Senior Project
Department of Economics

How Do Changes in Government Budget Deficits Affect the Exchange Rate?

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Abstract

Asset market theory stipulates that foreign exchange transactions are dominated by interest rate differentials between the home country and foreign markets as well as by market expectations about future changes in exchange rates (and thus the expected rate of return on assets). These two determinants can be influenced differently by changes in government budget deficits, making the ultimate effect of deficits on the exchange rate ambiguous. This paper uses data from a group of nations with a free floating exchange rate regime to perform statistical hypothesis testing on predictions drawn from asset market theory as to how changes in government deficits can affect the exchange rate.

Much of this paper's empirical model and theoretical background are based on a 1996 paper by Craig Hakkio of the Kansas City Federal Reserve. The sample group is comprised of 50 observations from 30 countries with a free floating exchange rate regime in the years 2015 and 2016. A series of four deficit effects based on Hakkio's methodology and informed by asset market theory were run with two control variables to assess how budget deficits affect the exchange rate through different channels. Two of the four effects, i.e. two of the hypothesizes drawn from asset market theory, for testing in this paper's empirical model had the same expected sign as theory would suggest but were not statistically significant. A third had the same expected sign in some models and not in others. This paper's model failed to show with statistical significance how changes in government budget deficits affect the exchange rate, but the majority of the predictions

about how changes in the deficit affect the exchange rate *were* supported by the data, just at a level short of statistical confidence.

Introduction

The exchange rate is an important determinant of international economic interactions. Purchasing power parity is not a rule without exceptions, and trends in exchange rates can ultimately affect the overall economic situation of a country, particularly with regard to exports and imports. Countries with a strong or strengthening currency may find it relatively cheaper to import foreign products, but this can have a negative impact on domestic production because the prices of that nation's products will seem relatively higher in the world market. Similarly, countries with a weak or weakening currency may find it easy to find buyers for their exports on the world market, but their citizens will lose buying power when it comes to imports, creating a situation where foreign products that cannot be produced domestically are expensive or harder to get in that country.

Some factors that affect the exchange rate are beyond the control of any government, such as consumer preferences. In nations with a free floating exchange rate regime especially, there is only so much a government can do to influence the price of its currency on the world market. This paper analyzes the possible ways government budget deficits can affect the exchange rate.

If government budget deficits have an effect on the exchange rate, it would be important to consider the implications, especially in the context of tax and appropriations bills that are projected to add hundreds of billions even trillions of dollars in deficits over

the course of the upcoming years. When policy makers consider the overall outcome of these kinds of bills, in addition to everything else, they should consider any pressure these enlarging deficits will exert on the exchange rate and how this change in the exchange rate will affect the nation's economy.

To add to a body of knowledge on the topic of how deficits can affect exchange rates, this paper uses theory and prior studies to refine a set of variables that measure the effects that deficits can have on the exchange rate through different channels. This paper seeks to empirically test their predicted effects using statistical hypothesis testing via an OLS model in SAS. The research question that the model attempts to address is, 'Does 2015 and 2016 data from a group of 30 nations with a free floating exchange rate regime support the predictions drawn from asset market theory about how changes in government budget deficits affect the exchange rate?'

Review of the Literature

A review of the literature shows a surprisingly small amount of recent work on the topic, and a need for more current research to be done. The primary empirical source on the topic is a 1996 report in the *Economic Review* by Craig Hakkio, of the Kansas City Federal Reserve. He first notes that in the U.S. government debt as a share of GDP grew from 37% to 63% from 1980 to 1994. While it grew from 41% to 70% of GDP in the major industrialized nations over the same time period. He sought to investigate how budget deficit reduction affected the exchange rate.

He uses findings from a 1996 International Monetary Fund study titled “Fiscal Challenges Facing Industrial Countries” that found that deficit reduction through tax cuts in countries with good records on inflation and debt tended to weaken the exchange rate while deficit reduction via spending cuts in countries with poor records on inflation and debt strengthened the exchange rate. He uses the findings of this study and the basic principles of asset market theory to refine a set of four ‘deficit effects’ or channels through which the government budget deficit affects the exchange rate.

His four effects were a direct effect, an expected inflation effect, a risk premium effect, and an expected rate of return effect. The theoretical logic of each effect is explained in the upcoming theory section.

Hakkio used data on real exchange rates over time to create a long term time trend to capture long run trends in exchange rate changes to add to the explanatory power of his model. Hakkio also added a long term interest rate differential to better separate the effects of government budget deficits from other factors that affect the exchange rate. Because Hakkio’s model contains these time trends, it does not contain an income effect as this paper’s mode does.

