# The Relationship Between Cash Flow And Capital Expenditure: Evidence From German Automobile Sector

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Submitted to the
Department of Banking and Finance
in partial fulfillment of the requirements for the Degree of

Master of Science
in
Banking and Finance

Eastern Mediterranean University
August 2014
Gazimagusa, North Cyprus

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# ABSTRACT

The present study investigates the long run equilibrium relationship between cash flow and capital expenditure in German automobile sector as one of the leaders of the automobile industry in the world. Johansen co-integration test confirmed the relationship between cash flow and capital expenditure in the long run. Cash flow has significant and inelastic impact on capital expenditure (-0.963). Error correction model reveals that capital expenditure in German automobile sector converges to its long term equilibrium level reasonably at 31.5% by the contribution of cash flow from operating activities. In short term, effect of cash flow operating on capital expenditure is statistically significant at $\alpha$=0.1, and it proves that there is a short term relationship between cash flow from operating activities and capital expenditure.

Furthermore, this study has proved that the relationship between cash flow and capital expenditure can fluctuate as businesses goes through different cycles of small and large capital expenditures.

**Keywords:** cash flow from operating activities, capital expenditure

# ÖZ

Bu çalışma, otomobil sektöründe dünyanın önde gelen ülkelerden biri olan Almanya'daki nakit akışlarının ve sermaye harcamalarının arasındaki uzun dönemli ilişkisini incelemektedir. Johansen kointegrasyon testi nakit akışları ve sermaye harcamaları arasındaki bu ilişkiyi teyit etmiştir. Nakit akışı, sermaye harcamaları üzerinde esnek olmayan bir etkiye sahiptir (-0,963). Hata düzeltme modelinin ortaya çıkardığı üzere, Almanya'daki sermaye harcamaları uzun dönemde yüzde 31.5 seviyesinde nakit akışlarının yönetim aktivitelerinden sağlanan katkıyla birleşmektedir. Kısa dönemde ise, nakit akışlarının sermaye harcamaları üzerindeki etkisi istatistiksel olarak alfa 0,1 seviyesinde anlamlı çıkmıştır, bu sonuç nakit akışları, yönetim aktiviteleri ve sermaye harcamaları arasında kısa dönemde bir ilişki olduğunu göstermektedir.

Bununla birlikte, bu çalışma göstermiştir ki, nakit akışları ve sermaye harcamaları konjonktür değişimlerine bağlı olarak dalgalanabilmektedir.

**Anahtar Kelimeler:** yönetim aktiviteleri nakit akışları, sermaye harcamaları.

# ACKNOWLEDGEMENT

First of all, I would like to thank God for giving me the perseverance and energy to complete my project and throughout my life. Next, I would like to express my special thanks of gratitude to Prof. Dr. Salih Katırcıoğlu for his guidance and constant supervision as well as for providing necessary information regarding the project & also for his support in completing the project.

I would like to express my gratitude towards my parents who have been a constant source of inspiration and support during the preparation of this project and my life.

Lastly, I would like to thank my friends for the encouragement and support through tough times and those who have lent a hand to complete this thesis.

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| | |
|---|---|
| ADF | Augmented Dickey Fuller |
| AIC | Akaike Information Criteria |
| CE | Capital Expenditure |
| CO | Cash Flow from Operating Activities |
| ECM | Error Correction Mechanism |
| ECT | Error Correction Term |
| EG | Engle Granger |
| IPS | Im, Pesaran and Shin |
| LLC | Levin, Lin and Chu |
| PEG | Pedroni Engle Granger |
| PP | Phillips Perron |
| VECM | Vector Error Correction Model |

# Chapter 1

# INTRODUCTION

Cash flow is widely recognized and considered as one of the most important inputs and factors in analyses of financial health and growth of the company. Management performance evaluation is mostly dependent on cash flow relationships such as investment coverage ratio and total coverage ratio.

Companies use financing, operations and investment for earning cash. Negative cash flow necessarily doesn't mean that the company has bad performance and inevitably is not a sign of a bad company. The reason behind that is that new and young companies spend lots of their cash into capital spending. These companies must have a reason behind their spending and they have to expect a reasonable earning from their investment. Companies with enough cash in hand are able to invest their cash into the business for generating more cash and profit. In personal financing, cash outflows are from expenses or investments. Cash flow can be used as a sign to show the company's financial strength.

Components of cash flow are valuable data for predicting bankruptcy, classification of loan risk and bond ratings. Cash flow statement is one of the most practical financial tools for evaluation and suitable allocation of financial recourses. It shows the quality of management tradeoffs and creates a benchmark for judging the effectiveness of it and helps for making decisions about the changes in the company’s strategies.

In 1980s, Western accounting theorists believed that cash flow is a basic in measurement of performance of a company and represented the cash as the king. It has become the most widely used and robust index that the US SEC required all the companies to use cash flow as an important index in their annual reports.

