1.410555	0.1605

	1			
CPI	2.690216	1.642524	1.637855	0.1036
EX	0.539904	0.395854	1.363897	0.1747
Rp	0.217864	0.895073	0.243404	0.8080
D3	0.103305	0.057829	1.786378	0.0761
D4	-0.282404	0.057242	-4.933514	0.0000
D5	-0.136116	0.057171	-2.380880	0.0185
D6	0.335615	0.062417	5.376959	0.0000
D9	-0.305832	0.066889	-4.572240	0.0000
D10	-0.302530	0.068226	-4.434242	0.0000
D11	-0.112570	0.058869	-1.912222	0.0578
LY5S(-1)	0.599894	0.056822	10.55751	0.0000
LY5S(-3)	0.199785	0.074313	2.688433	0.0080
LY5S(-5)	-0.106157	0.066952	-1.585568	0.1150

R-squared	0.759922	Mean dependent var	2.804902
Adjusted R-squared	0.738975	S.D. dependent var	0.336176
S.E. of regression	0.171754	Akaike info criterion	-0.603529
Sum squared resid	4.395427	Schwarz criterion	-0.337808
Log likelihood	63.18764	F-statistic	36.27932
Durbin-Watson stat	2.151594	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	1.689666	Probability	0.195666

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.610817	Probability	0.830248

White Heteroskedasticity Test:

F-statistic	1.203814	Probability	0.262503

Ramsey RESET Test:

F-statistic	2.500256	Probability	0.085549

ARCH Test: (1 lag)

F-statistic	6.588216	Probability	0.011182

ARCH Test: (12)

F-statistic	1.455332	Probability	0.148504

Norway

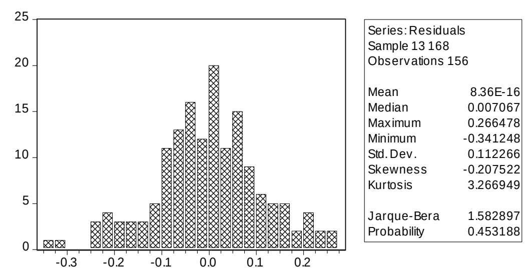
Equation 1 Denmark

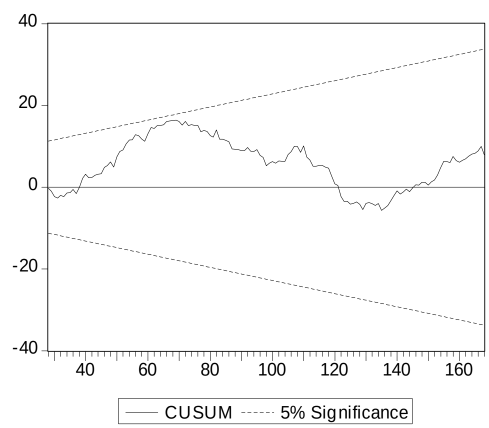
Dependent Variable: LY1N
Method: Least Squares
Date: 12/27/07 Time: 01:18
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.003059	0.927384	2.159903	0.0325
CPI	-0.411580	0.476516	-0.863727	0.3892
EX	0.041037	0.627468	0.065401	0.9479
Rp	0.023892	0.623491	0.038319	0.9695
D3	0.163731	0.053542	3.057996	0.0027
D5	-0.151893	0.064444	-2.356969	0.0198
D6	0.294058	0.075985	3.869955	0.0002
D7	0.265679	0.054183	4.903354	0.0000
LY1N(-1)	0.212817	0.043851	4.853144	0.0000
LY1N(-3)	-0.129238	0.043971	-2.939202	0.0038
LY1N(-6)	-0.124055	0.042238	-2.937039	0.0039
LY1N(-7)	0.144829	0.040429	3.582298	0.0005

LY1N(-9)	-0.130432	0.048031	-2.715593	0.0074
LY1N(-11)	0.292194	0.060564	4.824506	0.0000
LY1N(-12)	0.360838	0.075853	4.757068	0.0000

