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Active investing in the automotive industry through market and fundamental approaches

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1. Introduction

The car manufacturing industry is entering into a new cycle. This decade could be a milestone for the whole industry. After more than a century developing more and more efficient mechanic motors, the car industry is preparing the future: the electric car. According to Helmers (2012), electric cars can serve as a suitable instrument towards a more sustainable future. Being increasingly concerned about environmental issues, individuals progressively change their way of living. They are aware that small actions may have a significant impact on earth's sustainability. Most of the largest car manufacturers identified the trend and massively invested in new technologies to prepare the future. Consequently, the demand in electric cars is awaited to grow at an exponential pace in the forthcoming years. Tesla is an example of the growing success of electric cars. The American car manufacturer intends to be a leader in the industry in the upcoming years. Founded in 2003, the brand launched in 2016 the new Tesla Model 3, which will be commercialized in 2017. Despite some technical uncertainties, 400,000 cars were already pre-ordered, illustrating the increasingly enthusiasm for affordable electric cars.

The aim of this paper is to capture benefits from the transition period the car manufacturing industry is currently facing. One needs to find out what are investors' feelings about the future of the automotive industry. Is it possible for an investor to reap benefits from those foreseen technological changes by building an active portfolio solely composed by car manufacturers? Defenders of the efficient market hypothesis would certainly give a negative answer. Indeed, according to the efficient market hypothesis, the available information is directly reflected in stock prices, meaning that active investing is not profitable. However, is the market really efficient ? The financial literature is divided on this point. Authors such as Clarke et al. (2001), strongly believe in market efficiency. On the other hand, Malkiel (2003) and Grossman & Stiglitz (1980) demonstrate the existence of market anomalies, meaning that active investors may capture excess returns from market inefficiencies. Typically, the existence of seasonality of returns, behavioural biases, etc. are evidences that are highlighted by some authors to reject the efficient market hypothesis.

By assuming an inefficiency of the markets, I develop two investment strategies, which

intend to capture excess returns. I analyse and estimate the fundamental value of six pre-selected car manufacturers: Volkswagen AG, Toyota Motor Company, General Motors, Ford Motor Company, Hyundai Motor Company and Peugeot S.A.

The first approach intends to isolate firms' stock mispricing by building a mean market neutral strategy. The systematic aspect of returns is modelled through a three-factors Fama and French model. By removing systematic risk, the only source of return relies on stocks' alpha (i.e. the mispricing of the stock). The final portfolio consists of long and short positions and is, on average, hedged against market movements. I also set a maximum idiosyncratic volatility threshold in order to avoid large movements within the portfolio.

The second approach analyses stocks' mispricing by directly focusing on fundamental characteristics. The financial literature largely covered the subject. I select two methods to analyse firms' characteristics. Firstly, I build a logistic regression based on lagged historical ratios. This model intends to predict the nature of next period's excess returns. Nevertheless, stock prices reflect investors' expectations about future financial performance. Using exclusively historical information is therefore not necessary suitable. The large time span between available information also limits the accuracy of such a model. This leads me to the second method I choose to estimate firms' intrinsic value. I forecast future returns based on discounted free cash-flow models. This method combines both historical and future figures. In fact, the DCF method suggests that the value of a firm is the sum of all the discounted future cash-flows. Despite a theoretical coherency, this method strongly relies on analysts' expectations and assumptions.

Both investment strategies intend to exploit security anomalies by capturing alternative sources of return than the benchmark and other related risk factors. In an active portfolio framework, the realized return strongly depends on the analyst ability to identify security-specific anomalies. Active investing strategies are riskier and more volatile than passive investing strategies. However, if the investor identifies good opportunities, returns may largely outperform passive investing strategies.

Finally, I compare the two investment strategies and show that both models agree to take large long positions on Asian car manufacturers (Toyota and Hyundai). Conversely, Ford Motor Company is shorted in both portfolios.

2. Theoretical framework

Every day, investors are screening the market, searching for unseen profit opportunities. Nevertheless, stock returns are extremely laborious to predict. Selecting the right stocks to invest in appears sometimes more as an art rather than a science. However, since the beginning of the twentieth century, investigations have been conducted in order to capture the drivers of stock returns. Countless theories and models have been developed in order to predict and model the behaviour of stock returns. The trade-off between return and risk plays a central role in financial economics (Kinnunen, 2013). An investor who takes additional risk will require a premium, reflected by higher expected returns. Therefore, returns may be expressed as a function of risk. With the asset capital pricing model, Merton (1973) is the first one to provide a model that links expected returns and risk. According to Chowdhry and Schwartz (2013), returns have an intrinsic and a global aspect. As returns are function of risk, the risk of a portfolio can be divided into those two components (Bodie et al., 2014).

$$\sigma^2(p) = \overbrace{\sum_{i=1}^{I} \beta_{p,i}^2 * \sigma_{F,i}^2}^{Systematic\ risk} + \underbrace{\sigma^2(e_p)}_{Idiosyncratic\ risk}$$

Risk is probably the biggest concern for most of investors who generally seek to mitigate risk. Hedging is a technique used in finance to reduce substantial gains or losses suffered by an investor. The first well-known concept used for hedging risk in finance is diversification. Investors can reduce risk by diversifying across asset classes (asset allocations). In our case, we are focusing on equities and developing an equity hedging strategy is imperative to mitigate risk within the portfolio. Investors developed several equity strategies that vary in returns and risk. One of the most common is the 130/30 strategy. It consists in going short in 30% of assets and going long on 130% of assets. This approach can be seen as an equity extension. Shorting 30% generates cash that can be used in the long position. However, this position is highly risky and may introduce idiosyncratic risk within the portfolio. Other investment strategies are often used by investors (long only, tactical beta, etc.). Those strategies present generally a high risk profile and are not always adequate in volatile markets (Reiner, 2014).

The car manufacturing industry displays stronger fluctuations than the economy-wide and the manufacturing businesses. The economic downturn of 2008 confirmed the historical volatility of the car manufacturing industry. The reduced demand in cars over that period has been magnified by a lack of access to credit, leading individuals to postpone their car purchases.

As the car manufacturing stocks are relatively sensitive to market movements, the first part of this paper is dedicated to the development of a systematic risk hedging strategy. Although the point is rarely discussed in the academic literature, shareholders may create value by reducing exposure against systematic risk (Chowdhry & Schwartz, 2013). Hedging the systematic risk is executed through a market neutral strategy. The market neutral strategy as defined by Valle et al. (2013) exhibits performance independent from that of an underlying market. Market neutral investment strategies are designed to exploit equity market inefficiencies. The market neutral strategy typically involves long and short positions within a same country or industry (Foerster et al., 2006). If such strategies are able to reap benefits from market inefficiencies, they should provide significant abnormal (or excess) returns.

The second part of the paper is devoted to the idiosyncratic analysis. Fama (1965) said that "*on the average, competition will cause the full effects of new information on intrinsic values to be reflected instantaneously in actual prices*". However, most of active investors believe they are able to select and identify equity mispricing and that they will outperform the benchmark. Active investors are trying to maximize alphas. From this point of view, active investors believe in the existing of market anomalies; rejecting the efficient market hypothesis. Those market anomalies seem however to disappear, reverse or attenuate (Schwert, 2003). In contrast, passive investors generally accept the efficiency of the market (Fuller, 2000).

For an active investor, a strategy based on equity mispricing could be profitable if he is able to identify unseen opportunities. The second part of the paper is therefore devoted to the establishment of a long/short investment strategy. The aim is here to take long positions on undervalued stocks and short positions on overvalued stocks. Fundamental analysis tries to identify the return drivers that are uncorrelated to the benchmark. While the market neutral strategy intends to generate abnormal returns through a risk factor approach, the fundamental-based investment strategy aims to capture excess returns by analysing intrinsic characteristics rather than risk factors. To conclude, the market neutral approach is a top-down approach whereas the fundamental analysis is a bottom-up approach.

2.1. **Systematic analysis**

Systematic risk can be defined as the exposure of a company to risk factors that are not specific to companies' intrinsic characteristics. Those risk factors influence all companies but not necessary in the same way. The point is here to determine which factors may have significant impact on the returns of individual companies. In a risk-factors model, excess returns are regressed on chosen economic risk loadings.

$$E(R) = \alpha_i + \sum_{i=1}^{I} \beta_i * F_i + \epsilon_i$$

Developing a portfolio hedged against systematic risk seeks to reduce overall portfolio risk and neutralizes broad market movements. We regard a portfolio with zero exposure to risk factors. The market neutral strategy relies on a combination of actively managed long and short positions. The main disadvantages of this strategy are the measurement of the systematic risk and the ability of the investor to neutralize market movements. Systematic risk can be measured towards empirical models such as the capital asset pricing model. In this model, expected returns are supposed to be solely driven by market excess returns. However, many other researches showed that stock returns are only partially affected by market premium. Different studies identified a myriad of risk-factors.

Other researches are also pledging against the validity of the capital asset pricing model. Indeed, some authors observed that the levered beta of a company is not necessary a return driver. Nowadays different studies have shown that a high beta does not necessary lead to higher returns. Fama and MacBeth (1973) and Black (1972) demonstrated that higher betas were not necessary associated with higher returns. Other authors even observed a negative correlation between those two variables. Frazzini and Pedersen (2013) developed the betting against beta strategy, which consists of short positions on high-beta stocks and long positions on low-beta stocks. This theory exhibited significant positive abnormal returns. Those different points of view do not aim to reconsider the efficacy of financials models. One needs just to keep in mind that stock prices are extremely complex to forecast. Risk-factors models do not fully capture excess returns' volatility. A significant part of stocks' excess returns is not explained by risk-factors models and is explained by fundamental characteristics, behavioural finance, etc. The risk-factor model is expected to capture only a fraction of total returns.

Despite countless theories and empirical analyses, one model exhibited significant results in different studies. In 1992, Fama and French developed a three-factors model aiming to model the systematic risk. This model is recognized in the whole financial literature and has frequently been used to measure excess returns. Conceptually speaking, the Fama and French three-factors model is simply an extension of the capital asset

pricing model. The authors, in addition to the risk premium factor, added two other risk loadings. The model consists of:

- *Risk Premium*: The return of a stock is proportional to the return observed on the market. It is the risk factor developed in the capital asset pricing model.
- *Small Minus Big (SMB)* : Risk factor that illustrates the frequent outperforming of small companies against larger. SMB measures the spread between small and large sized companies, which is based on the market capitalization of the firm.
- *High Minus Low (HML)* : Risk factor that illustrates the general outperforming of high book-to-value stocks compared to low book-to-value stocks. HML measures the spread in returns between value and growth stocks. The factor shows if an investor was relying on market inefficiencies to gain excess returns.

The Fama and French model is based on time-series and cross-sectional regressions. The results obtained by Fama and French were encouraging and much more significant than the outcomes obtained via the capital asset pricing model. The authors confirmed those results in another research conducted in 2012. For this reason, the systematic risk is modelled through the three-factors Fama and French model and the hedging strategy is based on the results provided by this model. The excess returns of the portfolio, solely composed by car manufacturers, are regressed on the three risk factors as indicated in the following equation:

$$E(R)_p = \sum_{i=1}^{I} w_i * \alpha_i + \sum_{i=1}^{I} w_i * \beta_{i,(R_m - R_f)} * (R_m - R_f) + \sum_{i=1}^{I} w_i * \beta_{i,SMB} * SMB + \sum_{i=1}^{I} w_i * \beta_{i,HML} * HML$$

Where w is the weight of stock i within the portfolio.

Active investors scour the market and try to maximize stoks' alphas. Alpha refers to returns derived from skilled active management that are uncorrelated with the market. This measure reflects market inefficiencies. Such a source of return is identified through fundamental analysis and aims to pick up stocks that outperform the benchmark (Litterman, 2005). A positive alpha means that the stock, based on the underlying analysis, should generate positive abnormal returns. This signals to the active investor that the stock is potentially undervalued and a long position should be adequate. The opposite is true for negative alphas. The stock is probably overvalued and the investor would go short on that specific stock. As the portfolio is neutral against the market, alphas are the only source of return. Measures of all risk loadings should not be significantly different from zero, meaning that there is no exposure to risk factors. The investment strategy can therefore be written as an optimization model.

$$MaxE(R)_p = \sum_{i=1}^{I} \alpha_i$$

$$u.c. \sum_{i=1}^{I} w_i * \beta_{i,(R_m - R_f)} * (R_m - R_f) + \sum_{i=1}^{I} w_i * \beta_{i,SMB} * SMB + \sum_{i=1}^{I} w_i * \beta_{i,HML} * HML = 0$$

Where w is the weight of stock i within the portfolio.

One needs to keep in mind that this kind of portfolio will never be fully hedged against market movements. Indeed, excess returns are regressed on historical information. The sensitivity of individual car manufacturers is subject to change over time, leading to changes in coefficient estimations. Consequently, an investor may never be fully protected against market movements.

Finally, the estimation of risk factors is conducted on individual stocks. In the financial literature, Blume (1970) aggregates stocks into portfolios to perform a factor model. According to him, betas are estimated with errors and aggregating stocks would diversify away this estimation error. However, Ang et al. (2010) empirically demonstrated that Bume's theory was wrong and that using individual stocks on a multi-factor model would not lead to higher estimation errors. Therefore, using individuals stocks to estimate Fama and French's risk loadings is also suitable and is applied in the empirical analysis.

2.2. **Fundamental analysis: logistic regression**

Idiosyncratic return is function of idiosyncratic risk, which can be defined as the stock sensitivity derived from fundamental characteristics. A change in dividends, margins, cash-flows, etc. might for instance be responsible of stock variations. If Grossman & Stiglitz (1980) market inefficiency theory is correct, information is not immediately integrated by investors and equities may be mispriced. Alpha investing strategies could be a generator of positive excess returns; rejecting Fama's market efficiency theory (1970).

Market anomalies can be identified through a fundamental analysis of stock prices. Based on past historical characteristics, an investor wishes to predict future excess returns. The investor will take long positions on stocks that are expected to generate positive excess returns in the future. Conversely, the investor will short the stocks that are expected to generate negative excess returns. One way to predict the nature of excess returns is to build a logistic regression.

The logistic regression is a model for dichotomous data. Excess returns are regressed on a set of control variables. The logit transformation computes the probabilities that the response variable belongs to a specific class.

$$log\frac{p(x)}{1-p(x)} = \beta_0 + \boldsymbol{\beta}\ \mathbf{x} \qquad \text{Where beta is a vector of regression coefficients.}$$

In our scenario, the response variable is the nature of the excess return. The stock is either expected to generate positive or negative returns. If the probability that the stock generates positive returns in the future is higher than 50%, the stock belongs to category 1 and 0 otherwise. The outcome of the response variable (y_i) can summarized as follow:

$$If \begin{cases} \text{Excess return} \geq 0 \rightarrow y_i = 1 & \forall i = 1, ...n \\ \text{Excess return} < 0 \rightarrow y_i = 0 & \forall i = 1, ...n \end{cases}$$

The outcome of the logistic regression is easily interpreted by the investor. If the response variable for an individual stock is one, the model forecasts positive excess returns in the future. In that case, the investor should go long on that stock. Conversely, if the response variable is zero, the investor should go short on the stock.

The logistic regression model is often estimated from individual data, using ordinary least square (OLS). The main issue of such a model is to identify fundamental variables

that could explain stock returns. If we suppose an equity mispricing, available information is not directly integrated by investors. Therefore, the fundamental state of a company does not immediately reflect the stock price. Lagged fundamental variables are therefore regressed on the response variable (whether an excess return is positive or not). The main uncertainty of the model goes on the selection of fundamental variables that would effectively affect stock returns. The methodology is established on a characteristic-based approach (the control variables). This model is quite flexible to the extent that many observable characteristics may be used to model the idiosyncratic component of returns.

The logit model contains variables of different natures : capital structure, margins, working capital, dividends, etc. Similar variables (e.g. EBITDA margin and EBIT margin) do not coexist in the model to avoid redundancy and I selected the most relevant ones. In order to choose the most pertinent variables, one needs to review the financial literature that covered the subject. Uncounted variables and ratios are potentially significant and only the most likely of them have been developed here below.

Leverage ratio: In a world without taxes, transaction costs (no costs associated with issuing new debt or equity) and agency costs, Modigliani & Miller (1958) showed that the capital structure of a company and thus its leverage, has no impact on the firm value. The value of the levered firm is the same as the value of the unlevered firm. If the return of an investment exceeds the WACC, the financial policy of the firm has no consequence. However, the assumptions of Modigliani and Miller's model are not realistic and further researches suppose the capital structure influences the value of the firm. Even if researches agree on the point that leverage impacts value, the sign of the relation stands unclear. The main finding of Graham (2000) assumes that debt has a positive impact on value since debt is tax deductible. In fact, Graham (2000) finds the average benefit of the tax deductibility of interest payments adds up to 9.7% of total market value. Korteweg (2010) finds also a positive relation between debt and value due to the tax shield. This finding is also supported by Van Binsbergen et al. (2010). However, adding debt up to a certain point destroys value, meaning that there is an optimum leverage level. Finally, according to Myers & Majluf (1984), in the spirit of the pecking order theory (that assumes an optimum leverage ratio), issuing equity is a bad signal. In fact, an equity issue may signal to investors that the stock is overvalued and therefore, in order to finance a new investment project, a company should preferably use financial slack or debt. Each firm that is momently far from its optimum leverage, whatever the reason, looks to adjust its leverage (Flannery & Rangan, 2006).

On the other side, a positive relation between leverage and value may appear as con-

ter intuitive. A higher level of debt could indicate that the firm encounters difficulties to find potential investors or that the firm has not enough financial slack to finance its activities. In that case, a negative relation between leverage and market value can be expected.

EBITDA: This is certainly one of the most relevant figure in a valuation process. EBITDA multiples (transaction or trading multiples) are extremely common to have a first insight on a company's fundamental value. EBITDA is an operational item where D&A have not been deducted as they are not cash outflows. EBITDA is therefore often used by analysts to make investment decisions. According to Persson and Stahlberg (2007), it is possible to outperform the market by investing in stocks that have been considered as undervalued through an EV[1]/EBITDA ratio analysis. A change in the EBITDA could therefore send a signal to shareholders.

Dividend payout ratio: Surprisingly, Fama and French (1998) identified a positive relationship between the dividend payout ratio and the value of a firm. This research presents counter-intuitive results to the extent that a higher payout ratio induces a lower perpetual growth, which is one of the main driver of a firm's terminal value. Therefore it might be interesting to observe what is the sign of the relation in the automotive industry.

Price-to-book ratio : Fama and French already pointed this variable as significant in their paper of 1992. This variable is also relatively intuitive. A low price too book value (e.g. <1) might suggest that the stock is undervalued. Value stocks (low price-to-book), may also signal a financial distress state. In such a case, the investment strategy highly relies on investor's personal expectations. Pessimistic investors may opt for a short-selling strategy even though those stocks are generally illiquid. On the other hand, a value-based trading strategy bets on the firm surviving financial distress and in case of success may generate high abnormal returns (Avramov & Zhou, 2010).

[1]Equity Value

Momentum: Financial literature largely investigated and analysed time-series patterns to find that momentum has a significant impact on stock price returns, meaning that a stock price behaviour can be explained by past information In fact, several theories do exist:

- *Short term reversals* (Lehmann, 1990). This strategy exploits the tendency of stocks with large gains or losses to reverse to the mean in a short-term frame.
- *Medium term continuation* (Jegadeesh & Titman, 1993). Buying winning stocks and sell losing stocks generate around 1% monthly return in the forthcoming years.
- *Long-term reversals or mean reversion* (DeBondt & Thaler, 1985). The object of this strategy is to buy portfolios made up of losers and sell portfolios made of winners of the past three to five years. De Bondt and Thaler attribute their finding to investor's overreaction.
- *Short-term momentum effect* (Carhart, 1997). The price of the security is more likely to keep moving in the same direction in a short-term frame. This concept is frequently used in technical analysis.

The financial literature already identified the impact of the momentum variable on stock returns. Nevertheless, we find myriad of contradicting theories. Consequently, it would be interesting to observe which theory is supported in the car manufacturing industry.

Capital Expenditures: Lev and Thiagrajan (1993) state that capital investments represent a fundamental signal for analysts that is useful for predicting future stock returns. Capital expenditures may appear as a price driver to the extent that a high level of capital expenditures may signal to investors that the company is seeking to expand its activities even though it reduces free cash-flows. Therefore, shareholder's wealth is expected to be positively correlated to capital spendings. The right level of investments is a real trade-off for a company manager. On the first side, he wants to generate sufficient cash-flows to ensure a good financial state. On the other side, too many cash flows signal a lack of involvement and real expansion strategy that may discourage investors.

Volume: The amount of traded stocks is also an indicator for an investor. Under information asymmetry, investors are only willing to buy a firm's stock at a discount (Warr et al., 2012) and information asymmetry is expected to be lower in high volumes trading days. In fact, trading volumes tend to generally increase after a press release and directly affect the price. In that case, higher trading volumes are linked to higher prices.

Nevertheless, a high trading volume may, in some cases, be the consequence of a financial crack or panic. Consequently, trading volumes would negatively be associated to values.

Finally, other variables such as security issuing are known to influence stock prices but are difficult to measure. Mikkeslon and Partch (1986) state that seasoned equity offerings (SEO's) induce significantly negative abnormal returns around their announcement dates. Bayless and Chaplinsky (1991) state that the expectations of security type that will be issued will also have an impact on abnormal returns.

An increasing number of variables would imply a growing complexity of the model. As a consequence, the model would fail to generalize the instances and there would be over-fitting within the model. In order to avoid such a phenomenon, the number of variables in the logistic regression is limited. A strong focus is given to the variables mentioned above.

Despite numerous researches that showed the impact of the mentioned variables, it is likely that the analysed characteristics will not be significant. Indeed, ratios are only available on a quarterly or annually basis, which limits the amount of information. Moreover, ratios are only a snapshot of reality. It is likely that published ratios hide the real financial wealth of the company. Window-dressing techniques are relatively common in financial statements publications and could therefore induce a misrepresentation of the reality. In such a case, one needs to develop an alternative way of estimating the fundamental value of car manufacturers. A classical alternative is the discounted free cash-flow model. In parallel to the logistic regression, a discounted free cash-flow analysis of each car manufacturer is performed. If the results of the logistic regression are not significant, the fundamental value estimated through the DCF models will be chosen to build the active investment strategy. The discounted free cash-flow method requires forecasts and assumptions, which are briefly discussed in the following section.

