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**Stock Market Misvaluation and Foreign
Direct Investment in the USA**
A Cointegrating Relationship

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Abstract

The dynamics of misvaluation and Foreign Direct Investment (FDI) have long been debated in light of the efficient market hypothesis. Still, the existence of misvaluation in itself raises the eyebrows of economists as it would entail the possibility of cross-border arbitrage. Consequently, within the debate trying to enlighten the matter, the primary purpose of this thesis is to investigate the dynamics between FDI and misvaluation on the US equity market between 1950 and 2014. More specifically, it aims to examine the presence of fire-sales in periods of undervaluation and the possibility of stock market predictability by examining foreign investor's reaction to market misvaluation. To carry this out, a misvaluation proxy is estimated and regressed together with FDI within a Vector Error Correction Model (VECM) framework. Consistent with fire-sale FDI hypothesis, we find that foreign investors respond positively to undervaluation in the short-run. In addition, we find that investors also react profitably in the short-run by investing in periods when equity is undervalued and liquidate in periods when equity is overvalued. In the long-run however, FDI doesn't respond to misvaluation.

Keywords: Misvaluation, Foreign Direct Investment, Cointegration, Fire-sale Hypothesis, Market Predictability

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“Price is what you pay, value is what you get”

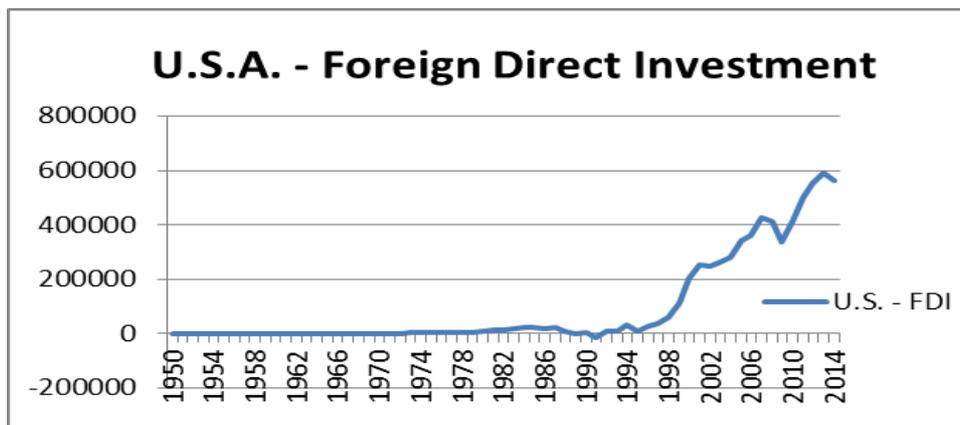
- Warren Buffett

1. Introduction

1.1 Background

In 1950, the total amount of Foreign Direct Investment (FDI) moving into the U.S. amounted to \$991 million. At the end of 2014, that same number was substantially higher amounting to \$563,942 million, an increase by over 568%. Under the same period, the U.S. has seen its fair share of ups and downs with a total of 10 recessions; the two most recent being the dot-com bubble in 2000 and the great recession in 2008 (Federal Reserve Bank of Minneapolis, 2015). In addition, it has also been a period which has been characterized by high growth rates and unparalleled technological advances. Consequently inciting repeating valuation waves over the years and as a result, brought about the question as to how exactly FDI has reacted to these valuation waves?

GRAPH 1: Seasonally adjusted Foreign Direct Investment going into the U.S. in millions of USD (Source: Federal Reserve St. Louis)



According to the Efficient Market Hypothesis (EMH), it is said to be virtually impossible to “beat the market” given that share prices always incorporate and reflect all relevant information. As a result, investors should not be able to use either technical or fundamental analysis in order to either buy undervalued stocks or sell overvalued stocks to beat the market. Despite this assumption, EMH has received a lot of criticism over the years as investors at times feel that the market stock price doesn’t match the underlying firm’s value (Malkiel, 2003). For instance, Thaler and DeBondt (1985) argues that investors are subject to waves of optimism and pessimism that causes systematical deviations in the stock prices.

Consequently, there is reason to believe that even though investment flows provide a high degree of capital integration and efficiency, it does not guarantee that the market is perfect. For even with a large and liquid public equity market, irrational expectations can cause cross-market misvaluation, which wouldn't have been the case within a perfectly efficient and integrated market (Baker, Foley and Wurgler, 2009).

In fact, since the mid-1980's, a lot of research has emerged aiming to prove inefficiencies of the markets and return predictability (Kim and Shamsuddin, 2013). One interesting example is the adaptive market hypothesis by Lo (2004) and Anatolyev (2009) in which return predictability can be observed from time to time. However, despite much of the recent research contradicting Eugene Fama's Efficient Market Hypothesis from 1970, the subject still remains heavily debated. Unfortunately, the debate often boils down to the definition of misvaluation and efficient markets, making it hard to interpret the results of previous research (Malkiel, 2003).

In this thesis, a distinction is therefore made between mispricing and misvaluation. Misvaluation is defined as deviations from a specific set of fundamentals and should therefore not be confused with asset pricing models with for example stochastic discount factors. Consequently, misvaluation is in this paper assumed to capture the dissimilarity in value contra price declared in some specific fundamentals through time.

1.2 FDI and Misvaluation

Defined as the occurrence of a foreigner investing in an affiliate, Foreign Direct Investment (FDI) is in layman's terms related to financial flows, which results in a change of a position.¹ As such, traditional FDI theories have catered to tangible determinants of firms cross-border investments such as ownership advantages (Dunning, 1977), knowledge capital (Markusen, 1984) or potential for gaining economies of scale and scope by internalizing transactions (Buckley & Casson, 1976; Rugman, 1981). All while assuming as stated above, that the markets are efficient and perfectly integrated.

The problem which they have arguably overlooked according to Forssbaeck and Oxelheim (2011) is the fact that frictions such as information asymmetries or capital market

¹ A position can be defined as a cumulative amount of financing in either debt or equity that a foreign direct investor has provided its affiliates, which in most cases amounts to at least 10% (Source: BEA- U.S. Dept. of Commerce)

segmentation between countries can give rise to distinct cost-of-capital effect on cross-border direct investment. A case, which makes it apparent that while target-market characteristics are well-recognized, source country firm characteristics that make it possible to undertake cross-border investments also have an effect.

Further, Oxelheim (2001) states that there are in particular two ways a cost-of-capital effect on FDI can happen, namely either through *reactive* or *proactive* firm behavior in the event of market inefficiencies. *Reactive* responses refers to firms finding foreign investment projects profitable in comparison to local firms because the net present value of the project is valued differently. Mainly through misvaluation being attributable to a specific industry, group of firms or geographic area as proposed by Vishny and Shleifer (2003) or that some firms simply have an advantage which makes them value firms differently.

Similarly, the *proactive* response assumes a two-part world capital market where a local firm faces the decision to either stay at home with local cost-of-capital or invest proactively to internationalize its cost-of-capital and benefit from economies of scale and scope of a multinational firm. This form of behavioral response however can come in forms other than FDI, such as cross-listing of stock on more liquid market, foreign issues of equity and/or debt and “bonding” strategies to reduce information asymmetry (Oxelheim, 2001).

A similar but slightly less refined theory developed by Baker, Foley and Wurgler (2009) point out another route to how FDI is affected. In their theory, the effects originate from either a “cheap finance” channel in terms of a source-country overvaluation or a “cheap asset” channel which refers to a host-country undervaluation. Regardless, their study brings forth cross-border investments as a result of imperfect integration across various capital markets around the world as a potential reason for the possibility of cross-border arbitrage by multinationals through Foreign Direct Investments.

Similarly, Polk and Sapienza (2004) have also found evidence that misvaluation affect the levels of investments that are undertaken by firms, while Dong, Hirshleifer, Richardsson and Teoh (2006) suggest that firms tend to time new equity issues within time periods of misvaluation. Thus, both suggesting that there is a strengthening possibility that investors seek to time market misvaluation with their investments. The occurrence of foreign firms seeking to invest in undervalued assets is called the “fire-sale FDI” hypothesis and was

developed by Shleifer and Vishny (2010). The hypothesis states that countries suffering from financial distress are able to attract foreign investors aiming to buy undervalued equity at fire-sale prices. Several researchers have attempted to prove this hypothesis with different results, for instance Coval and Stafford (2007) found evidence of the fire-sale hypothesis with respect to funds instead of foreign investments, while attempts by Baker, Foley and Wurgler (2009) and Weitzel, Kling and Gerritsen, (2014) were less successful in proving the hypothesis on the US and Europe equity markets.

