Does currency depreciation necessarily result in positive trade balance ? new evidence from Norway

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Abstract

The aim of this study is to investigate how exchange rate affects the trade balance in developed countries such as Norway, by using Time Series Multivariate Forecasting techniques to test the correlation in the long run. Theoretically, low exchange rates have positive impact on trade balance. However, it is only possible when the sum of the elasticity of demand for export commodities and demand for import goods is greater than unity. Accordingly, this study found no empirical evidence for the effect of exchange rate on trade balance in the long run. This is perhaps due to the fact that exports did not respond as expected. Norway products are mostly petroleum goods. It is known that petroleum goods have low price elasticity of demand; as prices become lower (or home currency depreciates compared to foreign currencies) foreigners will buy a constant amount of the petroleum goods. It also means, however, that if there is an increase in price (home currency appreciates compared to foreign currencies), demand for petroleum products will remain the same. The research is unique in the sense that no previous studies have been done on this issue for Norway. It also discusses the policy implications from the results of this study, stressing that policymakers should not be more concerned with external instability of the country through exchange rate as compared to the other variables such as inflation or perhaps lending interest rate.

Keywords: exchange rate, trade balance

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I. Introduction: The Issue Motivating This Article

The general belief is that a change in the exchange rate of a local currency will have an impact on the trade balance of that country. More specifically, when currency depreciates the competitiveness of country exported goods increases in the foreign markets. However, the downside is that depreciation of the local currency increases the cost of imported goods, and as a result, the welfare of the country decreases as its population consumes less. Alternatively, when a currency appreciates the opposite is expected to happen. We may fail to accurately conclude the overall economic impact of exchange rate on a country's trade balance, however it is sensible to believe that appreciation has a negative and depreciation a positive impact on the country's trade balance. Consequently, all countries in some way are involved in international trade (imports and exports), with desire to promote their exports. Therefore, this discussion gives further inquiry on the consequences of appreciation and depreciation of a currency on a trade balance.

It is sensible to believe that appreciation of a currency leads to lower exports and higher imports, and depreciation will have the opposite effect. With this regard, lower exports and higher imports will decrease the trade surplus of the country while higher exports and lower imports will increase the same. A depreciation of the currency increase the aggregate demand (AD) and it is likely to lead to a higher level of real GDP. The reason is that country's residents will find that imported goods are very expensive, and they will prefer to switch to buying goods produced domestically. However, the opposite is expected to incur if the currency appreciated. The country's residents will find imported goods inexpensive relative to goods produced domestically, and the volume of imports will increase, leading to lower GDP. This implies that there are two elements to be noted on depreciation and appreciation and its impact on the trade balance. Firstly, it is assumed that a country has export and import potential, and depreciation and appreciation is the price inelastic for exported and imported goods in foreign markets. Secondly, we also assume that depreciation and appreciation is supported by sound macroeconomic fundamentals and can maintain competitiveness in foreign markets i.e. the economy has capacity to produce more output for export.

However, some empirical studies investigating the effects of exchange rate tend not to be consistent and they have produced an array of country specific results. In short, currency exchange rate volatility has an adverse impact on trade. McKinnon (1990) and McKinnon and Ohno (1997)

have shown that in open economies, exchange rate changes may have unpredictable effects on trade balances. This is further supported by (Oskooee-Bahmani, 1998; Gylfason and Ratedzki 1991). They suggest that in some cases depreciation had no impact on the trade balance, neither by improving nor causing a decline in the trade balance. This can be interpreted from two different aspects.

Firstly, the elasticity of demand for exports and imports in that case is price inelastic, and the reduced price of exported goods abroad would lead to only a small increase in quantity sold; the same seems to be applicable in case of import. Hence, the total amount of exports or import may reduce or increase, however the volatility will not be significant. Furthermore, the impact of the changes may require some time to adjust in the real economy. In the short run, the demand and supply may be inelastic, but as time goes on, the demand and supply become price elastic, and hence lead to greater impact to the on the trade balance. Secondly, the state of the global economy could affect the trade balance. When the global economy is in recession, depreciation may not bring much impact on the demand for export goods abroad and *vice versa.* Therefore, looking from all these perspectives, and based on the theoretical controversy, the issue regarding the effect of exchange rate on the trade balance remains unresolved.

With these uncertain consequences of the volatility of exchange rate, this study attempts to analyse the impact of exchange rate on Norway's trade balance between 1980 and 2009. Norway has not experienced exchange rate effect in their trade balance, as it is presented in figure 1. Prior to this study, in 1970, Norwegian krone depreciated significantly compared to USD, and the trade balance seems to be unaffected. However, after 1980s, when Norwegian krone started to appreciate compared to USD, we can see slight improvements in the trade balance of the Norway, for entire period of the study. However, exchange rate has experienced volatility over the period of this study while the trade balance had a slight upward curve throughout, suggesting that exchange rate has not played a major impact on Norway's trade balance.

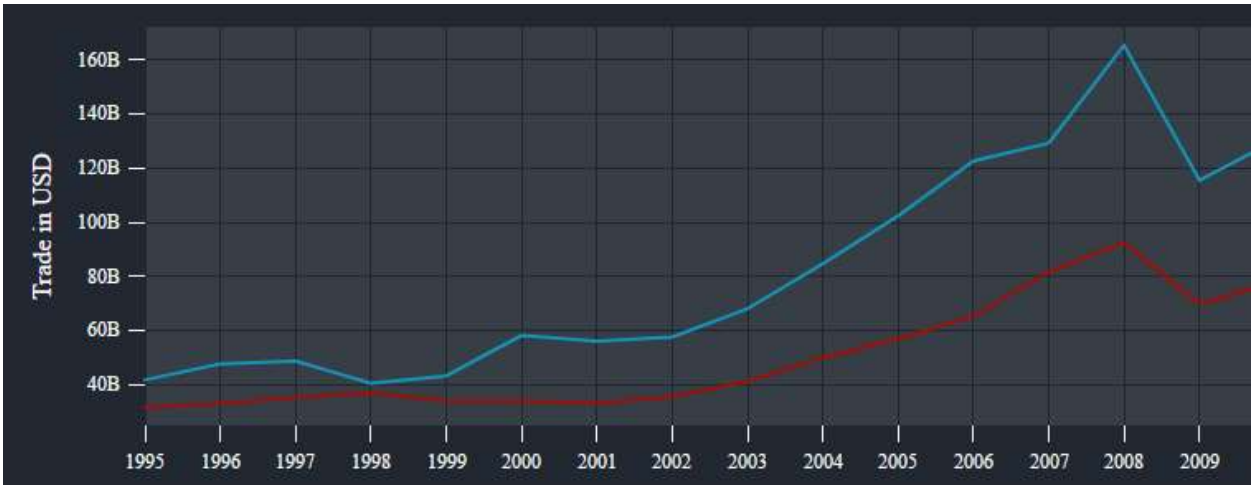


Figure 1 – Exch. Rate, Exports, Imports (Norway)

