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Macroeconomic Effect on the Automobile Sales in Top Four Automobile Production Countries*

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En Büyük Dört Otomobil Üreticisi Ülkedeki Araç Satışlarının Makroekonomik Etkileri

Abstract

The automotive industry is a major industrial and economic force worldwide. This paper examines macroeconomic effect with six variables on the automobile sales in top four automobile production countries. These variables are real GDP, GDP per capita, automobile production, inflation, gasoline price, and exchange rate; and the countries has been selected are China, USA, Japan, and Germany that has first four highest automobile production countries in the world. The findings shows that real GDP, car production, gasoline price have positive impact towards car sales while change in GDP percapita, inflation and exchange rate cause the opposite. Some variables in this research based on findings is inconsistent with the previous findings done by other researcher. While for those top countries GDP percapita and gasoline price have different effect to the automobile sales. The reason of that situation is because GDP percapita that reflect fluctuation of income perpeople of those countries have no significant effectto the number of automobile sales.

Anahtar Kelimeler: Automobile Sales, Real GDP, Automobile Production, Gasoline Price.

JEL Codes: E23, F14

Özet

Otomotiv endüstrisi dünya genelinde önemli bir sanayi kolu ve ülkeler için ekonomik bir güçtür. Bu çalışmanın amacı altı değişkenin otomobil üretimi üzerindeki makroekonomik etkisini incelemektir. Söz konusu değişkenler; reel GSYİH, kişi başı GSYİH, otomobil üretimi, enflasyon oranları, benzin fiyatları ve döviz kurudur. Çalışmanın analiz kısmı için seçilen ülkeler ise Çin, ABD, Japonya ve Almanya'dır. Bu ekonomiler dünyada otomobil üretiminde en büyük pay sahibi ilk dört ülkedir. Çalışma bulgularına göre, reel GSYİH, otomobil üretimi ve benzin fiyatlarının otomobil satışları üzerinde olumlu etkileri olduğunu gösterirken, kişi başı GSYİH, enflasyon ve döviz kuru tam tersi olarak üretim üzerinde olumsuz etkiler göstermiştir. Bu çalışmadaki bazı

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değişkenlerin otomobil satışı üzerindeki etkileri literatürdeki diğer bazı çalışmalara göre çelişen sonuçlar göstermiştir. Örneğin bu üst düzey ülkeler için kişi başı GSYİH ve benzin fiyatlarının otomobil satışları üzerinde farklı etkileri vardır. Bu durumun nedeni, söz konusu ülkelerin her birinin kişi başına düşen gelir düzeylerinin büyük dalgalanma göstermesidir.

Keywords: Otomobil Satışları, Otomobil Üretimi, Benzin Fiyatları

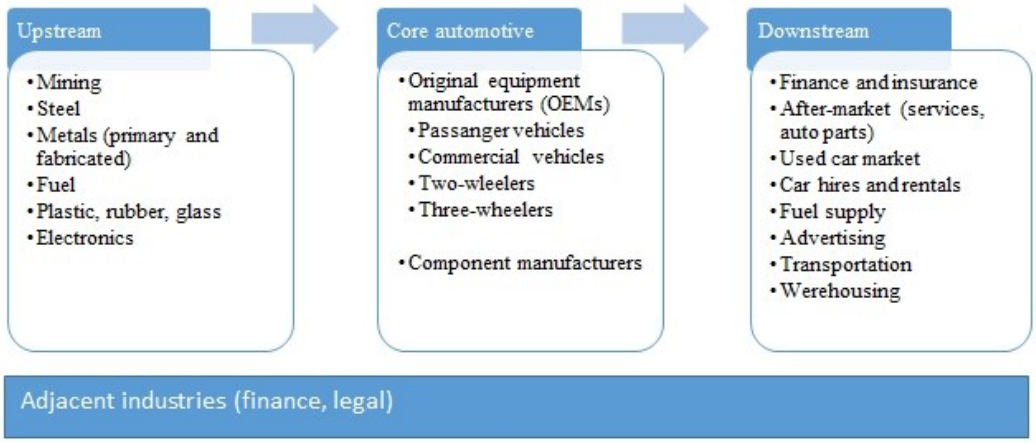
JEL Kodları: E23, F14

Introduction

Transportation is one of the most essential economic goods in the modern world. An efficient mode of transportation ensures the mobility of individuals and product delivery could be conducted in a safe and timely manner. To meet this requirement, various types and models of vehicles were produced by automotive companies to fulfil the needs of consumers especially in the context of passenger vehicles.

