Stockholm School of Economics
4350 Thesis in Finance

Growth Opportunities, Investment Propensity and Currency Risk Premia

Author:
Martin Welz*

Supervisor:
Mariassunta Giannetti

Abstract

Recent studies have found a link between exchange rate returns and macroeconomic imbalances. However, focusing mainly on standard fundamentals might not identify the true drivers of an economy's future repayment ability and therefore currency risk. In order to test two more intricate characteristics that potentially add to a currency's riskiness, I propose a beta pricing model with two factors. The investment factor captures risk that results from the coincidence of current account deficits and a high propensity to use capital inflows on consumption rather than investment. The growth opportunities factor proxies for the perceived risk of poor future economic growth due to an unfavorable industry mix. In asset pricing tests, I confirm my hypothesis that both types of risk are priced. Current account deficit countries with low investment spending offer higher returns to currency investors. The same is true for countries with a large share of low-growth industries. Taken together, the two factors are able to explain more than two thirds of the cross-sectional variation in currency excess returns.

JEL Classification: F31, F37, G12, G15
Keywords: Carry trade, Capital inflows, Currency risk premia, Growth opportunities

Submission Date: May 19, 2014
Presentation Date: May 26, 2014

∗40258@student.hhs.se

Acknowledgements

I would like to thank my supervisor Mariassunta Giannetti, professor of Finance at the Stockholm School of Economics, for her support and helpful remarks during the course of writing this thesis. I owe thanks to Stephan Siegel who kindly provided me with data on growth opportunities produced in Bekaert et al. (2007). I also want to acknowledge the useful input and encouragement I received from Zhelu Jia, Simon Schindler, Alexander Tanski and Yan Wang.

All remaining mistakes are my responsibility.

Contents

1 Introduction

One of the most puzzling phenomena in international finance is the relationship between exchange rate changes and interest rate differentials. Intuition tells financial economists that high-interest rate currencies should be expected to depreciate compared to their low-interest rate counterparts in a move to align total expected returns (interest plus change in exchange rate) on foreign versus domestically denominated holdings. This hypothesis is known as Uncovered Interest Parity (UIP). Its widely documented empirical failure (see Froot and Thaler (1990), Lewis (1995) or Engel (1996) for a summary) combined with the assumption that market participants have rational expectations suggests the existence of risk premia accruing to investors in high-yielding currencies.

Research analyzing the determinants of these risk premia so far has stressed the role of consumption risk, deviation of the exchange rate from its long-run equilibrium and macroeconomic fundamentals. Recently, Della Corte, Riddiough and Sarno (2014) advance the idea that currency risk premia compensate investors for exposure to global economic imbalances that have seen strong growth in the forefront of the financial crisis of 2008. The authors propose a global imbalance factor that measures risk associated with large external liabilities and a high propensity to issue debt in a foreign currency. In asset pricing tests, they find that such a factor is able to explain large parts of the cross-sectional variation in currency excess returns.

Yet, I argue that looking at a country's (accumulated) current account imbalances alone does not tell the whole story about how safe or risky its currency is. In order to understand where currency risk comes from, it is useful to remember what a unit of currency actually represents: an obligation of the issuing country's economy to supply the currency holder on demand and in exchange for his money with assets, goods or services at an unknown future point in time. Hence, a currency investor is essentially a country's creditor. As a result, any risk to the country's economy decreases the likelihood of repayment and therefore constitutes a risk to the investor. Following this logic, I identify two more intricate characteristics that should drive a country's currency risk.

First, I hypothesize that current account imbalances give rise to additional currency risk only when combined with a low propensity to invest capital inflows productively. I term this risk "low-investment risk". In fact, past or present current account deficits do not per se impede a country's repayment ability. Rather, being able to borrow from the rest of the world enhances a country's set of consumption-saving choices, allowing it to optimally adjust to growth expectations. Hence, a country that has considerable economic opportunities, yet needs to import the capital to invest in exploiting them, is ill-advised not to run temporary current account deficits until it has tapped its full potential. As the extra economic growth will enable it to repay through increased future exports, currency risk for such a country should fall, not rise. However, if a country uses its capital inflows for the sole purpose of bringing forward domestic consumption, its economy will not see any additional growth. The country will merely accumulate debt and increase the risk on its currency.

Secondly, currency risk should also be related to a country's growth opportunities. The more growth – and thereby repayment security – can be created with any given level of investment spending, the smaller the return a currency has to promise to investors. Now, in terms of growth opportunities, not all countries are created equal. The differences in growth potential are particularly pronounced between emerging and developed economies. Notwithstanding, a variety of other factors such as a country's educational system, its raw material deposits etc. play a role as well. Therefore, measuring growth opportunities is not straightforward. However, I find such a measure proposed in Bekaert et al. (2007) who infer the growth potential from global P/E ratios weighted by a country's industry mix. Since P/E ratios reflect market expectations, the measure essentially captures expected growth. As rational investors should shy away from currencies of countries for which they expect poor growth, growth risk should be another major determinant of currency risk premia.

In order to verify my predictions, I propose a beta pricing model with two factors: the investment factor (INV) and the growth opportunities factor (GOF). INV proxies for low-investment risk. It is constructed as a low-minus-high strategy long in currencies of current account deficit countries that exhibit a low propensity to invest and short in currencies of surplus countries with a high investment propensity. I capture growth risk with GOF. This factor is a low-minus-high strategy long in currencies of countries with low expected growth and short in currencies of their high-growth counterparts. I then conduct cross-sectional asset pricing tests for five portfolios of currencies sorted by their one-month forward premia vis-à-vis the US dollar.

The main finding of this paper is that both risks are indeed priced. That is, current account deficit countries with low investment spending offer significantly higher returns to currency investors. The same is true for countries with poor growth opportunities due to an unfavorable industry mix. Together, the two risk factors are able to explain more than two thirds of the cross-sectional variation in currency excess returns.

My results are puzzling with regard to the signs of the beta estimates from the time series regressions. For most currency portfolios beta estimates are negative, suggesting that the portfolios provide a hedge against each factor's risk type. This result contradicts the economic logic that the risky, high return portfolios should show a positive exposure to either factor. The most likely cause I identify is the limited sample size due to non-availability of either data on foreign exchange or growth opportunities.

The remainder of this paper is organized as follows. Section 2 develops the theoretical background of my analysis. Section 3 informs about the data sources and provides details on the construction of the carry trade portfolios and the proposed factors. Descriptive statistics and a preliminary analysis can be found in Section 4. In Section 5, I present the formal asset pricing methodology and address potential econometric issues before Section 6 provides a discussion of the results. Section 7 contains further analysis regarding the model's explanatory power as well as two robustness exercises. Finally, I conclude in Section 8.

2 Theoretical Background

In order to explain the origin of currency risk premia, Lustig and Verdelhan (2007) try to establish a link to consumption risk. Yet, they run into the same predicament as comparable approaches to rationalizing equity risk premia have. The considerable magnitude of currency excess returns that lies at the roots of the carry trade's alluring profitability can only be reconciled with observed fluctuations in consumption assuming sky-high investor risk-aversion. In the wake of the financial crisis, a lot of the research focus has turned to the importance of global economic imbalances characterized by the existence of large and persistent current account deficits. In particular, the sustainability of the massive trade imbalances between the two largest economies in the world, the US and China, and their exchange rate implications have been a constant source of controversy between policymakers on both sides of the pacific and a matter of debate for economists around the world. Correspondingly, in the recent past, various instances of sudden and large depreciations mainly of emerging market currencies have been attributed to large current account deficits, sometimes in connection with political factors or monetary policy decisions. In a high-profile example in early 2014, international media blamed the sudden depreciation of the currencies of Brazil, India, Indonesia, South Africa and Turkey – termed the "Fragile Five" – upon the announcement of the US Federal Reserve to scale back its "Quantitative Easing" program on their large and notorious current account deficits.[1] In a recent paper, Della Corte, Riddiough and Sarno (2014)

[1]Curiously, the equally large and persistent current account deficits of the US as well as a historically unrivaled expansionary monetary policy led by the Federal Reserve have not caused a depreciation of the US dollar towards other major currencies such as the euro or the Chinese yuan

explain the cross-section of currency excess returns as a function of a currency's exposure to 'global imbalance risk'. They construct their global imbalance factor by first sorting currency excess returns into portfolios according to a country's net international investment position (NIIP) and its propensity to issue debt in a foreign currency and in a second step computing the excess returns of the riskiest over the safest portfolio. In asset pricing tests, they find that such a factor is able to explain large parts of the cross-sectional variation in currency excess returns. Their idea is straightforward: Since running a current account deficit essentially means that an economy is borrowing from the rest of the world, currency risk premia should be explicable by looking at how indebted a country already is and how likely it is that a given country takes on debt in foreign currency, bringing about the risk of a sudden leverage increase in the case of a depreciation. Yet, I argue that – on theoretical grounds – looking at (accumulated) current account imbalances alone does not tell the whole story about how safe or risky a country's currency is.