2.3. Fundamental analysis: DCF valuations

2.3.1. Introduction

All the valuations of the selected companies are based on similar assumptions in order to keep as much coherency as possible. The object of the discounted cash-flow model is to value the equity of a company in a going concern assumption (Jennergren, 2011). The equity value of a firm depends on its ability to generate future cash-flows. The forecast of those cash-flows requires an estimation of future P&L and balance sheets items. All the forecasts are base on a five years time frame and rely either on a corporate business plan or on market trends. Historical information is also used to predict the future. The historical financial information has been collected through different sources and databases: annual reports, Bloomberg, Capital IQ and Thomson One.

2.3.2. P&L forecast

Revenues

Revenues of each car manufacturer have been estimated through the foreseen number of cars sold until 2020 and the expected revenues per car sold. For most of car manufacturers, the high-level aspect of the business plan does not permit to establish a detailed forecast for each brand owned by the company. In that case, the total revenues has only been predicted on a high-level basis, derived from companies' expectations.

- **Expected number of cars sold**: The predicted number of cars sold is based on companies' internal information when available: annual reports, long-term strategy, specialized websites, etc. This information has, in certain cases, been completed with predicted growth on the segment the brand belongs to (passenger cars, motorcycles, luxury, trucks, etc.) or on the geographical market (Europe, APAC, America, etc.) the company operates in.

  Car manufacturers globally identified the same trends in the industry and most of them focus their high-level strategy on them. Three global opportunities are currently emerging.

  Firstly, the passenger cars market is awaited to soar in the Asian and Middle East market (especially China and India) in the forthcoming years. On the other side Western Europe's growth is predicted to not exceed 2% per year. Finally, US market is currently recovering, sales fell short of expectations in December 2015 and

are expected to pursue this trend in 2016 [2]. General Motors, Audi (Volkswagen's group) and Peugeot aim to reap benefits from these geographical opportunities.

Secondly, car manufacturers also targeted the luxury and premium segments. Hyundai launched a luxury brand (Genesis) to cover this increasing demand. Toyota ambitions to further develop its premium brand Lexus. Regarding European car manufacturers, Volkswagen intends to combine this trend with the recovering US market. Indeed, the German group aims to further develop its premium brand Audi in the US market. A few years ago, Peugeot already created its premium brand DS, which was formerly a model of its brand Citroen. Finally, concerning the American car manufacturers, General Motors launched a prestige Cadillac model in 2016. The whole luxury/premium segment is awaited to grow at a promising 6.67% CAGR until 2020[3].

Thirdly, the emerging demand for electric and hybrid cars is also an important opportunity -or threat- for the car manufacturers. Since a few years, the electric vehicles segment faces an exponential growth[4], which creates a promising new market for the whole industry. Nevertheless, car manufacturers should not wait to invest in the segment. History showed that a company should not rely on historical successful products but should continuously innovate to hold a predominant position in the market.

- **Expected revenues per car**: The revenue per car is relatively stable and is awaited to grow with the expected inflation rate (between 1% and 2% per year). The forecasted revenue per car sold is thus simply the last period revenue per car adjusted by the expected inflation.

When the expected cars sold and the foreseen revenues per car have been estimated, it is possible to forecast the revenues relative to the automotive section. Other sources of revenue such as financing activities have been considered as being proportional to the total activity of the firm. If the available information was not complete enough to build a complete business plan, the forecast of the revenues has been performed on a high-level basis.

[2]Source:www.reuters.com/article/us-usa-autos-idUSKBN0UJ1C620160105

[3]Source: Statista, own estimations

[4]Source:www.autosinsight.com/industry-trend-analysis-electric-vehicles-continue-exponential-growth-trend-jan-2016

Operational expenses

Operational expenses (opex) are linked to manufacturers' activities and are expected to be positively correlated to the total turnover.

- **Cost of goods sold (COGS)**: Cost of goods sold are proportional to sales. However, the gross margin is subject to convergence between weighted average cost of capital and return on invested capital. A plug is applied to the gross margin in order to ensure the convergence, impacting the level of cost of good sales.
- **Administrative Expenses**: Administrative expenses consist predominantly of the cost of employees. The number of employees working in the company is directly proportional to its level of activity and thus its revenues. Nevertheless, such as the cost of good sold, the administrative expenses are subject to the convergence between ROIC and WACC, meaning that the ratio of administrative expenses to revenues is not necessary stable.
- **Other operating result**: As this item is considered as an operating item, it has been linked with the company's activities: the revenues.
- **Taxes**: based on the average historical effective tax rate.

Financing items

All the financing items depend on the firm's capital structure. The main item in this section concerns the interest expenses (i.e. the interests a firm pays on its debt). According to Palepu (2013), "*net interest expense after tax can be calculated as the product of the average interest rates after taxes an the debt to capital ratio*". The estimation of future debt to capital ratio is thus pre-required to predict net interest expenses.

Other P&L items

Minority interests have been kept constant over time. Extraordinary items have either been considered as constant or null. The non-recurring aspect of extraordinary items does not allow an accurate forecast. We can not assume growth trends on those items. Therefore they have been kept constant or null over time.

2.3.3. **Balance sheet**

Working Capital

Change in net working capital is negatively proportional to cash-flows. It therefore has an impact on the final value of the firm. Working capital has core components but some items are sometimes added at the analyst's own discretion. In this paper, working capital is defined as follow:

	Inventories
+	Prepaid Expenses
+	Trade Receivables
+	Other current assets
−	Trade Payables
−	Accrued Expenses
−	Other current assets
=	Working Capital

As the working capital measures a gap between operational cash-in and cash-out, working capital items have been estimated in terms of days. A positive change in net working capital may correspond to providing credits to the firms' customer. In that case, the firm carries an increasing default risk as the time between receivables and payables increases. This means that a company pays its payables before recording receivables from its current activities. According to Tamari (1966), working capital ratios are good bankruptcy predictors. For instance, the ratio of current assets to current liabilities indicates the firm's ability to meet such liabilities. Nevertheless, a high or low current ratio strongly depends on the industry the company operates in. Relative working capital ratios are thus more relevant than absolute ratios to analyse the financial state of a firm. The main components of working capital have been estimated on the following basis.

- $Inventory\ days = \frac{Inventories}{COGS} * 365$
- $Trade\ receivable\ days = \frac{Trade\ receivables}{Turnover} * 365$
- $Trade\ payable\ days = \frac{Trade\ payables}{Turnover} * 365$

Future inventory, receivable and payable days have been kept constant over time. All the other current assets have been forecasted on a turnover basis (other current assets, other current liabilities, etc.)

Fixed assets

The book value of fixed assets is reduced by depreciations and amortizations. However, investments in properties, lands, plants, buildings, etc. increase fixed assets' book value. As a consequence, the relation between fixed assets, CAPEX and D&A can be depicted as follow:

$$Fixed\,assets_{(t)} = Fixed\,assets_{(t-1)} + CAPEX_{(t)} - D\&A_{(t)}$$

Depreciations have been forecasted on a turnover basis. CAPEX have been computed as being equal to depreciations plus a ratio of sales. Indeed, in a going-concern scenario, CAPEX are generally higher than depreciations to ensure the perpetual development of the company. Internal information was sometimes available on future investment strategies, forecasts, etc. This information has been taken into account when available. For instance, Volkswagen and Toyota both decided to cut into capital expenditures but not for the same reason. Volkswagen decided to reduce investments in order to free-up financial slack as a consequence to future fines. On the other hand, Toyota decided to decrease investments in the forthcoming years in order to generate more cash-flows.

Equity

Subscribed capital is maintained constant except if an increase in capital is planned. Retained earnings are proportional to last year's earnings, yearly net income and dividend payout ratio. The reported income is added to the retained earnings:

$$Retained\,earnings_{(t)} = Retained\,earnings_{(t-1)} + Net\ Income_{(t)} - Dividends_{(t)}$$

Historical dividend payout ratios have been estimated through this equation.

Provisions

Provisions are generally estimated as proportional to the revenues (e.g. provisions for pensions, taxes, etc.) except for extraordinary events. Volkswagen for instance is expected to largely increase its provisions due to fines coming from the American Government, which are currently estimated at about €9-10 bn[5]. Provisions can either be considered as being part of net financial debt or equity. The classification depends on the nature of the provision. Typically, a provision subject to interests is classified as net financial debt. All other provisions are considered as equity.

[5]Source: Bloomberg

Financial Debt

As stated by Graham (2000), Myers & Majluf (1984) and Korteweg (2010), an optimal leverage ratio does exist. All the manufacturers analysed are already mature companies and are expected to already be at their desired leverage ratio. Effectively, most of the companies have relatively stable historical leverage ratios and are predicted to be stable in the forthcoming years. As the level of equity has already been forecasted and knowing the leverage ratio, it is possible to estimate the financial debt (including short and long term financial liabilities). All the financial debt has been grouped and no distinction between short and long term financial debt has been made for the predicted financial statements. Net financial debt comprises all debts subject to interests, subtracted by the level of operational cash.

Finally, all the valuations are subject to the convergence between the return on invested capital and the weighted average cost of capital. When setting up a business plan, returns on invested capital are generally high. On a long term basis, the company is not able to generate such excess returns on investments. In a perpetual growth concern, the returns on invested capital gradually converge to investors' required return: the weighted average cost of capital. If such a method is not applied, the terminal value will be estimated on non-sustainable returns, which will, in most cases, lead to an exaggeration of firms' real value. The return on average capital is defined in this paper as the ratio of earnings after taxes before interests to invested capitals. Invested capitals consist of equity and financial debt.

2.4. Limitations

All main items being discussed, the DCF analysis of each manufacturer is later developed in order to gain some insight on manufacturers' current wealth and future perspectives. However, before starting the empirical work, it is important to keep in mind that DCF valuations are more an art than a science and that valuations might be extremely sensitive to inputs.

The main goal of DCF valuations is to determine the intrinsic value of a company. Based on this, an investor is able to take the most appropriate investment decision. However even tough the free cash-flow model seems relevant on a theoretical framework, it is not always an accurate predictive model in practice. The fundamental analysis does not capture all the drivers that impact a stock price. We discuss below a non-exhaustive list of factors that are not taken into account by the discounted free cash-flow model.

- **News and extraordinary events**: The DCF model assumes that the value of a company relies on its ability to generate operational free cash-flows. The Volkswagen case illustrates the weakness and the limitations of such a model. The German automotive leader is currently under the spotlight. Volkswagen will probably have to pay several billion euro fines in the forthcoming years due to the emissions scandal. As a consequence, the stock price of Volkswagen plummeted. However, this fine has no impact on operational free-cash flows (and thus on the enterprise value of Volkswagen) as the fine is considered as an extraordinary item.

  From another point of view, news provided by social media can also impact firm value. Through a research of Luo et al. (2013), it appeared that social-media based metrics (e.g. consumer reviews and ratings) are significant leading indicators of firm equity value. Therefore, company-specific news released on social media can have a significant impact on its return while the fundamental value of the company would remain unchanged.

- **Expectations and behavioural biases** The model offers an indication of the intrinsic theoretical value of the company but appears sometimes inaccurate to predict the future behaviour of a stock. The movements in the stock prices depend on investors' expectations. The decisions made by investors are often biased, which could increase the gap between the intrinsic value of the stock with the reality. According to Baker and Ricciardi (2014), investors display different biases that influence their decisions. For instance, Shefrin et al. (1985) observe that investors tend to sell outperforming stocks too early and keep "losers" too long in the portfolio. Therefore, the gap between the intrinsic value of a stock and the reality depends on biases, which can not all be modelled by an analytic model such as the discounted free-cash flow model or the logistic regression.

- **Inputs sensitivity and expectations**: The final result of the discounted free cash-flow model is highly sensitive to inputs changes. The weighted average cost of capital and the perpetual growth influence largely the output of the model. On the first side, the WACC is a weighted average of the cost of equity and the cost of debt. The cost of equity is determined through the Capital Asset Pricing Model. However, Fama and French (1992) demonstrated the lack of accuracy of the capital asset pricing model. According to their researches, a higher beta does not necessary lead to a higher return and the CAPM had a R^2 close to 0% to predict returns. Moreover, the estimation of the beta relies on historical data. Depending on the

time-span, analysts might have different levered beta, which could lead to different interpretations.

Finally, the perpetual growth seems correct in theory: the growth of the company will be proportional to the retained earnings and the return on equity. However, some economists are pledging for the end of growth. The world is not extensive, the perpetual growth is now more and more considered as a myth. Therefore, how a model can accurately perform if it is based on highly sensitive variables ? However, it does not exist a perfect model and the discounted free cash-flow is a suitable proxy.

2.5. **Conclusion**

The final goal of the market neutral and fundamental strategies is similar. By offsetting mean market risk in the Fama and French approach, the investors should have, on average, alphas as sole source of return. Alpha is a measure of stock mispricing. The market neutral strategy enables the investors to isolate the car manufacturers' alphas. In such a case, investors would take advantage of market inefficiencies. The second investment strategy takes its roots in the fundamental characteristics of the companies (discounted free cash-flow or logistic regression). The gap between the fundamental and the current value reflects market inefficiencies. The empirical section illustrates the positions an active investor should take to reap benefits from those market inefficiencies.

3. Empirical analysis

3.1. Systematic analysis

3.1.1. Data gathering

Car manufacturers' excess returns have been regressed individually on a Fama and French three-factors model in order to model the systematic risk. Historical excess returns have been collected on a monthly basis on the Thomson One database, from May 1996 to February 2016. For some car manufacturers, excess returns were not available for the whole period. In such a case, I gathered the largest available sample. Table 3.1 briefly describes the sample of selected data, where N is the size of the sample, $\overline{R}$ is the average monthly excess return, σ is the historical standard deviation and S is the skewness.

	N	$\overline{R}$	σ	S
Volkswagen	200	1.09%	0.11	-0.53
Toyota	238	0.49%	0.08	0.81
General Motors	63	0.12%	0.09	0.49
Ford	238	0.64%	0.14	3.06
Hyundai	195	1.39%	0.11	-0.16
Peugeot	238	0.45%	0.11	0.26

Table 3.1: *Descriptive summary of car manufacturers. Estimations based on monthly data collected on Thomson One, from May 1996 to February 2016*

All car manufacturers exhibit relatively similar performances. Average historical excess returns are all positive and are ranging from 0.12% to 1.39%. Despite their larger average excess returns, Volkswagen and Hyundai are the only two car manufacturers that present a negative skewness, meaning that there is greater-than-normal probability of big negative returns.

The sample size is relatively the same for each car manufacturer except for General Motors. As a consequence to the financial crisis, the U.S. government has nationalized the company from 2008 to 2010. In 2010, the group was listed again. The sample of General Motors contains thus data from 2010 to 2016, which explains the smaller dataset size.

Simultaneously, the Fama and French risk factors have been gathered through the Kenneth R. French data library on a monthly basis, from May 1996 to February 2016. The Kenneth R. French data library proposes continuously updated data for the risk factors identified by Fama and French. The risk factors are either available on a global or regional scale. Regional risk factors are available for Europe, Japan, Asia-Pacific and North America. The point is here to determine whether it is more relevant to use global or regional risk factors.

According to Griffin & Lemmon (2002), Fama and French factors are country specific rather than global. Regressions for portfolios and individual stocks indicate that domestic returns explain much more the variation in stock prices than global risk factors. The decomposition of risk factors into domestic components exhibits lower pricing errors. Therefore, it is more relevant to use regional risk factors. We use European risk factors for Volkswagen and Peugeot, North American factors for General Motors and Ford, Japanese factors for Toyota and Asian factors for Hyundai.

Finally, the three risk factors consist of the market premium ($R_m - R_f$), the small minus big effect (SMB) and the high minus low effect (HML) such as developed in the theoretical framework (cfr. 2.1). A short description of the regional risk factors is displayed in the Table 3.2.

	$(R_m - R_f)$	SMB	HML
Europe			
Mean	*0.49*	*0.06*	*0.36*
Standard deviation	*5.24*	*2.33*	*2.61*
Japan			
Mean	*-0.03*	*0.00*	*0.39*
Standard deviation	*5.24*	*3.14*	*2.94*
North America			
Mean	*0.54*	*0.05*	*0.27*
Standard deviation	*4.58*	*3.25*	*3.47*
Asia-Pacific			
Mean	*0.62*	*-0.12*	*0.60*
Standard deviation	*5.94*	*2.99*	*2.69*

Table 3.2: *Descriptive summary of Fama and French monthly risk factors from May 1996 to February 2016. Data collected on Kenneth R. French data library*

The market premium risk factor is positive for each region except for Japan. The average market excess return in Japan is close to zero, meaning that over the last twenty years, the Japanese market did not outperform the risk-free rate. The SMB risk-factor is relatively close to zero, meaning that on average, small firms did not necessary outperform

large companies. Finally, the sign of HML is positive, telling us that on average value stocks outperformed growth stocks over the last twenty years.

3.1.2. **Estimation of risk factor coefficients**

Data being collected, we can now run individual linear regressions of car manufacturers' excess return on the Fama and French three-factors model. We run a regression for each car manufacturer. We find a coefficient estimate for each risk factor (the betas) and an intercept (the alpha, the mispricing) for each regression.

The Table 3.3[1] displayed below illustrates the time-series regression of car manufacturers on the Fama and French three-factors model. The $(R_m - R_f)$ factor is significant at a 95% level for all car manufacturers. The capital asset pricing model probably identified the most important risk factor for excess returns. The sign of the relation is positive. When market returns are increasing, car manufacturers are positively influenced by those good market conditions. Outcomes of the two other factors added by Fama and French are much more variate. SMB is only significant at a 95% level of confidence for Toyota. For other companies, the p-value is relatively high, meaning that we fail to reject the null hypothesis (SMB significantly differs from zero). The sign of SMB for Toyota is negative. When large companies outperform small firms, it has a positive impact for Toyota. As Toyota is a large company, good market conditions for large companies is certainly positively affecting Toyota, which could explain the negative relation of SMB and excess return for Toyota Motor Corporation. Finally, HML is significant at a 95% confidence level for Volkswagen and Ford and at a 90% level for Peugeot S.A.. In each case, the sign of the relation is positive. This implies that value stocks (i.e. stocks that trade at a lower price than their fundamental value) tend to outperform growth stocks (overvalued stocks), which is the relation observed by Fama and French. Intercepts are non-significant. This could support the market efficiency theory which postulates that stocks are always fairly priced. Indeed, alphas equal to zero imply that excess returns are solely driven by the risk factors. However, we fail to reject the null hypothesis. As a consequence, we fail not make any conclusion about alphas. Moreover, R^2 are ranging from 11% (Hyundai) to 50% (General Motors). Only a low part of the variance is explained by the model. Other risk factors or characteristics may explain excess returns of car manufacturers. Market inefficiencies could also be a reason of the low R^2 of the risk-factor model.

[1] More details about individual regressions are available in Appendix 6.1.

	Intercept	$(R_m - R_f)$	SMB	HML
Volkswagen				
Estimates	$4.79 * 10^{-3}$	$9.54 * 10^{-3}$	$3.44 * 10^{-3}$	$7.24 * 10^{-3}$
Standard error	$7.10 * 10^{-3}$	$1.31 * 10^{-3}$	$3.15 * 10^{-3}$	$2.57 * 10^{-3}$
p-value	0.50	$7.13 * 10^{-12}$	0.91	$5.34 * 10^{-3}$
Significance	-	***	-	***
R^2	0.27			
Toyota				
Estimates	$5.30 * 10^{-3}$	$5.79 * 10^{-3}$	$-9.70 * 10^{-3}$	$-3.63 * 10^{-4}$
Standard error	$4.41 * 10^{-3}$	$8.49 * 10^{-4}$	$1.39 * 10^{-3}$	$1.51 * 10^{-3}$
p-value	0.23	$8.11 * 10^{-11}$	$3.36 * 10^{-11}$	0.81
Significance	-	***	***	-
R^2	0.29			
General Motors				
Estimates	$-1.00 * 10^{-2}$	$1.50 * 10^{-2}$	$5.17 * 10^{-3}$	$2.28 * 10^{-3}$
Standard error	$8.40 * 10^{-3}$	$2.40 * 10^{-3}$	$4.36 * 10^{-3}$	$4.09 * 10^{-3}$
p-value	0.22	$3.16 * 10^{-8}$	0.24	0.58
Significance	-	***	-	-
R^2	0.50			
Ford				
Estimates	$-5.35 * 10^{-3}$	$1.72 * 10^{-2}$	$7.53 * 10^{-3}$	$9.40 * 10^{-3}$
Standard error	$7.82 * 10^{-3}$	$1.76 * 10^{-3}$	$2.58 * 10^{-3}$	$2.40 * 10^{-3}$
p-value	0.49	$2 * 10^{-16}$	0.77	$1.2 * 10^{-4}$
Significance	-	***	-	***
R^2	0.31			
Hyundai				
Estimates	$8.32 * 10^{-3}$	$6.29 * 10^{-3}$	$-5.38 * 10^{-4}$	$2.73 * 10^{-3}$
Standard error	$7.63 * 10^{-3}$	$1.28 * 10^{-3}$	$2.53 * 10^{-3}$	$2.79 * 10^{-3}$
p-value	0.28	$2.01 * 10^{-6}$	0.83	0.33
Significance	-	***	-	-
R^2	0.11			
Peugeot S.A.				
Estimates	$-2.12 * 10^{-4}$	$1.03 * 10^{-2}$	$2.72 * 10^{-3}$	$4.00 * 10^{-3}$
Standard error	$6.03 * 10^{-3}$	$1.17 * 10^{-3}$	$2.60 * 10^{-3}$	$2.34 * 10^{-3}$
p-value	0.72	$3.03 * 10^{-16}$	0.29	0.09
Significance	-	***	-	.
R^2	0.28			

Table 3.3: *Fama and French three-factors model on car manufacturers. Significance codes: '-' >0.10, '.' <0.10, '*' <0.05, '**' <0.01, '***' <0.001. Monthly data from 1996 to 2016 collected on Kenneth R. French data library (for the risk factors) and Thomson One (for the excess returns)*

To conclude, we observe that the factors identified by Fama and French are in general significant, except for the SMB risk factor. Market premium is the principal individual excess return driver. It has a positive relation with individual excess return as well as HML risk loading.

