Exchange Rates and Government Debt

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Abstract

This paper studies how government debt variables impact estimates of the classic and new UIP puzzles for quarterly data between 2000 and 2020 of 6 developed countries in relation to the United States. I estimate country-pair VECMs to model cointegration relations between debt variables, price differences, interest rates differences and nominal exchange rate.

I compare this framework with one without debt variables following Engel (2016) using quarterly data between 1979 and 2020. In the framework without debt, I don't find the new UIP puzzle while in the framework with debt, I do find it.

Government debt variables are significant and alter the sign of comovements between difference in interest rates and far-ahead ex-post and ex-ante excess currency returns. The magnitude of the effect is economically relevant.

Government debts coefficients cannot be uniquely associated with convenience yield story.

Keywords: Exchange Rates; Government Debt; UIP puzzle; Excess Currency Returns.

JEL Codes: E42; E60; F31.

1 Introduction

Exchange rates have been studied for decades with different angles: from determination of the levels for demand of traded goods (based on Dornbusch (1976) and Mundell-Fleming) to resolution of puzzles (see review essays by Engel (1996, 2014) , Obstfeld and Rogoff (2000) and Ishtoki and Mukhin (2017)).

Two of the puzzles are referred to as the uncovered interest parity (UIP) , both in classic and new form. The classic UIP puzzle finds that there is positive correlation between high interest rate countries and excess currency returns. This happens at frequencies between six or more hours[1] and quarters for low inflation countries and does not happen for long term bonds (Chinn and Meredith (2004)).

The new UIP puzzle has been documented by Engel (2016) and Valchev(2020): after an initial positive correlation, there is a reversal between interest rates and excess currency returns. Part of the literature considers the role of liquidity or convenience into play in order to explain these puzzles. Intuitively, short-term bonds that are safe and liquid give an additional benefit to interest rate returns: counting this effect, the two puzzles may be jointly explained theoretically. Indeed, high value from liquidity is referred as high convenience yield of a bond and it may vary depending on the demand and supply of safe and liquid government bonds.

This paper studies the interaction of the classic and new UIP puzzle with government debts for each of G6 countries with the US. The motivation comes from two intuitions. First, if liquidity plays a role in explaining exchange rate puzzles, it is useful to incorporate a broad proxy for it in our estimation of the puzzles. Second, a decent and ready available proxy for every country is the amount of government debt. On top of these, another motivation is to check for possible long term relations between fundamentals and government debt in order to correctly estimate the UIP puzzles and other statistical facts.

As Engel (2016) points out, these countries' exchange rates are interesting to study because they have been floating since the early 1970's, with little state direct intervention and deep markets, relatively little inflation and very little default risk [2].

This paper first estimates a three variables Vector Error Correction Mechanism (VECM) for country pairs between nominal exchange rate, interest rates differences and price differences. I use the setup of Engel (2016) with extended data covering 1979-2020[3], but using quarterly data instead of monthly one.[4]

Secondly, I choose the best four-variable VECM between five types of government debt variables according to both intuition and cointegration relation's smoothness [5]. The chosen model is estimated in a sample 2000-2020 due to data availability. Multiple regressions are performed after the VECM estimation.

[1] Chaboud and Wright (2005) finds that below six hours, classic UIP actually holds well.

[2] Apart from Italy during the 2010-2011 sovereign bond crisis.

[3] Previous data covers 1979-2009.

[4] This choice is due to the second step where government data are only released as quarterly.

[5] The debt variables have been added as fourth variables in the ordering.

First, I estimate Fama regressions both on real and nominal terms. These equations regress one step ahead excess currency returns against interest rates differences.

Second, I regress the level of real exchange rate on differences in real interest rates.

Third, I regress the sum of future expected excess currency returns on differences in real interest rates to estimate the potential reversal of the UIP puzzle (i.e. the new UIP puzzle).

Fourth, I regress far-ahead ex-ante excess currency returns on real and nominal differences in interest rates, doing so also over different subsamples. Fifth, I regress far-ahead ex-post excess currency returns on real and nominal differences in interet rates, for multiple quarters up to three years.

The following step adds debt variables to the previous equations. Generally I first estimate equations adding only the relative debt innovations, while in a second round I add to the estimation the total amount of Home government debt (US debt) and Foreign government debt.

Estimation results bring surprises. There is one key result from the model without debt in the quarterly sample 1979-2020: I do find the classic UIP puzzle but I cannot find the new UIP puzzle in the data.

This is stated by three regression results. First in eq. 9 I find positive and not significant coefficients for differences in real rates with respect to the future sums of expected foreign excess currency returns. In Engel(2016) these coefficients were negative and significant. This result is influenced by the different trend-cycle decomposition used for building the LHS of the equation, since I used an Hodrick-Prescott filter while Engel used the Beveridge-Nelson decomposition.

Second in eq 10 and 11 I find mostly positive coefficients, while Engel finds a lot of negative ones. This means that differences in real and nominal rates covary positively with far-ahead ex-ante excess currency returns.

Third in eq. 12 and 13 I find positive coefficients, while Engel finds negative ones. This means that differences in real and nominal rates covary positively with far-ahead ex-post excess currency returns.

The model with debt in the quarterly sample 2000-2020 brings some interesting findings.

First, the debt variables are significant for all the equations considered apart from the Fama regressions in real and nominal terms (where Foreign debt is somewhat significant in a minority of countries).

Second, introducing debt variables changes sign of coefficients for five out of eight sets of equations. For eq. 8a on the level of real exchange rate, for eq. 10a and **??** on ex-ante far-ahead excess currency returns and for eq. 12a and **??** on ex-post far-ahead excess currency returns.

Third, the magnitude of the coefficients for debt is economically important. Consider a 1 trillion increase in debt variables. For the real and nominal Fama regressions, Foreign debt has single digit percentage effects, while for the other regressions it has between single and double digit percentage effects.

Fourth, the coefficients on foreign debt are always an order of magnitude greater in absolute value than the coefficients on the other debt variables.

Fifth, the sign of US debt and Foreign debt are respectively positive and negative for almost all set of equations apart from the one in levels that is eq. 8a. These coefficients are not in line with government debt only as a function of past convenience yields, that would require opposite signs.

Sixth, relative debt innovations may be interpreted as differences in convenience yields, i.e. as $-(\Psi_h - \Psi_f)$ in Valchev (2020). Real convenience yields are positively correlated with real foreign excess currency returns (eq. 7a).

From a general standpoint, the results in eq. **??** and **??** partially solve one of the central puzzle of Engel (2016). Indeed, for France, Germany and Canada's pairs the high interest countries have now the lower level of real exchange rate that confirms them as the riskier countries in a bilateral comparison. Similarly, Italy and Japan have negative point estimates in eq. **??**, but they are not statistically significant. These results strongly support a new coherence of the "risk" framework over the standard textbook Mundell-Fleming model.

In conclusion, this paper does not find confirmation of the reversal of UIP puzzle for the whole 1979-2020 sample at quarterly level, but only for the 2000-2020 sample. Taking into account government debt variables is helpful to study the new UIP puzzle, but not the classic one. Differences in interest rates are positively correlated with ex-ante and ex-post excess currency returns, while Home government debt is positively correlated and Foreign government debt is negatively correlated.

Sections 2 outlines the literature review, Section 3 explains data sources, Section 4 explains the model, Section 5 shows regression results, Section 6 concludes.

2 Literature review

The literature review on these topics is big and expanding. For somewhat comprehensive review, see Engel (1996) and Engel (2014).

The Uncovered Interest Parity puzzle in its classical form has been introduced by Fama (1984): defining $s_t = \frac{Home}{Foreign}$ as log nominal ER ($\uparrow s_t$ means Home depreciate), a typical Fama regression:

$$s_{t+1} - s_t = \alpha + \beta(i_t - i_t^*) + \epsilon_{t+1}$$

Data suggests that $\hat{\beta} < 0$ instead of $\beta = 1$, i.e. high interest rates countries see overtime an appreciation of currency up to quarter time frequency.

This paper builds on two main previous works: Engel (2016) and Valchev (2020). Valchev (2020) uses panel data to find empirical evidence of convenience yields' importance for the classic and new UIP. He also builds a theoretical model with endogenous convenience yields' fluctuations that replicates both the classic UIP puzzle and the new one.

Ishtoki and Mukhin (2017) explain 6 exchange rate puzzles by using a setup that blends international asset demand shocks with a framework that makes these shocks propagates very little within the pair of countries. In their paper, shocks propagates little because of Home bias in consumption, weak substituability between domestic and foreign goods (little variance of Terms of Trade) and strategic complementarieties in price setting. They find that an increase in the demand for Foreign assets decreases the ex-ante foreign currency excess returns. In this paper, I find evidence that increase in supply of foreign government debt decreases the ex-ante and ex-post foreign currency excess returns.

Lately convenience yields and liquidity have been growingly incorporated in international macroeconomics and finance. Among the contributions, the paper by Krishnamurty and Vissing-Jorgensen (2012) finds that when debt to GDP ratio is low, Treasuries are more scarce and there is higher convenience yield. This implies that supply of government bonds impacts convenience yields such that higher supply decreases them.

In addition to Valchev (2020), there have been several key contributions. There are models that use the idea of bond convenience yields for closed economy asset puzzles, as Bansal and Coleman (1996) and Lagos (2010). The idea is that certain assets give an additional benefit other than the bare interest rate. Jiang et al (2018) build a theory that links demand for foreign safe assets and the nominal exchange rate for US. They claim to solve most of the exchange rate disconnect puzzle for US by defining a specific form of convenience yield. By defining as convenience yield the different yield between foreign government bonds and US bonds, they show that an increase in this convenience yield implies an impact appreciation of the dollar and a following depreciation that increases the ex-ante foreign currency excess return.

Engel and Wu (2019) find that accounting for liquidity yield on government bonds gives explanatory power to monetary shocks and price differences, differently from what the literature on forecasting and exchange rate disconnect had previously found.

Du et al (2018) study convenience yields for G10 currencies between 2000 and 2016. They include in their study US, Germany, Japan, UK that are useful for this work. The US treasury premium is defined as the convenience yield on US treasury bonds minus the convenience yield on foreign treasury bonds, such that a positive premium implies that US convenience yield is higher than foreign. They find that there are country-pair treasury premia with different average and dynamics. Treasury premia at 3 month horizon are higher than 5 year horizon, and they both increased during the Global Financial Crisis with higher jump by the 3 month premia. Moreover, there has been a steady decline in treasury premia after the GFC for the currencies considered. In line with this evidence, I find that US total debt has decisively lower coefficients than foreign total debt in prediction of both ex-ante and ex-post currency excess returns. Against this evidence, I find that the sign of coefficients is inverted: total US government debt correlates positively with foreign excess currency return and total foreign debt correlates negatively with foreign excess currency returns.

Van Bisbergen et al (2019) use a new methodology to estimate risk-free rates between 2004 and 2018, using the put-call parity relationship for European style options. By this method, they get risk-free rates from risky assets and compare them to risk- free rates on government bonds. The difference is indeed the convenience yield. As Du et al (2018), they find higher convenience yields at short term rather than long term horizon (65 versus 40 basis point) and strongly varying in time of financial distress.

Moreover they find that a forecasting factor constructed from cross section of convenience yields (a la Cochrane and Piazzesi 2005) has substantial forecasting power for both government bond excess returns (conventional risk premia) and their risk-free rate excess returns (risk premia minus the convenience yields), even when controlling for other factors of the literature. This evidence parallels my results that total government debt covaries with currency excess returns.

Lilley et al (2019) define as "Exchange Rate Reconnect" the fact that after the GFC , exchange rates correlate with macroeconomic fundamentals according to both IMF data [6] and a micro datasets with security level data. In particular, broad US dollar comoves closely with global risk appetite. In addition, only between 2007-2012 the broad US dollar co-moves also with US foreign bond purchases, even if they conclude that this correlation is probably caused by the movement in global risk appetite. The broad dollar and global risk appetite co-movement seems to depend on the changed relations between dollar and riskier currencies, such as Australian dollar. When US investors buy less US treasuries or more domestic corporate debt, the

[6] balance of payment data and International Investment positions to measure quarterly US capital flows

dollar depreciates.

Other approaches to the topic of safe and liquid assets includes Caballero, Farhi and Gourinchas (2017) on the safe asset conundrum and the same authors for the consequences of this for the growing difference between capital and equity risk premia.

One key aspect of the study is the long-run relation of nominal exchange rate with macroeconomic variables. Being unit root processes, the presence of a specific long run relation takes the form of cointegration. As Engel (2014) reports, there are 4 studies that find cointegration between economic fundamentals and exchange rates: Groen (2000), Mark and Sul (2001), Rapach and Wohar (2002), Cerra and Saxena (2010).

Groen (2000) studies cointegration between exchange rates and macroeconomic fundamentals given by the "monetary exchange model" (assuming quantity theory of money). Using both time series and panel data, the conclusion is that there is indeed cointegration between 14 bilateral exchange rates (with US and with the German mark) with relative log money supplies and relative log production.

This paper finds cointegration among nominal exchange rates and two fundamentals such as relative price differences and relative interest rates differences, plus adding relative government debt shocks.

3 Data

Price level data are taken from OECD quarterly data, with 2010 as base year.

Government debt data are from the BIS, using nominal value data in US billion dollars.

Nominal exchange rates are daily values taken for every first day of the quarter at FRED, Federal Reserve Bank of Saint Louis. To be noted that this means that in the dataset, the nominal ER of December is the nominal ER of the first day of January.

Interest rates are constructed by using daily data of 1-month annual Eurorates provided by Intercapital from June 1979 to July or October 2020, depending on the pair of countries considered. These quarterly rates are calculated using this formula (as an example, the first 3 month of each year): $(1+r_{january})(1+r_{february})(1+r_{march})-1$

This strategy should be equal to sell short a foreign bond today, convert foreign currency into dollars, buy US bonds, rollover the 1 month bond for 2 time until the last day of march and then buy back the short with the dollars from the maturing US bonds.

4 The model

This analysis follows closely the setup by Engel (2016).