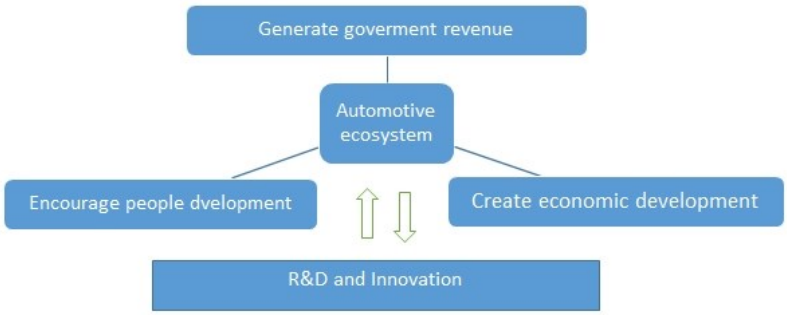
The automobile is a pillar of the global economy, a main driver of macroeconomic growth and stability and technological advancement inboth developed and developing countries, spanning many adjacent industries. The core automotive industry (vehicle and parts makers) support wide range of business segment, both upstream and downstream, along with adjacent industries (figure 1).

Figure 1. The Core Automotive Industry Supports Upstream And Downstream Industries



Automotive contributes to several important dimensions of nation building: generating government revenue, creating economic development, encouraging people development, and fostering R&D and innovation (figure 2).

Figure 2.The Auto Industry's Contribution To The Economy



Generating revenue. The automotive sector contributes significant tax revenues from vehicle sales, usage-related levies, personal income taxes, and business taxes. Production and sales of new and used vehicles, parts, and services deliver excise, sales, value-added, and local taxes and import duties.

Economic development. The automotive industry is important to global economic development.Globally, automotive contributes roughly 3 percent of all GDP output; the share is even higher in emerging markets, with rates in China and India at 7 percent and rising.

People development. Worldwide there is one motor vehicle for every five people; in the United States there is one car for every 1.25 citizens. Automobiles can increase quality of life through increased mobility, comfort, and safety.

Fostering R&D and innovation.R&D investment by automakers is driven by consumer demands for more product variety, better performance, improved safety, higher emission standards, and lower costs.

1. Automotive Market

Four main markets dominate global car sales are China, the United States, Germany, and Japan. China has been the largest market since 2009, and its lead over the United States is growing with each dominant market in terms of passenger car sales, emerging

markets are yet to impose themselves in terms of sales volumes. The hoped-for El Dorado is struggling to materialize as economic and political crises slow household vehicle ownership rates.

Car sales by market reflect the economic difficulties facing various countries. The recovery is sluggish in Europe; in the United States it is more pronounced, but "jobless"; in Japan it is underpinned by public policies; in the emerging countries it is lagging behind. despite high expectations. Car registrations are also a major indicator of a country's economic health. This report sheds light on their expected trends.(Economic Outlook, 2014: 5)

Growth in global automotive production is likely to remainat around +4% per year in2014 and 2015, with anincrease in production inChina, India, and Mexico at theexpense of Europe. Productionis even expected to exceed100 million vehicles by 2017.The major componentmanufacturers, which areessential for auto makers,have relocated to followproduction and registerhealthy levels of profitability.(Economic Outlook, 2014:8)

Global new automobile sales totaled 20.44 million units during the first quarter of 2016. That is 2.8% more than the total posted in Q1 2015, or 558,700 more units. The biggest contributors to this growth were the Chinese and European markets, both of which continued to show positive macroeconomic trends. Meanwhile the US car market moderated its growth, whilst Japan, Brazil and Russia recorded the biggest drops.(JATO, 2016:16) By JATO Dynamic Limited has summarized to identify countries which have high influence to the world automobile market (Table 1).

Table 1. Top Ten Automobile Markets 2016-Q1

Countries	**Units (000)**	**Change Q1 (2015-2016)**
China	6.073	+6%
USA	4.081	+3%
Japan	1.449	-7%
UK	871	+5%
Germany	849	+5%
India	807	+3%
France	616	+8%
Italy	558	+21%
Brazil	465	-28%
South Korea	416	+5%

Source: JATO Dynamics Limited

With growth of +10% in 2014 and +8% expected for 2015, the Chinese market is extending its lead after having surpassed overtaken the US market in 2009. At nearly 20 million units sold in 2014, it now accounts for 27% of global sales. Moreover, with an ownership rate of close to 5%, it offers all auto makers very attractive prospects for long-term growth of around +8% to +10% per year. It is a vehicle market whose role is growing: with 21 million units sold in 2015, it will be 25% larger than the US market.

