

Factors Affecting The New Vehicle Registration In The Eu Countries

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Abstract

The objective of this study is to determine whether economic factors (namely price, consumer preferences, consumer income, interest rate, fuel prices, industrial production, and trade) have any explanatory power on new vehicle registry in the EU member countries. To meet this objective, a panel cointegration analysis was applied to the panel of thirteen EU countries for the time period spanning from January 1999 to August 2010. This study concludes that while the vehicle sales in the EU are determined by the macroeconomic factors instead of the factors in the demand theory, the consumer preferences are impetuses for passenger car sales in the EU countries.

Keywords: new vehicle sales, demand theory, macro economic variables, EU countries, panel cointegration,

1. INTRODUCTION

Automotive industry has become very dynamic and competitive sectors on a global scale in recent years. Since the industry is considered as a crucial contributor to economic growth, it has been observed that most of the developed countries (such as the USA, Germany, France, UK, Italy, Spain and South Korea) and many of the less developed ones (such as China, India, Malaysia, Thailand) have policies for becoming major players on world market by improving their own industry. Therefore, prediction of new vehicle registry is of great interest for policy makers, legislators, transport and urban planners, and traffic engineers in nations whose economies highly depend on the vehicle industry because the prediction of future vehicle registry has a vital importance in terms of forecasting national accounts as well as future energy and infrastructure requirements (Abu-Eisheh and Mannering, 2002). Predicting the new vehicle registration and having information about the determinants of the vehicle demand has also crucial importance for the strategic planning of vehicle manufacturers.

The industry plays a vital role in the economies of European Union (EU) member countries, the world's largest vehicle producer and playground for a highly competitive and innovative

industry, in terms of manufacturing, employment, exports, Research&Development and government revenue (European Automobile Manufacturers' Association (hereafter ACEA), 2011). As of 2009, Germany is the largest vehicle producer (5.2 million units) in the EU followed by Spain, France, United Kingdom (UK), Italy, Czech Republic, and Poland (ACEA, 2011).

Vehicle production and demand in most of the countries (including the EU) show upward and downward trends from time to time depending on the changes in economic conditions. Wad (2009) stated that "the effect of the global crisis came immediately with the stop for consumer credit and rapidly declining consumer confidence hitting in particular durable and expensive purchases like automobiles". Even though 14.1 million new cars were registered in the EU by 2009, the automotive industry experienced the biggest decline in EU car sales since 1993. New passenger car registrations decreased by 9.5% compared to the pre-crisis levels of 2007 (1.6% compared to 2008) and commercial vehicle registrations declined by 32.4% compared to 2008 (ACEA, 2011).

Due to the significance of the vehicle industry on the economies of EU member countries, from both policy makers and manufacturers' perspectives, there is a need to establish a policy framework that grows the automotive industry. In this context, it is important to determine the factors affecting the new vehicle registry in EU member countries. However, the empirical attempts on the determinants of the vehicle sales in the EU countries are very scarce and this gap in the literature provides room for examining the factors affecting the new vehicle sales in the EU countries. This paper thereby aims at addressing to which extent the economic factors have impact on the number of new vehicle registry in EU countries. To meet this objective, a panel data analysis was applied to the panel consisting of thirteen EU countries for the period January 1999-August 2010.

2. Literature review

There are a limited number of studies in the literature related to the determinants of vehicle demand. In an early study, Abu-Eisheh and Mannering (2002) analyzed the determinants of automobile import in West Bank and their estimation and simulation results showed that population/employment, economic growth, oil prices, exchange rates, and governmental policies have relative importance on the importation of automobiles. They concluded that much of the growth in automobile ownership is determined by economic growth.

Lord and Sahito (2010) analyzed whether yen-for-dollar exchange rate and gasoline prices have impact on the demand for Japanese cars in the US and found that demand for Japanese imports is positively correlated with the gasoline prices. They also found a positive relationship between the yen-for-dollar exchange rate and imports after 1988.

Alper and Mumcu (2007) estimated the demand for new automobiles in Turkey and found that the origin of automobile's country and quality have impacts on the demand for automobile in Turkey and found that the demand for new automobiles is price inelastic in the short run.

Mannering (1988) conducted a study to determine how consumers in the USA value interest rates in their new car choice decisions. His findings shows that consumers tend to overvalue interest rates relative to their true worth, proving the success of interest rate incentive programs.