I analyze country pairs for G6 countries with the United States as Home country and Canada, France, Germany, Italy, Japan, UK as Foreign countries (whose variables are denoted by an asterisk). I consider quarterly data for prices, interest rates and nominal exchange rates.

i_t is Home one-period nominal interest rate for deposits that pays off at time t+1.

s_t is the log of foreign exchange rate, denoted as US dollar price of foreign currency. This means that lower s_t implies dollar appreciation.

The excess return on foreign deposit from t to t+1 is:

$$\rho_{t+1} \equiv s_{t+1} - s_t + i_t^* - i_t \tag{1}$$

To be clear, this is the first-order log approximation of foreign excess return, expressed in Home currency terms.[7] In this paper, expected excess returns for one period ahead are defined as $E_t\rho_{t+1}$.

r_t is the ex-ante real interest rate, defined approximately by $r_t = i_t - E_t\pi_{t+1}$, where $\pi_{t+1} \equiv p_{t+1} - p_t$. This means that we approximate the real interest rate by taking the expectation of the difference between log prices tomorrow minus log prices today. As above, the variance of inflation is assumed constant.

The real exchange rate is $q_t \equiv s_t + p_t^* - p_t$.

I am interested in the classic UIP puzzle both in nominal and real terms, respectively defined here as: $cov(E_t\rho_{t+1}, i_t^* - i_t) > 0$ and $cov(E_t q_{t+1} - q_t + r_t^* - r_t, r_t^* - r_t) > 0$

In order to account for the new UIP puzzle, I am interested in the sum of future deviations from the UIP parity.

Engel (2016) explain in details his reasoning, but here is a quicker explanation. By iteration of 1, we get:

$$(E_t \sum_{j=0}^{\infty}(\rho_{t+j+1} - \bar{\rho})) = s_t^{IP} - s_t^T \tag{2}$$

where $s_t^{IP} = E_t \sum_{j=0}^{\infty}(i_{t+j}^* - i_{t+j} - (\overline{i^* - i}))$ is the infinite sum of future expected UIP deviations from their mean and $s_t^T = s_t - \underbrace{lim}_{k\to\infty}(E_t s_{t+k} - k(\overline{s_{+1} - s}))$ is the transitory component, affected by a mean zero random walk that is the second part.

In simple terms, I am interested in the covariance between real interest rate differences and future expected excess returns, to see whether higher than average interest rates covary positively or else with future expected excess returns.

[7] See Engel (2016) and (1996) for the role of variance in expected excess returns.

Intuitively, if UIP holds then $E_t \rho_{t+j} = 0$ for j a positive integer. Hence if UIP holds at all periods, the differences between the expected excess returns and their mean should be equal to zero. In this paper, I use a particular approximation of $(E_t \sum_{j=0}^{\infty}(\rho_{t+j+1} - \bar{\rho}))$ by using a Hodrick-Prescott filter to identify s_t^T. Considering 2 and adding prices on both sides, Engel finds a real exchange rate version of 2[8] :

$$q_t - \underbrace{lim}_{k\to\infty}(E_t q_{t+k}) = E_t \sum_{j=0}^{\infty}(r_{t+j}^* - r_{t+j} - (r^* \bar{-} r)) - E_t \sum_{j=0}^{\infty}(\rho_{t+j+1} - \bar{\rho}) \tag{3}$$

Differences in today real exchange rate from his long-run mean is given respectively by sum of future expected differences in real interest rates (UIP condition) minus the UIP deviations.

Below here I write the main equations:

A version of the Fama regression:

$$\rho_{t+1} = \zeta_s + \beta_s(i_t^* - i_t) + u_{s,t+1} \tag{4}$$

The VECM setup a la Engel:

$$x_t = \begin{bmatrix} s_t \\ p_t - p_t^* \\ i_t - i_t^* \end{bmatrix} \tag{5}$$

$$x_t - x_{t-1} = C_0 + Gx_{t-1} + C_1(x_{t-1} - x_{t-2}) + C_2(x_{t-2} - x_{t-3}) + C_3(x_{t-3} - x_{t-4}) + C_4(x_{t-4} - x_{t-5}) + u_t \tag{6}$$

The real version of Fama regression:

$$q_{t+1} - q_t + \hat{r}_t^* - \hat{r}_t = \zeta_q + \beta_q(\hat{r}_t^* - \hat{r}_t) + u_{q,t+1} \tag{7}$$

The regression of real exchange rate on differences in real interest rates:

$$q_t = \zeta_Q + \beta_Q(\hat{r}_t^* - \hat{r}_t) + u_{Q,t+1} \tag{8}$$

Eq. 9 search for comovements between the sum of future expected excess currency returns and real interest rates:

$$\hat{E}_t \sum_{j=0}^{\infty}(\rho_{t+j+1} - \bar{\rho}) = \zeta_\rho + \beta_\rho(\hat{r}_t^* - \hat{r}_t) + u_{\rho,t} \tag{9}$$

Eq. 10 and 11 search for comovements between expected future excess currency returns and interest

[8] The key assumption here is that Purchasing Power Parity holds in the long run, hence the real exchange rate is stationary and the second term on LHS is the unconditional mean

rates, respectively real and nominal:

$$\hat{E}_t(\rho_{t+j}) = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + u_t^j \tag{10}$$

$$\hat{E}_t(\rho_{t+j}) = \zeta_j + \beta_j(i_t^* - i_t) + u_t^j \tag{11}$$

Eq. 12 and 13 search for comovements between ex-post future excess currency returns and interest rates, respectively real and nominal:

$$\rho_{t+j} = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + u_t^j \tag{12}$$

$$\rho_{t+j} = \zeta_j + \beta_j(i_t^* - i_t) + u_t^j \tag{13}$$

In my empirical excercise, I use Stata 15 and the VECM package found there.
For every Home-Foreign pair, I compared different information criteria to get the optimal lag lenght. As a general criteria, I gave preferences to single cointegration relation unless impossible to find.

After the 3 variables VECM, I add debt variables. I build 4 variables VECM in order to estimate properly the long-run relations between price differential, interest rate differential, nominal exchange rate and debt variables.
I have collected data from the BIS on nominal value in billion of dollars of outstanding government debt. Nominal value is taken to parse out consideration of value of debt and overall default risk: I want to observe known quantities instead of a function of these quantities that represents a judgement by markets.
For every 2 country pair Home-Foreign, I created 5 VECMs with a different specification of debt variables :

1. $debt_t = \Delta debt_{Home,t} - \Delta debt_{Foreign,t}$
2. $debt_t = debt_{Home,t} - debt_{Foreign,t}$
3. $debt_t = \Delta debt_{Foreign,t}$
4. $debt_t = \Delta debt_{Home,t}$
5. $debt_t = deb_{Home,t}$

The first is the relative difference in debt emission respect to the previous period, the second is the relative debt difference, the third is the difference of Foreign country's debt emission, the fourth is the difference in Home country's debt emission, the fifth is the Home debt (US debt).

The comparison of different options for the debt variables is useful to see what type of variable best represent a cointegration relation with the other 3 variables. The evaluation of this is done using two criteria: theoretical intuition and visual comparison of cointegration relationship. Theoretical intuition suggests that convenience yields are about relative marginal changes in debt emission, hence the first specification should be the best. Another specification that might make sense is the third one, in case US government debt are ignored in a two country setup since they matter for all countries because they are the dominant currency. Visual comparison of the cointegration relationships over time works as the more it seems a white noise process, the best the considered VECM is able to model it.

$$x_t = \begin{bmatrix} s_t \\ p_t - p_t^* \\ i_t - i_t^* \\ debt_t \end{bmatrix} \tag{5a}$$

The final choice is for the first specification of the VECM for every country pair, the one with $debt_t = \Delta debt_{Home,t} - \Delta debt_{Foreign,t}$ [9].

[9]Cointegration relations are graphed in the Online Appendix for all the 5 specifications for country pairs, together with information on rank and lag choice.

5 Regression results

First, I estimate Eq. 7, 8, 9, 10, 12, in a sample of quarterly data between 1979 and 2020. Second, I estimate both the equations $7, 8, 9, 10, 12$ and equations $7a, 8a, 9a, 10a, 12a$ in which I added debt variables as covariates in a sample of quarterly data between 2000 and 2020 [10].

I show here one part of the result, picking the country pair US-France for equations 10,12 and 10a,12a. The full results are in Section C and D of the Appendix.

[10] Generally I first estimate equations adding only the relative debt innovations, while in a second round I add to the estimation the total amount of Home government debt (US debt) and Foreign government debt.

First, for the full sample real Fama regression coefficients are significant and slightly smaller than Engel's, apart from Italy and Canada. For the smaller sample, coefficients are positive, slightly smaller and significant. Foreign debt coefficient is significant and negative only for France and Italy, with a 1 trillion increase effect to -5 % for both. Equation 7:

$$q_{t+1} - q_t + \hat{r}_t^* - \hat{r}_t = \zeta_q + \beta_q(\hat{r}_t^* - \hat{r}_t) + u_{q,t+1}$$

Figure 1: Equation 7. Fama regression in real terms.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real.Exc.ret.t+1.Ita	Real.Exc.ret.t+1.Can	Real.Exc.ret.t+1.Ger	Real.Exc.ret.t+1.Fra	Real.Exc.ret.t+1.UK	Real.Exc.ret.t+1.Jap
(r*-r) Italy	0.922***					
	(17.35)					
(r*-r) Canada		1.023***				
		(10.64)				
(r*-r) Germany			1.047***			
			(15.14)			
(r*-r) France				0.967***		
				(13.45)		
(r*-r) UK					0.966***	
					(9.54)	
(r*-r) Japan						0.888***
						(10.21)
Constant	0.00178	-0.00326	0.000599	-0.00264	-0.00514	-0.00398
	(0.26)	(-0.49)	(0.09)	(-0.36)	(-0.64)	(-0.34)
Observations	160	162	162	162	159	161

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$q_{t+1} - q_t + \hat{r}_t^* - \hat{r}_t = \zeta_q + \beta_q(\hat{r}_t^* - \hat{r}_t) + \phi_q debt_t + u_{q,t+1} \tag{7a}$$

Figure 2: Equation 7a. Real Fama regressions with debt.

	(1) Real.Exc.ret.t+1.Ita	(2) Real.Exc.ret.t+1.Can	(3) Real.Exc.ret.t+1.Ger	(4) Real.Exc.ret.t+1.Fra	(5) Real.Exc.ret.t+1.UK	(6) Real.Exc.ret.t+1.Jap
(r*-r) Italy	0.667***					
	(3.41)					
Rel.debt.innov.Ita	-0.00000818					
	(-0.34)					
Debt.US	-0.000000614	-0.00000186	-0.00000182	0.00000131	-0.00000220	0.00000299
	(-0.27)	(-0.58)	(-0.89)	(0.42)	(-0.52)	(0.81)
Debt.Ita	-0.0000520**					
	(-2.37)					
(r*-r) Canada		0.635***				
		(5.48)				
Rel.debt.innov.Can		0.0000221				
		(0.66)				
Debt.Can		-0.0000234				
		(-0.46)				
(r*-r) Germany			0.681***			
			(3.18)			
Rel.debt.innov.Ger			-0.0000170			
			(-0.60)			
Debt.Ger			-0.0000309+			
			(-1.85)			
(r*-r) France				0.657***		
				(3.26)		
Rel.debt.innov.Fra				-0.00000587		
				(-0.24)		
Debt.Fra				-0.0000527**		
				(-2.20)		
(r*-r) UK					0.230	
					(0.97)	
Rel.debt.innov.UK					-0.00000136	
					(-0.06)	
Debt.UK					-0.0000325	
					(-1.05)	
(r*-r) Japan						0.702***
						(4.63)
Rel.debt.innov.Jap						-0.0000287
						(-1.56)
Debt.Jap						-0.00000538
						(-0.51)
Constant	0.134***	0.0441	0.0976***	0.0928***	0.0928***	-0.00988
	(3.47)	(1.46)	(3.15)	(3.56)	(4.99)	(-0.18)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Second, for the full sample the level of real exchange rate is correlated with real interest rate differences (apart from France and less for UK), but coefficients are two order of magnitude littler than Engel's. For the smaller sample, the level of real exchange rate is positively correlated (but not significant) with real interest rate differences only until all debt variables are included. Indeed this brings a negative correlation between the level of real exchange rate and real interest rate. All debt variables are significant and Foreign debt has big effects. Equation 8:

$$q_t = \zeta_Q + \beta_Q(\hat{r}_t^* - \hat{r}_t) + u_{Q,t+1}$$

Figure 3: Equation 8. Levels of real exchange rates and differences in real interest rates.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real ER Italy	Real ER Canada	Real ER Germany	Real ER France	Real ER UK	Real ER Japan
(r*-r) Italy	0.423^{+}					
	(1.87)					
(r*-r) Canada		1.428^{***}				
		(2.62)				
(r*-r) Germany			1.565^{***}			
			(3.95)			
(r*-r) France				-0.241		
				(-0.79)		
(r*-r) UK					0.691^{**}	
					(2.01)	
(r*-r) Japan						1.358^{***}
						(2.70)
Constant	0.234^{***}	-0.184^{***}	0.243^{***}	0.219^{***}	0.421^{***}	-4.420^{***}
	(5.50)	(-3.79)	(6.26)	(5.05)	(9.44)	(-62.62)
Observations	161	163	163	163	160	162

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$q_t = \zeta_Q + \beta_Q(\hat{r}_t^* - \hat{r}_t) + \phi_Q debt_t + u_{Q,t+1} \tag{8a}$$

Figure 4: Equation 8a.