Forecasting currency fluctuations turns out to be a big challenge for economic theorists. In the paper written by Richard Meese and Kenneth Rogoff (1983), they demonstrated that a simple statistical model of the random walk—which states that the best forecast of the exchange rate tomorrow is the exchange rate today—shows better results in forecasting the exchange rate than any of the economic models available at that time. In addition, economic researchers have shown that the exchange rate tends to be "disconnected" from the fundamentals, or the factors that usually affect the exchange rate in economic models. These findings are known as the Meese-Rogoff puzzle and the "exchange rate disconnect" puzzle, respectively. In a 2005 paper written by Charles Engel and Kenneth West, demonstrated that given the statistical properties of the fundamentals and the discount factor of the individuals (the weight they place on future consumption relative to

today's consumption), it should be expected that exchange rate behaviour is similar to a random walk.[3]

In a 2002 paper, "Order Flow and Exchange Rate Dynamics," Charles Evans and Richard Lyons took another approach. They showed that using information on the demand and supply of foreign currency (the order flows by the banks participating in the foreign exchange market), it is possible to forecast currency appreciation and depreciation in the short run better than using the random walk.[4]

For this reason, controlling for other variables (i.e. inflation, lending interest rate, openness and GDP), in this paper I will make a humble attempt and try to identify the impact of exchange rate on trade balance in Norway. Surprisingly, to the best of my knowledge, there has not been any study of this kind conducted for the case of Norway before.

The remainder of the paper is organized as follows. Section II is literature review, providing theoretical background on the impact of exchange rate on trade balance. Section III depicts methodology that is used, section IV presents data, results of empirical analysis and main findings. Lastly, section V brings concluding remarks.

II. The Literature Review

Various studies have been carried out to explain the effect of exchange rate on the trade balance of both developed and developing countries. Studies showed mixed results, implying the uniqueness of each study conducted for particular country or region. Some studies have shown the significant effect of exchange rate on trade balance, while others have found opposite. Bahmani-Oskooee (2001) studied the long-run relationship between the trade balance and the real exchange rates of 11 Middle Eastern countries using co integration techniques. The findings were that the trade balance and the real exchange rate were co-integrated and devaluation could improve the trade balance in the long run. On the other hand, Ogbonna (1982) examined the devaluation of the Nigerian currency, on Nigeria's balance of payments and findings were that devaluation failed to improve the balance of payments. Narayan and Narayan (2004) analysed the long-run and short-

[3] Galina Hale, "Currency Appreciation and Depreciation." International Encyclopedia of the Social Sciences. 2008. Retrieved May 09, 2015 from Encyclopedia.com: http://www.encyclopedia.com/doc/1G2-3045300508.html
[4] Ibid

run determinants of Fiji's trade balance. They found the existence of long-run relationship among the trade balance, real exchange rate, domestic and foreign incomes. They also found the effect of the exchange rate on trade balance where the growth in domestic income adversely affects the trade balance while that of foreign income improves it.

Himarios (1989) analysed the effectiveness of devaluation on the trade balance of 27 countries. The results showed the nominal devaluation resulted in effect on real devaluation that lasts for at least three years and has been a successful policy tool for adjustment of trade balance. Rose (1991) has estimated the responsiveness of trade balances of five Organizations for Economic Cooperation and Development (OECD) countries to real exchange rates in the post-Bretton Woods era using a number of techniques. He concluded that there was little to support the view that real exchange rates affect the trade balance. Empirical studies like Junz and Rhomberg (1973) showed that devaluation may have a negative impact on trade balance in the short run but improve in the long run. Nguyen(1993) and Bahmani - Oskoeee and Xu(2013) have also proved that depreciation has an adverse effect on trade balance in the short run. Alemu and Lee (2014) found no evidence for the effect of depreciation to improve trade balance of about 14 Asian economies.

Some studies have also been conducted about the trade and exchange rate in Malaysia. For example, study done by Baharumshah (2001) indicated that the real exchange rate, domestic income and foreign income are important determinants of Malaysian bilateral trade balance. Yusoff (1991) utilized a distributed lag model to estimate the supply of and export demand for Malaysian manufactured goods. The findings were that the real exchange rate and world income are important determinants of exports of manufactures. Devaluation will increase the demand for exports and it lasts for two years.

III. Methodology Used

For the purpose of this paper Time Series Multivariate Forecasting technique has been carried out to analyse the currency depreciation effect on balance of trade. Prior to this technique, OLS regression-based analysis was conducted in order to assess the study. However, OLS regression analysis suffers from various limitations which make the model specification unreliable, thus further leading to unrealistic results. Therefore, utilizing Time Series technique, particularly

cointegration, error correction modelling and variance decomposition, the study has been improved.

Even though the variables selected have strong theoretical foundations (based on the literature), theories alone are not enough to derive conclusions or to forecast. Thus, attempt was made toward empirical data. Therefore, ARDL of the Time Series technique was used in order to derive the proper results, and to have strong foundations for analysing the data and testing the relationship among the variables.

There are several reasons to select this method. First, it can fulfill our objectives to find the causality relationship between the variables. Second, it can be applied irrespective of whether the variables are stationary or non stationary and also has better small sample properties (Narayan & Smyth, 2005). In addition, a simple linear transformation allows a dynamic error correction model (ECM) to be derived from ARDL (Banerjee et al, 1993). The ECM integrates the shortrun dynamics with the long-run equilibrium without losing long-run information (Pesaran & Chin, 1999). Furthermore, the endogeneity is less a problem in ARDL framework because it is free of residual correlation (Jalil et al., 2013). Pesaran and Shin (1999) have shown that the ARDL method can distinguish between dependent and explanatory variables and the estimation is possible even when the explanatory variables are endogenous (Pesaran and Pesaran, 1997; Pesaran et al., 2001). Since we have a mix of I (0) and I (1) variables in the sample (Table 2), this is an advantage for us, as compared to the conventional Granger causality test of which it requires all the variable to be stationary in first difference form only.

Prior to applying ARDL, stationarity of variables is investigated whether the variables are stationary or non-stationary at the level form. Determining the stationary of the variables has been regarded as a pre-requisite step for many methods in econometrics, since it may help in selecting the most appropriate method. Although ARDL does not require any stationary test, examining the sequence of the integration may assist in determining the suitability of the method (Sulaiman & Abdul-Rahim, 2013). To test the stationarity of each variable, two tests, namely ADF test and PP test have been carried out.

