

Examining how exchange rate fluctuation effects trade balances

Empirically establishing the correlation
between exchange rate and balance of trade,
the Marshall-Lerner condition and J effect

Ratib M Ali – 09205005
Mahsima A Kamal – 09205015

March 15, 2012

BRAC University

ABSTRACT

This paper will examine the effects on an economy's overall balance of trade due to fluctuations in its exchange rate, followed by how the Marshall-Lerner and J- curve come into effect in influencing a country's current account. Econometric analyses using regression have been carried out to show the relationship between exchange rate effects and the trade balance for certain countries, showing which countries' trade balance situation prove the Marshall-Lerner assumption to be valid and which countries' trade balances show signs of the J curve effect, to be elaborated further. We will also examine whether some of these countries have both the Marshall-Lerner and J-effect showing up in their trade balance trends in recent years, either of the two, or if any other factors apart from their exchange rate patterns are more active in influencing certain countries' balance of trade positions.

Contents

| | |
|--|----|
| Introduction | 3 |
| Literature Review | 3 |
| Methodology | 5 |
| Results and Findings | 6 |
| J curve effect and Marshall-Lerner condition | 8 |
| Conclusion | 10 |
| Bibliography | 11 |
| Appendix | 12 |

Introduction

The exchange rate, which is the price of one country's domestic currency in terms of another foreign currency, is used to determine the difference between the volume of goods and services that are exported and imported to and from a country, thereby determining its current account position and trade balance with other countries. Exchange rates of some countries are prone to high fluctuations, which are pegged against a strong currency, usually the U.S. dollar, mostly for developing countries, while other countries usually the more developed ones have fixed exchange rates. Exchange rates determine the relative prices of our imports and exports, and are therefore key in determining the trade balance deficits or surpluses. *Ceteris paribus*, currency depreciation widens the trade balance whereas depreciation shrinks it. However, the extent and time lag for this effect is examined by the Marshall-Lerner condition and the J effect.

These are the two main concepts that explain the relationship between a country's exchange rate and balance of trade. The Marshall-Lerner condition looks at the price elasticities of the demand for exports and imports of a country. It says that all else equal, if the sum of the price elasticities of a country's exports and imports exceed a coefficient of 1, then a depreciation of that country's currency will improve its current account as should be the case during a currency depreciation mentioned earlier due to the level of exports exceeding imports, if the demand for both exports and imports are sufficient price elastic, therefore summing up to a coefficient higher than 1. The J-curve represents the time lag during which a country's current account deteriorates before it actually improves following currency depreciation. This could be due to previously signed contracts with import and export orders placed in advance, therefore new shipment taking time to adjust to the relative price change. Expanding foreign consumption of domestic exports also takes time to adjust to the new price change. Most industrial countries have J-curves lasting for 6 months to a year for the actual depreciation to take effect. This time path takes the shape of a 'J' giving it its name. Evidence also suggests that J-curve effects strengthen the volatile nature of exchange rates further (Krugman & Obstfeld, 2009).

Literature Review

Many Asian developing countries due to their inability to maintain fixed exchange rates, were led into higher macroeconomic imbalances prior to the Asian currency crisis in 1997 (Lal & Lowinger, 2002). Movements of the exchange rates affect the current account by an appreciation of the domestic currency, where the value of the domestic currency rises relative to the foreign currency,

thereby raising the reducing the demand for domestic goods by domestic as well as foreign consumers as domestic goods are becoming more expensive. As a result, the level of exports to foreign countries falls, while imports rise, leading to a current account deficit, while a depreciation of the domestic currency has the opposite effect making domestic goods cheaper relative to foreign ones, leading to a current account surplus, due to more goods being exported than is being imported (Krugman & Obstfeld, 2009). Exchange rate fluctuations have a considerable impact on a country's balance of trade or current account, but the extent to which the current account is being affected by these factors is explained by the Marshall-Lerner condition and J-curve.

