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How Does a Depreciation in the Exchange Rate Affect Trade Over Time?

Bachelor's thesis within Economics

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Abstract

The purpose of this thesis is to examine how a depreciation in the exchange rate affects the trade balance in an economy over time. The outcomes of a depreciation are possible to analyze through the J-curve phenomenon that shows the relation between the exchange rate and the trade balance both in the short-run and the long-run. The data used in this thesis cover 39 countries and their quarterly changes in exchange rate between 1982 and 2005. The largest depreciation for each country during these years was detected and is the base for this research. In this thesis, focus is on the trade ratio rather than the trade balance for empirical purposes. The relation between the largest depreciations and its effect on the trade ratio are examined in two sets of regressions. The results show no evidence of a J-curve in neither one of the sets of regressions, even though the trade ratio is positively affected by the depreciation. When testing only for significantly large depreciations in the exchange rate the affect on the trade ratio is stronger, all else equal. According to the findings in this thesis, a depreciation in the real effective exchange rate causes the trade ratio to increase immediately and then decrease over time. The conclusion is that the findings are not in line with the J-curve phenomenon tested for; however, they support standard trade theory with the Marshall-Lerner condition being met i.e. a depreciation in the exchange rate will affect the trade balance positively.

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1 Introduction

The exchange rate is often discussed in macroeconomics because of its impact on the economy as a whole. Fluctuations in the exchange rate have large influences on wages, interest rates, prices, production levels, and employment. These variables have a large impact on people's everyday life and the standard of living.

The exchange rate and its ultimate effects on trade, national income, and welfare of a nation are of importance for policymakers. The size on the effects of changes in exchange rates is critical information for trade and exchange rate policymakers (Demirden & Pastine, 1995).

Economists have during a long period of time put emphasize on the relation between exchange rates and the trade balance. Since the middle of the twentieth century, there has been development in macroeconomic analysis that shows results on this issue. For an open economy, the reaction of the exchange rate fluctuations on the trade balance is important to understand because of the possibility to target the trade balance to get the optimal national income.

Devaluation under a fixed exchange rate regime is typically expected to eliminate persistent trade balance deficits. A devaluation of the currency will decrease prices of the home country's exports abroad and increase the price of imports at home, inducing export quantity to rise and import quantity to decrease, thereby influencing the trade balance positively. The impact of the exchange rates can be different in the long-run compared to the short-run due to the slow adjustment of the trade quantity to the new exchange rate level. A theory that explains this relationship and makes it easier to predict the outcome of a devaluation or a depreciation of the exchange rate for policymakers is the theory of the J-curve.

According to the J-curve theory, after a real depreciation or devaluation the trade balance is expected to deteriorate at first due to increased import value in terms of domestic currency due to sticky prices. Subsequently, over time the volume of export will increase and the volume of import will decrease when adjusting for the new exchange rate and the trade balance will then improve.

1.1 The purpose and methodology

The purpose of this thesis is to investigate how a depreciation in the exchange rate affects a country's trade balance over time. After how long will the trade balance improve, if ever, by a depreciation in the exchange rate?

By examining whether the J-curve is detected in both the short-run and the long-run, one will be able to find the various relations that exists between the exchange rate and the trade balance at different points in time after a depreciation.

The countries covered empirically for this thesis are spread geographically, have different trade agreements, and trade different kind of goods and services. The countries selected are all open economies and are all classified as high or upper-middle income economies, with exception of Thailand, which is rated among the lower-middle income countries in the world (World Bank, 2009).

1.2 Background

Several studies have been done within this subject on how currency depreciation affects the trade balance. Different researchers have different ways to assess the impacts of currency depreciations. The different ways can be divided into four main groups of approaches. The first group takes the Marshall-Lerner condition into account and tests for the long-run effects on the trade balance. The Marshall-Lerner condition states that in order to get a positive effect on the trade balance the demand for the domestic nation's export and the nation's demand for imports needs to be sufficiently elastic. The condition states that the two elasticities added together must exceed unity. The second approach directly relates the trade balance to the exchange rate with the aim to look at both long-run and short-run effects. The approach presents the short-run outcome of the depreciation by analyzing the J-curve effect. The third group examines the S-curve, which is closely related to the J-curve. The S-curve examines the path of the cross-correlation between the current, the future and past values of the trade balance. Only a limited number of studies have been done of this approach. The cross-correlation examines the S-curve and focuses on the symmetric shape of the cross-correlation function show the dynamic path of the relation between the real exchange rate and the trade balance. The S-curve cannot predict the long-run effect. The fourth group of studies provides a direct method of predicting the impact of a devaluation regarding a country's inpayments, outpayments, and eventually also the trade balance. The inpayments are the value of imports and outpayments represent the value of exports (Bahmani-Oskooee & Bolhasani, 2009).

The focus in this thesis will be on the first and second approach, mainly because they are the most acknowledged analytical methods and there are plenty of material and test results covering them.

The Marshall-Lerner condition is based on the elasticity approach; volumes of imports and exports are sensitive to real exchange rates. Even though the condition is a basic and old model that has received critique over the years, it is still an important approach when analyzing the relation between the exchange rate and trade balance. Despite the complexity of the increase of international trade, capital flows, and technology, the approach still remains the center of today's modern economic analysis of negative trade balance and the link to the exchange rates fluctuations (Isard, 1996).

The Marshall-Lerner condition has been examined by many researchers who have reached the result that after a depreciation in the exchange rate the trade balance improves in the long-run. For example, Bahmani-Oskooee and Niroomand (1998) tested for various countries, Bahmani-Oskooee (1986) for developing countries, and Houthakker and Magee (1969) for a number of countries, most of them developed.

The J-curve effect is a phenomenon that has been proven important for examining the impact in the trade balance after a depreciation. The J-curve deals with the length and depth of a deterioration in the trade balance after a depreciation before its recovery to see if it will improve over its initial value in the long-run. The existence of a J-curve phenomenon in an economy and how strong the effect is on the trade balance and has been examined by many researchers in the past.

