To: Volkswagen Management
From: Rudy Dey
Subject: Spanish Market Entry and Industry Competition Analysis
Date: 4/13/21

<u>Executive Summary:</u>

- Market Analysis
  - Price and Horsepower and Price and Weight both have strong positive correlations
  - Total Industry Quantity Sold and The Total Industry Revenue numbers have both recovered back to the level before the large dips both measures experienced between 2011 and 2014
  - Based on the Herfindahl-Hirschman Index metric, the European car market is becoming more competitive, which may be driving the increases in quantity sold and revenue.
    - Bodes well for Volkswagen when thinking of expanding more into Spanish market; people are buying more cars as competition has increased.
- Demand Estimation
  - Best model for estimating the price elasticity of demand is the cost instruments model that makes no theoretical assumptions and only uses the arithmetic method to determine elasticity of demand.
    - The model shows that the price elasticity of demand when using cost instruments to account for changes in prices due to changes in input cost of steel, without the theoretical assumptions, and using brand fixed-effects, is relatively elastic in the European car market.
    - This falls in line with the underlying economic concepts which say that the price elasticity of demand is more elastic in a competitive market since there are many substitutes.
      - According to Figure 3, the European Car Industry is a competitive market, which has gotten more competitive over the time period between 2009 and 2015
- Competitive Analysis
  - When comparing product elasticities of demand between Fiat, Volkswagen, BMW, Volvo, and Mitsubishi, Fiat leads the way with the product elasticity distribution between -1 and -2, with Volkwagen following in second with product elasticities between -2 and -3.
    - Fiat loses less in quantity sold when increasing in price.
  - Compact car types lead the way in product level elasticity of demand with elasticity distribution around -2.
  - When comparing product level margins in 2015 between Fiat, Volkswagen, BMW, Volvo, and Mitsubishi, Fiat leads the way with the highest margins. Mitsubishi and Volkswagen are close second.
    - Fiat has managed to increase their margins over time whereas Volkwagen has remained stagnant
- Mergers/Acquisitions
  - Merging with Honda, Mitsubishi, Saab, Suzuki, Subaru, or Ssangyang would not trigger an investigation by the EU.

Recommendation: Given the market trends and Volkswagen product elasticities in comparison to other automakers, it would be a good idea for Volkswagen to expand into the Spanish market. Volkswagen should focus on making Compact cars and Minivans that have high horsepower, and work on increasing their margins in a similar fashion to what Fiat has done. Merging/acquiring companies in the process shown in Figure 11, would steadily increase the profits Volkswagen sees over the next five years.

Market Analysis:
Price units and other variables derived from Price are in 10,000 2011 Euros

- Exploratory Data Summary - non indicator variables

	Quantity	Price	CO2	Weight	CC	HP	Revenue
count	2810.000000	2810.000000	2810.000000	2810.000000	2810.000000	2810.000000	2810.000000
mean	1980.273665	2.826167	152.116837	1434.574026	1853.032136	141.369395	4562.459181
std	3447.504869	1.370128	43.266684	318.035928	602.744561	57.190212	7795.971920
min	1.000000	0.581234	37.000000	753.213167	798.999998	45.000000	1.172472
25%	104.000000	1.823695	120.246786	1210.028282	1461.000023	103.171602	254.862875
50%	520.500000	2.533465	144.425445	1411.962966	1723.079684	132.651924	1258.817005
75%	2305.750000	3.479953	171.083923	1610.599224	2024.272912	163.979008	5218.270195
max	28614.000000	9.415248	373.450001	2583.000022	5749.400000	484.285719	69027.028727

- Variable Correlation Matrix - non indicator variables

	Quantity	Price	CO2	Weight	CC	HP	Revenue
Quantity	1.000000	-0.219009	-0.318461	-0.177292	-0.206681	-0.265653	0.951655
Price	-0.219009	1.000000	0.633456	0.840724	0.848670	0.924827	-0.092045
CO2	-0.318461	0.633456	1.000000	0.697953	0.797435	0.671333	-0.267964
Weight	-0.177292	0.840724	0.697953	1.000000	0.818240	0.778277	-0.044761
CC	-0.206681	0.848670	0.797435	0.818240	1.000000	0.867030	-0.109383
HP	-0.265653	0.924827	0.671333	0.778277	0.867030	1.000000	-0.168545
Revenue	0.951655	-0.092045	-0.267964	-0.044761	-0.109383	-0.168545	1.000000

The correlation table is used to get a preliminary view of how strongly related the non indicator variables are. The Revenue and Quantity variables of course have the strongest positive correlation since Revenue is determined using Quantity sold. Price and HP (Horsepower) also have a strong positive correlation, suggesting that Firms price cars higher the more horsepower it has.