There are earlier papers that sought to explore the effects of budget deficits on exchange rates, however these studies were not confined to free floating exchange rate regimes and use sample data from before the era when exchange rates became so entirely dominated by asset transfers. For instance, a 1992 paper using 1970’s-1980’s data by Burney and Ahktar on budget deficits and their effects on exchange rates in Pakistan is informative, but Pakistan at the time was engaged in a policy of managing its exchange rate so as to help boost domestic production by making imports of manufactured goods

artificially expensive by managing the exchange rate. Their paper is useful for understanding how changes in a currency's value can affect the economy in general, which would be important for policy makers to consider once they knew how their currency's value would change in response to changes in deficits.

A 1990 paper by John Abell sought to explore the effects that budget deficits have on exchange rates. He first notes that between 1979 and 1985, the dollar appreciated by over 40%, and during the same time the U.S. budget deficit grew from 16 billion to 200 billion dollars. In the early 90's, it appears there was more interest in how skyrocketing deficits affected interest rates and ultimately exchange rates. Abell does a good job summarizing the debate as it stood in 1990.

"According to Hakkio and Higgins it is high U.S. interest rates and foreign capital inflows into the U.S. that provide the linkage between these two events. [the growth of the deficit and the strengthening of the dollar 1979-1985] There is a considerable debate in the literature as to the precise influence of budget deficits upon these various linkages. Evans, for example, suggests that large deficits did not cause the rise in the dollar. Also, there are numerous studies refuting the association between deficits and interest rates; see Evans and Hoelscher for example. On the other hand, Plosser reports a positive association between government spending and interest rates and Hoelscher reports a positive association between deficits and long-term rates." (Abell, 1990)

Many of the published studies on the issue are from the early 1990's, looking at 1970's and 1980's data on deficits and exchange rates. It appears to have been a more prominent issue in economics research in the early to mid-1990's.

A 2000 dissertation by De Moura E Silva explored the effects of government budget deficits on exchange rates, but again not within a strictly free floating sample of countries. He found that the level of currency devaluation associated with government deficits varied between developed and developing countries. However a devaluation is an official change in the value of a currency within a managed exchange rate system, not the same thing as depreciation in a free floating system. Like Burney and Ahktar's paper, it was informative as to the thinking of managed exchange rate regimes and how these exchange rate changes can affect the economy as a whole.

Another example of earlier work on the topic is a 1994 paper by Stacie Beck. She sought to test predictions drawn from the Ricardian equivalence theorem about public saving habits in response to government deficits. She then applied her findings within the context of exchange rates. Her paper did not seek to quantify or test the effects of deficits the way Hakkio's paper did and thus Becks' work is of lesser influence on this paper's model. However, her paper was interesting and suggested Japanese market participants behaved according to Ricardian equivalence theorem in response to deficits while German, British, Canadian, and American market participants did not.

All in all, the amount of empirical work on the topic is small and not very recent. Hakkio is the most recent and relevant source on the topic and his work is over 20 years old now. The other work on the topic is even older and not concerned with strictly free floating exchange rate regimes. A review of the literature reveals that there is much more investigating to do on this topic especially now that deficits are even larger and more nations are using a free floating exchange rate regime.

Theory

Throughout the theoretical section, the exchange rate 'E' will be the price in dollars of a unit of foreign currency and the U.S. will be the home country. In the empirical model section each country 'i' is it's own home country and an real exchange rate index is used to show changes in the currency's value but in this theory section for simplicity, all discussion will be from the viewpoint of the U.S.'s deficits and the U.S. buyer's price in dollars for a unit of foreign currency, E.

The empirical model that was derived to examine the effects of government budget deficits on the exchange rate is drawn from Asset Market Theory. This theory is based upon the principle that in the short-term, the market for foreign currencies is dominated by two main factors: (i) market expectations about future expected returns of assets and (ii) differences in short term interest rates between the home country and the foreign country. New information coming into the market can make an agent anticipate *future* changes in the exchange rate that affects the expected returns on financial assets. The consequent buying and selling of currency to purchase financial securities thus impacts the current exchange rate.

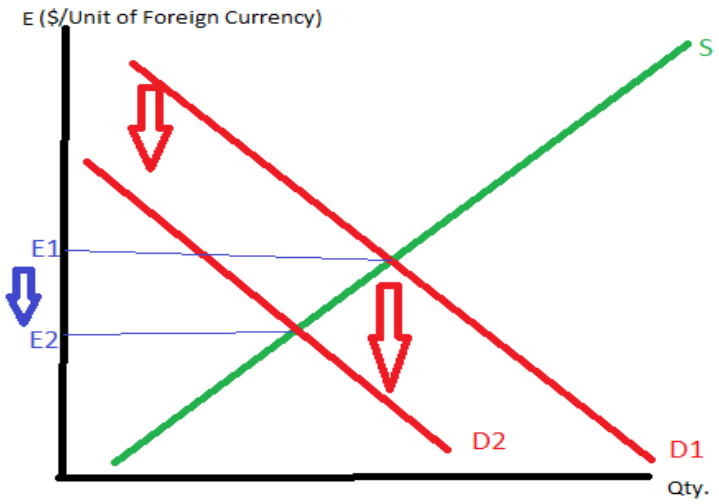
The exchange rate can change by over two percentage points in a single day. (Carbaugh, 2013). These sudden swings in the exchange rate are driven by the volume of assets being traded in global markets. In fact, 98% of foreign exchange transactions are attributable to assets being traded in global markets, as opposed to being used for the financing of imports and exports (Carbaugh, 2013).