	(1) Real ER Italy	(2) Real ER Canada	(3) Real ER Germany	(4) Real ER France	(5) Real ER UK	(6) Real ER Japan
(r*-r) Italy	-0.222					
	(-1.15)					
Rel.debt.innov.Ita	0.0000923**					
	(2.30)					
Debt.US	-0.0000546***	-0.000135***	-0.0000437***	-0.000101***	-0.000106***	-0.0000884***
	(-13.91)	(-11.23)	(-11.97)	(-15.17)	(-6.71)	(-17.58)
Debt.Ita	0.000734***					
	(16.82)					
(r*-r) Canada		-0.532**				
		(-2.15)				
Rel.debt.innov.Can		0.000244***				
		(5.22)				
Debt.Can		0.00263***				
		(11.65)				
(r*-r) Germany			-0.849***			
			(-3.92)			
Rel.debt.innov.Ger			0.000105***			
			(2.88)			
Debt.Ger			0.000542***			
			(12.96)			
(r*-r) France				-0.682***		
				(-3.52)		
Rel.debt.innov.Fra				0.000116***		
				(3.14)		
Debt.Fra				0.000882***		
				(15.07)		
(r*-r) UK					0.135	
					(0.33)	
Rel.debt.innov.UK					0.00000984	
					(0.15)	
Debt.UK					0.000603***	
					(5.62)	
(r*-r) Japan						-0.197
						(-0.83)
Rel.debt.innov.Jap						0.0000413
						(1.57)
Debt.Jap						0.000218***
						(11.95)
Constant	-0.832***	-1.229***	-0.454***	-0.292***	0.746***	-5.140***
	(-11.81)	(-9.99)	(-6.23)	(-5.13)	(7.03)	(-40.05)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results in Equations 7 and 8 constitute a significant redefinition of the central puzzle in Engel (2016). Indeed, Engel (2016) finds on one side the classic UIP puzzle for all the country pairs, while on the other side a positive coefficient in eq. 8 states that high interest rates countries have higher level of real exchange rates. This is a contradiction since the classic UIP puzzle implies that high interest rate countries are riskier, while high level of real exchange rates implies less risk. This contradiction puts ”risk” models on one side and Mundell-Fleming models on the other, with both class of models being able to explain just one of the two empirical facts.

My findings state that including government debt quantities in the estimation changes the sign of the coefficients in eq. 8 for 5 pair of countries out of 6, with 3 that are statistically significant. For these country pairs, the Engel puzzle is not anymore there: high interest rate countries are more risky in both ways, from a UIP puzzle standpoint and by considering the now lower level of real exchange rates.

Third, for the full sample the sum of expected excess currency returns is positively correlated with differences in real rates [11], but not significant. This is starkly different from Engel's negative and significant coefficients. For the smaller sample, the sum of future expected excess currency returns is now negatively correlated with differences in real rates. US debt and Foreign debt have (mostly) significant coefficients, respectively positive and negative. A 1 trillion increase in Foreign debt has an effect between -28 and -5 %. Equation 9:

$$\hat{E}_t \sum_{j=0}^{\infty} (\rho_{t+j+1} - \bar{\rho}) = \zeta_\rho + \beta_\rho (\hat{r}_t^* - \hat{r}_t) + u_{\rho,t}$$

Figure 5: Equation 9. New UIP puzzle evidence.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sum.exp.exc.ret.Ita	Sum.exp.exc.ret.Can	Sum.exp.exc.ret.Fra	Sum.exp.exc.ret.Ger	Sum.exp.exc.ret.UK	Sum.exp.exc.ret.Jap
(r*-r) Italy	0.0788					
	(0.68)					
(r*-r) Canada		0.374				
		(0.90)				
(r*-r) France			0.192			
			(0.72)			
(r*-r) Germany				0.204^{**}		
				(2.16)		
(r*-r) UK					0.347^{+}	
					(1.77)	
(r*-r) Japan						-0.0874
						(-0.46)
Constant	0.149^{***}	0.150^{***}	0.173^{***}	-0.0485^{***}	0.296^{***}	0.102^{***}
	(6.87)	(5.74)	(5.21)	(-4.46)	(11.33)	(3.62)
Observations	161	163	163	163	160	162

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[11] Apart from Japan.

$$\hat{E}_t \sum_{j=0}^{\infty} (\rho_{t+j+1} - \bar{\rho}) = \zeta_\rho + \beta_\rho(\hat{r}_t^* - \hat{r}_t) + \phi_\rho debt_t + u_{\rho,t} \tag{9a}$$

Figure 6: Equation 9a.

	(1)	(2)
	Sum.exp.exc.ret.Fra	Sum.exp.exc.ret.Fra
(r*-r) France	-0.501***	-0.386^{+}
	(-2.82)	(-1.74)
Rel.debt.innov.Fra		0.0000455
		(1.54)
Debt.US		0.0000154***
		(3.73)
Debt.Fra		-0.000148***
		(-3.88)
Constant	-0.0258**	0.0752
	(-2.18)	(1.57)
Observations	76	76

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fourth, for the full sample differences in real and nominal rates covary positively with far-ahead ex-ante excess currency returns, confirming the fourth result and the difference with Engel's. Negative coefficients are found only for 2005-2020 and for some countries. For the smaller sample, differences in real and nominal rates covary (mostly) negatively with far-ahead ex-ante excess currency returns without debt variables, while adding debt variables creates a positive correlation.

US debt coefficients are all positive and significant, Foreign debt coefficients are all negative and significant.

Equation 10:

$$\hat{E}_t(\rho_{t+j}) = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + u_t^j$$

In both the above equations, I computed the LHS by using an in-sample dynamic forecast. This forecast has been repeated for 3 time spans: post 1985 (columns 1 and 2), post 1995 (columns 3 and 4) and post 2005 (columns 5 and 6), in order to have different subsamples of data considered. This equations give betas that are a weighted average of the set of betas shown by Engel.

Figure 7: Equation 10. France.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post1985.Fra	Exp.exc.ret.post1985.Fra	Exp.exc.ret.post1995.Fra	Exp.exc.ret.post1995.Fra	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2005.Fra
(r*-r) France	1.326***		0.125		-0.124	
	(4.93)		(0.25)		(-1.04)	
(i*-i) France		1.592***		0.189		-0.203
		(4.80)		(0.23)		(-0.97)
Constant	-0.678***	-0.681***	-0.0650+	-0.0637	-0.0480***	-0.0496***
	(-20.06)	(-20.62)	(-1.77)	(-1.58)	(-3.27)	(-3.19)
Observations	143	143	104	104	64	64

t statistics in parentheses

$^+$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$\hat{E}_t(\rho_{t+j}) = \zeta_{10a} + \beta_{10a}(\hat{r}^*_t - \hat{r}_t) + \phi_j debt_t + u^j_t \tag{10a}$$

In both the above equations, I computed the LHS by using an in-sample dynamic forecast. This forecast has been repeated for 3 time spans: post 2005 (columns 1 and 2), post 2010 (columns 3 and 4) and post 2015 (columns 5 and 6), in order to have different subsamples of data considered. This equations give betas that are a weighted average of the set of betas shown by Engel.

Figure 8: Equation 10a-11a. France.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2015.Fra	Exp.exc.ret.post2015.Fra
(r*-r) France	-0.591^{+}		-1.045***		0.313	
	(-1.87)		(-5.66)		(0.86)	
(i*-i) France		-0.860^{+}		-1.561***		0.602
		(-1.87)		(-3.48)		(1.53)
Constant	0.0509**	0.0492**	0.0850***	0.0766***	0.00238	0.0155
	(2.22)	(2.19)	(3.69)	(3.13)	(0.09)	(0.71)
Observations	63	65	43	45	23	25

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2015.Fra	Exp.exc.ret.post2015.Fra
(r*-r) France	0.888***		0.748***		0.726***	
	(5.13)		(5.35)		(4.69)	
Rel.debt.innov.Fra	-0.0000236	-0.0000183	-0.0000716***	-0.0000455***	-0.0000509***	-0.0000314**
	(-0.66)	(-0.74)	(-6.58)	(-3.10)	(-3.80)	(-2.13)
Debt.US	0.0000527***	0.0000561***	0.0000499***	0.0000489***	0.0000380***	0.0000342***
	(11.50)	(17.14)	(17.56)	(9.36)	(7.38)	(10.99)
Debt.Fra	-0.000381***	-0.000408***	-0.000434***	-0.000392***	-0.000402***	-0.000340***
	(-11.63)	(-13.91)	(-13.27)	(-12.30)	(-13.84)	(-10.09)
(i*-i) France		1.279***		0.826**		0.770***
		(8.53)		(2.48)		(4.96)
Constant	0.204***	0.226***	0.396***	0.303***	0.345***	0.257**
	(8.15)	(7.91)	(6.23)	(3.60)	(5.05)	(2.74)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fifth, for the full sample differences in real and nominal rates covary positively with far-ahead ex-post excess currency returns, differently from Engel's. For the smaller sample, differences in real and nominal rates still covary positively with far-ahead ex-post excess currency returns, but they often lose significance. US debt coefficients are significant and positive, Foreign debt coefficients are significant and negative.

Equation 12:

$$\rho_{t+j} = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + u_t^j$$

This regression uses ex-post excess returns on foreign deposit. The regression is performed from 1 quarter to 12 quarters (3 years).

Figure 9: Equation 12. France.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Fran	Exc.ret.t+2.Fra	Exc.ret.t+3.Fra	Exc.ret.t+4.Fra	Exc.ret.t+5.Fra	Exc.ret.t+6.Fra
(r*-r) France	0.915***	0.899***	0.870***	0.858***	0.883***	0.884***
	(17.21)	(11.69)	(8.40)	(6.43)	(5.46)	(4.43)
Constant	0.000382	-0.00129	-0.00256	-0.00343	-0.00478	-0.00484
	(0.07)	(-0.13)	(-0.18)	(-0.19)	(-0.22)	(-0.20)
Observations	162	161	160	159	158	157

t statistics in parentheses

$^+$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Fra	Exc.ret.t+8.Fra	Exc.ret.t+9.Fra	Exc.ret.t+10.Fra	Exc.ret.t+11.Fra	Exc.ret.t+12.Fra
(r*-r) France	0.881***	0.910***	0.929***	1.018***	1.048***	1.096***
	(3.92)	(3.67)	(3.52)	(3.70)	(3.85)	(4.02)
Constant	-0.00481	-0.00556	-0.00578	-0.00711	-0.00585	-0.00583
	(-0.18)	(-0.19)	(-0.18)	(-0.21)	(-0.17)	(-0.16)
Observations	156	155	154	153	152	151

t statistics in parentheses

$^+$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$\rho_{t+j} = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + \phi_j debt_t + u_t^j \tag{12a}$$

Figure 10: Equation 12a. France.

	(1)	(2)	(3)
	Exc.ret.(t+1) Fran	Exc.ret.t+2.Fra	Exc.ret.t+3.Fra
(r*-r) France	0.490**	0.360	0.420**
	(2.58)	(1.55)	(2.07)
Rel.debt.innov.Fra	0.0000138	0.0000436	0.0000419
	(0.47)	(0.94)	(0.77)
Debt.Fra	-0.0000573**	-0.000118***	-0.000180***
	(-2.47)	(-3.27)	(-4.37)
Debt.US	0.00000218	0.00000630	0.0000114**
	(0.70)	(1.38)	(2.05)
Constant	0.0856***	0.155***	0.222***
	(3.69)	(4.46)	(6.13)
Observations	76	76	75

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+4.Fra	Exc.ret.t+5.Fra	Exc.ret.t+6.Fra
(r*-r) France	0.513**	0.609***	0.538**
	(2.50)	(2.83)	(2.61)
Rel.debt.innov.Fra	0.0000426	0.0000311	0.0000260
	(0.94)	(0.77)	(0.67)
Debt.Fra	-0.000236***	-0.000267***	-0.000291***
	(-5.32)	(-5.71)	(-5.96)
Debt.US	0.0000162***	0.0000189***	0.0000198***
	(2.66)	(3.17)	(3.24)
Constant	0.279***	0.315***	0.354***
	(7.47)	(7.58)	(8.05)
Observations	74	73	72

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 11: Equation 12a. France.

	(1)	(2)	(3)
	Exc.ret.t+7.Fra	Exc.ret.t+8.Fra	Exc.ret.t+9.Fra
(r*-r) France	0.452^{+}	0.478^{+}	0.468
	(1.95)	(1.80)	(1.61)
Rel.debt.innov.Fra	0.0000226	0.0000488	0.0000540
	(0.55)	(1.05)	(1.00)
Debt.Fra	-0.000319***	-0.000358***	-0.000377***
	(-6.48)	(-7.69)	(-7.89)
Debt.US	0.0000217***	0.0000252***	0.0000263***
	(3.46)	(4.33)	(4.40)
Constant	0.388***	0.421***	0.444***
	(8.63)	(9.20)	(9.31)
Observations	71	70	69

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+10.Fra	Exc.ret.t+11.Fra	Exc.ret.t+12.Fra
(r*-r) France	0.582**	0.760***	0.871***
	(2.11)	(2.93)	(3.76)
Rel.debt.innov.Fra	0.0000455	0.0000157	-0.00000488
	(0.81)	(0.33)	(-0.12)
Debt.Fra	-0.000397***	-0.000396***	-0.000396***
	(-8.27)	(-7.92)	(-8.35)
Debt.US	0.0000282***	0.0000283***	0.0000279***
	(4.77)	(4.77)	(5.07)
Constant	0.463***	0.465***	0.472***
	(9.53)	(9.53)	(9.99)
Observations	68	67	66

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Eq. 9 and eq. 10 mark another difference with the Engel paper. Engel finds that the sum of future expected excess returns (minus the mean) is negatively correlated with real interest rates difference at monthly level between 1979 and 2009. This paper finds otherwise since in the full 1979-2020 sample at quarterly level there is no trace of the new UIP puzzle, i.e. the reversal of UIP puzzle. This result is confirmed by the two first columns of Figure 7, where there are positive coefficients in eq. 10 for France.

The new UIP puzzle is found in the subsample 2000-2020, as certified by eq. 9a and 10a. By using debt in the estimation process, but without including it as regressor, the new UIP puzzle exists in the subsample.

A further difference emerges when the debt variables are included as regressors, since real interest rate differences become positively correlated again. This complicates the interpretation and remains as an additional puzzle.

There are some comments on the results from a government debt standpoint.