Below are the key figures to observe when looking to understand the European car market from 2009 to 2015. Figure 1 and 2 suggest that over the 7 year time period the industry has been able to maintain a relatively plateaued amount of cars sold and revenue brought it. There was a large dip in both the quantity sold and revenue (understandable since the two variables are highly correlated) from 2011 to 2014. This is not a causational study, so the true cause of the dip in sales cannot be determined, but it can be inferred that the dip in sales came as the world wide economy shrank after the 2008-2010 financial crisis and so people bought less cars. However, it bodes well for the industry that the quantity sold and revenue both bounced back starting in 2014. The bounce back in sales of cars also coincides with the increase in industry competition as shown in Figure 3 using the Herfindahl-Hirschman Index Value as the metric used to determine industry competition. The trends in the Quantity Sold and Revenue bodes well for Volkswagen's

plans to expand more into the Spanish market; it's clear that people have started to buy more cars even as more competitors have entered the market and increased competition.

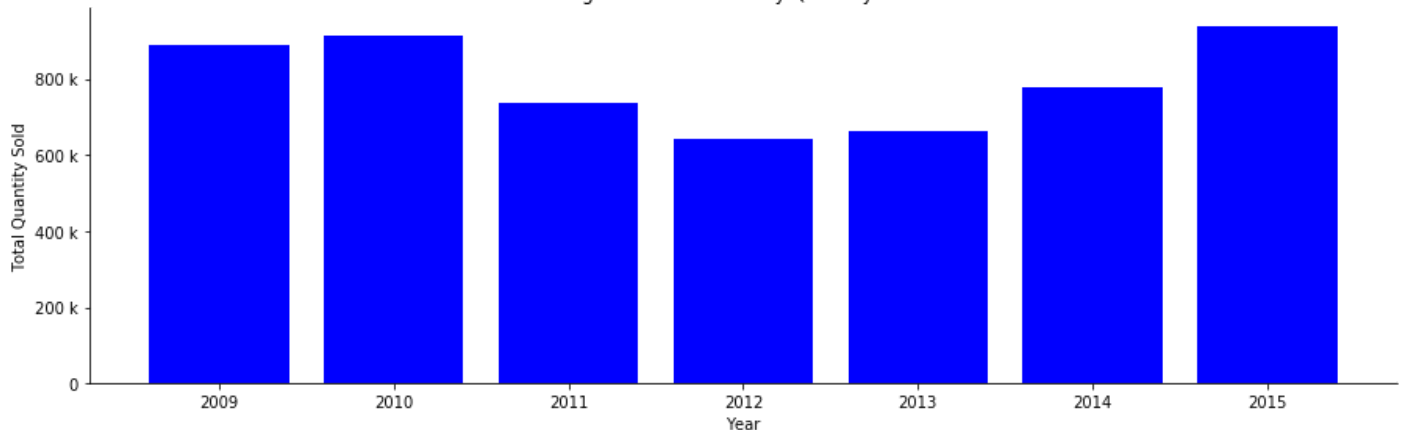Figure 1: Total Industry Quantity Sold

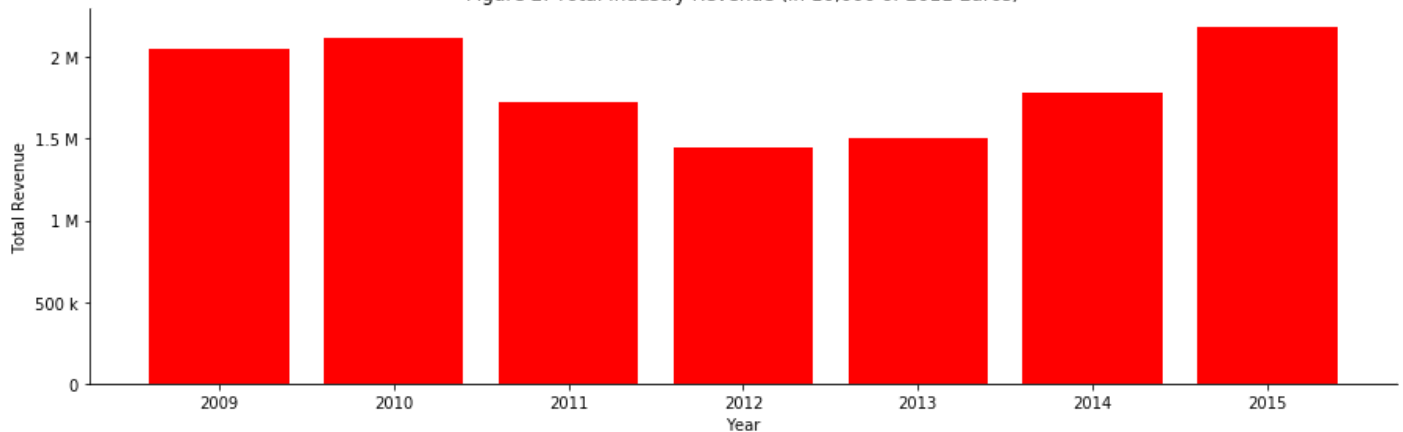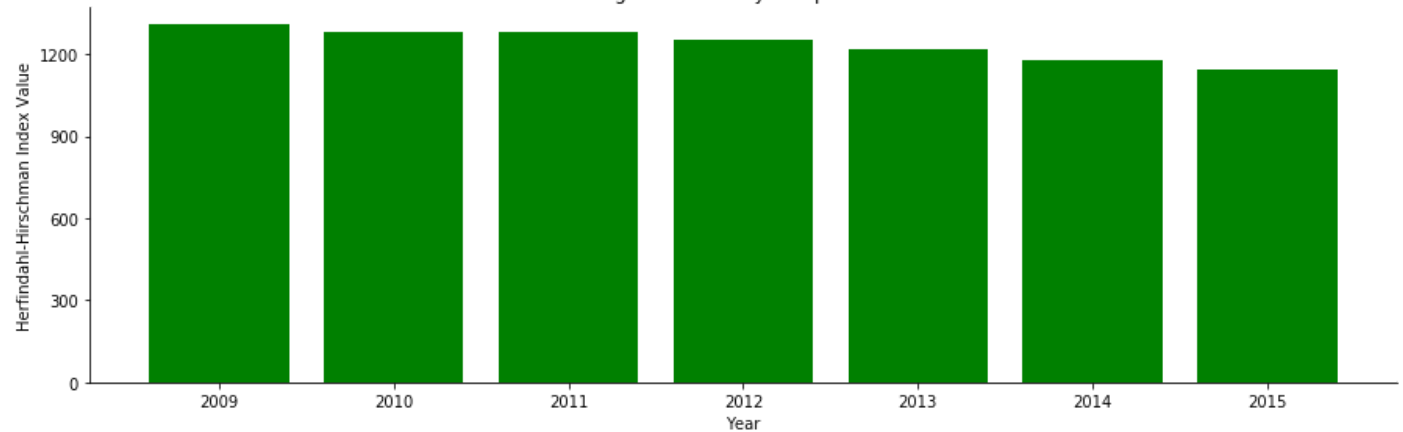Figure 2: Total Industry Revenue (in 10,000 of 2011 Euros)

Figure 3: Industry Competition

Demand Estimation:

Note: The coefficients in the table below show how much quantity units change by for every one unit increase in the independent variables (Price, HP_Weight, Diesel, Compact, etc.). For example, in the Instrumental Variables with Brand Fixed Effects model, quantity decreases by 0.9201 for every one unit increase in Price. This suggests that the price elasticity of demand for this model is relatively inelastic.

The table below shows various different models to determine the elasticity of demand.

The first three OLS models are theoretical models that were created with the assumption that 20% of people choose to buy a car each year, 15% of people choose to buy a car each year, and 10% of people choose to buy a car each year, respectively. These three OLS models have the same demand estimation, which shows a relatively inelastic demand elasticity (assuming 80%, 85% and 90% of people choose not to buy a car each year).