2.1 'Good' and 'Bad' Current Account Deficits

As mentioned before, running a current account deficit is not a bad idea per se. In fact, borrowing from the rest of the world allows a country to optimally adjust to growth expectations and smoothen its consumption path. In this specific case, a negative current account balance does not increase depreciation risk as it enables additional economic growth. A good example of a country that has successfully shown how persistent current account deficits can be sustained over decades is the one of Australia. Starting from the early 1950s, the Australian current account balance has been in the red for virtually every single year except for one. Reaching lows of -7% ever since the 1980s, the magnitude of these deficits has been anything but negligible. Yet, since the lion's share of the perpetual capital inflows has been used to build up and industrialize the country's economy and especially the extensive and highly profitable mining business, the Australian dollar has not suffered from what many economists at the time warned to be an "unsustainable imbalance".[2] In fact, since the end of the Bretton Woods system of fixed exchange rates in 1971 it has instead appreciated by more than 20% versus its US counterpart.[3] For this reason, Garton, Sedgwick and Shirodkar (2010) conclude their analysis of Australia's current account by rejecting the idea that its imbalances were a matter of concern. Consequently, in an increasingly globalized world the growing occurrence of current

so far. The notable exception is the Japanese yen versus which the US dollar has gained more than 30% since late 2012. This movement, however, is most likely due to the implementation of "Abenomics", an economic reform program encompassing decisively expansionary monetary policies by the Bank of Japan at the request of incumbent Prime Minister Shinzō Abe.

[2]For an overview of the debate see Belkar, Cockerell and Kent (2007).

[3]Source: US Federal Reserve Economic Research & Data

account imbalances is not necessarily a sign of unhealthiness. Rather, it is the desired consequence of increased financial mobility, allowing capital to flow to where it can be put to its most productive use.

What the example of Australia illustrates holds true for any debtor's payback capabilities. Every lender has to consider whether his debtor's future means will be sufficient to cover the interest burden and to repay the principal. This is the reason why a prudent mortgage banker will always ask for a proof of income and consider the likelihood that the borrower will be able to maintain or even increase this income over the credit period. The exact same logic holds on a macroeconomic scale. A rational investor will consider whether a current account deficit country is likely to grow its economy thanks to the resulting capital inflows, as this is crucial for determining its future 'solvency'.[4] Picture a country that – other than Australia – uses the extra capital flowing in to finance a higher level of private or public consumption than what would be feasible would it not live beyond its means. Such a country does not acquire any additional means of production or achieve productivity gains that allow for a future increase in domestic output. Instead, it merely accumulates debt. As investors see this country's repayment ability degrading, they are more likely to withdraw funding in bad times. A sudden exodus of capital in turn forces the country to immediately balance its current account, typically through a large depreciation that reduces the price of exports while making imports more expensive. It follows that past or present current account imbalances alone should not drive currency risk. Instead, it should be the difference between 'prudent' and 'imprudent' deficit countries that is reflected in the magnitude of risk premia.

2.2 Growth Opportunities

Secondly, not all economies are created equal when it comes to their economies' growth opportunities. Particularly, many emerging economies have the potential to grow their GDP at double digit percentages on a year-over-year basis whereas the industrialized countries typically regard any GDP increase larger than two percent as indicative of a healthy growth path. According to data from the World Economic Outlook database of the International Monetary Fund (IMF), over the past decade the average developing economy grew by 6.5 percent yearly[5] compared to a meager 1.6 percent realized in advanced countries. Looking at intra-group dispersion however makes it very clear that drawing the line between the developed and the less

[4]Of course, a currency investor does not have an explicit contract with a country's economy defining what he is owed in exchange for his holdings. Therefore, an economy cannot become insolvent in itself. Rather, the risk for the currency investor is that of a deprecation of its holdings reducing their external purchasing power or domestic inflation, reducing their internal purchasing power.

[5]For "Developing Asia" this value was even higher at 8.5%.

developed world would mean to oversimplify the matter. Differing growth opportunities reflect a wide variety of underlying factors other than the current state of economic development. Among those are a country's political system, the quality of its educational system, its raw material deposits, geographical position, the degree of integration into global financial markets etc. Even though growth opportunities are hard to measure, I argue that they could also play a key role in explaining currency risk. That is because growth opportunities determine how much added economic strength can be created with a given level of investment spending. The more attractive the average investment opportunity in a given country is, the more its economy will benefit from each dollar of inflowing capital. Ultimately, a strong economy generates repayment security for investors and mitigates currency risk.

In order to identify the effects of growth prospects on currency risk premia, I obtain data on a country specific measure of growth opportunities termed "GGO" (for Global Growth Opportunities) that I find in Bekaert et al. (2007). GGO is based on the idea that a country's growth opportunities are closely related to its industry structure. The larger the relative size of companies from growth-intense industries is, the better are the country's overall growth prospects. As GGO employs *global* industry-P/E ratios weighted by a country's industry mix, it is an exogenous measure of market expectations of future growth.

3 Data, Carry Trade Portfolios and Factors

This section describes the data on exchange rates, current account balances, GDP, NIIP, investment and consumption spending as well as on GGO employed in the empirical analysis. I then describe the construction of the carry trade portfolios and my two factors.

3.1 Data on Foreign Exchange Rates

I obtain spot and one month-forward exchange rates vis-à-vis the US dollar from Barclays, Reuters and the Bank of England via Datastream. The analysis comprises first-of-the-month observations over a total of just less than 21 years from February 1985 to December 2005, which is the last month for which data on growth opportunities is available. In total, the sample includes 39 countries (plus the euro area): Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Germany, Greece, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kenya, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Pakistan, Philippines, Portugal, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Tunisia, Turkey, the United Kingdom and Venezuela. As in Della Corte, Riddiough and Sarno (2014), I remove the Eurozone countries from the sample after the inception of the euro in January 1999 and replace them by the euro area.

With the exception of the Venezuelan bolivar which has come under rigid governmental control implemented by former president Chávez in 2003, all of the currencies have traded freely over the sample period and the forward quotes are obtained from deliverable forward contracts for all currencies but the Brazilian real and the Chilean peso. Hence, it has been historically feasible for currency investors to set up carry trades within the timely and compository framework of the sample. Thereby, I avert the danger of dubious findings in a setting where results might be driven by artificial quotes that never actually constituted trading opportunities.

3.2 Macroeconomic Data

I obtain yearly data on nominal GDP as well as domestic consumption (public plus private) and investment spending as a percentage of GDP for the 39 countries and the euro area from the World Development Indicators database of the World Bank for the time period of 1985-2005. Since the data lack observations for consumption spending in the Eurozone, I compute these values as the average of the respective values for each Eurozone member state in the sample weighted by its GDP size. Omitting only Luxembourg, these countries, namely Austria, Belgium, Finland, Germany, Greece, France, Ireland, Italy and Portugal taken together represented more than 99% of the total economic output of the Eurozone at the time. Current account balance data (also as a percentage of GDP) for the same time period is obtained via Datastream from the International Financial Statistics database of the International Monetary Fund (IMF). Lastly, data on the 2005 Net International Investment Position for six countries is obtained from the Balance of Payments Statistics database, also provided by the IMF.

3.3 Data on Growth Opportunities

I obtain monthly observations from February 1985 to December 2005 on the Global Growth Opportunities measure (GGO) developed in Bekaert et al. (2007), kindly provided by Stephan Siegel. For every country and month, GGO is constructed as the natural logarithm of global PE-ratios weighted by relative market capitalization of the local industries:

$$GGO_{i,t} = ln[IW'_{i,t}PE_{w,t}]$$

where PE_w denotes the vector of world industry PE-ratios and IW_i the vector of industry weights for country i. Using global rather than local PE-ratios, GGO is an exogenous measure of growth opportunities that successfully predicts investment and GDP growth both in developed and emerging economies. For a more detailed description and tests of predictive power see the original JF-article. As for the macroeconomic data, I compute observations for the Eurozone from 1999 on by taking the GDP-weighted average of euro member state observations.

3.4 Construction of Carry Trade Portfolios

In constructing the five carry trade portfolios, I adhere closely to the methodology pioneered in Lustig and Verdelhan (2007), also used by Della Corte, Riddiough and Sarno (2014).

Let the forward and spot rate in foreign currency per US dollar be denoted by S_t and F_t respectively. From the point of view of a US dollar investor, the excess return rx_{t+1} on buying a foreign currency forward at time t before selling it in the spot market at time $t + 1$ is then given by

$$rx_{t+1} = (F_t - S_{t+1})/S_t.$$

Once I have calculated the excess returns of each individual currency, they have to be sorted into five portfolios according to their interest rate differential vis-à-vis the US dollar. Recall that Covered Interest Parity forces the forward premium $(F_t - S_{t+1})/S_t$ to be equal to the differential $i_t^* - i_t$ between foreign and domestic interest rates over the maturity of the forward contract. Consequently, sorting the currencies by their forward premium is equivalent to sorting them by interest rate differential. Since I already possess the necessary information to calculate the forward premia for each month, I use those rather than searching for data on each country's historical term structure.

3.5 The Factors

This subsection provides details on the construction of the investment and the growth opportunities factor as well as the rationale behind their design.

