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Inbound Tourism Modelling, Gothenburg Case

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Abstract

This thesis research project focuses on the description of the determinants and the tourism demand function in the Gothenburg region as a destination, measured by guest night production and using the general to specific modeling approach from the top five markets: Sweden, Norway, UK, USA and Germany. Norway is used as a substitute destination with the aim to observe effects in the demand function of Gothenburg. Furthermore, through the demand function we derive the own-price, cross-price and income elasticities from these five origins markets. We work with an annualized times series data from 1982 to 2013. The main findings are related to the domestic and regional markets in Gothenburg. If the price in Gothenburg increases by 1%, the domestic demand decreases by 0.7%. If the price in the complementary destination Norway increases, the domestic demand in Gothenburg is low affected. Nevertheless, the Norwegian market decreases the overnight demand in Gothenburg by 0.35%, due to a 1% increase in Gothenburg´s prices.

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I. Introduction

The global growth of the travel and tourism industry in the 90´s has motivated stronger interest developing studies in this field. The Econometrics have become popular to analyze and work on the determinants of the demand function and forecast the destination trends. Thereby, we will primarily analyze recent developments of tourism demand studies in terms of modelling techniques and their forecasting performances. Then, after a comprehensive review of econometric instruments, we move on to the model selection and the diagnostic test procedure to forecast the destination.

Furthermore, the world travel and tourism industry has been forecasted to grow 2.4% for the next ten years (until 2024), for that reason it is important to develop correct public policies to incentivize efficiency and competition in the sector. One of the goals in the thesis is to generate literature related to tourism economics and the production of relevant information to policy-makers. Further, the thesis describes the determinants of the demand function of Gothenburg as a destination, measured by guest nights production, income and prices variations, from the main five origin markets.

The methodology and the scale of tourism can be measured in many ways, but we work under two specific perspectives due to the data availability; the domestic-regional and international inbound modelling. Additionally, we measure the own and cross prices effects in the region and assess if the touristic product is observed as a normal good. The geographical touristic destination studied is Gothenburg region encompassing the communities of: Ale, Lerum, Lilla Edet, Göteborg, Mölndal, Kungälv, Alingsås, Kungsbacka, Härryda, Partille, Öckerö, Stennungsund and Tjörn.

Based on the annual report from Göteborg & Co, Statistics Sweden and Swedish Agency for Economic and Regional Growth[1], Gothenburg region has produced 4 080 925 guest nights in the year 2014. The domestic segment represents 72.9% of the total market, with 2 973 336 guest nights production in the Gothenburg region. In the regional-international level, the main market by size volume importance is Norway with 257 027 guest nights production, followed by Germany with 110 406 guest nights production. The Norwegian and German segments represent 6.3% and 2.7% of the total market, respectively. The level of production from United Kingdom performs

[1] Table 5 Commercial guest nights production in Gothenburg; Annex 2

around 2.2% of the total market, with 89 519 guest nights production in year 2014. Figure 1, shows a graphical view of the four main markets for the Gothenburg region, based on guest nights production previously described. We can observe that the biggest supplier is represented by Norway, followed by Germany, UK and USA respectively[2].

The gap found in the literature reviewed is related with the issues on estimations modelling and forecasting destinations before the turn of the century, where the lack of diagnostic tests has produced weak coefficients to interpret the market trends. The diagnostic test procedure as the significance level, autocorrelation, heteroscedasticity and random walk behavior are the mainly weaknesses of the studies reviewed. However, in the last 15 years, researches have performed a new battery test in traditional econometric instruments to model and forecast destinations using statistical and economic assumptions. The innovations on software programs have developed new useful tools to generate valuable information in the international inbound-outbound flows analysis of travelers in the entire globe.

The dependent variable on international tourism demand is often measured by the guest nights production in the main destination. According to the world tourism organization[3], persons that travel from his/her residence point and overnight can be described as visitors or guests. The guest night production is the quantity of guests that overnight at least one night in the destination point. The destination point is the geographical region where individuals travel and overnight for different reasons. Health, religion, sports, culture, festivals, business, conference or pleasure as the main goal, can define tourism as the group of activities that stimulate the destinations´ economy. The destinations´ economy is stimulated through employment and the delivery of basic services such as; water, food, beverages and room service. In the Gothenburg region the level of employment that tourism generates is around 17 000 full-time jobs in 2012[4], working in 3 685 118 available rooms in the destination and other services related.

One of the main problems with the empirical cases before the year 2000 was the lack of a correct diagnostic test procedure. With the aim of finding quality outcomes, the diagnostic test has become important estimating the coefficients and the respective

[2] Figure 1; annex 1

[3] https://s3-eu-west-1.amazonaws.com/staticunwto/Statistics/Glossary+of+terms.pdf

[4] Swedish Agency for Economic and Regional Growth 2013

interpretation of the modelling and forecasting methodology. With the aim of generating useful economic literature applied to Tourism empirical cases, we work in a comprehensive description of the OLS and ADLM models in the appendix section.

The discussion about the R^2 as measure of fit is the main debate in the literature reviewed regarding to the interpretations of OLS regressions. After the year 2000, several researchers have designed new test procedures to assess the quality of the coefficients with the aim to forecast the destination with new instruments. In the model estimation of this thesis, we describe why is not enough the analysis based on the R^2 as main indicator, related to unit root presence and omitted variable bias

The main lessons are related with the findings in the regional-domestic market level. The methodology and the data work in the regional-domestic approach. The tool used in the analysis, can capture the dynamics of the sector through lag variables in the domestic-regional markets. In general, the methodology performs the destination forecasting well. In section II you will find the literature reviewed. Then, section III describes the theoretical framework. After that, the methodology and data in section IV. Furthermore, results and analysis are located in section V and finally the conclusions in section VI.

II. Literature Reviewed

To motivate the knowledge gap that the thesis aim to fill, over 35 different empirical studies on international tourism demand modelling and forecasting using econometric approaches are reviewed in the thesis. East Asia and North American region dominates tourism research studies prior to 2000. Most of the papers focus on the inbound and outbound tourism in these regions related to the global market flows. Nevertheless, wide spread studies from Europe and Oceania have been emerging under the last 15 years. UK, Spain, China-Hong Kong, Japan, Australia and New Zeeland have become important actors in the publication of several studies forecasting the destination and working in the analysis of the determinants of the demand function. Furthermore, we have observed a chronological evolution of the methodologies that researchers perform to assess the destination point based on the demand function and using different instruments, assumptions and perspectives from 1960 to 2010.

2.1 Econometric modelling for tourism demand

In the next section we will describe the main econometric models used to forecast and analyze the determinants of tourism demand. In the literature reviewed, one of the problems for many studies is the underestimation to choose the correct instrument for the defined methodology. We screen the main econometrical instruments used to forecast destinations as follows:

i) Panel data, the cross-sectional analysis is based using inbound-outbound tourism demand estimation, taking account the different origin of the countries studied. The literature reviewed shows studies from T. Garin-Munoz, and T. Perez-Amarral (2001), Durbarry and Sinclair (2005), Ledesma-Rodriguez et al. (2001), Naude and Sayman (2005) focused in panel data tourism demand analysis, where the single equation model is commonly observed in the literature reviewed. The single equation model can be estimated using IV instruments, fixed effects and random effect.

ii) Time series, there are two main instruments found in the literature review; structural time-series model (STSM) and time-varying parameter model (TVM). Both instruments can capture the time varying properties of the time series, where you can measure the seasonal effect of tourism under the year over a defined period of time. The STSM as instrument should be able to observe the trend of the determinants of the demand function and how the cyclical components can vary over time. The STSM gives the availability to work in a single equation. The analysis is based on the comparison of different origin destinations related to a main destination, it is called non-causal basic structural model (BSM), (Turner and Witt 2001 a, b, Kulendran and Witt 2001). The TVP method was developed to overcome the unrealistic assumption of constant coefficients in the late 90´s. The TVP model can also works in a single equation level to assess different origin destinations related to a main travel point, but additionally regarding to the STSM instrument, the TVP estimation allows the coefficients measured the ability to vary over time, (Ridington 1999, Song, Chon and Wong 2003, and Li *et al*. 2005). Nevertheless, the TVP requires large sample observations to be confident on its estimations. The TVP model can be estimated using the Kalman filter algorithm. The main focus of this methodology is the evolution of the demand elasticities over a relatively long period. The literature reviewed describes the TVP method likely to generate more accurate forecast of tourism demand than STSM estimations.

iii) The standard co-integration model (CI) and error correction model (ECM) are econometric techniques for modeling and forecasting tourism demand. They were popular and exposed in many studies in the 90´s. The problem was that they were restricted to static model analysis. For that reason, they were exposed from quite few problems such as spurious regressions, (Song and Witt 2000). Now, with new software improvements, lag variables can be included in the demand estimation and it is possible to obtain the dynamic outcomes of the demand analysis. Dynamic models such as ADLM, should overcome the spurious problem from the static model by using the CI/ECM analysis, (Hendry 1995, pp232). Some additional advantages of ECM models are that almost all regressors are orthogonal and this avoids the occurrence of multicollinearity, which may otherwise be a serious problem in the econometric analysis, (Lathiras,P. and Syriopoulos 1998). In both models the short and long run analysis is traced. Is important to mention that CI model not always hold, for that reason the application of this instrument should be object of strict statistical test. To conclude this section, based on Li, Song and Witt (2005), we describe four CI/ECM main estimation methods; Engle-Granger (1987) two-stage approach (EG), the Wickens-Breush (1988) one-stage approach (WB), the ADLM approach (Pesaran and Shin, 1995), and the Johansen (1988) maximum likelihood approach (JML).

iv) Vector autoregressive approach (VAR). In the literature reviewed, most traditional tourism demand models are specified in a single-equation form. This characteristic implicitly assumes that the explanatory variables are exogenous. But, if the assumption is not valid, the estimated parameters of the model are likely to be bias and hence, inconsistent. In this case where the exogeneity is not satisfy, the VAR model is more appropriate, (Li, Song and Witt 2005). The VAR model is based on a system of equations in which all variables are treated as endogenous. The JML CI/ECM analysis is based on the unrestricted VAR method.

v) The almost ideal demand systems (AIDS) can be used to test the properties of homogeneity and symmetry associated with demand theory. This model can analyze the interdependence of budget allocation to different tourist products/destinations. Moreover, both uncompensated and compensated demand elasticities including expenditure, own-price and cross-price elasticities can be calculated. They have a stronger theoretical basis than the single-equation approach from STSM and TVP models. Based on Lathiras,P and Syriopoulos (1998), and Li, Song and Witt (2005), we found in the literature reviewed three alternative methods to estimate the AIDS demand system; OLS regression, seemingly unrelated regression (SUR) and maximum likelihood (ML). The particularity of this model is that it has been developed from the original static form to the error correction form. Durbarry and Sinclair (2005), Li, Song and Witt (2005), Durbarry and Sinclair (2005) have worked with specified EC-AIDS models to examine the dynamics of tourists´ consumption behavior, combining the ECM with the AIDS.

vi) The autoregressive distributed lag model (ADLM) is one of the most recommendable instruments for its flexibility and the ability to measure the variation of the time series lengths and avoid the spurious regression as a consequence of unit root presence. On the empirical fields ADLM performs good for its simplicity structure. In fact the VAR instrument is a special case of the ADLM model, where the explanatory variables are assumed to be endogenous.

The main methods can be summarized as follows; the STSM has been used more often when monthly or quarterly data is concerned. The annual data on the other hand, has always been used in the estimation of AIDS models. The main reason being these later models aim to examine long-run demand elasticities. However, the TVP model has been applied to annual data, but it is still possible to incorporate seasonality into the specifications. Similarly, the ECM and VAR models are flexible to perform data with different frequencies depending on the integration order, (Song and Witt 2000).

From times series to panel data analysis, the studies revels that no single forecasting method can out-perform the alternatives in all cases. However, in this thesis, we will focus in the time series analysis using ADLM. One of the main reasons is because using the general to specific approach the static model is designed to analyze the destination price-income effects by year and lag variables are able to observe the dynamics in the inbound-flow of guest nights production in the studied destination.

2.2 Explanatory variables and functional form

Almost all studies in travel and tourism focus on the demand function and its determinants. As earlier explained and consistent with previous tourism demand studies, the main factors considered to study demand function are income, own price, cross-price and travel costs variables. Specifically, we define that the most significant determinants founded in the literature reviewed of international-domestic tourism demand were the income and prices.