There are two stages involved in ARDL. The first stage involves investigating the existence of the long-run relationship between the variables by computing the F-statistic to test the significance of the lagged levels of the variables in the error correction form of the underlying ARDL model. Pesaran et al, 2001, present two sets of asymptotic critical values for testing cointegration for a given significance level. The set with lower value is computed assuming that the regressors are I(0) and the other set with upper value is computed assuming that the regressors are I(1). If the computed F statistics exceeds the upper critical value, the null hypothesis of no cointegration can be rejected. If it falls below the lower critical value the null hypothesis cannot be rejected. Finally, if the F-statistics value falls between the lower and upper critical values the result is inconclusive.

The second stage is pursued only if the first stage is satisfied i.e. that there is long run relationship between the variables. The second stage in this study involves estimating the long run model by selecting the orders of ARDL model using AIC and estimating an Error Correction Model (ECM) using the long-run estimates. This enables the speed of adjustment of the dependent variable to independent variables to be estimated. A value of zero indicates non-existence of long-run relationships whilst a value of between -1 and 0 indicates existence of partial adjustment. A value smaller than -1 indicates the model over adjusts in the current period and a positive value indicates the system moves away from equilibrium in the long run. First, we need to test the existence of a long-run relationship among the variables. This is estimated through the ordinary least square method with each variable in turn as a dependent variable and F-test will be conducted for each regression model to test the existence of long-run relationship among the variables.

$$\Delta TB_t = a_0 + \sum_{i=1}^{p} b_i \Delta TB_{t-1} + \sum_{i=1}^{p} c_i \Delta GDP_{t-1} + \sum_{i=1}^{p} d_i \Delta CPI_{t-1} + \sum_{i=1}^{p} e_i \Delta ER_{t-1} + \sum_{i=1}^{p} f_i \Delta IR_{t-1} \sum_{i=1}^{p} e_i \Delta OP_{t-1} + \delta_1 TB_{t-1} + \delta_2 GDP_{t-1} + \delta_3 CPI_{t-1} + \delta_4 ER_{t-1} + \delta_5 IR_{t-1} + \delta_6 OP_{t-1} + \varepsilon_t$$

$$\Delta GDP_t = a_0 + \sum_{i=1}^{p} b_i \Delta TB_{t-1} + \sum_{i=1}^{p} c_i \Delta GDP_{t-1} + \sum_{i=1}^{p} d_i \Delta CPI_{t-1} + \sum_{i=1}^{p} e_i \Delta ER_{t-1} + \sum_{i=1}^{p} f_i \Delta IR_{t-1} \sum_{i=1}^{p} e_i \Delta OP_{t-1} + \delta_1 TB_{t-1} + \delta_2 GDP_{t-1} + \delta_3 CPI_{t-1} + \delta_4 ER_{t-1} + \delta_5 IR_{t-1} + \delta_6 OP_{t-1} + \varepsilon_t$$

$$\Delta CPI_t = a_0 + \sum_{i=1}^{p} b_i \Delta TB_{t-1} + \sum_{i=1}^{p} c_i \Delta GDP_{t-1} + \sum_{i=1}^{p} d_i \Delta CPI_{t-1} + \sum_{i=1}^{p} e_i \Delta ER_{t-1} + \sum_{i=1}^{p} f_i \Delta IR_{t-1} \sum_{i=1}^{p} e_i \Delta OP_{t-1} + \delta_1 TB_{t-1} + \delta_2 GDP_{t-1} + \delta_3 CPI_{t-1} + \delta_4 ER_{t-1} + \delta_5 IR_{t-1} + \delta_6 OP_{t-1} + \varepsilon_t$$

$$\Delta ER_t = a_0 + \sum_{i=1}^{p} b_i \Delta TB_{t-1} + \sum_{i=1}^{p} c_i \Delta GDP_{t-1} + \sum_{i=1}^{p} d_i \Delta CPI_{t-1} + \sum_{i=1}^{p} e_i \Delta ER_{t-1} + \sum_{i=1}^{p} f_i \Delta IR_{t-1} \sum_{i=1}^{p} e_i \Delta OP_{t-1} + \delta_1 TB_{t-1} + \delta_2 GDP_{t-1} + \delta_3 CPI_{t-1} + \delta_4 ER_{t-1} + \delta_5 IR_{t-1} + \delta_6 OP_{t-1} + \varepsilon_t$$

$$\Delta IR_t = a_0 + \sum_{i=1}^{p} b_i \Delta TB_{t-1} + \sum_{i=1}^{p} c_i \Delta GDP_{t-1} + \sum_{i=1}^{p} d_i \Delta CPI_{t-1} + \sum_{i=1}^{p} e_i \Delta ER_{t-1} + \sum_{i=1}^{p} f_i \Delta IR_{t-1} \sum_{i=1}^{p} e_i \Delta OP_{t-1} + \delta_1 TB_{t-1} + \delta_2 GDP_{t-1} + \delta_3 CPI_{t-1} + \delta_4 ER_{t-1} + \delta_5 IR_{t-1} + \delta_6 OP_{t-1} + \varepsilon_t$$

$$\Delta OP_t = a_0 + \sum_{i=1}^{p} b_i \Delta TB_{t-1} + \sum_{i=1}^{p} c_i \Delta GDP_{t-1} + \sum_{i=1}^{p} d_i \Delta CPI_{t-1} + \sum_{i=1}^{p} e_i \Delta ER_{t-1} + \sum_{i=1}^{p} f_i \Delta IR_{t-1} \sum_{i=1}^{p} e_i \Delta OP_{t-1} + \delta_1 TB_{t-1} + \delta_2 GDP_{t-1} + \delta_3 CPI_{t-1} + \delta_4 ER_{t-1} + \delta_5 IR_{t-1} + \delta_6 OP_{t-1} + \varepsilon_t$$

Equation 1 – regression

IV. Data, Empirical Results and Discussion

The study implements quarterly data for the period of 1980–2009 for Norway, where all the variables were collected from IMF. The only exception is the variable OP, which represents the degree of the openness of the economy, and was derived from the ratio of total trade/GDP.

Above data seems to have significant number of years, starting from the year 1980 (which showed to be the earliest period found to have relevant data necessary for the study) until 2009. Even more significant is that quarterly data was used, adding more data points to the study. The variables used in this study are taken based on earlier empirical studies and theoretical explanations, and those include: trade balance (TB), exchange rate (ER), inflation – based on Consumer Price Index (CPI), lending interest rate (IR), Gross Domestic product (GDP) and degree of openness – derived as Trade/GDP (OP).

Unit Root Test

The first difference of the natural log form of each variable is taken, with prefix 'D' showing the differenced form, e.g.

$$DTB = LTB_t - LTB_{t-1}$$

A non-stationary series have an infinite variance (it grows over time), shocks are permanent (on the series) and its autocorrelations tend to be unity. On the other hand, stationary series have a mean (to which it tends to return), a finite variance, shocks are transitory, autocorrelation coefficients die out as the number of lags grows. If the series is 'stationary', the demand-side short

run macroeconomic stabilisation policies are likely to be effective but if the series is 'non-stationary', the supply-side policies are more likely to be effective.