Furthermore, while it is possible that investments are timed with periods of mispricing, other studies have found the direct opposite relation to be true as well. For example, in a study by Froot and Dabora (1999), they found that country-level investor demand pressures also have an effect on local valuations, thus initiating the discussion whether there exists a simultaneous relationship between misvaluation and FDI.

1.3 Objective

The aim of this paper is to examine the dynamics of stock market misvaluation and foreign direct investment. More specifically, whether it is possible to provide evidence of fire-sales during periods of financial distress and furthermore whether the reaction of foreign investors to periods of misvaluation indicates stock market predictability. This will be analyzed in both the short-run and long-run. Given objective, previous literature and economic reasoning, the research questions are as follows:

Q1: Are significant increases of foreign direct investment during periods of undervaluation present?

Q2: Is the occurrence of misvaluation driving foreign investors to react profitably?

These questions do not provide a univocal answer to whether the fire-sale hypothesis or stock market predictability theory are true or false. Nevertheless, by answering the questions, this paper hopes to contribute to the further understanding of the relationship between misvaluation and Foreign Direct Investment and how they react to one another. To do this, the thesis is structured as follows: section 2 will present the theory behind the misvaluation proxy, followed by its practical implementation and estimation. Afterwards, the empirical methodology used to investigate the dynamics of misvaluation and FDI is presented. This is

then followed by the estimated results in section 3, analysis in section 4 and lastly conclusion in section 5.

2. Method

2.1 Misvaluation Proxy

As a first step, before any analysis of the different dynamics between misvaluation and FDI can be carried out, a proxy for misvaluation itself must be estimated. To empirically estimate a proxy for misvaluation of publicly traded US firms between 1950-2015, the method used by Rhodes-Kropf, Robinson, and Viswanathan (RRV) (2005) has been applied.

The method that RRV uses builds on a decomposition of the Market-to-Book (MB) value into two parts:

$$\left(\frac{M}{B}\right) = \left(\frac{M}{V}\right) \left(\frac{V}{B}\right) \quad (1)$$

Where M is market value, B is book value, and V is some measure of the fundamental or ‘true value’. In this equation, the MB value is rewritten as a quotient of market value to fundamental value multiplied by fundamental value to book value. By assuming that the fundamental value V exists it is possible to analyze the effects of misvaluation. The first term, i.e., $\left(\frac{M}{V}\right)$ defines misvaluation since it captures the difference of market value and true value of a specific firm. The second part $\left(\frac{V}{B}\right)$ captures the true value to book and thus measure growth opportunities exempt from misvaluation.

By assuming that a perfectly true or fundamental value, v , exists. The markets would anticipate all future growth, discount rates and cash flows, implying $\left(\frac{M}{V}\right) = 1$ with no pricing error present and $\left(\frac{V}{B}\right) = \left(\frac{M}{B}\right)$ at all times. However, assuming presence of misvaluation is plausible due to previous research by for instance Baker, Stein and Wurgler (2003) and Polk and Sapienza (2004).

To empirically capture the true value of specific firms, RRV suggests a sector-level, cross-sectional regression based on firm-level market equity fundamentals. To perform the regression, MB value is decomposed into logarithmic values which accordingly yields,

$$\ln(M) - \ln(B) \equiv \ln(M) - \ln(V) + \ln(V) - \ln(B) \quad (2)$$

Additionally, RRV breaks down $\ln(M) - \ln(V)$ further by assuming that one component of misvaluation stems from a firm-specific error and another one from a sector specific error which is shared with all firms in the sector. Denoting the fundamental value from the regression and the long run sector fundamental value $v(\theta_{it}; \alpha_{jt})$ and $v(\theta_{it}; \alpha_j)$ respectively, the components of MB value may be written,

$$\ln(M) - \ln(B) = \ln(M) - v(\theta_{it}; \alpha_{jt}) + v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}; \bar{\alpha}_j) + v(\theta_{it}; \bar{\alpha}_j) - \ln(B) \quad (3)$$

Where $\ln(M) - v(\theta_{it}; \alpha_{jt})$ is the firm-specific error, $v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}; \bar{\alpha}_j)$ is the time-series sector error and finally $v(\theta_{it}; \bar{\alpha}_j) - \ln(B)$ capturing the long-run difference between long run value and book. Moreover, in order for the decomposition to work, an appropriate estimate of $v(\theta_{it}; \alpha_{jt})$ and $v(\theta_{it}; \bar{\alpha}_j)$ must be obtained.

Since the market value, M , of a firm may be expressed as the present value of expected free cash flows, FCF , it is possible to write M at a specific time according to,

$$M_t = \int_t^{\infty} \exp^{-\int_t^{\tau} r(\eta) d\eta} FCF(\tau) d\tau \quad (4)$$

where $r(\eta)$ is time-varying discount rate. Assuming that the value of the firm is given by the book value plus the value of the residual income (RI), (4) may be expressed

$$M_t = B_t + \int_t^{\infty} \exp^{-\int_t^{\tau} r(\eta) d\eta} RI(\tau) d\tau \quad (5)$$

Since the empirical observations are in discrete time (5) will be transformed accordingly. By assuming discrete time and the residual income to be the difference between return on equity (ROE) and the cost of capital (r_{τ}) multiplied by the previous period's capital stock, the market value of a firm can be expressed,

$$M_t = B_t + E_t \left[\sum_{\tau=t+1}^{\infty} \frac{(ROE_{\tau} - r_{\tau})}{(1+r_{\tau})^{\tau}} B_{\tau-1} \right] \quad (6)$$

In the first part of model (6), market equity is linked to book equity. To measure this, two identifying restrictions have to be made. First, the expected future Return On Equity (ROE) is a constant multiple of expected future discount rates, i.e. ($E_t[ROE_{\tau}] = \lambda E_t[r_{\tau}] \forall \tau > t$). This assumption corresponds to markup pricing, potential of competitive entry or technological

change, forcing expectations of future profitability to be multiples of discount rates. Secondly, book equity is expected to grow at a constant rate over time.

Thus, in order to account for the possibility that multiples vary over time the model is estimated cross-sectionally for each accounting year. Furthermore, the data is grouped according to the 12-Fama-French industries² and estimated within industry to account for industry specific differences of the tested multiples and value of the companies. The Fama and French 12 industry classification is a narrowed specification of the 48 industry classifications of Fama and French (1998). Finally the model is estimated in logs to account for right-skewness in the accounting data. Hence, the restrictions do not have to be imposed on growth rates or discount rates to remain constant within our multiples as it now accounts for time-varying risk premium and expected growth opportunities. The above equation can be used as starting point to a variety of econometric specification but this thesis focus on the third model specified by RRV namely,

$$\ln(M_{it}) = \alpha_{0jt} + \alpha_{1jt}\ln(B_{jt}) + \alpha_{2jt}\ln(NI)_{it}^+ + \alpha_{3jt}I_{(<0)}\ln(NI)_{it}^+ + \alpha_{4jt}LEV_{it} + \epsilon_{it} \quad (7)$$

The first coefficient α_{0jt} , represent the average market value associated with a firm in industry j at time t and the second coefficient α_{1jt} is the multiple associated with incremental book equity. In addition to linking market equity to book equity, intuitively the importance of net income in explaining cross-sectional variation in market values could be of interest. Hence $\alpha_{2jt}\ln(NI)_{it}^+$ and $\alpha_{3jt}I_{(<0)}\ln(NI)_{it}^+$ are added to the regression, where NI_{it}^+ represents absolute value of net income and $I_{(<0)}\ln(NI)_{it}^+$ is used as an indicator function to avoid that firms with negative income observations are neglected, given that the equation is estimated in logs. By adding the indicator function, through the separation of positive and negative net income multiples (α_{2jt} and α_{3jt}) in the estimation, the negative observations are able to be a part of the equation without tainting the ‘earnings multiple’ interpretation of α_{2jt} . Lastly, to account for the fact that both book-value and net income impose restrictions that firms are solely priced against industry and year averages, leverage $\alpha_{4jt}LEV_{it}$ is added. This is done in order to account for within-industry differences as well as capture the fact that some industries are characterized by high debt loads while others are more inclined towards equity. The equation in (7) is an extension of the first and second model developed by RRV. By removing leverage effect, LEV , (7) is transformed into their second model and by additionally

² The 12 Fama French Industries are the following: Other, Consumer Nondurables, Consumer Durables, Manufacturing, Energy, Chemicals & Allied, Business Equipment, Telecom, Utilities, Shops Wholesales, Health Care and Finance

removing the absolute value of net income, $\ln(NI)^+$, (7) will equal their first model. Hence, the model used in this thesis controls for both the within industry effect of leverage and difference in net income. Amongst their model specifications this one controls for most variables and also has the highest R^2 of all performed regressions during their considered time period. Finally, it is important to underline that the equation in (7) is not an asset-pricing equation. The expected returns are not related to any specific priced risk factors in the economy. However, since the multiples embody discount rates and expected growth rates, the coefficients evidently capture risk characteristics of the average firm in the industry (Rhodes-Kropf, Robinson, and Viswanathan, 2004).