Starting with the explanatory variables description, we find a wide set of options to work with income and prices; exchange rates, power purchasing parity, consumer price index and hotels prices, just for mention some of them.

The income in the tourism demand function is from the origin countries. The level of income from the guests´ residence can be measured by the gross domestic product and gross domestic product per capita for each country. In the literature reviewed both variables perform without problems the different instruments in the computable modeling process. Nevertheless, I use GDP as the main indicator, with the aim to observe if the international-domestic guest nights flows define the destination as a normal good. In this case, the GDP satisfies the thesis´ requirements.

The appropriate measurement for the own-price and cross-price of tourism is difficult to obtain. In the literature reviewed, we found two main price elements; the cost of travel to the destination and the cost of living for tourists in the destination. In the absence of a proxy variable, the variable of travel cost is often excluded from the demand system (Lathiras and Siriopoulos 1998). Nevertheless, to solve this problem researches include in the specifications dummy or lag variables. With the dummy variables they should be able to control the effects of these travel cost aspects in the demand function. With the lag variables researches can observe the dynamics in the sector. A special observation regarding to the cost variable is due to the fact that only in a few cases the use of proxies result in significant coefficient estimations (Li, Song and Witt 2005). Related to travel costs, we need to consider charters, train and car trips in the set of options.

Regarding to the functional form, it is important to carefully define the main structure of the demand system. In this thesis, we will work with the linear demand function for two main reasons. First, numerous empirical studies recommend that tourism demand can bet modeled using simple linear variables relations, as well as the power function in terms of model´s statistical significance and forecasting ability. Under this comparison the linear model performs relative stable, (Witt and Witt 1992, Song and Witt 2000, and Lee *et al.* 1996). Second, the power function can be manipulated into a logarithmic linear specification, which can be estimated easily using OLS, as well as the linear model. Researches or managers should be able to compare both models results relatively easy.

Additionally, the semi-log system was often performed with multiple variable models. The log-linear regression was the predominant functional form in the context of tourism demand studies in the 90´s and most of the results deal with the spurious regression problem[5]. For that reason, the next section is developed to give a comprehensive description of the diagnostic test procedure that we will go through the model and coefficients assessment.

2.3 Diagnostic Tests Procedure

One of the main issues from the studies before the turn of the century was the lack of a diagnostics check in the empirical studies. As a consequence, the inferences of the major studies under this period might be highly sensitive to the statistical assumptions, (Lim 1997a). The situation had changed by the late 90´s, where in addition to the conventional statistic reported in the earlier studies such as goodness of fit, F statistic and Durbin-Watson autocorrelation, several studies started to carry out tests for unit root, higher-order autocorrelation, non-normality, miss-specification, structural breaks and forecasting failure, (Dritsakis 2004, Kim and Song 1998, Song and Witt 2000, and Song, Romally and Liu 1998, Li, Song and Witt 2005)[6].

In general, the literature reviewed defines clearly the gap that should be tackle. Now, the economical and statistical assumptions define the model and its implications. The next section gives a comprehensive description of the theoretical framework used in this thesis.

III. Theoretical Framework

After a comprehensive inspection of literature and regarding to the thesis project, we define two broad groups in all reviewed studies on tourism demand and forecasting. They can be defined as, non-causal and causal models. The non-causal modeling

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5 In section IV, we have described the spurious regression problem.

6 In the appendix section we describe the different tests under the diagnostic procedure.

focuses mainly on times series analysis. The non-causal forecasting models extrapolate historic trends of tourism demand into the future without considering the underlining causes of the trend, (Song, Wong and Chon 2003). The non-causal models are usually performed including methodologies related to the exponential smoothing and Box-Jenkins procedures (Box and Jenkins, 1976).

On the other hand, the causal models concentrates on econometric techniques. The causal modeling observes insights related to the determinants of the demand function. However, based on Martin and Witt (1987), Song and Witt (2000), the exponential smoothing approach to forecast demand for tourism in a number of destinations performs reasonably stable among a wide range of causal and non-causal forecasting models. Regarding the Box-Jenkins approach, we find that the instrument can outperforms the causal models based on the traditional regression techniques, including the naïve no-change model, (Turner *et al*. 1995, Witt *et al*. 1994, and Witt *et al*. 2003, Song and Witt 2000).

The major limitation of the non-causal models is that they are not based on any theory that highlights the tourists' decision-making process. Econometric models, which are mainly causal models, are carefully constructed based on economic theory. These econometric instruments can give us valuable insights based on the way the individuals would take a decision on the destination choice. Additionally, through the elasticity analysis the causal model draw to the forecasters the opportunity to assess the direction and the magnitude in which tourists would respond, given any changes in the determinant factors of the demand function, (Song and Witt 2000).

3.1 Determinants of tourism demand function

The elasticity can assess the scope on effects in the destination and origin countries, due to price or income changes. Both indicators give us useful suggestions for pricing formulation and competition strategies in the market. Based on Crouch (1992), Song and Wong (2003), we can highlight that a key factor of the demand analysis is the income elasticity. The income elasticity is a main aspect on the design of the supply policies.

In our study case, we focus on the demand analysis of the market. The term of tourism demand based on Witt and Song (2000) is defined for a particular destination as the quantity of the tourism product, which means the combination of tourism goods and services, that consumers are willing to purchase during a specified period under a given set of conditions. The inbound demand function for the tourism product in destination i = Gothenburg, by residents of origin j = USA, UK, Germany, Norway and Sweden/domestic, is given by

$$Q_{ij} = f\,(Y_j,\ P_{ij},\ P_{sj}) \qquad (1)$$

where Q_{ij} is the quantity of guest night production demanded in destination i by residents of origin country j.

Y_j is the level of income in origin country j

P_{ij} is the price of tourism in destination i, for residents in origin country j

P_{sj} is the price of tourism in the substitute destination s, for resident in origin country j

Based on classic microeconomic theory, the most important factors that influence demand for consumption are the own price of the good, the price of a substitute good and the consumers´ income. Following the same reasoning in this thesis we study the below mathematical equation. This function is proposed to model the demand for Gothenburg regional tourism by residents from; Norway, UK, Germany, USA and the rest of Sweden defined as domestic tourism demand. The main focus is on business travelers and leisure tourists, which represent more than 90% of the regional tourism market in the Gothenburg.

The most basic relation between the explanatory variables is the linear relationship, and this is expressed as follows

$$Q_{jt} = \alpha_0 + \alpha_1 Y_{jt} + \alpha_2 P_{jt} + \alpha_3 P_{sjt} + \varrho_{jt} \qquad (2)$$

The equation (2) represents the linear tourism demand function for Gothenburg, where Q_{jt} is the tourism demand variable measured by tourism guest nights from country j to Gothenburg at time t.

The variable P_{jt} is the price of tourism in Gothenburg for residents from origin country j at time t. The P_{st} is the price of tourism in the substitute destination at time t for residents from origin country j. The variable Y_{jt} represents the income level of the origin country j at time t. The income variable is measured by the GDP of each country. As described before, the main goal with the income variable is to observe if the international-regional touristic product is observed as a normal good. The residual term is defined as "ȩ" and it is used to capture the influence of all other factors that are not considered in the demand model for the Gothenburg region. It is important to mention that we have paid special attention to this last residual factor, because tourism demand is influenced by many economic and non-economic factors and we could not include them all due to lack of data, for example travel costs.

In this thesis we focus on the inbounds tourism demand from the top five markets for Gothenburg as a destination. We have use the consumption price index and exchange rate to develop an approach ratio for living cost in the studied destinations.

The definition of the own price variable follows as;

$$P_{ijt} = (CPI_{sw}/EX_{sw})/(CPI_j/EX_j), \qquad j = 1, 2, 3, 4 \qquad (3)$$

In the equation (3), the CPI_{sw} and the CPI_j are the consumer price index for the Gothenburg region and the origin country j respectively. To find the rights ratios, an exhaustive search to get the best set of price estimators based on the results of the tests procedures was necessary.

After an intensive search for appropriate indicators the CPI and the EX rates could succeed all the battery tests with the best significance level. Under the searching process we have worked with the Power Purchasing Parity and the CPI, both performs well the battery tests. Nevertheless, the ratio of the CPI between the EX rate has received a better significance level assessment. For that reason, we decided to use the ratio (CPI/EX rate) as the main indicator of the relative consumer price index of tourism in the destination point related with the relative consumer price index of tourism in the origin countries.

The variables EX_{sw} and EX_j are the exchange rate indexes for Gothenburg and origin country j, respectively. The exchange rate is the annual average market rate of the local currency against the US dollar. Thereby, we can estimate the cost of tourism in the Gothenburg region relative to the costs of tourism in the origin country j. In theory, the tourism costs should include tourists´ living costs in the destination and travel costs to the destination. Further, we found reasonable explanation in favor of arguing that the average economy airfare is not considered to be a good proxy for the travel cost measure, (Lathiras and Siriopoulos 1998, and Li, Song and Witt 2005).

However, due to the lack of information and the purposes of this thesis, the own price variable only contains the living cost component. What we expect to observe is the sensibility on prices changes, which should be related in some level with the distance costs from Gothenburg as destination. If the distance increases, the level of costs increase as well and the own Price elasticity is expected to be highly sensitive to prices changes in the destination point.

In this particular case it is important to mention that the price of tourism in Gothenburg for the domestic market is defined as $P_{jt} = (CPI_{sw}/EX_{sw})$. This second best estimator is due to the lack of regional information i.e., there are no estimations that measure the differences in prices of touristic products between Stockholm and Gothenburg or Malmö and Gothenburg. In some cases the hoteliers´ prices can be used as estimation across entities. For that reason, we introduce the inflation factor to observe the economic internal stability over time in Sweden. Further, the exchange rate is used to observe the external factors related with the Swedish economy over time.

The substitute price P_{sjt} is defined, as a relative consumer price index of a preview selected region, in this case Norway. This decision takes place after a long discussion and assessment of different geographical destinations points close to Gothenburg. As mentioned before, there are no variables that measure the regional level of tourism prices. Furthermore, it could be possible to estimate the price including a ratio that captures the quantity effect in guest night production divided by the total quantity in the substitute destinations. However, we couldn´t obtain the quantity of guest night production in Oslo, Copenhagen, Malmö and Stockholm from the five origin markets[7].

When selecting the substitutes destinations, geographic and cultural insights are considered. The substitute price index is calculated by weighing the consumer price index of Norway on each origin market destination according to its proportion with the respective exchange rates, and it is given as,

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[7] Potential alternative, Song, Wong and Chong (2003), use a ratio relation in the substitute destination as follows; $P_{sjt} = (CPI_s/EX_s)\, w_j$, where, $w_j = (TGN_{sj} / \Sigma_{sj=1,2,3} TGN_{sj})$. W is the proportion of total guest nights production from origin country j in destination i, between the total guest night productions of substitution destinations related with the same origin country j.

$$Psjt = (CPInw/EXnw)/(CPIj/EXj), \quad j = 1, 2, 3, 4 \qquad (4)$$

The equation (4) describes the relative consumer price of tourism in Norway as a substitute destination from the Gothenburg region for the residents of the origin countries, (Song, Wong and Chon 2003). In other words, it is the relative consumer price of tourism in Norway from the origin markets (Sweden, USA, UK and Germany). This substitute price index will help us to understand how a change in prices in Norway affects Gothenburg's demand function. Theoretically, the symbol of this variable depends on how is observe by the origin markets, it could be observed as a substitution or complementary destination.

In general, the income, the set of price equations and the share of international quantity of guest nights satisfy the requirements to work with the demand function. However, there are other factors that may influence tourism demand including the marketing expenditure in the main origin destinations and the diversity in the touristic product. Oil prices and countries in conflict are external factors that have damaged the travel and tourism industry in past periods. Also, lacks of financial or economic stability are aspects to be considered in the analysis. Furthermore, research has been developed using statistical tools to control these external aspects in the analysis, with the aim to understand the issues. Based on the literature reviewed, (Song, Wong and Chon 2003) we argue that the exclusion of a few of these variables does not appear to affect the overall goodness of fit in the model equation.