3.1.3. **Market neutral strategy**

The systematic risk being modelled, it is now possible to build a market neutral investment strategy. The optimal weighting of the portfolio is executed through Excel's Solver. The optimization model aims to maximize the excess returns while keeping the systematic risk equal to zero (cfr 1.1). This is equivalent to maximize the intercepts provided by the Fama and French model. In order to slightly benefit from diversification effects, the model will require to invest in each car manufacturer.

$$w_i \neq 0 \quad \forall i = 1, ...n$$

Where w is the weight of stock i within the portfolio.

The portfolio is not fully diversified as the companies are all operating in the same industry and only six car manufacturers are taken into account. Indeed, according to Statman (1987), a well-diversified portfolio must include at least between 30 and 40 randomly chosen stocks. Xu (2003) postulates that one needs to hold 20 stocks to diversify away 90% of the idiosyncratic risk[2]. In our case, the portfolio won't be well-diversified but holding six stocks within the same portfolio partially remove idiosyncratic risk.

Finally, long positions are limited to 100% of the total investment. In fact, as short-selling is allowed in the model, an investor could take a position higher than 100% of its total investment. This constraint limits large positions on a specific stock. As a consequence, this avoids large variances in individual expected returns.

According to Engelberg et al. (2014), short-selling is more risky than long positions. Indeed, short sellers face margin calls. When stocks increase above a determined threshold, the borrower must deposit a margin on a separate account in order to ensure the reimbursement of the borrowed funds. However, in some cases, the stock raises above a certain level and the borrower is not able to redeem his stocks. D'Avolio (2002) estimates that approximately 2% of borrowed stocks are recalled in any month because of reimbursement difficulties. As a consequence, short selling positions are limited to -50% of total investment. Eventually, two other constraints are added to the existing model.

$$\sum_{i=1}^{I} w_i = 1$$

$$-0.50 \leq w_i \leq 1 \quad \forall i = 1, ...n$$

The first constraint reflects that the weight of the portfolio should be equal to 100%. The second constraint refers to the limits in the size of investing positions, detailed above.

[2]Analysis conducted on the Shanghai Stock Exchange

Finally, investors generally seek to minimize the idiosyncratic risk of their portfolios. The portfolio consists of companies operating within the same industry. Firms are direct competitors. Their returns are awaited to be positively correlated. In that case, a combination of long and short positions could potentially offset idiosyncratic volatility in the portfolio, which can be expressed as follow.

$$\sigma^2(e)_p = \sum_{i=1}^{I} w_i^2 * \sigma_i^2 + \sum_{i=1}^{I} \sum_{j=1}^{J} Cov(i,j) * w_i * w_j \quad \forall i \neq j$$

Which is equivalent to

$$\sigma^2(e)_p = \sum_{i=1}^{I} w_i^2 * \sigma_i^2 + \sum_{i=1}^{I} \sum_{j=1}^{J} \rho_{i,j} * w_i * w_j * \sigma_i * \sigma_j \quad \forall i \neq j$$

The whole optimization process can be summarized as follow.

$$Max \sum_{i=1}^{I} E(R)_i$$

$$u.c. \sum_{i=1}^{I} w_i * \beta_{i,(R_m - R_f)} * (R_m - R_f) + \sum_{i=1}^{I} w_i * \beta_{i,SMB} * SMB + \sum_{i=1}^{I} w_i * \beta_{i,HML} * HML = 0$$

$$\sigma^2(e)_p = \sum_{i=1}^{I} w_i^2 * \sigma_i^2 + \sum_{i=1}^{I} \sum_{j=1}^{J} Cov(i,j) * w_i * w_j = 0 \quad \forall i \neq j$$

$$-0.50 \leq w_i \leq 1 \quad \forall i = 1, ...n$$

$$\sum_{i=1}^{I} w_i = 1$$

Now that the optimization process has been developed, one needs to estimate the correlation matrix. The matrix has been estimated by using monthly historical excess returns from 1996 to 2016. The information has been collected on Thomson One, and the correlation matrix is depicted on Table 3.4.

	Ford	General Motors	Hyundai	Peugeot S.A.	Toyota	Volkswagen
Ford	1	0.22	0.27	0.13	0.30	0.31
General Motors	0.22	1	0.03	0.08	0.19	0.28
Hyundai	0.27	0.03	1	-0.07	0.15	0.33
Peugeot S.A.	0.13	0.08	-0.07	1	0.06	0.10
Toyota	0.30	0.19	0.15	0.06	1	0.27
Volkswagen	0.31	0.28	0.33	0.10	0.27	1

Table 3.4: *Car manufacturers correlation matrix. Estimation based on monthly excess returns from May 1996 to February 2016, collected on Thomson One*

We observe a general positive correlation in stock returns between car manufacturers. Strangely enough, companies operating in the same geographical region do not seem to be more correlated than with other companies. However, we observe that larger car manufacturers (Volkswagen, Toyota, General Motors and Ford) present higher correlations while the two smallest manufacturers present lower correlation with their competitors.

The optimization process can now be run with out-of-sample data. The optimum portfolio is built with the Fama and French risk factors of March 2016. Those risk factors have been collected on the Kenneth R. French data library. Based on the results of the individual regressions (cfr 3.1.2), we can run the optimization process though Solver's Excel.

Table 3.5 finally exhibits the optimum portfolio an investor should hold for March 2016, based on the constraints mentioned above. We observe that long positions are only taken on stocks that present positive intercepts (alphas). The largest long position is taken on the stock which presents the largest mispricing: Hyundai. The other long positions are taken on Toyota and Volkswagen. Short positions are taken on stocks that present negative intercepts (alphas): General Motors, Ford and Peugeot. Globally, all risk factors were positive in March 2016. The optimum portfolio is on average hedged against market movements, meaning that we can not benefit from those good market conditions and the investor solely relies on market inefficiencies.

	Intercept	$(R_m - R_f)$	SMB	HML
Volkswagen				
Estimates	$4.79 * 10^{-3}$	$9.54 * 10^{-3}$	$3.44 * 10^{-3}$	$7.24 * 10^{-3}$
Risk factors		6.74	1.70	1.16
Weight	40%			
Toyota				
Estimates	$5.30 * 10^{-3}$	$5.79 * 10^{-3}$	$-9.70 * 10^{-3}$	$-3.63 * 10^{-4}$
Risk factors		4.81	3.40	−2.20
Weight	52%			
General Motors				
Estimates	$-1.00 * 10^{-2}$	$1.50 * 10^{-2}$	$5.17 * 10^{-3}$	$2.28 * 10^{-3}$
Risk factors		7.00	1.05	2.11
Weight	-5%			
Ford				
Estimates	$-5.35 * 10^{-3}$	$1.72 * 10^{-2}$	$7.53 * 10^{-3}$	$9.40 * 10^{-3}$
Risk factors		7.00	1.05	2.11
Weight	-41%			
Hyundai				
Estimates	$8.32 * 10^{-3}$	$6.29 * 10^{-3}$	$-5.38 * 10^{-4}$	$2.73 * 10^{-3}$
Risk factors		10.47	−2.80	2.22
Weight	100%			
Peugeot S.A.				
Estimates	$-2.12 * 10^{-4}$	$1.03 * 10^{-2}$	$2.72 * 10^{-3}$	$4.00 * 10^{-3}$
Risk factors		6.74	1.70	1.16
Weight	-46%			
$E(R)_p$	1.67%			

Table 3.5: *Optimal mean market neutral portfolio. March 2016 risk factors. Data collected on Kenneth R. French data library*

The portfolio exhibited in the Table 3.5 is also protected against idiosyncratic volatility. An investor who likes gambling might be tempted to increase the idiosyncratic volatility within the portfolio in order to expect larger returns. One needs to keep in mind that a modification of the idiosyncratic constraint might imply a portfolio rebalancing in the optimization process.

We created a mean neutral market portfolio hedged against idiosyncratic volatility. This portfolio is expected to generate a monthly return of 1.67%. However, all the estimations have computed with historical data. Volatilities and correlations are therefore not constant, meaning that our portfolio is in practice not fully hedged against idiosyncratic volatility.

We have built a portfolio that captured stocks' alphas by modelling the systematic risk. The second part of the paper also aims to build an optimal portfolio by identifying market inefficiencies. However, instead of a market approach, we adopt in this second part a fundamental approach.

3.2. Logistic regression on fundamental variables

3.2.1. Model

With the increasing availability of information, investors are interested in predicting stocks. Such as discussed in the theoretical framework (cfr. 2.2), the logistic regression is used to discriminate positive from negative excess returns. The outcome of the logistic regression is a simple tool for investors to identify mispriced stocks. If the response variable is one, the excess return is expected to be positive during the next period and the investor should go long on that stock.

The choice of control variables on which excess returns are regressed has already been developed in the theoretical framework. The logistic regression contains relative variables that measure leverage, EBITDA, dividends, volume, investments level, equity mispricing and momentum.

- **Leverage**: It exists a myriad of ratios that estimate the leverage. In our case, the debt-to-equity ratio has been selected as a proxy to measure the leverage, it is measured as: $Debt - to - Equity = \frac{Total\ Debt}{Total\ Equity}$. It is a continuous variable.

- **EBITDA**: Earnings before interests, taxes and D&A directly reflect the firm operational activities and its multiple is often used to have some insight about the value of a firm. In December 2015, automotive manufacturers' enterprise value were worth on average 8.3x the EBITDA [3]. It is a continuous variable expressed as a percentage of sales.

- **Dividends**: Dividends are not paid every quarter. They are generalized as a categorical variable equal to 1 if dividends have been paid and 0 otherwise. Note that some car manufacturers did not pay dividends over the analysed period. In that case, the impact of the dividend variable could not be measured.

- **Volume**: This variables measures the number of shares traded over the period. It is a continuous variable.

- **Momentum**: The theoretical framework illustrated the different existing theories that analysed the momentum effect. Last period excess return serves as a proxy to measure the momentum effect in the logistic regression: $Momentum = Excess\ Return_{t-1}$. It is a continuous variable.

[3] Source: PwC Automotive Valuation Quarterly Update Q4 2015

- **Investments**: The level of investment is measured through capital expenditures, which include investments in tangible and intangible fixed assets. Investments in tangible assets refer to investments in plants, land, properties, etc. On the other hand, capital expenditures in intangible assets refer to investments in patents, brands, etc. It is a continuous variable expressed as a percentage of sales.

- **Mispricing**: The mispricing of a stock is measured in this model by the price-to-book ratio. A low price-to-book ratio (<1) indicates that the price is currently quoting below its book value, which could indicate an undervaluation of the stock. Conversely, a high price-to-book ratio suggests that the stock is currently overvalued. The price-to-book ratio is defined as $\frac{Share\ Price}{BookValue/Share}$. It is a continuous variable.

As this section focuses on the fundamental analysis, we deliberately omit macroeconomic variables (e.g. market premium, interest rates, etc.). The purpose of the logistic regression is to predict whether an excess return will be positive or negative for next period. For this reason, excess returns are regressed on lagged control variables. We use relative measures rather than absolute values. We want the variables to be on a same scale. Finally, the logistic regression can be summarized with the following equation.

$$y_{t+1} = \beta_0 + \beta_1 * \frac{\delta Volume_t}{Volume_{t-1}} + \beta_2 * \frac{\delta Capex_t}{Capex_{t-1}} + \beta_3 * \frac{\delta EBITDA_t}{EBITDA_{t-1}} + \beta_4 * \frac{\delta Leverage_t}{Leverage_{t-1}} + \beta_5 * \frac{\delta Momentum_t}{Momentum_{t-1}} + \beta_6 * Dividends_{t-1} + \epsilon_{t+1}$$

The model being constructed, one needs now to collect the information necessary to run the logistic regression.

3.2.2. Data collection and description

The excess returns and the control variables have been collected on Capital IQ and Thomson One on a quarterly basis or on an annually basis if quarterly reports were not available. The sample has been collected from 1987 to 2016. All the control variables are continuous except dividends which is a categorical variable. Those continuous variables are shortly described in Table 3.6. N corresponds to the size of the sample. Leverage is the debt to equity ratio, EBITDA is the EBITDA margin, Capex is the ratio of capital expenditures to sales, Price/book is the price-to-book ratio and volume is the monthly amount of traded shares.

	N	Leverage	EBITDA	Capex	Price/book	Volume
Volkswagen	64	1.26	10.48%	7.41%	0.89	1,105.47m
Toyota	30	0.75	12.15%	6.01%	1.43	156.58m
General Motors	21	0.76	7.75%	7.13%	1.45	303.21m
Ford	89	8.87	9.97%	5.11%	2.42	594.04m
Hyundai	24	0.98	11.10%	4.31%	0.70	101.24m
Peugeot	72	2.06	6.79%	4.08%	0.40	97.14m

Table 3.6: *Average value of the control variables used in the logistic regression. Data collected on Thomson One and Capital IQ from 1987 to 2016, on a quarterly basis*

The Table 3.6. exhibits the average value of the control variables for each car manufacturer. Firstly, the size of the dataset is relatively limited, which can limit the accuracy of the regression. For Toyota, only annual figures were available. Data for General Motors was available only starting of 2010, the year of its re-entering on the stock exchange. Data for Hyundai Motor Company was only available on a quarterly basis starting of March 2010. The lack of data availability explains the differences in dataset sizes.

We observe that most of car manufacturers present a leverage ratio close to 1. However, we also observe that Ford Motor Company is mainly financed with debt and exhibits a leveraga ratio of 8.87. In the future, Ford expects to slightly decrease its leverage by restructuring its activities.

Capital expenditures represent a larger share of total revenues for bigger car manufacturers (Volkswagen, Toyota and General Motors) than for smaller car manufacturers (Ford, Hyundai and Peugeot). Asian car manufacturers enjoy larger operating margins than their competitors. Firms that encountered financial difficulties over the last years (i.e. General Motors and Peugeot) exhibit lower operating margins.

European car manufacturers (Volkswagen and Peugeot) historically behavioured as value stock (on average, the price-to-book ratio was below one), while American car manufacturers exhibit an average historical price-to-book ratio above than one.

Finally, we observe a high liquidity of Volkswagen's stocks, which is partially due to the cornering the group faced between 2007 and 2010. Porsche cornered the market in shares of Volkswagen, which briefly saw Volkswagen to become the largest market capitalization in the world. As a consequence, volumes largely increased over that period, explaining the high average of traded shares. American car manufacturers appear as more liquid than Asian manufacturers. Peugeot, which is the smallest car manufacturer of the selected group is the less liquid stock.

3.2.3. **Estimations**

The model being exposed and ratios estimated, we can run the logistic regression through R Commander. We observe in Table 3.7 that the logistic regression failed to provide significant information. Variables are not significant at a 95% confidence level.

Ratios are computed on a quarterly (or annually) basis and the long time span between estimations is probably one explanation of the weakness of the model. Ratios are only snapshots of the reality and do not capture the continuity of operations. The model does not take into account events that took place between two quarters or between two years. It only captures information at the end of the period.

Moreover, most of the car manufacturers are already mature companies. Ratios such as leverage or EBITDA do not change substantially between two quarters while the stock price may face large movements. The stability of the selected set of variables is probably another reason of the model weakness.

In addition to that, as we focus on fundamental variables, the model does not take macroeconomic conditions into account. As shown in the systematic risk section, returns are driven by market conditions. Despite positive performances, the return of a stock could be completely absorbed by market conditions. Therefore, intrinsic characteristics would fail to explain poor stock excess returns.

Finally, stock prices reflect investors' future expectations about the company. These expectations are sometimes subject to behavioural biases that are not reflected in intrinsic characteristics. Ratios are based on historical figures and do not capture investors' future expectations.

All these elements explain the reason why the logistic regression failed to predict the nature of future excess returns (whether positive or negative).

	VW	Toyota	GM	Ford	Hyundai	Peugeot
Intercept						
Estimates	-0.55	0.41	-0.60	0.06	0.32	0.10
p-value	0.57	0.49	0.46	0.79	0.52	0.73
Significance	-	-	-	-	-	-
Volume						
Estimates	0.04	-0.85	3.69	-0.59	-0.71	-0.17
p-value	0.92	0.56	0.21	0.36	0.44	0.78
Significance	-	-	-	-	-	-
Capex						
Estimates	-0.08	-0.32	-0.38	-0.06	-0.12	0.20
p-value	0.40	0.36	0.28	0.19	0.22	0.35
Significance	-	-	-	-	-	-
EBITDA						
Estimates	0.002	0.18	0.10	-0.17	0.11	-0.12
p-value	0.95	0.24	0.38	0.08	0.27	0.40
Significance	-	-	-	-	-	-
Leverage						
Estimates	0.13	-4.96	8.77	1.05	-3.11	-2.05
p-value	0.92	0.26	0.19	0.29	0.30	0.32
Significance	-	-	-	-	-	-
Momentum						
Estimates	-1.37	-0.69	-4.84	-0.47	-0.66	-0.12
p-value	0.26	0.71	0.25	0.64	0.61	0.87
Significance	-	-	-	-	-	-
Dividends						
Estimates	1.13	-0.31	NA	0.53	-0.28	NA
p-value	0.25	0.49	NA	0.38	0.45	NA
Significance	-	-	-	-	-	-
Price-to-book						
Estimates	0.03	-0.21	-0.68	-0.03	-0.44	-0.01
p-value	0.31	0.20	0.43	0.78	0.33	0.71
Significance	-	-	-	-	-	-

Table 3.7: *Logistic regression on car manufacturers. Data collected on Capital IQ and Thomson One from 1986 to 2016. Significance codes: '-' >0.10, '.' <0.10, '*' <0.05, '**' <0.01, '***' <0.001.*

Regarding the high p-values of variables within the logistic regression, we can not conclude anything about the outcomes provided by the model. The logistic regression failed to predict the nature of future excess returns. Consequently, one needs to estimate the fundamental value of the car manufacturers with another method. The fundamental analysis of stocks will therefore be based on discounted cash-flows analyses. The detailed valuation of each car manufacturer is developed more in details in the forthcoming section.

4. Discounted free cash-flow analysis

4.1. Volkswagen

4.1.1. Introduction

The German car manufacturer Volkswagen, one of the leading car manufacturer with Toyota, sells more than 10 million cars per year. However, the German company is under fire after the emission scandal discovered during the last quarter of 2015. Volkswagen installed a pirate software on more than 11 millions vehicles. The group has been constrained to recall the concerned vehicles and remove the fraudulent software. Beside the recall and the 'reparation' cost, Volkswagen will probably have to pay billion dollar fines. The exact amounts remain ambiguous but the German company already expects around €10bn American fine. Other governments (such as France or Belgium) are expected to prosecute the German company. As a consequence to the scandal, Volkswagen's stock price plummeted in the last quarter of 2015. It fell by 35% in only 4 days. Investors may find in this stock a lucrative -but risky- opportunity. Investors may adopt two completely different approaches when focusing on Volkswagen AG. According to Hong & Stein (1999), individuals under-react on a short term basis; the released information is not immediately assimilated. This is contradictory to the efficient market hypothesis developed by Fama (1970), meaning that markets are probably not fully efficient and that active portfolio management is profitable (Grossman & Stiglitz, 1980). In that case, it would mean that investors, after the awareness of the scandal, would have under-reacted to the news and the information will take some time to be fully assimilated. The scandal would not be fully integrated at the moment and the stock would still be overvalued. On the other side, it is a well-known bias in behavioural finance: investors tend to over-react to bad news. Investors would act irrationally and therefore Volkswagen AG's stock price would now, just a few months after the scandal, be undervalued. Such behavioural biases may induce financial cracks or bubbles. The current situation of Volkswagen being discussed, we can now focus on its valuation.

4.1.2. **Valuation**

Volkswagen has a wide brand portfolio and is active in almost every segment of the automotive industry. The group owns renowned brands such as Audi, Seat, Bugati, Skoda, Ducati, Lamborghini, Bentley, Porsche, Volkswagen (commercial and passenger vehicles), Scania and Man. Each brand is expected to grow differently, principally depending on the brand's strategy, geographical market and segment.

The first source of potential growth relies in a defined strategy of some Volkswagen's brands[1]. While passenger cars are overflowing the middle-class segment (Volkswagen, Ford, Toyota, etc.) in developed countries, the luxury segment enjoys substantial potential. Indeed, Volkswagen is expected to face two-digits annual growth rates for Lamborghini, Bugati and Bentley. Volkswagen is also developing a market penetration strategy in the U.S for its premium brand Audi. Today, Audi sells around 180.000 vehicles per year in the U.S and 1.8 million worldwide. As a result to their penetration strategy, the brand foresees to yearly sell 300.000 vehicles in the U.S. and 2.000.000 units worldwide by 2018.

Volkswagen's motorcycle segment (Ducati) is also facing a large success. Indeed, the brand faced a 25% growth in 2015 and expects a 7.9% CAGR until 2020. Finally, the low-cost segment, represented by Seat is also facing a growing success which is translated by an expected 5.1% CAGR until 2018.

The second source of potential relies in emerging markets (APAC and Middle East). Those markets are expecting above average growth rates; especially for low-end brands such as Skoda (+9% in Asia in 2016).

Finally, it is important to mention that despite an encouraging business plan, Volkswagen cut its forecasts as a result to the emission scandal. Indeed, over the last quarter of 2015, the German group faced a 10% decrease in its sales in comparison with 2014's last quarter. In this context, initial forecasts are no more reachable, especially in the sort term, and all sales have been reduced by a digressive coefficient.

Volkswagen AG's historical and future performance is illustrated in the Table 4.1 and Figure 4.1 displayed below.