As mentioned earlier, the Marshall-Lerner condition states that given the price elasticities of both the exports and imports of a country are somewhat high, currency depreciation will lead to a current account surplus. However, this may not always be the case if the goods traded are price inelastic. In this case, the current account will be adversely affected, and this shall be explored in the latter section using econometric analysis, where the Marshall-Lerner assumption does not hold for all countries due to the types of goods traded along with other factors affecting their trade balances and not just their exchange rate fluctuations. Also, we have seen that as currency depreciation or devaluation improves the current account, many countries in the last decade or two, have not experienced the appropriate impacts on their current accounts. One such country is Brazil, which experienced a persistent deficit on its trade balance during 1990-1998 due to an appreciation in its real exchange rate (Gomes & Paz, 2005). Analysis had been carried out to check whether the Marshall-Lerner and J-effect hold in the aftermath of real exchange rate devaluation, and also to examine the short run and long run effects of real exchange rate depreciation on the Brazilian Trade Model in the 1990s. It was argued that the trade balance could be improved via currency depreciation. However, this would only occur in the long run if the Marshall-Lerner condition would hold, but also deteriorate in the short run if the J-effect took place. Using the VEC-M (vector error correction model), using monthly observations from January 1990-December 1998, it was seen that the Marshall-Lerner condition did hold for that period, while the J-curve effect also held for the short run.

Other studies have shown how the J-curve effect has been present in the trade balances of most East Asian countries during the period in which these countries experienced high growth especially during the '60s to the '90s. Analysis using cointegration technique, error correction model and impulse response function were carried out in around 7 countries such as Korea, Indonesia, Malaysia, Singapore and the Philippines among a few to examine their J-curves under different

exchange rate regimes explain the differences in their trade balances due to changes in exchange rates (Lal & Lowinger, 2002). Each country had varying results for shapes of their J-curves, as the different countries had different time lags before their current accounts improved. These differences were also due to varying trade and commercial policies, yet, 6 out of the 7 countries examined had confirmed J-curve patterns. Carrying out these analyses showed that real effective exchange rates have a significant impact on a country's trade balance. These observations may be helpful to aid the ongoing policy discussions regarding effects of exchange rate changes on the trade balances of developing countries. Therefore, results from these studies can explain why certain developing countries should choose fixed or flexible exchange rates that affect their trade balances. It can also show how the effects of other different variables may dampen the Marshall-Lerner or J-curve effects on trade balances. This can be shown in more detail in the next section, through econometric analysis carried out to illustrate impacts on trade balances of other countries and whether the Marshall-Lerner and J-curve effects are evident in them or not.

Methodology

In order to establish any relationship between exchange rates and trade balances, we need to obtain data sets. Yearly averages were obtained for the taka-rupee (BDT/INR) historic exchange rate (FXTOP, 2012) and the aggregate trade balance (defined by exports less imports) between Bangladesh and India (Department of Commerce, 2012). This yearly data was collected for the years 1996 to 2010 inclusive. Similar data was required for the Bangladesh-Europe regression, so the average yearly taka-euro (BDT/EUR) historic exchange rates (FXTOP, 2012) and the annual trade balance between Bangladesh and European Union (eurostat, 2009) were obtained as well. These data were for the years 2004 to 2010. Then, the annual GDP of Bangladesh (World Bank, 2012) between 1996 and 2010 was also obtained to incorporate in the enhanced model.

In the second part of the analysis, we used data about the US-Norway monthly trade balance (U.S. Census Bureau, 2012), the monthly average krone-dollar (NOK/USD) exchange rate (FXTOP, 2012) the Norwegian quarterly GDP (Statistisk sentralbyrå, 2012) and the US quarterly GDP (BEA, 2012). These data were obtained for all quarters between 2000 and 2011 inclusive.

Examination of the Marshall-Lerner condition and the J-curve effect required the choice of a currency with a pegged exchange rate. That way, when that peg was changed, we would be able to observe the change in trade balances and see whether the two phenomena take place or not. The two

currencies chosen for this purpose were the Kuwaiti Dinar (KWD) and the Lithuanian Lita (LTL). One Dinar was pegged against the USD at the rate \$3.34, which was then revised to \$3.61 on June 16, 2007 (Merzaban, 2007). The lita was originally pegged against the dollar at 4 litas to a dollar, and the peg was revised on February 2, 2002 against the euro, changing the current value of the lita to 2.65 litas to a dollar (Press and Information Division, ECB, 2004). For this analysis, we used the monthly trade balance between the US and Kuwait for the period 2006 to 2009 (U.S. Census Bureau, 2012), encompassing the peg change, and between the US and Lithuania for the period 2001 to 2003 (U.S. Census Bureau, 2012), covering the peg revision.