In this framework, the debt variable used inside the VECM is $debt_t = \Delta debt_{Home,t} - \Delta debt_{Foreign,t}$ From now on, let's call it *delta* to differentiate it from total debt . This is a relative debt innovation at time t. For the purpose of comparison, a positive shock to this variable is having an effect that is similar to a negative shock to the difference in convenience yields. For example, in the Valchev (2020) framework, a positive shock to delta is a negative shock to $\Psi_h - \Psi_f$. I am not interested in the comparable magnitude of the shock, but on the general intuition of it.

One key dimension of analysis is the comparison between the effect of delta and the effect of total US and foreign debt. Indeed it is interesting to see whether all the signs are coherent with a convenience yield story. The main results are stated here.

First, in eq. 7a delta's coefficients are negative. This means that real foreign excess currency returns are positively correlated with convenience yields.

Second, when the regression includes all forms of debt, in eq. 7a US debt has (mostly) a positive coefficient, while foreign debt has a negative coefficient. These signs are not consistent with government debt being a unique function of convenience yields.

Third, in eq. 8a delta's coefficients are positive, US debt's coefficients are negative and Foreign debt's ones are positive.

Fourth, in eq. 9a delta's coefficients are positive, US debt's coefficients are positive and Foreign debt's ones are negative. These three coefficients are consistent among themselves.

By using 9a, all three groups of coefficients are consistent between estimation, but they are not consistent with a convenience yield story. Indeed, increase in Home debt implies a decrease in relative convenience yields and this makes the foreign excess currency return to increase, contrary to theory (the reasoning is inverse for foreign debt increases).

Fifth, in eq. 10a delta's coefficients are negative, US debt's coefficients are positive and Foreign debt's ones are negative.

Sixth, in eq. 12a delta's coefficients are positive, US debt's coefficients are positive and Foreign debt's ones are negative.

In the last two points it is clear that US debt and foreign debt are not in line with a convenience yield story.

6 Conclusion

This paper studies exchange rates and government debt. This is motivated by growing evidence that liquidity measures and asset demand shocks are important for solving exchange rates puzzles.

In this paper, I compare a Engel (2016) framework with extended data with one augmented by government debt variables for a shorter period of time due to data availability. After selecting the best debt definition for the VECM, I proceed to estimate Fama regressions in real variables, an equation to directly links real exchange rate levels and differences in real interest rates and equations to verify the existence of the new UIP puzzle. This is done by regressing far-ahead ex-ante and ex-post excess currency returns against real interest rates differences.

Results confirm only partially Engel (2016) results, since the new UIP puzzle is not found in the sample without debt.

Once debt variables are introduced, there are some interesting results and here we outline some of them. First, the debt variables are significant for all the equations considered apart from the Fama regressions. Second, introducing debt variables changes sign of coefficients for five out of eight sets of equations. Third, the magnitude of the coefficients for debt is economically important. Consider a 1 trillion increase in debt variables. For the real Fama regressions Foreign debt has single digit percentage effects, while for the other regressions it has between single and double digit percentage effects. Fourth, the sign of coefficients for total government debt are not in line with government debt only as a function of past convenience yields, since that would require opposite signs. Fifth, the central puzzle of Engel (2016) is resolved for 3 out of 6 country pairs since high interest rates countries are riskier both from a level of exchange rates standpoint and a rate of exchange rates standpoint.

All together, these findings place government debt in a new light for the study of currency excess returns.

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Appendix C. Classic and new UIP puzzle without debt variables.

This section estimates Eq. 7, 8, 9, 10, 12 in a sample of quarterly data between 1979 and 2020.

The main findings are anticipated here.

First, real Fama regression coefficients are significant and slightly smaller than Engel's, apart from Italy and Canada.

Second, the level of real exchange rate is correlated with real interest rate differences (apart from France and less for UK), but coefficients are two order of magnitude littler than Engel's.

Third, the sum of expected excess currency returns is positively correlated with differences in real rates [12], but not significant. This is starkly different from Engel's negative and significant coefficients.

Fourth, differences in real rates covary positively with far-ahead ex-ante excess currency returns, confirming the third result and the difference with Engel's. Negative coefficients are found only for 2005-2020 and for some countries.

Fifth, differences in real rates covary positively with far-ahead ex-post excess currency returns, differently from Engel's.

Modifying slightly Fama (1984), uncovered interest parity implies that $\beta_s = 0$ and $\zeta_s = 0$. Previous studies find that $\beta_s > 0$ that is the UIP puzzle. Equations use Newey West standard errors.

[12] Apart from Japan.

Equation 7:

$$q_{t+1} - q_t + \hat{r}_t^* - \hat{r}_t = \zeta_q + \beta_q(\hat{r}_t^* - \hat{r}_t) + u_{q,t+1}$$

It is a Fama regression in real terms, built using estimates coming from the VECM. Coefficients are slightly smaller here for 4 country pairs, apart from Italy and Canada.

Figure 12: Equation 7. Fama regression in real terms.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real.Exc.ret.t+1.Ita	Real.Exc.ret.t+1.Can	Real.Exc.ret.t+1.Ger	Real.Exc.ret.t+1.Fra	Real.Exc.ret.t+1.UK	Real.Exc.ret.t+1.Jap
(r*-r) Italy	0.922***					
	(17.35)					
(r*-r) Canada		1.023***				
		(10.64)				
(r*-r) Germany			1.047***			
			(15.14)			
(r*-r) France				0.967***		
				(13.45)		
(r*-r) UK					0.966***	
					(9.54)	
(r*-r) Japan						0.888***
						(10.21)
Constant	0.00178	-0.00326	0.000599	-0.00264	-0.00514	-0.00398
	(0.26)	(-0.49)	(0.09)	(-0.36)	(-0.64)	(-0.34)
Observations	160	162	162	162	159	161

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Equation 8:

$$q_t = \zeta_Q + \beta_Q(\hat{r}_t^* - \hat{r}_t) + u_{Q,t+1}$$

This equation states how real exchange rate covaries with differences in real interest rates.
Coefficients are remarkably little respect to Engel (2016): the difference is two orders of magnitude. Significance is absent for France and at 95% for UK

Figure 13: Equation 8. Levels of real exchange rates and differences in real interest rates.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real ER Italy	Real ER Canada	Real ER Germany	Real ER France	Real ER UK	Real ER Japan
(r*-r) Italy	0.423^{+}					
	(1.87)					
(r*-r) Canada		1.428^{***}				
		(2.62)				
(r*-r) Germany			1.565^{***}			
			(3.95)			
(r*-r) France				-0.241		
				(-0.79)		
(r*-r) UK					0.691^{**}	
					(2.01)	
(r*-r) Japan						1.358^{***}
						(2.70)
Constant	0.234^{***}	-0.184^{***}	0.243^{***}	0.219^{***}	0.421^{***}	-4.420^{***}
	(5.50)	(-3.79)	(6.26)	(5.05)	(9.44)	(-62.62)
Observations	161	163	163	163	160	162

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Equation 9:

$$\hat{E}_t \sum_{j=0}^{\infty} (\rho_{t+j+1} - \bar{\rho}) = \zeta_\rho + \beta_\rho (\hat{r}_t^* - \hat{r}_t) + u_{\rho,t}$$

This equation get the LHS by Eq 2 and defines the new UIP puzzle: do higher real interest rates countries see higher or lower cumulative anticipated risk premiums ?

The temporary component of nominal exchange rate is derived by using a Hodrick-Prescott filter. Coefficients are very different from Engel (2016): positive instead of strongly negative (apart from Japan) and in general not significant.

Figure 14: Equation 9. New UIP puzzle evidence.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sum.exp.exc.ret.Ita	Sum.exp.exc.ret.Can	Sum.exp.exc.ret.Fra	Sum.exp.exc.ret.Ger	Sum.exp.exc.ret.UK	Sum.exp.exc.ret.Jap
(r*-r) Italy	0.0788					
	(0.68)					
(r*-r) Canada		0.374				
		(0.90)				
(r*-r) France			0.192			
			(0.72)			
(r*-r) Germany				0.204^{**}		
				(2.16)		
(r*-r) UK					0.347^{+}	
					(1.77)	
(r*-r) Japan						-0.0874
						(-0.46)
Constant	0.149^{***}	0.150^{***}	0.173^{***}	-0.0485^{***}	0.296^{***}	0.102^{***}
	(6.87)	(5.74)	(5.21)	(-4.46)	(11.33)	(3.62)
Observations	161	163	163	163	160	162

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Equation 10:

$$\hat{E}_t(\rho_{t+j}) = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + u_t^j$$

This equation is meant to capture specific betas at different expectation' horizons, to see if and where the reversal of UIP takes place.

I implemented regressions:

In the above equation, I computed the LHS by using an in-sample dynamic forecast. This forecast has been repeated for 3 time spans: post 1985 (columns 1 and 2), post 1995 (columns 3 and 4) and post 2005 (columns 5 and 6), in order to have different subsamples of data considered. This equation give betas that are a weighted average of the set of betas shown by Engel.

For most country pairs, the only negative value I find comes on post 2005 data, while for the whole sample (columns 1 and 2) a positive coefficient means that in quarterly data there is no reversal of UIP puzzle.

Figure 15: Equation 10. Italy and Canada.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post1985.Ita	Exp.exc.ret.post1985.Ita	Exp.exc.ret.post1995.Ita	Exp.exc.ret.post1995.Ita	Exp.exc.ret.post2005.Ita	Exp.exc.ret.post2005.Ita
(r*-r) Italy	0.387**		0.352		-0.356**	
	(2.34)		(1.49)		(-2.15)	
(i*-i) Italy		0.434**		0.469		-0.603**
		(2.32)		(1.55)		(-2.21)
Constant	-0.177***	-0.179***	0.0631**	0.0633**	-0.0167	-0.0219
	(-6.96)	(-6.97)	(2.36)	(2.38)	(-0.92)	(-1.18)
Observations	143	143	104	104	64	64

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post1985.Can	Exp.exc.ret.post1985.Can	Exp.exc.ret.post1995.Can	Exp.exc.ret.post1995.Can	Exp.exc.ret.post2005.Can	Exp.exc.ret.post2005.Can
(r*-r) Canada	0.853***		-0.137		-0.554	
	(2.65)		(-0.19)		(-0.98)	
(i*-i) Canada		0.903***		-0.166		-1.258
		(2.72)		(-0.18)		(-1.49)
Constant	-0.120***	-0.121***	-0.175***	-0.175***	-0.0914***	-0.0898***
	(-4.13)	(-4.14)	(-5.77)	(-5.80)	(-4.58)	(-4.52)
Observations	143	143	103	103	63	63

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 16: Equation 10. France and Germany.

	(1) Exp.exc.ret.post1985.Fra	(2) Exp.exc.ret.post1985.Fra	(3) Exp.exc.ret.post1995.Fra	(4) Exp.exc.ret.post1995.Fra	(5) Exp.exc.ret.post2005.Fra	(6) Exp.exc.ret.post2005.Fra
(r*-r) France	1.326***		0.125		-0.124	
	(4.93)		(0.25)		(-1.04)	
(i*-i) France		1.592***		0.189		-0.203
		(4.80)		(0.23)		(-0.97)
Constant	-0.678***	-0.681***	-0.0650+	-0.0637	-0.0480***	-0.0496***
	(-20.06)	(-20.62)	(-1.77)	(-1.58)	(-3.27)	(-3.19)
Observations	143	143	104	104	64	64

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exp.exc.ret.post1985.Ger	(2) Exp.exc.ret.post1985.Ger	(3) Exp.exc.ret.post1995.Ger	(4) Exp.exc.ret.post1995.Ger	(5) Exp.exc.ret.post2005.Ger	(6) Exp.exc.ret.post2005.Ger
(r*-r) Germany	0.296		0.252		-0.643+	
	(1.39)		(0.67)		(-1.87)	
(i*-i) Germany		0.403		0.434		-1.022+
		(1.53)		(0.73)		(-1.91)
Constant	-0.348***	-0.347***	0.0931***	0.0975***	0.0717***	0.0637**
	(-14.28)	(-14.31)	(3.11)	(3.07)	(2.77)	(2.56)
Observations	143	143	104	104	64	64

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 17: Equation 10. Japan and United Kingdom.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post1985.Jap	Exp.exc.ret.post1985.Jap	Exp.exc.ret.post1995.Jap	Exp.exc.ret.post1995.Jap	Exp.exc.ret.post2005.Jap	Exp.exc.ret.post2005.Jap
(r*-r) Japan	0.585^{***}		0.794^{***}		0.0805	
	(3.12)		(3.18)		(0.24)	
(i*-i) Japan		1.312^{***}		1.717^{***}		0.263
		(3.34)		(3.49)		(0.39)
Constant	-0.354^{***}	-0.305^{***}	0.311^{***}	0.382^{***}	0.0821	0.0907
	(-9.45)	(-6.61)	(6.56)	(6.39)	(1.53)	(1.35)
Observations	143	143	103	103	63	63

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post1985.UK	Exp.exc.ret.post1985.UK	Exp.exc.ret.post1995.UK	Exp.exc.ret.post1995.UK	Exp.exc.ret.post2005.UK	Exp.exc.ret.post2005.UK
(r*-r) UK	0.213		-0.437^{+}		-0.534^{**}	
	(1.45)		(-1.86)		(-2.07)	
(i*-i) UK		0.327^{+}		-0.757^{+}		-1.262^{**}
		(1.74)		(-1.67)		(-2.15)
Constant	-0.0362^{+}	-0.0424^{+}	0.0162	0.0223	0.0196	0.0239
	(-1.67)	(-1.76)	(0.74)	(0.94)	(0.80)	(1.03)
Observations	143	143	103	103	63	63

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Equation 12:

$$\rho_{t+j} = \zeta_j + \beta_j(\hat{r}^*_t - \hat{r}_t) + u^j_t$$

This regression uses ex-post excess returns on foreign deposit. The regression is performed from 1 quarter to 12 quarters (3 years). Coefficients are consistently positive and significant for all countries at all time, hence confirming that the new UIP puzzle does not result in quarterly data in this form.