The resulting regression coefficients are then able to generate measures of value at a point in time, and account for both variation in market expectations of return and growth over time and industry. Thus, a misvaluation proxy is constructed that measures both firm and sector level mispricing. Through this method, it will be possible to not only see the idiosyncratic component to misvaluation, but also sector and market misvaluation as a result of the market being overheated and if that has a significant implication at the firm level.

2.2 Implementation of Misvaluation Proxy

2.2.1 Data

The data used to implement the model for the misvaluation proxy has been retrieved from COMPUSTAT. Thus, the variables consist of all available data on fundamentals of companies traded on both the small and major stock exchanges in the United States from 1950 to 2014. In total, the exchanges covered by COMPUSTAT are as follows: New York Stock Exchange (NYSE), American Stock Exchange (AMEX), OTC Bulletin Board, NASDAQ-NMS Stock Market (NASDAQ), Boston Stock Exchange, Midwest Exchange, Pacific Exchange, Philadelphia Exchange, Other-OTC and unlisted evaluated equity.

From the retrieved data, Market value (M) is defined as the closing price of the fiscal year times the number of shares (used to calculate earnings per share) outstanding at the same time³. Book value (B) is calculated using book value per share times the number of shares (used to calculate earnings per share) outstanding, Net Income (NI) is defined as the income or loss reported by a company after subtracting expenses and losses from all revenues and

³ Between 1950-1960 all data are listed by calendar year and consequently the market value from calendar year end is used

gains. Finally, leverage ratio (*LEV*) is defined as the quotient of total debt and total assets, where total debt is defined as total debt in current liabilities (sum of long-term debt that is due in one year) plus total long term debt (all debt that is due in more than one year). All variables are obtained from the fiscal year end of each company⁴, totaling 250,773 observations which stretch from 1950 until 2014.

2.2.2 Estimation of Misvaluation Proxy

In order to perform the proxy-regressions the data must be sorted in fiscal years and sector. The data are therefore sorted using the 12-Fama-French industry classification. The 12-Fama-French industries are obtained by converting the company SIC-codes into the corresponding industry. The conversions are made accordingly with a SIC to Fama-French-Industry translation guide obtained from the homepage of Professor Kenneth R. French from Tuck School of Business. Once the industry classifications are obtained the data is sorted accordingly within each year. The proxy is then estimated by regressing within each industry and year, which in total sums up to 780 estimated regressions.

In some industries obtained from the early part of our set (1950-1960), there isn't any presence of negative net income. Consequently, α_{3jt} , the parameter assigned to control for negative net income should in these cases be omitted. This was solved by creating an algorithm in Matlab which provide the estimates. The algorithm distinguishes the different industries and recognizes cases with non-existing data on negative net income which removes multicollinearity and makes it possible to have a more extensive dataset. Hence, the equation in (7) is regressed within all industries from 1950 until 2014 except the industries that doesn't display any negative net income where accordingly parameter α_{3jt} is omitted.

The firm-specific errors are obtained by calculating, $\ln(M_{it}) - v(\theta_{it}; \alpha_{jt})$ and the errors are sorted within fiscal year according to the stock ownership code of the companies. The firm-specific errors of the companies listed on the major stock exchanges (NYSE, AMEX and NASDAQ) are then saved for each year. The misvaluation proxy for time t is then defined as the average misvaluation error MV_t of the companies listed on major stock exchanges,

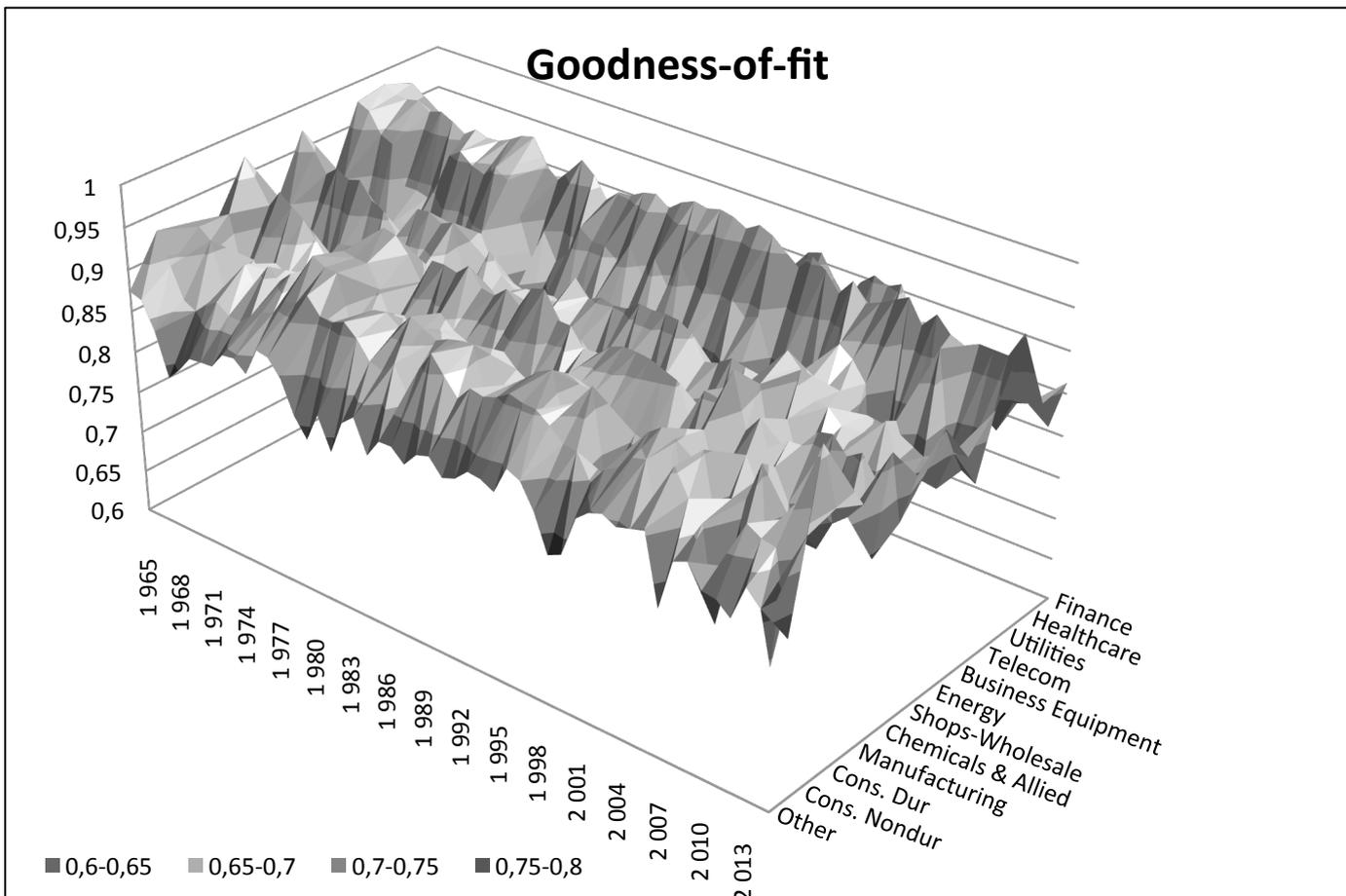
⁴ The following acronyms are used in COMPUSTAT, Price Close-Annual-Fiscal (PRCC_F), Price Close-Annual-Calender (PRCC_C), Book Value Per Share (BKVLPS), Common Shares Used to calculate Earnings Per Share Outstanding (CSHPRI), Net Income (NI), Total Debt in Current Liabilities (DLC), Total Long Term Debt (DLTT), Total Assets (AO)

$$MV_t = \frac{\sum_{i=1}^N \sum_{j=1}^{12} \ln(M_{it}) - v(\theta_{it}; \alpha_{jt})}{N} \quad (8)$$

Where N is the number of companies listed on a major stock exchange at time t . Thus $t = \{1, \dots, 65\}$ where $t = 1$ corresponds to the misvaluation proxy of 1950. There is of course possible to derive other misvaluation proxies of for example pink sheet stocks or non-publicly traded stocks but since the purpose of this essay is to investigate the effect of misvaluation on foreign direct investment, the valuation waves of the major stock exchanges are assumed to be more interesting to evaluate.