3.2 Other aspects of tourism demand modelling

In the literature reviewed, we discover that there are not many differences in the methodologies used to forecast and analyze the demand function in the touristic inbound-outbound flows after the year 2000. The screen studies mainly focus on touristic expenditures, income, own price and cross-price elasticities. These studies observe the behavior of the short and long run perspective. The idea behind it is to develop the static model and focus on the equilibrium assumptions (short run), and then apply lag variables in the equation to observe the dynamic process over time (long-run).

Consistent with the theoretical framework, studies have shown that the income elasticity is generally greater than one, indicating that international tourism is considered a luxury product. We find one of the main reasons based on the distance factor. The distance plays a role in the international context, because the touristic product can be observed as a luxury good besides as a normal one when the distance from the destination increases. Empirically, the distance can be observed through the variation of the coefficients from the demand function and the sensibility level to price changes in the destinations. In addition to these findings using the CI/ECM approach, we have found arguments supporting the fact that income affects tourism demand even more in the long run than in the short period of time.

Regarding prices, the own-price elasticities are normally negative. These facts indicate that Friedman´s (1957) permanent income hypothesis holds. The intuition behind it describes that people´s consumption depends on what people expect to earn over a considerable period of time and fluctuations in income regarded as temporal have little effect on their consumption expnditure. Many empirical studies suggest that values of both the income and own-price elasticities in the long run are greater than their short-run counterparts. It means that those tourists are more sensitive to income/price changes in the long term than in the short term, (Li, Song and Witt 2005). In counterpart, the cross-price elasticities contribute to the analysis of the interrelationships between alternative destinations in the short and long perspective, in classic microeconomic theory this is defined as substitution effect.

The policy implication behind the study of the elasticities is related to measure the competition level in the sector, due to the substitution degree, in the different alternative destinations. Therefore, the implication could be to adopt appropriate strategies based on the specific attributes of the touristic product or perhaps to focus on different origin market segments to boost their competitive advantages in the destination. On the other hand, complementary destinations can take advantage and launch a joint strategy on the marketing programs aiming to maximize profits as complementary destinations. The magnitude of the estimated price elasticity of demand can provide useful information for policy-makers, (Song and Witt 2000). They argue that total tourism revenue may increase, decrease or remain the same as a result of a change in tourism prices and this depends on the value of the price elasticity. They describe three ranges of values that are relevant:

i) If the absolute value of the price elasticity exceeds unity, the demand of tourism is price elastic. An increase in tourism price will result in a more than proportionate decrease in quantity demanded, and as a result total tourism revenue will fall.

ii) If the absolute value of the price elasticity equals unity, the demand curve is a rectangular hyperbola. Total tourism revenue will remain constant with a change in tourism price.

iii) If the absolute value of the price elasticity is less than unity, the demand for tourism is price inelastic. An increase in tourism price will result in a less than proportionate decrease in quantity demanded, and as a result total tourism revenue will rise.

Finally, it is important to mention that according to economic theory, the total revenue will continue to increase as long as marginal revenue is positive. If we know the price elasticity of the demand, we can calculate the marginal revenue for the destination. Different market segments are related with different influencing factors and as a consequence produce different decision-making processes, (Li, Song and Witt 2005). For this reason and as mentioned before, we focus on the main volume of the guest night production in the Gothenburg, business and leisure tourism segments.

IV. Data and Methodology

We use the hospitality statistics database from Göteborg & Co, delivered by SCB. The data used in this thesis, covers annual outcomes on guest nights statistics in the Gothenburg region from 1982 to 2013. In empirical cases annual data is most often used, because there is little available information on hoteliers sector and it is simple to work with. The use of quarterly data has increased researches´ interest to measure the scope of seasonality effects in the international tourism demand analysis. We understand from the studies reviewed that the own-prices and substitution prices are highly related with seasonal effects. For that reason, quarterly data has become important in the demand modelling and forecasting studies, (Song and Witt 2000). The monthly data is also an effective data set to perform the seasonal effect in the destination point and develop estimations on long-term trends.

It is important to mention that increasing the number of observations results in more degrees of freedom in the model estimations. These observations gives more flexibility to consider additional influencing factors. In addition, the lag variables are used to draw the dynamics of tourism demand in the destination point; in this way we forecast Gothenburg using annual data of guest night production. Thereby, the gap in the literature reviewed emphasize the lack of available information from the intra-regional level and no empirical studies were founded measuring the west coast of Sweden through a computable modelling process.

4.1 Data description and summary statistics

The available information focuses on guest night volumes and the main origin markets for Gothenburg region. Furthermore, we use statistics from the World Bank database related to the consumer price index, inflation and the exchange rates from 1982 to 2013.

Based on equation (3), the index price of tourism is equal to one if the relative consumer price is the same in both countries. If the relative consumer price of tourism is bigger than one, the relative consumer price of tourism is more expensive in Sweden. In other words, the relative consumer price of tourism is cheaper in the origin country *j*. If the relative consumer price of tourism is less than one, the relative consumer price of tourism is cheaper in Sweden. In other words, the relative consumer price of tourism is more expensive in the origin country *j*. The intuition works in the same way, when the substitution destination price index is interpreted, Norway in our study case.

Based on the table 1, we observe that on average the volume of US guest nights production in Gothenburg region is 41 872 by year. The United States is the smallest origin market in the thesis cases, but it is still in the top five destinations for Gothenburg[8]. The relative consumer price of tourism in Sweden for US people on average is 14% from 1982 to 2013. i.e., that Gothenburg as a destination has become cheaper than the US. The standard deviation is relatively low and it oscillates around 10%. Regarding the relative consumer price of tourism in Norway for US people, the substitution destination has become 12% cheaper under the same period. Its' standard deviation moves over 22%, which is relative large. The ratio relation between the Norwegian crown and the US dollar seems to have disturbance periods under the estimation.

Moving on the European market, the average production of Germany on guest nights in Gothenburg region is 71 462 by year from 1982 to 2013. The relative consumer price of tourism in Sweden for Germans on average reflects that Gothenburg as a

[8] In the annex section we attached the table with the commercial guest night statistics for Gothenburg from 2008 to 2014.

destination has become cheaper than Germany 7% under the estimation period. A low standard deviation of 8% reflects a stable behavior over time. The relative consumer price of tourism in Norway for Germans in the same period on average has become cheaper by 19%. The standard deviation is 17%, due to regular variations over time.

Table 1 Descriptive statistics of the variables employed

Variables	Description	Mean	Std. Dev
USA	Number of guest nights from USA in Gothenburg	**41872.88**	**14067**
GDPus	Gross Domestic Product USA	**9.42E+12**	**4.9E+12**
Prswus	Relative consumer price of tourism in Sweden for US people	**0.1407**	**0.1072**
Prnwus	Relative consumer price of tourism in Norway for US people	**0.1273**	**0.2258**
Germany	Number of guest nights from Germany in Gothenburg	**71462.38**	**21580.03**
GDPge	Gross Domestic Product Germany	**2.2E+12**	**9.41E+11**
Prswge	Relative consumer price of tourism in Sweden for Germans	**0.0771**	**0.0761**
Prnwge	Relative consumer price of tourism in Norway for Germans	**0.1907**	**0.1741**
UK	Number of guest nights from United Kingdom in Gothenburg	**64516.16**	**22594.47**
GDPuk	Gross Domestic Product United kingdom	**1.56E+12**	**7.83E+11**
Prswuk	Relative consumer price of tourism in Sweden for UK people	**0.0644**	**0.0504**
Prnwuk	Relative consumer price of tourism in Norway for UK people	**0.0900**	**0.0593**
Sweden	Number of Swedish guest nights in Gothenburg	**1530797**	**597026.9**
GDPsw	Gross Domestic Product Sweden	**3.02E+11**	**1.39E+11**
Prsw	Relative consumer price of tourism in Sweden	**0.4781**	**0.4868**
Prnwsw	Relative consumer price of tourism in Norway for Swedish	**-0.9331**	**10.2847**
Norway	Number of guest nights from Norway in Gothenburg	**169709.6**	**57367.83**
GDPnw	Gross Domestic Product Norway	**2.13E+11**	**1.45E+11**
Prnw	Relative consumer price of tourism in Norway	**0.5012**	**0.3827**
Prswnw	Relative consumer price of tourism in Sweden for Norwegians	**0.9585**	**0.7889**

In the same period, tourists from the United Kingdom produce on average 64 516 guest nights per year. The consumer average price variation is 6% and it means that Sweden as a destination has become cheaper than the UK. The standard deviation is 5%, which represents a stable behavior over time. On average the relative consumer price of tourism in Norway for UK travelers represents 9%, i.e., that the destination has become cheaper under the studied period. Further, the standard deviation is almost 6% a signal of relative stability over time.

The domestic demand forecasted by the “Sweden” variable, represents the number of Swedish guest nights production in the Gothenburg region. The domestic market has produced on average 1 530 797 guest nights in the studied destination per year, from 1982 to 2013. It is in fact the main market in Gothenburg. The relative consumer price of tourism in Sweden for the domestic market represents on average more than 47%, i.e. that the Swedish crown has increased the purchasing power over the US dollar under the studied period. The standard deviation has strong variations in the estimation; it represents more than 48%. Further, the relative consumer price of tourism in Norway for Swedish travelers is negative related, i.e. that the substitution destination and the main destination have suffered deflationary periods. The relative consumer price of tourism in Norway for Swedish travelers on average is -93%. This means that the price ratio between Sweden and Norway on average moves on the same levels, likely related because of geographical reasons. Besides the standard deviation having large oscillations, the relative consumer price index of both countries shows similar tourism price levels over time.

Table 2 Descriptive statistics of the variables employed

Variables	Description	Mean	Std. Dev.
CPI sw	Consumer Price index Sweden, inflation factor	**3.3177**	**3.167**
CPI nw	Consumer Price index Norway, inflation factor	**3.4598**	**2.6291**
CPI ge	Consumer Price index Germany, inflation factor	**1.2951**	**1.2707**
CPI uk	Consumer Price index UK, inflation factor	**2.1857**	**1.922**
CPI us	Consumer Price index US, inflation factor	**2.992**	**1.2579**
Ex us	Exchange rate base US dollar	**1**	**0**
Ex uk	Exchange rate pounds per dollar	**0.6207**	**0.0608**
Ex ge	Exchange rate euros per dollar	**0.9208**	**0.2123**
Ex nw	Exchange rate Norwegian crowns per dollar	**6.8737**	**0.9062**
Ex sw	Exchange rate Swedish crowns per dollar	**7.3546**	**1.0835**

Norway has produced on average 169 709 guest nights in Gothenburg from years 1982 to 2013. The relative consumer price of tourism in Sweden for Norwegians travelers on average is 95%, i.e., that the price ratio between Norway and Sweden reflects similar tourism price levels over time. As mentioned before, based on equation (3), the index price of tourism is equal to one if the relative consumer price is the same in both countries, in this case Norway and Sweden. Besides to have large variations in the standard deviation, the regional market reflect the close relation between the destinations likely correlated by geographical reasons.

According to table 2, the average inflation level in Sweden was 3.3% by year, from 1982 to 2013. Norway has a slightly higher inflation rate than Sweden, 3.4% on average during the same mentioned period. Looking at the American market, on average the US inflation rate has performed slightly under 3%. The UK and Germany have smaller average inflation rates than the USA, Norway and Sweden under the estimated period, 2.2% and 1.3% respectively.

The US dollar is the exchange rate base with mean one and zero standard deviation. On the bottom of the table 2, we can observe the average behavior of the exchanges rates from the five origin markets. On average the exchange rate for the Swedish crown is 7.3 SEK per US dollar. The Norwegian exchange rate on average has stayed around the 6.8 NOK per US dollar mark. On the other hand, the UK and German exchange rates have a stronger relation vs. the US dollar over time. On average in the studied period, the UK and German exchange rates were 0.62 £ per US dollar and 0.92 € per US dollar, respectively. It is important to mention the fact that tourist expectations are based on the forex market, for that reason it is necessary to include the inflation factor through the consumer prices indexes from each origin country[9].

External factors like the oil prices can affect the level of costs in the travel and tourism industry. Furthermore, the distance between the origin country and the destination point, as well as social-political conflicts can be important aspects to consider under the relative consumer prices behavior in the analysis over time. The increment of costs can be reflected in the prices of the touristic product. The prices are expected to increase when the price of oil is expensive. For that reason, the distance is an important geographical factor to consider when designing a business strategy or investing in advertising.