Magee (1973) showed the J-curve phenomenon by testing the results from the 15 percent depreciation in the exchange rate that the US experienced in 1971. The findings showed that the US trade balance worsened in the short-run and improved in the long-run. The article also states the theoretical arguments of the phenomenon. Many other researchers have found support for the J-curve phenomenon, among them are; Wilson (1993), Bahmani-Oskooee and Alse (1994), Demirden and Pastine (1995), Marwah and Klein (1996), Hacker and Hatemi-J (2003), and Narayan and Narayan (2004).

However, there are also researchers who have not found any evidence that their empirical studies supports the theory of the J-curve. Bahmani-Oskooee and Ratha (2004) did not detect a J-curve phenomenon in the short-run but they did find a favorable long-run effect on the trade balance. Moffett (1989) found a weak J-curve shaped more in the form of a wave. Other researchers not finding any support for the J-curve phenomenon are Bahmani-Oskooee and Goswami (2004), Flemingham (1988), Shirvani and Wilbratte (1997), Rose (1991), and Rose and Yellen (1989).

An appreciation in the exchange rate can cause what is called an inverse J-curve. However, Bahmani-Oskooee found an inverse J-curve after depreciations in the real exchange rates for four countries and presented this in an amendment to his earlier article written in 1985. In the amendment, the results indicate that the trade balances increase at first and then deteriorate over time (Bahmani-Oskooee, 1989).

The J-curve phenomenon has also been tested on industry basis. Ardalani and Bahmani-Oskooee (2007) found the long-run effect of a depreciation in the trade balance although with no evidence for a J-curve, while Bahmani-Oskooee and Hajilee (2009) found evidence for a J-curve on an industry basis.

1.3 Outline

The outline of this thesis is as following: In part 2, the theoretical framework will be put forward and presented. The method and the data set for this study is put forward in section 3 and the regression model in part 4. In part 5, the results of the regressions are presented and analyzed. The conclusions drawn from the regression analysis in this thesis are found in part 6 along with suggestions for further studies.

2 Theoretical framework

The real exchange rate affects the competiveness of the commodities that a country is exporting. Different theories that are put forward in this part reflect how a country experiences a real depreciation of the exchange rate and its effects on the trade balance. The concentration of this thesis is based on real exchange rate[1] changes and not nominal because a nominal exchange rate fall may be offset by a higher domestic inflation and have no effect on the net exports.

2.1 Trade theory

Standard trade theory relates trade in goods with the real exchange rate. Setting all other variables fixed, the trade theory states that the exchange rate can affect the economy´s imports and exports. A fluctuation in the exchange rate affects both the value and volume of trade. If the real exchange rate rises for the home country i.e. if there is a real depreciation, the households in the domestic country can get less foreign goods and services in exchange for a unit of domestic goods and services. Thereby a unit of foreign good would give more of domestic goods, resulting in domestic households buying less foreign goods and foreign households wanting to purchase relatively more domestic goods. The higher the real exchange rate the more surplus in the net exports the country will obtain (Zhang, 2008).

Lerner widened standard trade theory by including price elasticities of demand for imports and exports as important elements in determining the effect of exchange rate changes on the trade balance. An increase in exports and cut down on imports due to depreciation in the exchange rate does not necessarily mean a correction, or even an improvement, in the trade balance. The trade balance is not concerned with the amounts of physical goods but with their actual values (Lerner, 1944).

2.2 Elasticity approach

The trade balance varies depending upon price elasticities of demand for imports and exports. The elasticity of demand and supply are defined as the responsiveness of the quantity demanded of goods or services to a change in its price. An analysis of the balance of payments based upon the price elasticities of demand for imports and exports is known as the elasticity approach. The elasticity approach was initially developed by Bickerdike-Robinson-Metzler in the middle of the twentieth century (Chee-Wooi & Tze-Haw, 2008).

The elasticity of a country's demand for foreign goods depends on the price sensitivity of demand for the different goods. The elasticity of a country's supply depends on a country's ability to provide goods demanded by both the foreign and domestic markets (Marshall, 1923/1997).

[1] Real exchange rate, ep^*/p, is the exchange rate times the price level in the foreign country divided by the price level in the domestic country.

Lower prices in the domestic country will generally increase foreign demand for domestic country's good, but only if the foreign elasticity of demand is elastic. If the foreign elasticity of demand for domestic goods is inelastic the quantity of domestic goods will not increase to the extent that it overcomes the decrease in the value of exports caused by the lower prices. Supposing the country begin with a zero trade balance, lower prices under those circumstances result in a deficit in the trade balance. The situation could be offset by a decrease in the domestic quantity of imports, if the domestic demand for imports is elastic. If the domestic demand for foreign goods is elastic, the price change in the domestic market will change the domestic consumer's behavior. The consumers will then switch to consume domestic goods rather than foreign goods causing the value of imports to decrease. If the decrease in value of domestic imports is greater than the decrease in value of domestic exports then the trade balance will improve (Lerner, 1944).

The elasticity approach is demonstrated in reality by policymakers when a country is facing a deficit in the trade balance. The policy makers have to take into account the responsiveness of imports and exports due to a change in the exchange rate to calculate to what extent devaluation would improve the trade balance. If the foreign demand for imports and domestic demand for imports are relatively elastic a small change in the spot rate can correct a deficit, and if they are relatively inelastic a large change in the spot rate is required to correct a deficit (Daniels & VanHoose, 2004).

Attempts to integrate the elasticity approach with the Keynesian focus on national income resulted in the so-called absorption approach. The absorption approach shows a feedback effect on the trade flows where a devaluation improves the trade balance, although less than under the Marshall-Lerner condition and the basic elasticity approach. The absorption approach made the researchers aware of the existence of what later was developed as the J-curve effect, explained below (Isard, 1995).

2.3 Marshall-Lerner condition

The Marshall-Lerner condition was developed by Abba Lerner, who used Alfred Marshall's model of trade to show the effect of a depreciation on the trade balance from different scenarios. The condition states that if policy makers devaluate a currency in order to get a positive effect on the trade balance, the demand for the nation's exports and the nation's demand for imports needs to be sufficiently elastic. The condition under the simplest of circumstances is that the two elasticities together must exceed one (Brown & Hogendorn, 2000).