Different studies have shown that the cash flow components, as part of total cash flow, differ from company to company. The important factors are size and industry group of the companies. Vogt (1997) defined the free cash flow as operating income before depreciation, less interest expense on debt, less dividends (preferred and common) and income taxes. Relationship of cash flow and capital spending explained by Vogt's (1994) by analyzing the Jensen's theory of free cash flow (1986) and realized that, since monitoring costs are too much and managers can benefit the company's over-investment, so cash flow will affect the capital expenditure intensely after considering for the cost of capital.

One of the favorite ways of measuring the company financial performance is considering the amount of free cash flow of the company which is calculated by operating cash flow minus capital expenditures. The size of free cash flow shows the amount of cash that a company generates, after paying all the money that is needed to maintain or increase its asset base. The importance of free cash flow comes from the allowance of the company to go for the opportunities that increase the shareholders' wealth. With no cash in hand, it's not possible to invent or develop new products, paying dividends and minimize debt.

Free cash flow can be wasted by managers on unprofitable capital spending. This unprofitable spending results in an increase in the cost of conflict between owners

and managers. Jensen (1986) also described free cash flow as excess of cash after investing all NPV positive projects while discounted at appropriate cost of capital.

The sale of any product represents what a business or a person expects to earn or to spend. Having enough cash in hand is essential for the solvency and will ensure the on time payment to creditors, employees and others. If the cash in hand is not enough, it can end in bankruptcy. The free cash flow related hypothesis also suggests that excess of cash flow in a company will be wasted on value and has a negative effect on capital expenditure because managers try to raise the asset of the firm rather than giving them to shareholders. (Jensen, 1986)

Cash flow statement is necessary for analysis of financial performance. When cash flow to capital expenditures ratio increases, it shows that the company has the financial ability to invest without borrowing money and through capital expenditure and it can be a good sign in a company. It is important to point that this ratio is an industry specific ratio and should be compared with the companies that have similar capital expenditure requirements.

Capital expenditure is usually found on the cash flow statement as the investment in equipment, plant or property. Public traded companies usually list their capital expenditure for a specific year in annual reports, which allows stockholders to know how the company is spending or investing their money. Almost all companies have capital expenditures on the yearly basis as they upgrade equipment and facilities consistently.

Free cash flow persuades the managers to expand the size and the number of the operations. Any unbeneficial expenditure can be the beginning of a major conflict between managers and stockholders. Sometimes free cash flow is not consistent with the main goal of the firm that is maximizing the wealth of the owners. The managers can distribute the free cash flow as the dividend or use it for share repurchase instead of wasting it on unbeneficial projects. Jensen (1986) studied the relationship between capital expenditure and free cash flow in automobile insurance industry. He tried to examine if business shape changes the manager's behavior. Jensen's theory suggests that capital expenditure rules the free cash flow.

As previous analyses showed, the agency problems in mutual firms are greater between owners and managers rather than in stock firms. It proves that the free cash flow conflicts are lower in stock insurance company rather than in mutual insurers. (Jensen, 1986)

Normally, well-known and big companies are investing the bigger proportion of their cash outflow for buying necessary equipment and plants rather than companies in a smaller size. The smaller firms are investing the least proportion of their total cash outflows as capital expenditure.

As discussed in many researches, capital spending is directly associated with the size of free cash flow, and the effect of free cash flow on capital expenditure grows as firm size decreases and insider ownership increases.

The vital part of evaluating the company's free cash flow is assessment of capital expenditure. Not attractive investments are those that the company spends a lot of

capital expenditure for them and doesn't gain corresponding rate of return. The ideal and healthy companies are those that can generate enough cash flow for the growth of a company and to fund dividends.

For a proper assessment of cash flow, it's important to calculate the necessary amount of fund and capital expenditure. Some empirical results have shown that company's financial performance and free cash flow have significant negative correlation. It proves that excess cash flow is not related to the company's financial performance or may be related in negative correlation. Researchers believe that the results are dependent on the market, industry background, study perspectives, samples and other factors.

Announcement of increase or decrease in capital expenditure influences the share price of the company with valuable investment opportunities. Although firms in industries such as high-technology, on average, may have better investment opportunities than the firms in other industries, but the ones with poor management may have lower growth than the ones in low technology and well management.

During last ten years, there was a great growth in the automobile sector that required enormous amount of capital spending. There are many companies that are worldwide active and listed in many exchanges around the world. Automakers are trying to make themselves ready for the growing demand in emerging markets. For serving in emerging markets, they are building local production facilities, producing vehicles for local consumers, increasing the sales and market sharing. Although the global automobile industry is in the middle of unprecedented expansion, growth and change but during last years, many of them faced financial and economic crisis and volatile

exchange rate. As a result of global environmental issues, many of them focused more and more on cash flow management.

Considering cash flow and capital expenditure is essential for evaluating the ability and strength of a company for obtaining long term assets with considering free cash flow. The proportion of cash flow to capital expenditure is different in businesses and through different cycles of small and large capital expenditures. This thesis regards the automobile industry of Germany as a research object and is going to analyses the relationship between capital expenditure and cash flow in the automobile sector as a basis of free cash flow.