Finally, the Gross Domestic Product is a useful tool to observe how changes in the level of income can affect the demand function of the travel destination. The gross domestic product of each country was positive related in all the cases, which implies that international guest nights consider the destination as a normal good. If the income

[9] Observe equation (3) and (4)

from the origin countries increases, the demand of Gothenburg as destination increases too. With the aim of screening out where the destination switches from substitution to complementary product from the tourist perspective or vice-versa, it is important to scope the effects of the relative consumer prices in the countries; both from regional and an international approach. Herein lies the importance of infrastructure to operate the destination in a competitive perspective relevant to other close and far geographical options.

4.2 Methodology

The methodology here presented is based on (Song and Witt 2000, pp 16). Under this section, we describe the methodology used on the OLS and Newey-West estimations in the static and dynamic models. The test hypotheses for the static and dynamic models are defined in this section. We will follow three main hypotheses:

i) Hypothesis I: The Engel curve suggest that if the price of tourism is held constant, an increase in tourists´ income will result in an increase in the demand for tourism to the destination provided that tourism is a normal or necessary good. In the thesis project case, income in the origin country has a positive effect on demand for tourism to both destinations.

ii) Hypothesis II: If the price of tourism in destination 1 increases while the price of tourism in destination 2 and consumers´ income in the origin country remain unchanged, a tourist will “switch” from going to destination 1 to destination 2, and therefore the demand for tourism to destination 1 will decrease. This is known as the substitution effect and it always moves in the opposite direction as the prices changes.

iii) Hypothesis III: With respect to the demand for tourism to destination 1, the effect of a price change in destination 2 can have either, a positive or negative effect. If destination 2 is substitute for destination 1 the demand for tourism to destination 1 will move in the same direction as to the price change in destination 2. On the other hand, if a tourist tends to travel to the two destination together, i.e., the destinations are complementary to each other, tourism demand to one destination will move in the opposite direction to the change in price of tourism in the other.

With the aim to find the best well behaved model and understanding that there are no defined criteria to decide which model to select or to perform forecasting we have reviewed over 35 studies regarding to tourism demand modelling. Most of them suggest the static model as a general beginning and move on the lag variables to find the dynamics in the sector. For that reason, ADLM was a useful tool to start to describe the market trends in Hong Kong-China, South Korea, Australia and New Zeeland.

It is well known based on previous studies that aggregate tourism expenditure, total tourism arrivals, tourism costs are often trended variables, i.e., the variables are non-stationary, Song and Witt (2000). This is a potential problem if we want to continue with the analysis of the demand function. If we have one variable with unit root behavior the OLS regression doesn´t works. For that reason we use the general to specific modelling process. The general to specific modelling approach was introduced by Sargan (1964) and later developed by Davidson *et al*. (1978); it is based on the equilibrium in the static scenario and observes the variations in the dynamics of the equation. In the next section, we introduce the methodology used in this study case.

4.2.1 The Static Model

The model starts with a general expression where all possible variables are included suggested by economic theory. Then, a dependent variable Y_t is determined by k explanatory variables. The data generating process can perform the follow equation

$$Y_t = \alpha + \Sigma_{j=1,k} \Sigma_{i=0,p} \beta_{ji} X_{jt-1} + \Sigma \phi Y_{t-1} + \varepsilon_t \qquad (5)$$

The equation (5) is defined as the autoregressive distributed lag model, where p is the lag length, which is determined by the type of data. The ε_t term is assumed to be normally distributed, with zero mean and constant variance, σ^2, i.e., $\varepsilon_t\ N(0, \sigma^2)$.

The equation (2) is represented as the linear demand function. The parameters α_1, α_2, α_3, are the coefficients that need to be empirically estimated, including the disturbance term, (Witt and Witt 1992, and Lee et al. 1996). The linear tourism demand equation is popular for the following two reasons. First, empirical studies have shown that many tourism demand relationships can be approximately represented by a linear relationship in the sample period, (Edwards 1985, and Smeral *et al*., 1992). Second, the coefficients in the linear model can be estimated relatively easy.

The inbound tourism demand function for the thesis is represented by equation (6)

$$q_{jt} = \beta o + \beta 1\ Y_{jt} + \beta 2\ P_{jt} + \beta 3\ P_{sjt} + \varepsilon_{it} \qquad j=1, 2, 3, 4, 5 \qquad (6)$$

The parameters β1, β2 and β3 are income, own-price, and substitute consumer prices of tourism in the studied destination, respectively. Based on the theoretical framework, I should expect that $\beta 2 < 0$. It means that an increase in the price of tourism in the destination would have a negative effect on tourism demand. The parameter β1 is expected to be positive as, $\beta 1 > 1$. Additionally, β3 is expected to be positive or negative, $\beta 3 >< 0$. It depends, if origin countries are observed as being complementary or a substitution product to the touristic substitute destination. The intuition behind it describes that the income level of the origin country and the price of tourism in the substitution destination would have a positive relation with tourism demand in the studied destination point, Gothenburg.

The equation (6) represents the static model of the thesis. It means that the equation does not consider the dynamic feature of the tourists´ decision process. Based on classic microeconomic theory, we understand that tourism demand should be a dynamic process, as tourists make decisions about which destination to choose based on the available options in the market and their own interests, (Song, Wong and Chong 2003). Therefore, the model used for modelling and forecasting tourism demand with annual data should reflect this feature. As mentioned before, a model specification known as the autoregressive distributed lag model is used to capture the dynamics of economic factors, and this specification is introduced to tourism forecasting by Song and Witt in the year 2000.

4.2.2 The dynamic model

The equation (7) is the empirical strategy that we test and prove that the current tourism demand function is influenced by current values of the explanatory variables.

The parameters α of equation (7) pass the entire battery test described in the diagnostic test section.

The basic form expression of the ADLM applied to my thesis can be written as

$$Q_{jt} = \alpha_0 + \alpha_1 Q_{jt-1} + \alpha_2 P_{jt} + \alpha_3 P_{jt-1} + \alpha_4 Y_{jt} + \alpha_5 Y_{jt-1} + \alpha_6 P_{st} + \alpha_7 P_{st-1} + \upsilon_{jt} \quad (7)$$

In this way, we take into the account the time factor of a tourists´ decision-making process. Based on the literature reviewed, for annual data two lags for each variable are normally enough to capture the dynamics of the tourism demand model, (Song and Witt 2000, pp. 28).

As we explained before, the lag variables on the right side of the equation (7) are related to the decision-making process and the dynamics of the sector. Tourism expectations and habit persistence are usually incorporated in tourism demand models through the use of the lag-variables. The intuition behind this argument is that the experience of the people in the particular destination will affect the decision to return to the destination or not on the future. There is much less uncertainty associated with holidaying again in that experienced destination compared with travelling to a new unvisited destination, (Song and Witt 2000). In the travel and tourism industry the effect of mouth-to-mouth recommendation is still an important aspect in the destination selection from those people who experienced a travel and recommend the destination to friends, partners or family members.

Furthermore, knowledge about the destination spreads as people share their experiences; as a consequence the amount of uncertainty for potential visitors to the destination is reducing. Based on Song, Wong and Chon (2003), we found evidence in empirical studies that a sort of learning process is taken into account, and in general perspective, it is risk averse. This risk averse is specially taken into account in the case of long period travels and high level of costs travel such as international holidays. The travel cost perspective is developed under the assumption that the price paid to access a destination point increases when the distance increases too. The travelers would also likely affect a wide number of tourists choosing the same destination in a future period of time.

A testing down procedure from the equation may be followed to eliminate variables, which are not statistically significant and/or economically acceptable for the economic theory. It means that the estimated coefficients that do not have the correct signs as predicted in economic theory, will be eliminated. As mentioned before, we will not include travel cost in the demand system, but we will introduce lag variables to observe the dynamics in the sector. This lack of information becomes a potential omitted variable bias problem when the distance increases from the studied destination. The outcomes would reflect lack of veracity in a realistic scenario. Under the diagnostic test, we introduce a lag instrument to observe the expectations and habit persistence in the analysis.

Once the outcomes pass all the diagnostic test procedure, finally we multiply the coefficient by the ratio between the parameter obtained in the regression and the total quantity production from the origin market *j*. The own-cross price elasticities are defined as $\eta = (dQ_{ij}/dX_j) * (X_j/Q_{ij})$, the *d* term denotes a partial derivative that are examining the impact on quantity demanded resulting from a change in prices, holding *ceteris paribus*. The elasticity term η can be defined as, $\eta = \alpha * (Pr_{ij}/Q_{ij})$. The parameter α, represents the coefficient from the Newey-West lag regression.

V. Results and Analysis

It is important to highlight the fact that once people have been experienced a trip and liked it, they try to return to that destination, (Song and Witt 2000). Furthermore, several researches argue that there is much less uncertainty associated with holidaying again in that country compared to traveling to a previously unvisited foreign country. It is well know that word of mouth recommendation (mouth-to-mouth) must play an important role in destination selection.

In the following section, we describe outcomes obtained after a cautiously diagnostic test procedure of the Gauss-Markov assumptions as well as the diagnostic test described in the appendix of the thesis.

5.1 Results from the International markets

Regarding the coefficients analysis from the international markets, in this case USA, Germany and UK the outcomes are shown in table 3. One of the advantages of the linear model is that we can test and observe each variable for every origin country equation.

Table 3 Regressions on OLS, Newey-West lag (1), Newey-West lag (9), Newey-West lag (10)

USA-Market-Inb	OLS	N-W Lag (1)	N-W Lag (9)	N-W Lag (10)
GDPus	**1.99e-09*** **	**1.99e-09**	**1.99e-09** **	**199e-09** **
	(6.48e-10)	**(6.82e-10)**	**(9.20e-10)**	**(9.16e-10)**
Prswus	**-14398**	**-14398**	**-14398**	**-14398**
	(23554)	**(24498)**	**(25466.27)**	**(25505.6)**
Prnwus	**-1869.98**	**-1869.98**	**-1869.98**	**-1869.98**
	(9510.15)	**(6669.07)**	**(6923.62)**	**(6798.78)**
cons	**25436.19**	**25436.19**	**25436.19**	**25436.19**
	((9232.69)	**(9961.67)**	**(13845.77)**	**(13762.88)**
GE-Market-Inb	OLS	N-W Lag (1)	N-W Lag (9)	N-W Lag (10)
GDPge	**1.43e-08*** **	**1.43e-08*** **	**1.43e-08*** **	**1.43e-08*** **
	(3.22e-09)	**(2.45e-09)**	**(2.81e-09)**	**(2.82e-08)**
Prswge	**68758.73** **	**68758.73***	**68758.73*** **	**68758.73*** **
	(31135.24)	**(34199.79)**	**(17702.85)**	**(17685.37)**
Prnwge	**28595.44** **	**28595.44** **	**28595.44** **	**28595.44** **
	(13434.8)	**(13030)**	**(10636.27)**	**(10517.72)**
cons	**31711.48*** **	**31711.48*** **	**31711.48** **	**31711.48** **
	(10422.58)	**(10432.54)**	**(13061.25)**	**(13012.75)**
UK-Market-Inb	OLS	N-W Lag (1)	N-W Lag (9)	N-W Lag (10)
GDPuk	**2.84e-08*** **	**2.84e-08*** **	**2.84e-08*** **	**2.84e-08*** **
	(4.31e-09)	**(3.92e-09)**	**(4.38e-09)**	**(4.24e-09)**
Prswuk	**69586.27**	**69586.27**	**69586.27***	**69586.27** **
	(56262.59)	**(47976.89)**	**(34251.42)**	**(29624.83)**
Prnwuk	**12469.65**	**12469.65**	**12469.65**	**12469.65**
	(42356.26)	**(39568.37)**	**(36313)**	**(35583.66)**
cons	**11829.36**	**11829.36**	**11829.36** **	**11829.36** **
	(11351.82)	**(7092.98)**	**(4835.20)**	**(4669.93)**

* Significant at 10% or lower lever

** Significant at 5% or lower level

*** Significant at 1% or lower level

In table 3, we can see that the OLS regression for the US market fail on the significance level test regarding the relative consumption prices estimations, as well as the constant term. We had expected a high level of autocorrelation on the equation (6) and potential random walk behavior, in this case the OLS regression will not be confident. When the relative consumer price index is developed under the assumption of costs of tourism and excluding the travel costs, the variable cannot capture this variation and generates confused outcomes. This omitted variable biased can be related to the distance factor. As the distance increases the cost increases too.