If the elasticity of demand for imports is greater than zero by the same amount as the elasticity of demand for exports is less than one, then the two elasticities of demand will add up to one, such as 0.4+0.6=1. Thus, the depreciation will have no effect on the trade balance. In general, if the sum of the two elasticities is less than one then in reaction to a depreciation the trade balance will decrease and if the sum is greater than one the trade balance will improve (Lerner, 1944).

The Marshall-Lerner condition is a condition of stability. If the sum of the two demand elasticities is not greater than unity, the equilibrium is unstable and a model with an unstable equilibrium is not efficient for measuring the outcome (Borkakoti, 1998).

For the Marshall-Lerner condition to hold, the increase in imports must be offset by a larger increase in exports to improve the trade balance (Chee-Wooi & Tze-Haw, 2008). The trade balance is only to be improved by a depreciation under the condition that the effects on quantity in statement 1 and 2 outweigh the price effect in statement 3 given below:

1. The depreciation will increase the demand for home's exports in the foreign country, given that the price of home's export in home's currency stays constant, the trade balance would improve, all else equal.
2. Domestic currency prices for imports will rise after a depreciation causing the demanded volume for imports to drop; resulting in an improvement of the domestic trade balance.
3. The home country must pay more for any remaining imports from the foreign country after a depreciation; causing the trade balance to deteriorate (Gärtner, 1993).

The reasoning above can also be explained by the volume effect and the value effect. For a depreciation to improve the trade balance the increase in export volume and decrease in import volume, that is the volume effect, would have to overcome the increase in import prices due to the value effect (Hacker & Hatemi-J, 2004). The value effect is reflected by the imports in domestic currency and will rise as in statement 3, and the volume effect is reflected in statements 1 and 2.

If the trade balance is balanced from the start, a full Marshall-Lerner condition is met if the trade balance rises over its initial value.

2.4 J-Curve effect

The J-curve reflects how a depreciation of a country's exchange rate affects its balance of trade over time. Immediately after the depreciation, the domestic importers are facing increased import prices in terms of the domestic currency; hence, the net export initially falls. In terms of foreign currency, the foreign market faces lower export prices but since the demand for exports and imports are relatively inelastic in the short-run the export and import volumes needs some time to adjust to the change in price. The elasticity of demand is affected by sluggishness in change of people's consumer behavior or the lag of renegotiating contracts. When the demand patterns adjust to the new exchange rate, the trade balance will start to improve (Mackintosh, Brown, Costello, Dawson, Tompson, & Trigg, 1996).

In the short term when prices are fixed the trade balance will face a decrease due to sticky prices and slowness to change. Goods will still be traded at the former price levels in the producer's currency and the home country will face a higher relative price for its imports and a lower relative price for its exports due to the depreciation of its currency. Thus, the trade balance and the terms of trade will worsen due higher value on the imports in the short-run. In the long-run the quantity will adjust to the new price level and the change in exchange rate; hence, the market and home country will experience an increase in its export volume and a decrease in its import volume and the trade balance will improve. The trade balance improves in the long-run and will increase to a higher level than before the depreciation. The dip and the recovery take the shape of the letter J, hence the term J-curve effect.

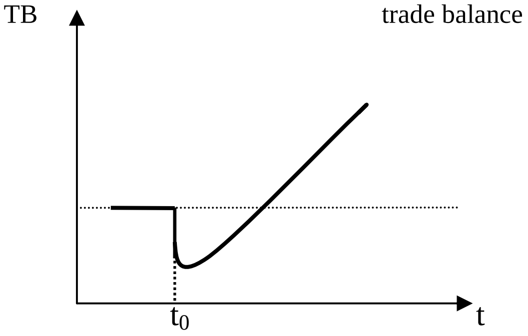

Figure 2.4-1 Sketch of the J-curve effect, t_0 is the time of depreciation.

Source: Authors own construction based on Gärtner, 1993.

The depreciation in the exchange rate must be sufficiently large to cause an effect on the trade balance. In the very short-run, immediately after the depreciation, the trade balance will worsen by the value of imports in foreign currency multiplied by the magnitude of the increase in the price of foreign currency since prices and volumes are fixed by contracts made before the depreciation. In the medium-run domestic demand will shift from foreign demand towards domestic production of substitution goods, causing an improvement in the trade balance that starts to rise from the bottom of the J-curve. A higher domestic demand will increase domestic production influencing the domestic price level to rise; this brings higher volume of export to higher export prices in the long-run. The increase in domestic export continues the improvement of the trade balance (Gärtner, 1993).

After a real depreciation in the real exchange rate, it takes some time before the volume effect responds. Therefore, one can expect the trade balance in the short run to react as the J-curve:

1. immediately after the depreciation the trade balance is expected to decline and drop below its initial level;
2. the trade balance does generally rise over time since the volume effect is recognized gradually in the economy, and
3. in the long-run eventually the trade balance ends up at a higher level than its initial value.

What is stated in point 1 and 2 is what is specified as a strong form of the J-curve and gives an immediate response to the change in the exchange rate. If the trade balance drops below the initial level, relatively soon but not immediately, then only point 2 is satisfied and there is a weak form of the J-curve. The third point indicates the full Marshall-Lerner condition if the trade balance initially is set to zero (Hacker & Hatemi-J, 2004). If point 3 is not fulfilled, the full Marshall-Lerner condition is not met in the long-run and the J-curve will flatten out at a lower value in the trade balance than initially, as seen in Figure 2.4-2 (Södersten & Reed, 1994).