3.5.1 Investment Factor

The purpose of the investment factor (INV) is to capture the risk that results from running current account deficits while funneling the resulting capital inflows into sustaining a higher consumption level rather than investing the money to the benefit of the country's future economic potential. Therefore, I follow the double-sorting methodology used in Della Corte, Riddiough and Sarno (2014) with the only difference that I end up with four instead of five currency portfolios.

After sorting currencies by current account balance relative to GDP, I split the data in two baskets. Then, within each basket, I sort the currencies by the countries' propensity to use capital inflows (finance capital outflows) to increase (by decreasing) investment or consumption. This investment propensity measure is computed as follows: First, I calculate the yearly average investment and consumption spending relative to GDP for all countries. In a second step, I compare each country's spending to the averages in order to determine whether a country exhibits a tendency to excessive or moderate spending of either type. Finally, for countries that invest and consume more (less) than average, I compute its excess investment (underconsumption) as a percentage of its total excess spending (underspending).

The reordered currencies, beginning with countries that run a current account surplus and finance their capital exports predominantly through a lower than average consumption rather than through cutting domestic investment (the safest currencies) and moving to current account deficit-countries that import capital primarily for consumption purposes (the riskiest currencies), are grouped into quartile portfolios. The investment factor is then constructed as the difference between the excess returns on the extreme portfolios. Since data on current account balance investment and consumption is only available at a yearly frequency, I keep values constant for each month until a new observation becomes available.

3.5.2 Growth Opportunities Factor

The idea behind the growth opportunities factor (GOF) is that the investment factor might not capture the differences between countries regarding what can be achieved with a given level of investment spending. Countries vary considerably with regard to their industry mix while industries vary with regard to their growth potential. Therefore, a country that relies heavily on traditional industries that are very profitable but have little or no potential to grow further due to saturated markets has to invest much more in relative terms to achieve a given amount of growth compared to a country full of expanding companies from, say, the technology sector. Since countries with a favorable industry mix should find it easier to generate economic growth, they should be the better debtors compared to their low-growth counterparts. As a result, by adding the growth opportunities factor to the model, I expect to further increase its explanatory power.

In order to construct the growth opportunities factor, I simply sort all currencies by their GGO-value into five portfolios and construct a low-minus-high-factor taking the difference in currency excess returns between the extreme portfolios. As for the carry trade and the investment factor portfolios, these portfolios are rebalanced monthly.

4 Descriptive Statistics and Preliminary Analysis

This section presents a preliminary analysis of the data based on descriptive statistics of the three sets of currency portfolios: the carry trade portfolios, the INV portfolios and the GO portfolios. Returns and standard deviations are annualized, data on skewness and kurtosis is not transformed.

4.1 Carry Trade Portfolios

Table 4.1 presents the descriptive statistics for the five carry trade portfolios that will later serve as the explained variables in the asset pricing framework.

Table 4.1: Descriptive Statistics – Carry Trade Portfolios

	Pf1	Pf2	Pf3	Pf4	Pf5	Pf5 - Pf1 (zero-cost carry trade)
mean	-0.047	0.021	0.036	0.047	0.125	0.180
median	-0.054	0.038	0.061	0.070	0.103	0.158
stddev	0.107	0.084	0.084	0.080	0.139	0.147
kurtosis	0.440	0.827	0.989	0.684	2.911	1.866
skewness	-0.200	-0.056	-0.328	-0.264	-0.013	-0.100
	Sorting Variable Forward Premium					
mean	-0.050	-0.001	0.018	0.043	0.199	

Notes:

The table presents descriptive statistics of five carry trade portfolios sorted on one-month forward premia (or interest rate differential) relative to the US dollar. Portfolio 1 (Pf1) contains the top 20% of all currencies with the lowest forward premia whereas Portfolio 5 (Pf5) contains the top 20% of all currencies with the highest forward premia. The last column shows returns to a low-minus-high strategy that is long in Pf5 and short in Pf1. Excess returns are reported in annualized form. The last row presents each portfolios average forward premium. The sample runs from February 1985 to December 2005. Exchange rates are from Barclays, Reuters and the Bank of England and obtained via Datastream.

As to be expected, the mean currency excess return on the portfolios shows a monotonically increasing pattern as the average forward premium for each portfolio rises. The portfolio containing the currencies of countries with a small or even negative interest rate differential vis-à-vis the US dollar also exhibits a negative average excess return. That is, a US-investor holding the lowest yielding currencies would have experienced an average loss of an annualized 4.7% over the sample period while investors in the other four portfolios would have experienced gains of 2.1%, 3.6%, 4.7% or 12.5% (for the portfolio containing the highest yielding currencies) respectively. Accordingly, a low-minus-high zero-cost strategy that is long in portfolio 5 and short in portfolio 1 would have yielded as high an average annualized return as 18%. These results are proof of the very strong profitability of the carry trade over the sample period running from February 1985 to December 2005. It is important to note, however, that the above reported returns are not adjusted for transaction costs. As the portfolios are rebalanced at a monthly frequency, i.e. a total of 251 times over the sample period, an adjustment for transaction costs would lower the actually realized returns considerably. However, the high profitability of the carry trade strategy in the data at hand does not come as a surprise given the very large interest rate differentials to the dollar I observe for the five portfolios. The average values here vary between -5% and startling 20% annually. Curiously, in contrast to Della Corte, Riddiough and Sarno (2014), I find a moderate skewness value of 0.2 for portfolio 1 whereas portfolio 5 exhibits almost no skewness, casting doubt on the hypothesis that high yielding currencies are systematically exposed to crash risk as put forward in Brunnermeier, Nagel, and Pedersen (2009).

4.2 INV Portfolios

Table 4.2 summarizes the descriptive statistics for the four portfolios sorted first by a country's current account deficit in proportion to its GDP size and in a second step by a country's propensity to invest rather than consume its disposable income as well as for the investment factor, constructed as a low-minus-high zero-cost strategy long in portfolio 1 and short in portfolio 4.

The mean excess return on INV is 0.9% per year. This value is much lower than I had expected based on the outlined economic theory. The median is even negative a -0.3% annually, implying that for more than half of the total number of observations, an investor in the investment factor would have experienced a negative return. This comes as quite a surprise as the double sorting produces a very large difference between portfolios both for the current account balance to GDP ratio as well as for investment propensity. While the supposedly most risky portfolio countries ran an average current account deficit of 2.2% over the sample period while spending merely 9.6% of the resulting capital inflows on investment purposes, the supposedly safest currencies saw an average 4.1% current account surplus, 83.7% of which were financed through below average consumption levels. If this high level of dispersion in the sorting variables actually captures low-investment risk, the result should be a significantly higher mean return.

4.3 GO Portfolios

The descriptive statistics for the currency portfolios sorted by the countries' global growth opportunities (GGO) and the resulting factor for the asset pricing tests, the

Table 4.2: Descriptive Statistics – INV Portfolios

	Pf1	Pf2	Pf3	Pf4	Pf1 - Pf4 (INV)
mean	0.046	0.032	0.031	0.037	0.009
median	0.045	0.064	0.061	0.074	-0.003
stddev	0.070	0.090	0.097	0.113	0.089
kurtosis	0.981	1.242	1.081	1.651	0.877
skewness	0.143	-0.767	-0.269	-0.520	0.460
Sorting Variables – CA to GDP, InvProp					
mean (CA to GDP)	-2.2%	-3.6%	3.9%	4.1%	
mean(InvProp)	9.6%	77.4%	19.4%	83.7%	

Notes:

This table presents descriptive statistics of currency portfolios sorted on current account balance to GDP and a country's propensity to spend (finance) capital inflows (outflows) on investment (by cutting consumption spending). Portfolio 1 (Pf1) contains the top 25% of all currencies with the largest current account deficits and the lowest propensity to invest the resulting capital inflows whereas Portfolio 4 (Pf4) contains the top 25% of all currencies with largest current account surpluses and the highest propensity to finance the resulting capital outflows by cutting consumption spending. INV denotes the investment factor and is equivalent to a low-minus-high strategy that is long in Pf1 and short in Pf4. The last two rows present each portfolio's average current account to GDP balance and average investment propensity. The sample runs from February 1985 to December 2005. Yearly data on current account balance relative to GDP is obtained from the International Financial Statistics database of the IMF, investment and consumption spending (both relative to GDP as well) are taken from the World Development Indicators database of the World Bank. Monthly observations are obtained by keeping end-of-period data constant until a new observation becomes available.

growth opportunities factor (GOF), are presented in Table 4.3.

While the portfolio of currencies of countries exhibiting the largest growth opportunities (average GGO = 3.1) yield an average annualized excess return of 1.9%, the currencies with the weakest growth opportunities (average GGO = 2.84) realized 4.9%. The difference of 2.9% represents of course the return on GOF. The finding of a positive mean return on GOF is in line with my expectations that currencies of countries with poor growth opportunities have to offer a premium to investors. A bit surprisingly though, the highest yielding portfolio turns out to be portfolio 3, the portfolio containing the currencies that came in second best in terms of the respective countries' growth opportunities. This portfolio – although containing currencies of relatively promising countries in terms of future economic growth – exhibits an annualized excess return of 5.3%.