The next three models, using the same theoretical assumptions for how many consumers buy a car each year, includes brand fixed effects in the model. As can be seen in the table, once brand fixed effects are included, the demand elasticity estimation becomes less inelastic, although still relatively inelastic, than the models without brand fixed effects. The brand fixed effects models are more elastic than the original OLS models because certain brands are more inelastic than others, so they pull the overall model price elasticity towards being more inelastic in the models without the brand fixed effects. Once the brand fixed effects are included, it gives a slightly more realistic view of the overall industry price elasticity of demand since the brands themselves vary in their own price elasticity of demand.

Since it is known that the assumptions that were used for the OLS models do not account for the changes in demand as a result of price increases caused by changes in input costs, Instrumental Variables with Cost Instruments models are used. These models account for the changes in prices caused by changes in the input cost of Steel, which increases the Weight of the car (refer to the correlation table above to note that Price and Weight have a strong, positive correlation -- an increase in Weight is strongly correlated with an increase in Price). The Instrumental Model shows that price elasticity of demand is less inelastic than the OLS models, which don't account for the price increases as a result of the changes in cost of Steel. Additionally, when including brand fixed-effects in the cost instrument model, the price elasticity gets even close to being elastic. The distribution of the demand elasticities for this model can be seen in Figure 4.

Finally, the last two models use the arithmetic method to measure demand elasticity instead of the theoretical assumptions that 85% of people choose not to buy a car by converting the Price and Quantity variables to log scale, along with including the cost instruments. These two final models, which should be the ones used to somewhat accurately infer the price elasticity of demand in the market, because there are no theoretical assumptions and they include cost instruments. These last two models show that the price elasticity of demand is relatively elastic. The models show that for every one unit increase in Price, the Quantity sold falls by roughly 3.15 units. This falls in line with the underlying economics concept for the price elasticity of demand since it is known that in competitive markets (refer to Figure 3 to see the HHI Index values for the industry, which show that the European car industry is a competitive market) the price elasticity of demand is relatively elastic. There are many substitutes consumers can choose from so firms are price takers in the market. Figure 5 shows the difference in the distribution of elasticities between the cost instruments model and the OLS model. The cost instruments models are clearly more in line with what we would expect from a

competitive industry; even with brand fixed-effects, the OLS model clearly overestimates how inelastic the price elasticities of demand are.

	OLS_80	OLS_85	OLS_90	OLS_Brand_80	OLS_Brand_85	OLS_Brand_90	Instrumental_Variables	Instrumental_Variables_Brand	Instru_Vars_w/o_Theoretical	Instru_Vars_w/o_Theoretical_Brand
GR[T.1]	0.012352	0.012352	0.012352	0.005138938	0.005138938	0.005138938	-0.025589594	-0.016930171	-0.307025655	-0.296288
Price	-0.29657	-0.29657	-0.29657	-0.524090826	-0.524090826	-0.524090826	-0.867917395	-0.920137728	NA	NA
HP_Weight	-16.3992	-16.3992	-16.3992	-13.00532383	-13.00532383	-13.00532383	5.591981147	-0.557238284	7.634021386	-0.831382
Diesel	1.25906	1.25906	1.25906	1.383146934	1.383146934	1.383146934	1.639983608	1.595720903	1.852796138	1.779358
Compact	0.334048	0.334048	0.334048	0.143031092	0.143031092	0.143031092	0.464673254	0.175524216	1.104644979	0.836875
Large	-0.299	-0.299	-0.299	-0.315041036	-0.315041036	-0.315041036	0.024456001	-0.138785558	0.889237917	0.767563
Luxury	-0.65669	-0.65669	-0.65669	-0.779216843	-0.779216843	-0.779216843	-0.054600087	-0.482233953	0.735335406	0.379208
Minivan	-0.57484	-0.57484	-0.57484	-0.695284993	-0.695284993	-0.695284993	-0.073907706	-0.398600177	0.59735754	0.305837
SUV	-0.45568	-0.45568	-0.45568	-0.215650339	-0.215650339	-0.215650339	0.240452301	0.234869746	0.991985526	1.053854
np.log(Price)	NA	NA	NA	NA	NA	NA	NA	NA	-3.143597153	-3.327612