McManus (2007) hypothesized that there is a link between gasoline price and selling price of automobiles in the USA and to reveal the existence of this link, he regressed the aggregate automobile prices on the number of independent variables including the interest rates. He found that interest rates has negative impact on the price of automobiles and concluded that since interest rate has negative impact on the automobile sales, automobile manufacturers overcomes this effect by reducing the selling price of automobiles.

Dotsey and Reid (1992) tested the effectiveness of interest rates, proxied for the monetary policy, and oil prices in economic activity for the USA and concluded that both tight monetary policy and oil price increases are statistically related to the declines in economic activity. Beck (2003) investigated the difference in consumers' responses to changes in the price of automobiles and changes in the level of the interest rate for automobile loans in USA and found that consumers respond to price changes rather than interest rate changes when purchasing a new automobile. His estimation results showed that there is a statistically significant and negative relationship between auto-demand and both interest rate and price variables. As expected, they found a positive and statistically significant positive relationship between auto-demand and disposable income.

3. Empirical Model and Data

To examine the determinant of new vehicle registrations in the EU, the demand model which is augmented with the macro-economic aggregates is described as follows:

$$\ln NV_{it} = \mu_0 + \mu_1 \ln P_{it} + \mu_2 \ln CCI_{it} + \mu_3 y_{it} + \mu_4 i_{it} + \mu_5 \ln FP_{it} + \mu_6 \ln IPI_{it} + \mu_7 \ln XM_{it} + \varepsilon_{it} \quad (1)$$

where *i* stands for the EU country, *t* refers to time period, *NV* is new vehicle sales, *P* is price of vehicles, *CCI* is consumer confidence indicator (consumer preferences), *y* is consumer's disposable income, *i* is interest rate, *FP* is fuel prices (diesel prices for the commercial vehicles, gasoline prices for the passenger cars), *IPI* is industrial production, and *XM* is total trade.

For new vehicles, four particular segments are considered in the estimations. The number of new registry for passenger cars (PC), light commercial vehicles (LCV) up to 3.5t - (excluding mini-buses up to 3.5t), commercial vehicles (CV) over 3.5t - (excluding buses&coaches over 3.5t), heavy commercial vehicles (HCV) over 16t - (excluding buses&coaches over 16t) were used for the dependent variables.

The independent variable price is one of the variables that represents the price of vehicles. In equation (1), the sign of the coefficient on the price is expected to be negative due to the demand theory which postulates that the quantity demanded is a negative function of the price.

One of the important contributions of this study to the empirical literature is to determine the sensitivity of the new vehicles sales to the consumer confidence indicator. Consumer confidence indicators were formulated in the late 1940's by George Katona at the University of Michigan as a way to include empirical measures of consumer expectations into the models of spending and saving behavior. The demand model described above includes a measure of the consumer confidence indicator to accounts for changes in consumers' preferences due to the current economic condition, recessions or expansions, which effect consumers' decision to buy a car. Concerning the theory of demand, this variable can be used as proxy to measure the consumers' preferences (Beck, 2003). With regard to the expected sign of the consumer confidence indicator,

the views are not unambiguous about to what extent the consumer confidence affects the demand of a good. On the one hand, a positive relationship is expected between new vehicle registration and consumer confidence indicators due to fact that optimistic consumer confidence may encourage consumers to make large expenses and to increase the tendency for borrowing. On the other hand, pessimism may cause consumers to decrease their expenditures and to make more strategic financial decisions.

The consumer income is one of the traditional determinant of a good consumed. The demand theory assumes that an increase in demand for a good is positively associated with an increase in consumer income. In this study, the growth rate of per capita income is used as a proxy for the consumer income.

Another independent variable representing the price of automobiles is interest rate that is included into the model to determine whether macroeconomic instability has any explanatory power on the new vehicle registry in the EU member countries. As a durable good, it is expected that the demand for vehicles is affected by the real interest rates. Accordingly, a negative relationship between interest rate and vehicle sales is expected due to fact that higher interest rates mean higher costs of borrowing for loans.

The fuel prices may be one of the important factors in explaining the fluctuations in new vehicle sales. High oil prices are expected to be negative effect on the consumer demand for the vehicles. According to Lee and Ni (2002), both the demand and supply of oil-sensitive industries are affected after an oil price shock. They also emphasized that the vehicle industry is negatively affected by oil price shocks and that the long run effects of oil price shocks will results in a weakening demand for full-size cars or opting for alternative means of transportation.

It was hypothesized that worldwide economic conditions are expected to have impact on demand for commercial vehicles. For the commercial vehicles, industrial production index and trade volume were added to the models as independent variables to determine the effectiveness of economic activities on vehicle demand. It is expected that there is a positive relationship between demand for commercial vehicles and both industrial production and trade volume. It is expected that the demand for the vehicles is expected to rise as the cargo transportation increases with the growing economic activity in the sectors such as the construction, agriculture, chemical, mining and service.