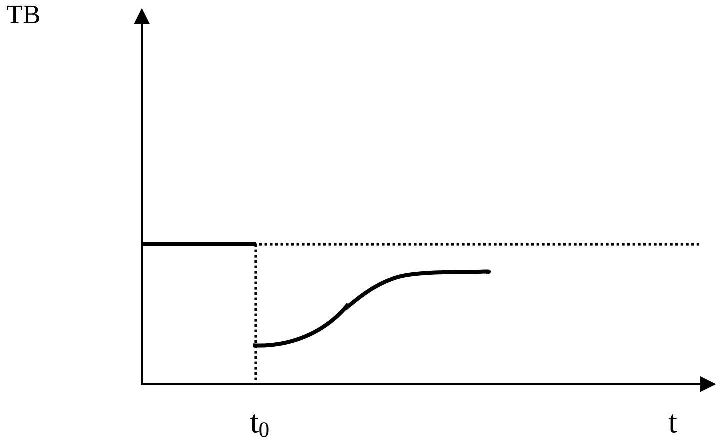

Figure 2.4-2 Sketch of the J-curve effect, without meeting the full Marshall-Lerner condition.

Source: Authors own construction based on Södersten and Reed, 1994.

The time frame for the J-curve, before the Marshall-Lerner condition kicks in and improves the trade balance, is said to be anytime between a few months to two or three years (Miles & Scott, (2002), Mackintosh et al. (1996), Dornbusch, Fischer & Startz, (2004)). To do an accurate estimation of the J-curve is essential for two reasons since it provides an indirect test for the Marshall-Lerner condition as well as an assessment over the length and the depth of the deterioration in the trade balance after a depreciation. This is vital information for trade and exchange rate policymakers (Demirden & Pastine, 1995).

2.5 Utilizing the trade ratio

In some studies of the J-curve, the trade ratio has been preferred over the trade balance. The trade ratio is not sensitive to the use of different currencies and is therefore preferred over the trade balance when presenting a J-curve based on more than two currencies. The procedure of deriving the trade ratio into a linearized model is based on research done by Hacker and Hatemi-J (2004). For comparative purposes, we present an equation for the trade balance, TB, as follows:

$$TB = PX_q - EP^*M_q, \tag{2.1}$$

where P is the price in domestic currency, X_q is the domestic quantity of exports exported to the world, E is the exchange rate, P* is the price level in the foreign market, and M_q is domestic quantity of imports from the world.

The trade ratio is equal to the value of exports, X, divided by the value of imports, M;

$$TR = \frac{X}{M} = \frac{PX_q}{EP^*M_q}, \tag{2.2}$$

where PX_q is the value of exports and EP^*M_q the value of imports. For a surplus in the trade balance, the PX_q has to be greater than EP^*M_q, i.e. the trade ratio would need to be greater than one.

The trade ratio may also be rewritten as;

$$TR = \frac{PX_q}{EP^*M_q} = \frac{TR_q}{RER}, \tag{2.3}$$

where TR_q, X_q/M_q, is the trade quantity ratio and RER, EP*/P, is the real exchange rate. For a real depreciation to improve the trade ratio the increase in export volume divided by import volume reflected in TR_q, the volume effect, must overcome the increase in RER, the value effect, shown in the denominator of (2.3).

The TR_q may be considered positively related to RER, since an increase in RER improves the price competitiveness of home country's products relative to foreign country's products. An increase in national income causes domestic imports to increase so the trade ratio decreases. These relationships are reflected in the following equation,

$$TR_q = f(RER, Y), \tag{2.4}$$

with,

$$\frac{\partial TR_q}{\partial RER} > 0, \frac{\partial TR_q}{\partial Y} < 0 \tag{2.5}$$

A percent change in the trade quantity ratio can be expressed as a function of percent change in real exchange rate and percent change in national income, Y, by making the simplifying assumption, consistent with (2.4) and (2.5), that

$$\%\Delta TR_q = g(\%\Delta RER, \%\Delta Y), \tag{2.6}$$

with,

$$\frac{\partial g}{\partial(\%\Delta RER)} > 0, \frac{\partial g}{\partial(\%\Delta Y)} < 0 \tag{2.7}$$

where "%Δ" means the "percent change in". The percent change in the trade ratio is the percent change in the trade ratio quantity ratio minus the percent change in the value in the real exchange rate, based on the relation in (2.3):

$$\%\Delta TR = \%\Delta TR_q - \%\Delta RER \tag{2.8}$$

Using (2.6);

$$\%\Delta TR = g(\%\Delta RER, \%\Delta Y) - \%\Delta RER, \qquad (2.9)$$

the percent change in the trade ratio is a function of the percent change in the real exchange rate and the percent change in the national income less the percent change in the value of real exchange rate. Linearizing this relationship one gets:

$$\%\Delta TR = \beta_0 + \beta_1 \%\Delta RER + \beta_2 \%\Delta Y, \qquad (2.10)$$

where the sign on β_1 depends on which one of the %ΔRER in (2.9) has the stronger impact on %ΔTR, and the sign on β_2 is negative.

3 Method and data

In this section, the method for this thesis is put forward and explained along with the data set.

3.1 Method

The real effective exchange rate, REER, is preferred over the real exchange rate, RER. The real effective exchange rate is the weighted average of a country's currency against a basket of other major currencies adjusted for inflation. The weights are decided by comparing the relative trade balances, in terms of one country's currency, with each other country within the basket (Investopedia, 2009). The difference between the countries' currency systems, floating, fixed, or pegged, is therefore of little importance and notice for this paper.

As stated above in section 2.5, this paper will use the trade ratio as the dependent variable in the regression for empirical purposes because of its insensitiveness to units of measurements.

To examine the purpose of this paper the focus has been on calculating the change between quarters to find the largest depreciation in the real effective exchange rate for each country in the sample over the years between 1982 and 2005.

After calculating the changes between the quarters, the greatest depreciation for the time span was detected and the time of its occurrence was defined as the base quarter, Q_0. The value and time of occurrence is stated in Appendix 1 and 2.

The quarterly changes in percentage terms in the regression model are tested over four years after the depreciation. The 16 quarters are chosen since the theory states that the trade ratio is likely to become positive on the J-curve somewhere after a few months up to three years after the depreciation.