As investors react to financial and economic reports and current events news, their expectations about future changes in exchange rates become self-fulfilling

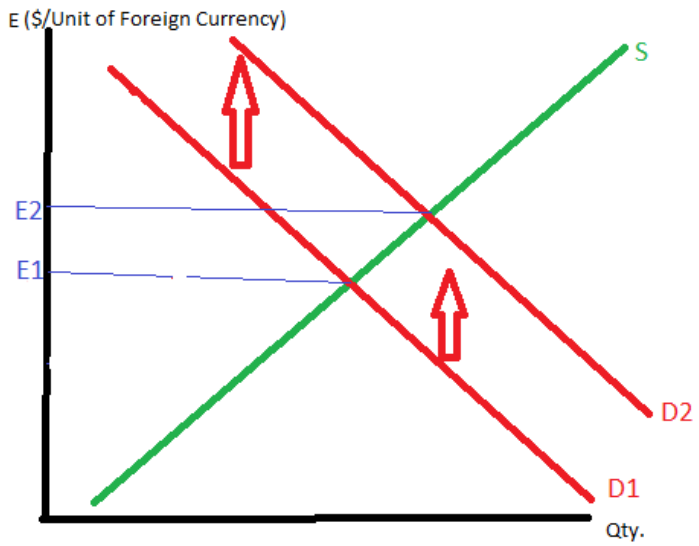
prophecies. For example, if an economic event occurs that causes investors to believe that the currency will appreciate in the future, they buy up the currency which increases the demand for that currency and actually causes it to appreciate, and vice versa.

Government budget deficits affect the market for loanable funds. When the government runs large deficits it must finance these deficits by borrowing money in the loanable funds market, which increases the demand for loanable funds. All else equal, this drives the interest rate up and can crowd out private investment. This increase in the short term interest rate directly affects the exchange rate E, in a negative direction if all else is held equal, because the U.S. is now a relatively more attractive place to invest, thus decreasing demand for foreign securities and consequently the demand for foreign currency. This would mean the home country, the U.S. in this case would see its currency appreciate because it now costs less dollars to buy one unit of a foreign currency.

Compared to if the government wasn't running as large of a deficit, the interest rate differential now makes the U.S. a relatively more attractive place to invest and the foreign country now relatively less attractive. Thus the quantity demanded of the foreign currency will be less and the subsequent demand shift will lead to a lower exchange rate, E. This effect has been dubbed the 'direct effect' in earlier research on the topic, a terminology this paper will use as well. Graphically this is the direct effect (Note: Effect is not drawn to scale and is for illustrating direction of change only, the real effect would be much smaller and harder to see on a graph)



Another channel through which government's budget deficits affects the exchange rate is termed the 'risk premium effect'. As government deficits increase, the total stock of government debt increases, thus the risk of default increases, even if ever so slightly for large industrialized nations like the U.S. (Hakkio, 1996) Market participants factor in this risk to their decision making. Thus, if the home country, the U.S., has relatively higher debt (and thus higher risk of default) than the foreign country, all else equal it will mean increased demand for foreign assets and thus foreign currency and this increased demand will exert upwards pressure on E, meaning the dollar would be depreciating. This effect is noted as 'risk premium effect' in the empirical model. Graphically:



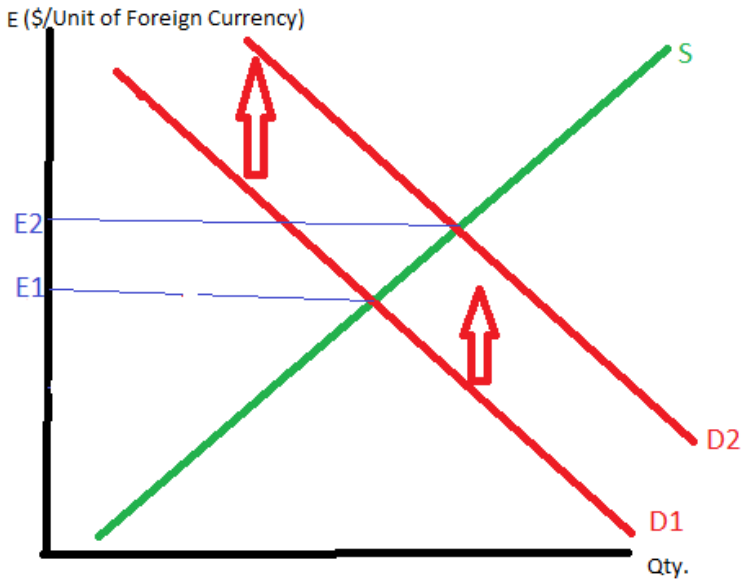
Another way the deficits can affect the exchange rate has been termed the 'Expected Rate of Return Effect'. This effect accounts for expectations of gains or losses by a changing exchange rate in the future. The basic idea is that if you expect to earn say 2% interest a year on a given security in a given local currency, and that currency is expected to appreciate by 1% relative to your home currency in the upcoming year, then your rate of return is expected to be 3% not 2% when the asset reaches maturity.