Table 4.3: Descriptive Statistics – GO Portfolios

	Pf1	Pf2	Pf3	Pf4	Pf5	Pf1 - Pf5 (GOF)
mean	0.049	0.028	0.033	0.053	0.019	0.029
median	0.058	0.067	0.056	0.045	0.085	0.009
stddev	0.112	0.082	0.103	0.088	0.100	0.108
kurtosis	2.007	1.417	6.660	0.903	0.943	2.982
skewness	-0.088	-0.589	-1.682	-0.078	-0.381	-0.401
			Sorting Variable GGO			
mean	2.84	2.93	2.98	3.04	3.10	

Notes:

The table presents descriptive statistics of five currency portfolios sorted on an exogenous measure of economic growth opportunities (GGO). Portfolio 1 (Pf1) contains the top 20% of all currencies with the poorest growth opportunities whereas Portfolio 5 (Pf5) contains the top 20% of all currencies with the best growth opportunities. The last column shows returns to a low-minus-high strategy that is long in Pf1 and short in Pf5. Excess returns are reported in annualized form. The last row presents each portfolio's average GGO-value. The sample runs from February 1985 to December 2005. Monthly data on GGO is taken from Bekaert et al. (2007), kindly provided by Stephan Siegel.

5 Asset Pricing Methodology

This section presents the methodology used to evaluate the pricing power of the investment and the growth opportunities factor in explaining the cross-sectional dispersion of the five carry trade portfolios. The asset pricing framework I set up adheres closely to the suggestions made in Cochrane (2005).

5.1 No-arbitrage Assumption and Beta Pricing Model

Starting from the rather uncontroversial assumption of no-arbitrage, we can derive that risk-adjusted excess returns are equal to zero, satisfying the following equation:

$$p = E[mrx]$$

where rx denotes an asset's excess return while m represents a Stochastic Discount Factor (SDF).

I propose a linear pricing model with two factors f_0 and f_1 such that:

$$m = b'f$$

where b is the vector of factor loadings. This specification implies a beta pricing model where the expected excess return on portfolio i is equal to the general factor risk price times the risk quantity for portfolio i:

$$E[rx^i] = \beta_0^i \lambda_0 + \beta_1^i \lambda_1$$

where λ_k is the market price of risk and β_k^i the risk exposure of portfolio i to factor k.

5.2 Factor Loadings and Prices

In order to test my model, I employ both the two-step regression framework proposed by Fama and MacBeth (1973) as well as the standard cross-sectional regression approach of average returns on the factor betas to double check my results. Both test frameworks start out in the same way. I obtain the factor loadings as the coefficient estimates by regressing each carry trade portfolio i's excess return rx^i on a constant and the risk factors f_0, f_1 over time:

$$rx_t^i = \alpha^i + \beta_{INV}^i INV_t + \beta_{GOF}^i GOF_t + \epsilon_t^i \qquad i = (1, \ldots, 5).$$

In the FMB-framework, these estimates now serve themselves as regressors in a set of cross-sectional regressions (across portfolios) equal to the number of points in time in the sample:

$$rx_t^i = a_t + \lambda_{INV,t} \beta_{INV}^i + \lambda_{GOF,t} \beta_{GOF}^i + \epsilon_t \qquad t = (1, \ldots, T).$$

The factor prices λ_k are then simply estimated as the mean of factor prices for all time periods.

Implementing the traditional cross-sectional approach on the other hand, I run one single cross-sectional regression of the time series averages of each portfolio's return on the beta estimates from the times series regressions:

$$E[rx^i] = a^i + \lambda_{INV} \beta_{INV}^i + \lambda_{GOF} \beta_{GOF}^i + \epsilon^i$$

Note that since I do not use a framework with rolling betas as Fama and MacBeth (FMB) did in their original article, the two methods are numerically equivalent and consequently have to produce the same coefficient estimates (Cochrane 2005).

5.3 Potential Collinearity of INV and GOF

One common econometric problem with multifactor models is the presence of (multi-)collinearity of factors. When two or more factors are to some degree collinear, that is, imperfect linear combinations of each other, the coefficient on at least one individual factor will be imprecisely estimated (Stock and Watson 2012). For the model I propose, that would be the case if the two sorting procedures employed to construct the factor underlying portfolios were based upon correlated measures. This correlation does not necessarily have to be linear itself though, as the sorting measures are merely used to decide upon the distribution of currencies to portfolios of their respective currency excess returns. Consequently, even an exponential correlation could lead to the same currencies attributed to the same portfolio for each factor.

Recall that the investment factor is essentially a low-minus-high strategy long in currencies of countries showing a weak current account balance as well as a low propensity to invest. The growth opportunities factor, on the other hand, measures exposure to currencies of countries with an unfavorable industry mix with regard to expectable future economic growth. Now, it is very plausible that in many cases, low domestic investment can be explained at least partially by poor investment opportunities in low-growth industries. Additionally, a very similar argument can be made to hypothesize a correlation between a large current account surplus and low domestic growth opportunities. Whenever investors face few attractive investment opportunities in their home country, they can be expected to seek higher returns abroad, giving rise to increased capital exports. Since running a current account surplus is necessarily associated with net capital outflows, a certain correlation between INV and GOF can consequently be expected to result from this relation as well. Note, however, that since the investment factor portfolios are sorted subsequently by descending current account balance and propensity to invest, the extreme portfolios used to construct INV contain currencies of countries that invest relatively little (much) while importing (exporting) capital. That is, the potential correlation with the GOF portfolios should show opposite signs for each of the two sorting variables. This should mitigate problems of collinearity considerably.

5.4 Factor Correlation

I compute Pearson's coefficient for linear correlation between the two factors. Its value of 0.186 implies that linear correlation between the two factors is minimal. Figure 5.1 shows a scatterplot of returns on the two factors.

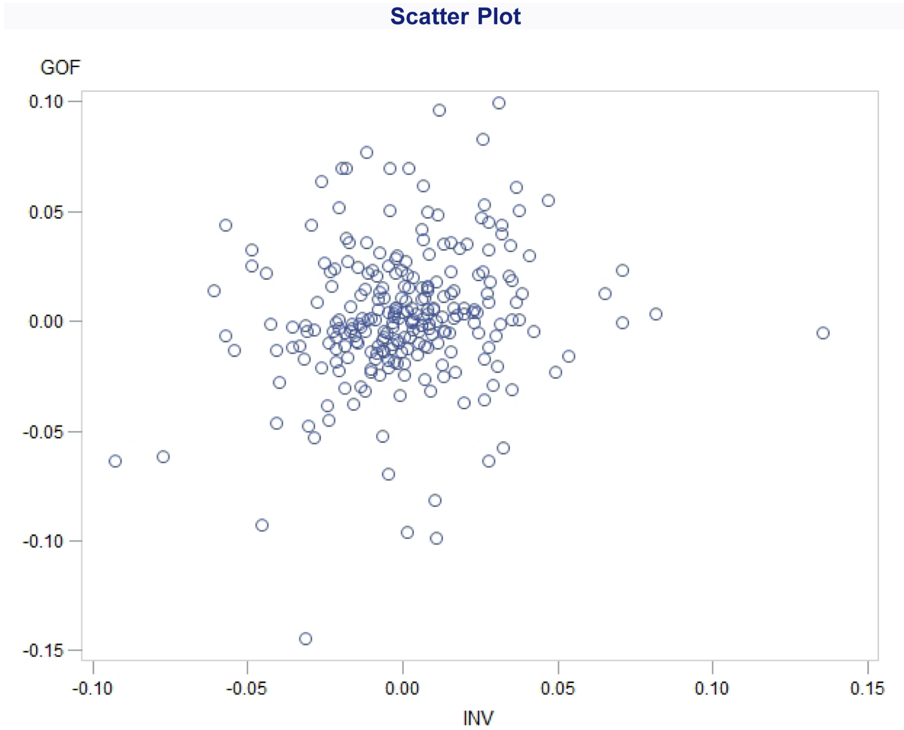

Figure 5.1: Scatterplot of Monthly INV and GOF Observations

The randomly spread out dots representing each observation pair confirm the impression that the factors are largely uncorrelated. Nonetheless, I chose to err on the conservative site and conduct a more formal test for collinearity.

5.5 Condition Index and VIF

Following Belsley, Kuh and Welsch (1980), I compute the condition index as well as the variance inflation factor (VIF) for the factors in the first-stage (time series) regressions. The condition index indicates the presence of near dependencies among the factors while the VIF provides the amount of inflation in the variances of the parameter estimates that would result from dependency of two or more factors.

According to the authors' suggestions, dependencies could start to affect the regression estimates at a condition index of around 10. Not before this number is larger than 100, the estimates could suffer from significant numerical errors. A collinearity problem occurs in the case that a factor showing a high condition index at the same time contributes largely (variance proportion exceeds 0.5) to the variance of another factor. Table 5.1 sums up the results of the collinearity analysis.

As condition indices are close to one for intercept and factors, it can be concluded that collinearity does not substantially influence the factor price estimates in the model even though variance contributions exceed 50% in three cases out of nine.