We can only assume about the stationarity of the variables but we cannot conclude. Therefore, ADF and PP tests needs to be run for the confirmation. Using Akaike Information Criteria (AIC) and Schwarz Bayesian Criteria (SBC), results of the ADF and PP will be analysed to see whether to proceed to the step 2. ADF Regression order will be selected based on the highest computed values of AIC and SBC.

Augmented Dickey-Fuller (ADF) test is used for each variable, while while PP is tested based on the t-statistics.. In the table 1 below presented are the outcomes of ADF test, in both level and differenced form. AIC and SBC tests show that not all variables are I(1)[5] in their first difference form. Based on this we need to apply the ARDL time series technique and move forward.

Table 1 – ADF Test Results

VARIABLE	TEST STATISTIC	CRITICAL VALUE	IMPLICATIONS
VARIABLES IN LEVEL FORM			
TB	**-.16248**	**-3.4494**	**Non-stationary**
GDP	**-3.4486**	**-3.4494**	**Non-stationary**
CPI	**-3.0030**	**-3.4494**	**Non-stationary**
ER	**-1.3289**	**-3.4494**	**Non-stationary**
IR	**-3.1986**	**-3.4494**	**Non-stationary**
OP	**-3.6714**	**-3.4494**	**Stationary**

VARIABLE	TEST STATISTIC	CRITICAL VALUE	IMPLICATIONS
VARIABLES IN DIFFERENCED FORM			
TB	**.27165**	**-3.0401**	**Non-stationary**
GDP	**-4.7196**	**-2.8870**	**Stationary**
CPI	**-3.2213**	**-2.8870**	**Stationary**
ER	**-6.6483**	**-2.8870**	**Stationary**
IR	**-5.8990**	**-2.8870**	**Stationary**
OP	**-4.3591**	**-2.8870**	**Stationary**

Table 2 – PP Test Results

VARIABLE	TEST STATISTIC	CRITICAL VALUE	IMPLICATION
VARIABLES IN LEVEL FORM			
TB	**1.1317**	**-3.5609**	**Non-stationary**
GDP	**-3.9875**	**-3.4273**	**Stationary**
CPI	**-7.5049**	**-3.4273**	**Stationary**
ER	**-1.3279**	**-3.4273**	**Non-stationary**
IR	**-2.0958**	**-3.4273**	**Non-stationary**
OP	**-4.0447**	**-3.4273**	**Stationary**

VARIABLE	TEST STATISTIC	CRITICAL VALUE	IMPLICATION
VARIABLES IN DIFFERENCED FORM			
TB	**-1.4737**	**-3.0888**	**Non-stationary**
GDP	**-15.2663**	**-2.8641**	**Stationary**
CPI	**-8.6487**	**-2.8641**	**Stationary**
ER	**-8.9691**	**-2.8641**	**Stationary**
IR	**-5.3305**	**-2.8641**	**Stationary**
OP	**-20.5454**	**-2.8641**	**Stationary**

Table 2 presents the outcomes of PP test, in both level and differenced form. The PP test shows that not all variables are I(1) or stationary in their differenced form. ADF and PP results do not show enough consistency for us to consider all variables to be I(1), i.e. non-Stationary in their level form and Stationary in their first difference form, indicating that the results of the forecasting are suspicious. Based on this we can move on with ARDL method.

Testing the existence of Long-Run Relationship

At this stage, we run the ARDL test to confirm the short-term and long-term relationship. The non-hypothesis of non-integration among the variables can be rejected if F-Statistics is higher than the upper bound. If F-Statistics is below than the lower bound, we cannot reject that

there is no long relationship between dependent variable and explanatory variables. If the F-Statistics falls in between, the implication is inconclusive. The results are given below.

Table 3 – Long-run relationship test

MODELS	F-STATISTICS	CV LOWER (95%)	CV UPPER (95%)
F_{TB} (TB | CPI GDP ER IR OP)	**1.5470**	**2.945**	**4.088**
F_{GDP} (GDP | CPI TB ER IR OP)	**8.4395**	**2.945**	**4.088**
F_{CPI} (CPI | TB GDP ER IR OP)	**1.4253**	**2.945**	**4.088**
F_{ER} (ER | CPI GDP TB IR OP)	**9.0821**	**2.945**	**4.088**
F_{IR} (IR | CPI GDP ER TB OP)	**3.1972**	**2.945**	**4.088**
F_{OP} (OP | CPI GDP ER IR TB)	**1.5297**	**2.945**	**4.088**

From the above table we find that when trade balance is the dependent variable, the calculated F_{TB} (TB | CPI GDP ER IR OP) = 1.5470 is less than lower bound of the critical value obtained from Pesaran et al. (2001), indicating there is no significant evidence for co-integration between Trade Balance and its determinant in Norway for the study period. These results reveal that a longrun level relationship does not exists between trade balance and exchange rate and they are not co-integrated, which means there is no strict theoretical relationship existing between the variables. The process has been repeated for the other variables and result shows that for GDP and ER (exchange rate) is highly cointegrated with its determinants. Additionally, we notice that the remaining variable such as CPI IR OP are not significant. In terms of exchange rate we determine that changes and volatility does significantly affect the remaining determinants including trade balance since it F-statistic is above the upper band. This is line with most of theory stating that volatility in exchange rate would affect trade balance. Our case remains an exception amongst others. These findings can have big implications for policy makers to tackle different problems.

Long-run Coefficient Estimation

Table 4 – Long-run coefficients

In the following table, the long-run coefficient estimation's representation for the ARDL model is selected with AIC Criterion:

	MODEL 1 TB	**MODEL 2 GDP**	**MODEL 3 CPI**	**MODEL 4 ER**	**MODEL 5 IR**	**MODEL 6 OP**
TB	./	.0081455** [.0065505]	.0035637** [.0014388]	.81940 [.0028175]	-.079472** [.0037983]	.0054115*** [.0078490]
GDP	-40.095*** [7.7665]	/	.20849*** [.063369]	-.068995 [.13264]	-.020302 [.18670]	.59632* [.34453]
CPI	79.2327** [32.9931]	.65421 [.39119]	/	-.019778 [.17932]	-.013131** [.26949]	-2.2635 [.97977]
ER	-22.6809 [13.2090]	-.25320 [.32369]	.17964** [.085457]	/	.0091895 [.27076]	-.46207 [.38561]
IR	-9.8162* [7.1431]	-.22615 [.22835]	.051112 [.047116]	.12920* [.11955]	/	.69100* [.37810]
OP	8.1715* [6.3628]	.043843* [.19227]	-.073235** [.038580]	-.074944* [.10876]	-.13203 [.15031]	/

The economic meaning of this result implies that the relationship among the variables is not spurious in some case of exchange rate it is, i.e. there is a theoretical relationship among some variables and they are in equilibrium in the long run. It also implies that not all variable contains information for the prediction of the other variables; it has implications for the extent of effectiveness of a Government's short run monetary, fiscal, and exchange rate stabilisation policies; it has implications for the coordination of the policies of the multinational firms.