Figure 4: Distribution of Demand Elasticities (Instrumenting for Price and Brand Fixed-Effect)
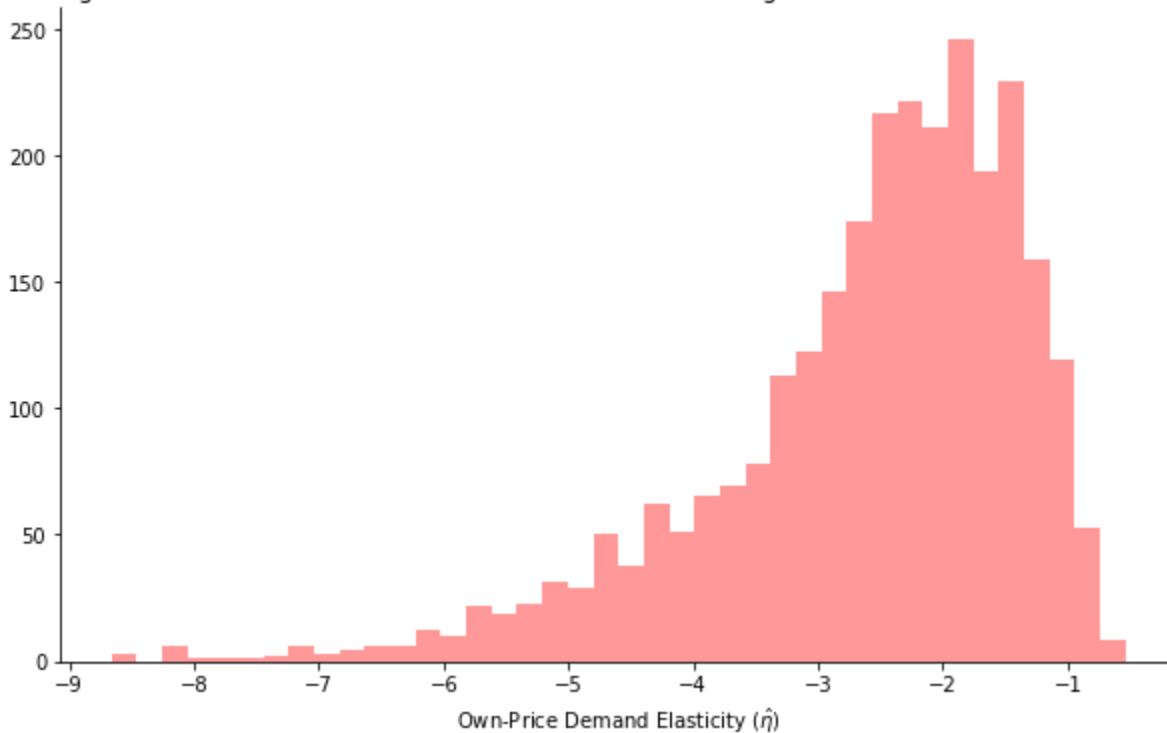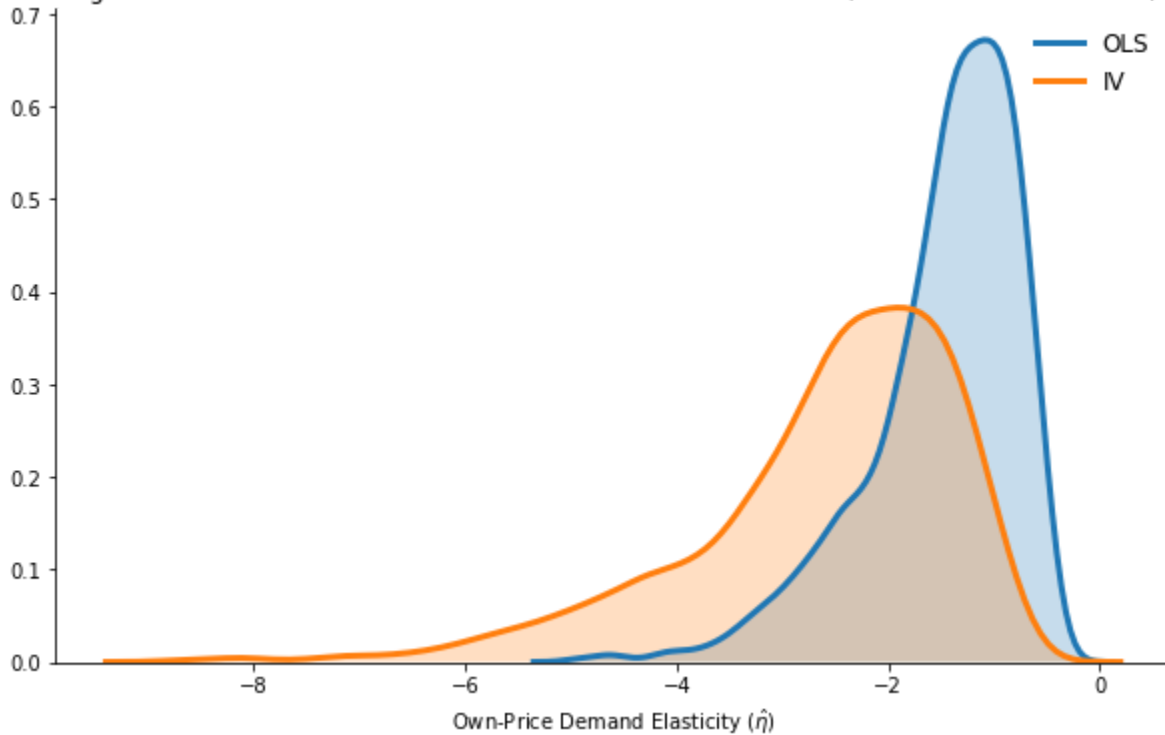
Figure 5: Distribution of Demand Elasticities Across Estimations (with Brand Fixed-Effects)