3.2 The data set

The data set was selected after the World Bank's rank of GDP/capita 2003. Thirty-nine countries was selected out of the first hundred countries ranked highest on this list, see list in Appendix 1, with the criteria of data availability on REER in the database EcoWin. The data used in this thesis was limited by the individual country's availability of data.

The selected countries represent strong economies spread over all continents in the world. The countries trade in different major commodities and have different trade agreements. All the selected countries are open economies and classified as high or upper-middle income economies, with exception of Thailand which is listed among the lower-middle income countries (World Bank, 2009).

The REER and GDP are expressed in units of each country's home currency. The trade ratio is converted into home currency, for those countries having their exports and imports stated in USD or EUR, by the monthly spot exchange rate and averaged out quarterly to be consistent with the quarterly GDP.

Since the countries' largest depreciations occur at different times in the past, there is no exceptional risk for serial correlation as normally would occur in time series. The data is cross-sectional data[2] and the countries in the data set are spread over the world in different continents both in the large sample test and in the smaller sample test.

[2] Since the model is based on cross-sectional data, and includes mixed values based on different periods in time for different countries, the data set can be considered seasonally adjusted.

4 The regression model

The regression model put forward in this section is an empirical extension of Equation 2.10.

Two tables of regression sets are presented and analyzed in the next coming section, 5.1 with the ambition to detect the J-curve along with a rise in the trade ratio over its initial value in the long-run. The data is calculated in percent change and tested through the regression model presented below;

$$\%\Delta TR_i = \hat{\beta}_0 + \hat{\beta}_1 \%\Delta DepREER_i + \hat{\beta}_2 \%\Delta Y_i + \hat{\beta}_3 \%\Delta REER_i + \hat{\varepsilon}_i, \qquad (4.1)$$

where the symbol $_i$ denotes the country observed and β_0 the intercept.

%ΔDepREER is the largest depreciation in the real effective exchange rate measured in percent change. %ΔTR is the percent change in trade ratio over time, %ΔY is the percent change in GDP over time, and %ΔREER is the percent change in real effective exchange rate over time since the quarter of the largest percent depreciation for the country. %ΔTR, %ΔY, and %ΔREER are calculated for various quarters after the depreciation with respect to the base quarter, Q_0, (with different regressions for each of those quarters) to determine how the %ΔDepREER impacts the trade ratio over time.

β_1 is expected to be negative in the regressions for the quarters shortly after the depreciation due to the effect the real effective exchange rate has on the trade ratio. When the real effective exchange rate depreciates, the home country must pay more for any remaining imports from the foreign market at the same relative price level due to sticky prices causing the trade ratio deteriorate in the short-run. The demand for domestic goods from foreign markets will start to increase and the demand for imports in the domestic country will decrease when volumes adjust to the new relative price level. The trade balance will then improve implying that the volume effect outweighs the value effect. The estimated coefficient will then rise from its bottom value and continue to affect the β_1 positively until it eventually might attain a positive value.

β_2 is expected to be negative. The trade ratio will decrease when GDP is greater within the nation, because the nation has a greater demand for foreign goods so the increase in import causes the trade ratio to decline.

There is no expected sign on β_3 since it can vary for the same reasons as for β_1. The inclusion of %ΔREER controls for the real effective exchange rate changes that have happened between the quarters after the original depreciation.

5 Empirical Analysis

The regression results are presented and analyzed in this section of the paper. Two tables are presented with the regression results along with graphical illustrations of the results for the estimated coefficient β_1.

5.1 Regression analysis

The first table, Table 5.1-1, is based on the regression results for Equation 4.1 for all the 39 countries included in the data set in this thesis. One regression is run for every quarter after the greatest depreciation for each country and is presented in the tables below. The regressions are run as individual regressions for every quarter over a time period of 4 years, 16 quarters, after the time of the depreciation. The quarter where the greatest depreciation occurred is stated as Q_0, as discussed in section 3.1, and the first quarter after that depreciation is Q_1, the second quarter Q_2, and so on.

In Q_0 the values in %ΔDepREER, %ΔTR, %ΔY, %ΔREER are calculated individually for their percent change at the time of the depreciation. The values for %ΔDepREER do not vary across the regressions, as the magnitude of the greatest depreciation in real effective exchange rate for any particular country does not vary. The values of the other variables %ΔTR, %ΔGDP, and %ΔREER do vary over time and their values in Q_1, Q_2, Q_3, …, Q_{16}, are the calculated percent change with respect to their value in Q_0.

The estimated intercept is given in the column of $\hat{\beta}_0$, the estimated slope coefficient for %ΔDepREER is given by $\hat{\beta}_1$, the estimates slope coefficient for %ΔY by $\hat{\beta}_2$, and the estimated slope coefficient for %ΔREER by $\hat{\beta}_3$.

Table 5.1-1 Regressions on the full data set, containing 39 countries.

Quarter	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	R^2
Q_0	-0.162962*** (0.030574)	2.452798*** (0.269236)	-0.500555 (0.384744)		0.701874
Q_1	-0.211255*** (0.045178)	4.141283*** (1.489528)	-0.758240* (0.441173)	-0.304545 (1.061625)	0.751161
Q_2	-0.217592*** (0.047986)	3.668341*** (0.749142)	-0.204866 (0.594871)	0.480067 (0.557697)	0.760452
Q_3	-0.141011*** (0.047943)	2.981825*** (0.562276)	-1.157031 (0.768300)	0.230032 (0.395861)	0.769014
Q_4	-0.111501*** (0.036832)	2.367091*** (0.510785)	-0.589955 (0.362340)	0.219627 (0.384033)	0.691319
Q_5	-0.086324** (0.036678)	2.662644*** (0.467645)	-0.670214** (0.285361)	0.027457 (0.331626)	0.724185
Q_6	-0.086963** (0.035882)	2.308118*** (0.414128)	-0.340762 (0.342471)	-0.026506 (0.271094)	0.665199
Q_7	-0.007206 (0.035309)	1.609917*** (0.334266)	-0.688095* (0.339486)	0.016127 (0.208956)	0.628100
Q_8	-0.022943 (0.036600)	0.828188** (0.378562)	-0.110522 (0.278090)	0.339835 (0.237982)	0.403213
Q_9	0.007632 (0.033899)	0.858974** (0.356811)	-0.310910 (0.219952)	0.388700* (0.222908)	0.471431
Q_{10}	-0.002888 (0.040737)	1.295954*** (0.370764)	-0.213314 (0.280281)	-0.014485 (0.215667)	0.387353
Q_{11}	0.060318 (0.040042)	0.660264** (0.314636)	-0.558220* (0.296408)	0.271125 (0.171119)	0.383428
Q_{12}	0.025517 (0.037226)	0.423877 (0.335124)	-0.155639 (0.216837)	0.386166** (0.174195)	0.332119
Q_{13}	0.043114 (0.035692)	0.291962 (0.337945)	-0.207306 (0.187596)	0.468388*** (0.168941)	0.366780
Q_{14}	0.003484 (0.039947)	0.765278** (0.376253)	-0.048268 (0.216464)	0.205714 (0.182873)	0.292724
Q_{15}	0.061722 (0.039144)	0.541580* (0.313179)	-0.411851** (0.202018)	0.339898** (0.149786)	0.399184
Q_{16}	0.022232 (0.037859)	0.362255 (0.323111)	-0.146519 (0.199441)	0.424300*** (0.144189)	0.400737