Results and Findings

From past literature, a simplistic model to establish a relationship between trade balance and exchange rate is using the following equation:

$$\text{Trade balance} = \beta_0 + \beta_1 \times \text{Exchange rate} + u \quad - \text{model 1}$$

Where the β 's are the coefficients and u is the stochastic disturbance.

We have tested this equation with the data of bilateral trade balance and the exchange rates of Bangladesh with India and the European Union. India was chosen because it is Bangladesh's largest exporter, and the EU because it is Bangladesh's largest importer. By running a regression, we obtain the following results:

| | India | | European Union | |
|---------------|-----------|---------|----------------|----------|
| Exchange rate | -2558.371 | (0.001) | 69.74268 | (0.026) |
| Constant | 1899.998 | (0.029) | -2328.917 | (0.313)* |
| R-squared | 0.6018 | | 0.6632 | |

Parentheses contain p-values. * denotes statistically insignificant.

These results clearly show that there is a relationship between exchange rates and trade balances, because the β_1 for India-Bangladesh is significant at 99.9% level, and the β_1 for Bangladesh-EU is significant at 97.4% level. The R-squared is above 0.6 showing a moderate fit.

Thus, we can predict the Bangladeshi trade balance against India using the equation:

$$\text{Trade balance} = 1900 - 2558 \times \text{Exchange rate} + u,$$

And the Bangladeshi trade balance against the European Union using the equation:

$$\text{Trade balance} = 69.7 \times \text{Exchange rate} - 2329 + u,$$

The β_1 for India-Bangladesh is negative, showing that currency depreciation (increase in the exchange rate) worsens the trade balance for India-Bangladesh. This implies that India must be an exporter to Bangladesh. This is consistent with our real-world observations. The β_1 for Bangladesh-EU is positive, showing that currency depreciation (increase in the exchange rate) strengthens the trade balance for Bangladesh-EU. This implies that EU must be an importer for Bangladesh. This too is consistent with our real-world observations.

However, because Bangladesh has a steadily increasing GDP, it may be the case that the increasing domestic demand is fuelling the exports and imports, deepening the trade balance, and consequently, trade balance has nothing to do with exchange rates. To control for GDP, we decided to establish a new equation:

$$\text{Balance} = \beta_0 + \beta_1 \times \text{Exchange rate} + \beta_2 \times \text{GDP} + u \quad \text{- model 2}$$

and run a multivariate regression. The trade balance of Bangladesh was regressed against both the exchange rate and its GDP. Analysis for India and EU are shown below:

| | India | | European Union | |
|---------------|-----------|----------|----------------|----------|
| Exchange rate | 528.6616 | (0.499)* | 12.59578 | (0.524)* |
| GDP | -58.00708 | (0.001) | 65.39364 | (0.016) |
| Constant | 1143.919 | (0.045) | -1580.408 | (0.207)* |
| R-squared | 0.8568 | | 0.9330 | |

Parentheses contain p-values. * denotes statistically insignificant.

These results tell us that the β_1 coefficient for the exchange rate in both the cases of India and EU are statistically insignificant even at a 50% tolerance level. However, the correlation between trade balance and GDP is statistically significant (significant at 98%+ level). This shows that in the case of Bangladesh, whose GDP is steadily rising but its currency is constantly depreciating, the exchange rate works as a proxy for the GDP, and hence, the two variables must have an autocorrelation, rendering this analysis futile.

To account for the steadily rising GDP, we decided to apply the two models proposed on a nation that has a slow economic growth. Norway is one such nation. Therefore, we obtained data for the Norwegian exchange rate, its GDP and trade balance with the United States, and ran a regression.