Competitive Analysis:

The firm to model after going forward for Volkswagen is Fiat. Based on Figure 7, it can clearly be seen that Fiat leads the way with price demand elasticity distribution. Fiat's distribution of price elasticity of demand is concentrated around -2, which suggests that most of the time they lose less in quantity sold when increasing prices compared to Volkswagen. Volkswagen comes in a close second along with Mitsubishi.

The dominance of Fiat among the automakers selected for this graph can be slightly explained by looking at the product elasticity across different segments in Figure 6. The compact car has most of its price elasticity of demand distribution around -2 as well (Fiat is well known for their Fiat Mini brand). Clearly the dominance of the Fiat compact cars is carrying its overall product elasticity of demand.

Additionally, Fiat also leads the way in product level margins in 2015 (refer to Figure 8). Based on Figures 9 and 10, it can be seen that Fiat has managed to slowly increase their product level margins over time, whereas Volkswagen has remained relatively constant.

If the decision to move further into the Spanish market is made, Volkswagen needs to follow in the pathway of Fiat. Volkswagen needs to focus on building and marketing small, Compact cars and Minivans rather than Luxury vehicles or SUVs to the Spanish market since Compact cars and Minivans both have more inelastic price elasticities of demand than the arithmetic and average elasticities. Additionally, there needs to be concerted effort made to start increasing the product level margins.

Figure 6: Product Elasticity Across Different Segments (Avg. price in 10,000 of 2011 euros)
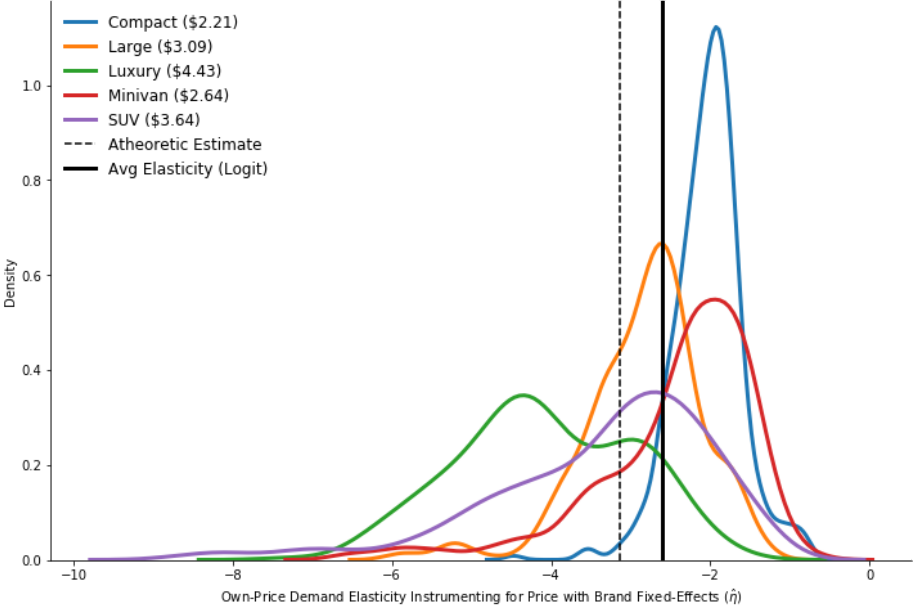