A 1996 International Monetary Fund study suggested that deficit reduction via spending cuts by the government tends to strengthen the exchange rate of a country. While deficit reduction through tax increases tended to weaken the exchange rate.

So as the country cuts its government spending, expectations about the future rate of return become more optimistic. Conversely, if the country's government is increasing its spending at an alarming rate investors will be more likely to believe that in the future, that country's currency will depreciate, thus lowering the rate of return. This effect is called 'expected rate of return' in this paper's model. In this case if the home country, the U.S., has had spending cuts, it will cause expectations about the expected rate of return to

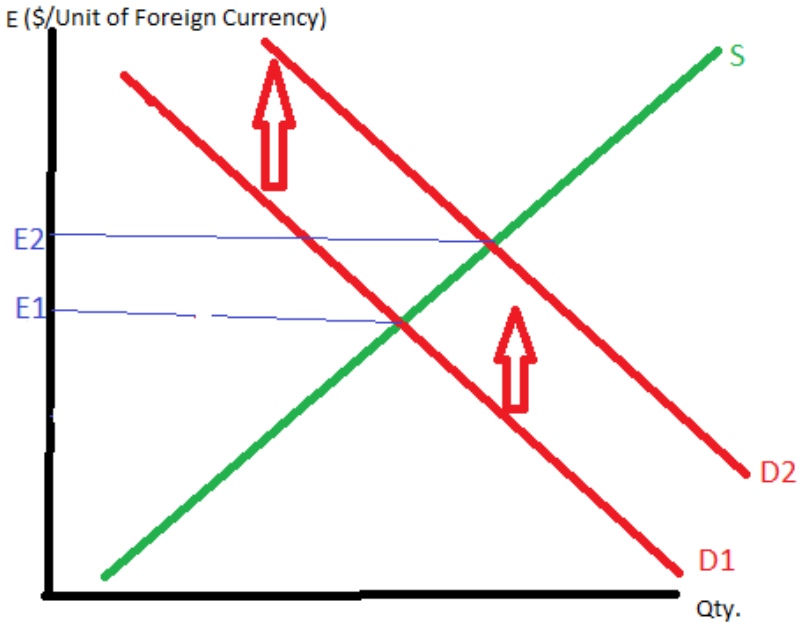
be more optimistic and thus decrease demand for foreign assets all else held equal to if the spending cuts had not been made. This lower demand for foreign assets correlates to lower demand for the foreign currency which exerts negative pressure on E.

However, to get data on this trend for my model I used the annual percent change in government spending, so the greater the rate of increase in government spending the greater the perceived chances of losing out due to the rate of return effect, and the more attractive a foreign asset will seem. In other words, if the IMF study suggested spending cuts is associated with appreciation, than growth in spending is taken to be associated with the opposite, depreciation. So all else equal as the rate of increase in government spending grows, foreign assets become more attractive, more foreign currency will be demanded, exerting upward pressure on E, meaning the dollar is depreciating. Graphically this is the Expected Rate of Return Effect:



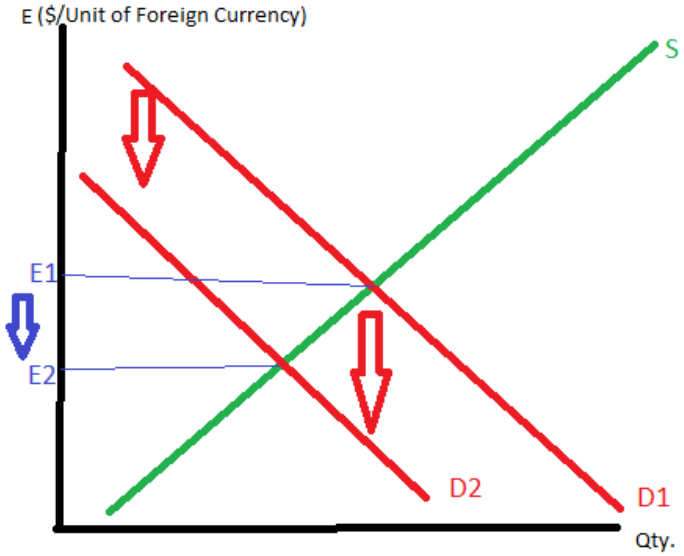
However, for some countries it is possible that the central bank can monetize the deficit by simply printing more money. This would transfer the deficit to the reduced buying power of individuals and firms holding that local currency. The perception of this