[1]Source: Volkswagen annual reports

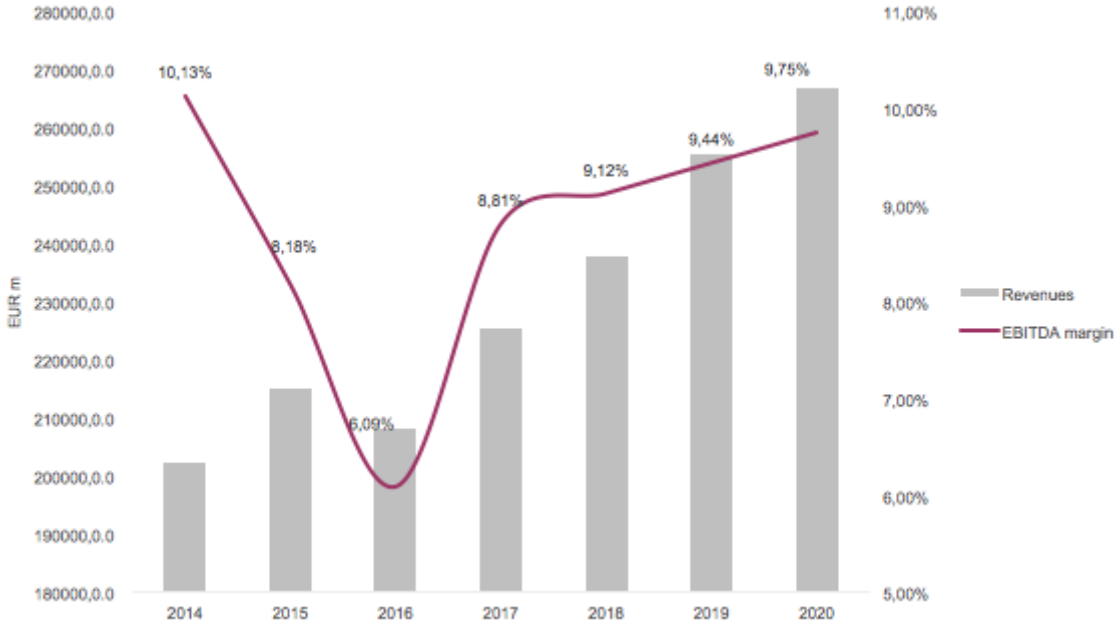

Figure 4.1: *Volkswagen's financial health evolution. Source: Capital IQ, Bloomberg, own estimations*

In millions	2014	2015	2016E	2018E	2020E
Revenues	202,458	215,003	208,166	237,851	266,755
Cars sold	10.19	10.58	10.17	11.21	12.06
COGS	168,064	180,219	176,833	197,123	219,397
Gross margin	16.99%	16.18%	16.49%	17.12%	17.75%
EBITDA	20,505	17,580	12,677	21,696	26,013
EBITDA margin	10.13%	8.18%	6.09%	9.12%	9.75%
Net income	10,985	6,359	1,510	5,658	7,796

Table 4.1: *Volkswagen business plan. Sources: Capital IQ, own estimations*

Revenues are expected to decrease in 2016 due to the scandal. It will take some years for Volkswagen to regain customers' trust. The cars recall will have a negative impact on operational margins, but the group is awaited to slowly recover in the forthcoming years. Cost of recall is integrated in operational costs as it directly concerns the manufacture of the cars. On the other side, the fine is considered as an extraordinary item and solely impacts the net income, not the operational items.

Concerning the cash flow-statement, Volkswagen faced an average historical tax rate of 25% and is expected to remain stable. Diverse fiscal deductions allows the group to have an effective tax rate lower than the national corporate tax rate. In order to ensure its financial health, Volkswagen decided to reduce its capital expenditures by €1.0bn in 2016 [2]. Negative cash-flow generation from 2016 to 2017 is due to the cost of cars recall

[2]Source: www.wsj.com/articles/vw-to-cut-capital-expenditure-boost-alternative-research-1448024411

which has been estimated to several billion euro (cfr. Figure 4.2). However it is important to keep in mind that this amount is only an forecast realised by Volkswagen and does not consider the legal sanctions. Moreover, the group is currently thinking about an alternative solution that could reduce the total cost of recall. Without any further information, a cost of €5bn has been considered[3].

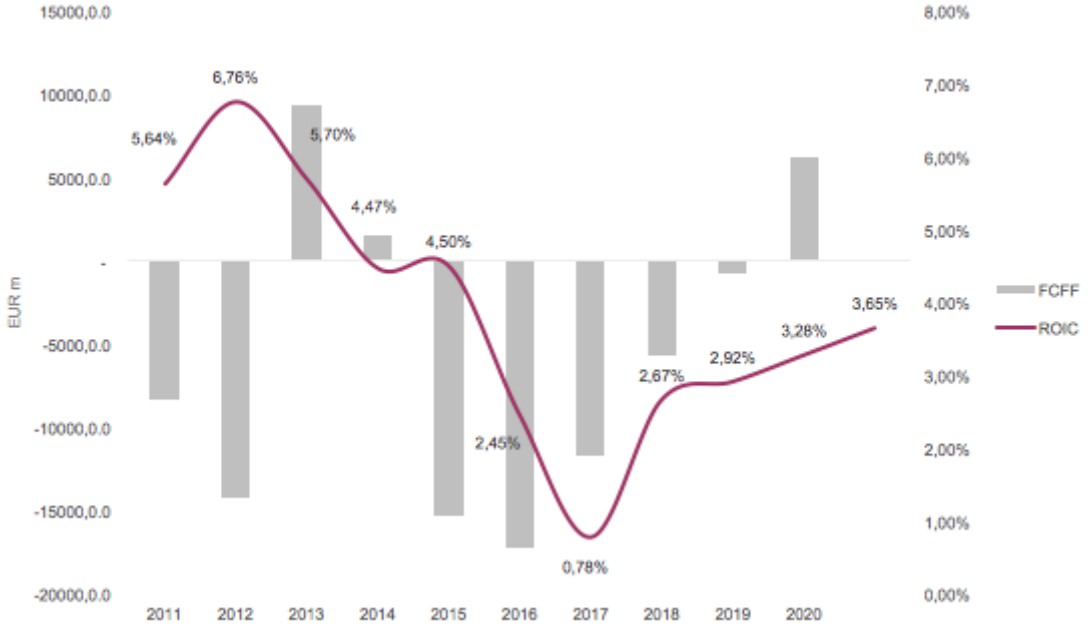

Figure 4.2: *Evolution of VW's historical and forecasted operational cash-flows. Source: Capital IQ, own estimations*

Now that the sources of income have been discussed, one needs to estimate the discount factor. The discount factor is based on a stable WACC, which is composed by the cost of equity and the cost of debt. Nowadays, companies are facing extremely low weighted average costs of capital. Indeed, interest rates are low and close to zero (even sometimes negatives), bringing a low cost of debt. Volkswagen has a market debt/equity ratio of 2.50, meaning that most of Volkswagen's WACC is driven by the cost of debt. Risk premium is also relatively low compared to historical figures. Due to the emission scandal, the stock encountered broad movements compared to the benchmark, leading to a sharp increase of Volkswagen's levered beta. Since the sub-prime crisis of 2008, car manufacturers are relatively volatile. Levered betas are high compared to measures prior the crisis. The market is now more stable and car companies' levered betas are expected to gradually converge to the market. This is the reason why the adjusted beta such as developed by Pinto et al. (2010) has been used as market sensitivity proxy for the valuations. The

[3]Source:www.bloomberg.com/news/articles/2015-10-22/vw-s-emissions-retrofit-may-be-among-costliest-recalls-ever

actual negative risk-free rates are abnormal and not suited for valuations. According to a study conducted by Ernst and Young (2015), the adequate risk-free rate should be the average of interest rates across European countries and not only selecting German's risk-free rate. Doing so, a 1% risk-free rate is used[4].

Risk-free rate	1%	Financial debt	EUR 150,428m
Risk premium	6.25%	Interest Expenses	EUR 2,460m
Adjusted beta	1.25	Effective tax rate	25.2%
Ke	8.81%	Kd	1.64%

Table 4.2: *Volkswagen AG weighted cost of capital estimation. Source: Capital IQ, ING Corporate Finance, own estimations*

Finally, based on inputs provided by Table 4.2, Volkswagen's weighted cost of capital is 3.65%. The actual ROIC is already close to the WACC, meaning that the ROIC-WACC convergence technique does not have a large impact on Volkswagen's final valuation. Large car manufacturers may struggle to enjoy substantial ROIC. Indeed, a group such as Volkswagen is already mature and well expanded. Business plans do not predict large sales expansions. Industry returns on invested capital are below average. The low expected level of ROIC in the case of Volkswagen may also be explained by the cost of cars recall that reduce significantly margins. A 1.5% perpetual growth rate is used for the terminal value estimation.

We finally find the intrinsic share price of Volkswagen **131€**[5], which lead us to think that investors over-reacted to fraud announcement. The final TV/EBITDA multiple is 6.3, which is close to the average of the industry, meaning that on a long-term horizon, Volkswagen AG would adopt a mean-reverse behaviour. We can also check our estimation with broker reports. We point out that our estimation is in the most frequent range of brokers' estimations. Detailed broker estimations are available in **Appendix 6.2.1**. Less than 20% of brokers recommend to sell the stock. However, most of them are relatively neutral about investment decision, even though the average of brokers' estimation show an undervaluation. Finally, we conclude that Volkswagen is slightly undervalued[6].

[4]Other inputs such as risk premium rates are an ING Corporate Finance internal estimations.
[5]As of April 15^{th} 2016
[6]As of April 15 2016

4.2. Toyota

4.2.1. Introduction

Toyota, the Japan corporation, is a leading car manufacturer in direct competition with Volkswagen. They approximately sell 10 million cars each year. Currently, the company owns Toyota, Lexus, Hino and has 50% participations in Daihatsu. They planned to buy back the remaining shares of Daihatsu in 2016 and to become its unique shareholder. Toyota is popular in developed and emerging markets. For many years, Toyota dominates the Japanese market. However, developed markets are mature and it is challenging for car manufacturers to further expand their activities in markets such as Western Europe or Japan; even with the emergence of electric cars. This last segment currently represents an insignificant share of Toyota global activities. Therefore, Toyota, is focusing on emerging markets, premium and low-end segments. Prospectives for middle-class models are flat. In the upcoming years, Toyota intends to reap benefits from the Chinese market, Lexus (premium) and Hino (low-end). Toyota expects to mainly develop Lexus in Europe and U.S., while Hino continues its expansion in the Asian market (especially India and Thailand).

4.2.2. Valuation

Toyota Motor Corporation is a stable automotive manufacturer and an historical strong cash-flow generator. The brand Toyota accounted in 2015 for more than 80% of the group's total revenue. Today, Daihatsu's revenues are not fully included in the consolidated Toyota Motor Corporation financial statements as they own only 50% of the corporation. However, the group has planned to buy-back the remaining shares during the year. Daihatsu's revenues will in that case be fully included into Toyota Motor Corporation's financial statements. The revenues of the group are awaited to grow at a 4% CAGR by 2020[7]. The gross margin has historically been increasing each year. However, this trend will stop in the future. Development of new car prototypes (electric, hydrogen, etc.) are mainly responsible of the future decrease in margins. Indeed, at the moment Toyota is facing economies of scale with its classical models and its mass production scheme. Those economies of scale are unreachable in the first years of new cars developments and the gross margin is therefore expected to slightly decrease in the forthcoming years. The rising of Tesla also brings a fierce competition on the promising electric cars segment, which will certainly put pressure on Toyota hybrid vehicles' market shares. In a close future, this will impact Toyota future cash-flows. This plug on the gross margin enables the convergence between the weighted cost of capital and the return on invested capital on a long-term basis. The structure of expected future financial figures can be

[7]Own estimations

depicted on Figure 4.3 and Table 4.3.

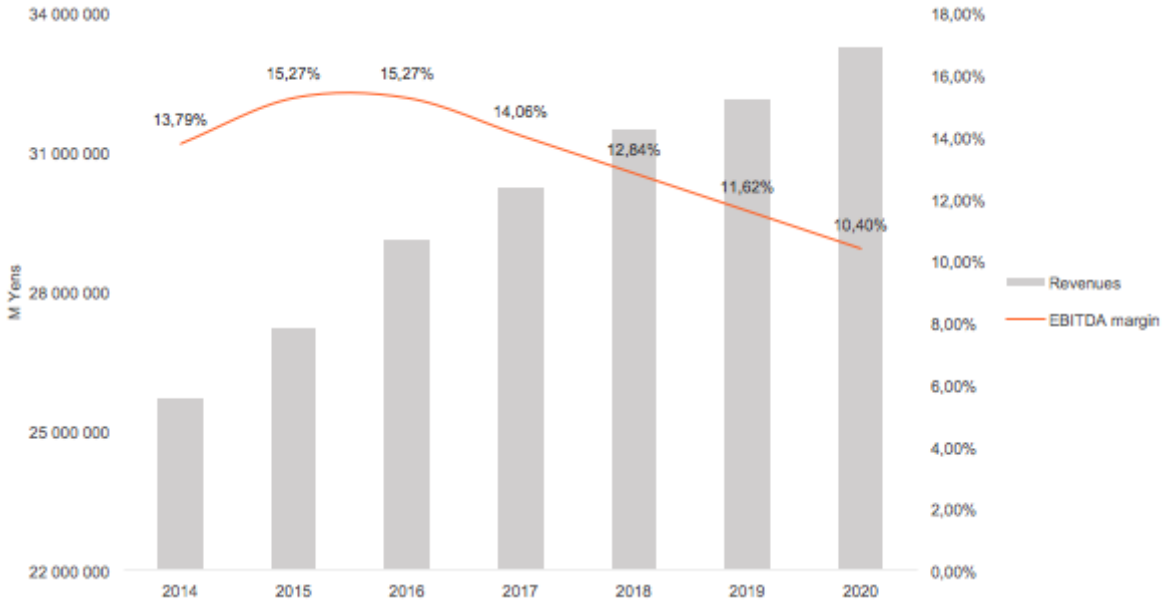

Figure 4.3: *Toyota expected revenues. Source: Capital IQ, Bloomberg, own estimations*

In billion yens	2014	2015	2016	2018E	2020E
Revenues	25,692	27,235	29,142	31,494	33,248
Cars sold	10.39	10.30	10.55	10.98	11.43
COGS	20,801	21,842	23,371	26,024	28,284
Gross margin	19.04%	19.80%	19.80%	17.37%	14.93%
EBITDA	3,543	4,160	4,451	4,043	3,459
EBITDA margin	13.79%	15.27%	15.27%	12.84%	10.40%
Net income	1,823	2,173	2,577	2,240	1,797

Table 4.3: *Toyota business plan. Source: Capital IQ, own estimations*

Toyota Motor Corporation's sales are awaited to grow at a 4% CAGR over the 2015-2020 period. The group is now generating comfortable margins that are expected to slightly decrease in the forthcoming years. Concerning the cash-flow statement, the historical average effective tax rate is around 34%, which is now the legal tax rate in Japan. Several years ago, the corporate tax rate was around 40% in Japan. Effective tax rate of last year has been used as proxy for upcoming effective tax rates. Toyota benefits from fiscal deductions to lower its taxable income. Toyota is foreseen to generate strong cash-flows in 2016 due to a cut in capital expenditures and a sharp decrease in change in net working capital. Toyota historical and expected free cash-flows are displayed thereafter (Figure 4.4).

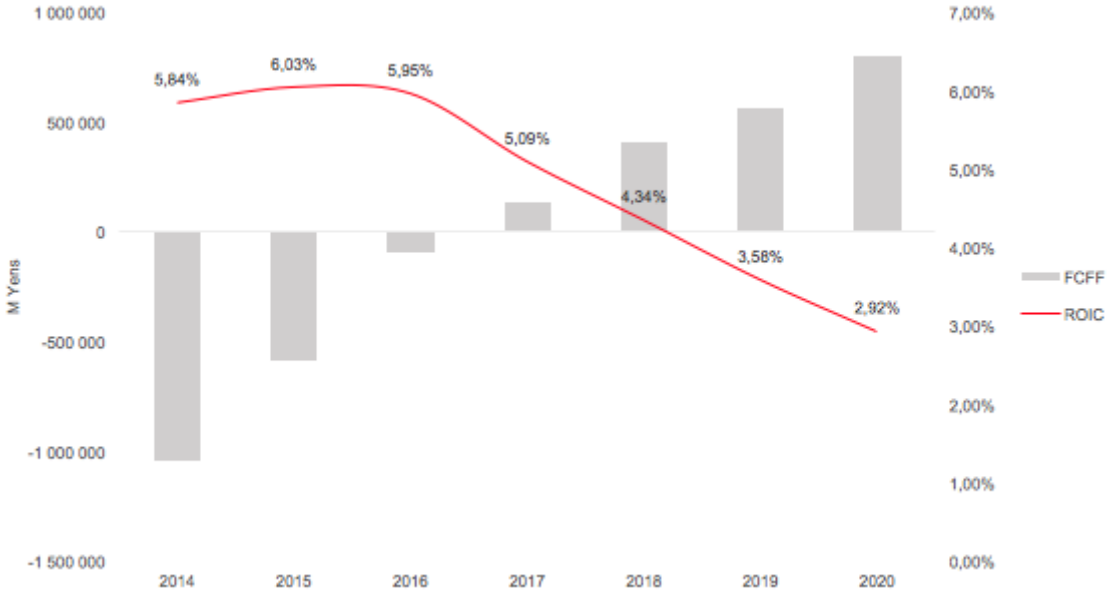

Figure 4.4: *Evolution of Toyota's historical and forecasted operational cash-flows, in billion yens. Source: Capital IQ, own estimations*

Once all the cash-flows have been forecasted, one needs to estimate the Toyota Motor Corporation's weighted average cost of capital. The decrease in the gross margin enables a convergence between the WACC and the return on invested capital. On a long-term basis firms generate returns on invested capital that are roughly equal to the average cost of capital. Toyota's debt-to-equity ratio is roughly equal to one, meaning that cost of equity and cost of debt contribute equally to the WACC. Due to a low adjusted levered beta (0.7) and low interest rates, Toyota's WACC is extraordinary low and therefore highly sensitive to changes in inputs. Inputs estimations (risk-free rate, risk premium and perpetual growth rate) are the same for each car manufacturer (cfr Table 4.4).

Risk-free rate	1%	Financial debt	YEN 19,355bn
Risk premium	6.25%	Interest Expenses	YEN 191bn
Adjusted beta	0.7	Effective tax rate	27.91%
Ke	5.38%	Kd	1%

Table 4.4: *Toyota Motor Corporation weighted cost of capital estimation. Source: Capital IQ, ING Corporate Finance, own estimations*

Toyota Motor Corporation's WACC is currently about 3%, which seems exceedingly low, but normal if we look at today's market conditions. Finally, the group's intrinsic share price is about **YEN 7,250**. The conclusion of the DCF model is that Toyota is currently undervalued[8] and that a long position could be profitable on that stock. Broker reports[9]

[8] As of April 2016
[9] cfr. Appendix 6.2.2

also serve as a final check. Brokers are of one mind, Toyota is undervalued and the average estimated share price is about 8,500 yens. Brokers are slightly more optimistic about Toyota's future performance but the conclusion is the same: Toyota appears as undervalued. If we compare the estimation with its current price[10], we conclude that the stock is currently floating below its fundamental value.

4.3. General Motors

4.3.1. Introduction

General Motors is an historical American leading car manufacturer. In the 90's, the group owned more than fifteen brands. However the situation worsened after the financial crisis of 2008. In 2009, the company went bankrupt. The American state temporary nationalised the company. The stock lost about 95% of its value. The company accomplished a P2P transaction (public to private). In 2010, the group was listed again. The group recovered well and sells now a bit less than 10 millions vehicles a year. Nowadays, General Motors owns a large range of brands: Buick, Cadillac, GMC, Chevrolet, Opel, Holden. The group is also established on the Asian continent with brands such as Autobaojun, Wuling and Faw Jiefang.

4.3.2. Valuation

General Motors is working to strengthen each brand on all the segments. However, contrary to Volkswagen and Toyota, General Motors expects only low-digits growth rates in the Asian market. On the other hand, they are taking advantage of the rising tide of sales in the U.S. market. The American market is anticipated to grow at a 5.5% CAGR by 2018[11]. General Motors' leading position in the US allows them to reap benefits from this favourable trend. Over the next five years, the company intends to launch eights new models. The firm also aims to penetrate new segments. General Motors also targeted the luxury segment, which is expected to grow by 35% by 2020[12]. In order to serve all this growing demand, General Motors intends to focus on new luxury Cadillac models. The large investments in new technology are expected to slightly decrease the group's operational margins. Finally, General Motors business plan can be summarized on Figure 4.5 and Table 4.5.

[10] April 15^{th} 2016

[11] Source:www.autonews.com/article/20150114/OEM09/150119809/analyst-forecasts-17-million-u.s.-sales-in-2015-20-million-in-2018

[12] Source: General Motors Annual Report 2014

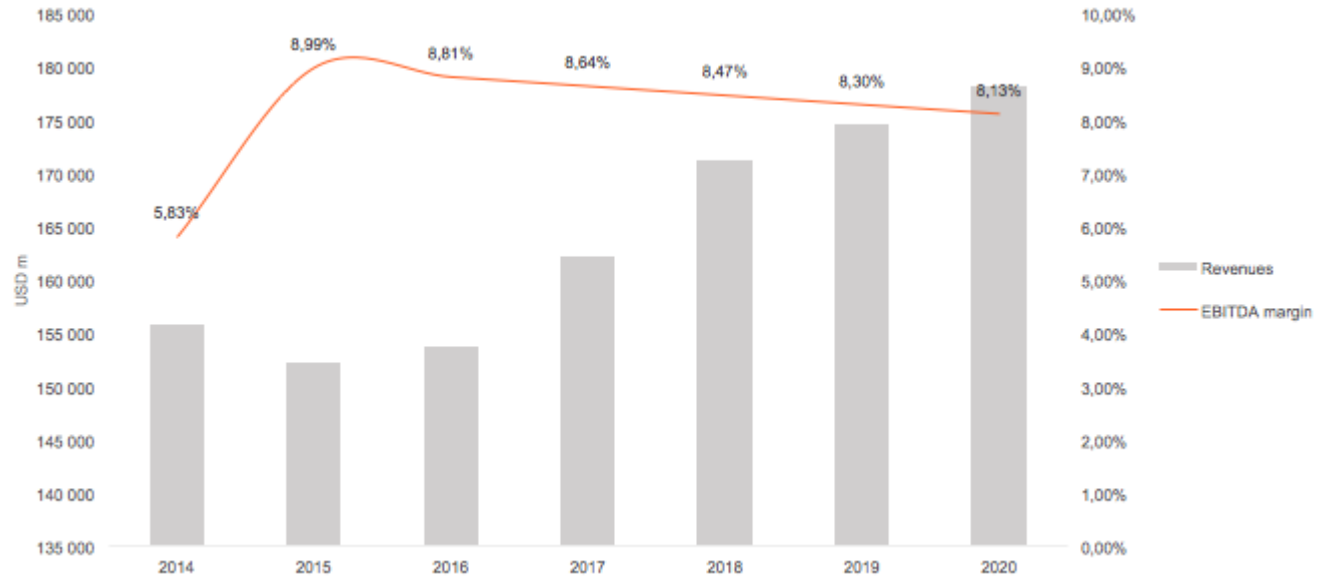

Figure 4.5: *General Motors expected revenues. Source: Capital IQ, Bloomberg, own estimations*

In million USD	2014	2015	2016E	2018E	2020E
Revenues	155,929	152,356	153,842	171,230	178,147
COGS	140,646	133,754	135,323	151,205	157,926
Gross margin	9.80%	12.21%	12.04%	11.69%	11.35%
EBITDA	9,084	13,690	13,559	14,504	14,478
EBITDA margin	5.83%	8.99%	8.81%	8.47%	8.13%
Net income	6,483	9,555	8,020	8,306	8,096

Table 4.5: *General Motors business plan. Source: Capital IQ, own estimations*

The increase in revenues is mainly supported by the recovering demand in the United States. General Motors does not expect significant growth in China in the forthcoming years. Development of new models induces a slight decrease in operating margins. This decrease permits the convergence between the return on invested capital and the weighted average cost of capital. The margin decrease is expected to be offset by the increase in revenues, leading to a stable net income. Operating cash-flows are highly depending on capital expenditures. Due to the launch of eight new models, the group started massive investments in 2016. Investments are anticipated to last at a high level due to the fierce competition and the continuous innovations in the industry. The estimated cash-flows are presented on the graph displayed thereafter (Figure 4.6).