Figure 18: Equation 12. Canada.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Can	Exc.ret.t+2.Can	Exc.ret.t+3.Can	Exc.ret.t+4.Can	Exc.ret.t+5.Can	Exc.ret.t+6.Can
(r*-r) Canada	0.975***	0.957***	0.997***	0.986***	1.028***	1.051***
	(20.56)	(11.05)	(9.27)	(7.21)	(6.21)	(5.49)
Constant	-0.000262	-0.000816	-0.00250	-0.00298	-0.00456	-0.00575
	(-0.08)	(-0.14)	(-0.31)	(-0.29)	(-0.37)	(-0.41)
Observations	162	161	160	159	158	157

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Can	Exc.ret.t+8.Can	Exc.ret.t+9.Can	Exc.ret.t+10.Can	Exc.ret.t+11.Can	Exc.ret.t+12.Can
(r*-r) Canada	0.975***	0.954***	0.880***	0.828***	0.779***	0.721**
	(4.59)	(4.10)	(3.56)	(3.27)	(2.93)	(2.57)
Constant	-0.00456	-0.00472	-0.00366	-0.00271	-0.00160	-0.000431
	(-0.29)	(-0.28)	(-0.20)	(-0.14)	(-0.08)	(-0.02)
Observations	156	155	154	153	152	151

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 19: Equation 12. France.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Fran	Exc.ret.t+2.Fra	Exc.ret.t+3.Fra	Exc.ret.t+4.Fra	Exc.ret.t+5.Fra	Exc.ret.t+6.Fra
(r*-r) France	0.915***	0.899***	0.870***	0.858***	0.883***	0.884***
	(17.21)	(11.69)	(8.40)	(6.43)	(5.46)	(4.43)
Constant	0.000382	-0.00129	-0.00256	-0.00343	-0.00478	-0.00484
	(0.07)	(-0.13)	(-0.18)	(-0.19)	(-0.22)	(-0.20)
Observations	162	161	160	159	158	157

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Fra	Exc.ret.t+8.Fra	Exc.ret.t+9.Fra	Exc.ret.t+10.Fra	Exc.ret.t+11.Fra	Exc.ret.t+12.Fra
(r*-r) France	0.881***	0.910***	0.929***	1.018***	1.048***	1.096***
	(3.92)	(3.67)	(3.52)	(3.70)	(3.85)	(4.02)
Constant	-0.00481	-0.00556	-0.00578	-0.00711	-0.00585	-0.00583
	(-0.18)	(-0.19)	(-0.18)	(-0.21)	(-0.17)	(-0.16)
Observations	156	155	154	153	152	151

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 20: Equation 12. Italy.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1)Ita	Exc.ret.t+2.Ita	Exc.ret.t+3.Ita	Exc.ret.t+4.Ita	Exc.ret.t+5.Ita	Exc.ret.t+6.Ita
(r*-r) Italy	0.893***	0.837***	0.784***	0.753***	0.729***	0.689***
	(22.72)	(15.12)	(9.68)	(7.98)	(6.88)	(6.00)
Constant	0.00493	0.00616	0.00762	0.00808	0.00792	0.00933
	(0.90)	(0.67)	(0.60)	(0.51)	(0.41)	(0.43)
Observations	160	159	158	157	156	155

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Ita	Exc.ret.t+8.Ita	Exc.ret.t+9.Ita	Exc.ret.t+10.Ita	Exc.ret.t+11.Ita	Exc.ret.t+12.Ita
(r*-r) Italy	0.645***	0.627***	0.598***	0.599***	0.592***	0.589***
	(5.03)	(4.48)	(4.21)	(4.00)	(3.71)	(3.48)
Constant	0.0116	0.0120	0.0139	0.0131	0.0134	0.0139
	(0.48)	(0.46)	(0.49)	(0.44)	(0.44)	(0.43)
Observations	154	153	152	151	150	149

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 21: Equation 12. Germany.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Germ	Exc.ret.t+2.Ger	Exc.ret.t+3.Ger	Exc.ret.t+4.Ger	Exc.ret.t+5.Ger	Exc.ret.t+6.Ger
(r*-r) Germany	0.919***	0.952***	0.974***	1.005***	1.020***	1.003***
	(15.65)	(9.91)	(7.72)	(6.34)	(5.23)	(4.67)
Constant	-0.00224	-0.000849	0.000324	0.00260	0.00459	0.00615
	(-0.41)	(-0.09)	(0.03)	(0.16)	(0.25)	(0.30)
Observations	162	161	160	159	158	157

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Ger	Exc.ret.t+8.Ger	Exc.ret.t+9.Ger	Exc.ret.t+10.Ger	Exc.ret.t+11.Ger	Exc.ret.t+12.Ger
(r*-r) Germany	1.005***	1.003***	1.000***	1.024***	0.990***	0.967***
	(4.08)	(3.78)	(3.38)	(3.23)	(2.98)	(2.73)
Constant	0.00801	0.00981	0.0117	0.0151	0.0174	0.0195
	(0.36)	(0.41)	(0.47)	(0.58)	(0.63)	(0.68)
Observations	156	155	154	153	152	151

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 22: Equation 12. Japan.

	(1) Exc.ret.(t+1) Jap	(2) Exc.ret.t+2.Jap	(3) Exc.ret.t+3.Jap	(4) Exc.ret.t+4.Jap	(5) Exc.ret.t+5.Jap	(6) Exc.ret.t+6.Jap
(r*-r) Japan	0.604***	0.725***	0.768***	0.746***	0.731***	0.719***
	(5.55)	(6.60)	(6.21)	(4.61)	(4.36)	(4.13)
Constant	-0.0276***	-0.0129	-0.00525	-0.00280	0.000167	0.00450
	(-2.82)	(-0.99)	(-0.32)	(-0.14)	(0.01)	(0.16)
Observations	161	160	159	158	157	156

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+7.Jap	(2) Exc.ret.t+8.Jap	(3) Exc.ret.t+9.Jap	(4) Exc.ret.t+10.Jap	(5) Exc.ret.t+11.Jap	(6) Exc.ret.t+12.Jap
(r*-r) Japan	0.708***	0.642***	0.651***	0.660***	0.576**	0.507+
	(3.81)	(3.36)	(3.17)	(3.02)	(2.48)	(1.96)
Constant	0.00844	0.00778	0.0137	0.0204	0.0196	0.0191
	(0.27)	(0.22)	(0.36)	(0.50)	(0.46)	(0.42)
Observations	155	154	153	152	151	150

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 23: Equation 12. UK.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) UK	Exc.ret.t+2.UK	Exc.ret.t+3.UK	Exc.ret.t+4.UK	Exc.ret.t+5.UK	Exc.ret.t+6.UK
(r*-r) UK	0.762***	0.812***	0.824***	0.831***	0.899***	0.916***
	(8.39)	(7.84)	(6.66)	(6.46)	(6.06)	(5.36)
Constant	0.00692	0.000764	-0.00275	-0.00579	-0.0116	-0.0147
	(0.96)	(0.07)	(-0.21)	(-0.36)	(-0.61)	(-0.68)
Observations	159	158	157	156	155	154

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.UK	Exc.ret.t+8.UK	Exc.ret.t+9.UK	Exc.ret.t+10.UK	Exc.ret.t+11.UK	Exc.ret.t+12.UK
(r*-r) UK	0.912***	0.919***	0.953***	0.981***	0.943***	0.927***
	(4.82)	(4.62)	(4.26)	(4.18)	(3.80)	(3.53)
Constant	-0.0168	-0.0194	-0.0228	-0.0247	-0.0237	-0.0240
	(-0.70)	(-0.74)	(-0.80)	(-0.81)	(-0.72)	(-0.67)
Observations	153	152	151	150	149	148

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix D. Classic and new UIP puzzle with debt variables.

This section estimates both the equations $7, 8, 9, 10, 12$ and equations $7a, 8a, 9a, 10a, 12a$ in which I added debt variables as covariates in a sample of quarterly data between 2000 and 2020. Generally I first estimate equations adding only the relative debt innovations, while in a second round I add to the estimation the total amount of Home government debt (US debt) and Foreign government debt.
The main findings are anticipated here.

First, the real version of Fama regression coefficients are positive, slightly smaller and significant. Foreign debt coefficient is significant and negative only for France and Italy, with a 1 trillion increase effect to -5 % for both.
Second, the level of real exchange rate is positively correlated (but not significant) with real real interest rate differences only until all debt variables are included. Indeed this brings a negative correlation between the level of real exchange rate and real interest rate. All debt variables are significant and Foreign debt has big effects.
Third, the sum of future expected excess currency returns is now negatively correlated with differences in real rates. US debt and Foreign debt have (mostly) significant coefficients, respectively positive and negative. A 1 trillion increase in Foreign debt has an effect between -28 % and -5 %.
Fourth, without debt variables differences in real rates covary (mostly) negatively with far-ahead ex-ante excess currency returns, while adding debt variables creates a positive correlation.
US debt coefficients are all positive and significant, Foreign debt coefficients are all negative and significant.
Fifth, differences in real rates still covary positively with far-ahead ex-post excess currency returns, but they often lose significance. US debt coefficients are significant and positive, Foreign debt coefficients are significant and negative.

In this framework, the debt variable used inside the VECM is $debt_t = \Delta debt_{Home,t} - \Delta debt_{Foreign,t}$ From now on, let's call it *delta* to differentiate it from total debt . This is a relative debt innovation at time t. For the purpose of comparison, a positive shock to this variable is having an effect that is similar to a negative shock to the difference in convenience yields. For example, in the Valchev (2020) framework, a positive shock to delta is a negative shock to $\Psi_h - \Psi_f$. I am not interested in the comparable magnitude of the shock, but on the general intuition of it.

One key dimension of analysis is the comparison between the effect of delta and the effect of total US and foreign debt. Indeed it is interesting to see whether all the signs are coherent with a convenience yield story.

The main results are stated here.

First, in eq. 7a delta's coefficients are negative. This means that real foreign excess currency returns are positively correlated with convenience yields.

Second, when the regression includes all forms of debt, in eq. 7a US debt has (mostly) a positive coefficient, while foreign debt has a negative coefficient. These signs are not consistent with government debt being a unique function of convenience yields.

Third, in eq. 8a delta's coefficients are positive, US debt's coefficients are negative and Foreign debt's ones are positive.

Fourth, in eq. 9a delta's coefficients are positive, US debt's coefficients are positive and Foreign debt's ones are negative. These three coefficients are consistent among themselves.

By using 9a, all three groups of coefficients are consistent between estimation, but they are not consistent with a convenience yield story. Indeed, increase in Home debt implies a decrease in relative convenience yields and this makes the foreign excess currency return to increase, contrary to theory (the reasoning is inverse for foreign debt increases).

Fifth, in eq. 10a delta's coefficients are negative, US debt's coefficients are positive and Foreign debt's ones are negative.

Sixth, in eq. 12a delta's coefficients are positive, US debt's coefficients are positive and Foreign debt's ones are negative.

In the last two points it is clear that US debt and foreign debt are not in line with a convenience yield story.

$$q_{t+1} - q_t + \hat{r}_t^* - \hat{r}_t = \zeta_q + \beta_q(\hat{r}_t^* - \hat{r}_t) + \phi_q debt_t + u_{q,t+1} \tag{7a}$$

For the real version of the Fama regression, coefficients are slightly smaller and positive. Adding debt variables is useful only for France and Italy, with negative coefficients and somewhat significant.

On the first round of estimations, relative debt innovations are not significant, while 1 trillion changes are between - 5 and 0 % effects.

On the second round of estimations, all debt variables are not significant except for Foreign debt for Italy and France. 1 trillion changes have effects between -3 and and 2.2% for relative debt innovations, -0.3 and 1.3 % for US debt and between -5 and -0.5 % for Foreign debt.

Figure 24: Equation 7a. Real Fama regressions with debt.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real.Exc.ret.t+1.Ita	Real.Exc.ret.t+1.Can	Real.Exc.ret.t+1.Ger	Real.Exc.ret.t+1.Fra	Real.Exc.ret.t+1.UK	Real.Exc.ret.t+
(r*-r) Italy	0.807***					
	(3.85)					
(r*-r) Canada		0.634***				
		(5.17)				
(r*-r) Germany			0.778***			
			(3.84)			
(r*-r) France				0.791***		
				(3.85)		
(r*-r) UK					0.546+	
					(1.96)	
(r*-r) Japan						0.656***
						(4.44)
Constant	0.00254	0.00345	0.00184	0.00192	0.00455	-0.0251+
	(0.26)	(0.36)	(0.19)	(0.20)	(0.51)	(-1.98)
Observations	76	87	76	76	76	85

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 25: Equation 7a. Real Fama regressions with debt.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real.Exc.ret.t+1.Ita	Real.Exc.ret.t+1.Can	Real.Exc.ret.t+1.Ger	Real.Exc.ret.t+1.Fra	Real.Exc.ret.t+1.UK	Real.Exc.ret.t+1.Jap
(r*-r) Italy	0.849***					
	(3.99)					
Rel.debt.innov.Ita	-0.0000367					
	(-1.42)					
(r*-r) Canada		0.636***				
		(5.10)				
Rel.debt.innov.Can		-0.00000336				
		(-0.12)				
(r*-r) Germany			0.822***			
			(4.07)			
Rel.debt.innov.Ger			-0.0000459			
			(-1.64)			
(r*-r) France				0.822***		
				(3.95)		
Rel.debt.innov.Fra				-0.0000343		
				(-1.33)		
(r*-r) UK					0.545+	
					(1.96)	
Rel.debt.innov.UK					-0.0000277	
					(-1.43)	
(r*-r) Japan						0.699***
						(4.46)
Rel.debt.innov.Jap						-0.0000244
						(-1.54)
Constant	0.0104	0.00406	0.0117	0.00899	0.0101	-0.0194
	(0.82)	(0.33)	(0.92)	(0.71)	(1.03)	(-1.62)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 26: Equation 7a. Real Fama regressions with debt.