The evolution of the R^2 values obtained from regressing (7) depicts the goodness-of-fit for the different industries over time. The R^2 values are high and form twelve stochastic processes that fluctuate from approximately 0.98 to 0.69. This is similar to the result obtained from RRV who received average R^2 values that stretched from 0,8 to 0,94.

Graph 2: R^2 -values from misvaluation regression per industry



The long run alphas and standard errors for each industry as well as the average R^2 values are given in table 1. Thus, the constant, parameter of Book Value and Net Income are on average significant while the parameter of negative Net Income and Leverage Ratio surprisingly is insignificant. The average R^2 values are high. This is not surprising since the model regresses book value on market value from the same trading day. Thus, it is likely that they are very correlated.

Table 1. Misvaluation proxy output

	Other	Consumer Nondurables	Consumer Durables	Manufacturing	Energy	Chemicals & Allied	Business Equipment	Telecom	Utilities	Shops-Wholesale	Health-care	Finance
$\bar{\alpha}_0$	4.6040*** (0.1740)	3.9898*** (0.1630)	4.2014*** (0.2000)	4.1454*** (0.1427)	3.9233*** (0.1970)	5.2308*** (0.1944)	4.4934*** (0.1677)	3.9076*** (0.2321)	4.1729*** (0.0956)	4.7824*** (0.1531)	5.2349*** (0.1976)	3.9799** (0.1496)
$\bar{\alpha}_1$	0.5582*** (0.0164)	0.5934*** (0.0146)	0.5847*** (0.0179)	0.5831*** (0.0128)	0.6381*** (0.0172)	0.4835*** (0.0169)	0.5863*** (0.0163)	0.6446*** (0.0196)	0.5616*** (0.0074)	0.5131*** (0.0141)	0.5404*** (0.0191)	0.6081*** (0.0133)
$\bar{\alpha}_2$	0.4034*** (0.0731)	0.4631*** (0.0616)	0.3996*** (0.0695)	0.4256*** (0.0533)	0.2990*** (0.0581)	0.5388*** (0.0605)	0.4232*** (0.0750)	0.2901*** (0.0612)	0.4350*** (0.0232)	0.5257*** (0.0647)	0.4403*** (0.0760)	0.3570*** (0.0547)
$\bar{\alpha}_3$	0.1550 (0.2732)	-0.2683 (0.3839)	-0.1874 (0.3443)	-0.1428 (0.3635)	-0.1502 (0.2820)	0.3956 (1.1454)	-0.1478 (0.2894)	-0.0696 (0.2666)	-0.0293 (0.3017)	-0.3582 (0.2941)	-0.0809 (0.2905)	-0.2034 (0.2292)
$\bar{\alpha}_4$	0.2786 (0.5612)	-0.1736 (0.5904)	0.0051 (0.7828)	-0.1036 (0.5434)	0.2910 (0.6682)	-0.1278 (0.7773)	-0.0156 (0.7462)	0.6477 (0.5777)	0.4487 (0.2410)	-0.1555 (0.5564)	-0.4154 (0.7884)	-0.0370 (0.4202)
R^2	0.8418	0.8903	0.8992	0.8827	0.9063	0.9201	0.8545	0.8885	0.9568	0.8738	0.8577	0.8628

The numbers within parenthesis is the standard error of the parameter and the significance level is shown by * (**=1%, ** = 5%, * = 10%)

2.3 Misvaluation and Foreign Direct Investment

Having estimated a proxy for misvaluation, the Vector Autoregression (VAR) framework as adopted by Emmanuel Fahri and Stavros Panageas in the paper on “*The Real Effects of stock market mispricing at the Aggregate*” is applied to examine the relationship between misvaluation and Foreign Direct Investments.

2.3.1 Data

In the paper of Fahri and Panageas (2004), a VAR-model is applied to determine the real effects of stock market misvaluation. Their aim with the model was to investigate if misvaluation on the stock market distorts the “real” magnitudes of the economy and specifically whether less mature companies was affected more than mature firms. In their model, aggregated data of Tobin’s q, investment to capital, corporate profits (CP) and volume traded (VT) on the NYSE is used. Since the objective of this thesis is to investigate the effects of stock market misvaluation on FDI some adjustments are made from their model.

In this paper Tobin's q is substituted with the misvaluation proxy. The misvaluation proxy could be viewed as a refinement of Tobin's q , in which valuations retrieved from sector multiples provide better estimates of replacement costs than traditional accounting measures, (Rhode-Kropf, Robinson and Viswanathan, 2004). Furthermore, the investment to capital ratio is replaced by FDI. The aggregated corporate profits and volume traded at NYSE are the same. The of FDI and CP are obtained from the Federal Reserve Bank of St Louis and the data of VT are obtained from Wren Inc's database. Also, the data set used in this thesis consists of annual observations from 1950 to 2014 compared to the data on investment from Fahri and Panageas (2004) which only covers 25 years. Consequently, the data in this paper is better suited to evaluate possible long run relationships.

2.3.2 Specifying the Model

By applying a VAR, it is possible to examine additional aspects of the variables in a specified model. The VAR models a system of equations with more than one dependent variable and allows the dependent variables to be determined by both lags of itself and lags of other variables. Also, with the dependent variables as endogenous, the lagged variables are predetermined and thus exogenous. This gives VAR an advantage of not requiring restrictions similar to that of a structural model. However, despite being an advantageous model in many ways, VAR is often referred to as a-theoretical and therefore have problems with specifications such as lag length and stationarity. It is therefore imperative to first run a few necessary controls and transformations of the data in order to find the best possible VAR specification, Brooks (2014).

The first necessary step is to make sure that all variables are transformed into similar denominations as it is difficult to compare in absolute values. Consequently, all variables (FDI, VT and CP) are changed into ratios using log, except for the misvaluation proxy which was originally regressed in logarithmic form. Besides transforming for comparative purposes, all variables are logged in order to deal with right skewness of the data. Reducing or eliminating skewness is necessary to make sure that correlation or regression estimates aren't influenced by outliers or influential points.

Further, it is also of importance that the variables are stationary since it influences the way the series behave or react to shocks. If the variables are non-stationary, then the persistence of a shock will be constant, whereas if they are stationary then the effect of a shock will gradually

diminish. In addition, having non-stationary series can lead to a spurious regression where the regression shows a high R^2 despite lack of a clear or well-defined explainable relation between the series. This is due to the fact that if two independent variables have the same trend over time, then they will have a high R^2 -value despite being completely unrelated. Further, using a non-stationary series will result in invalid asymptotic tests as standard t-ratios will not follow a normal distribution.

As the data in the VAR model needs to be stationary, both an Augmented Dickey-Fuller (ADF) test and KPSS test is conducted on each of the four variables. The ADF test examines the value of ψ in the equation

$$\Delta y_t = \phi_0 + \lambda t + \psi y_{t-1} + \sum_{i=2}^p \beta_i \Delta y_{t-i+1} + u_t \quad (9)$$

where $\psi = (\sum_{i=1}^p \phi_i - 1)$ and $\beta_i = -\sum_{j=1}^p \phi_j$ with the null hypothesis being $H_0: \psi = 0$ implying a unit root and the alternative hypothesis being $H_1: \psi < 0$ i.e. $I(p)$. The equation in (9) is the most restricted specification of the Augmented Dickey Fuller test since it controls for both an intercept, ϕ_0 and a time trend, λt . Controlling for a time trend prevents the econometrician from rejecting the null of non-stationarity when there in fact only is a time trend present. Should the test conclude that the series is non-stationary, then there is a unit root present and p is therefore increased to investigate if the process is stationary in a higher difference. Once the test shows stationarity in one level, then it will be stationary on the next level as well. Though the ADF test is the most common for testing stationarity, it does have a disadvantage of being biased towards non-rejection if there is a smaller set of observations and a greater variance (Enders, 2010). Therefore, each of the ADF tests are cross-examined with the KPSS developed by Kwiatkowski, Denis, et al (1992). However, since the KPSS tests also use asymptotical critical values and also have small property issues none of the tests are flawless (Jönsson, 2006). Nevertheless, this test follows the opposite hypothesis where H_0 : stationarity and H_1 : non-stationarity and by performing both tests the researcher hopefully can be more certain of the true process of the variable. The KPSS test statistic is calculated by regressing the dependent variable on a constant or a constant with time trend,

$$Y_t = \alpha + \xi t + \varepsilon_t \quad (10)$$

The residuals are then summed and saved, i.e. $S_t = \sum_{s=1}^t \varepsilon_s \quad \forall t$. Consequently the KPSS-test is a Lagrange multiplier test and the test statistic is calculated by:

$$KPSS = \frac{S_t^2}{\hat{\sigma}_\varepsilon^2} \quad (11)$$

where $\hat{\sigma}_\varepsilon^2$ is the estimated residual variance from (10), (Verbeek, 2012). The results of both tests can be seen in the tables below:

Table 4. P-values from the Augmented Dickey-Fuller Test

ADF				
Level	ln(FDI)	ln(Misvaluation)	ln(CP)	ln(VT)
I(1)	0.0000	0.0000	0.0000	0.0000
I(2)	0.7052	0.1513	0.0302	0.3395

**Tests controlling for both an intercept and a time trend

Table 3. Critical values from the KPSS-test

KPSS				
Level	ln(FDI)**	ln(Misvaluation)**	ln(CP)**	ln(VT)**
I(1)	0.0439	-	-	-
I(2)	-	-	-	-
Critical	0.146	0.146	0.146	0.146

** Tests controlling for both an intercept and a time trend

From the results, the ADF test shows that misvaluation (MV), VT and FDI are first difference stationary, while CP is stationary in levels. The KPSS test only confirms the results in the case of FDI. However, the test statistics from the KPSS test are unreliable in small samples. The KPSS test may therefore be unreliable with small sample properties (Jönsson, 2006). Furthermore, since the ADF test is biased towards non-rejection and not the opposite, there is no reason to suspect an incorrect rejection (Enders, 2010). Therefore, when evaluating the results of the unit root tests, emphasis is put on the ADF-test.

It can also be useful to intuitively try to figure out the process of the variables. From the misvaluation model, book value and market value are assumed to increase over time. Hence, even though the average percentage misvaluation is constant over time, the real value of the proxy increases, which suggests first level stationarity. Therefore, both MV and VT is treated as integrated of order one.

Since FDI, MV and VT are integrated of the same order, it is of interest to evaluate if there exists a long run relationship between these variables. Moreover, the corporate profits variable CP is level stationary and is consequently not subject to a long run relationship. To evaluate possible cointegrating relations, the starting point is the unrestricted VAR. The Johansen approach (1991) is then adopted to determine the specification of the VAR and if a long run relation should be incorporated in the model. Hence the following unrestricted VAR is specified:

$$\begin{pmatrix} Ln(FDI_t) \\ Ln(MV_t) \\ Ln(VT_t) \end{pmatrix} = \mu + B_1 \begin{pmatrix} Ln(FDI_{t-1}) \\ Ln(MV_{t-1}) \\ Ln(VT_{t-1}) \end{pmatrix} + B_2 \begin{pmatrix} Ln(FDI_{t-2}) \\ Ln(MV_{t-2}) \\ Ln(VT_{t-2}) \end{pmatrix} + \alpha_1 \ln(CP_t) + \alpha_2 \ln(CP_{t-2}) + u_t \quad (12)$$

Writing (10) in a more compact form therefore yields,

$$Y_t = \mu + B_1 Y_{t-1} + B_2 Y_{t-2} + \alpha_1 \ln(CP_t) + \alpha_2 \ln(CP_{t-2}) + u_t \quad (13)$$

Where Y_t is 3×1 , B_1 and B_2 are 3×3 and u_t is a 3×1 vector of disturbance terms, while α_1 and α_2 are scalar terms. From the regression in (13) information criteria's (IC's) are calculated to determine the optimal lag length of the regression. Even though the variables are non-stationary the information criteria's are able to determine the optimal lag length (Enders ,2010). The IC method is used as it handles the trade-off between the number of variables and the fit of the model as compared to the cross equation restriction which exhibits the risk of ending up with different results. From the IC method, there are three main information criterias: Schwarz's Bayesian Information Criterion (SBIC), Hanna-Quinn Information Criterion (HQIC) and Akaike's Information Criterion (AIC).⁵ Though no Information Criterion is superior to any other, SBIC is known for being increasingly strict with a larger penalty term in comparison to the others. The information criterions are gathered in table 4.

Table 4. Optimal lag length test

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	41.4837	-	0.0001	-1.3270	-1.2204	-1.2855
1	262.5090	411.5644	0.0000	-8.6382	-8.2119	-8.4722
2	283.2875	36.5415	0.0000	-9.0444	-8.2984	-8.7538

⁵ See APPENDIX for specification of each test.

The results are thereby univocal and it can be concluded that a two-lag VAR is optimal according to the information criteria's.

Due to MP, FDI and VT being integrated of the same order, a restricted VAR model that allow the econometrician to investigate possible long run relations should be evaluated. In order to transform the non-stationary variables into stationary variables, the first difference of MP, FDI and VT are taken, i.e. differencing with Y_{t-1} . Subsequently, differencing (13) with Y_{t-1} transforms the VAR into the following VECM.

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \Gamma \Delta Y_{t-1} + \alpha_1 \ln(CP_t) + \alpha_2 \ln(CP_{t-2}) + u_t \quad (14)$$

Now, ΔY_t is a vector of stationary variables and assuming that Π has zero rank i.e. $rank(\Pi) = 0$, then all elements in ΔY_t are linearly independent. If all elements in ΔY_t are linearly independent, then per definition there cannot exist a long run linear relationship between the variables and there aren't any presence of cointegration. Defining $\Pi = B_1 - I_3$ and $\Gamma = B_2 - I_3$, the number of cointegrating relationships in ΔY_t will equal the rank of Π , whilst Γ will capture any higher order of cointegrating relationships commonly referred to as multicointegration. It is straightforward to see that if $rank(\Pi) = 0$ then each row (or column) of Π will equal zero which reduces (14) into

$$\Delta Y_t = \mu + \Gamma \Delta Y_{t-1} + \ln(CP_t) + \alpha_2 \ln(CP_{t-2}) + u_t \quad (15)$$

which is the usual VAR model in first differences. Obviously (15) lacks a long run relationship of the variables in Y_t . The rank of Π can be determined by calculating the number of non-zero roots i.e. eigenvalues, λ_i in the characteristic equation of the matrix. Hence, to determine the number of cointegrating relations in (14), the eigenvalues from Π are estimated $\hat{\lambda}_i$ and the following test statistic is calculated,

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \quad (16)$$

$$\lambda_{max}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (17)$$

Where T is the value of usable observations. The statistic in (16) tests the null hypothesis that the number of cointegrating vectors is less than or equal to r against a general alternative. Hence, if the estimated eigenvalue $\hat{\lambda}_i = 0$ the sum will equal to zero and therefore the more non-zero eigenvalues the more negative the statistic will be. In (17) the null hypothesis is that the number of cointegrating vectors is r against the alternative hypothesis $r + 1$. Again, the closer the estimated eigenvalue $\hat{\lambda}_{r+1}$ are to zero, the closer the test statistic will be to zero.

Finally, it is possible to elaborate with the VECM specification before running the tests. One must determine if there exist a time trend and intercept in the cointegrating equation i.e. whether there exists an intercept in the VAR and if a quadratic trend should be included in the data.⁶ Running the regression of both the case with a time trend and a quadratic term yields insignificant estimates of respective coefficients. Hence, there is reason to believe that these control variables are unnecessary. However, when including an intercept in the VAR-specification, it becomes significant in one of the three equations. The estimated regressions can be found in the appendix. Accordingly, the cointegration tests are performed on two specifications. The first one includes an intercept solely in the cointegrating relation whilst the other model includes an intercept both in the cointegrating equation and the VAR-part of the VECM (Enders, 2010). The test statistics are displayed in table 5.