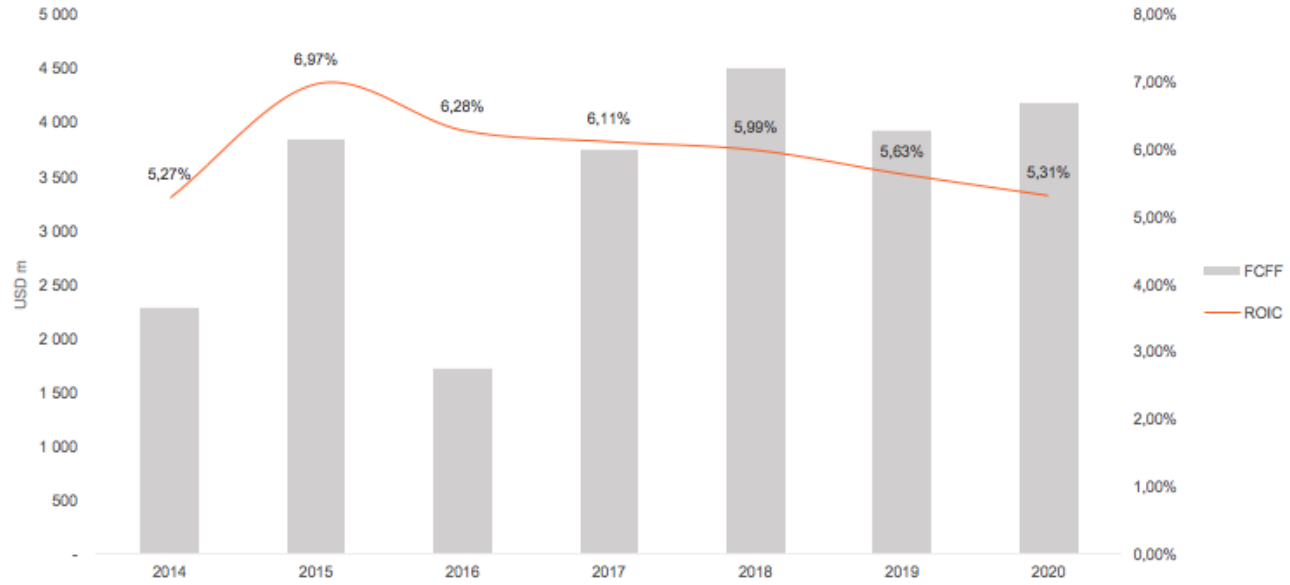

Figure 4.6: *Evolution of General Motors' historical and forecasted operational cash-flows, in million USD. Source: Capital IQ, own estimations*

In 2015, General Motors generated above historical average cash-flows. This was mainly due to a large decrease in working capital. In 2016, the group observes an increase in working capital, which significantly lowers its operational cash-flows. The future investments are offset by the decrease in working capital. Consequently, cash-flows are expected to grow by a modest 1.65% CAGR between 2015 and 2020. Once all the cash-flows have been forecasted, one needs to estimate the general Motors' weighted average cost of capital. Market equity is roughly equal to financial debt. The two sources of financing contribute equally to the weighted average cost of capital. Indeed, in 2015, the financial debt to equity ratio was about 0.9. General Motors' adjusted levered beta is 1.25. This confirms that car manufacturers tend to be more volatile than the market. The weighted average cost of capital has been estimated with the ensuing inputs (Table 4.6).

Risk-free rate	1%	Financial debt	USD 43,320m
Risk premium	6.25%	Interest Expenses	USD 48.82m
Adjusted beta	1.25	Effective tax rate	27.91%
Ke	8.81%	Kd	0.98%

Table 4.6: *General Motors weighted cost of capital estimation. Source: Capital IQ, ING Corporate Finance, own estimations*

Finally, we find a weighted average cost of capital of 5.06%. Due to a lower debt to equity ratio, General Motors has a higher WACC than most of its competitors. Valuation is based on a 1.5% perpetual growth rate. Finally, we find a fundamental stock price of **34.61 USD**, which let us think that General Motors is slightly undervalued. We can

compare this outcome with broker reports[13] to control our final valuation. Average broker reports depicted an average stock price of **38.00 USD**, which confirms our estimation.

4.4. Ford

4.4.1. Introduction

Founded in 1903 with a capital of 28.000 USD, Ford Motor Company is nowadays one of the leading car manufacturer in the world. In the beginning of the twentieth century, Ford revolutionized the production system and is at the base of mass production. However, during the war period, its main competitor General Motors was the most successful corporation in the world. During two decades, Ford was declining. It is only after World War II that the company reacted. They went in recreating themselves in the image of General Motors. The firm's rebirth was supported by a business model similar to General Motors. More recently, the group acquired diverse brands and currently owns Ford and Lincoln. Their previous portfolio comprised also prestigious brands such as Jaguar or Aston Martin. In December 2009, the group sold Volvo Car Corporation to a Chinese group for an amount of USD 1.8bn[14].

4.4.2. Valuation

The strategy that Ford adopted is different from other car manufacturers. They currently focus on restructuring and cost cutting. The selling of prior owned brands is the result of the Ford Motor Company restructuring plan. Back in 2007, Ford was operating on 27 production platforms. Nowadays, Ford has 12 platforms and targets 8 production platforms in the forthcoming years. This cost management strategy balances the constant innovation investments. Technology improvements put pressure on car manufacturers. As a consequence, Ford margins are expected to be relatively flat in the forthcoming years. Indeed, the innovation investments are offset by cost savings. As Ford's core strategy is now based on cost savings, the company is not anticipated to enjoy large increases in units cars sold. Consequently, revenues are foreseen to grow at a lower pace than the American market demand. Ford is believed to grow at a 3.6% CAGR by 2018[15]. Currently, Ford does not exhibit real expansion strategy. The result of this position is reflected in their forecasted future performance (Figure 4.7 and Table 4.7).

[13] cfr. Appendix 6.2.5
[14] Source: MergerMarkets
[15] Source: Capital IQ

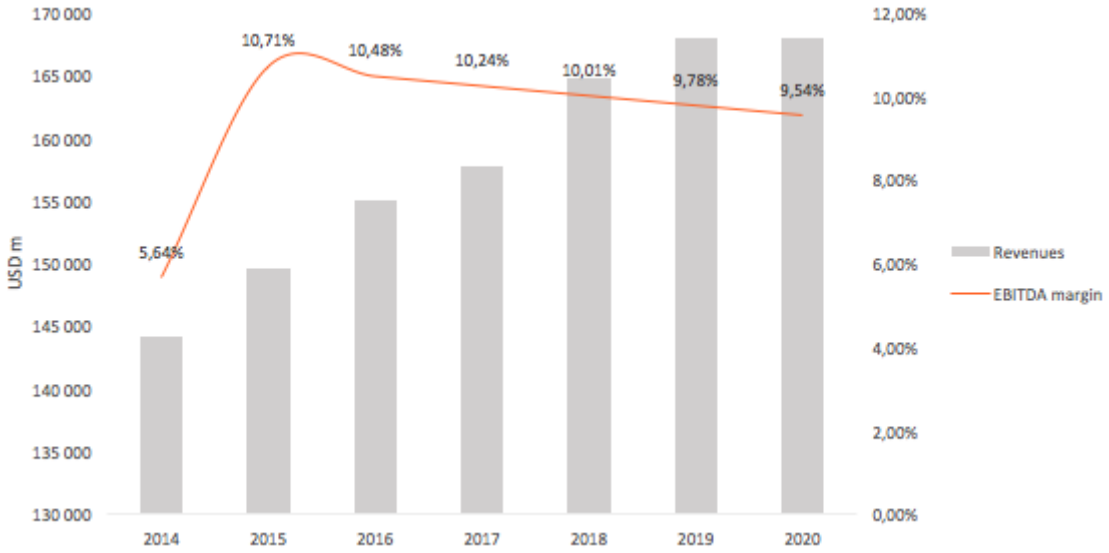

Figure 4.7: *Ford expected revenues. Source: Capital IQ, Bloomberg, own estimations*

In million USD	2014	2015	2016E	2018E	2020E
Revenues	144,077	149,558	154,965	164,691	167,985
COGS	131,526	131,005	135,741	144,261	147,146
EBITDA	8,132	16,017	16,234	16,484	16,029
EBITDA margin	5.64%	10.71%	10.48%	10.01%	9.54%
Net income	1,231	7,373	5,508	5,255	4,776

Table 4.7: *Ford business plan. Source: Capital IQ, own estimations*

The restructuring activities conducted by Ford allows the group to enjoy higher margins than its direct competitor General Motors. Despite their lack of innovation strategy, margins are expected to slightly decrease due to the required investments within the industry. In such a changing environment, companies can not wait to invest. Kodak and Nokia are unfortunate examples of companies that did not innovate to remain a leading player within their respective industries. Despite a lack of information on that subject, we can expect Ford to follow the pace, innovate and remain a key player within the automotive industry. The absence of expansion strategy is translated in a relatively flat business plan, with only small growth rates. The pressure on margins reflects the decreasing scheme of Ford's free operating cash-flows. Return on invested capital is expected to gradually converge to the weighted average cost of capital.

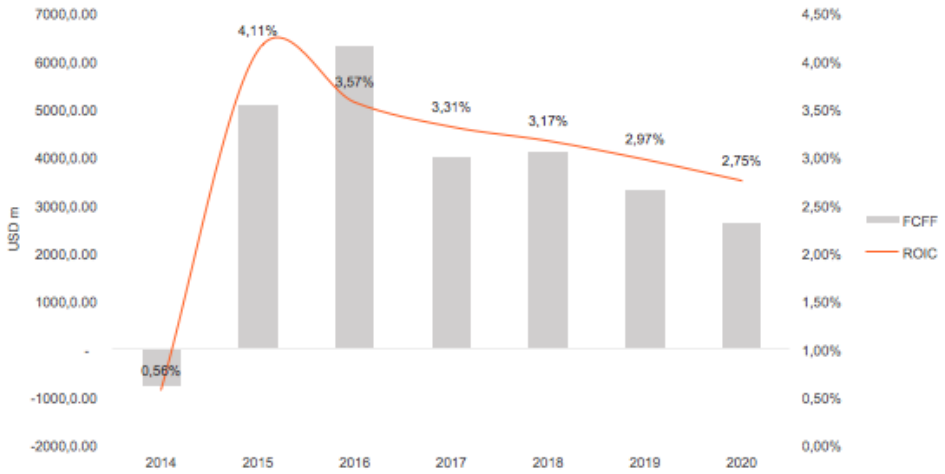

Figure 4.8: *Evolution of Ford' historical and forecasted operational cash-flows, in million USD. Source: Capital IQ, own estimations*

The sharp increase in 2015's cash-flow (cfr. Figure 4.8) is due to an increase in operating margins, result of the restructuring activities. In 2016, free-cash flows are expected to increase due to a lower working capital requirement. Afterwards, the structure is the same as for margins: operational cash-flows slightly decrease. One needs now to estimate Ford's weighted average cost of capital. Ford is extremely volatile, which is reflected by a large adjusted levered beta (1.38). The company uses mainly debt to finance its activities. Market equity accounted for only 25% of financial resources at the end of 2015. Cost of debt is Ford's key driver for the weighted average cost of capital estimation. All inputs used to compute Ford's WACC are exhibited in the Table 4.8.

Risk-free rate	1%	Financial debt	USD 141,771m
Risk premium	6.25%	Interest Expenses	USD 1,417m
Adjusted beta	1.38	Effective tax rate	28.10%
Ke	9.63%	Kd	1%

Table 4.8: *Ford Motor Company weighted cost of capital estimation. Source: Capital IQ, ING Corporate Finance, own estimations*

Finally, we find a weighted average cost of capital of 2.91%. The low WACC implies a high sensitivity in inputs changes. A small change in perpetual growth might have significant impact on the final price. A 10% increase in perpetual growth (i.e. 1.65%) generates an increase of 45% in the final stock price. We used the same assumptions for perpetual growth as for prior valuations. Finally, we obtain a final stock price of **12 USD**, which is slightly lower than its market price[16]. We conclude that the price is overvalued. We can ultimately check this value with broker reports. Financial specialists obtained a price of **USD 15.00** (cfr. Appendix 6.2.4), which is slightly more optimistic than our results.

[16] As of April 15^{th} 2016

4.5. Peugeot S.A.

4.5.1. Introduction

Founded in 1896, Peugeot S.A. (PSA) is a worldwide car manufacturer. The group generates most of its revenue in Europe and more particularly in France. The group currently owns three brands: Peugeot, Citroen and DS. Michelin, the tyre manufacturer, sold Citroen to Peugeot in 1976. More recently, the group created a luxury line within Citroen: DS. The motivation behind the division into two legal entities is the same as for Toyota and Lexus. The company identified the need to develop itself on the premium segment. Citroen has always been seen as a "low-cost" car manufacturer. In order to not change its initial positioning, the company decided to create a separate legal entity to serve the premium segment. Far away from the industry leaders, the French group sold approximately 3 millions cars worldwide in 2015. In 2015, PSA registered significant growth in Europe (+5.86%) while it struggled in the rest of the world and more particularly in China[17].

4.5.2. Valuation

In 2016, PSA disclosed its ambitious business plan 'Push to Pass' until 2021[18] . Two years ago, the group was close to go bankrupt. Today, PSA surfs on a recovering market and has ambitious goals within the upcoming years. The company aims to develop 28 new models distributed on its three brands. Peugeot's strategy is not limited to a product portfolio expansion. Indeed, they aim to re-enter in the U.S. market, which gives a glimpse of a post-crisis growing market. Finally, the group also focuses on the future of the car. Indeed, they planned to invest in the development of an autonomous car. Peugeot expects to increase its turnover to EUR 70bn by 2021. The deployment of the strategy requires massive investments in research and development. Capital expenditures are anticipated to grow by 20% per year until 2020 in order to meet group's business plan. Despite large investments, the group is still expected to show margin increases. In fact, during the financial distress period of Peugeot, the company was facing below-average operating margins. Now, they are recovering and the EBITDA margin increased by 180% between 2014 and 2015. The group is forecasted to slowly go back on track and generate higher margins. Leverage is also expected to increase to finance the business plan targets. As the group was no more profitable since a few years, they don't have enough financial resources to finance their projects themselves. The Push to Pass business plan is reflected in Figure 4.9 and Table 4.9.

[17]Source: PSA annual report: 2015

[18]Source:www.caradisiac.com/decryptage-nouveau-plan-push-to-pass-de-psa-peugeot-citroen-l-ambition-raisonnable-de-carlos-tavares-son-patron-107585.html

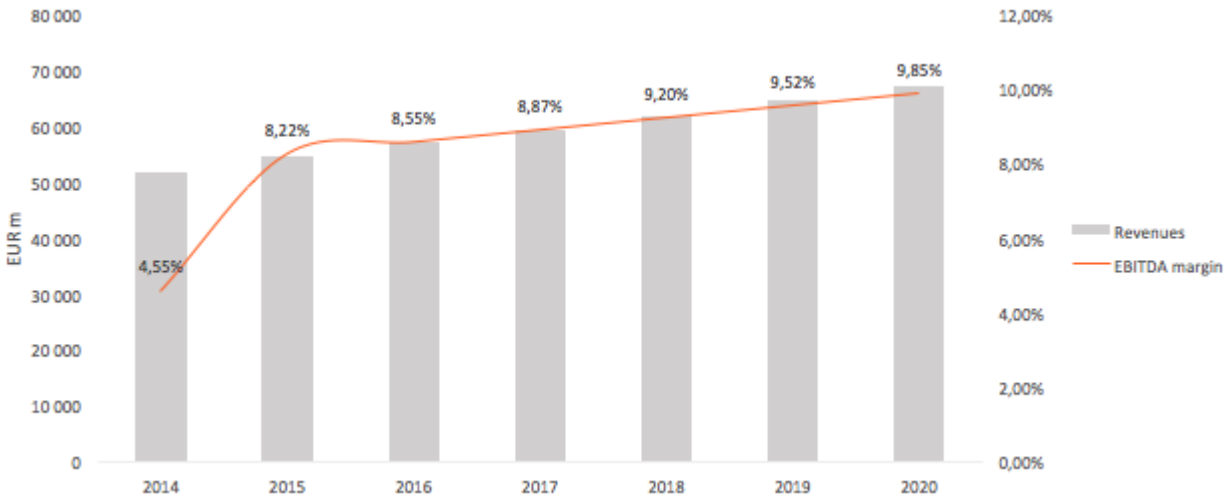

Figure 4.9: *Peugeot expected revenues. Source: Capital IQ, Bloomberg, own estimations*

In million EUR	2014	2015E	2016E	2018E	2020E
Revenues	51,592	54,676	56,975	61,865	67,176
COGS	43,094	44,618	46,494	50,485	54,819
EBITDA	1,576	1,771	1,845	2,004	2,176
EBITDA margin	4.55%	8.22%	8.55%	9.20%	9.65%
Net income	(706)	899	1,369	1,816	2,310

Table 4.9: *Peugeot business plan. Source: Capital IQ, own estimations, Push to Pass business plan*

Peugeot's business plan is ambitious but not unrealistic. If the goals are met, the group will just catch up its backlog on other competitors and become an average profitable player in the automotive industry. Peugeot S.A. intends to retrieve its historical stability and to become more and more international. Currently, the brand is mainly renowned in France but the group expects to expand their activities and penetrate the American market. By 2020, the operating margins are expecting to be in the average of the automotive industry. Today, the French group exhibits lower margins than its competitors. Operating cash-flows are however expected to decrease compared to 2015 results. This is just the consequence of Peugeot's expansion strategy. Capital expenditures are responsible of the low expected operational cash-flows. The evolution of Peugeot's future free operational cash-flows are exhibited on Figure 4.10.

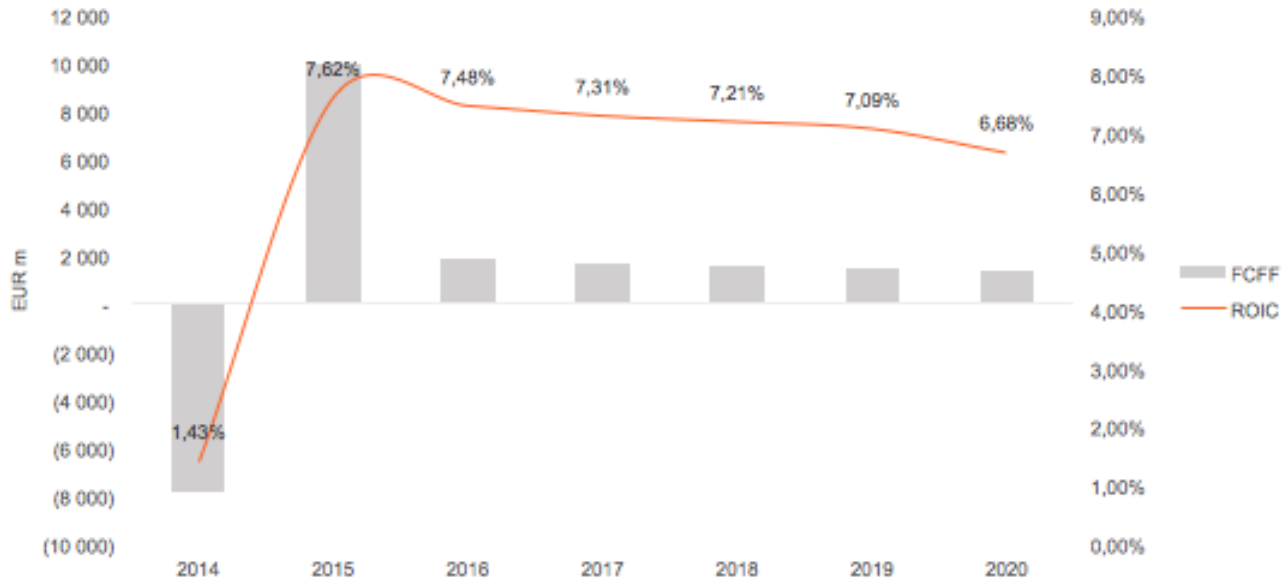

Figure 4.10: *Evolution of Peugeot' historical and forecasted operational cash-flows, in million EUR. Source: Capital IQ, own estimations*

Free-cash flows are awaited to be stable while the return on invested capital slowly converges to the weighted cost of capital. One needs now to estimate Peugeot's weighted average cost of capital. The group has an adjusted levered beta of 1.44. Peugeot was relatively volatile during its financial distress phase, explaining Peugeot's high levered beta. Other cost of equity inputs are the same as used for all the other valuations. The interesting point relies in the cost of debt, which is significantly higher than other car manufacturers. As Peugeot was no more profitable for some years, banks were distrustful about Peugeot's future. A few years ago, newspapers were evoking the likelihood of a bankruptcy. At the same time, Peugeot still needed financial resources to survive. Due to the delicate position of the group, banks required high interest rates on their loans. This situation is illustrated in the Table 4.10.