Based on the literature reviewed prices are expected to be non-stationary variables in the times series analysis. For that reason, we work with the lag variables, and perform the same equation with the Newey-West instrument instead of the OLS is a cause of potential unit root presence. We conclude that for the US market the methodology works, but the price definitions of the model are not significant to describe the relation between the explanatory and the dependent variables related to the studied destination. One potential solution is to develop another price index, where the distance factor can be included. A second option is to work with dummy variables and observe the seasonality effect in the prices and the demand function.

Moving on to the analysis of the inbound demand tourism of Gothenburg, the European market describes a different scenario. The coefficients seem to perform well in the model equation. Nevertheless, we can observe the coefficients Prsw ge/uk having the wrong sing expected based on our theoretical framework and produce confuse outcomes. One reason is related to possible small sample bias, the CPI ge/uk miss several observations on the sample of 32 years. Another reason is that the distance factor makes a presence in the estimation and it is likely to generate omitted variable bias too.

On the other price index, the Prnwge variable has positive sign, which defines the substitute destination as a substitution touristic product from Gothenburg region. The parameter is not the cross-elasticity. If we follow the theoretical framework definition and the methodology established for the linear model, the next step is to multiply the coefficient obtained from the Newey-West regression "α" by the proportion of the coefficients divided by the total quantity from country *j*; $\eta = (\alpha)*(Pr_j/Q_{jt})$. The cross-price elasticity related to the substitute destination for Germans shows that 1% price increase in Norway; increase on average the demand production in Gothenburg 11 442 guest nights. The quantity cross-price elasticity effect in Gothenburg represents 10% of the total production from the German market in 2014, due to 1% price variation in Norway.

The price index Prnwuk is not significant at the 10% level. As we explained before, this result could be likely not significant for the missing observations in the sample.

However, we describe the outcome and its behavior. Following the same methodology as before explained, the quantity cross-price elasticity effect in Gothenburg represents the 2.6% of the total UK market in 2014, due to 1% price variation in Norway. This means that the demand in Gothenburg increase on average 2 410 guest night production, due to 1% price increase in Norway. The substitute destination Norway is observed as substitution touristic product from UK perspective.

It is important to mention, that before we can start to make final conclusions and go forward for this thesis could be a unit root test and co-integration analysis for a power functional[10] form and compare results from the different models. The encompassing test can be useful to decide which model to select. When the relative consumer price index is developed under the assumption of cost of tourism in the destination and excluding the travel costs, the model cannot capture this variation and generates confused outcomes with small samples. For the purposes of the thesis we assume these outcomes results in weak coefficients, besides that, the methodology performs stable the data set. In general, a potential solution is to aggregate the seasonality effects through dummy variables and observe the effect in the demand function.

5.2 Results from the National-Regional markets

Once described the international perspective of the thesis case, we move slightly to the regional markets. The domestic demand outcomes seem to satisfy the entire battery test, including the significance level in the OLS regression and the Newey-West instrument.

If we follow the same methodology, based on table 4, we argue that a 1% increase in the own-price elasticity of tourism in Sweden, decrease the domestic demand in 20 931 guest nights production in the Gothenburg region. This result represents 0.7% of the domestic market in the year 2014. The production in 2014 was 2 973 336 guest nights in the Gothenburg region. The domestic tourism own-price elasticity is low sensitive to price changes in their own country. The competitive level in the destination sector performs competitive prices too.

Furthermore, Norway is observed as a complementary destination for the domestic market that normally travels via Gothenburg. This means that Gothenburg is an intermediary point destination for many of the Swedish travelers. If prices in Norway

[10] Based on Witt and Witt 1995 the power functional form is an alternative functional form to forecast the destination after the linear model analysis.

increase in 1%, the cross-price elasticity effect of guest nights production in Gothenburg must decrease the quantity demanded. However, the cross-price effect in the destination is almost zero. This outcome is related to a low sensitive level of cross-price changes in the quantity demanded. Here the importance of monitoring and understanding the origin markets and then developing a strategy to sell the destination point, using the best available information from each market. The distance between the countries is likely related with the effect of the cross-price variations related to Gothenburg and Norway.

Table 4 Regressions on OLS, Newey-West lag (1), Newey-West lag (2), Newey-West lag (4)

SW-Market-Inb	OLS	N-W Lag (1)	N-W Lag (9)	N-W Lag (10)
GDPsw	**3.72e-06*** **	**3.72e-06*** **	**3.72e-06*** **	**3.72e-06*** **
	(2.62e-07)	**(2.35e-07)**	**(2.63e-07)**	**(2.35e-07)**
Prsw	**-179000.7** **	**-179000.7** **	**-179000.7*** **	**-179000.7*** **
	(71587.18)	**(70088.29)**	**(52312.97)**	**(48624.27)**
Prnwsw	**-2603.44** **	**-2603.44** **	**-2603.44** **	**-2603.44** **
	(3098.91)	**(1176.77)**	**(1012.22)**	**(1001.75)**
cons	**489549.1*** **	**489549.1*** **	**489549.1*** **	**489549.1*** **
	(104085.9)	**(112634.3)**	**((123618.1)**	**(116256.9)**
NW-Market-Inb	OLS	N-W Lag (1)	N-W Lag (9)	N-W Lag (10)
GDPnw	**2.07e-07*** **	**2.07e-07*** **	**2.07e-07*** **	**2.07e-07*** **
	(7.46e-08)	**(5.73e-08)**	**(6.95e-08)**	**(6.83e-08)**
Prswnw	**-12507.13**	**-12507.13* **	**-12507.13* **	**-12507.13** **
	(11932.42)	**(7355.43)**	**(6376.36)**	**(6057.84)**
cons	**114384.5** **	**114384.5** **	**114384.5** **	**114384.5** **
	(37615.38)	**(38455.42)**	**(28613.69)**	**(31121.67)**

* significant at 10% or lower lever

** significant at 5% or lower level

*** significant at 1% or lower level

Finally, the Norwegian market outcomes describe the following scenario. In this case for the Prswnw could pass the diagnostic test in the lag (1), lag (9) and lag (10) at the significance level of 10%, 10% and 5% respectively. According to table 4, we can observe that the standard deviation has been reduced when we applied the lag level into the regression. The Norwegians are low sensitive to price changes in Gothenburg. In other words, if the Prswnw increase 1%, the demand of guest nights in Gothenburg as destination decrease in 922 guest nights production from Norway. This represents a decrease of 0.35% of the total Norwegian market in Gothenburg in year 2014. The Norwegian economy is strong positioned related with the Sweden economy behavior over time.

However, based on Figure 1, at the end of the 80´s we can observer a strong fall of the Norwegian market from 246 334 guest nights production in 1987 to 93 036 in 1993. The market suffered a drop of -164%. It should not be until 2014 when the Norwegian market recovered the level of 1987, with 257 027 guest nights production in Gothenburg region. This phenomenon is related to political and economic disturbances in the studied regions.

VI. Conclusions

The experience industry has boosted the economy activity in the travel and tourism sector in the last 30 years. Concepts like eco-tourism, natural adventure, food culture and sustainability have incorporate new rules to explore the destination point and share it to the globe market. The natural resources and infrastructure are highly related with the destination point successful. The experience has become an important factor for tourism operators who want to invest and benchmarked the geography, with the aim of increase welfare and revenues for the different local actors.

One of the purposes of this study is to generate literature and elaborate the first market approach using computable modelling instruments, to monitoring origin markets of Gothenburg as destination. It is important to observe the appendix procedures with the aim to understand how we obtain the best coefficients and estimators based on economical and statistical assumptions. Furthermore, the nature of the information is a long process of recompilation and human effort, through a huge network of hoteliers, hostels, tourist operators and other actors that in somehow are part of the supply chain process of the travel and tourism sector.

The results have some policy implications. Hence, the own-price elasticity is the same, as the coefficient of the own-price variable, and it does not depend on the price, i.e., is a quantity ratio, (Song and Witt 2000). The constant demand elasticity property is useful because is easy to understand from the executive and managerial perspective. It allows policy-makers to assess the percent impact on tourism demand resulting from a 1% change in one of the explanatory variables, while holding all other variables constant, *ceteris paribus*.

Regarding to the outcomes of the five origin markets, we divide the conclusion in two parts; the international and the regional market. Related to the international market analysis where we include USA, UK and Germany. One variable that pass all battery test and it is significant in all five markets too is the income, GDP variable. This result holds with our theoretical framework, supporting the idea that international tourism can be observed as normal or luxury good. The line between them is still not clear, but is likely to be related with the distance and costs factors when the perspective switch from the normal to the luxury definition.

The US market fail in the estimation due to omitted variable biased. The price ratio indexes couldn´t pass the significance level test. The distance could be a likely factor in the weakness of the coefficients. Another way to approach to this market is through the incorporation of the seasonality effect in the data. The time varying parameter would be able to capture the seasonal effects and produce quality outcomes.

On the other hand, the European markets are modelling by UK and Germany as origin countries. The small sample bias affects the own-price elasticity estimation in the Europe market. However, the cross-price elasticity related to the substitute destination for Germans shows that 1% price increase in Norway; increase on average the demand production in Gothenburg 11 442 guest nights. The quantity cross-price elasticity effect in Gothenburg represents 10% of the total production from the German market in 2014, due to 1% price variation in Norway.

In the regional-domestic scale, the variables from the domestic demand satisfy the diagnostic test procedure. Based on the elasticity methodology before defined, we argue that 1% increase on the own-price elasticity of tourism in Sweden, decrease the domestic demand in 20 931 guest nights production in Gothenburg. This result represents the 0.7% of the domestic market in the year 2014. The domestic tourism own-price elasticity is low sensitive to price changes in their own country, in other words the destination has competitive prices. The domestic demand is the main origin market in Gothenburg as destination. The relative consumer price of tourism in Sweden has a negative relation with the quantity demanded from the domestic market, which follows our theoretical framework.

Furthermore, the relative consumer price of tourism in Norway for Swedish people is negative related. This means that Norway is observed as a complementary destination for many Swedish travelers. The intuition behind describes that Gothenburg is mainly used as intermediate destination point for some travelers that have a final destination, a touristic product located in Norway, Denmark or some other point in the west Swedish coast. If prices in Norway increase in 1%, the cross-price elasticity effect of guest nights production in Gothenburg must decrease the quantity demanded. However, the cross-price effect in the destination tends to zero, the distance factor seems to have some effect in the estimation.

Based on the positive relation with the income variable and its´ significance level of the estimated coefficients, Gothenburg as destination is observed as a normal good by the regional and domestic demand. The Norwegians are low sensitive to price changes in Gothenburg. If the own-price elasticity increase 1%, the demand of guest nights in Gothenburg as destination decrease in 922 guest nights production from the Norway market. This represents a decrease of 0.35% of the total Norwegian market in Gothenburg in year 2014. The Norwegian economy is strong positioned related with the Sweden economy over time. Furthermore, we highlight the fact that in the late 80´s the Norwegian market falls over 160% in the guest nights production. It was until 2014 when Norway recovers the same level, as year 1987, today is the second biggest market in the Gothenburg region.

In general, we can conclude that the ADLM as estimator instrument performs stable in the domestic-regional level, but is unstable modelling on international markets. Regarding to the methodology, it was really pedagogic the steps followed to develop the different models. The methodology is flexible and easy to manipulate. As the first approach to the analysis in the destination market, the thesis satisfy their own main goals which were related to; generate useful literature for policy-makers and try to understand the destination working with computable modelling tools. In conclusion and after a comprehensive search the two main markets represented by Sweden and Norway, are well described with the available data, the methodology and the instruments used in this thesis.

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VIII Appendix

1 Significance level test

First, we are going to proceed testing the significance level of the coefficients. A commonly used statistic test for this hypothesis is the t-statistic, which can be computed as

$$t = \hat{B}_{ijt} \,/\, SE\,(\hat{B}_{ijt}) \qquad (1)$$

The SE ($\hat{B}_{ijt}$) is the standard error of the coefficient. The parameter $\hat{B}_{ijt}$ is the estimated regression coefficient. The number of degrees of the t-statistic is T – K, where T is the number of observations and K is the number of coefficients in the regression model including the constant term. The t test is applied to review and examine where the dependent variable is related with some of the explanatory variables. The results based on this methodology are presented in section V.