From the point of TB findings show that four variables – OP, IR, GDP and CPI - are significant, while the remaining variable - ER to be insignificant.

The results shown above are not following the theory completely ant there are some deviations and contradictions with established theory, precisely in the case of exchange rate. Based on the theory, this variable should be significant due to the previously explained relation of goods becoming cheaper with a depreciating rate hence and increased export. In case of CPI the theory confirms our finding because due to the inflation prices of goods and services would go up, which would supposedly affect the balance of trade.

Until now, theoretical long run relationship was established between certain variables. Now we can move to the final steps of the study which test the Causality. VCD is the first part of testing the Causality, based on which we can determine the extent to which the change in one variable is caused by another variable in previous period.

Error Correction Model

Table 5 – Error Correlation Model

In the following table, the ECM's representation for the ARDL model is selected with AIC Criterion:

VARIABLE	COEFFICIENT	STANDARD ERROR	T-RATIO (PROB)	IMPLICATION
ECM(-1)DTB	.20715	.56540	.36638[.719]	exogenous
ECM(-1)DGDP	-.52906	.27986	-1.8904[.440]	exogenous
ECM(-1)DCPI	-.25433	.077694	-3.2735[.004]	endogenous
ECM(-1)DER	-.46438	.17552	-2.6458[.017]	endogenous
ECM(-1)DIR	-.17877	.17154	-1.0422[.031]	endogenous
ECM(-1)DOP	-.18918	.18004	-1.7302[.061]	endogenous

Denotes significance level at 5%

The causal connection among the variables is determined by the significance of error correction model (ECM) in each model. If the ECM is significant, it entailed that the dependent variable in the model is an endogenous variable, and if the ECM is insignificant, it implies that the dependent variable of the model is an exogenous variable.

Our results show that Trade Balance (TB), and Gross Domestic Product (GDP) are exogenous variable, while the other variables, namely Consumer Price Index (CPI), and Exchange Rate (ER), Lending interest rate (IR) and degree of openness (OP) are endogenous variable. The exogenous variables are the leaders and endogenous variables are the followers. From these results, we can conclude that CPI , ER, OP and IR follow the movement of the exogenous variables. The coefficient of error correction term indicates the speed of adjustment of disequilibrium in the model, and the higher the magnitude of the coefficient means the better the speed of adjustment. The negative sign in the coefficient confirmed the existence of cointegration. In our result, the coefficient of ECM of GDP is (-.52906) implies a fast speed of adjustment compare to for Lending interest rate (IR) or degree of openness (OP). This possible because this variable is affected by other variables, hence if there is any disequilibrium in the model, it might take some times for this variable to get back to equilibrium. It is possibly due to the intervention of government by enforcing monetary and fiscal policy to control the GDP and trade balance. This helps us to argue that there is a dynamic relationship between trade balance and exchange rate. However, from the ARDL result, we could not determine the relative exogeneity and endogeneity of each variable in our sample. Especially considering the contradicting results of exchange rate being significant while it is endogenous in our ARDL test. Therefore, we decided to conduct the additional steps which are VDC and IRF simulation to see the relative exogeneity and endogeneity, and to see how long it takes for the variables to go back to equilibrium if there is a shock in one of the variables.

VDC Test

Previously we couldn't comment anything based on relative exogenity and endogenity of the variables. This means that we couldn't say which variable is the strongest leader and which variable is the weakest follower. However, using VDC test we will be able to make that conclusion. VDC test was done in Generalized approach.

	Horizon	DGDP	DTB	DCPI	DER	DIR	DOP	TOTAL	RANK
DGDP	5	48%	10%	8%	4%	25%	6%	100%	1
DTB	5	23%	34%	16%	4%	16%	6%	100%	3
DCPI	5	3%	37%	14%	8%	30%	7%	100%	5
DER	5	11%	27%	17%	9%	32%	4%	100%	6
DIR	5	9%	29%	9%	7%	39%	7%	100%	2

DOP	5	11%	29%	18%	5%	21%	15%	100%	4

Table 6 – VDC Test Results – Horizon 5

	Horizon	DGDP	DTB	DCPI	DER	DIR	DOP	TOTAL	RANK
DGDP	10	39%	16%	9%	6%	25%	6%	100%	1
DTB	10	15%	34%	16%	5%	25%	6%	100%	3
DCPI	10	5%	37%	15%	7%	29%	7%	100%	4
DER	10	14%	27%	15%	10%	29%	4%	100%	6
DIR	10	7%	33%	10%	8%	35%	7%	100%	2
DOP	10	12%	29%	16%	6%	26%	11%	100%	5

Table 7 – VDC Test Result – Horizon 10

	Horizon	DGDP	DTB	DCPI	DER	DIR	DOP	TOTAL	RANK
DGDP	20	32%	19%	11%	6%	26%	6%	100%	2
DTB	20	9%	36%	15%	7%	27%	7%	100%	1
DCPI	20	6%	38%	14%	7%	28%	7%	100%	4
DER	20	11%	30%	16%	7%	31%	4%	100%	6
DIR	20	7%	35%	12%	7%	31%	7%	100%	3
DOP	20	8%	34%	15%	7%	28%	8%	100%	5

Table 8 – VDC Test Result – Horizon 20

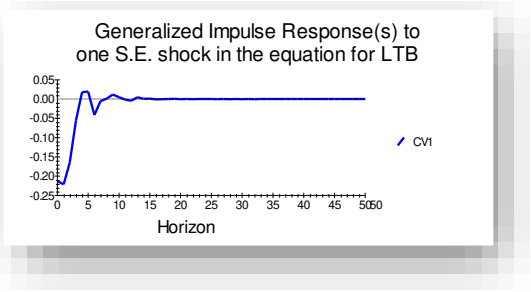
In the tables presented above, three horizons are taken respectively 5 10 and 20, all the variables are turned into proportions, attributable to shocks from all the variables. The percentage form in each column shows changes in the variables due to shocks from other variables. The highlighted sections inside the tables show those variables with highest exogenity, which represents the dependency of each variable on its own past. It shows that higher the percentage in the section, the more exogenous is the variable. That is handled by the Generalized test, which doesn't depend on the ordering of the variables.