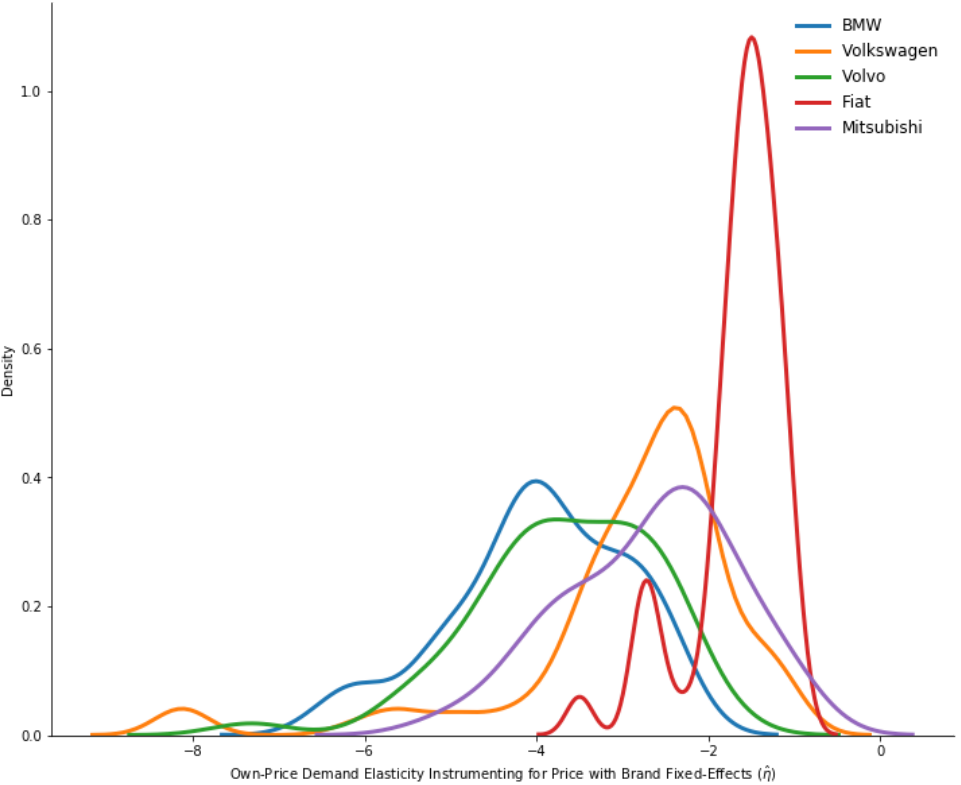Figure 7: Product Elasticity Across Different Automakers
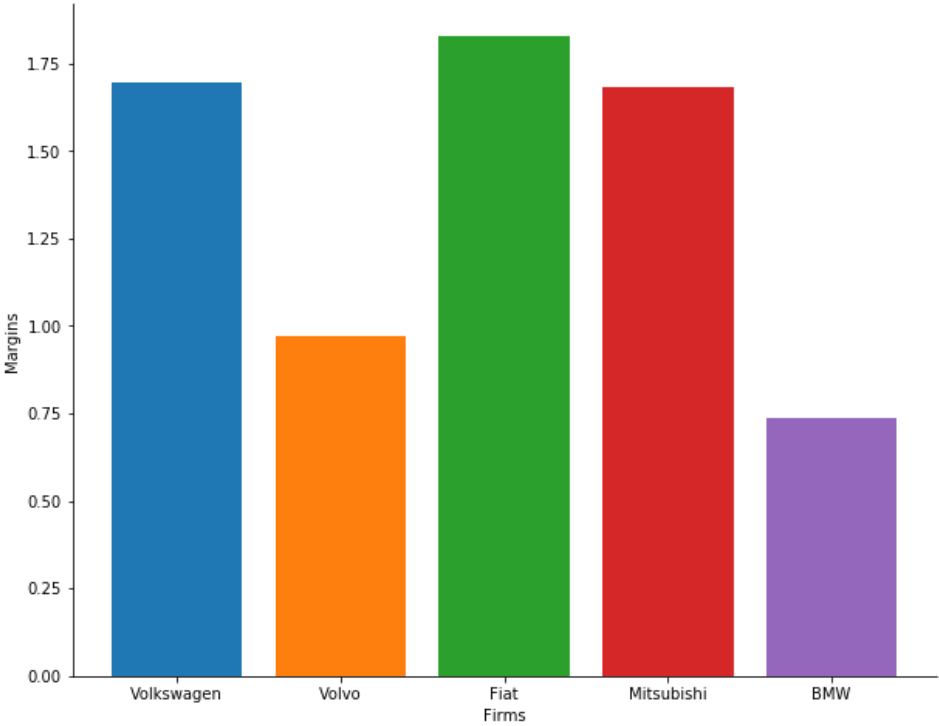
Figure 8: Product-Level Margins in 2015