Table 5. Cointegration tests

		No intercept in VAR		Intercept in Coint Eq & VAR	
		Trace	Max	Trace	Max
$r = 0$	$\hat{\lambda}_1$	0.2907**	0.2907*	0.2700**	0.2700
	p_1	(0.0443)	(0.0845)	(0.0310)	(0.1002)
$r \leq 1$	$\hat{\lambda}_2$	0.1467	0.1467	0.1314	0.1314
	p_2	(0.2227)	(0.3802)	(0.1272)	(0.3344)
$r \leq 2$	$\hat{\lambda}_3$	0.0883	0.0883	0.0680	0.0680
	p_3	(0.2289)	(0.2289)	(0.0399)	(0.0399)

Note: The p-values are provided in the parenthesis. Significance levels (): $p < 0,05$; *, $p < 0,01$; **, $p < 0,001$;***.*

The results can be interpreted following the principle developed by Pantula (1989) commonly referred to as Pantula's principle. The procedure starts by investigating the most restricted model and examine the result from the test with the null of no cointegration. Thereafter, the econometrician investigates the results from the less restricted model on the same hypothesis. The very first time the researcher is unable to reject the hypothesis it is time to stop and

⁶ There is actually one more possible specification available in the Eviews software than discussed above. Excluding the intercept in both the cointegrating equation and VAR are unrealistic (the mean of the series are different from zero) and therefore neglected.

evaluate the result. Accordingly, by observing the results from the model with an intercept in both the cointegrating equation and the VAR, the null of no cointegration is rejected on the five percent significance level using the trace test, while it precisely fails to reject the null on the ten percent significance level using the Max test. Since the null can't be rejected it is unnecessary to evaluate any other model. Nevertheless, the results from the two test statistics do not yield entirely the same results. The Trace test suggests that there exists a cointegrating vector while the Max test does not. When the test approaches yields different results Helmut and Pentti (2001) proved that the power between the two tests differ when the sample size is small. In the regressions tested the sample size is 65 which can be considered somewhat small. Hence, the power of the Trace test statistics is proved to be superior to the Max test. Additionally the p-value of the Max test precisely fails to reject the null on the ten percent level. As a result, the VECM specification with one cointegrating vector and an intercept in both the VAR and cointegrating equation is used for the analysis.

To be able to analyze the short term dynamics and retrieve the impulse response functions it is necessary to implement a Cholesky decomposition. The Cholesky decomposition enables the researcher to isolate reactions of one standard deviation increase to the endogenous variables. Further, the decomposition puts a restriction on the residual covariance matrix in order to isolate and trace the time paths of shocks on one variable upon another. For the used VECM model, the decomposition looks as follows:

$$e_{FDI} = \varepsilon_{FDI} \quad (18)$$

$$e_{MV} = c_{21}\varepsilon_{FDI} + \varepsilon_{MV} \quad (19)$$

$$e_{VT} = c_{31}\varepsilon_{FDI} + c_{32}\varepsilon_{MV} + \varepsilon_{VT} \quad (20)$$

The order of the Cholesky decomposition is important since it has implications for the results. The order chosen in this thesis gives most importance to innovations in FDI, less importance to changes in MV and the least importance to VT.

Finally, in order to be certain that the impulse response function yields reliable estimates it is necessary to ensure that the VECM model is stable. This is done by calculating the inverse roots of the characteristic polynomial. In the VECM specification used in this thesis it is possible to conclude that the model is stable and the graph depicting the roots can be found in the appendix.

3. Results

3.1 VECM

As previously stated the VECM model is a restricted extension of VAR which is designed to deal with non-stationary series that are cointegrated. The difference between the traditional VAR and that of VECM is that VECM restricts the long run behavior of the endogenous variables to converge toward long run equilibrium while allowing for an adjustment mechanisms that describe how the variables react when they move out of long-run equilibrium. In short, the cointegration term, also known as the speed-of-adjustment coefficient gradually corrects the deviation from the long-run equilibrium through a series of partial short-run adjustments. If any of the elements in the cointegrating equation deviate from the long-run equilibrium the speed of adjustment coefficient determines the speed back to equilibrium. Hence, if the speed-of-adjustment coefficients are non-zero each of the variables will adjust to partially restore the long-term relationship to equilibrium. In order for a cointegrating relation to exist the speed-of-adjustment coefficient must be significant and its absolute value less than unity. The estimates from the VECM specification with two lags, one cointegrating vector and an intercept in both the VAR and the cointegrating equation is given in table 6.

Table 6. VECM model

Coint. Equation			
<i>LnFDI</i>	1		
<i>LnMV</i>	-353.973*** (-80.9327)		
<i>LnVT</i>	4.7611* (-2.4362)		
δ	-40.5637		
Error Correction	<i>FDI</i>	<i>MV</i>	<i>VT</i>
Speed-of-Adjustment	-0,0009 (-0.0024)	0,0016*** (-0.0004)	-0.0087 (-0.0085)
<i>D(LnFDI)</i>	0.7123*** (-0.1402)	0.0430** (-0.0213)	0.7480 (-0.4899)
<i>D(LnFDI(-1))</i>	0.0230 (-0.1450)	-0.0268 (-0.0220)	-0.5453 (-0.5067)
<i>D(LnMV)</i>	-1.7810** (-0.8605)	0.1274 (-0.1307)	-2.0363 (-3.0063)
<i>D(LnMV(-1))</i>	-0.7862 (-0.8458)	0,2759** (-0.1285)	2,7401 (-2.9548)
<i>D(LnVT)</i>	-0.0112 (-0.0392)	0.106* (-0.0060)	-0.2005 (-0.1369)
<i>D(LnVT(-1))</i>	-0.0092 (-0.0396)	0.0189*** (-0.0060)	0.0612 (-0.1384)
<i>LnCP</i>	0.0035 (-0.0171)	-0.0101*** (-0.0026)	0.0345 (-0.0597)
μ	0.0077 (-0.1171)	0.0625*** (-0.0178)	-0.1276 (-0.4092)
R^2	0.5165	0.4354	0.1402

Note: The p-values are provided in the parenthesis. Significance levels (): p<0,05; (*): p<0,01; (**): p<0,001; (***)*

It is important to note that the estimates obtained from the model should be interpreted with caution since the misvaluation proxy is measured in a completely theoretical unit. An increase of MV is defined as an increase in the average deviation from the sector multiples. Consequently, the actual values of the misvaluation proxy are small compared to the values of the other variables. Therefore, the real impact of changes in MV is of less interest compared to the dynamics of the valuation waves.

The result obtained suggests that there exists one significant speed-of-adjustment coefficient namely, the one corresponding to misvaluation. The speed-of-adjustment coefficient of MV is significant at the one percent level. This implies that MV is exclusively responsible for getting the relationship back to its long run equilibrium. The absolute value of the speed-of-

adjustment coefficient of MV is also less than unity which indicates that the relationship converges towards long run equilibrium.

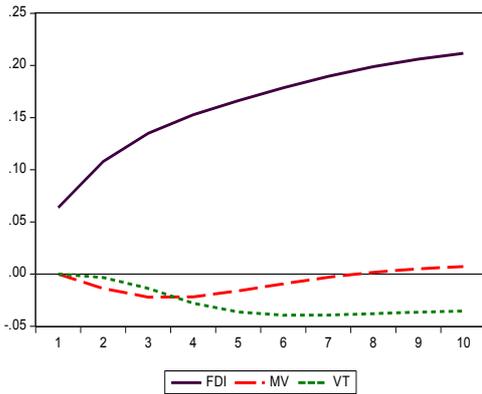
Furthermore, $D(\ln FDI)$ is significant both when it is regressed on itself and on MV. It is positive in both cases, which in the case of misvaluation suggests that a one unit increase in FDI has a positive effect on MV i.e. overvaluation. The coefficient on $D(\ln MV)$ has a significant negative effect on FDI at the five percent significance level. Consequently, if there is a negative shock to MV which make the stock market undervalued, FDI will increase and vice versa. The coefficient of $D(\ln MV(-1))$ is significant when regressed on itself as a dependent variable. This indicates that there might be persistency in MV. This means that a shock in MV will tend to affect future MV positively. Furthermore, the coefficients of $D(\ln VT)$ and $D(\ln VT(-1))$ are both positively significant when regressed on market value. Hence, an increase in VT causes MV to increase. Finally, the coefficient on the exogenous variables $\ln CP$ and μ has negatively respectively positively significant effect on MV at the one percent level.

There are not any significant variables in the error correction equation of VT which is reflected in the goodness-of-fit R^2 . Further, R^2 is also substantially lower in the VT equation compared to the other equations. The model with FDI as dependent variable has the highest R^2 value of 0.52 but only yields two significant coefficients. Last but not least, the model with MV as dependent yields six significant coefficients and a R^2 value of 0.44.

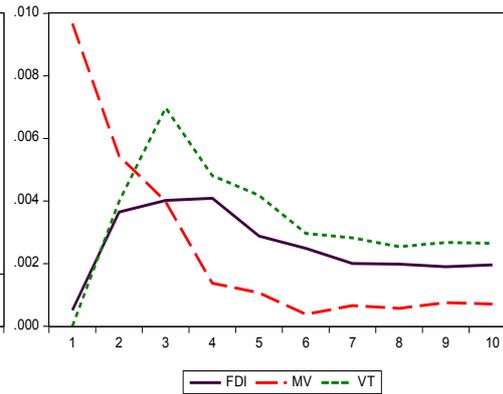
3.2 Impulse Responses

To analyze the short run dynamics of the model impulse response functions are obtained. Through the impulse response functions, reactions of each endogenous variable, to isolated one standard deviation shocks in the other endogenous variables can be investigated. The results from the impulse response function on each of the endogenous variables are depicted in graph 3, 4 and 5.