2 Testing for autocorrelation

The Durbin-Watson (DW) statistic is the most widely used test for detecting the problem of autocorrelation in the regression residuals regarding to inbound demands modelling, Song and Witt (2000). However, the DW statistic can just measure for the presence of first-order autocorrelation in the regression. For that reason we used the Lagrange Multiplier test (LM) test. With LM, we are going to observe the level of autocorrelation in the regression. The LM statistic is not limited to testing for the presence of first-order autocorrelation. Another advantage of the LM test is that even if the lagged dependent variable is on the right side of the regression model the test is still valid. To compute the test, we describe the follow equation (2),

$$\hat{\varepsilon}_{it} = \beta_0 - \beta_1 X_{jt} + \beta_2 X_{jt} + \beta_3 X_{sjt} + \rho_1 \hat{\varepsilon}_{it-1} + \rho_2 \hat{\varepsilon}_{it-2} + \ldots + \rho_\rho \hat{\varepsilon}_{it-\rho} + \upsilon_t \qquad (2)$$

where the X_{ij} are the explanatory variables. The β and ρ are parameters and the $\hat{\varepsilon}_{it-\rho}$ are the lagged residuals from the estimated regression model. The null hypothesis in this case is defined as; Ho: $\rho_1 = \rho_2 = \ldots = \rho_\rho = 0$, the test statistic is nR^2, where n is the sample size and R^2 is calculated from the regression. In large samples, the statistic has a X^2 distribution with ρ degrees of freedom. The value of nR^2 need to exceed the critical value of X^2, to suggest the existence of autocorrelation. It is important to mention that we also use the corrgram (Stata-command) to describe the interrelationship of the variables through the variance-covariance matrix in the analysis section[11].

3 Newey-West test diagnostic

To control potential heteroscedasticity problems, we found in the literature reviewed that the Newey-West test helps us to solve the problem of the spurious regression using the lag variables, as well as the detected autocorrelation problem. After the analysis, we can find the optimal lag level to run the regression. In fact, if you run the ADLM model at lag (0) you will obtain the classical robust regression, as well still controlling the heteroscedasticity and autocorrelation problems. With the Newey-West instrument we will observe how change the significant level of the explanatory variables.

4 Description of the model estimation and the Gauss-Markov assumptions

This is the first time modeling the Gothenburg region using regional data from Sweden Statistic database. For that reason, I will start with the most general model approach and select the specific model, once the parameters can approve the different tests under the model selection procedure.

The model estimation is straightforward and it is divided in four steps, Song and Witt (2000, pp. 34-40). The first step is to estimate the equation (6) using OLS with the aim to observe whether the explanatory variables are statistically significant or not for each origin market. Why use the OLS estimator? In the literature reviewed, I found multiple arguments that describe the strengths and weaknesses of the OLS as estimator. If the OLS estimator is unbiased, it means that is consistent, has a variance that is inversely proportional to "n" observations and has a normal sampling distribution when the sample size is large. Under specific conditions the OLS performs efficient. Specifically, if the least squares assumptions holds and if the errors are homoscedastic, then the OLS estimator has the smallest variance of all conditionally unbiased estimators. It means that the OLS is the best linear conditionally unbiased estimator, well known it in the literature as BLUE.

[11] The variance-covariance matrix and the auto-correlation graphics are attached in the annex section

In other words, the sample average estimation is the most efficient estimator of the population mean among the class of all estimators that are unbiased and are weighted averages of the observations in the sample. This assumption holds in the regional-domestic analysis of the study case in question. The OLS well performs in the regional-domestic market analysis, as well as the Newey-West instrument.

The methodology of the OLS estimation for the thesis purposes is defined as follows: consider a general system of "m" stochastic equations given by,

$$Y_i = X_i \beta_i + ȩ_i \qquad i = 1, 2, \ldots M \qquad (10)$$

Where Y_i is a (T x 1) vector on the dependent variables, $ȩ_i$ is a (T x 1) vector of random errors with $E(ȩ_i) = 0$, X_i is a (T x n_i) matrix of observations on n_i exogenous and lag variables including a constant term, β_i is (n_i x 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, n_i is the number of rows in the vector β_i.

The M equations system can be written separately as follows;

$$Y_1 = X_1\beta_1 + ȩ_1$$

$$Y_2 = X_2\beta_2 + ȩ_2$$

0

0

$$Y_m = X_m\beta_m + ȩ_m$$

After this stage, I define the matrix model written as;

$$\begin{vmatrix} Y_1 \\ Y_2 \\ \ldots \\ Y_m \end{vmatrix} = \begin{vmatrix} X_1 & 0 & 0 & 0 \\ 0 & X_2 & 0 & 0 \\ 0 & 0 & \ldots & 0 \\ 0 & 0 & 0 & X_m \end{vmatrix} * \begin{vmatrix} \beta_1 \\ B_2 \\ \ldots \\ \beta_m \end{vmatrix} + \begin{vmatrix} ȩ_1 \\ ȩ_2 \\ \ldots \\ ȩ_m \end{vmatrix}$$

This model can be written compactly as

$$Y = X\beta + ę \qquad (11)$$

Where, Y and ę are of dimension (TM x 1), X is of dimension (TM x n), $n=\Sigma_{i=1,M}\, n_i$ and finally β is of dimension (k x 1).

At this stage we have to make the following assumptions based on Gauss Markov. There are four least squares assumptions in the multiple regression models.

A1. The conditional distribution of υ_i given $X_{1i}, X_{2i}, \ldots, X_{ki}$, has a mean of zero. This assumption extends the first squares assumption with a single regressor to multiple regressors. The intuition behind this assumption, means that sometimes Yi is above the population regression line and sometimes below the population regression line, but on average over the population regression line, Yi falls on the population regression line. Therefore, for any value of the regressors, the expected value of υ_i is zero. As in the case for regression with a single regressor, this is the key assumption that makes the OLS estimators unbiased. E ($ę_i / X_{1i}, X_{2i}, \ldots, X_{ki}$) = 0.

A2. The second assumption is that ($X_{1i}, X_{2i}, \ldots, X_{ki}, Y_i$), $i = 1, \ldots, n$, are independently and identically distributed (i.i.d.) random variables. This assumption holds automatically if simple random sampling collects the data.

A3. Large outliers are unlikely. The third least squares assumption is that large outlier, who means, observations with values far outside the usual range of the data, are unlikely. This assumption serves as a reminder that, in a multiple regression the OLS estimator can be sensitive to large outliers.

A4. No perfect multi-collinerity. The fourth assumption is new to the multiple regression models. It rules out an inconvenient situation, called perfect multi-collinearity, in which is impossible to compute the OLS estimator. It means that the regressors are said to exhibit perfect multi-collinearity, if one of the regressors is a perfect linear function of the other regressors. I can conclude that the fourth least square assumption is that the regressors have not perfect multi-collinearity.

The distribution of the OLS estimators in multiple regressions depends basically on the size of the sample. Because the data differ from one sample to the next, different samples produce different values of the OLS estimations. This variation across possible samples gives rise to the uncertainty associated with the OLS estimations of the population regression coefficients, $\beta_0, \beta_1, \ldots, \beta_k$. This variation is summarized in the sampling distribution of the OLS estimators. If the Gauss Markov assumptions hold, then in large samples the OLS estimators $\hat{\beta}_0$, $\hat{\beta}_1$, …, $\hat{\beta}_k$ are jointly normally distributed and each $\hat{\beta}_i$ is Normally distributed $N(\beta_i, \sigma_{\beta i, 2})$, $i = 0, 1, \ldots, k$.

Following the matrix structure from equation (9) and holding the Gauss Markov assumptions, I can rewrite the OLS estimator as; $\hat{\beta}^{ols} = (X'X)\, X'Y$, with the variance, $Var(\hat{\beta}^{ols}) = (X'X)^{-1} X'\Psi X(X'X)^{-1}$. The value of Ψ represents the matrix of variance and covariance defined as

$$E(\varepsilon\, \varepsilon') = \Sigma\, \Theta I_T = \Psi, \text{ where } \Sigma = \begin{vmatrix} \sigma_{11} & \sigma_{12} & .. & \sigma_{1M} \\ \sigma_{21} & \sigma_{22} & .. & \sigma_{2M} \\ : & : & :. & : \\ \sigma_{M1} & \sigma_{M2} & .. & \sigma_{MM} \end{vmatrix}$$

The matrix is an M x M positive definite symmetric matrix and Θ represents the kronecker product. Thus the errors at each equation are assumed to be homoscedastic and not auto-correlated. As earlier mention this last estimator ($\hat{\beta}^{ols}$) knows as the best linear unbiased estimator.

Moving on the residual terms, these are estimated values of the dependent variable, in this case quantity of guest nights from five origin countries *j*, and are obtained as

$$\hat{\varepsilon}_{it} = q_{jt} - \hat{\beta}_0 - \hat{\beta}_1 Y_{jt} - \hat{\beta}_2 P_{jt} - \hat{\beta}_3 P_{sjt} \quad (12)$$

$$\hat{Q}_{jt} = \hat{\beta}_0 + \hat{\beta}_1 Y_{jt} + \hat{\beta}_2 P_{jt} + \hat{\beta}_3 P_{sjt} + \varepsilon_{it} = Q_{jt} - \hat{\varepsilon}_{it} \quad (13)$$

Now, we define the variance of the residuals equal to $\hat{\sigma}^2_{it}$ and it is computed from the equation (13) as

$$S^2_{it} = \hat{\sigma}^2_{it} = \Sigma\, \hat{\varepsilon}^2_{it} / T - K \quad (14)$$

Where *T* is the number of observations used in the estimation of guest night production by origin country. The *K* is the number of estimated regression coefficients including the constant term.

The OLS minimizes the sum of squares of the residuals and ensures that the estimated regression equation is the best in terms of the model´s fit to the data.

$$SSR = \Sigma (Q_{it} – \hat{Q}_{it})^2 = \Sigma (Q_{it} – \hat{\beta}_0 – \hat{\beta}_1 Y_{jt} - \hat{\beta}_2 P_{jt} – \hat{\beta}_3 P_{sjt})^2 \quad (15)$$

Now, the measures of fit are defined as the square of the residuals, R^2. The R^2 is equal to the ratio of the explained sum of squares (ESS) divided by the total sum squares (TSS). In fact looking by other perspective, it can be described as 1 minus the radio of the sum of squared residuals (SSR) proportional to the total sum of squares.

$$R^2 = ESS/ TSS \quad (16)$$

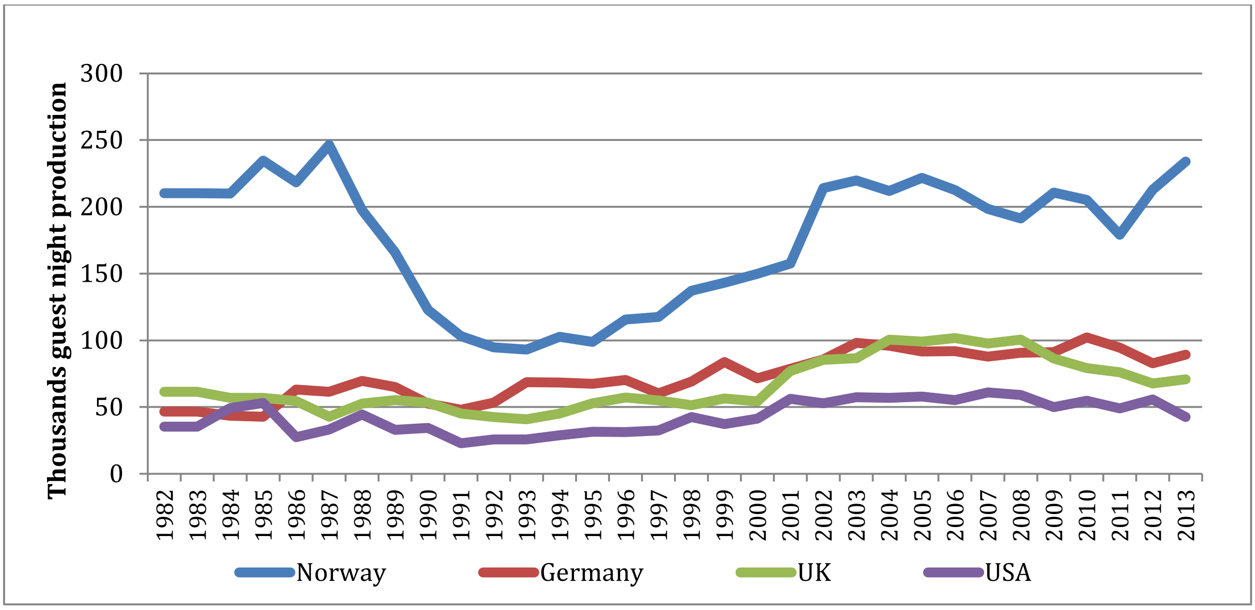
$$R^2 = 1 – (SSS/ TSS) \quad (17)$$

The R^2 ranges between 0 and 1 and is called the coefficient of determination. If $\hat{\beta}_1 = 0$, then X_{ij} explains none of the variation of the dependent variable. The explained sum of squares is zero. The predicted value of the dependent variable based on the regression is just its´ sample average. In this case, the R^2 is zero. In contrast, if X_{ij} explains all of the variation of the dependent variable then the explained sum of squares equals the total sum of squares and R^2 tend to be 1.