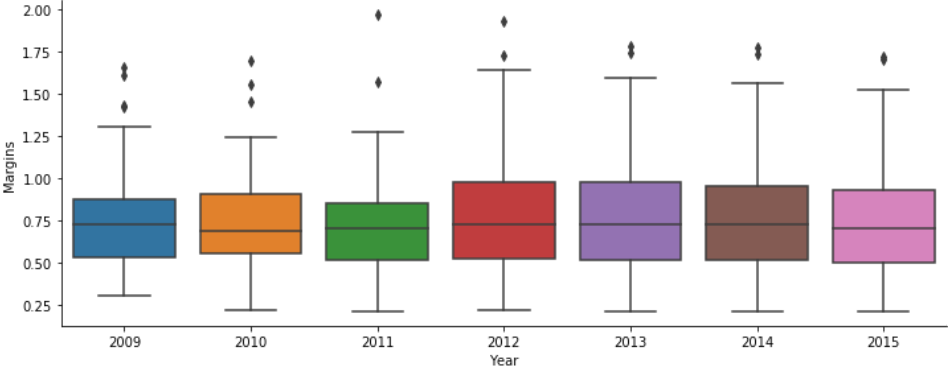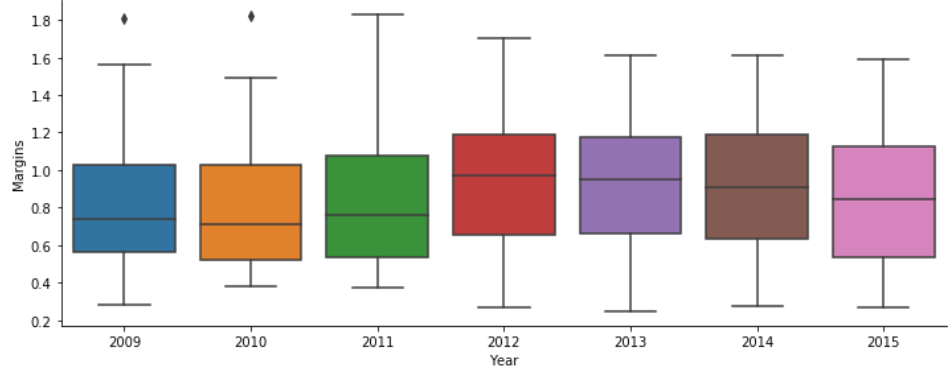Figure 9: Volkswagen Margins over Time

Figure 10: Fiat Margins over Time

Mergers/Acquisitions:

One of the ways for Volkswagen to increase their profits is by merging/acquiring another automaker and making their production process more efficient and decreasing their marginal costs. However, it is important to keep in mind that the EU has requirements that must be met in order for companies to be allowed to be merged/acquired.

Using the HHI index values as a measure of industry competition, the EU chooses not to investigate mergers/acquisitions between companies if the industry HHI is less than 1000, between 1000 and 1800 and the change in HHI after a merger/acquisition is less than 100, or if the HHI is greater than 1800 and the change in HHI after a merger/acquisition is less than 50.

Keeping these requirements in mind, the companies that Volkswagen can merge with/acquire without triggering an EU investigation are Honda, Mitsubishi, Saab, Suzuki, Subaru, and Ssangyong. One route Volkswagen can take in order to acquire/merge with these companies is by acquiring/merging with one of these companies at a time each year. Figure 11 shows the profit levels for Volkswagen if they chose to merge with Honda, then Mitsubishi, then Saab, then Suzuki, and finally Subaru, over the next five years. It is not a good idea to merge with more than one company at a time since this would make the change in HHI greater than 100, which would trigger an investigation by the EU.

Figure 11: Volkswagen Profits After Mergers Each Year After 2015