R-squared	0.924183	Mean dependent var	3.466393
Adjusted R-squared	0.916655	S.D. dependent var	0.407723
S.E. of regression	0.117708	Akaike info criterion	-1.350012
Sum squared resid	1.953572	Schwarz criterion	-1.056757
Log likelihood	120.3009	F-statistic	122.7668
Durbin-Watson stat	2.064753	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	0.481396	Probability	0.488940

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	1.576505	Probability	0.106212

White Heteroskedasticity Test:

F-statistic	1.413267	Probability	0.112602

Ramsey RESET Test:

F-statistic	2.329920	Probability	0.101093

ARCH Test: (1 lag)

F-statistic	0.399305	Probability	0.528391

ARCH Test: (12)

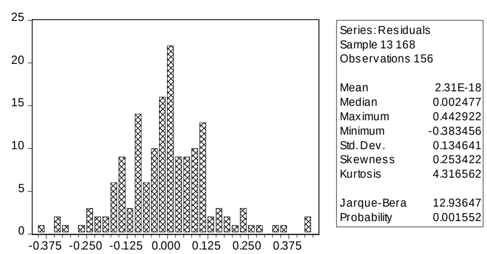
F-statistic	1.177853	Probability	0.305457

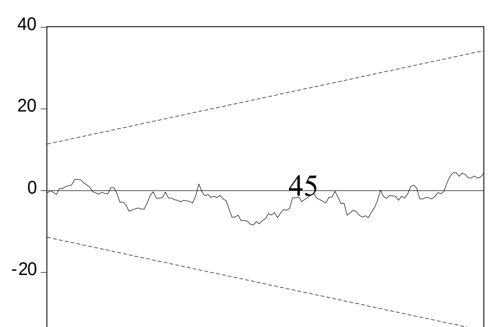
Equation 2: UK

Dependent Variable: LY2N
Method: Least Squares
Date: 12/27/07 Time: 01:26
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.326944	1.343139	-1.732466	0.0853
CPI	2.305063	0.665217	3.465131	0.0007
EX	-0.750340	0.349183	-2.148847	0.0333
Rp	-1.391284	0.587439	-2.368391	0.0192
D2	0.158940	0.043887	3.621603	0.0004
D3	0.268909	0.050052	5.372568	0.0000
D6	0.461864	0.065972	7.000883	0.0000
D7	0.459506	0.064187	7.158867	0.0000
D8	0.377767	0.057190	6.605537	0.0000
LY2N(-11)	0.145403	0.049788	2.920454	0.0041
LY2N(-12)	0.215580	0.077283	2.789482	0.0060

R-squared	0.804600	Mean dependent var	3.384617
Adjusted R-squared	0.791124	S.D. dependent var	0.304590
S.E. of regression	0.139207	Akaike info criterion	-1.037813
Sum squared resid	2.809877	Schwarz criterion	-0.822759
Log likelihood	91.94939	F-statistic	59.70672
Durbin-Watson stat	1.748807	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	2.237018	Probability	0.136929

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.807708	Probability	0.642062

White Heteroskedasticity Test:

F-statistic	3.060427	Probability	0.000270

Ramsey RESET Test:

F-statistic	8.079328	Probability	0.000474

ARCH Test: (1 lag)

F-statistic	1.139148	Probability	0.287514

ARCH Test: (12)