	(1) Real.Exc.ret.t+1.Ita	(2) Real.Exc.ret.t+1.Can	(3) Real.Exc.ret.t+1.Ger	(4) Real.Exc.ret.t+1.Fra	(5) Real.Exc.ret.t+1.UK	(6) Real.Exc.ret.t+1.Jap
(r*-r) Italy	0.667***					
	(3.41)					
Rel.debt.innov.Ita	-0.00000818					
	(-0.34)					
Debt.US	-0.000000614	-0.00000186	-0.00000182	0.00000131	-0.00000220	0.00000299
	(-0.27)	(-0.58)	(-0.89)	(0.42)	(-0.52)	(0.81)
Debt.Ita	-0.0000520**					
	(-2.37)					
(r*-r) Canada		0.635***				
		(5.48)				
Rel.debt.innov.Can		0.0000221				
		(0.66)				
Debt.Can		-0.0000234				
		(-0.46)				
(r*-r) Germany			0.681***			
			(3.18)			
Rel.debt.innov.Ger			-0.0000170			
			(-0.60)			
Debt.Ger			-0.0000309+			
			(-1.85)			
(r*-r) France				0.657***		
				(3.26)		
Rel.debt.innov.Fra				-0.00000587		
				(-0.24)		
Debt.Fra				-0.0000527**		
				(-2.20)		
(r*-r) UK					0.230	
					(0.97)	
Rel.debt.innov.UK					-0.00000136	
					(-0.06)	
Debt.UK					-0.0000325	
					(-1.05)	
(r*-r) Japan						0.702***
						(4.63)
Rel.debt.innov.Jap						-0.0000287
						(-1.56)
Debt.Jap						-0.00000538
						(-0.51)
Constant	0.134***	0.0441	0.0976***	0.0928***	0.0928***	-0.00988
	(3.47)	(1.46)	(3.15)	(3.56)	(4.99)	(-0.18)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$q_t = \zeta_Q + \beta_Q(\hat{r}_t^* - \hat{r}_t) + \phi_Q debt_t + u_{Q,t+1} \tag{8a}$$

Coefficients are halved with respect to the estimation without debt. They are positive and they lose significance (except for UK).

On the first round of estimation, β_Qs remain positive and relative debt innovations are not significant except for UK. A 1 trillion change has effects between -24 % (UK) and 29 % (Canada).

On the second round of estimations, β_Qs become negative and coefficients for all debt variables are significant. Relative debt innovations have positive coefficients, US debt has negative coefficients (except Uk and Japan) and Foreign debt has big and positive coefficients. A 1 trillion change in Foreign debt has effects between 22 % and 263 % .

Figure 27: Equation 8.

	(1)	(2)	(3)	(4)	(5)	(6)
	Real ER Italy	Real ER Canada	Real ER Germany	Real ER France	Real ER UK	Real ER Japan
(r*-r) Italy	0.715					
	(0.88)					
(r*-r) Canada		0.728				
		(1.55)				
(r*-r) Germany			0.745			
			(0.96)			
(r*-r) France				0.790		
				(0.95)		
(r*-r) UK					2.023***	
					(3.85)	
(r*-r) Japan						0.573
						(1.11)
Constant	0.254***	-0.160**	0.272***	0.275***	0.385***	-4.346***
	(4.58)	(-2.04)	(5.12)	(4.92)	(7.53)	(-55.02)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 28: Equation 8a.

	(1) Real ER Italy	(2) Real ER Canada	(3) Real ER Germany	(4) Real ER France	(5) Real ER UK	(6) Real ER Japan
(r*-r) Italy	0.644					
	(0.69)					
Rel.debt.innov.Ita	0.0000617					
	(0.46)					
(r*-r) Canada		0.494				
		(1.09)				
Rel.debt.innov.Can		0.000294				
		(1.47)				
(r*-r) Germany			0.708			
			(0.82)			
Rel.debt.innov.Ger			0.0000388			
			(0.30)			
(r*-r) France				0.738		
				(0.81)		
Rel.debt.innov.Fra				0.0000569		
				(0.43)		
(r*-r) UK					2.010***	
					(4.09)	
Rel.debt.innov.UK					-0.000242**	
					(-2.32)	
(r*-r) Japan						0.727
						(1.35)
Rel.debt.innov.Jap						-0.0000893
						(-1.66)
Constant	0.241***	-0.213**	0.263***	0.263***	0.433***	-4.325***
	(3.16)	(-2.37)	(3.54)	(3.52)	(6.75)	(-51.43)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 29: Equation 8a.

	(1) Real ER Italy	(2) Real ER Canada	(3) Real ER Germany	(4) Real ER France	(5) Real ER UK	(6) Real ER Japan
(r*-r) Italy	-0.222					
	(-1.15)					
Rel.debt.innov.Ita	0.0000923**					
	(2.30)					
Debt.US	-0.0000546***	-0.000135***	-0.0000437***	-0.000101***	-0.000106***	-0.0000884***
	(-13.91)	(-11.23)	(-11.97)	(-15.17)	(-6.71)	(-17.58)
Debt.Ita	0.000734***					
	(16.82)					
(r*-r) Canada		-0.532**				
		(-2.15)				
Rel.debt.innov.Can		0.000244***				
		(5.22)				
Debt.Can		0.00263***				
		(11.65)				
(r*-r) Germany			-0.849***			
			(-3.92)			
Rel.debt.innov.Ger			0.000105***			
			(2.88)			
Debt.Ger			0.000542***			
			(12.96)			
(r*-r) France				-0.682***		
				(-3.52)		
Rel.debt.innov.Fra				0.000116***		
				(3.14)		
Debt.Fra				0.000882***		
				(15.07)		
(r*-r) UK					0.135	
					(0.33)	
Rel.debt.innov.UK					0.00000984	
					(0.15)	
Debt.UK					0.000603***	
					(5.62)	
(r*-r) Japan						-0.197
						(-0.83)
Rel.debt.innov.Jap						0.0000413
						(1.57)
Debt.Jap						0.000218***
						(11.95)
Constant	-0.832***	-1.229***	-0.454***	-0.292***	0.746***	-5.140***
	(-11.81)	(-9.99)	(-6.23)	(-5.13)	(7.03)	(-40.05)
Observations	76	87	76	76	76	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$\hat{E}_t \sum_{j=0}^{\infty} (\rho_{t+j+1} - \bar{\rho}) = \zeta_\rho + \beta_\rho (\hat{r}_t^* - \hat{r}_t) + \phi_\rho debt_t + u_{\rho,t} \tag{9a}$$

Coefficients β_ρ are negative and somewhat significant (except for Canada, Japan). Adding debt variables makes β_ρs not significant, but still negative.

US debt's coefficients are positive, strongly significant for Canada, Japan and France, less for UK, no for Germany and Italy. Foreign debt's coefficients are all negative and significant. 1 trillion change in US debt has an effect between 0.4 and 2 % . 1 trillion change in Foreign debt has an effect between -28 and -5 % .

Figure 30: Equation 9a.

	(1) Sum.exp.exc.ret.Can	(2) Sum.exp.exc.ret.Can
(r*-r) Canada	0.0624	0.136
	(0.84)	(1.58)
Rel.debt.innov.Can		0.0000457
		(1.18)
Debt.US		0.0000146^{***}
		(4.03)
Debt.Can		-0.000276^{***}
		(-5.37)
Constant	-0.00646	0.0875^{***}
	(-0.69)	(4.03)
Observations	87	87

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Sum.exp.exc.ret.Fra	(2) Sum.exp.exc.ret.Fra
(r*-r) France	-0.501^{***}	-0.386^{+}
	(-2.82)	(-1.74)
Rel.debt.innov.Fra		0.0000455
		(1.54)
Debt.US		0.0000154^{***}
		(3.73)
Debt.Fra		-0.000148^{***}
		(-3.88)
Constant	-0.0258^{**}	0.0752
	(-2.18)	(1.57)
Observations	76	76

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 31: Equation 9a.

	(1) Sum.exp.exc.ret.Ger	(2) Sum.exp.exc.ret.Ger
(r*-r) Germany	-0.462**	-0.394
	(-2.58)	(-1.64)
Rel.debt.innov.Ger		0.0000548+
		(1.99)
Debt.US		0.00000434+
		(1.68)
Debt.Ger		-0.0000833***
		(-3.19)
Constant	-0.0288**	0.0962+
	(-2.46)	(1.67)
Observations	76	76

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Sum.exp.exc.ret.Ita	(2) Sum.exp.exc.ret.Ita
(r*-r) Italy	-0.430**	-0.444+
	(-2.45)	(-1.92)
Rel.debt.innov.Ita		0.0000581**
		(2.01)
Debt.US		0.00000583+
		(1.98)
Debt.Ita		-0.0000934***
		(-2.82)
Constant	-0.0147	0.122+
	(-1.26)	(1.78)
Observations	76	76

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 32: Equation 9a.

	(1)	(2)
	Sum.exp.exc.ret.Jap	Sum.exp.exc.ret.Jap
(r*-r) Japan	-0.286^{+}	-0.106
	(-1.74)	(-0.71)
Rel.debt.innov.Jap		0.0000314**
		(2.51)
Debt.US		0.0000180***
		(5.88)
Debt.Jap		-0.0000511***
		(-7.54)
Constant	-0.0469**	0.166***
	(-2.48)	(3.37)
Observations	85	85

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)
	Sum.exp.exc.ret.UK	Sum.exp.exc.ret.UK
(r*-r) UK	-0.306***	-0.252
	(-2.66)	(-1.64)
Rel.debt.innov.UK		0.0000514
		(1.22)
Debt.US		0.0000154**
		(2.41)
Debt.UK		-0.000123***
		(-2.76)
Constant	-0.00395	-0.00258
	(-0.34)	(-0.09)
Observations	76	76

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$\hat{E}_t(\rho_{t+j}) = \zeta_{10a} + \beta_{10a}(\hat{r}_t^* - \hat{r}_t) + \phi_j debt_t + u_t^j \tag{10a}$$

In the above equation, I computed the LHS by using an in-sample dynamic forecast. This forecast has been repeated for 3 time spans: post 2005 (columns 1 and 2), post 2010 (columns 3 and 4) and post 2015 (columns 5 and 6), in order to have different subsamples of data considered. This equation give betas that are a weighted average of the set of betas shown by Engel. Consider that here I use different time spans respect to the 3 variable VECM, hence comparison is more tricky.

Comparing equations 10 and 10a, β_{10a} go from mixed (both in sign and significance) to strongly positive and significant. US debt's coefficients are always positive and significant, while Foreign debt's coefficients are negative and significant. Only for Italy, Japan and UK the delta- variables have some significance (they are positive).

In terms of magnitude of coefficients, 1 trillion change has single digit percentage effects on the dependent variables for relative debt innovations and US debt, while has a double digit percentage effect for Foreign debt.

Figure 33: Equation 10a. Canada.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Can	Exp.exc.ret.post2005.Can	Exp.exc.ret.post2010.Can	Exp.exc.ret.post2010.Can	Exp.exc.ret.post2015.Can	Exp.exc.ret.post2015.Can
(r*-r) Canada	0.0206		-0.207		0.186^{**}	
	(0.12)		(-1.01)		(2.08)	
(i*-i) Canada		-0.963		-4.686^{***}		-0.404
		(-0.70)		(-4.58)		(-0.58)
Constant	-0.0130	-0.00774	0.157^{***}	0.197^{***}	0.0333^{***}	0.0347^{***}
	(-0.41)	(-0.24)	(4.30)	(7.22)	(3.12)	(3.12)
Observations	63	64	43	44	23	24

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Can	Exp.exc.ret.post2005.Can	Exp.exc.ret.post2010.Can	Exp.exc.ret.post2010.Can	Exp.exc.ret.post2015.Can	Exp.exc.ret.post2015.Can
(r*-r) Canada	0.313^{***}		0.303^{***}		0.308^{***}	
	(4.02)		(3.59)		(3.84)	
Rel.debt.innov.Can	-0.0000279	-0.0000310	-0.0000647^{***}	-0.0000484^{**}	-0.0000348^{+}	-0.0000111
	(-0.89)	(-1.26)	(-3.60)	(-2.71)	(-1.77)	(-0.49)
Debt.US	0.0000526^{***}	0.0000556^{***}	0.0000514^{***}	0.0000548^{***}	0.0000316^{***}	0.0000306^{***}
	(15.84)	(18.70)	(18.88)	(16.65)	(6.77)	(6.33)
Debt.Can	-0.000739^{***}	-0.000818^{***}	-0.000646^{***}	-0.000704^{***}	-0.000584^{***}	-0.000486^{***}
	(-11.73)	(-12.57)	(-9.06)	(-9.49)	(-6.20)	(-3.92)
(i*-i) Canada		1.211^{***}		1.117^{**}		0.683^{+}
		(4.40)		(2.53)		(1.87)
Constant	0.101^{**}	0.149^{***}	0.152^{+}	0.161^{**}	0.204^{**}	0.0926
	(2.17)	(3.21)	(1.98)	(2.49)	(2.82)	(0.76)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 34: Equation 10a. France.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2015.Fra	Exp.exc.ret.post2015.Fra
(r*-r) France	-0.591^{+}		-1.045***		0.313	
	(-1.87)		(-5.66)		(0.86)	
(i*-i) France		-0.860^{+}		-1.561***		0.602
		(-1.87)		(-3.48)		(1.53)
Constant	0.0509**	0.0492**	0.0850***	0.0766***	0.00238	0.0155
	(2.22)	(2.19)	(3.69)	(3.13)	(0.09)	(0.71)
Observations	63	65	43	45	23	25