Table 5.1: Collinearity Analysis – Condition Index and VIF

Number	Eigenvalue	Condition Index	Proportion of Variance Contribution		
			Intercept	INV	GOF
1	1.213	1.000	0.090	0.332	0.373
2	0.981	1.112	0.865	0.134	0.010
3	0.806	1.227	0.044	0.534	0.617

Notes:

The table presents the collinearity diagnostics for the investment, the growth opportunities factor and a constant within the time series regression framework. The condition indices are the square roots of the ratio of the largest eigenvalue to each individual eigenvalue, whereas the variance inflation factor (VIF) indicates the amount of variance in each regressor that is due to dependency of two or more other regressors.

Therefore, this issue can be safely disregarded in the following analysis of asset pricing test results.

5.6 Standard Errors for Financial Panel Data

A second problem to be aware of when applying the standard cross-sectional framework to panel data is that its standard errors are not corrected for cross-sectional correlation. Therefore, for common financial data they are typically understated by as much as a factor of 10 (Cochrane 2005). This problem does not exist for the FMB-standard errors whose calculation by default takes into account the likely presence of cross-sectional correlation. Nonetheless, FMB-standard errors are fully unbiased only if the lambda estimates for each time period are independent and identically distributed (i.i.d.), that is, there is no serial correlation in the sample. While this is a very reasonable assumption for return data in general, it could be problematic in the sample at hand where the investment factor portfolios show a certain compository persistence as the macroeconomic sorting variables remain unchanged for the duration of a year. It follows that if currency excess returns follow a momentum pattern, the assumption of i.i.d. observations would be violated.

A standard way to address this issue when analyzing financial panel data is to adjust the FMB-standard errors for autocorrelation following Newey and West (1987), a method also used in Della Corte, Riddiough and Sarno (2014). However, Gow, Ormazabel and Taylor (2010) and Thompson (2011) argue that this type of correction is well-intended yet severely flawed as in this case, Newey-West is applied to a time series of *coefficients*, whereas the dependence is in the *underlying data*. Running a simulation that allows for varying levels of cross-sectional and time-series correlation in observed regressors and unobserved errors, the former three demonstrate empirically that Newey-West-adjusted FMB-standard errors are still biased in the presence of such double dependence. As a remedy, both papers propose the computation of two-way clustered standard errors. However, as most of the financial literature follows the convention of computing Newey-West errors, I also opt for their usage. The debate around which correction might be the most appropriate for financial panel data is more of an econometric nature and would exceed the scope of this master thesis.

6 Asset Pricing Test Results

This section presents the asset pricing test results for the investment and the growth opportunities factor and discusses their implications.

Table 6.1 consists of two panels. While Panel A shows the coefficient estimates and the goodness-of-fit measure for the time series regressions, Panel B does so for the two different types of second step (cross-sectional) regressions.

6.1 Time Series Results

The results from the time series regressions allow me to identify which of the currency portfolios load positively or negatively on the two factors. Confirming the surprising pattern in descriptive statistics, the estimates of the betas for the investment factor are all negative. This suggests that every single of the five portfolios, even the one containing the currencies with the highest interest rate differential vis-à-vis the US dollar, provides a hedge against the risk of running large current account deficits while spending most of the resulting capital inflows on consumption purposes. According to theory, however, currencies yielding relatively high excess returns should have positive, not negative exposure to INV as running high current account deficits while neglecting domestic investment should give rise to considerable depreciation risk. Therefore, I would have expected the investment factor betas to show an increasing pattern as average forward premia rise across portfolios.

The estimates of the betas for the growth opportunities factor show an even more puzzling behavior. While the other four portfolios show a negative sign in front of the factor loadings, again suggesting that they provide a hedge against the risk that a country suffers from scarce growth opportunities, the portfolio with the lowest interest rate differential (or forward premium) currencies loads positively on growth risk. Again, this goes against the logic presented before: Countries with a promising industry mix in terms of future growth should be the better debtors. Therefore, their currencies should load negatively on the GOF. I would then have expected the same pattern as described before: As the average measure for growth opportunities decreases across portfolios, the factor loadings for GOF should show

Table 6.1: Asset Pricing Test Results – The Two-factor Model

Panel A: Time Series Results – Pricing Errors and Factor Betas				
	α	β_{INV}	β_{GOF}	R^2
Pf1	-0.003*	-0.646*	-0.075	0.31
	(0.002)	(0.105)	(0.071)	
Pf2	0.002	-0.371*	-0.069	0.18
	(0.001)	(0.071)	(0.061)	
Pf3	0.004*	-0.339*	-0.133*	0.18
	(0.001)	(0.056)	(0.055)	
Pf4	0.004*	-0.302*	-0.084	0.14
	(0.002)	(0.083)	(0.059)	
Pf5	0.009*	-0.570*	0.457*	0.21
	(0.003)	(0.161)	(0.122)	
Panel B: Cross-sectional Results – Factor Prices				
	a	λ_{INV}	λ_{GOF}	R^2
FMB	0.013*	0.024*	0.022*	0.68
	(0.003)	(0.006)	(0.005)	
CSR	0.013	0.024	0.022	

Notes:

The table presents time series and cross-sectional asset pricing results for the two-factor model based on the investment (INV) and the growth opportunities (GOF) factor. The test assets are excess returns to five carry trade portfolios sorted on one-month forward premia. Panel A reports OLS estimates of time series regressions with Newey and West (1987) standard errors in parentheses as well as the time series R^2. Panel B reports Fama-MacBeth (FMB) and standard cross-sectional (CSR) estimates of an intercept and the factor prices λ_k and the cross-sectional R^2. The standard errors reported in parentheses are corrected for autocorrelation as in Newey and West (1987). The portfolios are rebalanced monthly from February 1985 to December 2005.

higher and higher values. However, note that only two of the five beta estimates for the GOF are statistically significant at the 5%-level of confidence.

The model's pricing errors are captured by the regression intercepts α^i. For four out of five alphas, I have to reject the null hypothesis of equality to zero. Hence, it does not come as a surprise that the time-series R^2s reported in the last column range only from 11 to 25 percent, implying that most of the explanatory variables' time series variation remains unexplained. This does not disprove my model, however, as its objective is to explain the cross-sectional variance of currency excess returns, not its variation over time.

6.2 Fama-MacBeth and Cross-sectional Results

The results from FMB- and cross-sectional regression provide the estimates for the factor prices λ_k, i.e. how much a given amount of exposure to the two risk factors 'pays' in terms of excess returns. In line with what I expected, the prices for exposure to either factor are positive. Most importantly, the estimates for both factor prices are statistically significant at the 5%-level, confirming my hypotheses about the relevance of investment and growth opportunities factor in determining currency risk. The more a currency portfolio loads on INV or GOF, the higher its expected excess return. The annualized risk premia on both the investment factor and the growth opportunities factor are very large at about 33% and 30% respectively. Different from Della Corte, Riddiough and Sarno (2014) I do not report the factor loadings for the SDF b_k as this is necessary only in the case of correlated factors (Cochrane 2005).

The regression intercept is again statistically significantly different from zero. It is important to note, however, that it does not represent the model's pricing error here. Rather, I chose to include a constant in my regressions in order to capture the common over- or underpricing of cross-sectional models and as a result obtain more precise estimates of the factor premia (Cochrane 2005). The cross-sectional R^2 sheds light on the overall explanatory power of the two-factor model: 68% of the cross-sectional variance in portfolio excess returns can be explained using INV, GOF and a constant. This value compares to an R^2 of 84% that Della Cote, Riddiough and Sarno (2014) report for the combination of a dollar and their global imbalance factor. It follows that even though my factors based on a country's current account balance and investment propensity and its exogenously measured growth opportunities do not do as good a job as the global imbalance model, they are still able to explain more than two thirds of the cross-sectional variation in currency excess returns.

7 Further Analysis and Robustness

This section contains further analysis on the model's sources of explanatory power and robustness. First, I analyze a potential correlation between mine and the global imbalance model. Secondly, I rerun stepwise restricted versions of the model to determine the relative contribution of each of the two factors. In a third step, I take a closer look at the investment factor, testing two alternative low-minus-high factors each based on only one of the sorting variables underlying its construction. Finally, I discuss the results of different exercises designed to validate the model's robustness to outliers and in a shorter sample period.

7.1 INV and the Global Imbalance Model

As I propose the investment factor as an alternative to the global imbalance factor of Della Corte, Riddiough and Sarno (2014), a natural question to explore is to which extent the two factors proxy for the same type of risk and whether INV effectively adds explanatory power. The straightforward way to do so would be to add the global imbalance factor to my model, measure factor correlation and look at the model's adjusted R^2. However, the data underlying the factor's construction – especially the one on a country's propensity to issue debt in a foreign currency – is not publicly available. As a workaround, I conduct a qualitative analysis looking at whether the riskiest (safest) countries according to my double sorting procedure on current account balance and investment propensity also exhibit a large negative (positive) NIIP, the primary sorting variable underlying the construction of the global imbalance factor. Table 7.1 lists the three most commonly represented countries for each of the extreme investment portfolios used to construct INV and their NIIP as a percentage of GDP at the end of the sample period in 2005.