This study covers the monthly data spanning from January 1999 to August 2010 for 13 EU countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, Sweden, and United Kingdom). The starting date of time period and the cross-sectional dimension of the panel are restricted to availability of the variables in concern for the EU countries. The monthly data for the new registration of vehicles, short-term interest rates, harmonized index of consumer prices were obtained from EUROSTAT databank. To reflect relative movements in the average aggregate price level for new vehicles, motorcars inflation is measured by harmonized index of consumer prices (2005=100). We observe seasonal cycles in the passenger cars and therefore the seasonally adjusted observations for this variable were used in the analysis. The monthly observations for the consumer confidence indicators, industrial production index, trade volume in goods were obtained from OECD databank. Trade volume (export+import) was indexed by taking January 2005=100 as the base time. Since monthly data for the growth rate of per capita income is not available for the countries in hand, the quarterly

data for the growth rate of per capita income retrieved from OECD database and was transformed to monthly observations by means of cubic spline interpolation method (PROC EXPAND procedure in SAS). The fuel prices are measured as including taxes and duties and were obtained from European Commission Oil Bulletin.

4. Methods and Findings

In order to search for the long-run relations among the new vehicle sales and their determinants in equation (1), this study utilizes panel cointegration methods. The justification behind the use of panel cointegration analysis is due to the fact that panel data methods are more powerful than times series analysis since the panel data gets additional information from the cross-sectional dimension in addition to the time series dimension.

In the first step of our empirical analysis, unit root properties of the series are investigated via four panel unit root tests developed by Breitung (2000), Levin et al. (2000), Im et al. (2003), and Hadri (2000). The panel unit root analysis indicates that while the variables of interest have unit root in their level forms, they are stationary in the first-difference form⁷⁶. The unit root analysis therefore implies that the variables may be cointegrated in the long-run, which provide a room to continue the empirical analysis with the examination of the cointegration properties of the variables.

To analyze the existence of the long-run equilibrium relationship among the variables in question, several panel cointegration tests are developed in McKoskey and Kao (1998), Kao (1999), Pedroni (1999). The test of McKoskey and Kao (1998) and of Kao (1999) strictly assumes a homogenous panel cointegration vector for the panel. Pedroni (1999) relaxes this assumption by allowing heterogeneous cointegration vectors among cross-sectional units of the panel.

To test for the null of no-cointegration in the panel, Pedroni (1999) developed the seven cointegration statistics which are asymptotically distributed as standard normal⁷⁷. First, four statistics are based on the within-dimension approach which pools the autoregressive coefficient across different members for the unit root tests on the estimated residuals. The next three statistics are based on the between-dimension approach which averages the individually estimated coefficients for each member in the panel.

The results from the panel cointegration tests are reported in Table 1. The findings strongly support that the new sales of commercial vehicles, light commercial vehicles, and heavy commercial vehicles in the EU are cointegrated with the prices, the consumer confidence index, the interest rate, the real income growth, the diesel prices, the industrial production, and the trade

⁷⁶See Pedroni (1999) for further details and mathematical representation of the statistics.

⁷⁷Single-family homes are unattached houses and townhouses, including individually owned and operated housing units as well as single-family townhouse condominiums. Currently, some 66 percent of all U.S. housing consists of single or one-family homes (Listokin, D. and Burchell, R.W., Housing (shelter), Microsoft® Student 2009 [DVD], Redmond, WA: Microsoft Corporation, 2008).

volume. Similarly, the passenger car sales tend to be move together in line with the changes in the prices, the consumer confidence index, interest rate, the consumer income, and the gasoline prices. The existence of the cointegration relations is also implies that the short-run deviations from the steady-state equilibrium in the estimated demand models for the vehicles are corrected over time. Accordingly, the policy makers in the EU countries may not quickly react to the short-term shocks to the new vehicle sales.

Table 1: Results for panel cointegration tests

Statistic	Commercial vehicles (CV)	Light commercial vehicles (LCV)	Heavy commercial vehicles (HCV)	Passenger Cars (PC)
<u>Within-dimension</u>				
Panel v-stat	6.02	6.42	5.92	12.92
Panel rho-stat	-29.37	-21.94	-28.30	-27.37
Panel pp-stat	-30.71	-24.80	-29.52	-29.19
Panel adf-stat	-28.24	-22.14	-27.69	-22.99
<u>Between-dimension</u>				
Group rho-stat	-30.48	-23.79	-29.28	-28.63
Group pp-stat	-35.20	-29.68	-33.64	-31.81
Group adf-stat	-32.05	-26.88	-31.29	-27.01

The critical value at 1 percent level of significance is 1.96 for panel v-stat and -1.96 for other statistics. All the statistics are statistically significant at 1 percent level of significance.