risk was included in a 1996 model developed by Hakkio for a paper on the topic. This effect he termed the 'expected inflation effect'. His reasoning was "if country i's inflation rate is high, investors may believe that country i's monetary authority is more likely to monetize the deficit than if the inflation rate was low". The expected inflation effect will have a positive effect on E. If the home country, U.S. in this case, has relatively higher inflation than the foreign country, this perceived higher risk of future inflation will increase demand for foreign assets, and consequently foreign currency. This increase in demand for foreign currency will increase E. This effect will be referred to as 'expected inflation' in the empirical model. Graphically:



Lastly, periodic business cycle fluctuations affect the exchange rate. A country experiencing recession will be less attractive to investors who will not demand as much of the local currency. If the country is in a period of rapid economic expansion then more

units of the local currency will be demanded. So if the U.S. is experiencing an economic expansion relative to other nations, all else held equal, less foreign assets will be demanded, meaning less of the foreign currency will be demanded, and E will be lower, or the dollar will appreciate. In this paper's model this effect will be called the 'income effect'. Graphically:



Research Question, Empirical Model and Data Sources

The paper's research question is: Does 2015 and 2016 data from countries with free floating exchange rate regimes support the predictions drawn from asset market theory about how government budget deficits affect the exchange rate?

Hypothesis testing was done by running a linear OLS model in SAS to compute t-values and determine whether the predictions were supported at the 5% confidence level and the 1% confidence level

The Empirical model is as follows:

$\Delta E = \alpha + \beta_1[direct\ effect] + \beta_2[risk\ premium\ effect] + \beta_3[expected\ rate\ of\ return\ effect] + \beta_4[income\ effect] + \beta_5[expected\ inflation\ effect] + \beta_6[interest] + error\ term$

Expected signs: $\beta_1: Negative$ $\beta_2: Negative$ $\beta_3: Negative$

$\beta_4: Positive$ $\beta_5: Negative$ $\beta_6: Positive$

Table 1.1 Variable Definitions, Summary Statistics, and data sources

Variable	Definition	Group Mean [2015,2016]Mean Change Difference (2015,2015)	(Variance, St. Dev) of Mean [Variance, St. Dev] of Final Effect's Value	Source
ΔE	Real Effective exchange Rate index, (constant 2010 US$) Yearly Change Since Difference not calculated, the figures are the average change in real exchange rate index for 2015 and 2016 respectively	[NA] (-4.5,-0.04)	NA, [43.42,6.59]	[1]
[risk premium effect] ΔGov't debt – group avg. ΔGov't debt	General Government debt (% of GDP) yearly change : used to calculate difference between change in total stock of government debt in country i and group average change	[78.36, 78.19] (2.2, 2.12)	(1662.19,40.77), [130.19, 11.41]	[2]
[*income effect*] ΔGDP growth – Group avg. ΔGDP growth	GDP growth (annual %) yearly change: used to calculate the difference between country i's economy's change in growth and group average change in growth	[3.1,2.2] (0.98, -0.864)	(12.04,3.47), [20.97,4.58]	[1]

[*direct effect*] ΔDeficit – Group avg. ΔDeficit	Government Budget balance (% of GDP) yearly change: used to calculate difference between the change in country i's deficit and the group average change for the year	[-4.75,-4.45] (0.167, -0.191)	(9.85,3.14), [10.89,3.33]	[2]
[Expected Inflation] ΔInflation – Group avg. ΔInflation	Inflation, GDP deflator (annual %) : used to calculate difference between change in U.S. inflation and group average change in inflation	[1.17,0.92] (0.083, -0.278)	(2.99,1.73), [3.38,1.84]	[1]
[interest] ΔInterest – Group avg. ΔInterest	Money Market Rate/ Treasury bill rate, %, used to calculate the difference between the change in country i's short term interest rate and the group average change	[0.68, 0.28] (-0.2539, -0.2534)	(3.24,1.80), [0.21,0.46]	[3]
[*expected rate of return*] ΔSpending – Group avg. ΔSpending	General government Final Consumption Expenditure (annual % growth) yearly change : used to calculate change in government spending, then taking the difference between the change in country i's figure and group average change	[2.22,2.53] (-0.462, 0.13)	(2.82,1.68), [2.78,1.67]	[1]

[1] World Bank, World Development Indicators Database

[2] World Bank, GovData360 Database

[3] OECD, online OECD finance indicators data catalogue

The dependent variable is the change in the real effective exchange rate index over the course of the year, and the right hand side variables are the four effects developed by Hakkio to explain how deficits can affect the exchange rate along with an income effect and a monetary policy control variable. Data on the country's real effective exchange rate from 2014, 2015, and 2016 was used to calculate the ΔE for 2015 and 2016 respectively, and then regressed by the right hand side variables which are based on Hakkio's methodology.