Table 7.1: INV Extreme Portfolio Countries and NIIP to GDP

	Frequency of occurence in portfolio	NIIP in % of GDP (2005)
Portfolio 1 ('riskiest curencies')		
United Kingdom	15/20 years	-19%
Canada	11/20 years	-12%
South Africa	11/20 years	-87%
Portfolio 4 ('safest curencies')		
Japan	20/20 years	+34%
Switzerland	19/20 years	+124%
Norway	14/20 years	+55%

Notes:

The table presents the three most commonly represented countries for each of the extreme investment portfolios used to construct INV and their NIIP as a percentage of GDP at the end of the sample period in 2005. Data on Net International Investment Position is obtained from the Balance of Payments Statistics database of the IMF.

As the countries with the strongest exposure to low-investment risk, the United Kingdom, Canada and South Africa all exhibit negative net foreign assets at the end of the sample period, while the countries with the least exposure, Japan, Switzerland and Norway exhibit a strongly positive net foreign asset position, it seems extremely likely that INV is correlated to the global imbalance factor. However, it is important to note that any inference on the basis of this simplifying exercise has to be treated with caution. Only a more rigourous correlation analysis could reveal how strong that correlation is in fact and whether INV holds any explanatory power above and beyond what the global imbalance model already explains.

7.2 Relative Contribution of Each Factor

A second logical question to ask is how large each of the two factors' contribution to the overall explanatory power of my model is. Since the correlation analysis yielded the result that the two factors are nearly completely uncorrelated, this question can be answered easily. The explanatory power of each factor can simply be tested by stepwise restricting the model to two separate univariate regressions. The R^2s of the two restricted models will then provide a good indication of each factor's contribution. Their sum should not exceed the R^2 of the two-factor model substantially. Table 7.2 reports the results for the two restricted, single-factor models employing either the investment or the growth opportunities factor exclusively.

The two restricted models differ in predictive power in the cross-sectional stage regressions as the growth opportunities factor alone explains 40% of the variation in the carry trade portfolio returns while the investment factor only explains 27% of it. As a result, it can be concluded that GOF also contributes more to the two-factor model's total explanatory power. Note that the two univariate R^2s exactly add up to the bivariate R^2. This confirms my finding that collinearity does not play any role in the model. Consistent with that, the factor betas from the time series stage change relatively little and exhibit the exact same patterns as in the bivariate approach.

7.3 Explanatory Power of INV under Scrutiny

Now that the relative importance of INV and GOF for the explanatory power of the initial two-factor model is determined, a third question arises. Since INV is constructed using a double sorting methodology, it is worth exploring whether its explanatory power stems from the sorting by a country's current account balance or by its propensity to invest capital inflows. For this purpose, I do two reruns of the asset pricing framework used above. The first one employs a single low-minus-high factor based exclusively on the ranking of currencies into portfolios by current account balance data (termed the current account factor or CAF) while for the second one, the single factor is constructed according to the ranking by the investment propensity measure described before (termed the investment propensity factor or IPF).[6] Again, I report the results of both the time series as well as the cross-sectional regressions. Table 7.3 summarizes the results for CAF.

[6]For descriptive statistics of the CA/IP portfolios please see Tables A.1 and A.2 in the appendix.

Table 7.2: Asset Pricing Test Results – Restricted Models

Panel A: Time Series Results – Pricing Errors and Factor Betas						
	INV only			GOF only		
	α	β_{INV}	R^2	α	β_{GOF}	R^2
Pf1	-0.004*	-0.663*	0.30	-0.004	-0.173*	0.03
	(0.002)	(0.103)		(0.002)	(0.085)	
Pf2	0.002	-0.387*	0.17	0.002	-0.126	0.03
	(0.001)	(0.084)		(0.002)	(0.067)	
Pf3	0.003	-0.369*	0.15	0.003*	-0.185*	0.06
	(0.002)	(0.057)		(0.002)	(0.062)	
Pf4	0.004*	-0.321*	0.13	0.004*	-0.130	0.03
	(0.002)	(0.070)		(0.002)	(0.068)	
Pf5	0.010*	-0.467*	0.09	0.009*	0.370*	0.08
	(0.004)	(0.184)		(0.003)	(0.132)	

Panel B: Cross-sectional Results – Factor Prices						
	INV only			GOF only		
	a	λ_{INV}	R^2	a	λ_{GOF}	R^2
FMB	0.011*	0.019*	0.27	0.004*	0.017*	0.40
	(0.003)	(0.006)		(0.001)	(0.005)	
CSR	0.011	0.019		0.004	0.017	

Notes:

The table presents time series and cross-sectional asset pricing results for the two restricted single-factor models based on either the investment (INV) or the growth opportunities (GOF) factor alone. The test assets are still the excess returns to the five carry trade portfolios sorted on one-month forward premia. Panel A reports OLS estimates of time series regressions with Newey and West (1987) standard errors in parentheses as well as the time series R^2. Panel B reports Fama-MacBeth (FMB) and standard cross-sectional (CSR) estimates of an intercept and the factor prices λ_k and the cross-sectional R^2. The standard errors reported in parentheses are corrected for autocorrelation as in Newey and West (1987). The portfolios are rebalanced monthly from February 1985 to December 2005.

All five carry trade portfolios load negatively on the current account factor, presenting the same puzzling behavior seen before. The factor price estimate for the current account factor alone is positive and highly statistically significant. The annualized premium on CAF is a startling 102%. This simple model, taking into account only the size of each country's current account balance for the year the observations of its currency excess returns are made can explain as much as 36% of the cross-sectional variation in carry trade portfolio returns. Table 7.4 summarizes

Table 7.3: Asset Pricing Test Results – The Current Account Factor

Panel A: Time Series Results – Pricing Errors and Factor Betas			
	α	β_{CAF}	R^2
Pf1	-0.003	-0.366*	0.16
	(0.002)	(0.061)	
Pf2	0.003	-0.272*	0.14
	(0.002)	(0.058)	
Pf3	0.004*	-0.210*	0.08
	(0.002)	(0.049)	
Pf4	0.004*	-0.202*	0.08
	(0.002)	(0.054)	
Pf5	0.010*	-0.193	0.03
	(0.004)	(0.160)	

Panel B: Cross-sectional Results – Factor Prices			
	a	λ_{CAF}	R^2
FMB	0.018*	0.060*	0.36
	(0.004)	(0.013)	
CSR	0.018	0.060	

Notes:

The table presents time series and cross-sectional asset pricing results a single-factor model employing an alternative risk factor based exclusively on the size of current account deficits, the current account factor (CAF). The test assets are still the excess returns to the five carry trade portfolios sorted on one-month forward premia. Panel A reports OLS estimates of time series regressions with Newey and West (1987) standard errors in parentheses as well as the time series R^2. Panel B reports Fama-MacBeth (FMB) and standard cross-sectional (CSR) estimates of an intercept and the factor price λ_{CAF} and the cross-sectional R^2. The standard errors reported in parentheses are corrected for autocorrelation as in Newey and West (1987). The portfolios are rebalanced monthly from February 1985 to December 2005.

the results for IPF.

Once more all portfolios load negatively on the investment propensity factor, especially so portfolio five containing the highest yielding currencies. Again, this is hard to reconcile with the outlined theoretical reflections concluding that high risk premia should go hand in hand with a country's 'imprudent' investment behavior and not vice versa.

Even worse, the factor price estimate for the investment propensity factor is

Table 7.4: Asset Pricing Test Results – The Investment Propensity Factor

Panel A: Time Series Results – Pricing Errors and Factor Betas			
	α	β_{IPF}	R^2
Pf1	-0.005*	-0.242*	0.03
	(0.002)	(0.109)	
Pf2	0.001	-0.113	0.01
	(0.002)	(0.074)	
Pf3	0.003	-0.028	0.00
	(0.002)	(0.076)	
Pf4	0.004*	-0.085	0.01
	(0.002)	(0.061)	
Pf5	0.009*	-0.404*	0.05
	(0.003)	(0.205)	
Panel B: Cross-sectional Results – Factor Prices			
	a	λ_{IPF}	R^2
FMB	0.001	-0.012*	0.31
	(0.001)	(0.006)	
CSR	0.001	-0.012	

Notes:

The table presents time series and cross-sectional asset pricing results a single-factor model employing an alternative risk factor based exclusively on a propensity to spend (finance) capital inflows (outflows) on investment (by cutting consumption spending), the investment propensity factor (IPF). The test assets are still the excess returns to the five carry trade portfolios sorted on one-month forward premia. Panel A reports OLS estimates of time series regressions with Newey and West (1987) standard errors in parentheses as well as the time series R^2. Panel B reports Fama-MacBeth (FMB) and standard cross-sectional (CSR) estimates of an intercept and the factor price λ_{CAF} and the cross-sectional R^2. The standard errors reported in parentheses are corrected for autocorrelation as in Newey and West (1987). The portfolios are rebalanced monthly from February 1985 to December 2005.

negative and statistically significant. A negative factor price suggests that currencies of countries which have a positive exposure to investment propensity risk yield systematically lower excess returns than countries with no exposure at all or even a negative exposure. This completely contradicts the economic logic of the nature of currency risk determinants. Even though this model seems to explain 31% of the cross-sectional variation in carry trade portfolio returns in the sample, it will therefore most likely not serve as a valuable predictor out-of-sample.