Notes:
a. Regression with d.f. 35, *significant at 10%, ** significant at 5%, *** significant at 1%.
b. The values within the parenthesis are associated with the standard errors.
c. Q_0 is regressed excluding β_3, EViews is not able to regress the same value in two coefficients.
d. Q_{16} does not contain values for Croatia due to lack of data.
e. The subscripts on the Q's denote the number of quarters after the largest depreciation in REER.

From Table 5.1-1 one can find a positive relation between the depreciation in real effective exchange rate and the trade ratio, reflected by the coefficient estimates of β_1 in the second column. This is the opposite effect than what originally was expected. The trade ratio increases immediately as a response to the depreciation, without the decline in the trade ratio as theory expects at first. The estimated coefficient increases immediately but then gradually declines after reaching its greatest value at 4.141283 in Q_1. After Q_1 the positive effect on the estimated β_1 coefficient weakens and becomes less positive over time, however it never goes down to its initial value nor attains a negative value during the time span of our study. From this, the expectation on the trade ratio is that it rises initially but becomes less positive over time as Figure 5.1-1 shows below.

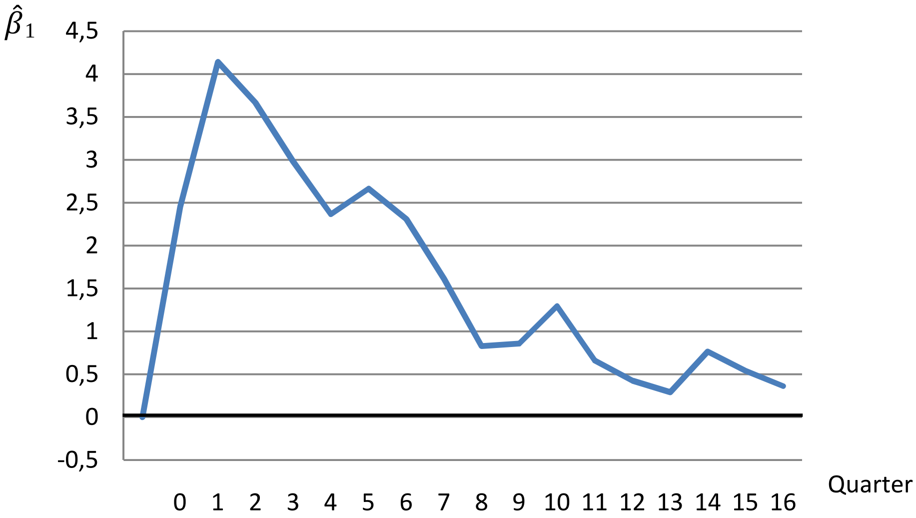

Figure 5.1-1 Sketch of the path of $\hat{\beta}_1$, with a long-run positive relation to the trade ratio.

According to the results, the trade ratio is strongly positively affected by a depreciation at first as it immediately increases but over time the effect is less recognized in the economy and the trade ratio falls. According to standard trade theory with the Marshall-Lerner condition being met, the trade balance is expected to be positively affected by a depreciation and this is in line with the results detected in the regressions above. The results support theory that states that the trade balance in a country is supposed to increase after a depreciation in the real exchange rate. However the results do not support the theory of the J-curve phenomenon, where the trade balance is expected to deteriorate at first and then gradually improve over time and attain a value over its initial value in the long-run. The results show that a depreciation in the real effective exchange rate strongly affects the trade ratio, but there is no indication of any value effect influencing the trade ratio negatively before the volume effect is recognized and causing the trade ratio to increase.

GDP does affect the trade ratio negatively as expected, reflected in the coefficient estimates for β_2. When GDP increases, the economy becomes stronger and people are able to consume more foreign goods causing the domestic imports to increase, and thereby the trade ratio decreases.

During the 4 years tested for, when conducting regressions on all 39 countries, the results indicate that, all else equal, after a major depreciation the trade ratio becomes positive immediately and then falls over time.

According to theory, greater depreciations would give a more defined result and greater impact on the trade balance. The sizes of the depreciations are not significantly large for all the countries tested for, and therefore maybe do not have a consequent effect on the economy as a whole. Small depreciations in the exchange rate are likely to be outweighed by other variables affecting the economy in determination of the trade ratio that the estimated coefficient is reflecting. The dynamics of the economies make it difficult to get a precise estimation of the expected effect on the trade ratio given the change in exchange rate, especially when that change is small. Selecting the countries with larger depreciations would give a more defined result and larger impact on the trade ratio, according to theory.

Therefore, new regressions were run to see if this would give different result and any empirical evidence for a J-curve effect for countries with a significantly larger depreciation in their real effective exchange rate. Table 5.1-2 contain regressions results for the 13 countries, listed in Appendix 2, that have a depreciation in their real effective exchange rate greater than 8 percent. Also here, one regression is run for every quarter and presented in Table 5.1-2 below.