F-statistic	0.807708	Probability	0.642062

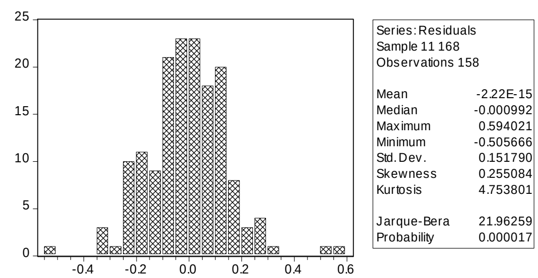
Equation 3 Switzerland

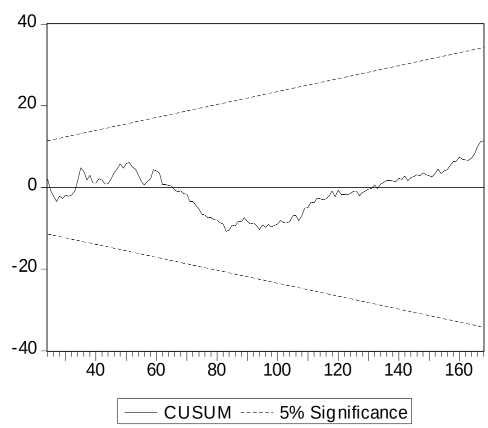
Dependent Variable: LY3N
Method: Least Squares
Date: 12/27/07 Time: 20:29
Sample(adjusted): 11 168
Included observations: 158 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.333285	2.462596	0.135339	0.8925
CPI	2.775242	0.705084	3.936046	0.0001
EX	-1.427495	0.889185	-1.605398	0.1106
Rp	-1.755044	0.684320	-2.564655	0.0113
D5	0.513811	0.064992	7.905813	0.0000
D6	1.341331	0.059197	22.65891	0.0000
D7	1.345281	0.066379	20.26659	0.0000
D8	0.720408	0.071672	10.05144	0.0000
D10	-0.332344	0.056364	-5.896409	0.0000
D11	-0.23694	0.059133	-4.006960	0.0001

	2			
LY3N(-1)	0.173318	0.046154	3.755225	0.0003
LY3N(-6)	-0.178542	0.037775	-4.726490	0.0000
LY3N(-10)	-0.132804	0.043088	-3.082155	0.0025

R-squared	0.949990	Mean dependent var	2.608956
Adjusted R-squared	0.945851	S.D. dependent var	0.678756
S.E. of regression	0.157946	Akaike info criterion	-0.774431
Sum squared resid	3.617308	Schwarz criterion	-0.522445
Log likelihood	74.18005	F-statistic	229.5339
Durbin-Watson stat	2.118971	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	1.013342	Probability	0.315792

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.437096	Probability	0.984499

White Heteroskedasticity Test:

F-statistic	3.875491	Probability	0.000002

Ramsey RESET Test:

F-statistic	4.554060	Probability	0.012096

ARCH Test: (1 lag)

F-statistic	0.069835	Probability	0.791929

ARCH Test: (12)

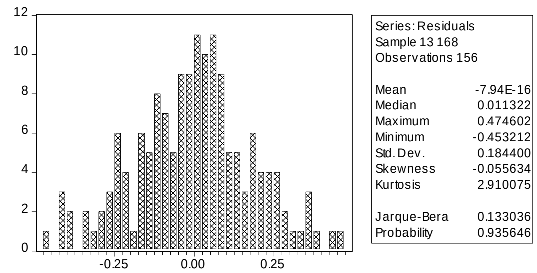
F-statistic	0.674812	Probability	0.773113

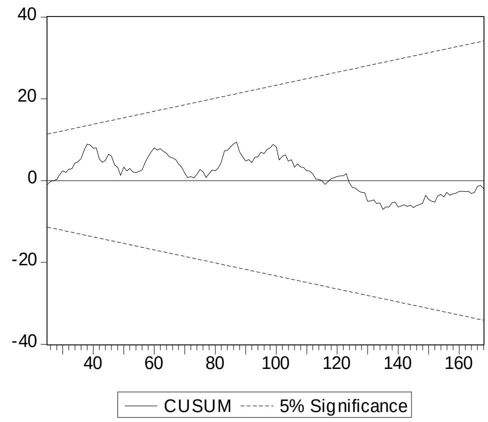
Equation 4 Japan

Dependent Variable: LY4N
Method: Least Squares
Date: 12/27/07 Time: 20:40
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.134247	1.833739	-1.163877	0.2464
CPI	0.906958	0.784255	1.156458	0.2494
EX	0.355452	0.321598	1.105268	0.2709
Rp	-1.118091	0.771935	-1.448426	0.1497
D4	-0.496612	0.071376	-6.957706	0.0000
D5	-0.158892	0.069900	-2.273135	0.0245
D6	0.254585	0.066018	3.856266	0.0002
D9	-0.255711	0.062027	-4.122585	0.0001
D10	-0.267070	0.063898	-4.179603	0.0001
LY4N(-1)	0.465861	0.056731	8.211690	0.0000
LY4N(-11)	0.192711	0.054702	3.522932	0.0006
LY4N(-12)	0.234211	0.072611	3.225562	0.0016