Risk-free rate	1%	Financial debt	EUR 13,314 m
Risk premium	6.25%	Interest Expenses	EUR 659 m
Adjusted beta	1.44	Effective tax rate	33.00%
Ke	10.00%	Kd	4.89%

Table 4.10: *Peugeot's WACC estimation inputs. Source: Capital IQ, ING Corporate Finance, own estimations*

Finally, we obtain a weighted average cost of capital of 6.8%. The firm is currently financed at 52% of equity and has a high cost of debt, explaining the high weighted average cost of capital compared to the rest of the industry. We fixed a 1.5% perpetual growth rate. The estimated intrinsic share price[19] is **EUR 19.8**. By comparing this result with

[19] As of April 15^{th} 2016

brokers' expectations[20], we can observe the same conclusion: Peugeot S.A. is currently undervalued.

4.6. Hyundai

4.6.1. Introduction

Founded in 1967, Hyundai Motor company is a Korean car manufacturer part of Hyundai Group, which also operates in real estate, steel, metals, financing activities, etc. Hyundai Motor Company, together with its subsidiaries, manufactures and distributes motor vehicles and parts worldwide. The company operates mainly under the vehicle division but has also financing activities. The vehicle segment offers different brands: Hyundai, Kia or Genesis. Currently Hyundai owns 32.8% of Kia. The financial division provides vehicle financing, credit card processing, insurance services, etc. In 2015, around 40% of the group's sales was domestic[21]. Hyundai Motor Corporation sold around 8 millions vehicles worldwide in 2015[22]. The car manufacturer enjoyed significant growth in the previous years. In 2008, Hyundai Motor Corporation was ranked as the eighth largest car manufacturer in the world. Despite its rapid growth, the group was in trouble in 2006 with the arrest of its former CEO for corruption. In 2015, the group was ranked at the fourth place of the largest car manufacturers after Volkswagen, Toyota and General Motors and expects a stable growth in the forthcoming years.

4.6.2. Valuation

After missing their sales target in 2015, largely due to Chinese market's weak performance, the group predicted a 1.6% increase in global sales to 8.13 million vehicles in 2016 (together with Kia). Such as most of its competitors, Hyundai focuses on the luxury segment and launched a new brand named Genesis. The group focuses on enhancing the development of environmentally friendly cars and mid-size luxury cars. Depression on emerging markets such as Brazil or Russia is predicted to hurt Hyundai's profitability in 2016[23]. Long-term strategy is focused on the Indian market. They aim to develop cars from scratch in this region. Hyundai also intends to develop its hybrid and electric cars segment. By 2020, Hyundai expects to develop 12 hybrid/electric models. Large investments in those technologies are expected to decrease operating margins. Finally, Hyundai Motor Company's business plan is reflected on the figures presented thereafter (Figure 4.11 and Table 4.11).

[20] cfr. Appendix 6.2.6

[21] Source: Hyundai annual report 2015

[22] Included Kia sales

[23] Source:http://www.wsj.com/articles/hyundai-motor-group-expects-tough-business-conditions-in-2016-1451865326

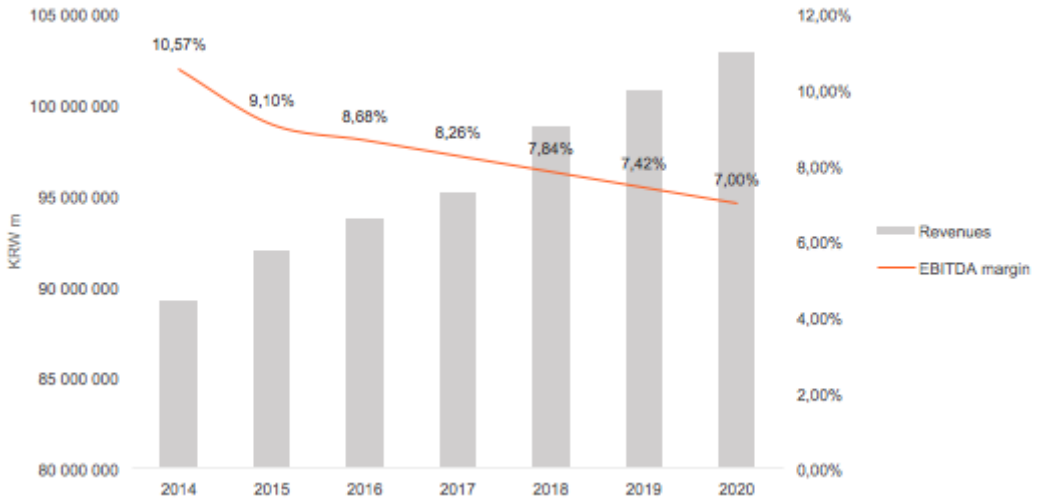

Figure 4.11: *Hyundai expected revenues. Source: Capital IQ, Bloomberg, own estimations*

In billion KRW	2014	2015	2016E	2018E	2020E
Revenues	89,256	91,959	93,715	98,871	102,865
COGS	70,126	73,701	75,109	79,241	82,443
EBITDA	9,431	8,368	8,357	8,459	8,428
EBITDA margin	10.57%	9.10%	8.92%	8.56%	8.19%
Net income	7,347	6,417	6,268	5,984	5,829

Table 4.11: *Hyundai Motor Corporation business plan. Source: Capital IQ, own estimations*

Hyundai is expecting low-digits growth rates. Operating margins are expected to slightly decrease such as the other car manufacturers (cfr. Figure 4.11). The fiercer competition within the industry put pressure on margins. Operating cash-flows are expected to increase year by year (cfr. Figure 4.12). The large negative cash-flow encountered in 2015 is due to an increase of 95% in capital expenditures during that period. This sharp increase in capital expenditures mainly consisted of R&D expenses to support the development of Hyundai's new brand: Genesis. During the previous years, capital expenditures were substantial in order to support the worldwide penetration strategy and the new product launches. Now that the brand is well established, capital expenditures are mainly going to support new product launches. As a consequence, operating cash-flows are expected to increase in the upcoming years. The evolution of predicted cash-flows (2014-2020) is depicted on Figure 4.11.

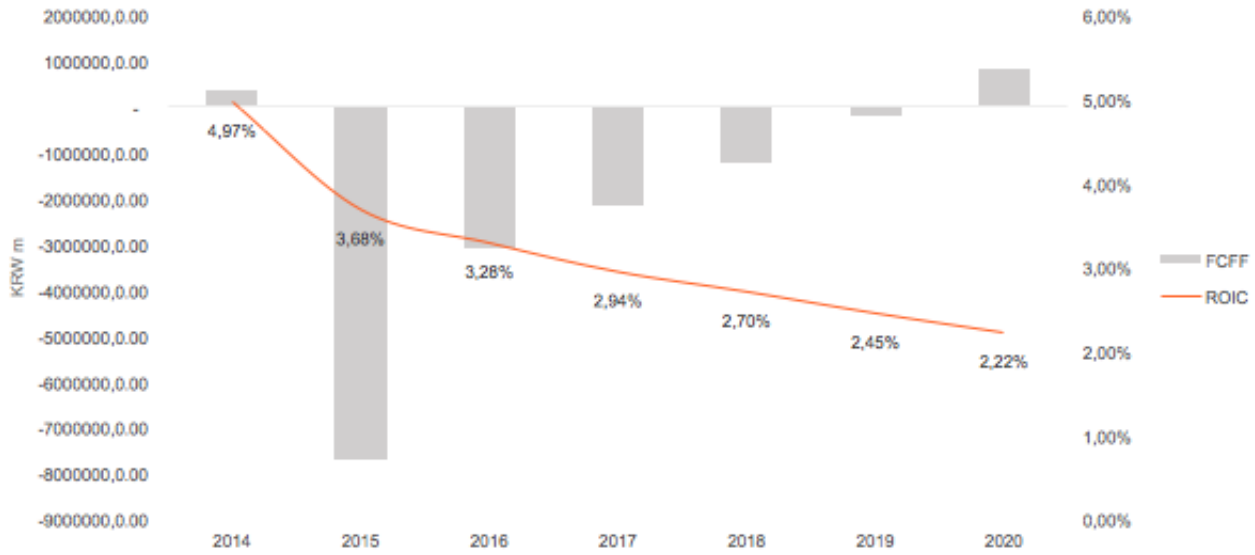

Figure 4.12: *Evolution of Hyundai's historical and forecasted operational cash-flows, in million KRW. Source: Capital IQ, own estimations*

The increasing pressure in the industry combined to disappointing results, are affecting the return on invested capital. One needs now to estimate Hyundai's weighted average cost of capital. Hyundai is mainly financed with financial debt. In fact, its financial debt to equity ratio is equal to 2.4. Hyundai currently pays 0.6% on its debt (cfr. Table 4.11), meaning that its weighted average cost of capital is relatively low in the industry.

Risk-free rate	1%	Financial debt	KRW 67.630 bn
Risk premium	6.25%	Interest Expenses	KRW 405 m
Adjusted beta	0.89	Effective tax rate	33.00%
Ke	6.58%	Kd	0.6%

Table 4.12: *Hyundai's WACC estimation inputs. Source: Capital IQ, ING Corporate Finance, own estimations*

Finally, we find a WACC of 2.22%. Assuming a 1.5% perpetual growth, we find a fundamental stock price of **KRW 189k**, which is higher than its current price of KRW 155k[24]. This suggests an undervaluation of Hyundai's stock price. This result seems to be confirmed by brokers[25].

The fundamental value of each car manufacturer being estimated, we can now develop investment strategies based on their intrinsic values. The goal is here the same as used in the systematic risk section: maximizing expected returns by setting a maximum volatility threshold.

[24] As of April 15^{th} 2016
[25] cfr. Appendix 6.2.3

4.7. **Expected returns overview**

Equity values have been estimated as of December 31^{th} 2016. The gap between fundamental and current price[26] represents the expected return of the stock from now to the end of the year. The expected returns reflect the market anomalies. For each stock, expected returns are displayed on the Table 4.13. Note that the fundamental analysis through discounted cash-flow analysis is not seen as a predictive model. It gives an insight of the value a stock should have. The discounted cash-flow method ignores behavioural biases that affect investors' returns.

Company	Estimated Price	Current Price	E(R)	Monthly E(R)
Volkswagen	EUR 131	EUR 127	3.15%	0.37%
Toyota	YEN 7.248	YEN 5.450	32.99%	3.41%
General Motors	USD 34.61	USD 32.50	6.49%	0.73%
Ford	USD 12.00	USD 14.50	-17.24%	-2.20%
Hyundai	KRW 189.090	KRW 155.000	21.94%	2.36%
Peugeot	EUR 19.8	EUR 16.5	20.00%	2.17%

Table 4.13: *Car manufacturers expected returns. Source: Bloomberg, own estimations*

Toyota, Peugeot and Hyundai seem to be undervalued. Investors are recommended to take long positions on those stocks. The expected returns for Volkswagen and General Motors are relatively low, fundamental prices are close to their current values. Finally, the only stock which seems to be overvalued is Ford.

4.8. **Optimal portfolio**

The fundamental analysis allowed investors to determine the mispricing of car manufacturers. Investors should go long on all stocks except Ford. However, due to the correlation effect, going long on a wide majority of plays could induce a high level of idiosyncratic volatility. An investor could seek to mitigate idiosyncratic risk within its portfolio. Similarly as for the systematic risk, we can construct a portfolio theoretically hedged against idiosyncratic volatility. In this situation we also limit long positions to 100% of the total investment value and short positions to 50%. The optimization process embraces the following pattern:

$$Max \sum_{i=1}^{I} E(R)_i$$

$$\text{u.c. } \sigma^2(e)_p = \sum_{i=1}^{I} w_i^2 * \sigma_i^2 + \sum_{i=1}^{I} \sum_{j=1}^{J} Cov(i,j) * w_i * w_j = 0 \quad \forall i \neq j$$

$$-0.50 \leq w_i \leq 1 \quad \forall i = 1, ...n$$

$$\sum_{i=1}^{I} w_i = 1$$

[26] As of April 15^{th} 2016

The constraints are exactly the same as used for the systematic section except that here, the portfolio is not market neutral. This implies that the portfolio is subject to market movements. Based on the monthly expect returns depicted in section 4.6, the optimal portfolio is displayed in the Table 4.14.

	Weight	$E(R)$
Volkswagen	-50%	-0.19%
Toyota	100%	3.41%
General Motors	0.04%	0%
Ford	-50%	1.10%
Hyundai	100%	2.36%
Peugeot	-0.04%	0%
Portfolio	100%	6.68%

Table 4.14: *Monthly expected returns of the optimal portfolio built on fundamental analysis. Source: Bloomberg, own estimations*

The optimum portfolio exhibits large expected returns, mainly driven by the large positions in Toyota and Hyundai. Those two stocks account for 89% of the expected return of the portfolio. Surprisingly, we find negative weights for Volkswagen and Peugeot whereas the fundamental analysis concluded they were undervalued. The short position is explained by the zero idiosyncratic constraint. As car manufacturers are globally positively correlated, only a combination of long and short positions can remove the idiosyncratic risk of the portfolio. Only shorting Ford does not allow the investor to hold a portfolio without idiosyncratic volatility. Therefore, short positions are required on Volskwagen and Peugeot, even though they are undervalued according to the fundamental analysis.

4.9. **Comparison between systematic and fundamental approaches**

If we compare the outcomes of both investment strategies based on market and fundamental approaches, we observe relatively similar trends (cfr. Table 4.15). Both methods suggest to take large long positions on Asian car manufacturers and to go short on Ford and Peugeot. Returns of both portfolios are not comparable as the systematic-based portfolio is more restrictive than the fundamental portfolio.

	Systematic approach	Fundamental approach
Volkswagen	Long	Short
Toyota	Long	Long
General Motors	Short	Long
Ford	Short	Short
Hyundai	Long	Long
Peugeot	Short	Short

Table 4.15: *Comparison between the systematic and fundamental approaches*

5. Conclusion

This paper develops investment strategies for six of the largest car manufacturers: Volkswagen, Toyota, General Motors, Ford, Hyundai and Peugeot. The two investment strategies intend to reap benefits from market anomalies.

In the market neutral approach, equity mispricing was estimated by removing returns derived from risk-factors (Risk premium, SMB and HML). The remaining expected return (i.e. the intercept of the regressions) is the return aspect which is not dependent from risk factors. It corresponds to stocks' alphas, which are continuously scoured by active investors. The portfolio developed in that section was mean but not variance neutral. Finally, we remove idiosyncratic volatility from the portfolio. Through this investment strategy, an investor expects a monthly return of 1.67%, mainly driven by large long positions on Toyota and Hyundai.

The second approach intends to directly estimate the fundamental aspect of returns by analysing firms' intrinsic characteristics. We observe that a logistic regression based on lagged fundamental ratios does not capture the structure of excess returns and fail to predict the nature of future excess returns. The weakness of the logistic regression has different sources. Ratios are only a snapshot of reality, they do not have a continuous aspect. The logistic regression aims to predict stock returns only with historical data. They do not consider any future prospectives of the company. This last point is crucial. An active investor is more concerned about future prospectives rather than historical performance. Therefore it is necessary to estimate the fundamental value of each car manufacturer with a model that takes future prospectives into account.

Consequently, we opt for a discounted free cash-flow model. This bottom-up method postulates that a firm's value is the sum of all the discounted future cash-flows. Despite the theoretical validity of such a model, final outcomes highly rely on analysts' assumptions. In order to keep consistency in the valuations, all the inputs assumptions required to estimate firms' average cost of capital have been kept constant. We observe a global undervaluation in the car manufacturing industry. This trend has potentially two sources.

Firstly, the efficient market hypothesis fails to explain excess volatility, bubbles, seasonality in returns, January effect, etc. Consequently, many studies have concluded to market inefficiency and this hypothesis is now seen as truth on relative basis (Degutis and Novickyte, 2014). By rejecting the EMH, stock prices do not immediately reflect all the available information. Car manufacturers are currently preparing the future and identified growth opportunities. The global undervaluation of car manufacturers could suggest that investors did not fully assimilated the information relative to growth opportunities.

Secondly, firms are currently operating under extraordinary low interest rates. Consequently, the weighted average cost of capital is low for each car manufacturer. A low discount factor due to unordinary market conditions could also explain the global undervaluation of car manufacturers. The only company that is currently overvalued (i.e. Ford) is the only one that does not present a real business plan for the upcoming years. The lack of real growth strategy is certainly seen as a negative signal for investor, explaining the overvaluation.

The portfolio constructed on fundamental analysis is expected to generate large returns, mainly driven by Toyota and Hyundai. Fundamental strategy is expected to generate larger returns than the market neutral strategy because the portfolio is less restrictive (there is no constraint relative to a risk-factor hedging).

Finally, if we compare the mean market neutral strategy with the fundamental analysis, we observe similar conclusions. In both approaches, we take advantage of the undervaluation of Hyundai and Toyota whereas we go short on Ford. Those three companies are the returns drivers. In both strategies we short Peugeot and take only small positions on General Motors. The position on Volkswagen is the sole main difference in two portfolios.

Volkswagen is certainly the more uncertain valuation. Despite different analyses that lead to an undervaluation, the German car manufacturer's future largely depends on the total cost of fraud. The billions euro fines and the cost of recall of the cars will severely impact the future of Volkswagen. Currently, more than 600,000 employees work for Volkswagen in Germany. A bankruptcy would have a considerable impact on Germany's economy. We can easily imagine a government intervention in case of financial distress such as encountered by General Motors a few years ago.

The considerable impact of Volkswagen on the economy of Germany leads financial institutions to think that Volkswagen is probably too big to fail. This phrase came about the financial crisis of 2008 to describe U.S. banks that were bailed out by the government.

The perverse effect of state interventionism lead large companies such as Volkswagen to take risks. In fact, they know that in case of financial distress they still can be saved by their domestic government. Due to the uncertainty of Volkswagen's future, its valuation is subject to significant changes in the forthcoming months.

Extraordinary news like Volkswagen's scandal are unpredictable. Despite a global undervaluation of the car manufacturing industry, all the valuations and models developed in this paper are only adequate in normal trading situations. History tells us that investors are never protected against a financial crack or distress and that in those situations, financial models and valuations are generally weak predictors.

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6. Appendices

6.1. Fama and French risk factors estimations

6.1.1. Volkswagen

Variance analysis

	Degré de liberme des carenne des ca			*F*	*F-Value*
Régression	3	0.695972	0.231991	23.69466	3.96E-13
Résidus	196	1.919004	0.009791		
Total	199	2.614976			

	Estimate	*:andard errc*	*t-stat*	*P-value*
Intercept	0.004794	0.007099	0.675308	0.500276
Rm - Rf	0.009545	0.001308	7.29732	7.13E-12
SMB	0.000344	0.003151	0.109115	0.913223
HML	0.007244	0.002572	2.817016	0.005343

Figure 6.1: *Results of Fama and French 3-factors model on Volkswagen. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

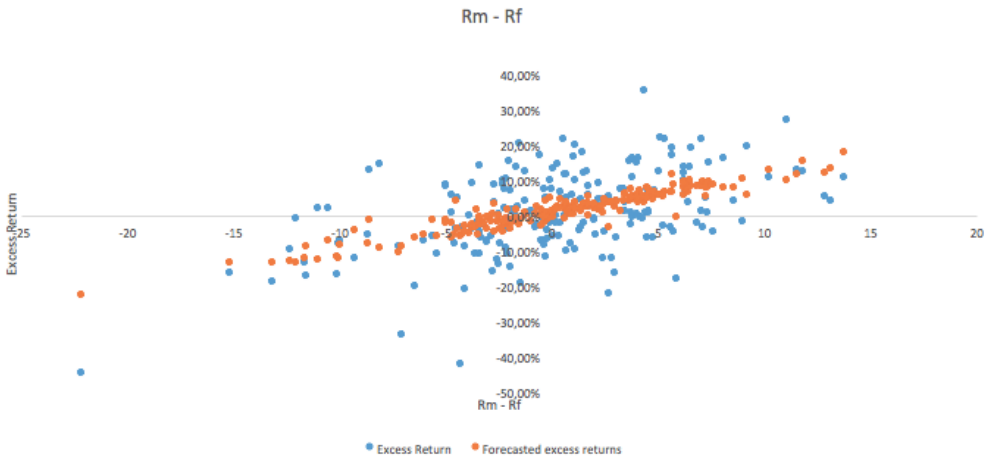

Figure 6.2: *Rm - Rf risk factor prediction on Volkswagen. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

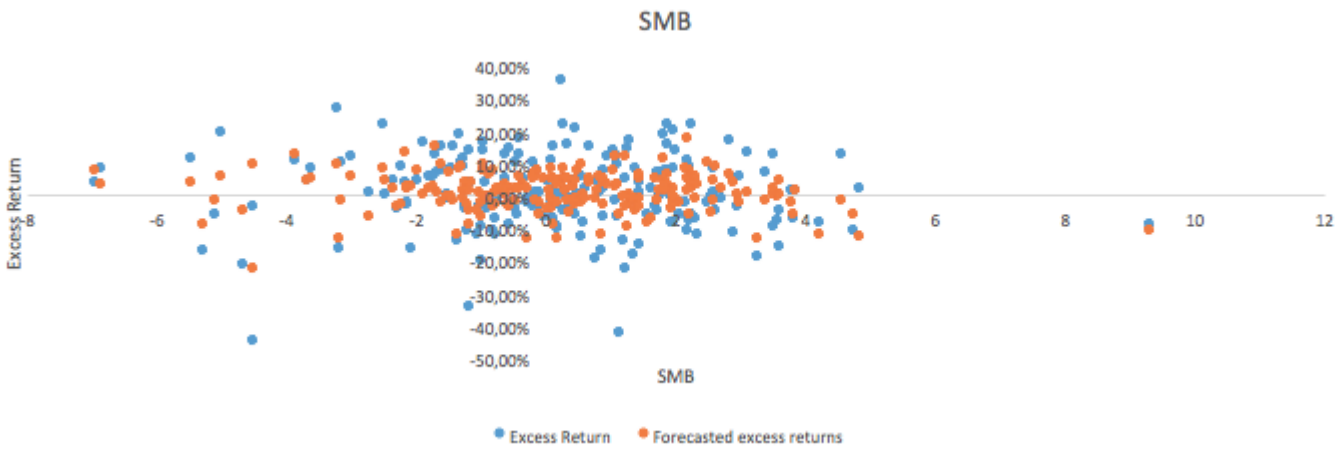

Figure 6.3: *SMB risk factor prediction on Volkswagen. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