The existence of the cointegration among the variables arises the question of to what extent the explanatory variables influence the new vehicle sales in the long-run. To estimate the long-run cointegration parameters, panel ordinary least squares (OLS), panel dynamic OLS (DOLS) and panel fully modified OLS (FMOLS) have been extensively utilized. Since these estimators are asymptotically equivalent, the choice among the methods depends upon their performance in finite samples (Banerjee, 1999). Monte Carlo experiments carried out by Kao and Chiang (2000) show that panel DOLS outperforms both panel OLS and FMOLS estimators. The recent Monte Carlo study of Wagner and Hluoskova (2009) indicate that the panel DOLS estimator outperforms both single- and system-equation panel cointegration methods. We therefore estimate the panel cointegration parameters by the group-mean panel DOLS estimator developed by Pedroni (2001). The panel DOLS estimator of Pedroni (2001) is flexible in examining cross-country heterogeneity in the panel as well as in providing the mean value of the panel cointegrationcoefficient.

Estimation of the cointegration parameters from the group-mean panel DOLS approach is computationally simple that the following regression model is estimated with the OLS for each member of the panel.

$$y_{it} = \alpha_i + \beta_i x_{it} + \sum_{k=-K_i}^{K_i} \alpha_{ik} \Delta x_{it-k} + \varepsilon_{it} \quad (2)$$

wherey denotes the dependent variable, x is the matrix of the explanatory variables (lnP, lnCCI, i, y, lnFP, lnIPI, lnXM), Δ is the first-difference operator, -K and K are leads and lags to be

determined. The panel cointegration parameter is constructed as $\hat{\beta}^* = N^{-1} \sum_{i=1}^N \beta_i$ where β_i is the cointegration parameter obtained from the individual OLS estimation of equation (2). Finally, the

associated t-ratio for the panel cointegration parameter is derived as $t_{\hat{\beta}^*} = N^{-1/2} \sum_{i=1}^N t_{\hat{\beta}_i}$.

The results for the panel cointegration estimations are reported in Table 2. Findings indicate that although some of the cointegration parameters appear to be insignificant, they have the expected signs. More specifically, while the commercial and heavy vehicles are negatively affected from interest rates, they are positively associated with a rise in the industrial production and in the total trade. For the light commercial vehicles, consumer confidence, income, and trade are found to be significantly positive. When we turn the passenger cars, it is found that while the passenger car sales are positively determined by the consumer confidence and the income, it is negatively determined by the interest rates.

Table 2: Results for panel cointegration estimation

	Commercial vehicles	Light commercial vehicles	Heavy commercial Vehicles	Passenger Cars
lnP	-1.74 (1.47)	-0.26 (1.49)	-1.23 (0.41)	-0.06 (1.28)
lnCCI	0.44 (0.73)	1.16 (2.15) **	0.10 (0.46)	0.75 (1.66) *
I	-0.04 (3.04) ***	-0.01 (0.98)	-0.05 (3.36) ***	-0.01 (2.18) **
Y	0.06 (0.95)	0.05 (2.31) **	0.03 (0.11)	0.02 (1.97) **
lnFP	-0.06 (0.74)	-0.43 (3.35)	-0.19 (1.24)	0.05 (0.08)
lnIPI	0.34 (2.38) ***	0.90 (1.36)	0.46 (3.40) ***	
lnXM	0.83 (3.40) ***	0.30 (2.80) ***	1.20 (4.28) ***	

Figures in parentheses are the absolute t-statistics. ***, **, * indicates the significance at 1, 5, and 10 percent level of statistical significance.

5. Conclusions and Policy Implications

In this study, we determine to what extent the economic variables affect the new vehicle sales in the selected EU countries over the period January 1999-August 2010 by means of panel cointegration analysis. The empirical results for the vehicles show that the vehicle sales are strongly associated with higher industrial production and trade. For the passenger cars, we find out that the passenger car sales are basically determined by the consumer preferences.

The panel cointegration analysis provides important implications about the vehicle sales in the EU. First of all, the macro economic variables such as interest rate, industrial production, and trade appear to be more pronounced factors in the fluctuations of the vehicle sales.

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