R-squared	0.809212	Mean dependent var	2.790702
Adjusted R-squared	0.794638	S.D. dependent var	0.422168
S.E. of regression	0.191314	Akaike info criterion	-0.396003
Sum squared resid	5.270525	Schwarz criterion	-0.161399
Log likelihood	42.88822	F-statistic	55.52410
Durbin-Watson stat	1.894875	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)			
F-statistic	0.740993	Probability	0.390784

Breusch-Godfrey Serial Correlation LM Test: (lag 12)			
F-statistic	0.633159	Probability	0.810849

White Heteroskedasticity Test:			
F-statistic	1.238695	Probability	0.242862

Ramsey RESET Test:			
F-statistic	1.206413	Probability	0.302317

ARCH Test: (1 lag)

F-statistic	0.040906	Probability	0.83998 9

ARCH Test: (12)

F-statistic	0.499262	Probability	0.91204 6

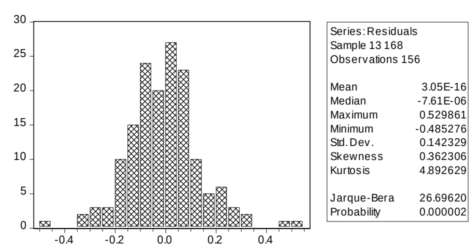
Equation 5 USA

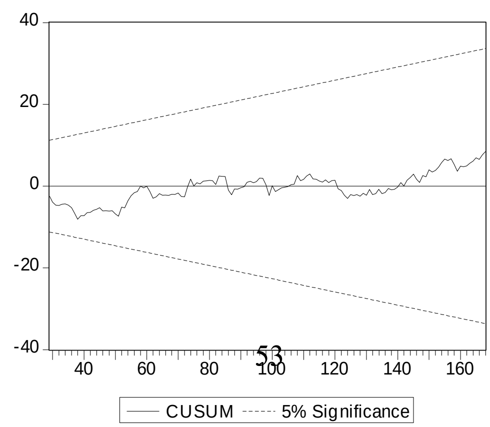
Dependent Variable: LY5N
Method: Least Squares
Date: 12/27/07 Time: 20:52
Sample(adjusted): 13 168
Included observations: 156 after adjusting endpoints

Variable	Coefficie nt	Std. Error	t-Statistic	Prob.
C	2.413798	1.576772	1.530848	0.1281
CPI	-0.55154 0	0.627360	-0.879144	0.3808

EX	0.141222	0.235539	0.599572	0.5498
Rp	-0.521152	0.616770	-0.844969	0.3996
D1	0.156740	0.059620	2.628974	0.0095
D2	0.206501	0.066931	3.085266	0.0025
D3	0.223657	0.062322	3.588751	0.0005
D5	0.474422	0.065277	7.267837	0.0000
D6	0.576053	0.084545	6.813597	0.0000
D7	0.504942	0.087244	5.787695	0.0000
D8	0.474265	0.087801	5.401564	0.0000
D9	0.255674	0.075244	3.397925	0.0009
D10	0.181149	0.062327	2.906439	0.0043
LY5N(-1)	0.387033	0.076874	5.034646	0.0000
LY5N(-2)	-0.147638	0.077491	-1.905240	0.0588
LY5N(-12)	0.178401	0.074972	2.379579	0.0187