The US market represents 23%of global sales of passengervehicles (PV) and light commercialvehicles (LCV), or 16.5million unitsIt has become very profitable onceagain, after the deep restructuringscarried out in 2009-2010. The USautomotive industry has thus regainedthe competitiveness it hadpreviously lost: for an unchangedlevel of production, the workforcehas been reduced by -20% andmany production sites have beenshut down. Armed with a renewedand completely restructured productrange, US groups have returnedto being profitable, although forGeneral Motors 2014 will be largelytarnished by massive callbacks ofits vehicles (nearly 25 million) forsafety reasons.

The automotive industry is one of the Japanese economy's core sectors, in 2013 automotive shipments accounted for 17.8% of the total of Japan's manufacturing shipments, and 40.9% of the value of the machinery industries combined shipments.(JAMA, 2015:22)The production of passenger vehicles by Japanese manufacturers in 2014 saw a slight increase of 1.1% compared to the previous year to total of 8.2 million units. In 2014 motor vehicles in Japan increased for the first time in two years, totaling 9.77 million units, up 1.5% from the previous year.

German automobile manufacturers produced over 15 million vehicles in 2015that equivalent to more than 19 percent of total global production. 21 of the world's 100 top automotive suppliers are German companies. Germany is the European car production leader: some 5.7 million passenger carsand 325.200 trucks and buses were manufactured in German plants in 2015. The automotive industry is the largest industry sector in Germany. In 2015, the auto sector recorded turnover of EUR 404 billion which is around 20% of the total German industry revenue. (GTAI, 2017:18)

2. Macroeconomic Report of the Countries

2.1. China

According to the World Bank, the Gross Domestic Product of China was 10351.11 billion USD in 2014, rank 2 globally. The GDP per capita was 7587.29 USD positioning China at rank number 77 in the world in terms of economic development.Foreign direct investment into China was 268.10 billion USD in 2014 which is 2.59 percent of GDP. We look primarily at the percent of GDP as opposed to the dollar amounts because larger economies would normally attract greater volumes of foreign investment. Values above 4-5 percent of GDP suggest that the country is an attractive foreign investment destination.

China is one of the main (top 10) trading partners of more than 100 economies that account for about 80 percent of world GDP. Given is key role in global and regional supply chains-importing intermediate and capital goods and exporting processed goods - China can also be a conduit for shocks that originate in other countries. Furthermore, over the past decade, China's role as a source of final demand has increased markedly: china's imports of final capital goods and consumption goods from Europe and the United State are material. IMF staff analysis suggest that a 1 percentage point investment-driven drop in China's output growth would reduce Group of Twenty (G20) growth by ¼ percentage point.

China's economic growth has proved to be quite resilient. At 6.9 percent for the whole year, the country's GDP growth rate for 2015 stayed very much in line with the official target. While slower than previous years, this is still among the highest of the world's major economies, and given the size of China's economy today, the increase in economic output in 2015 was more than in previous years when the growth rate was higher. In comparison, the US would have to grow at 4 percent in order to produce the same amount of incremental economic output that China generated with 6.9 percent growth. Unsurprisingly, according to forecasts prepared by the International Monetary Fund (IMF), China is expected to continue being the largest contributor to world GDP – in purchasing power parity terms – and is expected to account for nearly 20 percent of

world GDP by 2020, compared to 15.5 percent for the European Union and 14.9 percent for the US.(IMF, 2015)

China, now the world's largest economy on a purchasing power parity basis, is navigating a momentous but complex transition toward more sustainable growth based on consumption and services. Ultimately, that process will benefit both China and the world. Given China's important role in global trade, however, bumps along the way could have substantial spillover effects, especially on emerging market and developing economies.

2.2. United States of America

Seven yearsafterfinancial crisis, the United States comeback with economic recovery, while modest by historical standards, has been one of the strongest in the OECD, by robust monetary policy support and an early expansion. Many sector jobs have been created,about 2.6 million jobs in 2015, pushing unemployment down to its pre-crisis level fell to 5.0 percent, half its level in fall 2009, thereby providing consumers with higher income and improving their confidence. Health care price growth remained at low levels not seen in nearly five decades as the Nation's uninsured rate fell below 10 percent for the first time ever. (OECD, 2016)

The US economy continued to grow in 2015, as the recovery extended into its seventh year with widespread growth in domestic demand, strong gains in labor markets and real wages, and low inflation. Real gross domestic product (GDP) increased 1.8 percent during the four quarters of the year, down from 2.5-percent growth during 2013 and 2014.

Inflation remained low with consumer price inflation (CPI) at only 0.7 percent during the 12 months of 2015, reflecting a sharp decline in oil prices. Core CPI, which excludes food and energy, increased 2.1 percent, above the year-earlier rate of 1.6 percent. Real average hourly earnings of production and nonsupervisory workers rose 2.3 percent over the 12 months of 2015, as nominal wage growth exceeded price inflation.(Transmitted to the Congress, 2016)

Consumption growth was lackluster early in 2016, but data on retail sales and motor vehicle sales suggest that spending has picked up appreciably so far this quarter. Smoothing through the monthly fluctuations, consumer spending is reported to have increased at an annual rate of nearly 3 percent over the first four months of this year, only a little slower than the pace in 2015.