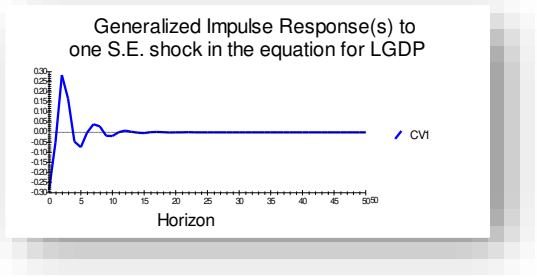
From the results, GDP appears to be the most exogenous variable among all, since it has the highest percentage of it variation explained by itself. However, as we increased the horizon TB took the lead and became the most exogenous variable. This is not in line with the theory. However, this is not the case in the horizon 5 and 10 where the second most exogenous variable is the lending

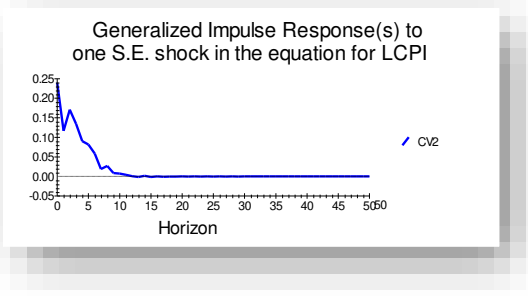
interest rate. This is however not in line with the research objective, but based on the theoretical literature we can consider TB to be the most exogenous variable, hence it remains within the scope of the research objective.

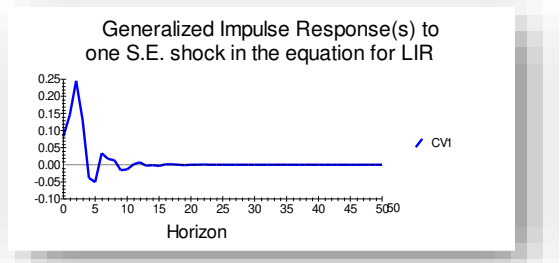
Impulse Response Function

In this part we do Impulse Response Function (IRF). It gives us the graphical interpretation of the information contained in the previous step, VDC, representing the same variables. IRFs essentially map out the dynamic response path of a variable owing to a one-period standard deviation shock to another variable. The IRFs are normalized such that zero represents the steady-state value of the response variable. In the Figure 2, presented are the results of shocking each variable, shocking the most exogenous variable TB for the Generalized approaches. These results are shown below for the Generalized approach. This effect is not very clear on the Orthogonalized graph, but looking at the Generalized the effect is obvious.









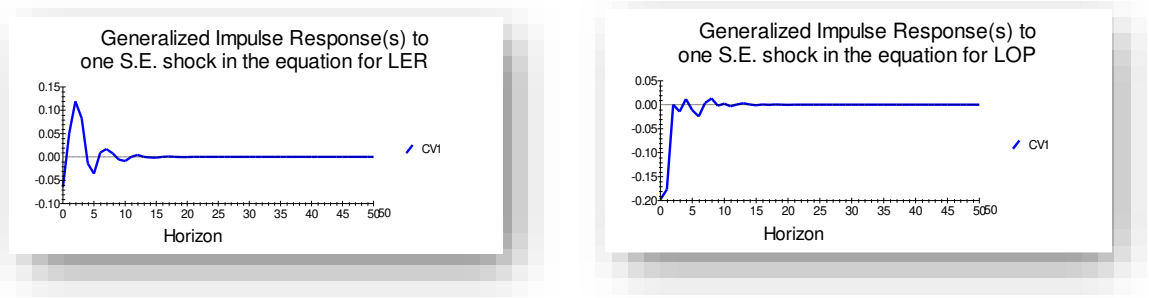


Figure 2 – IRF

The persistence profile is indicative of the time horizon required to get back to equilibrium when there is a system-wide shock. The main difference between IRF and PP is that the persistence profile trace bout the effects of a system-wide shock on the long-run relations but the IRFs trace out the effects of a variable-specific shock on the long run relationship. Figure 3 shows that it will take the model approximately five quarters to return to equilibrium. This means that, when there is some external shock to the system, the variables will go away from the equilibrium, resulting in the temporary situation where there is no cointegration among them. However, after five quarters, they will come back to the state of equilibrium and become cointegrated again.

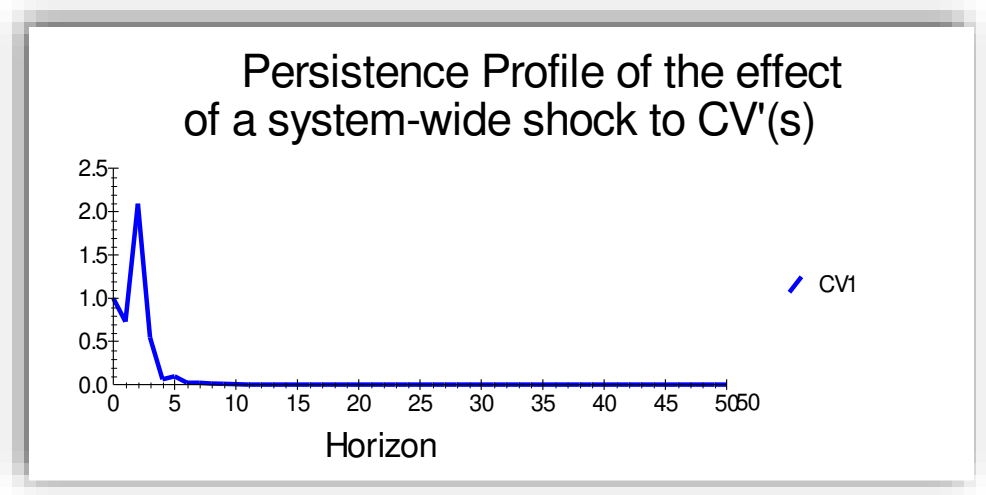


Figure 3 – PP Test Results

Policy Implications

This is the most important section of the research, as it is of most interest to the policymakers. In this section, attempt will be to highlight the policy implications in light of the economic meanings of the statistical results that were so far elaborated upon in the previous sections. Steps of the forecasting covered the area of theory, which is mostly of academic interest; indicating that our model is statistically sound, as per the requirements of Time Series Multivariate Forecasting techniques. The interpretation of the economic meaning of the results and the subsequent possible impacts on policies will, thus, begin from Step 5.