Figure 6.4: *HML risk factor prediction on Volkswagen. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

6.1.2. **Toyota**

Regression	
R2	0.287739
Standard error	0.067409
Observations	238

Variance analysis

	Degrees of freed	*Mean squareenne des ca*		*F*
Regression	3	0.429554	0.143185	31.5104
Résidus	234	1.063305	0.004544	
Total	237	1.492859		

	Estimates	*tandard errc*	*t-stat*	*Prob.*
Intercept	0.005302	0.004409	1.202652	0.230327
Mkt-Rf	0.005786	0.00085	6.810709	8.12E-11
SMb	-0.0097	0.001393	-6.96188	3.36E-11
HML	-0.00036	0.001516	-0.23966	0.810802

Figure 6.5: *Results of Fama and French 3-factors model on Toyota. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

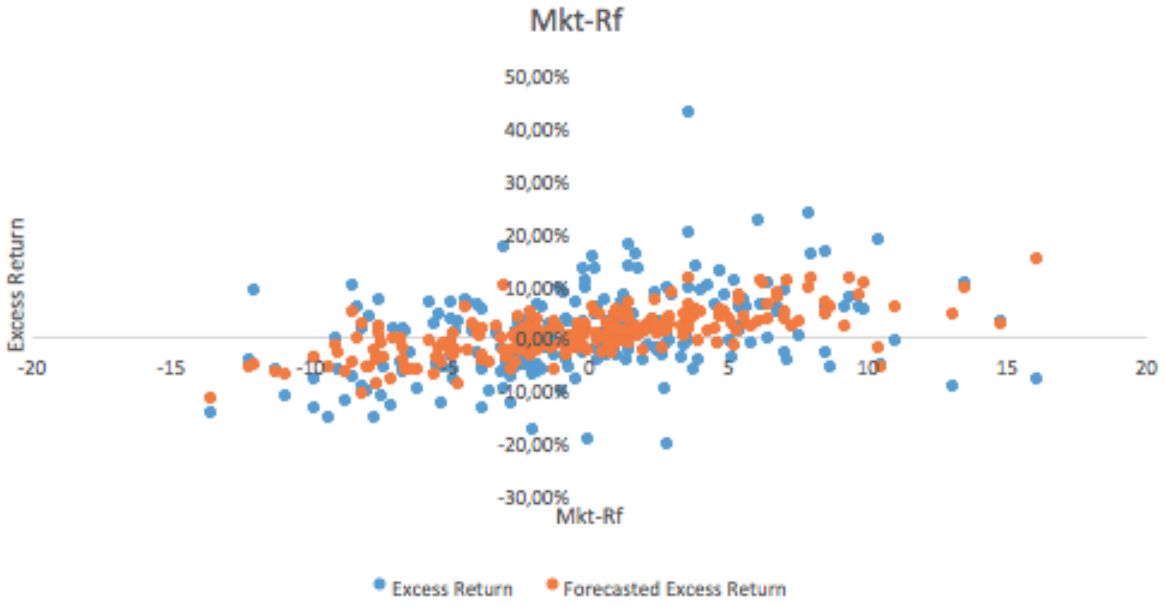

Figure 6.6: *Rm - Rf risk factor prediction on Toyota. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

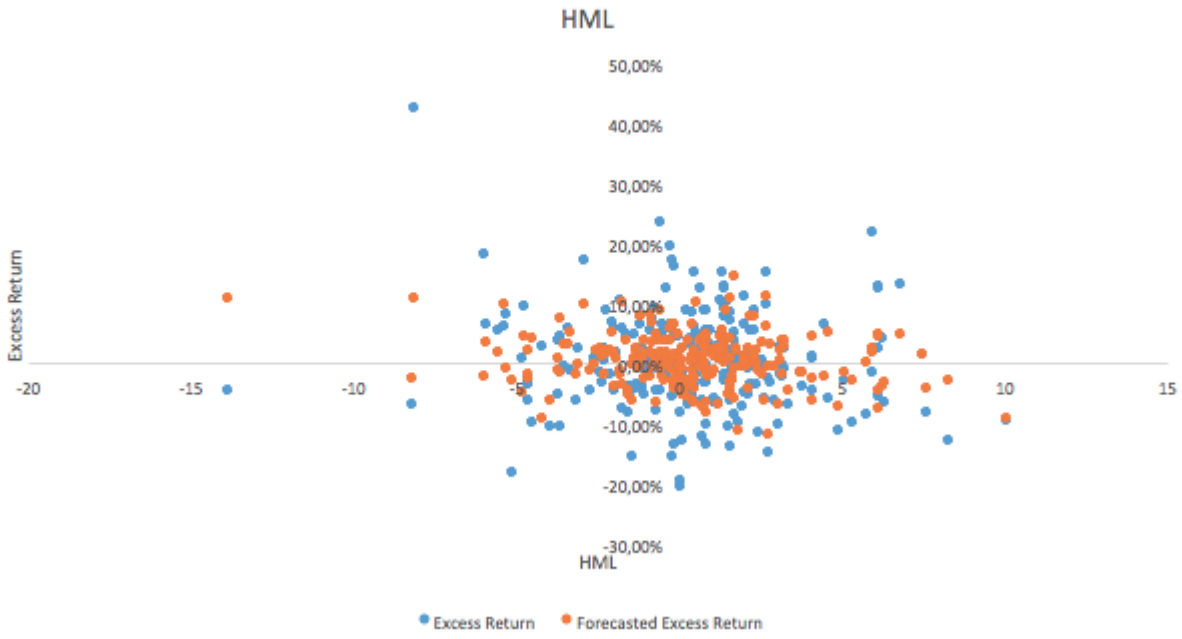

Figure 6.7: *HML risk factor prediction on Toyota. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

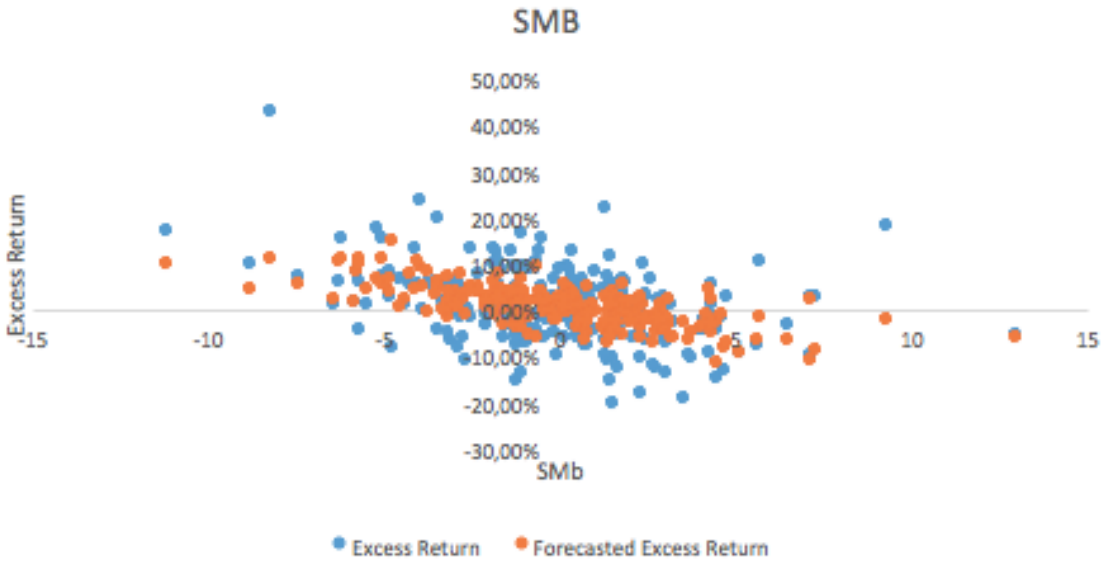

Figure 6.8: *SMB risk factor prediction on Toyota. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

6.1.3. General Motors

Statistics	
R2	0.501545
Standard er	0.062325
Observatio	63

Variance analysis

	Degrees of freed	*quare errorn*	*Squarre E.*	*F*
Régression	3	0.230602	0.076867	19.78858
Résidus	59	0.229181	0.003884	
Total	62	0.459783		

	Estimates	*:andard errc*	*t-stat*	*Prob.*
Intercept	-0.01051	0.008402	-1.25082	0.215939
Rm-Rf	0.015264	0.002397	6.36655	3.16E-08
SMB	0.005171	0.004355	1.187354	0.239846
HML	0.002276	0.004093	0.55597	0.580334

Figure 6.9: *Results of Fama and French 3-factors model on General Motors. Monthly excess returns collected on Thomson One, from 2010 to 2016.*

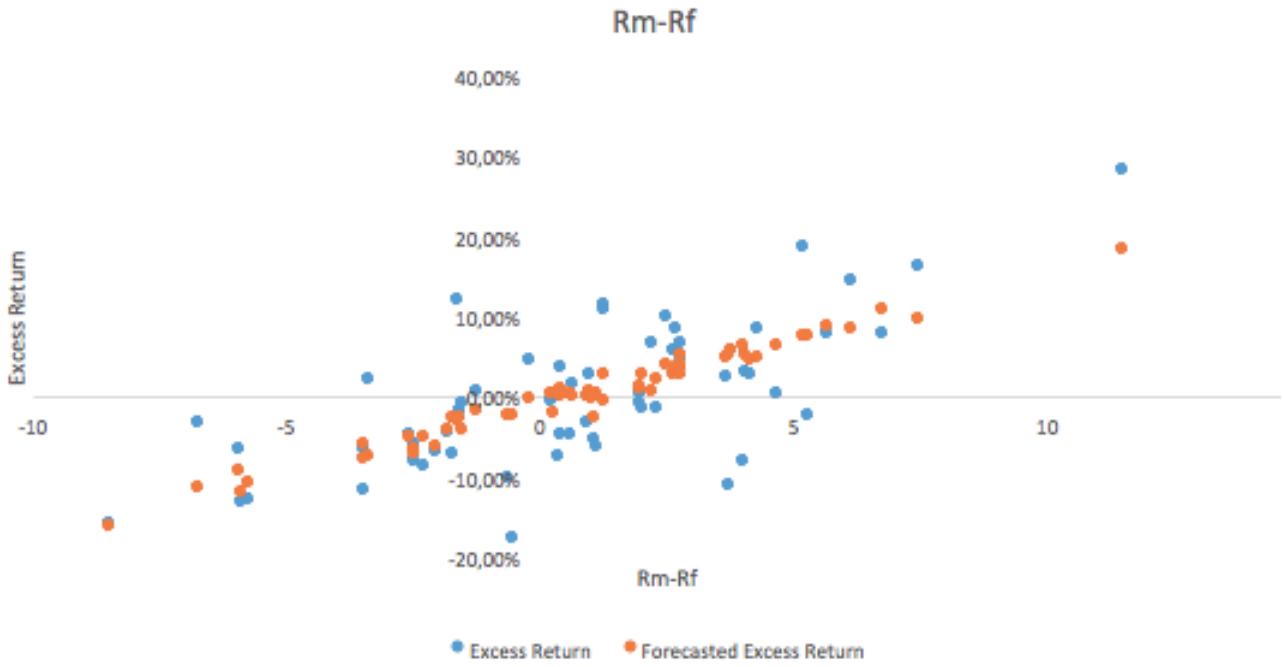

Figure 6.10: *Rm - Rf risk factor prediction on General Motors. Monthly excess returns collected on Thomson One, from 2010 to 2016.*

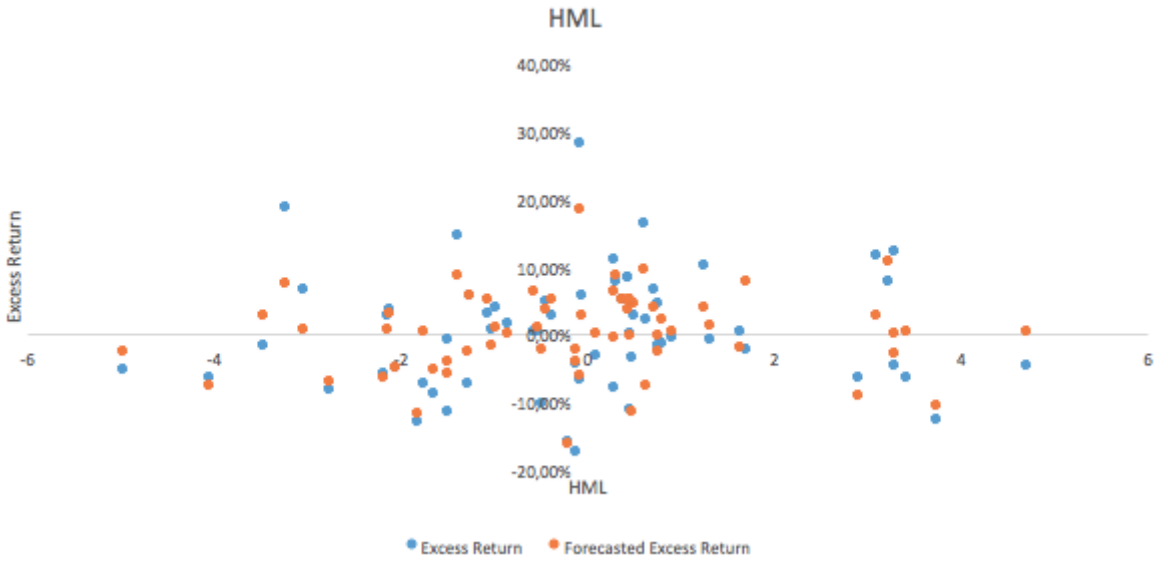

Figure 6.11: *HML risk factor prediction on General Motors. Monthly excess returns collected on Thomson One, from 2010 to 2016.*

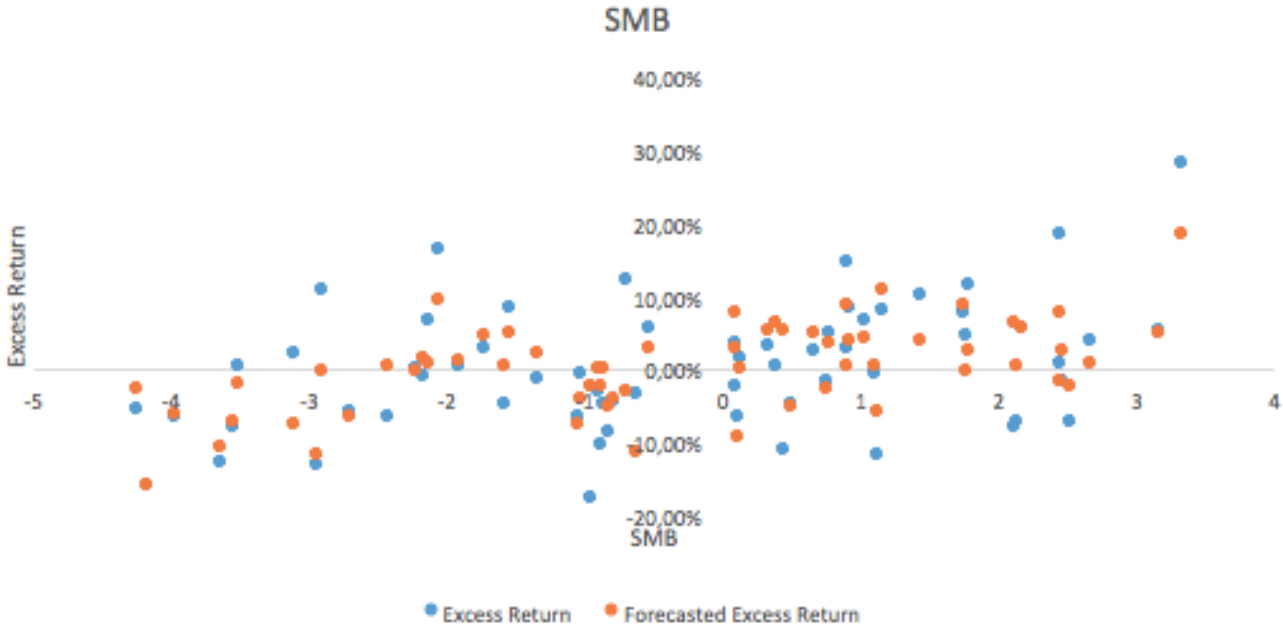

Figure 6.12: *SMB risk factor prediction on General Motors. Monthly excess returns collected on Thomson One, from 2010 to 2016.*

6.1.4. **Ford**

Statistics	
R2	0.3119
Standard error	0.118372
Observations	238

Variance analysis

	Degrees of freed	*Mean squareenne des ca*		*F*
Régression	3	1.486211	0.495404	35.35567
Résidus	234	3.278808	0.014012	
Total	237	4.76502		

	Estimate	*:andard errc*	*t-stat*
Constante	-0.00556	0.007771	-0.71576
Rm-Rf	0.017343	0.001751	9.902038
SMB	0.000849	0.002572	0.33002
HML	0.009362	0.002392	3.913329

Figure 6.13: *Results of Fama and French 3-factors model on Ford. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

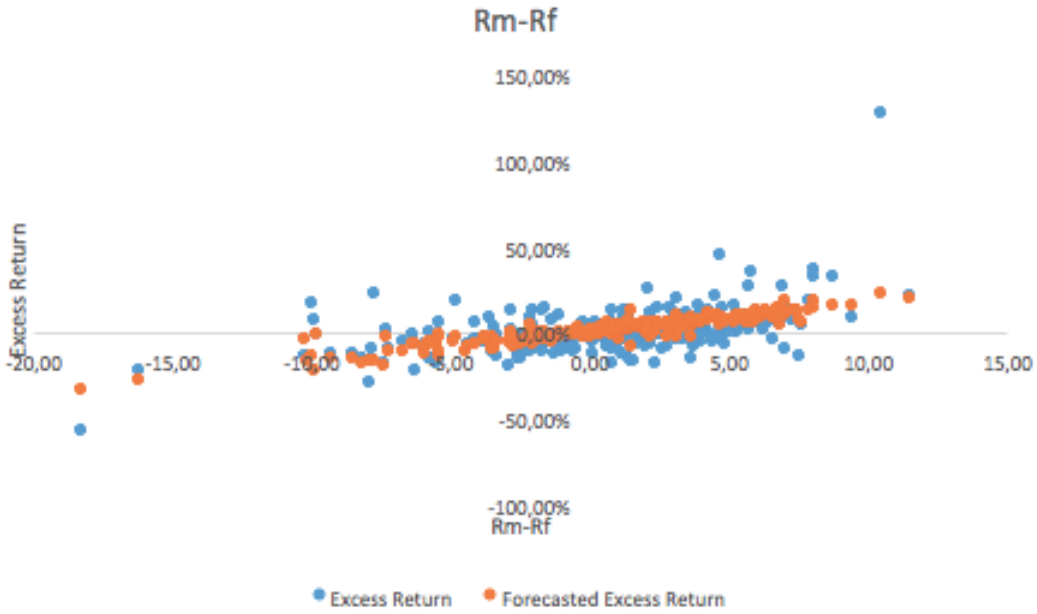

Figure 6.14: *Rm - Rf risk factor prediction on Ford. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

Figure 6.15: *HML risk factor prediction on Ford. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

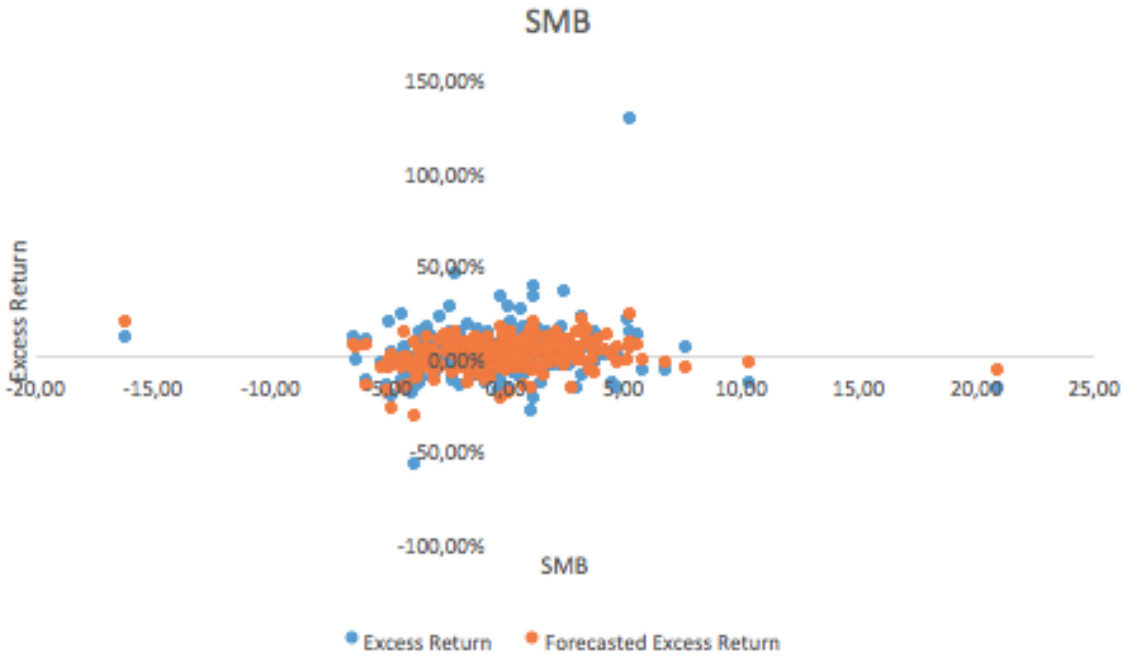

Figure 6.16: *SMB risk factor prediction on Ford. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

6.1.5. **Hyundai**

Regression	
Coefficient	0.114405
Standard er	0.102948
Observatio	195

ANALYSE DE VARIANCE

	Degrees of free	*quare error*	*n square er*	*F*	*F-value*
Régression	3	0.261506	0.087169	8.22476	3.55E-05
Résidus	191	2.024276	0.010598		
Total	194	2.285782			