2.3. Japan

During the past two decades, economic growth has been sluggish, reducing Japan's relative per capita income from a level matching the top half of OECD countries in the early 1990s to 14% below, sluggish growth and persistent deflation have reduced Japanese livingstandards below the OECD average. Gross government debt has risen to 226% of GDP, the highest in the OECD, driven by rising social spending and inadequate revenues. Rapid population ageing is putting continued pressure on public spending, while pushing down Japan's potential growth rate to around ¾ percent. Abenomics – bold monetary policy, flexible fiscal policy and a growth strategy to revitalize the economy and end deflation – had an immediate positive effect in 2013, thanks to the first two arrows. Growth was interrupted in the wake of the tax increase in April 2014, but resumed later in the year (OECD, 2015).The Abenomics economic reform agenda had shown signs of traction, but the economy unexpectedly fell into a recession in the third quarter of 2014, shrinking 1.9 percent at an annualized rate, driven primarily by the April sales tax hike.(Lannahan and Giles, 2015:)After years ofvery low inflation and deflation, Japanese inflation was forecast to remain above the 2 percent target for 2014, but it is estimated to fall short of it in 2015 at 1.8 percent.(EIU, 2014)

Reversing the fall in Japan's potential growth rate, which slowed from over 3% in theearly 1990s to around ¾ per cent in 2014 requires additional steps to: i) slow the decline in the labor force or even reverse it; and ii) boost labor productivity growth,which will depend to a large extent on innovation. The government aims to boost realannual output growth to 2% through 2022 (2.4% in per capita terms), well above the 0.9%rate of the past two decades. In December 2014, the government stated that "Japan mustaim to become the most innovative country in the world by carrying out social andeconomic structural changes". The ten key reforms in the Strategy that was revised inJune 2014

(Table 3), which have been addressed in previous *OECD Economic Surveys of Japan*,contain many important measures. However, the implementation of the third arrow haslagged behind the first two arrows. It is essential that Japan implement the plannedreforms. Moreover, further reforms are needed to achieve the 2% target. The issuesdiscussed below include the priorities in the 2015 edition of the OECD's *Going for Growth*: i) relaxing barriers in the service sector, in part through foreign direct investment; ii) reducing producer support for agriculture; iii) improving the efficiency of the tax system by raising the consumption tax and cutting the corporate tax; iv) raising female labor participation; and v) reforming employment protection.(OECD, 2015)

Growth is projected to remain at 0.5percent in 2016, before turning slightly negative to –0.1 percent in 2017 as the scheduled increase in the consumption tax rate (of 2 percentage points) goes into effect. The recent appreciation of theyen and weaker demand from emerging market economies are projected to restrain activity during the first half of 2016, but lower energy prices and fiscal measures adopted through the supplementary budget are expected to boost growth (with fiscal stimulus alone adding 0.5 percentage point to output). The Bank of Japan's quantitative and qualitative easing measures—including negative interest rates on marginal excess reserve deposits adopted in February—are expected to support private demand. Japan's medium- to long-term growth prospects remain weak, primarily reflecting a declining labor force.

2.4. Germany

Economic growth (the rate of change of real GDP). For that indicator, the average value for Germany during period 2000 to 2015was 1.2 percent with a minimum of -5.62 percent in 2009 and a maximum of 4.08 percent in 2010.

Gross Domestic Product. The average value for Germany during period 2000 to 2015 was 3091.42billion U.S. dollars with a minimum of 1949.95 billion U.S. dollars in 20000 and a maximum of 3868.29 billion U.S. dollars in 2014.

GDP per capita: Purchasing Power Parity. The average value for Germany during period 2000 to 2015 was 37740.58 U.S. dollars with a minimum of 23687.30 U.S. dollars in 2001 and a maximum of 47767.00 U.S. dollars in 2014.

Inflation: percent change in the Consumer Price Index. The average value for Germany during period 2000 to 2015 was 1.19 percent with a minimum of 0.2 percent in 2000 and a maximum of 2.6 percent in 2008.

Taxes on goods and services, percent of total revenue. The average value for Germany during period 1972 to 2014 was 23.14 percent with a minimum of 19.96 percent in 1997 and a maximum of 28.33 percent in 1972.

Unemployment rate. The average value for Germany during period 2000 to 2015 was 7.67 percent with a minimum of 5 percent in 2014 and a maximum of 11.1 percent in 2005.