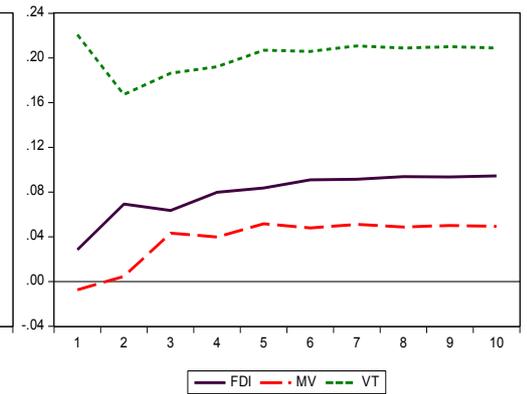
Graph 3. Response of FDI to Cholesky One S.D. Innovations



Graph 4. Response of MV to Cholesky One S.D. Innovations



Graph 5. Response of VT to Cholesky One S.D. Innovations



Starting with graph 3, it is evident that a one unit shock in MV will cause a decrease in FDI in period one. Further, FDI will continue to decrease until period three, then revert and gradually return back slightly beyond its starting point. A shock in VT will also cause a decrease of FDI but it will be more persistent than the reaction of MV. In fact a unit increase in VT will cause a negative shift in FDI that doesn't seem to diminish. Finally a one unit increase in FDI will cause a positive reaction towards itself. In fact it takes around twelve time periods until the shift is entirely completed according to the model.

The responses of MV captured in graph 4 seem to be positive and somewhat similar for both FDI and VT even though the magnitude of the response is more extensive from a shock in VT. The response of MV towards a shock on itself is depicted as a steep negative trend that seems to diminish after approximately six time periods. Hence, a period suffering from overvaluation seems to be followed by a period of undervaluation and vice versa.

Finally, the response of VT is depicted in graph 5. The response of a one unit shock in MV and the response of a shock in FDI seem to be very similar. The magnitude of a shock from FDI is clearly higher than of a shock in MV. The response from VT is however an increase up to the fourth or fifth time period when the effect gradually diminish. Additionally, it seems like the response from a shock in MV is one time period after the response of FDI. An increase in VT however seem to yield a negative response the next two time periods and then revert back to its starting point.

4. Analysis

In the following section, the results from the VECM model are analyzed together with previous research in order to answer the two previously stated questions: (1) Are significant increases of foreign direct investment during periods of undervaluation present? (2) Is the occurrence of misvaluation driving foreign investors to react profitably? This includes sub-sections discussing the short-run dynamics and long-run dynamics.

4.1 Short-Run Dynamics

Even though the error correction in the long-run is exclusively adjusted by the MV, it is interesting to evaluate the short run dynamics of the tested variables. Foremost, it is important to underline that the impulse response framework used in this thesis isolates the effects of one variable at a time and doesn't tell us about the course of events. Consequently, it could be the case that the true event history originates from shocks in all three variables simultaneously. In order to answer the questions above, focus is put on shocks to MV and FDI.

The results suggest that stock market undervaluation in the US attracts foreign investors which invest in the undervalued securities. This could be considered as evidence of the 'fire-sale' hypothesis developed by Shleifer and Vishny (2010), where countries affected by a crisis attract foreign investors that invest in the distressed and undervalued securities. Our results states that undervaluation causes a capital injection from foreign direct investment the following two time periods which then reverts back and beyond the original equilibrium. The total effect after ten time periods on FDI after an undervaluation is slightly negative. Initially an undervaluation causes capital inflows which then degenerate and finally results in an outflow of foreign money. Further, an increase in FDI causes an increase in misvaluation that causes overvaluation in the economy. Thus, in the short run, both MV and FDI seem to be simultaneously affected by movements in the corresponding variable. Since, the variables affect each other simultaneously it is also the case that an initial shock on FDI results in consequences to the valuation of US equity markets. An increase in foreign direct investment might occur due to unpleasing investment opportunities in the foreign investor's home markets. An increase in FDI would then give rise to overvaluation on the equity markets.

The short-run dynamics might be explained by applying Oxelheim's (2001) theory of reactive and proactive responses of investors. If Oxelheim's findings are applicable to the results, then the inflow of capital from FDI in periods of undervaluation is due to a positive net present value for a reactive foreign investor. Thus, reactive foreign investors invest in the undervalued securities which causes a positive effect on the mispricing and drives the valuations on the markets back toward the 'true' fundamental value. It could therefore be argued that the behavior of reactive investors causes the FDI injections during periods of undervaluation. Thus, the reactive investors act in accordance with the fire sale FDI hypothesis. In addition, a similar reasoning can also be drawn from Baker, Foley, and Wurgler's (2009) cheap finance channel or cheap asset channel.

4.2 Long run Dynamics

It is natural to assume that there exists a long run relation of investments and valuation. Since changes in market value foremost are determined by changes in the demand of stocks, the misvaluation proxy is driven by investment decisions. The speed of adjustment parameter of MV is the only significant of the cointegrating relations. Thus, in the long term, FDI are unaffected from shocks in both VT and MV. Consequently, the misvaluation proxy is solely responsible for maintaining the long run relation of the variables and corrects for the errors in the relation alone. Hence, the misvaluation proxy is not responsible for the evolution of FDI in the long run whilst our model suggests that the opposite is true. However, the result does not explain the origin of the correction mechanism incorporated in the valuation proxy. Consequently, the million dollar question boils down to: what is causing the misvaluation proxy to correct the long run relation of our variables?

One explanation could be that domestic investors are able to distinguish misvaluation caused by foreign investors. Naturally, the domestic investors will also be responsible for the evolution of the valuation proxy. This implies that domestic direct investment and other types of investment are responsible for restoring the long run relation through the valuation proxy by exploiting their knowledge of the markets valuation. If this can be proved, it would indicate the occurrence of stock market predictability where investors can exploit valuation errors for their own benefit. As a result, this would indicate that the cointegrating relation is mutual since both domestic investment and MV jointly would correct the errors caused by capital injections from foreign investors. Hence, including domestic direct investment and other investments in the cointegrating relation would therefore be of interest. This theory

could be argued using Oxelheim's (2001) theory of information asymmetries among investors, where domestic investors have an advantage of being better informed than foreign investors as a result of frictions. Despite these frictions however, it is assumed to only have a marginal effect, as information flows today are almost instantaneous across the world.

In contrast, it is also unlikely that no investors are able to detect valuation waves due to the results obtained from the short run dynamics. Nonetheless, it could be argued that the occurrence of new information will cause different investors to react in different time periods which results in valuation waves. On average, the investors interpret the new information correctly and therefore the stock will be correctly priced on average; an analogy, which is accepted by traditional efficient market hypothesis supporters.

Another possible reason to MV's insignificant effect on the long-run FDI could be attributable to effects on FDI not accounted for in this paper. These neglected variables could cause a more extensive effect on FDI in the long-run, where potential growth opportunities are influenced by domestic determinants. These could be for example related to market size, risk premium, labor unit cost, openness, and progress in structural reform related to privatization and banking sector. Another explanation could be that investors constantly seek the most profitable investments and therefore choose to invest in other markets outside of the US. For instance, there have been an increasing number of emerging markets and decreased costs attributable to investment since the 1950's. Due to these increased investment opportunities a long run relation may simply not exist. Even though the equity in the US may be undervalued, there might be an even more extensive undervaluation in another market. Thus, proving stock market predictability in terms a mutual cointegrating relationship might be impossible. (Ramona Jimborean, Anna Kelber, 2014).

5. Conclusion

The results suggest that the fire-sale FDI hypothesis is true in the short-run. It is evident from the impulse response function in graph 3 and the negative and significant value of $D(\ln MV)$ on FDI that foreign investors respond positively to undervaluation. Even though these findings prove that increases of foreign direct investment during periods of undervaluation occurs, further research must be done to isolate the responsible drivers of the fire-sale FDI hypothesis.

Lastly, the results can partially answer the second question, as investors react profitably (invests in undervalued equity and liquidates overvalued equity) in the short run. However, in the long run this is not the case as the speed-of-adjustment parameter of MV is exclusively driven by FDI and not the opposite. This means that foreign investors do not seem to take advantage of misvaluation in the long run. Nevertheless, this might be explained by effects not accounted for in this paper and is therefore left for further research.