For each of the Right hand side variables the variable's value is the change in country i's figure for that year minus the group average change in the respective figure. For instance for the expected inflation effect, if country i's inflation grew by 5% and the group average inflation grew by 1%, the final value for that variable for country i would be 4% for that year. In other words, each metric is the country's figure in relation to the group average.

In addition to the four effects described by Hakkio, an additional control variable was employed to account for other factors that can affect the exchange rate. To indirectly account for monetary policy a short term nominal interest rate differential was included as an additional regressor. The metric is the money market rate/treasury bill rate. The nominal rate on three month treasury bills was used wherever available. The expected sign for this variable is positive. If country i is increasing the interest rate on its three month treasury bonds year on year faster than the group average change for the time period, this would theoretically attract capital inflows and bid up the price of the local currency. However, in this sample group many of the countries with the highest inflation

also have the highest nominal interest rates so the overall effect of these significantly higher nominal interest rates is largely offset by the associated higher inflation.

Countries with free floating exchange rate regimes were chosen because their currencies operate under free market principles, allowing the deficits to show their true effects through market demand forces. Data from other countries where the currency is under a stabilization regime or pegged to another currency or a basket of currencies would not accurately show the deficit effects the same because market forces of supply and demand do not fully control the prices (exchange rates) of these currencies.

The sample set of countries is the set of countries listed as having a free floating exchange rate regime in the 2015 & 2016 IMF Annual Report on Exchange Arrangements and Exchange Restrictions. Somalia had to be omitted due to lack of data, even though it has switched to a free floating exchange rate regime. It is 27 countries for 2015 and 29 countries for 2016 which are listed below for reference. Parentheses indicate the date the regime changed to free floating from another system, so the two countries that switched during 2015 (Mexico and Russia) are only included in the 2016 group. Due to gaps in the data, the overall dataset consists of 50 observations across two years with data from three years.

Sample Set of Countries: Australia, Canada, Chile, Japan, Mexico (11/15), Norway, Poland,

Russia (07/15), Sweden, United Kingdom, United States, Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg Malta Netherlands Portugal Slovak Rep. Slovenia, and Spain

Results

Table 1.2 Results of Regressions

Dependent Variable: Change in the Real Effective Exchange Rate Index, 2014-2015, 2015-2016.

Right Hand Side Variables: See Table 1.1

Regressor	Model 1	Model 2	Model 3	Model 4	Model 5
[Direct Effect])	-0.05 *(0.19)*	-0.04 *(0.19)*	-0.05 *(0.19)*	-0.04 *(0.19)*	-0.03 *(0.18)*
[Risk Premium Effect]	-0.04 *(0.04)*		-0.03 *(0.03)*		
[Expected Rate of Return]	0.26 *(0.52)*	0.27 *(0.51)*			0.26 *(0.51)*
[Income Effect]	-0.05 *(0.23)*	-0.03 *(0.2)*	-0.05 *(0.23)*	-0.04 *(0.22)*	-0.03 *(0.10)*
[Expected Inflation Effect]	0.02 *(0.69)*	-0.04 *(0.68)*	0.0007 *(0.69)*	-0.05 *(0.68)*	
[Interest]	-0.16 *(1.68)*	-0.18 *(1.69)*	-0.12 *(1.67)*	-0.14 *(1.68)*	-0.17 *(1.57)*
Intercept	-2.05* *(0.91)*	-2.08* *(0.91)*	-2.06* *(0.92)*	-2.10* *(0.91)*	-2.08* *(0.91)*
Root Mean Squared Error	7.00	6.93	6.94	6.87	6.86
Adjusted R-Squared	-0.128	-0.107	-0.107	-0.09	-0.08
F-Statistic	0.07	0.06	0.05	0.03	0.07
n	50	50	50	50	50

***Denotes significance at 95% Confidence level, ** at 99% Confidence level**

(Heteroscedasticity Consistent Standard Error)

Interpretations:

Direct Effect- The parameter estimates range between -0.05 and -0.03 across all of the models, although in none was the coefficient statistically significant. The coefficient's sign matched the expected sign predicted by theory. To interpret this figure it is helpful to use the means, for 2015 and 2016 the average government budget balance as a percent of GDP for this group was -4.75 and -4.45 respectively, in other words the average yearly deficit was 4.75/4.45 of GDP for this group. The average change in the size of the deficit from one year to the next was 0.167 and -0.191 meaning that in 2015 deficits stopped growing year on year as quickly as they were in 2014 while in the 2016 the pace of deficits growing year on year began increasing again. To interpret the coefficient of -0.05 then one could say that if country i's budget deficit were to increase by 5% more than the group average change of 0.167 and -0.191 (So a year on year growth in the deficit of 4.833% for 2015 or 5.191% for 2016) This would be associated with an appreciation of the local currencies real exchange rate index value of 0.25. (Or an appreciation of 0.15 of real exchange rate index value if using the lower parameter estimate of -0.03) The theoretical background of the direct effect predicted growing deficits would be associated with appreciation at least through this channel so this parameter estimate matches the expected sign.