The automotive industry is the largest industry sector in Germany. In 2011, the auto sector recorded turnover of EUR 351 billion – around 20 percent of total German industry revenue. According to the A.T. Kearney Foreign Direct Investment Confidence Index 2012, Germany is the most attractive FDI destination in Europe. Internationally participating business executives also conclude that ongoing investment in sustainable business is an absolute imperative for successful market competition and shareholder satisfaction. The UNCTAD World Investment Report 2011 confirms Germany's reputation as one of the most attractive business locations in continental Europe. Ernst & Young finds Germany to be the most attractive investment location in Europe in 2012 with its *Standort Deutschland 2012 - Der Fels in der Brandung?*(A pillar of strength in troubled times?) international manager study. American interview partners also singled out German R&D – and partnerships with German universities and research centers – for specific praise. German R&D excellence is held in such high esteem that a number of US companies have established their own research centers here – many of them with global reach.

3. Literature Review

A few empirical studies have been conducted to examine the relationship between passenger car sales and various macroeconomic variables and the findings are generally mixed. Based on the review of these researches, several factors have been identified capable of influencing car sales. These include fluctuation in fuel price as well as loan interest, unemployment and income rates.

Dynaquest (2002) founds that there is also a strong relationship between new car sales and the nominal GDP just as there is a relationship between the total number of cars in use and the nominal GDP. However, the correlation between the sale of new cars and nominal GDP is not as strong as the relationship between the total number of cars in use and GDP. Based on Automotive Research (Smith and Chen, 2009), a historical correlation between annualized GDP and vehicle sales growth in US indicates that positive vehicle sales growth depends on three percent or higher GDP growth. Thus, vehicle sales can be expected to fall if the annualized GDP growth rate is below 1.0 percent. Generally, only a GDP above 3.0 is associated with growing sales. These findings show that there is a significant relationship between GDP and car sales in the US. According to Babatsou and Zervas (2011), it is clear that a good correlation exists between GDP with passenger car sales in the European Union countries. The results of this study clearly show that the number of passenger cars increases with GDP indicating a very good linear correlation (r =0.95). It clearly indicates that a regression in GDP will lead to a decrease of total passenger cars in use. Kongsberg Automotive (2008) analyzed the relationship between global car sales and global GDP from 1998 until 2008. The results show that there is a high correlation between global car sales and global GDP.

Other factors that have been analyzed were income level, interest rate, financial aggregate and unemployment rate. These include the research by Shahabudin (2009) on domestic and foreign care sales. In this research, it was discovered that all variables could significantly influence car sales. However, this regression model suffered from heteroscedasticity that affected the efficiency to gauge domestic and foreign car sales. In this research, it is proven that all variables could significantly influence car sales. However, the problem of heteroscedasticity had impaired the efficiency of the model as a whole.

On the other hand, Ludvigson (1998) tested the impact of financial policy on car sales pula which was attributed to the offering of bank loans for car purchase. The increase of basic interest rate was found to pose a significant negative impact on car sales. This is due to the lack of ability among commercial banks to provide loans for car buyers

As described by Dargaydan Gately (1999) following their research on car ownership in 26 countries from 1960 to 1992, it was discovered that the projected rate of car ownership for two decades until 2015 is high for low income nations. The same statistics is expected to be recorded in other economies including Portugal, Greece and Ireland. This is based on these countries' own expectation that they will achieve high income growth in the future. On the other hand, for China, India and Pakistan, car ownership increased twofold in line with their per capita income growth.

Dargay (2001) using Family Expenditure Survey from 1970 to 1995, it was found out that the statistics of vehicle ownership recorded a positive upward trend with income increase. However, there is a negative correlation when there is an income reduction. This is associated with the personal habit of individual consumers as vehicle is seen as an important necessity in the present context of everyday life.

Chifurira, et al. (2014) their object of study is to examine the impact of inflation on the automobile sales in South Africa over the sample period of 1969 to 2013. The finding of the study indicated that there is aunidirectional causal effect (one-way causality) from inflation to new vehicle sales.

Muhammad, et al. (2012) following their research to analyze the impact of economic variables on automobile sales in five ASEAN countries. The long term and short term correlation between these variables are implemented using the panel error-correction model. Annual data from 1996 to 2010 involving five variables from five ASEAN countries namely Malaysia, Singapore, Thailand, Philippines and Thailand were accumulated as sample for this research. Result from the test shows that gross domestic product (GDP), inflation (CPI), unemployment rate (UNEMP) and loan rate (LR) have significant long term correlation with automobile sales in these ASEAN countries. The value of error correction in the short term to achieve long term stability based on ECT parameter is found to be significant in Malaysia, Singapore and Thailand. On the other hand, each country is influenced by different variables in the short-term period.