IX Annexes

Annex 1

Figure 1, Guest Nights production in Gothenburg region, from 1982 to 2013



Source: SCB – Inkvarterisngsstatistic 2015, Tillväxtverket.

Annex 2

Table 5

Commercial guest nights by nationality 2010-2014 Gothenburg region
Hotels, hostels, holiday villages

	2010	2011	2012	2013	2014	Distribution 2014	Change in % 2014-2013
Total guest nights	3,378,028	3,504,207	3,613,287	3,795,260	4,080,925	100%	8%
Swedish guest nights	2,452,288	2,586,344	2,693,981	2,794,936	2,973,336	72.9%	6%
Foreign guest nights	925,740	917,863	919,306	992,087	1,107,589	27.1%	12%
Nordic guest nights (excl. Sweden)	298,582	261,674	293,855	324,867	353,116	8.7%	9%
European guest nights (excl. Nordic countries)	385,841	358,905	336,025	380,327	404,603	9.9%	6%
Other countries (excludin European countries)	241,317	297,284	289,426	286,893	349,870	8.6%	22%
Denmark	68,865	62,287	57,121	65,700	69,158	1.7%	5%
Norway	205,189	179,553	212,987	233,895	257,027	6.3%	10%
Finland	22,121	18,051	21,395	21,904	23,553	0.6%	8%
Germany	102,321	94,012	82,802	89,318	110,406	2.7%	24%
Great Britain	79,100	76,252	67,715	70,899	89,519	2.2%	26%
The Netherlands	28,143	27,018	25,602	24,853	28,242	0.7%	14%
France	31,151	31,871	31,026	35,558	35,594	0.9%	0%
Switzerland	17,759	13,132	12,319	12,991	16,872	0.4%	30%
Italy	26,323	23,574	20,972	21,023	20,611	0.5%	-2%
Spain	19,512	12,373	12,750	14,638	11,998	0.3%	-18%
Russia	9,177	5,504	7,601	9,609	6,767	0.2%	-30%
Poland	11,999	14,137	13,754	14,729	14,583	0.4%	-1%
Other European countries	62,763	62,815	60,605	67,025	73,389	1.8%	9%
USA	54,905	49,454	55,777	42,627	53,284	1.3%	25%
Canada	6,462	4,234	4,136	3,857	4,285	0.1%	11%
Japan	10,733	7,292	8,716	7,552	7,404	0.2%	-2%
China	15,361	22,989	22,565	23,416	32,077	0.8%	37%
Other countries	153,856	213,315	198,232	244,337	252,820	6.2%	3%

Source: Statistics Sweden and Swedish Agency for Economic and Regional growth 2015.

Annex 3

Autocorrelation tests by Market.

Origin country; USA

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	1.398	1	0.2370

H0: no serial correlation

Origin country; Germany

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	6.615	1	0.0101

H0: no serial correlation

Origin country; United Kingdom

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	11.777	1	0.0006

H0: no serial correlation

Origin country; Norway

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	3.045	1	0.0810

H0: no serial correlation

Origin country; Domestic demand Sweden

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	12.081	1	0.0005

H0: no serial correlation

Annex 4

Table 6 Correlation between variables used in the estimation model ADLM

	Norway	GDPnw	Prswnw	Germany	GDPge	Prswge	UK	GDPuk	Prswuk
Norway	1								
GDPnw	0.0711	1							
Prswnw	-0.1296	0.0683	1						
Germany	0.8779	0.6941	-0.023	1					
GDPge	0.6297	0.9572	0.0862	0.6461	1				
Prswge	-0.0807	-0.1185	0.5472	0.1026	-0.1649	1			
UK	0.8468	0.5895	0.0231	0.8247	0.5602	0.0471	1		
GDPuk	0.8502	0.9248	0.0735	0.7906	0.8837	-0.0916	0.806	1	
Prswuk	-0.2847	-0.36	0.6032	-0.1617	-0.4242	0.7636	-0.1459	-0.3593	1
USA	0.8742	0.628	0.0373	0.8266	0.5295	0.1123	0.907	0.8089	-0.0857
GDPus	0.8797	0.9582	-0.024	0.8115	0.8729	-0.1191	0.7201	0.9559	-0.3513
Prswus	-0.1389	0.0395	0.5725	0.0192	0.0968	0.2866	-0.0031	-0.0654	0.551
Sweden	0.8499	0.9709	-0.0289	0.7744	0.8932	-0.1355	0.6407	0.9217	-0.3747
GDPsw	0.7107	0.9876	0.0782	0.6689	0.9681	-0.1227	0.5746	0.9236	-0.4161
	USA	**GDPus**	**Prswus**	**Sweden**	**GDPsw**				
USA	1								
GDPus	0.7811	1							
Prswus	-0.0548	-0.0604	1						
Sweden	0.7112	0.9882	-0.0413	1					
GDPsw	0.5906	0.9302	-0.0079	0.9436	1				

Annex 5

corrgram Norway

```
                                          -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.4671   0.4865    7.657  0.0057          |---              |---
2       0.3896   0.1960   13.162  0.0014          |---              |-
3       0.3062  -0.0292    16.68  0.0008          |--               |
4       0.0966  -0.1919   17.042  0.0019          |                -|
5       0.0379   0.1264     17.1  0.0043          |                 |-
6      -0.0310   0.0049    17.14  0.0088          |                 |
7      -0.0406   0.1801   17.212  0.0161          |                 |-
8      -0.1008  -0.0179   17.673  0.0238          |                 |
9      -0.1483  -0.0531   18.713  0.0278         -|                 |
10      -0.1764   0.0280   20.251  0.0270        -|                 |
11      -0.2209   0.0415    22.78  0.0190        -|                 |
12      -0.2372  -0.0058   25.841  0.0113        -|                 |
13      -0.2335   0.0029   28.962  0.0066        -|                 |
14      -0.1762   0.1966    30.84  0.0058        -|                 |-
```

. corrgram Prnw

```
                                          -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.6191   0.6230    13.45  0.0002          |----             |----
2       0.4422   0.1161   20.541  0.0000          |---              |
3       0.3721   0.0538   25.736  0.0000          |--               |
4       0.3960   0.2023   31.828  0.0000          |---              |-
5       0.4228   0.4261   39.032  0.0000          |---              |---
6       0.2301  -0.0602   41.247  0.0000          |-                |
7       0.1079   0.0762   41.754  0.0000          |                 |
8       0.0921   0.2289   42.139  0.0000          |                 |-
```

```
9       -0.0023   0.0617   42.139  0.0000          |                 |
10       -0.0573  -0.0054   42.301  0.0000          |                 |
11       -0.0893   0.1451   42.714  0.0000          |                 |-
12       -0.1465  -0.1025   43.882  0.0000         -|                 |
13       -0.0957   0.3512   44.406  0.0000          |                 |--
14       -0.1794  -0.2262   46.351  0.0000         -|                -|

. corrgram Prswnw

                                          -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.3847   0.4051   5.1932  0.0227          |---              |---
2       -0.0455  -0.2584   5.2682  0.0718          |               --|
3        0.0502   0.2042   5.3626  0.1471          |                 |-
4        0.1407   0.0731    6.132  0.1895          |-                |
5       -0.0037  -0.1215   6.1325  0.2935          |                 |
6       -0.2244  -0.2610    8.239  0.2211         -|               --|
7       -0.2166  -0.1317    10.28  0.1733         -|                -|
8       -0.1763  -0.0359   11.689  0.1656         -|                 |
9       -0.0959  -0.0136   12.124  0.2064          |                 |
10       -0.0593  -0.0751   12.298  0.2656          |                 |
11       -0.0256   0.1607   12.332  0.3392          |                 |-
12        0.0118  -0.0408   12.339  0.4188          |                 |
13        0.0125   0.0162   12.348  0.4993          |                 |
14       -0.0237  -0.1791   12.382  0.5756          |                -|
```

```
. corrgram GDPnw

                                  -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.8926   1.0437   27.963  0.0000          |-------           |--------
2       0.7801   0.0926   50.032  0.0000          |------            |
3       0.6674   0.3898   66.742  0.0000          |-----             |---
4       0.5708  -0.1850   79.403  0.0000          |----             -|
5       0.4850  -0.0295   88.882  0.0000          |---               |
6       0.3566   0.4279   94.203  0.0000          |--                |---
7       0.2496   1.3359   96.915  0.0000          |-                 |--------
8       0.1603   0.9117    98.08  0.0000          |-                 |-------
9       0.0818  -0.1089   98.396  0.0000          |                  |
10       0.0184   0.8676   98.413  0.0000         |                  |------
11      -0.0297   0.6159   98.459  0.0000         |                  |----
12      -0.0703  -0.6403   98.728  0.0000         |             -----|
13      -0.1044   0.4343   99.352  0.0000         |                  |---
14      -0.1339   1.9132   100.44  0.0000        -|                  |--------
```

```
. corrgram Sweden

                                  -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.8841   1.0428   27.434  0.0000          |-------           |--------
2       0.7678  -0.1946   48.812  0.0000          |------           -|
3       0.6634   0.0584   65.321  0.0000          |-----             |
4       0.5724   0.1550   78.053  0.0000          |----              |-
5       0.4862   0.1871   87.581  0.0000          |---               |-
6       0.4076   0.2015   94.533  0.0000          |---               |-
7       0.3348   0.3407   99.411  0.0000          |--                |--
8       0.2636   0.0748   102.56  0.0000          |--                |
9       0.1846   0.2223   104.17  0.0000          |-                 |-
```

```
10      0.1132  -0.0960   104.81  0.0000         |              |
11      0.0239   0.0247   104.84  0.0000         |              |
12     -0.0573   0.0053   105.01  0.0000         |              |
13     -0.1119   0.3048   105.73  0.0000         |              |--
14     -0.1587   0.2592   107.25  0.0000        -|              |--
```

```
. corrgram Prsw

                                 -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.7135   0.7399   17.868  0.0000         |-----          |-----
2       0.5007   0.0030    26.96  0.0000        |----            |
3       0.4094   0.1364   33.249  0.0000         |---            |-
4       0.2972  -0.0390   36.681  0.0000         |--             |
5       0.2670   0.1755   39.554  0.0000         |--            |-
6       0.2681   0.0659   42.561  0.0000         |--             |
7       0.2338   0.1250   44.941  0.0000         |-             |
8       0.2078   0.1398   46.898  0.0000         |-             |-
9       0.0552   0.0364   47.042  0.0000         |             |
10     -0.0818   0.0630   47.373  0.0000         |              |
11     -0.0828   0.0666   47.728  0.0000         |              |
12     -0.1298   0.0654   48.645  0.0000        -|              |
13     -0.1629  -0.0102   50.165  0.0000        -|              |
14     -0.2441  -0.1541   53.766  0.0000        -|             -|
```