7.4 Robustness

One of the shortcomings of estimating a regression model using the method of Ordinary Least Squares (OLS) is its sensitivity to outliers. Since each observation's distance to the regression line is squared, values that are far out of the norm often have an overly strong influence on coefficients estimates and model fit. Therefore, I rerun the two-factor model while stepwise eliminating outliers for both the carry trade portfolios as well as the factors in order to see their influence on the parameter estimates. My results remain essentially unchanged.

Additionally, I cut off all observations for the time span before the year 1997 where the sample of countries is relatively small due to missing currency data. While for 1996, observations on the currencies of 14 countries are available, this number jumps to 24 for the year after. The changes in the results are again small with the exception of the factor loadings for GOF. Four of the five carry trade portfolios are now loading positively on GOF, a result that is much more in line with economic theory than the one obtained for the entire sample. This exercise suggest that retesting INV in a larger sample including more recent data from 2005 onwards might also yield times series beta estimates that conform with economic logic.

8 Conclusion

Motivated by the success of recent papers in linking the cross-section of currency risk premia and carry trade returns to macroeconomic variables and global economic imbalances, the present paper tries to investigate whether two important characteristics that are theoretically linked to a country's economic potential and thereby the probability of its currency to depreciate in foreign exchange markets are priced: the degree to which capital inflows are used on domestic investment or not and the prospects of a country to grow its economy against the background of its local industry mix. For this purpose, I construct and test a beta pricing model in which each of the factors captures a currency portfolio's exposure to the risk of doing badly with regard to either characteristic.

The main finding of this paper is that the factor premia are positive and statistically significant for both factors. Consequently, I conclude that both low-investment and growth risk are important in determining currency risk premia.

My results are puzzling with regard to the signs of the beta estimates from the time series regressions. For most portfolios and factors tested in this paper, they are negative, suggesting that the portfolios provide a hedge against each factor's risk type. While this result is conceivable for the portfolios containing low yielding currencies that exhibit low excess returns and consequently low risk, one should expect the risky, high return portfolios to show a positive exposure. However, for my growth opportunities factor, the puzzling pattern changes to be somewhat more in line with economic theory when limiting my analysis to the time period from 1997 to 2005 for which data on a larger number of countries is available.

On the whole, the present paper provides further empirical support for the existence of a link between exchange rate returns and a country's macroeconomic characteristics. It is up to future research to identify the factors that proxy best for those sources of currency risk and finally improve the mid- and long-run forecasting performance of exchange rate models that have been practically useless to this day.

References

Bekaert, G., Harvey, C. R., Lundblad, C. and Siegel, S., 2007, Global Growth Opportunities and Market Integration, Journal of Finance, 62, 1081-1137.

Belkar, R., Cockerell, L. and Kent, C., 2007, Current Account Deficits: The Australian Debate, Research Discussion Paper 2007-02, Economic Research Department, Reserve Bank of Australia.

Belsley, D. A., Kuh, E., and Welsch, R. E., 1980, Regression Diagnostics: Identifying Influential Data and Sources of Collinearity, New York: Wiley.

Bank for International Settlements, 2007, Interest Rate Differentials and the Role of Carry Trades, Annual Report 2007, Basel: Bank for International Settlements Press.

Brunnermeier, M. K., Nagel, S. and Pedersen L. H., 2009, Carry Trades and Currency Crashes, NBER Macroeconomics Annual 2008, 313-347.

Cochrane, J. H., 2005, Asset Pricing, Princeton: Princeton University Press.

Della Corte, P., Riddiough, S. J. and Sarno, L., 2014, Currency Premia and Global Imbalances, Working Paper Series, January 15, 2014.

Engel, C., 1996, The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence, Journal of Empirical Finance, 3, 123-192.

Engel, C. Mark, N. C. and West, K. D., 2007, Exchange Rate Models Are Not as Bad as You Think, NBER Macroeconomics Annual 2007, 381-441.

Fama, E. F., and MacBeth, J., 1973, Risk, Return and Equilibrium: Empirical Tests, Journal of Political Economy, 81, 607-636.

Froot, K. A. and Thaler, R. H., 1990, Anomalies: Foreign Exchange, Journal of Economic Perspectives, 4, 179-192.

Garton, P, Sedgwick, M. and Shirodkar, S., 2010, Australia's Current Account Deficit in a Global Imbalances Context, Economic Roundup, 1, 29 50.

Gow, I. D., Ormazabal, G. and Taylor, D. J., 2010, Correcting for Cross-Sectional and Time-Series Dependence in Accounting Research, Accounting Review, 85, 483-512.

Lewis, K. K., 1995, Puzzles in International Financial Markets, in G. Grossman and K. Rogoff, eds., Handbook of International Economics, 3, Elsevier Science, 1913 - 1971.

Lustig, H., and Verdelhan A., 2007, The Cross Section of Foreign Currency Risk Premia and US Consumption Growth Risk, American Economic Review, 97, 89-117.

Menkhoff, L., Sarno, L., Schmeling, M. and Schrimpf, A., 2012, Carry Trades and Global FX Volatility, Journal of Finance, 67, 681-718.

Menkhoff, L., Sarno, L., Schmeling, M. and Schrimpf, A., 2013, Currency Risk Premia and Macro Fundamentals, Working Paper Series, September 18, 2013.

Newey, W. K. and West, K. D., 1987, A Simple, Positive, Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, Econometrica, 55, 703-708.

Stock J. and Watson M. W., 2012, Introduction to Econometrics, 3rd International Edition, New York: Prentice Hall.

Thompson, S. B., 2011, Simple Formulas for Standard Errors that Cluster by Both Firm and Time, Journal of Financial Economics, 99, 1-10.

Appendix

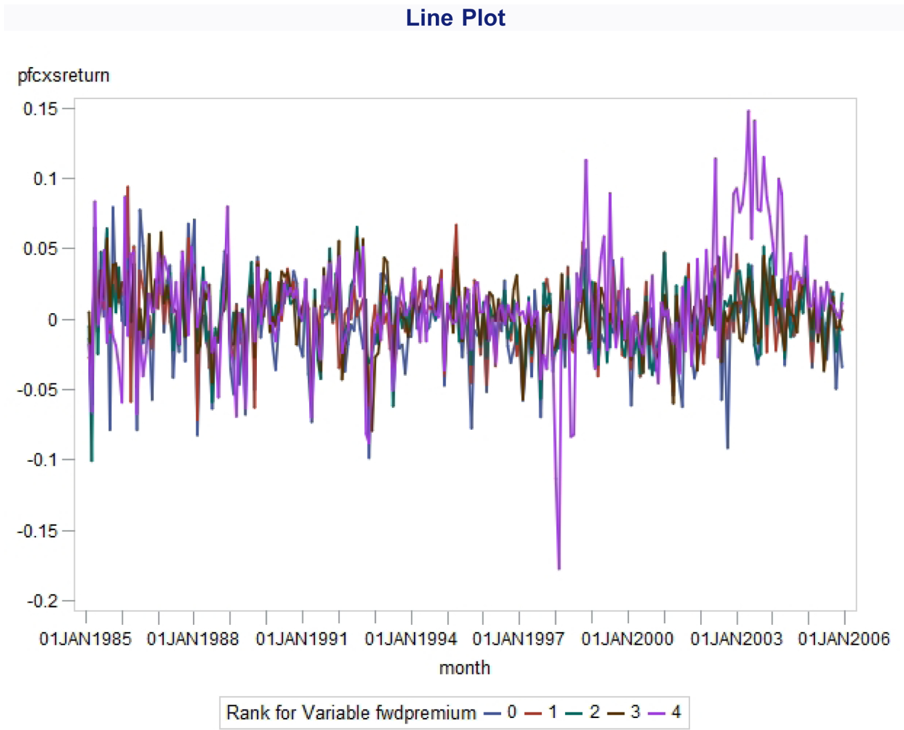

Figure A1: Line Plot of Monthly Returns on Five Carry Trade Portfolios

The figure shows a line plot of excess returns on the five carry trade portfolios sorted by forward premia. As to be expected, portfolio 5 (purple line) exhibits the biggest variation in returns as it contains the most risky currencies (with the biggest interest rate differential vis-à-vis the US dollar).