Risk Premium Effect- The parameter estimates for the risk premium effect were -0.03 and -0.04 in the models in which it was used. In none of the models was it statistically significant. This negative parameter estimate does match the expected sign

predicted by theory. The average change in the size of government debt as a percent of GDP for this group was 2.2 and 2.12 for 2015 and 2016 respectively. If country i's total stock of government debt grew by 7.2% of GDP in 2015 or 7.12% of GDP in 2016 (5% above the group average change) this would be associated with a depreciation of the local currencies real exchange rate index value of 0.15 to 0.2 .While this effect is small, theory predicted it would be small because most of the nations in this sample group are developed and developed countries rarely default on their debts, so it seems reasonable investors would not attribute too costly of a risk premium on growing debts in these countries, thus the small magnitude of the coefficient.

Expected Rate of Return Effect: The coefficient for the expected rate of return effect is around 0.26 across several models. This does not match the predicted sign. This would mean that for every percent of year on year growth in government spending above the group average, this would be associated with an appreciation of 0.26 of the local currencies real exchange rate index value. This sign was predicted to be negative based off the findings of a 1996 International Monetary Fund study that suggested that deficit reduction via spending cuts by the government tends to strengthen the exchange rate of a country. While deficit reduction through tax increases tended to weaken the exchange rate. Thus, a country who was not cutting their spending but actually increasing it faster than average would be predicted to have a negative effect on their currency's value as investors became wary of potential losses in rate of return due to a weakening exchange rate in the future.

Income Effect: The income effect's parameter estimate was between -0.03 and -0.05 across models. In none of the models was the coefficient statistically significant. This would imply that for every percent of GDP growth above the group average GDP growth for that year, country i's currency would be expected to depreciate by 0.03 to 0.05 of the real exchange rate index value. Or, if country i's GDP growth was 5% above the group average, this be associated with a depreciation of 0.15 to 0.25 of the currency's real exchange rate index value. This did not match the expected sign based on theory.

Expected Inflation Effect: The parameter estimates for the expected inflation effect ranged from -0.05 to 0.02 across models. This matched the expected sign for the models with negative parameter estimates but not for the models that returned positive parameter estimates. More of the models returned negative parameter estimates for this coefficient than positive ones. This coefficient was not statistically significant. This would be interpreted as for every percent in year on year growth in inflation above the grove average, this would be associated with a change in the currency's value in a range from a depreciation of 0.05 to an appreciation of 0.02 of real exchange rate index value.

Monetary Policy Control Variable: Interest- The parameter estimates for interest varied from -0.18 to -0.12. This does not match the expected sign. This coefficient would be interpreted as for every percent of year on year growth in interest rates above the group average this would be associated with a depreciation of the local currency by -0.12 to -0.18 of its real exchange rate index value. While this may seem puzzling at first, the countries with the highest short term interest rates (Treasury bill

rates) were often the countries with the highest inflation, so the negative coefficient isn't completely dubious.

Further Comments on Results: Although many of the parameter estimates matched the expected signs predicted by theory, none were statistically significant. When rates of change are used as both the dependent variable and the regressors in an ordinary least squares model it can lead to low t-values and statistically insignificant results. The published papers on the topic involve analyzing panel datasets with more advanced econometric techniques than this paper's model.

Because all the regressors were rates of change relative to the group average, a time control variable had to be removed, which resulted in a loss of explanatory power. Models like Hakkio's included a long term time trend in exchange rates as well as a long term interest rate differential. Most of the published papers used panel datasets, which are beyond the analysis of the econometric techniques of this paper. The medium run fluctuations in exchange rates, in which the exchange rate deviates from a long term trend, require sophisticated econometric techniques to disentangle medium run fluctuations in E (where the effects of government budget deficits would show) from the long term positive or negative trend in E with statistical significance.

Any future investigations should use an extensive panel dataset that covers many years and many countries, which will help to solve the problems faced by this paper's model.

Comments on why some of the Expected Signs did not match the Predictions

The parameter estimate for the expected rate of return effect did not have the expected sign in any of the models. This effect was derived by Hakkio based on a 1996 IMF study that found that deficit reduction via spending cuts by the government tends to strengthen the exchange rate of a country. (While deficit reduction through tax increases tended to weaken the exchange rate). Hence the metric used to quantify this effect was the change in the growth of government spending relative to the group average. However, this study is 22 years old now. It would be reasonable to assume things have changed quite a bit since then, especially since the study was published in 1996 but used data from even before then, so the trend discovered by this study might have been applicable to early 1990's spending patterns and exchange rate fluctuations but now, well over two decades later, and in a post-2008 financial crisis world, this finding just might not accurately describe exchange rate changes anymore. Alternatively, this trend could still be in effect but the years 2014-2016 could have been an outlier in terms of not adhering to a trend that is generally present in other years.