Table 5.1-2 Regressions on the 13 countries with the largest depreciations from the dataset.

Quarter	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	R^2
Q_0	-0.438076*** (0.059415)	3.632338*** (0.309779)	-0.062018 (0.434065)		0.937630
Q_1	-0.567440*** (0.088956)	5.680947*** (1.612057)	-0.687773 (0.503178)	-0.306815 (1.156415)	0.937359
Q_2	-0.567563*** (0.111576)	5.774777*** (0.979501)	-0.929757 (0.953885)	-0.072281 (0.622940)	0.923548
Q_3	-0.429374*** (0.107608)	4.042699*** (0.818055)	-1.042569 (1.247965)	0.383273 (0.544541)	0.893841
Q_4	-0.313465*** (0.094762)	2.650581*** (0.718797)	-0.547224 (0.542488)	0.786474 (0.548518)	0.866635
Q_5	-0.226417* (0.102557)	2.761685*** (0.772872)	-0.759751 (0.455517)	0.570725 (0.578820)	0.831953
Q_6	-0.185372 (0.105551)	2.462162*** (0.681665)	-0.633110 (0.722581)	0.315814 (0.481563)	0.774168
Q_7	-0.075327 (0.083646)	1.604024** (0.519304)	-0.835478 (0.686345)	0.326198 (0.344517)	0.754483
Q_8	-0.043526 (0.097371)	0.854190 (0.627256)	-0.132209 (0.570872)	0.457726 (0.393721)	0.531873
Q_9	0.020801 (0.086970)	0.763641 (0.582662)	-0.272673 (0.415084)	0.464203 (0.370709)	0.569800
Q_{10}	0.115907 (0.095909)	1.129707 (0.638480)	-0.722520 (0.578114)	-0.093451 (0.367697)	0.386970
Q_{11}	0.045795 (0.081020)	-0.001759 (0.566370)	0.053607 (0.751260)	0.712240** (0.296358)	0.574590
Q_{12}	0.073567 (0.084331)	0.036939 (0.545556)	-0.102675 (0.465408)	0.586538* (0.295861)	0.480224
Q_{13}	0.107442 (0.080955)	-0.364955 (0.609394)	-0.067527 (0.360803)	0.770607** (0.319822)	0.478718
Q_{14}	0.023018 (0.078776)	-0.703383 (0.646541)	0.642546 (0.470560)	1.070931** (0.357239)	0.587477
Q_{15}	0.056668 (0.075014)	-0.867010 (0.617836)	0.567071 (0.554963)	1.068804*** (0.309071)	0.643576
Q_{16}	0.035661 (0.059026)	-0.567670 (0.446809)	0.303056 (0.294140)	0.940670*** (0.231892)	0.732311

Notes:
a. Regression with d.f. 9, *significant at 10%, ** significant at 5%, *** significant at 1%.
b. The values within the parenthesis are associated with the standard errors.
c. Q_0 is regressed excluding β_3, EViews is not able to regress the same value in two coefficients.
e. The subscripts on the Q's denote the number of quarters after the largest depreciation in REER.

Examining the countries that have a depreciation greater than 8 percent gives a similar result compared to testing a mix of both small and large depreciations. From the results in Table 5.1-2, one can see that the estimated β_1 coefficients improve to a greater extent than in previous set of regressions, and gradually decrease over time and eventually attains negative values in the long-run. The estimated β_1 coefficient decreases after reaching its highest value in Q_2 at 5.774777 and then gradually decreases over time until it eventually attains a statistically insignificant negative value of -0.364955 in Q_{13}. The findings are presented graphically in Figure 5.1-2.

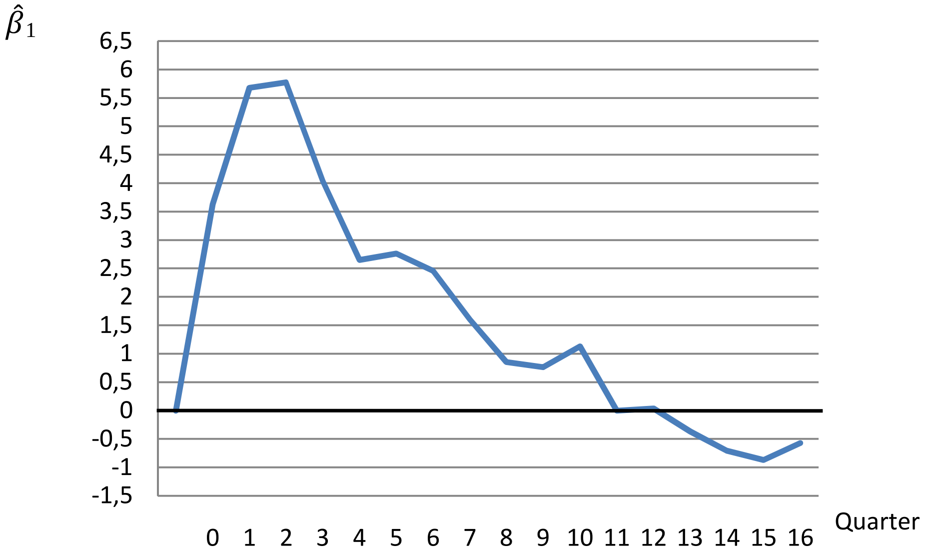

Figure 5.1-2 Sketch of the path of $\hat{\beta}_1$, with a long-run negative relation to the trade ratio.

The findings are similar to the inverse J-curve that Bahmani-Oskooee found after depreciations in the real exchange rates for four countries where the trade balance increased at first but then deteriorated over time (Bahmani-Oskooee, 1989).

Excluding the β_3 coefficient from the regression sets above does not affect the overall result significantly, except for the expected decrease in the R^2 in all the regressions; hence, the results are not presented in this thesis.

Neither heteroscedasticity nor multicollinearity was detected among the regressions. A full presentation of the tests for multicollinearity and heteroscedasticity are given in Appendix 3.