. corrgram GDPsw

```
                                      -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.8676   1.0039    26.42  0.0000          |------          |--------
2       0.7376  -0.0039   46.149  0.0000          |-----            |
3       0.6115   0.4278   60.177  0.0000          |----             |---
4       0.5062  -0.1360   70.135  0.0000          |----            -|
5       0.4166  -0.0974   77.129  0.0000          |---              |
6       0.2971   0.5187   80.822  0.0000          |--               |----
7       0.2032   0.2807    82.62  0.0000          |-                |--
8       0.1356   0.2323   83.453  0.0000          |-                |-
9       0.0716  -0.2760   83.695  0.0000          |               --|
10       0.0079   0.1415   83.698  0.0000         |                 |-
11      -0.0220   0.3769   83.723  0.0000         |                 |---
12      -0.0407   0.4276   83.814  0.0000         |                 |---
13      -0.0546  -0.0285   83.984  0.0000         |                 |
14      -0.0641   0.7740   84.233  0.0000         |                 |------
```

. corrgram Prnwsw

```
                                      -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1      -0.0510  -0.3702   .09132  0.7625          |               --|
2      -0.0119  -0.2312   .09648  0.9529          |                -|
3      -0.0326  -0.4245   .13635  0.9871          |              ---|
4       0.0959   0.6869   .49398  0.9741          |                 |-----
5      -0.0097   0.2520   .49778  0.9922          |                 |--
6       0.0010   0.3319   .49783  0.9979          |                 |--
7      -0.0379  -0.0913   .56031  0.9992          |                 |
8      -0.0604  -0.6344   .72569  0.9995          |            -----|
9      -0.0156  -0.5482   .73723  0.9998          |             ----|
```

```
10     -0.0320  -0.7523   .78794  0.9999          |          ------|
11      0.0206  -0.2017   .80991  1.0000          |               -|
12     -0.0449  -0.4173   .91937  1.0000          |             ---|
13     -0.0495  -0.9497   1.0595  1.0000          |         -------|
14     -0.0930  -2.2565   1.5827  1.0000          |        --------|
```

```
. corrgram Germany

                                          -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.7524   0.7710    19.87  0.0000          |------           |------
2       0.5845   0.2476   32.261  0.0000          |----             |-
3       0.4403  -0.0717   39.534  0.0000          |---              |
4       0.3669   0.2113   44.766  0.0000          |--               |-
5       0.3355   0.0456   49.301  0.0000          |--               |
6       0.3269   0.1898   53.773  0.0000          |--               |-
7       0.3475   0.1631   59.028  0.0000          |--               |-
8       0.2903   0.0461   62.849  0.0000          |--               |
9       0.1925   0.0044   64.602  0.0000          |-                |
10      0.0717   0.0026   64.856  0.0000          |                 |
11     -0.0140  -0.0444   64.866  0.0000          |                 |
12     -0.0598  -0.0832   65.061  0.0000          |                 |
13     -0.1080  -0.0609   65.729  0.0000          |                 |
14     -0.0915   0.2397   66.234  0.0000          |                 |-
```

. corrgram Prswge

```
                                          -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1      -0.0179  -0.0195   .00804  0.9286          |                  |
2      -0.2620  -0.2799   1.8206  0.4024        --|                --|
3      -0.1432  -0.1832   2.3908  0.4953         -|                 -|
4       0.1515   0.0915   3.0643  0.5471          |-                 |
5      -0.0349  -0.2224    3.102  0.6843          |                 -|
6      -0.2376  -0.7031   4.9655  0.5483         -|             -----|
7      -0.0660  -0.0583   5.1187  0.6455          |                  |
8       0.1763   0.3489   6.2905  0.6147          |-                 |--
9       0.0614  -0.8361   6.4435  0.6948          |            ------|
```

. corrgram GDPge

```
                                          -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.8906   0.9732    27.84  0.0000          |-------           |-------
2       0.7779  -0.0913   49.786  0.0000          |------            |
3       0.6515   0.2371   65.708  0.0000          |-----             |-
4       0.5267  -0.2782   76.487  0.0000          |----            --|
5       0.4019  -0.0272   82.997  0.0000          |---               |
6       0.2692   0.1017   86.031  0.0000          |--                |
7       0.1667   0.4306    87.24  0.0000          |-                 |---
8       0.0934   0.5724   87.636  0.0000          |                  |----
9       0.0408   0.0761   87.714  0.0000          |                  |
10     -0.0136  -0.2707   87.723  0.0000          |                --|
11     -0.0303   0.1804   87.771  0.0000          |                  |-
12     -0.0221   0.7421   87.798  0.0000          |                  |-----
13     -0.0154   0.1469   87.811  0.0000          |                  |-
14      0.0008  -0.5221   87.811  0.0000          |              ----|
```

```
. corrgram Prnwge

                                    -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.1976   0.1975   .98162  0.3218          |-                |-
2       -0.2119  -0.2681    2.167  0.3384         -|               --|
3       -0.1560  -0.0853   2.8431  0.4165         -|                 |
4       -0.0598  -0.0983   2.9479  0.5666          |                 |
5       -0.2521  -0.6800   4.9212  0.4256        --|            -----|
6       -0.0451   0.1948   4.9885  0.5453          |                 |-
7       -0.1228  -0.9884   5.5193  0.5969          |          -------|
8       -0.0478  -0.6222   5.6054  0.6913          |             ----|
9        0.0309  -1.1132   5.6441  0.7749          |         --------|

. corrgram UK

                                    -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.7257   0.7277   18.482  0.0000          |-----            |-----
2        0.6482   0.2790   33.719  0.0000          |-----            |--
3        0.5677  -0.0614    45.81  0.0000          |----             |
4        0.5102   0.0359   55.923  0.0000          |----             |
5        0.3762  -0.1460   61.626  0.0000          |---             -|
6        0.2609  -0.0202   64.474  0.0000          |--               |
7        0.1657   0.0115   65.668  0.0000          |-                |
8        0.0809   0.0292   65.965  0.0000          |                 |
9        0.0100   0.0024   65.969  0.0000          |                 |
10      -0.0571   0.0550    66.13  0.0000          |                 |
11      -0.1190  -0.0104   66.864  0.0000          |                 |
12      -0.1789   0.1095   68.604  0.0000         -|                 |
13      -0.2229  -0.0276    71.45  0.0000         -|                 |
```

. corrgram Prswuk

```
                                   -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.4645   0.5046   6.0693  0.0138          |---              |----
2        0.1124  -0.1008   6.4403  0.0399          |                 |
3       -0.0747  -0.1007   6.6116  0.0854          |                 |
4       -0.0630   0.0667   6.7391  0.1503          |                 |
5       -0.1720  -0.1071   7.7374  0.1713         -|                 |
6       -0.0946  -0.0118   8.0555  0.2341          |                 |
7       -0.0062   0.0784   8.0569  0.3276          |                 |
8        0.0283  -0.0798   8.0887  0.4249          |                 |
9       -0.0296  -0.1154   8.1257  0.5215          |                 |
10       0.0361   0.5789   8.1843  0.6108          |                 |----
```

. corrgram GDPuk

```
                                   -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.9154   0.9840   29.413  0.0000          |-------          |-------
2        0.8159  -0.2616   53.555  0.0000          |------         --|
3        0.7192   0.3617   72.962  0.0000          |-----            |--
4        0.6284  -0.2166   88.304  0.0000          |-----           -|
5        0.5433   0.2547    100.2  0.0000          |----             |--
6        0.4406   0.6711   108.32  0.0000          |---              |-----
7        0.3356   0.7235   113.22  0.0000          |--               |-----
8        0.2445   0.1891   115.93  0.0000          |-                |-
9        0.1596  -0.3378   117.14  0.0000          |-              --|
10       0.0730   0.0091    117.4  0.0000          |                 |
11       0.0037   0.4641    117.4  0.0000          |                 |---
12      -0.0562   1.2978   117.58  0.0000          |                 |--------
13      -0.1048   0.2161    118.2  0.0000          |                 |-
```

```
. corrgram Prnwuk

                                    -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.4264   0.4264   5.1128  0.0238          |---              |---
2        0.2372   0.0727   6.7635  0.0340          |-                |
3        0.2248   0.1380   8.3145  0.0399          |-                |-
4       -0.2033  -0.4679   9.6432  0.0469         -|              ---|
5       -0.0784   0.1641   9.8509  0.0796          |                 |-
6       -0.1248  -0.1824   10.404  0.1086          |                -|
7       -0.2439   0.0093   12.635  0.0815         -|                 |
8       -0.1232  -0.3269   13.237  0.1039          |               --|
9       -0.2477  -0.1986   15.825  0.0706         -|                -|
10      -0.2469  -0.3608   18.568  0.0461         -|               --|
```

```
. corrgram USA

                                    -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1        0.5412   0.5413    10.28  0.0013          |----             |----
2        0.4010   0.2012   16.111  0.0003          |---              |-
3        0.5482   0.3636   27.385  0.0000          |----             |--
4        0.4582  -0.0386   35.543  0.0000          |---              |
5        0.2961  -0.2768   39.076  0.0000          |--             --|
6        0.2380  -0.1295   41.446  0.0000          |-               -|
7        0.1328  -0.1014   42.213  0.0000          |-                |
8        0.1017   0.0063   42.683  0.0000          |                 |
9        0.0255   0.0624   42.713  0.0000          |                 |
10      -0.0488  -0.0040   42.831  0.0000          |                 |
11      -0.1284   0.0640   43.686  0.0000         -|                 |
12      -0.2099  -0.1058   46.082  0.0000         -|                 |
13      -0.1804   0.2409   47.945  0.0000         -|                 |-
```

. corrgram GDPus

```
                                      -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.9099   1.0167   29.056  0.0000         |-------          |--------
2       0.8198  -0.3883   53.431  0.0000         |------        ---|
3       0.7331   0.2760   73.595  0.0000         |-----            |--
4       0.6484   0.2517   89.932  0.0000         |-----            |--
5       0.5652   0.1559   102.81  0.0000         |----             |-
6       0.4716   0.2224   112.11  0.0000         |---              |-
7       0.3756  -0.6080   118.25  0.0000         |---          ----|
8       0.2828  -0.5444   121.87  0.0000         |--           ----|
9       0.1950  -0.3689   123.67  0.0000         |-              --|
10       0.1127   1.0021    124.3  0.0000         |                |--------
11       0.0376  -1.1706   124.37  0.0000         |         --------|
12      -0.0333   0.7446   124.43  0.0000         |                |-----
13      -0.1012   1.5894   125.02  0.0000         |                |--------
14      -0.1669   0.0459    126.7  0.0000        -|                |
```

. corrgram Prswus

```
                                      -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.6661   0.7106   15.571  0.0001         |-----            |-----
2       0.5397   0.2512   26.133  0.0000         |----             |--
3       0.4371   0.0116   33.301  0.0000         |---              |
4       0.3141  -0.0575   37.133  0.0000         |--               |
5       0.3012   0.1933   40.789  0.0000         |--               |-
6       0.1948  -0.1454   42.377  0.0000         |-               -|
7       0.2206   0.2270   44.495  0.0000         |-                |-
8       0.1627   0.1112   45.695  0.0000         |-                |
9      -0.0150  -0.2110   45.706  0.0000         |               -|
```

```
10      -0.1401  -0.0555   46.677  0.0000         -|               |
11      -0.1828  -0.0123   48.409  0.0000         -|               |
12      -0.1817   0.0684   50.205  0.0000         -|               |
13      -0.2656  -0.2687   54.244  0.0000        --|             --|
14      -0.2819  -0.1709   59.046  0.0000        --|              -|
```

```
. corrgram Prnwus

                                   -1       0       1 -1       0       1
 LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
------------------------------------------------------------------------------
1        0.0026   0.0022   .00023  0.9879          |               |
2        0.1604   0.1622   .93366  0.6270          |-              |-
3        0.1391   0.1500   1.6595  0.6460          |-              |-
4        0.0258   0.0054   1.6853  0.7934          |               |
5        0.1142   0.8302   2.2108  0.8193          |               |------
6       -0.0256  -0.3274   2.2382  0.8965          |             --|
7        0.0090   0.2898   2.2417  0.9453          |               |--
8       -0.0127  -0.0550   2.2491  0.9724          |               |
9       -0.0009   0.3426   2.2491  0.9869          |               |--
10      -0.0112  -0.0146   2.2554  0.9940          |               |
11      -0.0327   0.3364   2.3108  0.9971          |               |--
12      -0.0049   0.6100   2.3122  0.9988          |               |----
13       0.0370   0.8536   2.3904  0.9994          |               |------
14      -0.0235   0.0245   2.4239  0.9997          |               |
```