# Chapter 2

# LITERATURE REVIEW

Cash flow has been a controversial subject in investment decisions. Internally generated cash flow and effect of it on capital investment studied before but the reason of this influence is not well known yet. Irrelevance proposition states that firms take all NPV positive projects regardless of the source of financing. (Modigliani and Miller 1958)

Fazzari, Petersen and Hubbard (2000) found out that firms with low dividends rely more on cash flow and such firms, instead of using external financing, use working capital adjustment to maintain the necessary capital expenditure in a reasonable amount in order to smooth cash flow fluctuations. They also believed that for saving the cash flow, firms have to choose a policy of low dividend payment.

Calomiris and Hubbard (1995) proved that when firms with heavy dependency on cash flow need to finance capital expenditure, they have to pay the most taxes related to undistributed profits.

Jensen (1986) suggested that for some firms (with large level of free cash flow, undistributed cash flow plays an important role in the structure of capital expenditure because these firms are more likely to waste that cash flow on investments that are not profitable.

Devereux and Schiantareelli (1990) stated that the big companies in UK are mainly dependent on cash flow financing due to manager/shareholder agency problem. The reason behind that is the higher cost of the monitoring mechanism.

In another research, Jensen and Meckling (1979) defined the agency problem between managers and shareholders. They explained that managers tend to make decisions to maximize their wealth rather than to be the representative of the shareholders. In order to limit them, shareholders can use monitoring or incentives. They further talked about the firms that have a low level of insider ownership. They stated that these firms have greater incentives for doing investment in unprofitable projects with negative expected return on new capital expenditure. Such actions would obviously be inconsistent with firm's value maximization goal.

Amihud and Lev (1981) explained that there is an enticement among managers to minimize their employment risk. Managers, by diversifying the real asset portfolio, are trying to increase the certainty of their tenure. What they do is purchasing the assets that are not related to the primary business line of that firm. There is an option for managers to finance projects by using free cash flow. By doing this, they don't need funds from the capital markets.

As explained by Myers and Majluf (1984) if enough cash flow can be generated to finance the investment, then companies may have good investment opportunities for growth. Cash flow is dependent to the expected return from new investment.

Morck, Shleifer, and Vishny (1988) explained the appropriate level of insider ownership and cash flow. Firms with high insider ownership may finance

expenditures with just internal cash flow to avoid weakening the position of their ownership. Vogt (1997) referred to companies with a high level of cash flow without facing the agency problem. They minimized the undistributed cash flow by high dividend policy and had profitable investment expenditure and not desire to depend heavily on external cash flow to fund the investment. He explained that these firms will expect positive market response to the announcement of expenditures.

Vogt (1997) used 421 firms to observe the relationship between cash flow and capital expenditure. The announced capital expenditure in positive and direct way was correlated to the level of cash flow. The level of this relationship increased for the companies with beneficial investment opportunities, bigger size and higher insider ownership. These tests also suggest that when the planned expenditure for small firms is more dependent on cash flow, capital market may have a better response to the announced expenditure.

Vogt (1997) cleared that firms with high insider ownership and with smaller size are likely to expose the liquidity problem and they may also show a willingness for profitable investment opportunities even when the cash flow is not enough. With the growth in cash flow, the number of the profitable capital investment projects also grows. As a result, when expenditure is dependent on cash flow, the announcement of capital expenditure can results in a positive reaction of the shareholders.

Vogt (1997) explained the clear diversity in the response of the market to capital expenditure. He stated that different policies regarding capital expenditure should be taken to make the shareholder value more. Jensen (1986) described the agency issue. He stated that when the managers are trying to increase their wealth by not paying

out the dividends, paying debt or share repurchase, they may invest the funds in unprofitable investments.

Lang and Litzenberger (1989) explained dividends as one of the factors for eliminating free cash flow. Vogt (1994), in his model, showed that cash flow has influence on investment expenditure and companies with ideal investment opportunities prefer paying less dividend for preserving on cash flow.

Vogt (1994) explained that companies without dividend payment may show a strong relationship between cash flow and capital expenditure while the firms with highest dividends show the weakest relationship between cash flow and investment expenditure. These results suggested that small firms with low dividend policy relied heavily on cash flow. The small and low-dividend firms, that have cash flow financed growth, are likely to be value creating. On the other hand, for large and low-dividend firms, cash flow-financed growth is destroying. He suggested that the managers in companies with a high level of cash flow should take the policy of increase in dividend payout as a way to increase the efficiency of their capital expenditure. With having this policy, the shareholders may think that expensive monitoring of managers in not necessary. Pinegar and Wilbricht (1989) in a survey of 176 corporate managers discover that 84.3% of managers are willing to use internal cash flow to fund new investment rather than external sources.

Vogt (1994) analyzed free cash flow theory of Jensen (1986) and explained that: since monitoring in the companies is a costly process and managers can take advantage of overinvestment, so the cash flow has an important effect on investment expenditure after considering the cost of capital. In the firms with constraint in

liquidity, cash flow and any change in the stock and firm's liquidity, have a noticeable effect on investment expenditure. Companies with liquidity constraint and without dividend payment policy have the most significant relationship between cash flow and investment.

Strong and Meyer (1990) described that discretionary investment and share price are negatively related. There is a positive correlation between residual cash flow and discretionary investment. This correlation suggests that residual cash flow in the firm can be used to finance unprofitable investment expenditure.