6 Conclusion

The main findings in this thesis illustrate that there is a large positive impact on the trade ratio after a depreciation in the real effective exchange rate. The trade ratio does respond quickly to the depreciation in the real effective exchange rate and increases without any sign of negative effect before the increase, implying that no strong value effect is recognized in the economy. The results show no negative short-run impact on the trade ratio as the J-curve phenomenon expects, although the results are in line with the standard trade theory with the Marshall-Lerner condition holding, i.e. a depreciation in the exchange rate has a positive impact on the exports and negative impact on the imports for the domestic country. The immediate rise in the trade ratio could be due to that the volume effect is recognized to a greater extent than the value effect is in the economy.

What is to be seen from the two regressions sets, the first having countries with small and large depreciations for their greatest depreciations and the second including only countries with large depreciations for their greatest depreciation, is that the larger the depreciation the greater is the sensitivity of the trade ratio to that depreciation.

Suggestions for further studies in this field are to test whether there is a difference between weak and strong economies in detecting the relationship between a depreciation and the trade balance over time, or between large and small open economies.

Another suggestion of study is to measure the changes in elasticity of demand for exports and imports after a depreciation to investigate the validity of the Marshall-Lerner condition.

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Appendix 1

List of countries in data set and the depreciations tested in Table 5.1-1.

County, i	%ΔDepREER	Period of Time
Argentina	0.476915103	Q1 2002
Australia	0.06922043	Q3 1992
Austria	0.022930062	Q2 1991
Belgium	0.024650836	Q1 1997
Brazil	0.143715388	Q1 2002
Canada	0.044656368	Q2 1994
Chile	0.087758524	Q3 2001
Croatia	0.014155947	Q3 2005
Czech Republic	0.060471163	Q1 1999
Denmark	0.045180096	Q3 1993
Finland	0.090334719	Q4 1992
France	0.060191388	Q3 1982
Germany	0.035492458	Q2 1991
Greece	0.021203923	Q3 2003
Hong Kong	0.082067146	Q4 1998
Hungary	0.056101575	Q2 1995
Iceland	0.078066762	Q2 2001
Israel	0.101652169	Q4 1998
Italy	0.107978212	Q4 1992
Japan	0.106982423	Q3 1995
Luxembourg	0.019499731	Q1 1997
Mexico	0.040056799	Q1 2003
Netherlands	0.032612925	Q1 1997
New Zealand	0.061011638	Q1 2000
Norway	0.05599551	Q2 2003
Poland	0.09020749	Q3 2002
Portugal	0.048203455	Q3 1993
Russia	0.032743469	Q3 2002
Singapore	0.077230622	Q2 1986
Slovak Republic	0.050148606	Q4 1998
South Africa	0.16972099	Q4 2001
South Korea	0.059469492	Q1 2001
Spain	0.026010001	Q4 1992
Sweden	0.126312125	Q4 1998
Switzerland	0.057135429	Q1 1997
Thailand	0.179277919	Q3 1997
Turkey	0.185105674	Q2 2001
UK	0.12352359	Q4 1992
USA	0.055738184	Q2 1995

This is an example for the case of Argentina in how to calculate the largest depreciation, %ΔDepREER, between the quarters and the same method has been used for all countries. Q1 2002-Q4 2001/Q4 2001= 0.476915103

Appendix 2

List of countries in data set and the depreciations tested in Table 5.1-2.

County, i	%ΔDepREER	Period of Time
Argentina	0.476915103	Q1 2002
Brazil	0.143715388	Q1 2002
Chile	0.087758524	Q3 2001
Finland	0.090334719	Q4 1992
Israel	0.101652169	Q4 1998
Italy	0.107978212	Q4 1992
Japan	0.106982423	Q3 1995
Poland	0.09020749	Q3 2002
South Africa	0.16972099	Q4 2001
Sweden	0.126312125	Q4 1998
Thailand	0.179277919	Q3 1997
Turkey	0.185105674	Q2 2001
UK	0.12352359	Q4 1992

This is an example for the case of Argentina in how to calculate the largest depreciation, %ΔDepREER, between the quarters and the same method has been used for all countries. Q1 2002-Q4 2001/Q4 2001= 0.476915103

Appendix 3

Testing for heteroscedasticity and multicollinearity

The results from testing for heteroscedasticity and multicollinearity in the regressions done for the first quarter for every year for the main regression for all 39 observations are found in Table 5.1-1 in section 5.1. White`s test is constructed with the null hypothesis stating no heteroscedasticity among the residuals.

White´s test for heteroscedasticity

Quarter	F-statistics	Obs × R-squared	Chi-square crit.
Q_4	1.996173	14.91852	< 16.9190
Q_8	2.047245	15.15192	< 16.9190
Q_{12}	0.881523	8.377567	< 16.9190
Q_{16}	1.091481	9.869211	< 19.9190

On a 5 percent level, one can compare the observed R-squared with the critical Chi-square value at 16.9190 using the Chi-square table for degrees of freedom= 9 (Gujarati, 2003). We find that the null hypothesis of homoscedasticity cannot be rejected at the 5% significance level. Therefore, one can conclude that there is an equal spread in the disturbance terms in the data set.

Variance-Inflating Factor, testing for multicollinearity

Quarter	Explainatory variable	VIF
Q_4	Depreer	2.86518
	GDP	1.00189
	Reer	2.86732
Q_8	Depreer	2.10967
	GDP	1.01153
	Reer	2.09880
Q_{12}	Depreer	1.75973
	GDP	1.03380
	Reer	1.71566
Q_{16}	Depreer	1.78008
	GDP	1.12091
	Reer	1.63164

Referring to the table above and the value for Variance-Inflating Factor, VIF, one can conclude that there is no problem with multicollineraity in the regressions tested since all of the values for VIF are low. The VIF-test measures how a variance of a variable is inflated by the presence of multicollinearity. When VIF=1 there is no problem with multicollinearity. Values equal to 10 and higher are considered representing a problem of multicollinearity (Gujarati, 2003).