4. Empirical Analysis

4.1. Purpose of Study

The objective of this paper is focused on to analyze the impact of the macroeconomic condition on automobile sales in the countries that has highest automobile production in the world. Four countries that have been choose namely China, United Stated of America (USA), Japan, and Germany. The six variables of macroeconomic particularly Real Gross Domestic Product (GDP), Gross Domestic Product per Capita (GDP-C), Automobile Production (AUP), Inflation Rate (INF), Exchange Rate (XCR), and Unemployment Rate (UNEMP) for the period 2000 to 2015.

4.2. ResearchMethodology

The analysis was performed in the following stages: 1) data collection and assessment; 2) estimation model determination; 3) estimation method determination; 4) assumption tests; and 5)interpretation model.

Ordinary Least Square (OLS) and Fixed Effect Model (FEM) used for estimation model determination. A balanced panel data set is used which has equal number of observations for each individual (cross-section) and for best model selection, FEM hypothesis testing, OLS versus FEM, Chow test is used.(Gujarati, 2003, Hsiao, 2003 etc). Random effect model is not used because thenumber of countries are less than the number of independent variables.

1) Pooled OLS

While using the assumption that all coefficients are constant across time and individuals, we assume that there is neither significant country nor significant temporal effects.Ordinary least squares (OLS) regression model;

$$Y_{it} = \beta_1 + \beta_2 + \beta_3 X_{3it} + \ldots + \beta_n X_{nit} + u_{it}$$

2) Fixed Effects Models

To take into account the individuality of each country/ cross-sectional unit, intercept is varied by using dummy variable for fixed effects. Dummy for Pakistan is used as comparison.Fixed effect models for cross section (intercept or individual);

$$Y_{it} = \alpha_1 + \alpha_2 D_2 + \ldots.. + \alpha_n D_n + \beta_2 X_{2it} + \ldots + \beta_n X_{nit} + u_{it}$$

4.3. Empirical Result

4.3.1. Estimation Model Determination

After having the thorough discussion regarding the methods used in the current study we have reached on the following results.

Table1.OLS Result for Sales Data

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP	0.269512	0.049013	5.498841	0.0000
GDPC	-0.013304	0.001161	-11.46188	0.0000
PROD	0.812921	0.034792	23.36504	0.0000
INF	-0.072326	0.065419	-1.105583	0.2736
GSP	1.980303	0.308747	6.414006	0.0000
EXC	-0.016415	0.002715	-6.045117	0.0000
C	0.152710	0.382903	0.398820	0.6915

* Significant at 5% level of significance.

According to the Table 1, all variables are significant because P value < 0.05 except INF (inflation rate) that has P value > 0.05. According to this model the R-squared value is 0.984906. This regression assumes that all of countries have the same condition, but factually the countries are different. In constant coefficient model all intercepts and coefficients are assumed to be same (i.e. there is neither significant country nor significant temporal effects), in this way space and time dimensions of the pooled data are disregarded, data is pooled and an ordinary least squares (OLS) regression model is run. So these models are highly restricted assumptions about the model. Regardless of the simplicity of the model, the pooled regression may disfigure the true picture of the relationship between Y and the X's across the cross-sections. So, goes to second regression.

Table 2.FEM Result for Sales Data

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP	0.390893	0.084842	4.607305	0.0000
GDPC	-0.011506	0.003591	-3.204208	0.0023
PROD	0.799615	0.039842	20.06957	0.0000
INF	-0.041296	0.065530	-0.630185	0.5312
GSP	1.117507	0.689680	1.620326	0.1110
EXC	-0.004108	0.013437	-0.305707	0.7610
C	-0.614410	0.791012	-0.776739	0.4407

According to the Table 2, figure out that 3 of 6 variables are significant, they are Real GDP, GDP per capita, and Automobile Production. The rest of variables are not significant.

Different variations with reference to cross-section or time are applied to the fixed effects models here. The fixed effects model has constant slopes but intercepts differ according to the cross-sectional (group) unit. For i classes i –1 dummy variables are used to designate the particular country, this model is sometimes called the LSDV model. Another fixed effects panel model where the slope coefficients are constant, but the intercept varies over individual/ country as well as time. FEM with differential intercepts and slopes can also be applied on data, but inclusion of lot of variables and dummies may give results for which interpretation is cumbersome, because many dummies may cause the problem of multicollinearity. There is also a fixed effects panel model in which both intercepts and slopes might vary according to country and time. This model specifies i-1 country dummies, t-1time dummies, the variables under consideration and the interactions between them. If all of these are statistically significant, there is no reason to pool (Gujarati, 2003).