Alti (2003) found out that investment to cash flow sensitivity is higher in small firms with low dividends payout and high growth rate. Pratap and Rendon (2003), with combining financial and real frictions, tried to interpret two puzzles in the firm investment literature. In the first one, firms which are extremely constrained in liquidity are not changing their investment in response to incremental change in cash flow. In the second one, several firms increased their investment by relying on their internal funds, despite the availability of external sources of finance. He showed that due to non-convexities in the adjustment cost of technology, the investment may not be sensitive to cash flow for some liquidity constrained firms.

Brown and Petersen (2009) explained that there are many reasons to believe that investment cash flow sensitivity has decreased significantly, and the reason behind that may be the development of equity markets in US over the last three decades.

Theories behind optimal investment suggest that investments in the companies without much dependency on external financing and companies that don’t have any

significant difference in the cost of internal and external financing are less sensitive to the internally generated cash flow. Fazzari, Petersen and Hubbard (2000) explained that in the time of insignificant cost of external financing, companies prefer external funds for investments when internal funds are fluctuating.

Moyen (2004) found a strong relationship between internally generated cash flow and investment opportunities in his dynamic model. Better investment opportunities are equal to more investments and firms without any constraint can increase their externally generated capital to fund additional investments. With external financing, the investments in the companies that are unconstrained are more sensitive to cash flow in comparison with the firms that are financially constrained and don't use external financing.

The other studies such as Fazzari, Petersen and Hubbard (2000) showed that the proportion of sensitivity of investment to the amount of cash flow grows with the amount of financial constraint. In other studies, Zingales and Kaplan (1997) stated that the sensitivity of investment to cash flow in financially constraint companies is high. The empirical and theoretical researches suggest a non-monotonicity in the rate of relationship between investment and financial constraints.

Lyandres (2007) in his article stated that by changing the timing of the investment, the costs of external financing influence both the investment level and its relation and sensitivity to the level of cash flow. He also explained that when external capital is costly, as cost of external financing grows, the sensitivity of investment to cash flow increases with the same rate. Furthermore, he showed that there is a U-shaped relationship between the investment sensitivity to the cash flow that internally

generated and the cost of external funds. The reason of this U-shaped relation suggests that company's financial constraint will decrease by cash flow. It happens by making less dependency from the company to costly external funds.

Moyen (2004) stated that the companies with more financial constraint may have investments with higher sensitivity to cash flow than "least constrained" companies. Zingales and Kaplan (1997) in another paper explained that constrained firms should be known based on the quantitative and qualitative information in different reports of the company. They defined the firms without access to funds for financing their investment. He explained that these firms are likely to be constrained. He also called the companies with access to excess funds for financing their investment as the firms that are not expose to any constraints.

Ding, Guariglia & Knight (2013) in their research used a panel of over 116,000 firms in China (2000-2007). They showed that the companies with higher working capital show higher investment sensitivity in working capital to cash flow and low investment sensitivity in fixed capital to cash flow. It suggests that an active management of working capital may help firms to alleviate the effects of financial constraints on fixed investment.

# Chapter 3

# A SHORT REVIEW OF AUTOMOBILE INDUSTRY IN GERMANY

Germany is considered as the birthplace of the automobile industry. Karl Benz and Nikolaus Otto independently developed four-stroke internal combustion engines in the late 1870s. In 1901, the automobile production of Germany was about 900 cars a year. Germany is known as one of the best automobile producers in the world. Volkswagen group is one of the three biggest automobile producers in the industry.

In 2010, about 75% of the German-produced cars were exported. The reason was an increase in demand from Asian countries such as China and India. Automobile and its parts have been the principal exports in recent years. German automobile companies are ranked as the first place in the efficiency ranking. They spend 20 billion euro annually as expenditures. The automotive industry in Germany spends more money on research and development than other industries in the country. About 90,000 people are active in the area of research and development, and around ten patents are filed each day. (make-it-in-germany.com, 2014)

Five companies and their seven marques, lead the automobile production industry in Germany. Volkswagen AG, BMW AG, Porsche Audi, Daimler AG, Adam Opel AG and Ford-Werke are producing nearly six million vehicles yearly, and close to 5.5 million are produced in other countries by German brands.

## 3.1 Volkswagen Group

Volkswagen group is a multinational German automobile company that its production is beyond the passenger and commercial vehicles. They manufacture motorcycles, engines and turbo-machineries. The other activities of the Volkswagen group are financing, leasing and fleet management. In 2012, it produced the most motor vehicles in the world and named itself as the one of largest market share in Europe for more than 20 years. (volkswagenag.com, 2014)

## 3.2 Audi

In 1885, the automobile company of "Wanderer" was established. After years it became a branch of Audi AG, which also later merged into Audi. It later became the main supplier of the chassis for Gottlieb Daimler's four-wheeler.