The results are:

| | Model 1 | | Model 2 | |
|---------------|----------|----------|----------|---------|
| Exchange rate | 31.16388 | (0.395)* | 167.4224 | (0.007) |

| | | | |
|---------------|-----------|-----------|-----------|
| GDP of Norway | | 0.0051672 | (0.008) |
| Constant | -1270.476 | (0.000) | -4121.408 |
| | | | (0.000) |

Parentheses contain p-values. * denotes statistically insignificant.

This data set provides interesting results. It says that for nations with relatively stable GDPs, exchange rate alone cannot explain the trade balance (coefficient significant only at 60% level), but together with the GDP and the exchange rates, trade balances can be explained perfectly. At over 99% significance level, we can state that for Norway and United States:

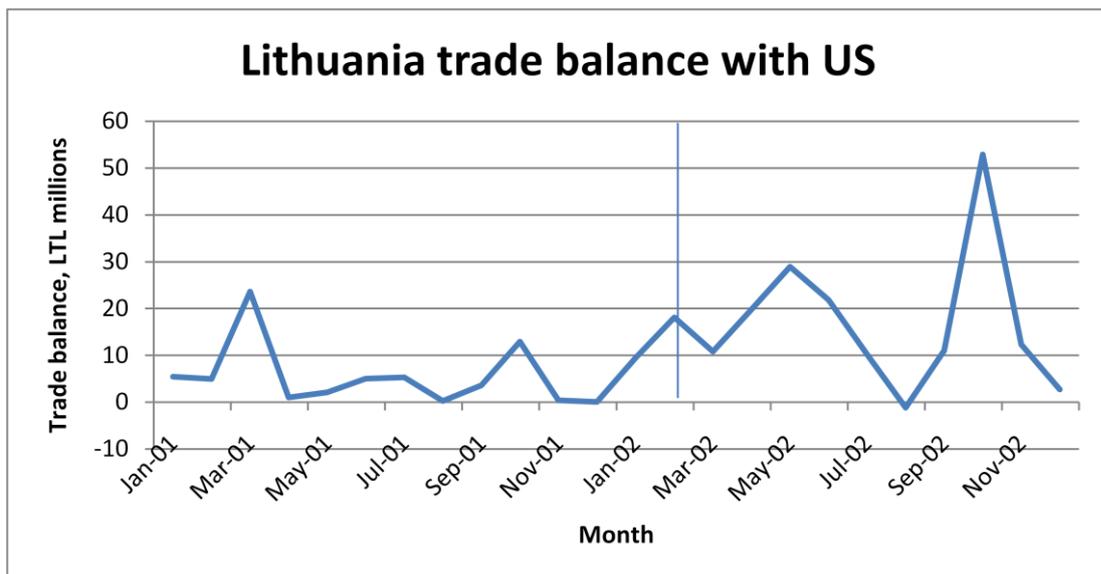
$$\text{Trade balance} = 167 \times \text{Exchange rate} + 0.00517 \times \text{GDP of Norway} - 4121 + u$$

The positive coefficient of the exchange rate variable indicates that the USA primarily imports from Norway, which is true from the real-world data available.

In both cases, we've omitted the GDP of India, European Union and the United States under the assumption that in relation to their trading partners (Bangladesh and Norway), the larger economy is so huge, and their trade with the partners is so small in comparison, that the larger partner's GDP will not affect the trade.