5. Estimation Method Determination

5.1. Chow Test (F Test)

Chow Test used for chose which the best model between Ordinary least squares (OLS) regression model and Fixed effects model.

Table 3. Chow Test Result

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.476253	(3,54)	0.0712
Cross-section Chi-square	8.249220	3	0.0411

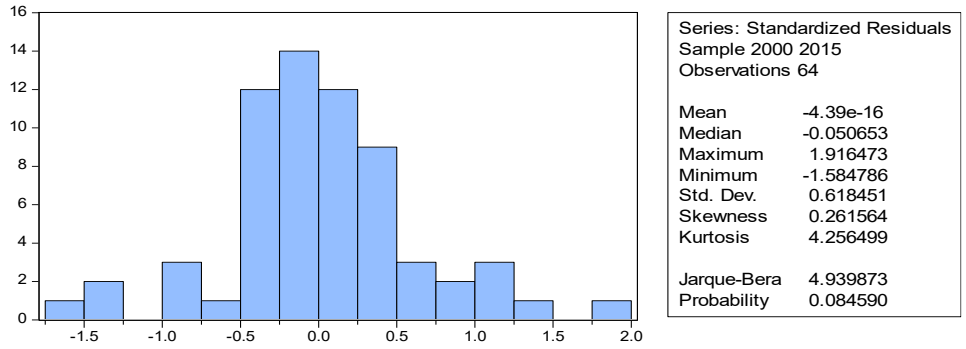
According to above table P value > 0.05, so Ha is rejected and H0 is accepted (Ordinary least squares regression model is appropriate).

6. Assumption Tests

6.1. Normality Test

Based on estimation method determination tests (Chow test), Common Effect Model is the most appropriate model for this regression panel model.

Table 4. Normality Test



With 6 independent variables and significant value 5%, so based on table chi square value is 12.592. That is mean JB value less than Chi Square value (4.939873 < 12.592), so this research data is normal distributed (H0 is accepted = normal data distributed).

6.2. Multicollinearity Test

Hypothesis for multicollinearity test is if value between two variables < 0.8, it's mean there is no multicollinearity. According to the table 5, the result is there are 2 variables have multicollinearity, the multicollinearity its exist between variables sales and automobile production.

Table 5. Multicollinearity Test

	SALES	RGDP	GDPC	PROD	INF	GSP	EXC
SALES	1.000000	0.363529	-0.414343	0.929647	0.330129	-0.126705	-0.155174
RGDP	0.363529	1.000000	0.468626	0.462410	0.248574	-0.344996	-0.263588
GDPC	-0.414343	0.468626	1.000000	-0.163840	-0.186727	0.335675	0.126439
PROD	0.929647	0.462410	-0.163840	1.000000	0.223583	-0.056991	0.081238
INF	0.330129	0.248574	-0.186727	0.223583	1.000000	-0.244694	-0.531275
GSP	-0.126705	-0.344996	0.335675	-0.056991	-0.244694	1.000000	0.237078
EXC	-0.155174	-0.263588	0.126439	0.081238	-0.531275	0.237078	1.000000

But as long as value of multicollinearity between sales and automobile production (0.929647) less than value of R^2 (0.984906), will not become a problem for the regression.

7. Interpretation Model

$Sales_{it=}$ 0.152710 + 0.269512$RGDP_{it}$-0.013304$GDPC_{it}$ + 0.812921$PROD_{it}$-0.072326INF_{it} + 1.980303GSP_{it}-0.016415EXC_{it}+ϵ_{it}

P value of all variables except inflation is 0.0000, it is meant that real GDP, GDP percapita, car production, gasoline price and excange rate have significant effect towards car sales. While inflation has p value 0.2736 which is more than 5%, that meant inflation has no significant effect towards car sales.According to the above equation, it can interpretated that real GDP, car production, gasoline price have positive impact towards car sales while change in GDP percapita, inflation and exchange rate cause the opposite.

Starting with the first variable of GDP, like as generally speaking one might assume that as GDP for the country increases, as would the sales of automotive. In regards to GDP growth andthe automobilesales in top four automobileproductioncountries reflects that there is a positive correlation between these two factors. After running a linear regression in e views 8, the resulting coefficient for GDP in relation to automobile sales was 0.269512. This positive coefficient shows the positive relationship between the two factors and how if GDP increases, automobilesales increases and vice versa. Essentially this means that as GDP increases by 100% automobile sales increasesby 26.95% respectively, while all other variables are held constant.

The second macro economic indicator analyzed was GDP percapita. When thinking about GDP percapita and its effect on automobile sales, one would probably assume thatthe GDP percapita has positive correlation like relationship between real GDP with

automobile sales. But regards to GDP percapita and automobile sales actually reflects that there is a negative correlation between these two factors. The coefficient for GDP percapita variable is -0.013304 showing a less negative relationship between automobile sales and GDP percapita.This means that as GDP percapita increases by 100%, automobile sales decreases by 1.33% respectively, while all other variables are held constant.