Audi is one of the most successful automobile companies in designing, production, marketing and distributing automobiles. In 2012, it was known as the third largest manufacturer of motor vehicles. Since 1966, most of the company (99.55%) has been owned by the subsidiary of Volkswagen group. After that, Volkswagen relaunched the Audi brand by producing the new series of F103. (volkswagenag.com, 2014)

## 3.3 Porsche

The company was founded in 1931. Initially, it offered consulting and motor vehicle development work. For many years, Porsche and Volkswagen have been in a close relationship together. Ferdinand Porsche is the designer of the first Volkswagen "Beetle" and the founder of Porsche. In 1969, Volkswagen and Porsche worked together for the first time for making the Porsche 914 (with Volkswagen engine) and 914-6, which had the Porsche engine. In 2002, the Cayenne was introduced. Porsche

shared entire chassis of Cayenne with Volkswagen and Audi Q7 also was produced in Volkswagen in Bratislava. (volkswagenag.com, 2104)

About 50.73% of the voting rights in Volkswagen are owned by Porsche, as the largest shareholder. In recent years, the company has been so profitable and nowadays has the highest profit per unit sold of any car company in the globe. (volkswagenag.com, 2014)

## 3.4 BMW

In 1917, BMW started its activity as an entity following a restructuring of the "Rapp Motoren Werke" aircraft manufacturing. In 1918 and by the terms of the Versailles Armistice Treaty, BMW stopped aircraft-engine production. In 1923, the company started the production of the motorcycle. The first car by BMW production was "Dixie" that was produced in Austin motor company in Birmingham, England. In 2012, and through a survey (forbes.com) BMW was ranked as the most reputable automobile company in the world. The ranking was based upon the willingness of people for buying a car, recommendations, and investment in a company.

Almost 56% of engines in BMW are powered by petrol and the rest 44% are powered by diesel. Four-cylinder models are about 27% of those petrol vehicles, and about nine percent of them are eight-cylinder models. (Johnson and Alan, 2005)

## 3.5 Mercedes-Benz

First time it appeared in 1926 under the name of Daimler-Benz and now is part of the big three luxury automakers in Germany and among the best luxury automobile sellers with Audi and BMW. Mercedes-Benz is a multinational section of the Daimler AG. It produces luxury automobiles, buses, trucks, etc.

Mercedes-Benz has been so active in many technological and safety fields. They have had outstanding performance in inventions and innovations that commonly used in other companies in the industry. It’s one of the best known brands in the automobile industry and also among the oldest ones that are still in existence and active. (edmunds.com, 2014)

# Chapter 4

# METHODOLOGY

## 4.1 Type and source of data

Data in this work are from 1994 to 2012 and in annual form. The variables are the cash flow from operating activities (CFO) and capital expenditure (CAPEX). Variables in the data set are in Euro currency units. Cash flow from operating activities is an accounting item indicating the money a company brings in from ongoing, regular business activities such as manufacturing and selling goods or providing a service. Cash flow from operating activities also includes the fluctuations in working capital that can include any decrease or increase in the inventory, short-term debt, or fluctuations in accounts receivable and accounts payable.

The other variable in this thesis is capital expenditure (CAPEX). The figures in both variables are gathered from Thomson Reuters software data stream and cash flow statements of automobile companies in Germany.

## 4.2 Methodology

In this study, the extent of dependency of capital expenditure to cash flow from operating activities in top automobile companies of Germany has been measured through the panel data econometrics. These companies are Audi, Porsche, Volkswagen, Daimler AG and BMW. The following econometric approaches are applied; unit root tests, Johansen co-integration test and vector error correction model. The Johansen co-integration test has been done through PEG (Pedroni Engle

Granger (1987)) test and vector error correction model were carried out at various lag structures.

### 4.2.1 Empirical Model

In more details, the present study investigates the effect of cash flow from operating activities (CFO) on capital expenditure of the automobile sector in Germany. Hence, the following equation has considered as functional relationship:

$$CAPEX = f(CFO) \quad (1)$$

The capital expenditure (CAPEX) is the function of cash flow from operating activities. The functional relationship in equation one can be described in logarithmic form in the following model:

$$CAPEX_t = \beta_0 + \beta_1 (CFO) + \varepsilon_1 \quad (2)$$

Where at period t, CFO represents the cash flow from operating activities, CAPEX represents the capital expenditure and e is the error term.

### 4.2.2 Unit Root Test

At this level, Unit Root test is performed on variables to test the stationarity. (constant mean and variance)

For panel data, panel unit root tests have been suggested by Pesaran and Shin (1998), Maddala and Wu (1999), Harris and Tzavalis (1999), Choi (2001) and Levin, lin and chu (2002). Breitung t-stat tests are used as common unit root process and Im, Pesaran and Shin W-stat, ADF- Fisher Chi-square PP- Fisher Chi-square are used as individual unit root process.

Levin, Lin and chu (2002), adopted an identical procedure to the ADF test for a unit root. Here the null hypothesis is the existence of unit root. Levin, Lin and chu model takes the following form:

$$\Delta yit=\rho yi,t-1+\sum_{L=1}^{pi} \theta iL\Delta yi,t-L+zit\gamma+\varepsilon it \quad (3)$$

The error terms are independent and the ρ is identical across all the cross sections. The length of lag for the lagged variable, that is dependent, is chosen in the usual way. In the test, the trend can be included as well.