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2005.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2010.Fra	Exp.exc.ret.post2015.Fra	Exp.exc.ret.post2015.Fra
(r*-r) France	0.888***		0.748***		0.726***	
	(5.13)		(5.35)		(4.69)	
Rel.debt.innov.Fra	-0.0000236	-0.0000183	-0.0000716***	-0.0000455***	-0.0000509***	-0.0000314**
	(-0.66)	(-0.74)	(-6.58)	(-3.10)	(-3.80)	(-2.13)
Debt.US	0.0000527***	0.0000561***	0.0000499***	0.0000489***	0.0000380***	0.0000342***
	(11.50)	(17.14)	(17.56)	(9.36)	(7.38)	(10.99)
Debt.Fra	-0.000381***	-0.000408***	-0.000434***	-0.000392***	-0.000402***	-0.000340***
	(-11.63)	(-13.91)	(-13.27)	(-12.30)	(-13.84)	(-10.09)
(i*-i) France		1.279***		0.826**		0.770***
		(8.53)		(2.48)		(4.96)
Constant	0.204***	0.226***	0.396***	0.303***	0.345***	0.257**
	(8.15)	(7.91)	(6.23)	(3.60)	(5.05)	(2.74)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 35: Equation 10a. Germany.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Ger	Exp.exc.ret.post2005.Ger	Exp.exc.ret.post2010.Ger	Exp.exc.ret.post2010.Ger	Exp.exc.ret.post2015.Ger	Exp.exc.ret.post2015.Ger
(r*-r) Germany	-0.601^{+}		-1.061***		0.273	
	(-1.87)		(-5.67)		(0.78)	
(i*-i) Germany		-0.873^{+}		-1.607***		0.591
		(-1.84)		(-3.51)		(1.54)
Constant	0.0552**	0.0536**	0.0753***	0.0664***	0.00218	0.0167
	(2.36)	(2.36)	(3.23)	(2.70)	(0.09)	(0.80)
Observations	63	65	43	45	23	25

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Ger	Exp.exc.ret.post2005.Ger	Exp.exc.ret.post2010.Ger	Exp.exc.ret.post2010.Ger	Exp.exc.ret.post2015.Ger	Exp.exc.ret.post2015.Ger
(r*-r) Germany	0.833***		1.034***		0.916***	
	(3.55)		(4.38)		(3.60)	
Rel.debt.innov.Ger	-0.0000131	-0.0000171	-0.0000665***	-0.0000362**	-0.0000141	-0.00000471
	(-0.34)	(-0.65)	(-3.57)	(-2.11)	(-0.81)	(-0.21)
Debt.US	0.0000275***	0.0000310***	0.0000256***	0.0000409***	-0.00000887	0.0000101**
	(8.29)	(10.89)	(5.86)	(8.03)	(-1.30)	(2.26)
Debt.Ger	-0.000216***	-0.000267***	-0.000238***	-0.000287***	-0.000421***	-0.000326***
	(-6.63)	(-9.40)	(-5.38)	(-9.26)	(-9.45)	(-7.44)
(i*-i) Germany		1.522***		2.707***		1.742***
		(5.15)		(6.37)		(9.48)
Constant	0.235***	0.324***	0.331**	0.232**	1.227***	0.674***
	(4.04)	(5.94)	(2.17)	(2.55)	(8.01)	(3.97)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 36: Equation 10a-11a. Italy.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Ita	Exp.exc.ret.post2005.Ita	Exp.exc.ret.post2010.Ita	Exp.exc.ret.post2010.Ita	Exp.exc.ret.post2015.Ita	Exp.exc.ret.post2015.Ita
(r*-r) Italy	-0.607^{+}		-1.055***		0.372	
	(-1.93)		(-5.57)		(1.23)	
(i*-i) Italy		-0.883^{+}		-1.577***		0.698^{+}
		(-1.91)		(-3.73)		(1.95)
Constant	0.0625***	0.0606***	0.0867***	0.0780***	-0.0114	0.00335
	(2.71)	(2.68)	(4.11)	(3.41)	(-0.50)	(0.17)
Observations	63	65	43	45	23	25

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Ita	Exp.exc.ret.post2005.Ita	Exp.exc.ret.post2010.Ita	Exp.exc.ret.post2010.Ita	Exp.exc.ret.post2015.Ita	Exp.exc.ret.post2015.Ita
(r*-r) Italy	0.767***		0.752***		0.661***	
	(4.36)		(4.59)		(3.62)	
Rel.debt.innov.Ita	-0.0000296	-0.0000178	-0.0000748***	-0.0000432**	-0.0000389**	-0.0000197
	(-0.76)	(-0.68)	(-4.83)	(-2.71)	(-2.13)	(-1.08)
Debt.US	0.0000351***	0.0000360***	0.0000363***	0.0000367***	0.0000192***	0.0000213***
	(10.89)	(19.03)	(13.42)	(6.19)	(4.46)	(5.17)
Debt.Ita	-0.000350***	-0.000357***	-0.000380***	-0.000339***	-0.000351***	-0.000288***
	(-10.73)	(-15.34)	(-9.95)	(-9.31)	(-8.23)	(-6.01)
(i*-i) Italy		1.000***		0.837^{+}		0.920***
		(4.74)		(2.00)		(3.46)
Constant	0.497***	0.505***	0.559***	0.435***	0.583***	0.385**
	(9.69)	(11.27)	(5.82)	(3.84)	(7.01)	(2.44)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 37: Equation 10a. Japan.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Jap	Exp.exc.ret.post2005.Jap	Exp.exc.ret.post2010.Jap	Exp.exc.ret.post2010.Jap	Exp.exc.ret.post2015.Jap	Exp.exc.ret.post2015.Jap
(r*-r) Japan	-0.248		-0.589***		0.462	
	(-1.03)		(-2.97)		(1.70)	
(i*-i) Japan		-0.396		-2.014**		1.868***
		(-0.78)		(-2.07)		(4.20)
Constant	-0.108**	-0.114**	0.123***	0.0915	-0.0896***	-0.0364
	(-2.63)	(-2.18)	(2.95)	(1.64)	(-3.35)	(-1.30)
Observations	63	64	43	44	23	24

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.Jap	Exp.exc.ret.post2005.Jap	Exp.exc.ret.post2010.Jap	Exp.exc.ret.post2010.Jap	Exp.exc.ret.post2015.Jap	Exp.exc.ret.post2015.Jap
(r*-r) Japan	0.370***		0.401***		0.250**	
	(2.88)		(4.12)		(2.69)	
Rel.debt.innov.Jap	-0.0000128	-0.00000569	-0.0000195	-0.0000114	-0.0000154**	-0.00000438
	(-1.03)	(-0.53)	(-1.40)	(-1.45)	(-2.52)	(-0.72)
Debt.US	0.0000368***	0.0000362***	0.0000373***	0.0000486***	0.00000802	0.00000826**
	(11.83)	(12.47)	(9.43)	(13.06)	(1.67)	(2.74)
Debt.Jap	-0.000110***	-0.000112***	-0.000108***	-0.000101***	-0.000109***	-0.0000928***
	(-12.29)	(-12.73)	(-10.05)	(-19.09)	(-14.89)	(-9.79)
(i*-i) Japan		0.569**		1.888***		0.652***
		(2.44)		(6.93)		(4.90)
Constant	0.405***	0.439***	0.613***	0.383***	0.812***	0.664***
	(5.03)	(4.94)	(4.39)	(4.44)	(13.30)	(11.60)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 38: Equation 10a. UK.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.UK	Exp.exc.ret.post2005.UK	Exp.exc.ret.post2010.UK	Exp.exc.ret.post2010.UK	Exp.exc.ret.post2015.UK	Exp.exc.ret.post2015.UK
(r*-r) UK	-0.373^{+}		-0.448**		-0.184	
	(-1.98)		(-2.38)		(-0.77)	
(i*-i) UK		-0.688^{+}		-1.375***		-0.433
		(-1.91)		(-4.00)		(-0.74)
Constant	0.131***	0.134***	0.0177	0.0121	0.0488**	0.0442^{+}
	(6.76)	(7.06)	(1.21)	(0.90)	(2.72)	(1.74)
Observations	63	64	43	44	23	24

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp.exc.ret.post2005.UK	Exp.exc.ret.post2005.UK	Exp.exc.ret.post2010.UK	Exp.exc.ret.post2010.UK	Exp.exc.ret.post2015.UK	Exp.exc.ret.post2015.UK
(r*-r) UK	0.236		0.196		0.379***	
	(1.36)		(1.20)		(3.39)	
Rel.debt.innov.UK	0.0000659	0.0000485	-0.0000286	-0.0000367	0.00000473	-0.00000810
	(1.26)	(1.03)	(-1.68)	(-1.61)	(0.17)	(-0.23)
Debt.US	0.0000311***	0.0000391***	0.0000277***	0.0000417***	0.00000700^{+}	0.0000120***
	(3.70)	(4.44)	(5.53)	(3.59)	(1.99)	(2.99)
Debt.UK	-0.000172***	-0.000200***	-0.000237***	-0.000307***	-0.000438***	-0.000385***
	(-3.38)	(-3.88)	(-5.41)	(-4.69)	(-6.80)	(-6.10)
(i*-i) UK		1.105***		1.640^{+}		0.600**
		(3.05)		(1.90)		(2.33)
Constant	0.00228	-0.0609	0.0936^{+}	0.0292	0.963***	0.753***
	(0.04)	(-1.21)	(1.71)	(0.47)	(5.13)	(4.31)
Observations	63	63	43	43	23	23

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$\rho_{t+j} = \zeta_j + \beta_j(\hat{r}_t^* - \hat{r}_t) + \phi_j debt_t + u_t^j \tag{12a}$$

Comparing 12 and 12a for the first 12 quarters, the β_js coefficients are still positive, but lose a lot of significance in the 4 variable VECM. Adding debt variables, β_js coefficients gain back some significance. US debt's coefficients are positive (not significant only for Italy), Foreign debt's coefficients are negative. Relative debt innovations' coefficients are only significant and positive for Canada and UK.

In terms of magnitude, 1 trillion change in relative debt innovations and US debt has a single digit percentage effect, while the effect of Foreign debt range from decimal percentage to double digit percentage.

Figure 39: Equation 12. Canada.

	(1) Exc.ret.(t+1) Can	(2) Exc.ret.t+2.Can	(3) Exc.ret.t+3.Can	(4) Exc.ret.t+4.Can	(5) Exc.ret.t+5.Can	(6) Exc.ret.t+6.Can
(r*-r) Canada	0.193**	0.102	0.189	0.136	0.155	0.335**
	(2.02)	(0.89)	(1.33)	(0.88)	(1.01)	(2.05)
Constant	0.00530	0.00675	0.00760	0.00974	0.0113	0.0117
	(0.87)	(0.71)	(0.59)	(0.60)	(0.58)	(0.53)
Observations	87	86	85	84	83	82

t statistics in parentheses

$^+$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+7.Can	(2) Exc.ret.t+8.Can	(3) Exc.ret.t+9.Can	(4) Exc.ret.t+10.Can	(5) Exc.ret.t+11.Can	(6) Exc.ret.t+12.Can
(r*-r) Canada	0.197	0.200	0.146	0.216	0.209	0.220
	(1.06)	(0.91)	(0.65)	(0.95)	(0.94)	(0.98)
Constant	0.0142	0.0161	0.0187	0.0209	0.0240	0.0269
	(0.57)	(0.59)	(0.63)	(0.65)	(0.70)	(0.73)
Observations	81	80	79	78	77	76

t statistics in parentheses

$^+$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 40: Equation 12a. Canada.

	(1) Exc.ret.(t+1) Can	(2) Exc.ret.t+2.Can	(3) Exc.ret.t+3.Can
(r*-r) Canada	0.161	0.0585	0.184
	(1.62)	(0.57)	(1.38)
Rel.debt.innov.Can	0.0000590**	0.000109***	0.0000949**
	(2.40)	(3.02)	(2.33)
Debt.Can	-0.0000212	-0.0000744	-0.000136+
	(-0.52)	(-1.16)	(-1.76)
Debt.US	-0.000000793	0.000000299	0.00000289
	(-0.33)	(0.08)	(0.61)
Constant	0.0248	0.0572+	0.0914**
	(1.09)	(1.79)	(2.27)
Observations	87	86	85

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+4.Can	(2) Exc.ret.t+5.Can	(3) Exc.ret.t+6.Can
(r*-r) Canada	0.162	0.198	0.403***
	(1.22)	(1.54)	(2.95)
Rel.debt.innov.Can	0.000113**	0.000153***	0.000176***
	(2.54)	(2.89)	(3.25)
Debt.Can	-0.000231**	-0.000295***	-0.000371***
	(-2.33)	(-2.70)	(-3.31)
Debt.US	0.00000724	0.00000909	0.0000117+
	(1.19)	(1.38)	(1.72)
Constant	0.134***	0.169***	0.209***
	(2.73)	(3.10)	(3.60)
Observations	84	83	82

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 41: Equation 12a. Canada.

	(1) Exc.ret.t+7.Can	(2) Exc.ret.t+8.Can	(3) Exc.ret.t+9.Can
(r*-r) Canada	0.293**	0.332+	0.314**
	(2.07)	(1.94)	(2.08)
Rel.debt.innov.Can	0.000169***	0.000174***	0.000191***
	(3.17)	(2.83)	(2.84)
Debt.Can	-0.000428***	-0.000514***	-0.000588***
	(-3.93)	(-4.58)	(-5.08)
Debt.US	0.0000142**	0.0000179***	0.0000206***
	(2.30)	(2.90)	(3.26)
Constant	0.241***	0.282***	0.323***
	(3.65)	(4.01)	(4.34)
Observations	81	80	79

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+10.Can	(2) Exc.ret.t+11.Can	(3) Exc.ret.t+12.Can
(r*-r) Canada	0.430***	0.500***	0.527***
	(3.09)	(3.55)	(3.54)
Rel.debt.innov.Can	0.000193***	0.000153**	0.000146**
	(2.82)	(2.42)	(2.48)
Debt.Can	-0.000668***	-0.000728***	-0.000770***
	(-6.27)	(-6.40)	(-6.68)
Debt.US	0.0000245***	0.0000270***	0.0000282***
	(4.45)	(4.64)	(4.87)
Constant	0.359***	0.398***	0.428***
	(4.75)	(4.95)	(5.21)
Observations	78	77	76

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 42: Equation 12. France.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Fran	Exc.ret.t+2.Fra	Exc.ret.t+3.Fra	Exc.ret.t+4.Fra	Exc.ret.t+5.Fra	Exc.ret.t+6.Fra
(r*-r) France	0.618***	0.556**	0.615**	0.703**	0.795**	0.745+
	(3.60)	(2.22)	(2.23)	(2.26)	(2.27)	(1.88)
Constant	0.000155	0.00292	0.00702	0.0110	0.0140	0.0158
	(0.02)	(0.22)	(0.41)	(0.54)	(0.61)	(0.62)
Observations	76	76	75	74	73	72

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Fra	Exc.ret.t+8.Fra	Exc.ret.t+9.Fra	Exc.ret.t+10.Fra	Exc.ret.t+11.Fra	Exc.ret.t+12.Fra
(r*-r) France	0.665	0.725	0.723	0.796+	0.901**	0.929**
	(1.49)	(1.48)	(1.49)	(1.76)	(2.17)	(2.13)
Constant	0.0166	0.0177	0.0183	0.0192	0.0199	0.0205
	(0.60)	(0.61)	(0.60)	(0.61)	(0.62)	(0.62)
Observations	71	70	69	68	67	66

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 43: Equation 12a. France.