More perplexing is the income effect's negative parameter estimate. The averages for ΔE are given in table 1.1. For 2015 and 2016 the average change in the real exchange rate index value were -4.5 and -0.04 respectively for this group of currencies. While the group average change in GDP growth was 0.98 and -0.864 respectively. This would indicate that the average GDP growth of these countries was higher in 2015 than in 2014, but that growth slowed on average from 2015 to 2016. Also, in the same years, it appears that the currencies generally weakened by 4.5 of real exchange rate index value in 2015,

but barely lost any value in 2016, on average depreciating by only 0.04 of real exchange rate index value. Thus, one could infer that the negative parameter estimates for the income effect is related to the fact that GDP growth slowed in the same year that these currencies generally held their value pretty well compared to other years.

The interest variable also doesn't have the expected sign as theory predicted but this coefficient is the most clear as too why. The countries with the highest inflation also had the highest nominal interest rates so the high nominal interest rate's ability to attract capital inflows (and thus bid up the price of the currency) was probably being negated by the high inflation's ability to dampen expectations about the ultimate rate of return (and thus keep demand for that currency from rising, and ultimately the price as well).

All in all, the use of a large panel dataset, covering many years and countries, is probably the best way to get around these problems in future investigations of the topic.

Comments on variance and potential reasons the regressors fell short of statistical significance

All of the parameter estimates for the channels through which the deficit affects the exchange rate fell short of statistical significance. If the variance of the dependent variable is low, and the data values are all in a relatively tight grouping, this can indicate that there is not much variation for the regressors to explain, potential leading to low t-values and statistically insignificant coefficients. If the variance of the dependent variable is high, but the t-values remain low, this can potentially indicate a problem with either the theoretical background or model set-up.

The mean value for the dependent variable was -4.5 and -0.04 for 2015 and 2016, while the standard deviation was 6.59. So it is not a problem of there not being much variation in the data. However, the theory is not the problem but the fact that the time series techniques and panel datasets used in the published papers on the topic are beyond the scope of this course. These more sophisticated econometric techniques are beyond the purview of the undergraduate level, but would be necessary to adequately investigate this topic. The low t-values and statistical insignificant results are due to the limited abilities of OLS to address a topic like this one. The published authors on the issue, who rely on advanced econometric techniques, found evidence to support these effects at statistically significant levels, implying that the low t-values were due to problems with this paper's model and not with the theoretical framework itself.

Conclusions

The parameter estimates had the expected signs for the direct effect, the risk premium effect, and for most of the models with an expected inflation effect. For the expected rate of return variable, the income variable, and the interest variable the parameter estimates did not match the expected signs. This paper's empirical model did not report any statistically significant results. However, the data does seem to reflect the direction of change in the exchange rate in response to certain government budget deficit changes that is in line with the predictions drawn from asset market theory.

Economics is a social science and in the sciences, a study that fails to support its hypothesis is not considered of less importance than one that does. To fail to prove something is not the same as to disprove it. Extremely complex economic functions, like

the medium run fluctuations in the exchange rate, are unlikely to be able to be simplified into simple, exception proof formulas. However, the theoretical framework of asset market theory can inform one as to through what channels the government's budget deficit may affect the exchange rate and in which direction. More advanced econometric techniques could in the future yield more concrete results with statistical significance. Hopefully this issue becomes better investigated in the future. As policymakers decide on budgets that include ever higher deficits it seems responsible to research every avenue through which this may affect the economy.

Appendix I: SAS Coding

```
data one;
set rates;
proc means;
run;
proc reg;
model deltaE = incomeFV expctdinfFV spendFV debtFV budgetFV interestFV
year / white;
model deltaE = incomeFV expctdinfFV spendFV debtFV budgetFV interestFV
/ white;
model deltaE = incomeFV expctdinfFV spendFV budgetFV interestFV year /
white;
model deltaE = incomeFV expctdinfFV budgetFV interestFV year / white;
model deltaE = incomeFV expctdinfFV debtFV budgetFV interestFV year /
white;
model deltaE = incomeFV spendFV debtFV budgetFV interestFV year /
white;
model deltaE = incomeFV spendFV debtFV budgetFV interestFV / white;
model deltaE = incomeFV spendFV budgetFV interestFV year / white;
model deltaE = incomeFV expctdinfFV spendFV debtFV budgetFV year /
white;
model deltaE = incomeFV expctdinfFV spendFV budgetFV year / white;
model deltaE = incomeFV expctdinfFV spendFV budgetFV / white;
run;
```

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