The IPS test (2003) is an alternative to the LL (1993), where all the ρ are identical and assuming a common unit root test procedure. It tests for individual unit root processes. IPS test takes the average of all the individual ADF test statistics. In this part, the null hypothesis contains a unit root for all i cross sections in each series.

The IPS (2003) model takes the following form:

$$\Delta yit=\rho iyi,t-1+\sum_{L=1}^{pi} \theta iL\Delta yi,t-L+zit\gamma+\varepsilon it \quad (4)$$

In the process of unit root test, the null hypothesis H(0) is when the series have a unit root and not stationary. Rejecting this null hypothesis means that series contain no unit root. At level, that is shown by I(0), we accept null if the series are non-stationary and then we move to the next level that is taking the first difference. For avoiding the problem of unknown data generating in unit root test and problems in rejecting the null hypothesis, the test should start from the most general model that includes both trend and intercept (Doldado, Jenkinson and Sosvilla-Rivero, 1990).

**4.2.3 Co-integration Tests**

Two approaches are applied in panel co-integration; the first one is based on the EG approach, and the other is the Johansen ML type methodology. In EG approach, the

Kao test assumes same values across all cross sections but Pedroni test assumes that they can be different across the cross sections.

The Pedroni and Kao tests are two-step (residual-based) co-integration tests (EG based (1987)). The Fisher test is combined form of Johansen test. Next level of the research is finding any co-integration between the variables, then the series is said to be co-integrated.

After realizing the order of integration for variables, co-integration between variables has been tested through Johansen co-integration test. We have to note that the series should be in the same order of integration, order (0), order (1) or order (2). In this thesis, Johansen approach applied for finding any co-integration between the variables. The test type in this process is Pedroni, EG based (1987).

**4.2.4 Error Correction Model**

The model narrows the long-run tendency of the cash flow operating to converge to its co-integrating relationship while allowing for short-run adjustment dynamics. The Error Correction Term (ECT) is the value in the form of one-period lagged of the residual from the static model. The following error correction model has followed:

$$\Delta CE_1 = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta CE_{\tau-1} + \sum_{i=0}^{n} \beta_2 \Delta CO_{\tau-1} + \beta_3(\varepsilon_{t-1}) + \mu t \qquad (5)$$

Where Δ shows a change in the CE and CO variables and et-1 is the one period lagged error correction term (ECT), The ECT in equation (5) shows how fast the disequilibrium between the short-run and the long-run values of the dependent variable is eliminated each period. The expected sign of ECT is negative (Katırcıoglu, 2010).

# Chapter 5

# EMPIRICAL RESULTS

## 5.1 Panel Unit Root Test

In this section, the result of the unit root test is presented. All variables were due to tests for unit roots at their level forms and first differences. The results of the unit root test proved that the variables were non- stationary at level except LLC for capital expenditure. Unlike the results at level, almost all variables were stationary at first difference and the null hypothesis is rejected at 1% level of significance.

CE represents capital expenditure, and CFO represents cash flow from operating activities. tT shows the most general model with both intercept and trend; tμ is the one with only intercept and without trend; t is the one with no intercept and no trend. *, ** and *** show the null hypothesis rejection at alpha 1 percent, 5 percent and 10 percent respectively. The test has been done in E-VIEWS version 7.0.

Table 5.1. Panel Unit Root Test-Level

| Statistics(level) | CE | lag | CFO | lag |
|---|---|---|---|---|
| Levin, Lin & Chu t (tT) | 1.52782 | 0 to 3 | -0.04867 | 0 to 2 |
| Levin, Lin & Chu t (tμ) | -1.48091 | 0 to 2 | 0.56149 | 0 to 2 |
| Levin, Lin & Chu t (t) | -1.67509** | 0 to 2 | 0.32552 | 0 to 3 |
| Lm-Pesaran and shin (tT) | -0.88451 | 0 to 3 | -0.96579 | 0 to 2 |
| Lm-Pesaran and shin (tμ) | -0.81670 | 0 to 2 | 0.92654 | 0 to 2 |
| Lm-Pesaran and shin (t) | _____ | 0 to 2 | _____ | 0 to 3 |
| ADF - Fisher Chi-square(tT) | 11.8272 | 0 to 3 | 15.0659 | 0 to 2 |
| ADF - Fisher Chi-square(tμ) | 12.8588 | 0 to 2 | 13.6322 | 0 to 2 |
| ADF - Fisher Chi-square(t) | 15.5572 | 0 to 2 | 10.4523 | 0 to 3 |
| PP - Fisher Chi-square(tT) | 8.25931 | 0 to 3 | 34.7293 | 0 to 2 |
| PP - Fisher Chi-square(tμ) | 10.2156 | 0 to 2 | 13.7686 | 0 to 2 |
| PP - Fisher Chi-square`(t) | 11.0174 | 0 to 2 | 17.9318 | 0 to 3 |