J curve effect and Marshall-Lerner condition

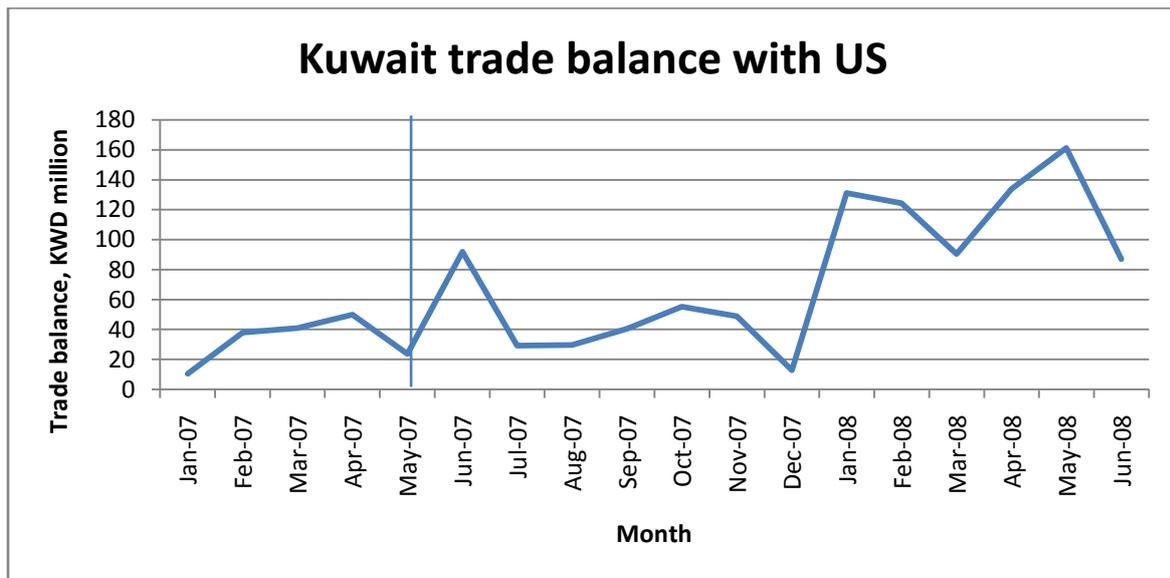
To examine the J curve effect, we chose a pegged currency where the peg was revised, to capture the effect of a change in trade balance holding the exchange rate constant after the one-time revision. Two currencies, the Kuwaiti dinar and the Lithuanian lita were used for this. Using the US-Lithuania monthly trade balance between 2001 and 2003, we plot the following graph:



The vertical line shows February 2002, the time when the litas was re-pegged from 4 litas = \$1 to approximately 2.65 litas = \$1. As we would expect, an appreciation of the currency would make American imports cheaper and exports to the US more expensive, therefore deteriorating the trade balance. Here, we see that the trade balance continues to increase at-large between January and June 2002 before dipping down to zero within August 2002. This effect is consistent with the J effect where it is predicted that an appreciation will cause the trade balance to rise first before falling eventually.

The slight fall in trade balances immediately following the revaluation of the litas might have been due to the increased market access into the European Union, its neighbours, due to pegging the currency to the euro. This might have diverted Lithuania's exports to Europe instead, reducing its trade balance with US.

Applying the same principles to the Kuwaiti dinar, we obtain the following graph:



The horizontal line indicates the June 16, 2007, the day the dinar was revalued from \$3.33 to \$3.61. An appreciation of the dinar would cause Kuwaiti exports to fall but its imports to rise, thereby having a plummeting trade balance. Consistent with our understanding of the J effect, the Kuwaiti trade balance first goes up before coming down. Unlike Lithuania, however, the trade balance does not fall below the initial level, but goes back to that level. We see Marshall-Lerner condition at work here. Because 98% of all Kuwaiti exports to the US are natural resources – petroleum, minerals and the likes – the Kuwaiti exports are price inelastic (US Census Bureau, 2012). As a result, the combined

elasticities of Kuwait's exports and imports to the US are less than one. In theory, this would result in trade balance augmentation after a currency appreciation.

From the graph, we see that the trade balance neither rose nor fell after the J effect. This may be because either the US substituted oil imports from Kuwait to other Gulf nations, or decided to use its domestic oil during that period to prevent importing at a high price.

Thus, we see the empirical evidence of the J effect as well as the Marshall-Lerner condition in the historic data from Kuwait and Lithuania.

Conclusion

Throughout our analysis, we sought to establish the reasons for which exchange rate fluctuations affected the trade balance, or the current account balance. Here, we see that an appreciation of the domestic currency makes domestic exports dearer to foreigners but foreign imports cheaper to us. This causes the exports to fall and imports to rise. The opposite is true for depreciation. Therefore, theory suggests that currency appreciation causes a fall in the trade balance (a lessening of the current account surplus or a deepening of the deficit) and vice versa. We used evidence from bilateral trade between Bangladesh and India, Bangladesh and the EU, and Norway and the US to empirically establish the theory. As a result, we created three predictive formulas for Bangladesh's trade balance with India, with EU and Norway's trade balance with US.