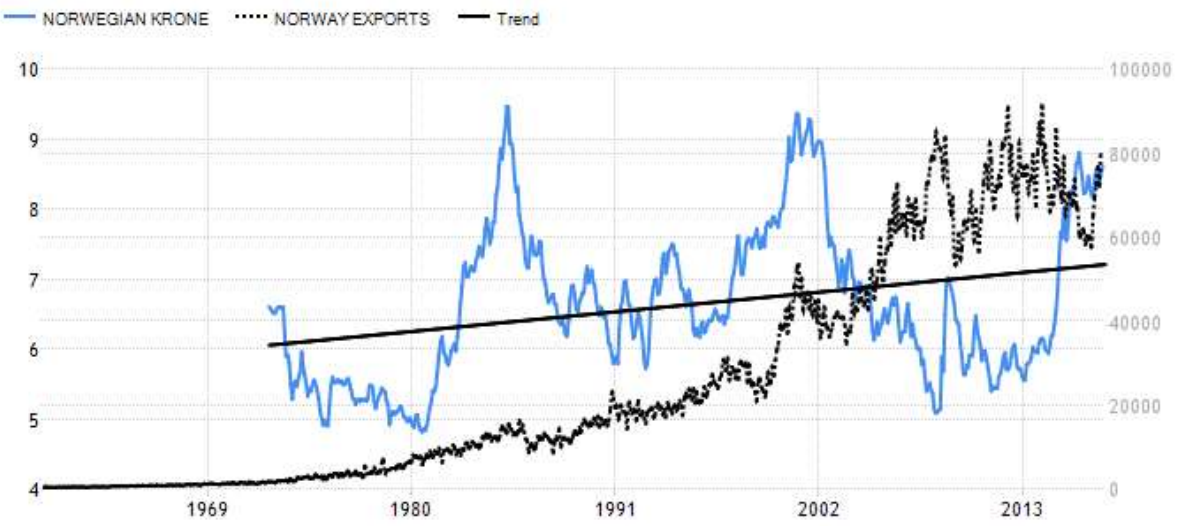
Our research results show to be, more or less, in line with literature. The co-integration test showed that the trade balance has low dependency on the exchange rate, hence being exogenous. On the other hand, exchange rate is shown as independent variable, hence endogenous, having no significant impact on trade balance. This implication is partially in line with theory, since theory shows mixed results with regard to this relationship.

Before moving further, it is important to highlight a factor in this research, under which the policy implications must be analysed. Normally, in Multivariate Time Series forecasting, the aim of establishing the ranking of exogenity of variables is to provide policymakers with a criteria on which variable they can target first to have the maximum impact, i.e. the most exogenous variable. However, the results show that exchange rate is not significant factor that can influence the trade balance of Norway, going apart from the classical theory, which shows the significant importance of depreciation or appreciation of the currency on balances of export and import.

The empirical results show that there is no evidence for the effect of exchange rate on the trade balance for the case of Norway. The reason is because Norway exports might not be price-sensitive, hence having no effect on the trade balance. Results show that exports increased gradually during the examined period despite the exchange rate being volatile, which again is not in line with classical theory. The main reason behind this is that Norway products are mostly petroleum products and as it is known that petroleum goods have a decreasing trend in price elasticity of demand. This means that lower the exchange rate of the country does not indicate a higher demand for its goods and services.

A study of the KOF institute has shown that the exchange rate fluctuations do not influence the pharmaceutical and chemical industry either.[6] Sales of machinery and electronics vary with changing exchange rates only in European countries such as Germany and France. Especially for clocks, watches and precision instruments the exchange rate does not matter for most purchasers because of reputation and brand reasons. In economic downturns and recessions, however, sold quantities may go down. This makes the krone similar to commodity currencies.

Below is the graph representing the relationship between Norway exports and Norwegian krone from 1980-2009 (Figure 7). As we can see, exports have a rising trend from the beginning period of the study, when the Norwegian krone was the lowest. The trend continued the same pattern as the time passed, with surprisingly slight increase during the Global Financial Crisis from 2007-2009. However, Norwegian krone exchange rate was not having that stable pattern and it fluctuated from time to time.

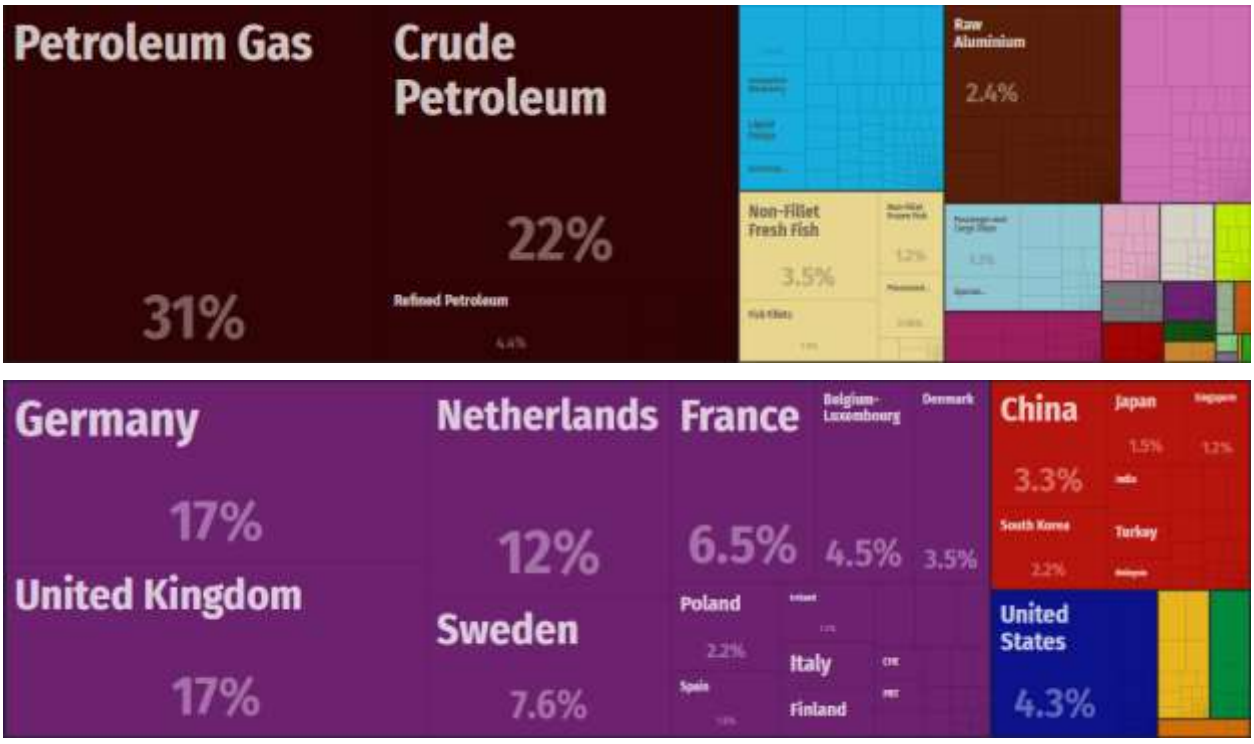


Source: TRADING ECONOMICS

Figure 4 – Norway krone and Norway Exports

6 M. Lamla, A. Lassmann, in KOF Analysen: "Spezialanalyse: Der Einfluss der Wechselkursentwicklung auf die schweizerischen Warenexporte: eine disaggregierte Analyse", Online Link, Summer 2011, SA1, page 42

From this we can conclude that policy makers in Norway should not be extremely exchange rate oriented because, when the Norwegian krone experiences volatilities, it has low to none effect on the exports, and therefore balance of trade.[7] From the perspective of other factors effect on trade balance we have openness (trade/GDP), lending interest rate, Consumer Price Index and GDP as significant factors. The positive and significant effect of openness on trade balance is highly expected since openness to trade can enhance productivity by enabling more efficient allocation of resources. It also provides greater opportunities to achieve economies of scale. In other words, as Dobre (2008) noted, openness to trade can play an important role in raising the long-run sustainable rate of productivity growth in the economy. These results are in line with literature and confirm that countries that have higher openness, their balance of trade is positive. Due to the high openness of trade between Norway and the rest of the world, Norway exports exceed their imports, hence trade surplus. However, Norway exports are mainly in the field of petroleum goods which show inelastic pricing as per Figure 8 below.