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Appendix

A.1 Information Criterion

The formulas of the information criteria's are given in formula A1, A2 and A3:

$$AIC = 2k - 2\ln(L) \quad (A1)$$

$$BIC = -2\ln(L) + k\ln(n) \quad (A2)$$

$$HQIC = -2L_{max} + 2k\log(n) \quad (A3)$$

A.2 Cointegration and Johansen's Cointegration test (Enders, 2010)

If there is a long-run relationship between different variables, then they are said to be cointegrated. For example, both X_t and Z_t are $I(1)$, but there exists a linear combination or cointegrating relationship such that a linear combination of the two variables are $I(0)$. A concept which is more explicitly defined as having $x_t = \begin{pmatrix} x_{1t} \\ x_{2t} \end{pmatrix}$ and there exists a cointegrating vector $\beta = (\beta_1 + \beta_2)$ such that (x_{1t}, x_{2t}) are all $I(d)$, but $\beta x_t = \beta_1 x_{1t} + \beta_2 x_{2t}$ is $I(d-b)$. Then x_{1t}, x_{2t} are cointegrated of order d, b or $x_t \sim I(d, b)$.

To see if there is a cointegrating relationship in a VAR-based equation, this paper uses the Johansen methodology (1991, 1995). Consider a standard VAR of order p :

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + \beta x_t + \epsilon_t$$

Where y_t is a k -vector of non-stationary $I(1)$ variables, x_t is a d -vector of deterministic variables and ϵ_t is a vector of innovations. From this model, VAR can be rewritten as

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta y_{t-i} + \beta x_t + \epsilon_t$$

Where:

$$\Pi = \sum_{i=1}^p A_i - I \quad \text{and} \quad \gamma_i = -\sum_{j=i+1}^p A_j$$

From Granger's representation theorem it is stated that the coefficient matrix Π has a reduced rank $r < k$, which means that there are $k \times r$ matrices α and β with rank r such that $\Pi = \alpha\beta'$

and $\beta'y_t$ is $I(0)$. In this relationship, r is the cointegrating rank while β is the cointegrating vector as previously noted and α is the adjustment parameters in the Vector Error Correction Model. Johansen's method is thus to estimate the Π matrix from an unrestricted VAR and test whether it is possible to reject the restrictions ($r < k$) implied by the reduced rank of Π .

To test for the number of cointegrating relations r that are insignificantly different from unity, both a trace and maximum eigenvalue test is conducted with the following two test statistics:

$$\lambda_{trace} = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i)$$

$$\lambda_{max}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

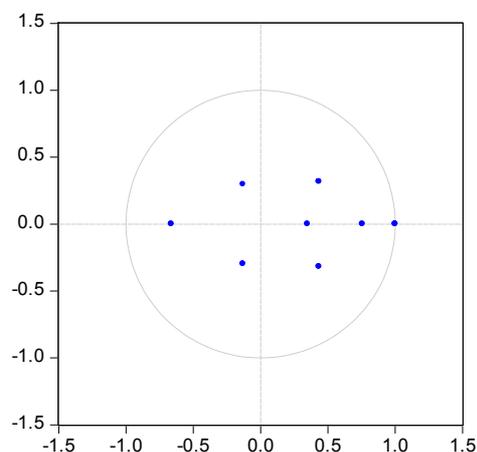
Where $\hat{\lambda}_i$ = the estimated values of characteristic roots obtained from the estimated π matrix
 T = Number of usable observations

The trace test tests whether there are $H_0: r$ cointegrating relations versus $H_1: k$ cointegrating relations, where k is the number of endogenous variables for $r = 0, 1, \dots, k-1$. Having k cointegrating relations would match the scenario where there are no unit roots and VAR would be the best specification for the leveled series. This is different from the maximum eigenvalue test which puts $H_0: r$ cointegrating relations against $H_1: r+1$ cointegrating relation.

A.3 Stability of VECM

The graph of A1 depicts the inverse roots of AR Characteristic polynomial. The VECM specification used in this thesis implies two roots equaling unity. Hence this model is stable.

Graph A1. Inverse Roots of AR Characteristic Polynomial



A.4 Regression outputs of VECM specifications

Table A1. Only intercept in cointegrating equation

<i>LnFDI</i>	1.000000		
<i>LnMV</i>	-1092.646 (250.463)		
<i>LnVT</i>	17.84272 (7.53930)		
δ	7.361838 (32.0721)		
	FDI	MV	VT
Speed-of-Adjustment	-0.0006 (0.00074)	0.0005 (0.00011)	-0.0044 (0.0026)
<i>D(LnFDI)</i>	0.7272 (0.1385)	0.0458 (0.0210)	0.8166 (0.4840)
<i>D(LnFDI(-1))</i>	0.0245 (0.1446)	-0.0239 (0.0220)	-0.5496 (0.5056)
<i>D(LnMV)</i>	-1.9256 (0.8393)	0.1048 (0.1277)	-2.8943 (2.9338)
<i>D(LnMV(-1))</i>	-0.8673 (0.8358)	0.2607 (0.1271)	2.1985 (2.9214)
<i>D(LnVT)</i>	-0.0031 (0.0384)	0.010394 (0.0058)	-0.157578 (0.1341)
<i>D(LnVT(-1))</i>	-0.0025 (0.0388)	0.0189 (0.00591)	0.0937 (0.13573)
<i>LnCP</i>	0.0145 (0.0144)	-0.0010 (0.0022)	0.0960 (0.0502)
R^2	0.5100	0.4263	0.1278

Table A2. Trend and intercept

<i>LnFDI</i>	1.0000		
<i>LnMV</i>	-176.1661 (36.9777)		
<i>LnVT</i>	4.185831 (1.89369)		
Trend	-0.453384 (0.29921)		
δ	-24.47619		
	FDI	MV	VT
Speed-of-Adjustment	-0.0029 (-0.0051)	0.0034 (-0.0008)	-0.0223 (-0.0179)
<i>D(LnFDI)</i>	0.7122 (-0.1397)	0.0453 (-0.0210)	0.7401 (-0.4867)
<i>D(LnFDI(-1))</i>	0.0230 (-0.1448)	-0.0271 (-0.0218)	-0.5438 (-0.5043)
<i>D(LnMV)</i>	-1.8839 (-0.8832)	0.1669 (-0.1329)	-2.5492 (-3.076)
<i>D(LnMV(-1))</i>	-0.8672 (-0.8564)	0.3012 (-0.1288)	2.3567 (-2.9830)
<i>D(LnVT)</i>	-0.0056 (-0.0411)	0.0051 (-0.0062)	-0.1611 (-0.1430)
<i>D(LnVT(-1))</i>	-0.0059 (-0.0400)	0.0151 (-0.0060)	0.0861 (-0.1394)
<i>LnCP</i>	0.0011 (-0.0091)	-0.0042 (-0.0014)	0.0054 (-0.0317)
μ	0.0231 (-0.0652)	0.0239 (-0.0098)	0.0614 (-0.2270)
R^2	0.518106	0.448115	0.148105

Table A3. Quadratic Trend and intercept

<i>LnFDI</i>	1.0000		
<i>LnMV</i>	-174.2228 (36.9287)		
<i>LnVT</i>	4.143251 (1.89117)		
Trend	-0.538816		
δ	-21.25747		
	FDI	MV	VT
Speed-of-Adjustment	-0.0031 (0.0051)	0.0034 (0.0008)	-0.0224 (0.0187)
<i>D(LnFDI)</i>	0.6854 (0.1393)	0.0447 (0.0214)	0.74707 (0.4958)
<i>D(LnFDI(-1))</i>	-0.0040 (0.1443)	-0.0278 (0.0222)	-0.5363 (0.5134)
<i>D(LnMV)</i>	-1.6320 (0.8900)	0.1726 (0.1367)	-2.6109 (3.1668)
<i>D(LnMV(-1))</i>	-0.6724 (0.8571)	0.3056 (0.1317)	2.3096 (3.050)
<i>D(LnVT)</i>	0.0006 (0.04082)	0.0052 (0.00627)	-0.1627 (0.1452)
<i>D(LnVT(-1))</i>	-0.0008 (0.0397)	0.0152 (0.0061)	0.0848 (0.1413)
<i>LnCP</i>	0.0752 (0.0511)	-0.0026 (0.0078)	-0.0144 (0.1817)
Trend	-0.0058 (0.0038)	0.0002 (0.0006)	-0.0005 (0.0134)
μ	0.075177 (0.0511)	-0.002581 (0.0078)	-0.014397 (0.1817)
R^2	0.5382	0.4486	0.1482