Then, we sought to explain why there was a time lag between the currency revaluation and changes in trade balance. This time lag is commonly referred to as the J effect, and it exists because most shipments for import and export are pre-ordered, and thus cannot immediately adjust to the new exchange rate. Therefore, for a brief period of time, the balance moves in the opposite direction of what the aforementioned theory would predict. This J effect too was established using empirical evidence from Lithuania and Kuwait and their trade balances with the US.

Lastly, we explicated the Marshall-Lerner condition – in theory, if the bilaterally traded goods are price inelastic as a whole, a currency appreciation will augment trade balance because of the low substitutability of the exports or imports. We showed that the Marshall-Lerner condition holds, by comparing Kuwait's trade balance with the US.

Bibliography

- BEA. (2012, February 29). *Gross Domestic Product*. Retrieved March 12, 2012, from U.S. Bureau of Economic Analysis (BEA): <http://www.bea.gov/national/xls/gdpchg.xls>
- Department of Commerce. (2012, March 11). *Export Import Data Bank*. Retrieved March 11, 2012, from Department of Commerce: <http://business.gov.in/outerwin.php?id=http://commerce.nic.in/eidb/ecntq.asp>
- eurostat. (2009). *External and intra-EU trade - a statistical yearbook: Data 1958 - 2008*. Luxembourg City: Publications Office of the European Union.
- FXTOP. (2012, March 11). *Historical exchange rates since 1990 with graphs*. Retrieved March 11, 2012, from FXTOP: <http://fxtop.com/en/historates.php?C1=EUR&C2=BDT&YA=1&DD1=01&MM1=01&YYYY1=2004&B=1&P=&I=1&DD2=31&MM2=12&YYYY2=2011&btnOK=Go%21>
- Gomes, F. A., & Paz, L. S. (2005). Can real exchange rate devaluation improve the trade balance? The 1990–1998 Brazilian case. *Applied Economics Letters* (12), 525-528.
- Krugman, P. R., & Obstfeld, M. (2009). *International Economics: Theory and Policy* (8 ed.). Noida: Dorling Kindersley India Pvt. Ltd.
- Lal, A. K., & Lowinger, T. C. (2002). The J-Curve: Evidence from East Asia. *Journal of Economic Integration*, 17 (2), 397-415.
- Merzaban, D. (2007, November 21). *Kuwait dinar jumps as dollar slide tests Gulf peg*. Retrieved March 12, 2012, from Reuters: <http://www.reuters.com/article/2007/11/21/gulf-currencies-idUSL2163915220071121>
- Press and Information Division, ECB. (2004, June 27). *Lithuanian litas included in the Exchange Rate Mechanism II (ERM II)*. Retrieved March 13, 2012, from European Central Bank: http://www.ecb.int/press/pr/date/2004/html/pr040627_1.en.html
- Statistisk sentralbyrå. (2012, March 12). *Final expenditure and gross domestic product, by macroeconomic indicators, time and contents*. Retrieved March 12, 2012, from Statistikkbanken: <http://statbank.ssb.no/statistikkbanken/selectvarval/saveselections.asp>
- U.S. Census Bureau. (2012, February). *Trade in Goods*. Retrieved March 12, 2012, from Foreign Trade: <http://www.census.gov/foreign-trade/balance/c4039.html>
- US Census Bureau. (2012, February 29). *Value of Exports, General Imports, and Imports by Country: Kuwait (5130)*. Retrieved March 14, 2012, from U.S. International Trade Statistics: http://censtats.census.gov/cgi-bin/naic3_6/naicCty.pl
- World Bank. (2012). *GDP Growth (annual %)*. Retrieved March 12, 2012, from World Bank Data: <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

Appendix

. (5 vars, 15 obs pasted into editor)