Source: Norway OEC Profile

Figure 5 – Norway Export Goods and Export Countries in 2016

[7] Norway benefits most from trade with the Germany, the United Kingdom, Netherlands, Sweden, France and "other world" (mostly emerging markets). Balance of trade with Europe is mostly positive due to excessive exports to European countries, mostly Germany. (Source: http://atlas.media.mit.edu/ - *"OEC Norway"*

Furthermore, study shows that inflation also has a negative impact on trade balance. The reason behind this is that a high rate of inflation is generally harmful to economic growth and specifically to trade balance, as it increases the cost of capital. High rate of inflation will also negatively affect the external value of money or the exchange rate of the country. Other countries will find the currency more expensive and hence there will be less demand for it. Lending interest rates also have negative effect on the trade balance. High lending interest rates reduce trade balance of country. This is because of the cost of borrowing which lowers the rate of capital investment, also due to the increase in the cost of capital. More to show, high lending interest rate may discourage potential entrepreneurs from undertaking production and export activities as it increases the cost of capital. These findings are in line with the theory, as opposed exchange rates, which showed not to be important because of the non- elasticity of prices for petroleum goods. However, policymakers need to pay attention to the inflation rate as well because they may have larger effect on services rather than goods.

Finally, GDP and trade balance have positive relationship because trade balance, also called 'net exports', is the component of GDP to the effect that a perfectly equilibrated trade balance makes the GDP dependent only on domestic values (consumption, public expenditure, investments). Therefore, trade surplus would increase the GDP and trade deficit would reduce it. A simultaneous increase of both imports and exports by the same amount leaves unaltered the trade balance. Any difference in dynamics between exports and imports has a multiplied effect on trade balance.

V. Conclusions

This paper attempts to test the effectiveness of exchange rate on the trade balance, and how important determinant it is for developed countries. Lower exchange rate should lead to the improvements of trade balance while higher exchange rates do opposite. Low exchange rates make local currency more attractive hence, increased demand for it. Therefore, export earnings would increase and that would improve the current account and the balance of trade. The classical economic theory prescribes that lower exchange rate improves trade balance. Based on the empirical evidence of this paper we can see that the study is not in line with the theory and previous literature. That is because, as Marshal-Lerner condition proposes, the ultimate outcome of trade balance depends on the nation's price elasticity of demand for exports and imports which might not be the case here.

The study has analyzed the effects of exchange rate on the trade balance for Norway over thirty years using quarterly data. Results tend to indicate that there is a low effect of exchange rate on that country's trade balance. This might be because Norway had trade surplus for a long period of time examined here. Another reason might be a relatively low elasticity of demand for Norway's main exports which happen to be petroleum. Our findings do contradict the well-established classical theory implying that exchange rate had a significant impact on a country's trade balance. Having said that, further research is required, possibly on some other developed countries as well, because some studies have shown the opposite results which are more in line with the established theory.

References

Baharumshah, A. Z. (2011). The effects of exchange rate on bilateral trade balance: new evidence from Malaysia and Thailand. *Asian Economic Journal*, 15, 291–312.

Bahmani-Oskooee, M. (2001). Nominal and real exchange rates of the Middle Eastern countries and their trade performances. *Applied Economics*, 31(1), 103 -111.

Himarios, D. (1989). Do devaluations improve the trade balance? The evidence revisited. *Economic* Inquiry, 40(1), 143–168.

Kenichi, R. M. (1997). Dollar and Yen: Resolving Economic. *MIT Press*.

Lee, A. A.-s. (2014). Examining the Effects of Currency Depreciation on Trade Balance in Selected Asian Economies. *International Journal of Global Business*, 7(1), 59-76.

Lyons, M. D. and M. Evans (2002). Order Flow and Exchange Rate Dynamics. *Journal of Political Economy*, 110(1), 170-180.

Masih, M. A. (1998). A fractional Cointegration Approach to testing mean Reversion Between Spot and Forward Exchange Rates: A Case of High Frequancy Data with Low Frequency Dynamics. *Journal of Business Finance and Accounting (JBFA),* 25(7-8), 987-1003.

Narayan, P. K. (2004). The J-curve: evidence from Fiji. *International Review of Applied*, 18, 369–380.

Nguyen, D. T. (1993). The Dynamic Effect of Devaluation on the Balance of Payments of a Small Debt-Ridden Open Economy. *The Economic Record*, 69(3), 285-294.

Ogbonna, M. N. (1982). Devaluation of the Naira in Nigeria. *Asian Economic Review*, 24, 19–43.

Oskooee-Bahmani, M. (1998). Do exchange rates follow a random walk process in Middle Eastern countries? *Economics Letters*, 58(3), 339-344.

Pesaran, B. P. (2009). *Time Series Econometrics using Microfit 5.0.* UK: Oxford University Press.

Radetzki, T. G. (1991). Does Devaluation Make Sense in the Least Developed Countries? *Economic Development and Cultural Change*, 40(1), 1-25.

Rhomberg, H. J. (1973). Price Competitiveness in Export Trade among Industrial Countries. *American Economic Review*, 63(2), 412 – 418.

Rogoff, R. M. (1983). Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample? *Journal of International Economics*, 14, 3-24.

Rose, A. K. (1991). The role of exchange rates in a popular model of international trade: does the "Marshall-Lerner" condition hold? *Journal of International Economics*, 30 (3-4), 301–316.

Wang, J. R. (1993). Sources of Fluctations in relative Prices: Evidence from High Inflation Countries. *Review of Economics and Statistics*, 75(4), 589-605.

West, C. E. (2005). Exchange Rates and Fundamentals. *Journal of Political Economy*, 113(3), 485-517.

Xu, M. B.-O. (2013). The J-Curve and Japan-China commodity trade. *Journal of Chinese Economic and Business Studies*, 11(1), 13-28.

Yusoff, M. B. (1991). An analysis of the supply and demand for Malaysian exports of manufactures. *The Singapore Economic Review*, 36, 22–34.