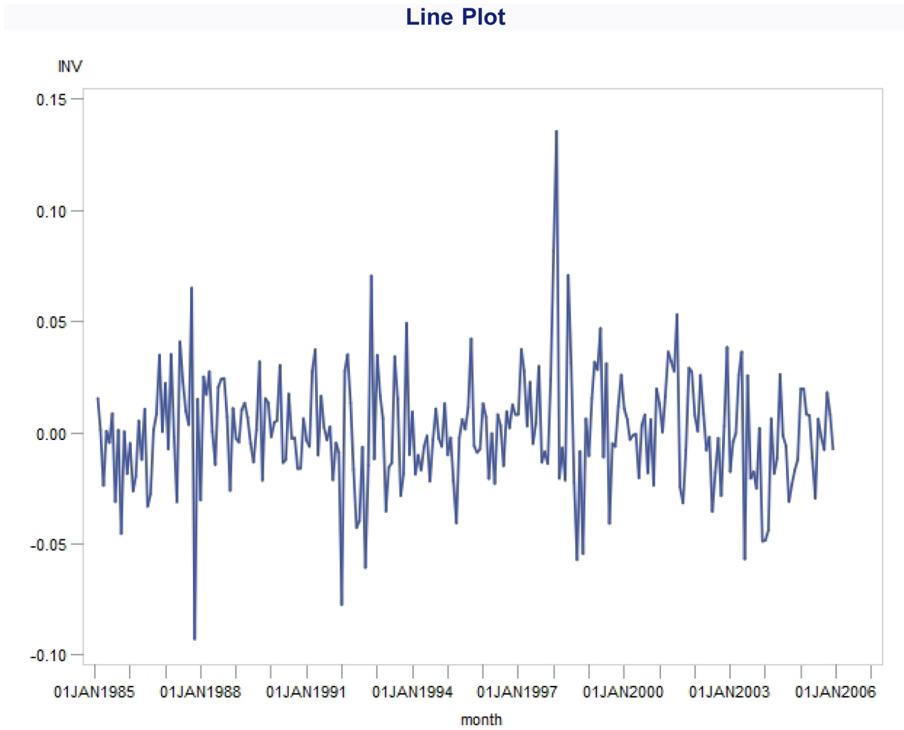

Figure A2: Line Plot of Monthly Returns on the Investment Factor

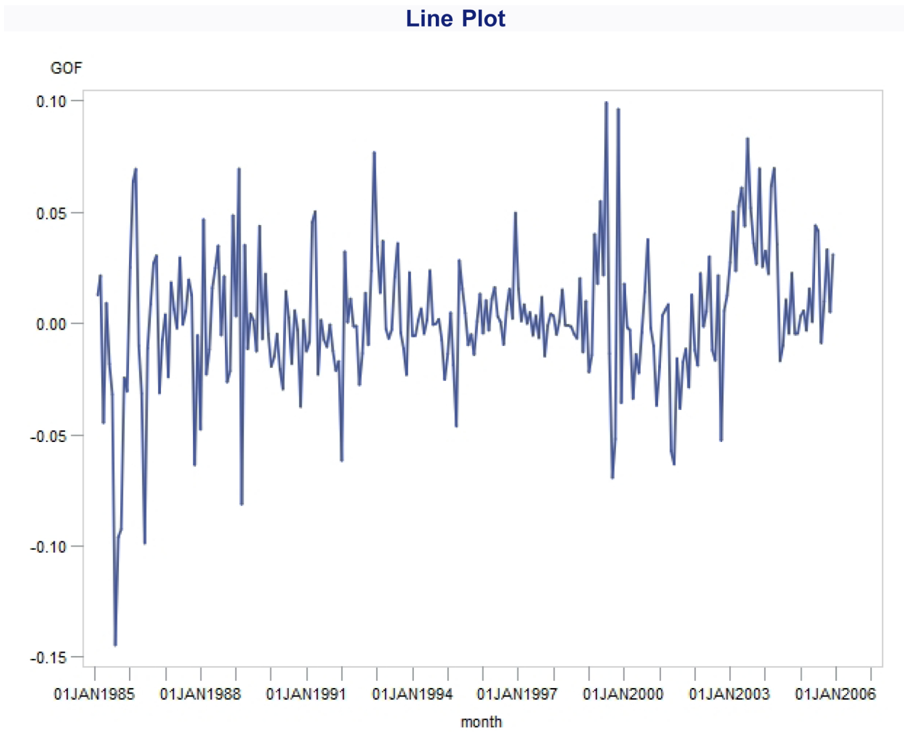

Figure A3: Line Plot of Monthly Returns on the Growth Opportunities Factor

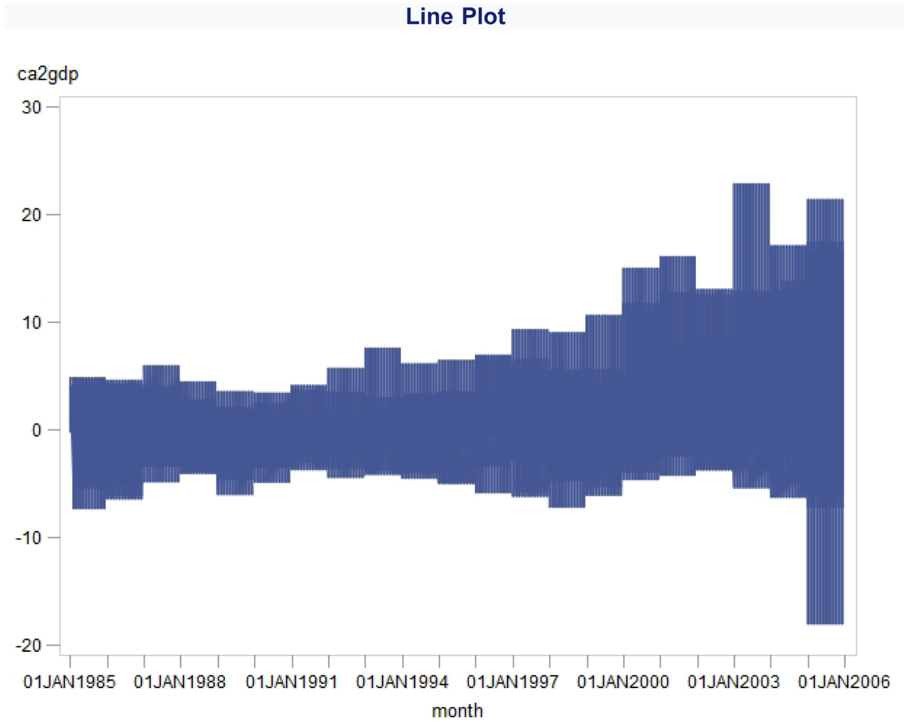

Figure A4: Current Account Balances Relative to GDP for Sample Countries

The figure shows the range of current account balances for every month of the sample period. Note the rising global imbalances in the forefront of the financial crisis of 2008 which have taken a good part of the blame for the following severe global recession.

Table A1: Descriptive Statistics – CA Portfolios

	Pf1	Pf2	Pf3	Pf4	Pf5	Pf1 - Pf5 (CAF)
mean	0.052	0.034	0.039	0.040	0.018	0.034
median	0.068	0.053	0.067	0.058	0.051	0.013
stddev	0.088	0.082	0.091	0.104	0.122	0.115
kurtosis	0.816	2.771	1.384	0.414	2.794	4.009
skewness	-0.288	-0.742	-0.431	-0.061	-0.886	0.623
Sorting Variable – CA to GDP						
mean	-4.6%	-2.3%	0.0%	2.7%	7.3%	

Notes:

The table presents descriptive statistics of five portfolios sorted on current account balance to GDP. Portfolio 1 (Pf1) contains the top 20% of all currencies with the largest current account deficits whereas Portfolio 5 (Pf5) contains the top 20% of all currencies with the largest current account surpluses. The last column shows returns to a low-minus-high strategy that is long in Pf1 and short in Pf5, termed the current account factor (CAF). Excess returns are reported in annualized form. The last row presents each portfolios average current account balance. The sample runs from February 1985 to December 2005. Yearly data on current account balance relative to GDP is obtained from the International Financial Statistics database of the IMF. Monthly observations are obtained by keeping end-of-period data constant until a new observation becomes available.

Table A2: Descriptive Statistics – IP Portfolios

	Pf1	Pf2	Pf3	Pf4	Pf5	Pf1 - Pf5 (IPF)
mean	0.038	-0.001	0.044	0.018	0.072	-0.032
median	0.051	0.043	0.078	0.071	0.075	0.012
stddev	0.085	0.158	0.113	0.112	0.104	0.077
kurtosis	1.503	34.930	0.836	3.454	1.339	-1.117
skewness	-0.039	-4.199	-0.349	-1.051	0.548	2.611
			Sorting Variable – InvProp			
mean	1.6%	31.1%	52.8%	71.4%	97.6%	

Notes:

The table presents descriptive statistics of five portfolios sorted on the propensity of a country to use (finance) capital inflows (outflows) on investment spending (by cutting consumption spending). Portfolio 1 (Pf1) contains all currencies with an investment propensity measure <20% whereas Portfolio 5 (Pf5) contains the all currencies with an investment propensity measure >80%. The last column shows returns to a low-minus-high strategy that is long in Pf1 and short in Pf5, termed the investment propensity factor (IPF). Excess returns are reported in annualized form. The last row presents each portfolios average investment propensity. The sample runs from February 1985 to December 2005. Yearly data on investment and consumption spending relative to GDP is obtained from the World Development Indicators database of the World Bank. Monthly observations are obtained by keeping end-of-period data constant until a new observation becomes available.