. reg balind inr

```

Source | SS   df   MS       Number of obs = 15
-----+-----
Model | 4955812.59   1   4955812.59       F( 1, 13) = 19.65
Residual | 3279259.85  13   252250.758       Prob > F = 0.0007
Total | 8235072.44  14   588219.46       R-squared = 0.6018
Adj R-squared = 0.5712
Root MSE = 502.25

```

```

-----+-----
balind | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----+-----
inr | -2558.371   577.1948  -4.43  0.001  -3805.325 -1311.418
_cons | 1899.998   775.1305    2.45  0.029    225.43 3574.565

```

. reg balind inr gdp

```

Source | SS   df   MS       Number of obs = 15
-----+-----
Model | 7055767.14   2   3527883.57       F( 2, 12) = 35.90
Residual | 1179305.3   12   98275.4414       Prob > F = 0.0000
Total | 8235072.44  14   588219.46       R-squared = 0.8568
Adj R-squared = 0.8329
Root MSE = 313.49

```

```

-----+-----
balind | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----+-----
inr | 528.6616   758.7998    0.70  0.499  -1124.621 2181.944
gdp | -58.00708  12.5487   -4.62  0.001  -85.34834 -30.66582
_cons | 1143.919   510.7168    2.24  0.045    31.1631 2256.676

```

. reg baleu eur

```

Source | SS   df   MS       Number of obs = 7
-----+-----
Model | 1953542.19   1   1953542.19       F( 1, 5) = 9.84
Residual | 992299.521   5   198459.904       Prob > F = 0.0257
Total | 2945841.71   6   490973.619       R-squared = 0.6632
Adj R-squared = 0.5958
Root MSE = 445.49

```

```

-----+-----
baleu | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----+-----
eur | 69.74268   22.22919    3.14  0.026    12.60073 126.8846
_cons | -2328.917  2076.154   -1.12  0.313  -7665.842 3008.007

```

. reg baleu eur gdp

```

Source | SS   df   MS       Number of obs = 7
-----+-----
Model | 1953542.19   2   976771.095       F( 2, 4) = 27.85
Residual | 992299.521   5   198459.904       Prob > F = 0.0000
Total | 2945841.71   7   422263.101       R-squared = 0.6632
Adj R-squared = 0.5958
Root MSE = 445.49

```

```

Model | 2748450   2   1374225       Prob > F = 0.0045
Residual | 197391.71   4   49347.9275       R-squared = 0.9330

```

```

-----+-----
Total | 2945841.71   6   490973.619       Adj R-squared = 0.8995
Root MSE = 222.14

```

```

-----+-----
baleu | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----+-----
eur | 12.59578   18.04462    0.70  0.524  -37.50413 62.69568
gdp | 65.39364   16.2934    4.01  0.016    20.15592 110.6314
_cons | -1580.408  1051.944   -1.50  0.207  -4501.072 1340.255

```

. reg Balance NOK

```

Source | SS   df   MS       Number of obs = 48
-----+-----
Model | 64025.8737   1   64025.8737       F( 1, 46) = 0.74
Residual | 3998147.88  46   86916.2582       Prob > F = 0.3952
Total | 4062173.75  47   86429.2287       R-squared = 0.0158
Adj R-squared = -0.0056
Root MSE = 294.82

```

```

-----+-----
Balance | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----+-----
NOK | 31.16388   36.30983    0.86  0.395  -41.92402 104.2518
_cons | -1270.476  251.4117   -5.05  0.000  -1776.541 -764.4103

```

. - preserve

. reg Balance NOK GDP

```

Source | SS   df   MS       Number of obs = 48
-----+-----
Model | 650522.697   2   325261.348       F( 2, 45) = 4.29
Residual | 3411651.05  45   75814.4679       Prob > F = 0.0197
Total | 4062173.75  47   86429.2287       R-squared = 0.1601
Adj R-squared = 0.1228
Root MSE = 275.34

```

```

-----+-----
Balance | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----+-----
NOK | 167.4224   59.58202    2.81  0.007    47.41801 287.4267
GDP | .0051672   .0018578    2.78  0.008    .0014254 .008909
_cons | -4121.408  1051.565   -3.92  0.000  -6239.369 -2003.447

```

Software used: Stata9