	Estimates	*tandard erro*	*t-stat*	*Prob.*
Intercept	0.008316	0.007634	1.089309	0.27739
Rm-Rf	0.006294	0.001284	4.903691	2.01E-06
SMB	-0.00054	0.00253	-0.21247	0.831965
HML	0.002731	0.002788	0.979683	0.328482

Figure 6.17: *Results of Fama and French 3-factors model on Hyundai. Monthly excess returns collected on Thomson One, from 1999 to 2016.*

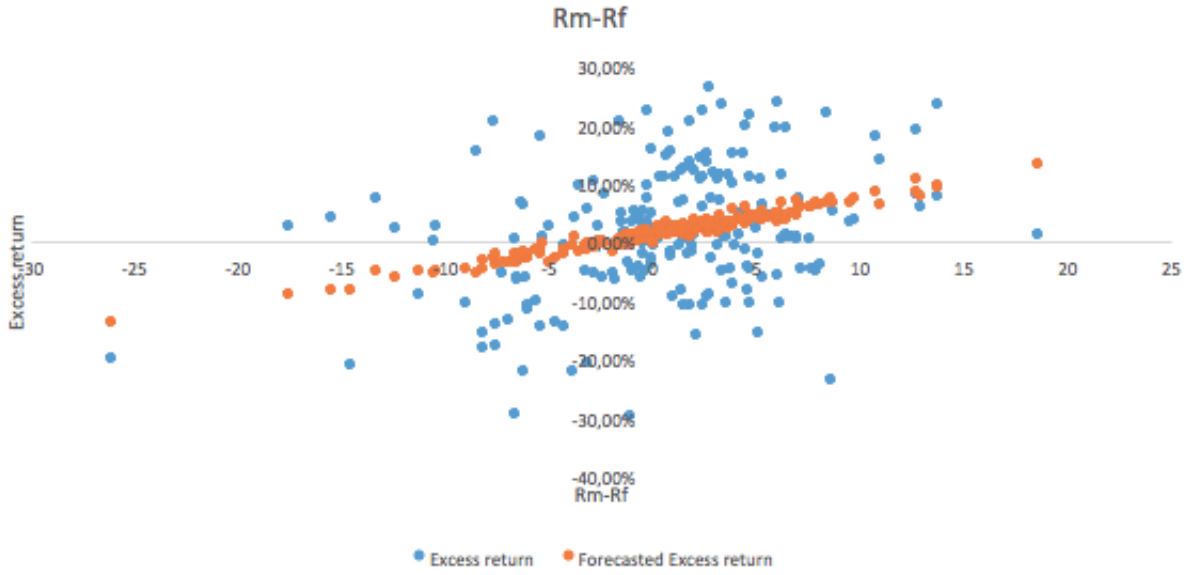

Figure 6.18: *Rm - Rf risk factor prediction on Hyundai. Monthly excess returns collected on Thomson One, from 1999 to 2016.*

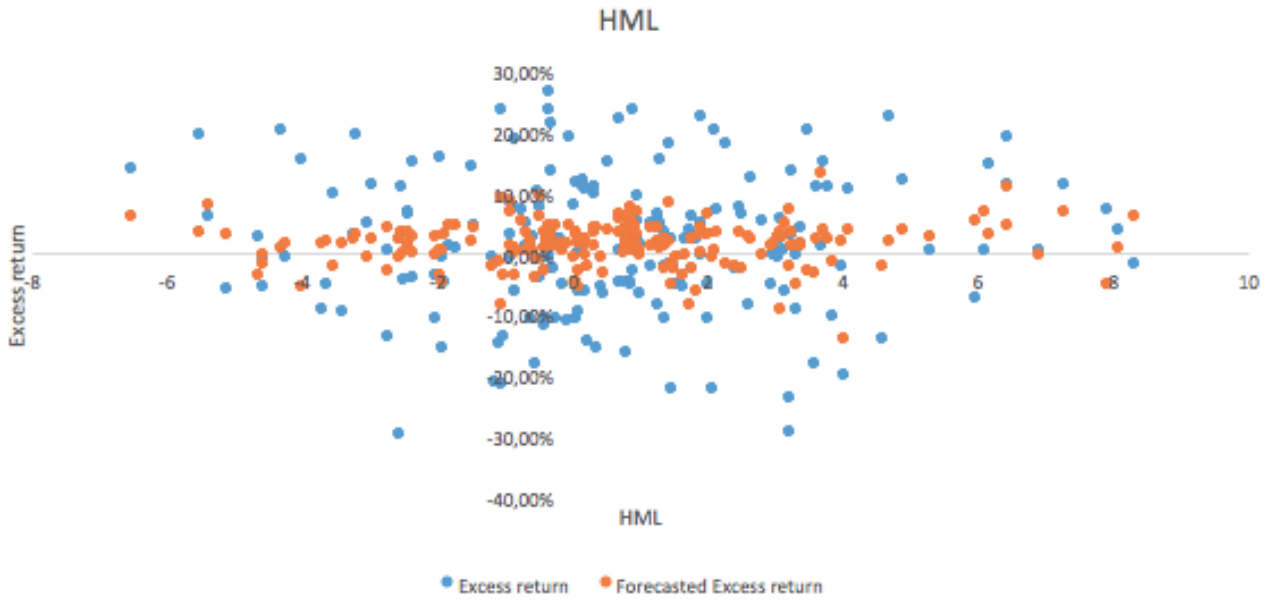

Figure 6.19: *HML risk factor prediction on Hyundai. Monthly excess returns collected on Thomson One, from 1999 to 2016.*

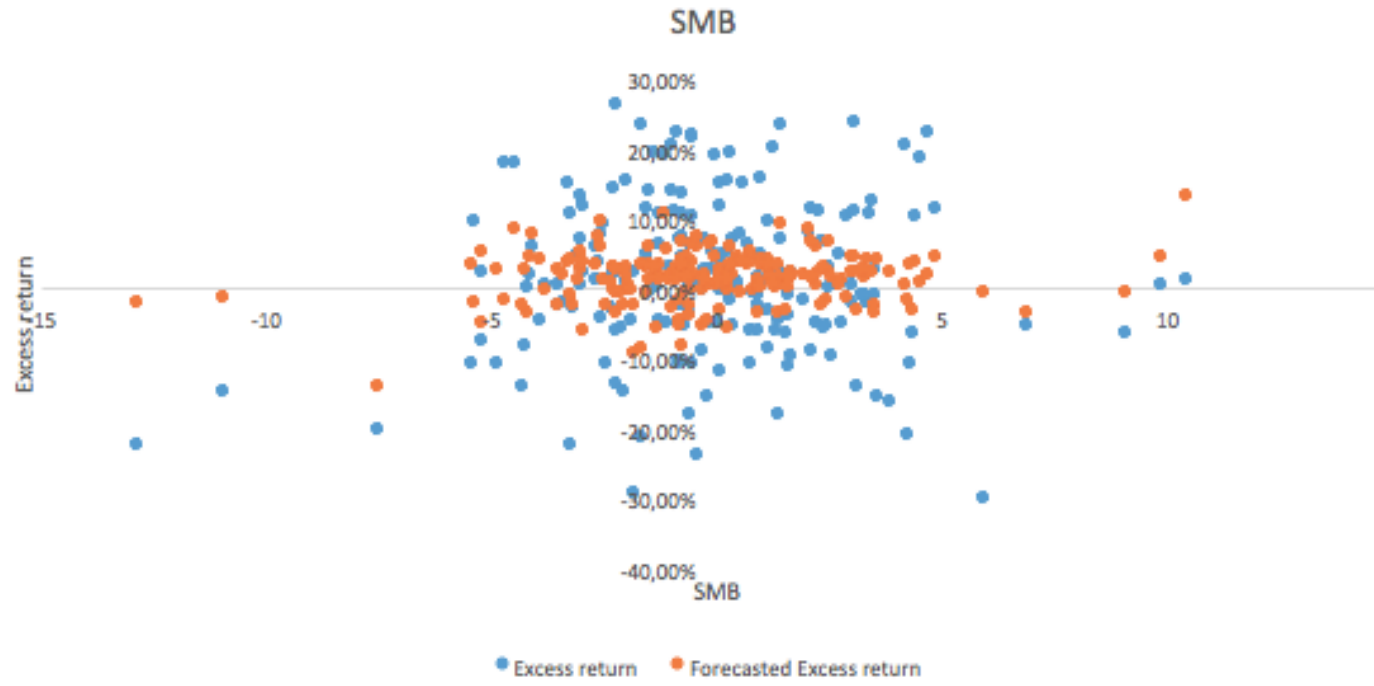

Figure 6.20: *SMB risk factor prediction on Hyundai. Monthly excess returns collected on Thomson One, from 1999 to 2016.*

6.1.6. **Peugeot**

Regression	
R2	0.276931
Standard er	0.091827
Observatio	238

Variance analysis

	Degrees of freed	*Square error*	*Mean square error*	*F*	*F-value*
Régression	3	0.755688421	0.25189614	29.87344928	2.18E-16
Résidus	234	1.973113191	0.008432108		
Total	237	2.728801612			

	Estimates	*Standard error*	*t-stat*	*Prob.*
Constante	-0.00213	0.006029278	-0.35310655	0.724326447
Rm-Rf	0.010337	0.00117436	8.801992297	3.02926E-16
SMB	0.00272	0.002601713	1.045419901	0.296907655
HML	0.004008	0.002335367	1.716241264	0.087441319

Figure 6.21: *Results of Fama and French 3-factors model on Peugeot. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

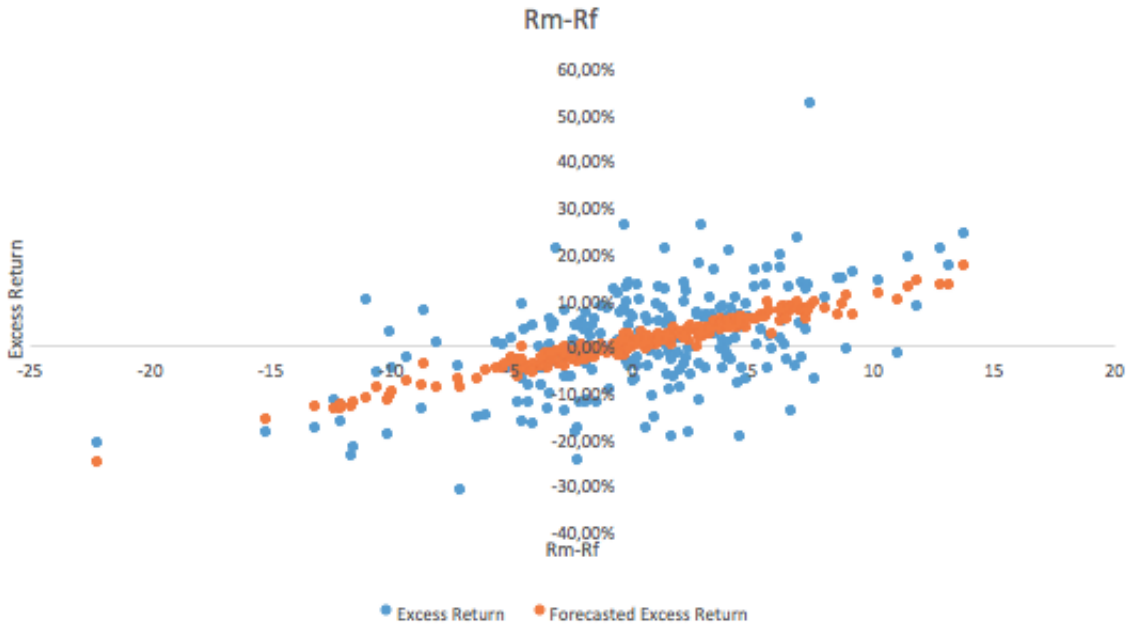

Figure 6.22: *Rm - Rf risk factor prediction on Peugeot. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

Figure 6.23: *HML risk factor prediction on Peugeot. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

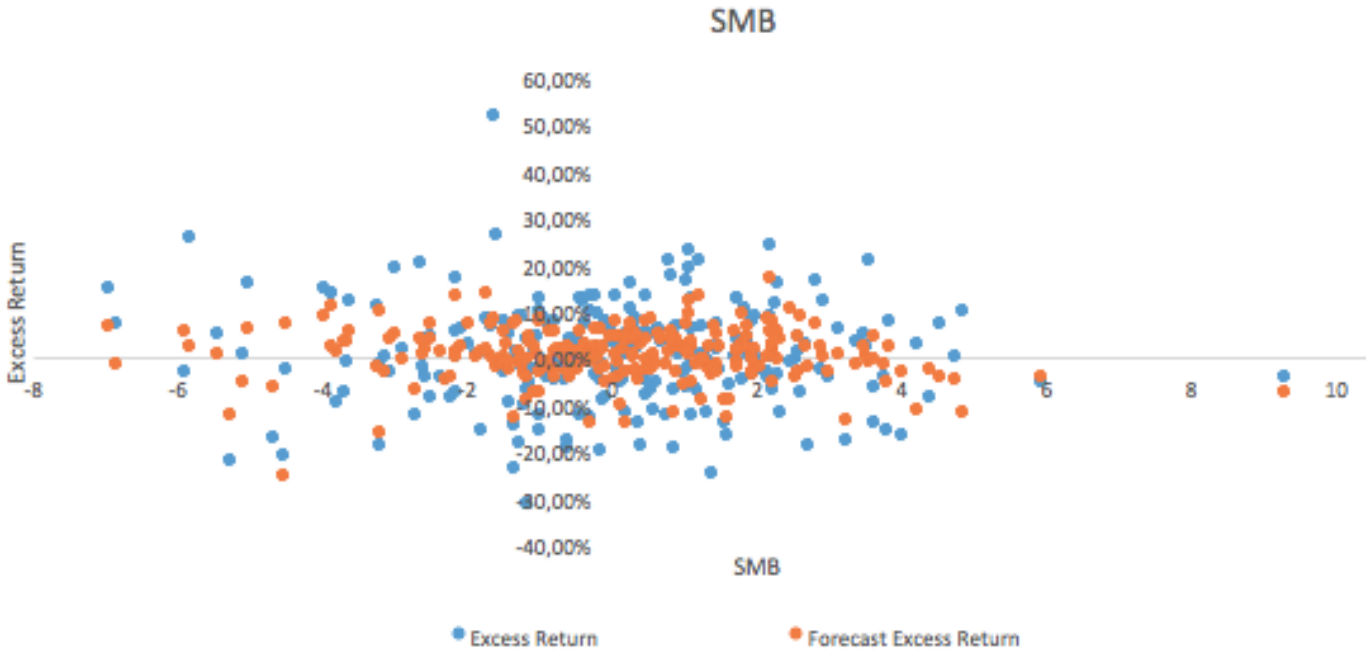

Figure 6.24: *SMB risk factor prediction on Peugeot. Monthly excess returns collected on Thomson One, from 1996 to 2016.*

6.2. **Broker estimations**

6.2.1. **Volkswagen**

Contributor	Target Price	Estimation Date	Recommendation
Bankhaus Lampe KG	94.00	11/01/2016	Sell
Barclays	106.00	13/11/2015	Hold
Berenberg Bank	160.00	30/11/2015	Buy
BofA Merrill Lynch	93.00	3/02/2016	Underperform
Citigroup Inc	163.00	19/01/2016	Buy
Clal Finance Ltd	160.00	8/02/2016	Buy
Credit Suisse	79.00	10/02/2016	Underperform
Deutsche Bank	135.00	1/02/2016	Hold
Dz Bank AG	83.00	5/01/2016	Sell
Evercore Partners Inc.	200.00	11/01/2016	Buy
Exane BNP Parisbas	143.00	19/01/2016	Outperform
Goldman Sachs	129.00	16/12/2015	n.d.
HSBC	111.00	25/01/2016	Hold
JP Morgan	169.00	7/01/2016	Hold
Landesbank Baden-Wuerttemberg C	161.00	4/01/2016	Buy
MainFirst Bank AG	193.00	10/02/2016	Buy
Morgan Stanley	125.00	11/02/2016	Hold
Morningstar Inc.	190.00	15/01/2016	Buy
Natixis S.A.	102.00	29/10/2015	Hold
Nord Landesbank	90.00	13/02/2016	Hold
Oddo Securities	135.00	10/12/2015	Hold
Redburn Partners LLP	140.00	26/01/2016	Hold
Societe Generale Cross Asset Reset	135.00	7/01/2016	Hold
UBS Investment Bank	160.00	22/01/2016	Buy
Warburg Research GmbH	140.00	3/02/2016	Hold
WGZ Bank AG	95.00	6/01/2016	Sell
Mean	130.42		Hold

Table 6.1: *Brokers recommendation on Volkswagen AG - Source: Capital IQ, Thomson One*

6.2.2. **Toyota Motor Corporation**

Contributor	Target Price	Estimation Date	Recommendation
BNP Paribas	8.800	5/02/2016	Buy
BofA Merrill Lynch	8.600	5/02/2016	Buy
Citigroup Inc	9.400	30/11/2015	Buy
CLSA Asia-Pacific Markets	8.200	17/02/2016	Buy
Credit Suisse	10.000	4/02/2016	Underperform
Daiwa Securities Capital Market Cc	8.500	8/02/2016	Buy
Deutsche Bank	9.200	8/02/2016	Buy
Evercore Partners Inc.	10.000	11/01/2016	Buy
Goldman Sachs	8.400	18/02/2016	Buy
Japan Invest Group plc	7.500	8/02/2016	Hold
Jefferies & Company, Inc.	8.000	5/02/2016	Buy
JP Morgan	6.400	16/02/2016	Hold
Macquarie Research	9.000	8/02/2016	Buy
Marusan Securities Co. Ltd	8.200	12/02/2016	Buy
Mitsubishi UFJ	8.700	5/02/2016	Buy
Mizuho Securities Co. Ltd	8.100	12/01/2016	Buy
Morgan Stanley	9.450	12/01/2016	Buy
Morningstar Inc.	7.531	9/02/2016	Buy
Nomura Securities Co. Ltd	8.300	5/02/2016	Buy
Nord Landesbank	8.100	9/02/2016	Buy
Okasan Securities Co. Ltd	9.400	25/12/2015	Buy
SMBC NIKKO	10.000	5/02/2016	Buy
Susquehanna Financial Group, LLP	8.663	12/02/2016	Buy
Tokai Tokyo Research Center Co.	8.200	25/12/2015	Buy
UBS Investment Bank	6.100	18/02/2016	Buy
Mean	8.509		Hold

Table 6.2: *Brokers recommendation on Toyota Motor Corporation - Source: Capital IQ, Thomson One*

6.2.3. **Hyundai Motor Corporation**

Contributor	Target Price	Estimation Date	Recommendation
Barclays	183.000	04/01/2016	Hold
Credit Suisse	190.000	29/02/2016	Buy
CIMB Research	190.000	26/01/2016	Buy
Deutsche Bank	205.000	26/01/2016	Buy
Ebest Investments & Securities	210.000	27/01/2016	Buy
HMC Investment Securities	220.276	27/01/2016	Buy
HSBC	150.000	06/04/2016	Hold
Kiwoom Securities Co Ltd	183.000	11/01/2016	Buy
Korea Investment & Securities	200.000	27/01/2016	Buy
Macquarie Research	140.000	29/02/2016	Hold
Meritz Securities	160.000	27/01/2016	Hold
Mirae Assets	190.000	27/01/2016	Buy
Morgan Stanley	n.d.	12/02/2016	Overweight
Morningstar	169.000	22/02/2016	Outperform
Nomura	160.000	26/01/2016	Hold
Samsung Securities	190.000	27/01/2016	Buy
ShinYoung Securities	190.000	27/01/2016	Buy
UBS	180.000	8/03/2016	Buy
Yaunta Securities	180.000	27/01/2016	Buy
Mean	183.000		Buy

Table 6.3: *Brokers recommendation on Hyundai Motor Corporation - Source: Capital IQ, Thomson One*

6.2.4. **Ford Motor Company**

Contributor	Target Price	Estimation Date	Recommendation
Craig Hallum Capital	13.00	29/01/2016	Hold
Credit Suisse	13.00	22/03/2016	Sell
Deutsche Bank	16.00	22/03/2016	Buy
JP Morgan	18.00	25/01/2016	Hold
Morgan Stanley	12.00	24/02/2016	Sell
Morningstar	18.00	01/03/2016	Buy
RBC Capital Market	14.00	22/03/2016	Hold
Susquehana Financial Group	11.50	04/02/2016	Neutral
UBS	22.00	22/03/2016	Buy
Value Engine	12.00	28/01/2016	Hold
Mean	15.00		Hold

Table 6.4: *Brokers recommendation on Ford Motor Company - Source: Capital IQ, Thomson One*

6.2.5. **General Motors**

Contributor	Target Price	Estimation Date	Recommendation
Barclays	39.00	18/01/2016	Hold
Buckingham Research Group	32.00	05/01/2016	Hold
Craig Hallum	34.00	03/02/2016	Buy
Credit Suisse	38.00	03/03/2016	Hold
Deutsche Bank	34.00	10/03/2016	Hold
J.P. Morgan	47.00	04/02/2016	Buy
Morningstar	48.00	01/03/2016	Buy
RBC Capital Market	30.00	09/03/2016	Hold
UBS	47.00	09/03/2016	Buy
Value Engine	32.94	22/01/2016	Hold
Mean	38.00		Hold

Table 6.5: *Brokers recommendation on General Motors - Source: Capital IQ, Thomson One*

6.2.6. **Peugeot S.A.**

Contributor	Target Price	Estimation Date	Recommendation
Barclays	22.00	06/04/2016	Buy
Credit Suisse	13.40	05/04/2016	Hold
Evercore	17.00	24/02/2016	Hold
Finlabo SSIM SPA	16.00	18/04/2016	Buy
HSBC	18.00	06/04/2016	Buy
Kepler Chevreux	18.00	06/04/2016	Buy
Minkabu	16.95	08/04/2016	Buy
Morgan Stanley	13.00	05/04/2016	Underweight
Morningstar	11.00	17/02/2016	Sell
Natixis	23.00	05/04/2016	Buy
Societe Generale	15.00	06/04/2016	Hold
UBS	15.00	05/04/2016	Hold
Mean	15.00		Hold

Table 6.6: *Brokers recommendation on Peugeot S.A. - Source: Capital IQ, Thomson One*