R-squared	0.853341	Mean dependent var	3.201418
Adjusted R-squared	0.837627	S.D. dependent var	0.371654
S.E. of regression	0.149760	Akaike info criterion	-0.862650
Sum squared resid	3.139930	Schwarz criterion	-0.549845
Log likelihood	83.28672	F-statistic	54.30616
Durbin-Watson stat	2.044317	Prob(F-statistic)	0.000000





Breusch-Godfrey Serial Correlation LM Test: (1 lag)

F-statistic	0.328200	Probability	0.567646

Breusch-Godfrey Serial Correlation LM Test: (lag 12)

F-statistic	0.361056	Probability	0.974479

White Heteroskedasticity Test:

F-statistic	2.615574	Probability	0.000477

Ramsey RESET Test:

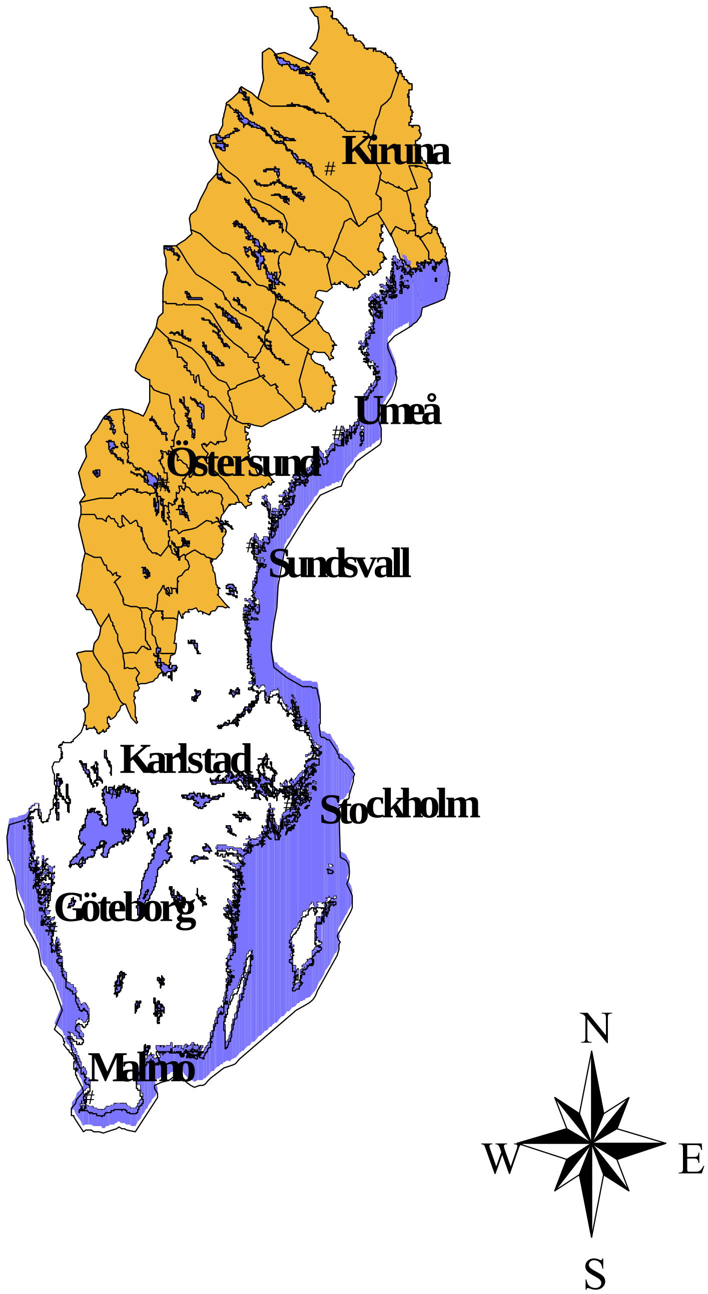
F-statistic	2.343928	Probability	0.099759

ARCH Test: (1 lag)

F-statistic	1.746908	Probability	0.188239

ARCH Test: (12)

F-statistic	1.282459	Probability	0.236223



Appendix D. The Objective 6 region in Sweden (yellow shadowed on the top and left).