Table 5.2. Panel Unit Root Test-First Difference

| Statistics(first difference) | CE | lag | CFO | lag |
|---|---|---|---|---|
| Levin, Lin & Chu t (tT) | -2.19368** | 0 to 3 | -7.42073* | 0 to 2 |
| Levin, Lin & Chu t (tμ) | -3.25684* | 0 to 3 | -2.33467* | 0 to 2 |
| Levin, Lin & Chu t (t) | -7.27562* | 0 to 1 | -6.70424* | 0 to 2 |
| Lm-Pesaran and shin (tT) | -2.32503* | 0 to 3 | -7.57957* | 0 to 2 |
| Lm-Pesaran and shin (tμ) | -3.87804* | 0 to 3 | -3.92617* | 0 to 2 |
| Lm-Pesaran and shin (t) | _____ | 0 to 1 | _____ | 0 to 2 |
| ADF - Fisher Chi-square(tT) | 25.1427* | 0 to 3 | 58.4046* | 0 to 2 |
| ADF - Fisher Chi-square(tμ) | 38.1133* | 0 to 3 | 38.7732* | 0 to 2 |
| ADF - Fisher Chi-square(t) | 63.7691* | 0 to 1 | 64.9034* | 0 to 2 |
| PP - Fisher Chi-square(tT) | 48.1302* | 0 to 3 | 82.5036* | 0 to 2 |
| PP - Fisher Chi-square(tμ) | 61.5418* | 0 to 3 | 98.3630* | 0 to 2 |
| PP - Fisher Chi-square`(t) | 90.3202* | 0 to 1 | 90.3733* | 0 to 2 |

As we can see in the results, CO and CE are not stationary at level, with trend and intercept. After omitting the trend and even without trend and intercept the result was the same but both are stationary at first difference.

## 5.2 Co-integration Analysis

Our variables were not stationary at level and were stationary at first difference or integrated of order “one”. At the next level, we have to do co-integration test to check if there is any possible co-integration between CE and CO or not. For doing this, Johansen co-integration test has employed through the test type of Pedroni (Engle-Granger based). In our defined model, the dependent variable is capital expenditure and our independent variable is cash flow from operating activities. Our null hypothesis states that there is no co-integration between the variables and the alternative hypothesis and concludes as existence of co-integration among them.

As test results are shown in table 5.2, since panel PP-Statistic, panel ADF-Statistic, group PP-Statistic and group ADF-Statistic are significant at 1%, a long run relationship could be inferred between capital expenditure and cash flow from operating activities.

Table 5.3. Johansen Test for Co-integration

| | Statistic | Prob. | Statistic | Prob. |
|---|---|---|---|---|
| Panel v-Statistic | 1.103123 | 0.1350 | -2.022099 | 0.9784 |
| Panel rho-Statistic | 0.633497 | 0.7368 | 0.492251 | 0.6887 |
| Panel PP-Statistic | -3.346778 | 0.0004 | -6.594058 | 0.0000 |
| Panel ADF-Statistic | -2.807987 | 0.0025 | -4.593320 | 0.0000 |
| Group rho-Statistic | 1.505888 | 0.9340 | | |
| Group PP-Statistic | -6.620239 | 0.0000 | | |
| Group ADF-Statistic | -4.646596 | 0.0000 | | |

## 5.3 Error Correction Model Estimation

In this study, different lag levels were tried until lag 2. According to co-integration results, long run vectors were found between capital expenditure and the independent variable. Based on our model (CAPEX =f (CFO) we have to estimate the long term coefficient and the error correction model for measuring short term coefficient. As can be seen in table 5.3, short term coefficients are not statistically significant which proves that there is no short term relationship among variables. Error correction model in lag one is 17.85 percent that is negative and statistically significant and proves that short run capital expenditure values converge to the level of its long run equilibrium by 17.85 percent speed of adjustment in yearly basis by the contribution of cash flow from operating activities. In long term, when cash flow operating increases by 1 unit the capital expenditure decreases by 1.468125 units and it is statistically significant. We continue the VEC to lag 2 to check if the results are more satisfactory or not.

With consideration of lag 2, we realize that short term effect of cash flow from operating activities on capital expenditure is statistically significant at $\alpha=0.1$ and it proves that there is a short term relationship between cash flow from operating activities and capital expenditure. If CO increases by 1 unit, CE decreases by 0.419077 units in the short term at lag one and 0.423868 units in lag two.

As results are shown in the table 5.3, short run values of capital expenditure converge to the level of its long run equilibrium by 31% speed of adjustment in yearly basis by the contribution of operating cash flow. When cash flow from operating activities increases by 1 unit, the capital expenditure decreases by 0.963646 units in the long term and it is statistically significant.