Followed by automobile production as the next variable analyzed has impact to automobile sales. Like a demand and supply law, its reveal that if supply is increases then the price will be goes down and the sales will be increase. When looking at the numerical results of the regression this hold true. The coefficient for automobile production variable is 0.812921 showing a positive relationship between automobile sales and automobile production.This means that as automobile production increases by 100%, automobile sales increases by 81.29% respectively, while all other variables are held constant.

Yet another macro economic indicator used in this study which influences the automobile sales is inflation. When looking at inflation and its potential persuasionof sales, one would most likely assume that there would be a positive relationship between the twobecause as inflation or general prices increase, as would the automobile sales. The statistical analysis of this actually reflects the opposite. The coefficient of the inflation variable is 0.072326 showing that there is indeed a negative relationship between the two factors. This means that if inflation increases, then the automobile sales will decreses while all other variables are held constant. This means that the inflation increases by 1 unit, automobile sales decreases by 7.23% respectively, while all other variables are held constant.

The other variable analyzed has influence to the automobile sales is gasoline price. As the gasoline is the main complementary items of automobile, so that the price of gasoline also becomes significant factor for automobile sales. By the economic theory the complementary items has negative relationship between the two, but in this study shows the opposite. The coefficient of the gasoline price variable is 1.980303 showing that there is a positive relationship between the two. It is means that as the gasoline priceincreases

by 1$, the number of automobile sales will increase 198.03% while all other variables are held constant.

The last variable analyzed in regard to responsiveness of automobile sales on the top four automobile production countries is exchange rate. Some of consument of automobile buy car from outside of the country automatically has different currency, therefore the exchange rate has influence to the automobile sales. The statistical analysis of this actually reflect a negative relationship between the two. The coefficient of the exchange rate variable is -0.016415 showing that there is a negative relationship between exchange rate and automobile sales. This means that as exchange rate increases by 100%, automobile sales decreases approximatelly 1.64% while all other variables are held constant.

Besides showing the analysis of the effect of macroeconomic variables on the number of automobile sales for the combined countries, for more details also displayed analysis of macroeconomic variables in each country. The result is presented in this below table.

Table 6. Individual Results of Panel Data of Automobile Sales Equation For 4 Countries

Variable		China	USA	Japan	Germany
RGDP	a	-0.697218	-0.588408	-23.25654	-0.187281
	b	2.921058	1.386631	7.71254	0.338676
	c	0.8167	0.6803	0.0146*	0.5937
GDPC	a	0.110742	0.018186	0.277441	-0.001603
	b	0.416649	0.04979	0.091876	0.001737
	c	0.7964	0.7225	0.0145*	0.3802
PROD	a	0.963654	0.421501	0.442501	-0.34883
	b	0.02623	0.059621	0.135706	0.310722
	c	0.0000*	0.0000*	0.0098*	0.2906
INF	a	0.010967	-0.010676	-0.206125	-0.052355
	b	0.020544	0.134911	0.124701	0.122386
	c	0.6064	0.9385	0.1327	0.6789
GSP	a	-0.173588	1.280896	-0.135917	0.064299
	b	0.465675	1.987886	1.020905	0.479763
	c	0.7179	0.5338	0.897	0.8963
EXC	a	0.052558	NA	-0.0638	0.665777
	b	0.257861	NA	0.04683	0.943228
	c	0.843	NA	0.2062	0.4981

a: coefficient, significant at 5 %b: standard errorc: probability value

According to Table 6, it is shown that real GDP and GDP percapita variable only has significant towards automobile sales in USA. On the other hand automobile production variable has sifnificant effect to the automobile sales in three countries, i.e. China, USA and Japan. Inflation, Gasoline price and exchange rate variables hasnon significant value to all of the countries. Exchange rate variable toUSA is not available, because itself currency used for basic calculating other country's currencies.

Conclusion

Overlooking these general economic indicators and their effect of automobile sales, it is safe to say that automobile sales in the top four automobile production countries have the same result for the variables such as GDP, automobile production, inflation and exchange rate like the previous common research. While for those top countries GDP percapita and gasoline price have different effect to the automobile sales. The reason of that situation is because GDP percapita that reflect fluctuation of income per people of those countries have no significant effect to the number of automobile sales. The same condition with the gasoline price, people in those countries have a good standard life, change of the gasoline price will not effect to the number of automobile sales, even in this study shows opposite result that when gasoline price increases, significantly automobile sales increases as well.

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