Table 5.4. Long Run Coefficient
Dependent variable: CE

| | coefficient | Standard error | t-statistics |
|---|---|---|---|
| CO(-1) | -0.963646 | 0.22887 | -4.21051 |

Table 5.5. Short Run Coefficient
Dependent variable: CE

| | coefficient | standard error | t-statistics |
|---|---|---|---|
| cointEq1 | -0.315046 | 0.07464 | -4.22077 |
| D(CO(-1)) | -0.419077 | 0.13961 | -3.00176 |
| D(CO(-2)) | -0.423868 | 0.15443 | -2.74481 |
| C | -173280.4 | 343952 | -0.50379 |

Adj. R-squared= 0.189443, R-squared=0.244961, Akaike AIC=32.69866
F-statistic=4.412311, S.E. equation=2933151, Schwarz SC=32.88547

# Chapter 6

# CONCLUSION AND POLICY IMPLICATIONS

This thesis has focused on the relationship between cash flow and capital expenditure in the automobile industry of Germany, which is the absolute leader of automobile production in Europe since the 1960s. It's one of the largest employers in the country and the world and has one of the biggest labor forces. As discussed before, automobile industry uses heavy capital expenditure. This amount of capital expenditure caused by changing models very frequently and most of it is needed for different levels in the industry such as design, production of new panels, presses, software, etc. The long run models in the present thesis show that cash flow and capital expenditure have statistically significant and negative relationship. Error correction model shows that capital expenditure converge to its long term equilibrium level at 31 percent speed of adjustment by the contribution of cash flow from operating activities which can be assumed as a reasonable convergence in terms of econometrics.

As stated before, automobile industry is one of the most capital intensive industries. Some of the general expenditures among industries are cost of machineries, factory, equipment, fixtures, trademarks, designs, etc. The relationship between cash flow and capital expenditure (as a basis for calculating free cash flow) is an important ratio for researchers and investors. The significance of this relationship demonstrates the ability of the industry to acquire long term assets by using free cash flow. As the

rate of relationship between cash flow and capital expenditure increases, it can be a positive sign.

As results prove in this thesis, the relationship between cash flow and capital expenditure is not positive and can move up and down during different cycles of large and small capital expenditure. The result obtained in this thesis shows a negative relationship between cash flow and capital expenditure in the automobile sector which is a capital intensive industry. The final results are inconsistent with the findings of Vogt (1997) who tried to investigate the relationship between cash flow and capital expenditure in 421 firms. He found out that capital expenditure is related to the level of cash flow strongly and positively.

Sometimes and in some sectors, the level of capital expenditure can be so low. It can be caused by the cycle of small capital expenditures for that industry and for a specific period. It's clear that shareholders have benefitted from companies' preference for returning cash via buybacks and dividends versus investments. If the industry is spending so much cash, there should be a good reason behind that and they should earn a reasonable high rate of return on their investments. At this level, the managers should convince the share-holders for more investment. The result of this research clearly shows the conflict between the managers and the shareholders and, as a result, there should be a balance between managers and shareholders desires for keeping the free cash flow in a reasonable level for maximizing shareholders' wealth. Financial discipline of the German automobile industry and the way of avoiding the agency problem, by keeping a balance between cash flow and capital expenditure, can be a guideline for other industries.

## 6.1 Shortcomings of the Study and Directions for Further Researches

With the data that covers a longer period and provides more observations we could have a more comprehensive result. Lack of data of Opel, as one the successful companies in the industry, was one of the shortcomings of this study. With this data available, the results would be perfect for Germany automobile sector. The other shortcoming refers to the comparison of the results of this research with the automobile sector in other countries for having a better perspective of the industry. Further research can focus on this relationship and ratio between cash flow and capital expenditure in other companies and countries. Need to note that, this ratio and relationship is an industry specific ratio and should be compared to the results of another company with a similar capital expenditure requirements.

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# APPENDIX

## Appendix A: Error Correction Model

| Co-integrating Eq: | CointEq1 | |
|---|---|---|
| CE(-1) | 1.000000 | |
| CO(-1) | -0.963646<br>(0.22887)<br>[-4.21051] | |
| C | -1125114. | |
| **Error Correction:** | **D(CE)** | **D(CO)** |
| CointEq1 | -0.315046<br>(0.07464)<br>[-4.22077] | 0.000161<br>(0.06515)<br>[ 0.00247] |
| D(CE(-1)) | 0.187140<br>(0.11331)<br>[ 1.65156] | 0.217835<br>(0.09890)<br>[ 2.20261] |
| D(CE(-2)) | 0.264720<br>(0.11847)<br>[ 2.23441] | 0.096126<br>(0.10341)<br>[ 0.92960] |
| D(CO(-1)) | -0.419077<br>(0.13961)<br>[-3.00176] | -0.445547<br>(0.12185)<br>[-3.65643] |
| D(CO(-2)) | -0.423868<br>(0.15443)<br>[-2.74481] | -0.490821<br>(0.13478)<br>[-3.64155] |
| C | -173280.4<br>(343952.)<br>[-0.50379] | -20471.42<br>(300204.)<br>[-0.06819] |
| R-squared | 0.244961 | 0.268866 |
| Adj. R-squared | 0.189443 | 0.215106 |
| Sum sq. resids | 5.85E+14 | 4.46E+14 |
| S.E. equation | 2933151. | 2560077. |
| F-statistic | 4.412311 | 5.001234 |
| Log likelihood | -1203.850 | -1193.783 |
| Akaike AIC | 32.69866 | 32.42658 |
| Schwarz SC | 32.88547 | 32.61339 |
| Mean dependent | -275207.5 | -149361.3 |
| S.D. dependent | 3257937. | 2889664. |