	(1)	(2)	(3)
	Exc.ret.(t+1) Fran	Exc.ret.t+2.Fra	Exc.ret.t+3.Fra
(r*-r) France	0.490**	0.360	0.420**
	(2.58)	(1.55)	(2.07)
Rel.debt.innov.Fra	0.0000138	0.0000436	0.0000419
	(0.47)	(0.94)	(0.77)
Debt.Fra	-0.0000573**	-0.000118***	-0.000180***
	(-2.47)	(-3.27)	(-4.37)
Debt.US	0.00000218	0.00000630	0.0000114**
	(0.70)	(1.38)	(2.05)
Constant	0.0856***	0.155***	0.222***
	(3.69)	(4.46)	(6.13)
Observations	76	76	75

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+4.Fra	Exc.ret.t+5.Fra	Exc.ret.t+6.Fra
(r*-r) France	0.513**	0.609***	0.538**
	(2.50)	(2.83)	(2.61)
Rel.debt.innov.Fra	0.0000426	0.0000311	0.0000260
	(0.94)	(0.77)	(0.67)
Debt.Fra	-0.000236***	-0.000267***	-0.000291***
	(-5.32)	(-5.71)	(-5.96)
Debt.US	0.0000162***	0.0000189***	0.0000198***
	(2.66)	(3.17)	(3.24)
Constant	0.279***	0.315***	0.354***
	(7.47)	(7.58)	(8.05)
Observations	74	73	72

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 44: Equation 12a. France.

	(1)	(2)	(3)
	Exc.ret.t+7.Fra	Exc.ret.t+8.Fra	Exc.ret.t+9.Fra
(r*-r) France	0.452^{+}	0.478^{+}	0.468
	(1.95)	(1.80)	(1.61)
Rel.debt.innov.Fra	0.0000226	0.0000488	0.0000540
	(0.55)	(1.05)	(1.00)
Debt.Fra	-0.000319***	-0.000358***	-0.000377***
	(-6.48)	(-7.69)	(-7.89)
Debt.US	0.0000217***	0.0000252***	0.0000263***
	(3.46)	(4.33)	(4.40)
Constant	0.388***	0.421***	0.444***
	(8.63)	(9.20)	(9.31)
Observations	71	70	69

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+10.Fra	Exc.ret.t+11.Fra	Exc.ret.t+12.Fra
(r*-r) France	0.582**	0.760***	0.871***
	(2.11)	(2.93)	(3.76)
Rel.debt.innov.Fra	0.0000455	0.0000157	-0.00000488
	(0.81)	(0.33)	(-0.12)
Debt.Fra	-0.000397***	-0.000396***	-0.000396***
	(-8.27)	(-7.92)	(-8.35)
Debt.US	0.0000282***	0.0000283***	0.0000279***
	(4.77)	(4.77)	(5.07)
Constant	0.463***	0.465***	0.472***
	(9.53)	(9.53)	(9.99)
Observations	68	67	66

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 45: Equation 12. Germany.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Germ	Exc.ret.t+2.Ger	Exc.ret.t+3.Ger	Exc.ret.t+4.Ger	Exc.ret.t+5.Ger	Exc.ret.t+6.Ger
(r*-r) Germany	0.609***	0.558**	0.605**	0.697**	0.786**	0.738+
	(3.59)	(2.27)	(2.20)	(2.25)	(2.28)	(1.90)
Constant	0.0000944	0.00298	0.00694	0.0109	0.0140	0.0158
	(0.01)	(0.23)	(0.40)	(0.53)	(0.61)	(0.63)
Observations	76	76	75	74	73	72

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Ger	Exc.ret.t+8.Ger	Exc.ret.t+9.Ger	Exc.ret.t+10.Ger	Exc.ret.t+11.Ger	Exc.ret.t+12.Ger
(r*-r) Germany	0.649	0.710	0.701	0.777+	0.871**	0.907**
	(1.48)	(1.47)	(1.47)	(1.76)	(2.13)	(2.12)
Constant	0.0165	0.0177	0.0183	0.0192	0.0199	0.0204
	(0.60)	(0.61)	(0.60)	(0.61)	(0.62)	(0.62)
Observations	71	70	69	68	67	66

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 46: Equation 12a. Germany.

	(1) Exc.ret.(t+1) Germ	(2) Exc.ret.t+2.Ger	(3) Exc.ret.t+3.Ger
(r*-r) Germany	0.471**	0.351	0.392+
	(2.31)	(1.44)	(1.87)
Rel.debt.innov.Ger	0.00000981	0.0000418	0.0000455
	(0.32)	(0.88)	(0.84)
Debt.Ger	-0.0000269	-0.0000624**	-0.0000999***
	(-1.61)	(-2.41)	(-3.14)
Debt.US	-0.00000222	-0.00000234	-0.00000158
	(-1.04)	(-0.81)	(-0.44)
Constant	0.0858***	0.164***	0.243***
	(3.00)	(3.73)	(4.94)
Observations	76	76	75

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+4.Ger	(2) Exc.ret.t+5.Ger	(3) Exc.ret.t+6.Ger
(r*-r) Germany	0.490**	0.611**	0.548**
	(2.41)	(2.65)	(2.38)
Rel.debt.innov.Ger	0.0000502	0.0000345	0.0000288
	(1.17)	(0.93)	(0.86)
Debt.Ger	-0.000135***	-0.000159***	-0.000178***
	(-3.84)	(-4.28)	(-4.59)
Debt.US	-0.000000445	0.000000808	0.000000693
	(-0.11)	(0.20)	(0.16)
Constant	0.313***	0.359***	0.406***
	(5.99)	(6.31)	(6.71)
Observations	74	73	72

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 47: Equation 12a. Germany.

	(1)	(2)	(3)
	Exc.ret.t+7.Ger	Exc.ret.t+8.Ger	Exc.ret.t+9.Ger
(r*-r) Germany	0.451^{+}	0.470	0.430
	(1.74)	(1.58)	(1.41)
Rel.debt.innov.Ger	0.0000251	0.0000523	0.0000654
	(0.65)	(1.05)	(1.18)
Debt.Ger	-0.000197***	-0.000225***	-0.000243***
	(-4.92)	(-5.54)	(-5.79)
Debt.US	0.000000995	0.00000228	0.00000282
	(0.22)	(0.52)	(0.61)
Constant	0.448***	0.492***	0.526***
	(7.06)	(7.51)	(7.77)
Observations	71	70	69

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+10.Ger	Exc.ret.t+11.Ger	Exc.ret.t+12.Ger
(r*-r) Germany	0.535^{+}	0.719***	0.822***
	(1.96)	(2.73)	(3.69)
Rel.debt.innov.Ger	0.0000589	0.0000272	0.00000566
	(1.07)	(0.60)	(0.16)
Debt.Ger	-0.000262***	-0.000269***	-0.000279***
	(-6.11)	(-6.58)	(-7.52)
Debt.US	0.00000426	0.00000568	0.00000662^{+}
	(0.92)	(1.38)	(1.85)
Constant	0.553***	0.560***	0.575***
	(8.12)	(8.52)	(9.52)
Observations	68	67	66

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 48: Equation 12. Italy.

	(1) Exc.ret.(t+1)Ita	(2) Exc.ret.t+2.Ita	(3) Exc.ret.t+3.Ita	(4) Exc.ret.t+4.Ita	(5) Exc.ret.t+5.Ita	(6) Exc.ret.t+6.Ita
(r*-r) Italy	0.621***	0.562**	0.611**	0.692**	0.793**	0.742+
	(3.61)	(2.25)	(2.21)	(2.22)	(2.28)	(1.88)
Constant	0.000160	0.00296	0.00702	0.0110	0.0141	0.0158
	(0.02)	(0.23)	(0.41)	(0.53)	(0.61)	(0.62)
Observations	76	76	75	74	73	72

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+7.Ita	(2) Exc.ret.t+8.Ita	(3) Exc.ret.t+9.Ita	(4) Exc.ret.t+10.Ita	(5) Exc.ret.t+11.Ita	(6) Exc.ret.t+12.Ita
(r*-r) Italy	0.664	0.715	0.712	0.771+	0.881**	0.918**
	(1.50)	(1.47)	(1.47)	(1.69)	(2.10)	(2.10)
Constant	0.0166	0.0177	0.0183	0.0191	0.0199	0.0205
	(0.61)	(0.61)	(0.60)	(0.60)	(0.62)	(0.62)
Observations	71	70	69	68	67	66

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 49: Equation 12a. Italy.

	(1) Exc.ret.(t+1)Ita	(2) Exc.ret.t+2.Ita	(3) Exc.ret.t+3.Ita
(r*-r) Italy	0.476**	0.313	0.325
	(2.57)	(1.35)	(1.52)
Rel.debt.innov.Ita	0.0000112	0.0000412	0.0000440
	(0.39)	(0.90)	(0.82)
Debt.Ita	-0.0000553***	-0.000108***	-0.000161***
	(-2.81)	(-3.45)	(-4.68)
Debt.US	-9.30e-08	0.00000107	0.00000304
	(-0.04)	(0.33)	(0.76)
Constant	0.129***	0.235***	0.340***
	(3.96)	(4.49)	(6.38)
Observations	76	76	75

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+4.Ita	(2) Exc.ret.t+5.Ita	(3) Exc.ret.t+6.Ita
(r*-r) Italy	0.380+	0.477**	0.406**
	(1.70)	(2.04)	(2.02)
Rel.debt.innov.Ita	0.0000460	0.0000352	0.0000273
	(1.06)	(0.96)	(0.79)
Debt.Ita	-0.000206***	-0.000232***	-0.000252***
	(-5.96)	(-6.46)	(-7.16)
Debt.US	0.00000479	0.00000598	0.00000576
	(1.15)	(1.49)	(1.46)
Constant	0.428***	0.480***	0.534***
	(8.27)	(8.73)	(9.83)
Observations	74	73	72

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 50: Equation 12a. Italy.

	(1) Exc.ret.t+7.Ita	(2) Exc.ret.t+8.Ita	(3) Exc.ret.t+9.Ita
(r*-r) Italy	0.303	0.301	0.267
	(1.47)	(1.24)	(0.98)
Rel.debt.innov.Ita	0.0000300	0.0000517	0.0000637
	(0.76)	(1.10)	(1.15)
Debt.Ita	-0.000277***	-0.000305***	-0.000321***
	(-8.13)	(-9.58)	(-9.26)
Debt.US	0.00000624	0.00000727+	0.00000732+
	(1.52)	(1.87)	(1.74)
Constant	0.587***	0.635***	0.671***
	(10.99)	(11.80)	(11.54)
Observations	71	70	69

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) Exc.ret.t+10.Ita	(2) Exc.ret.t+11.Ita	(3) Exc.ret.t+12.Ita
(r*-r) Italy	0.357	0.550**	0.699***
	(1.32)	(2.08)	(2.94)
Rel.debt.innov.Ita	0.0000583	0.0000248	-0.00000627
	(1.07)	(0.54)	(-0.16)
Debt.Ita	-0.000331***	-0.000323***	-0.000319***
	(-8.90)	(-7.89)	(-8.29)
Debt.US	0.00000747+	0.00000710	0.00000671+
	(1.76)	(1.65)	(1.68)
Constant	0.693***	0.685***	0.686***
	(10.94)	(9.96)	(10.29)
Observations	68	67	66

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 51: Equation 12. Japan.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) Jap	Exc.ret.t+2.Jap	Exc.ret.t+3.Jap	Exc.ret.t+4.Jap	Exc.ret.t+5.Jap	Exc.ret.t+6.Jap
(r*-r) Japan	0.436***	0.544***	0.561***	0.465**	0.438+	0.417
	(3.24)	(3.56)	(2.89)	(1.99)	(1.70)	(1.48)
Constant	-0.0335***	-0.0260+	-0.0255	-0.0315	-0.0333	-0.0344
	(-4.03)	(-1.96)	(-1.38)	(-1.39)	(-1.26)	(-1.15)
Observations	85	84	83	82	81	80

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.Jap	Exc.ret.t+8.Jap	Exc.ret.t+9.Jap	Exc.ret.t+10.Jap	Exc.ret.t+11.Jap	Exc.ret.t+12.Jap
(r*-r) Japan	0.369	0.233	0.147	0.0817	-0.0461	-0.207
	(1.16)	(0.72)	(0.44)	(0.22)	(-0.13)	(-0.57)
Constant	-0.0374	-0.0452	-0.0490	-0.0512	-0.0577	-0.0656
	(-1.12)	(-1.26)	(-1.26)	(-1.24)	(-1.36)	(-1.53)
Observations	79	78	77	76	75	74

t statistics in parentheses

+ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 52: Equation 12a. Japan.

	(1)	(2)	(3)
	Exc.ret.(t+1) Jap	Exc.ret.t+2.Jap	Exc.ret.t+3.Jap
(r*-r) Japan	0.308**	0.542***	0.671***
	(2.28)	(3.87)	(3.87)
Rel.debt.innov.Jap	0.00000999	0.0000175	-0.00000820
	(0.67)	(1.34)	(-0.53)
Debt.Jap	0.00000413	-0.0000121	-0.0000217
	(0.48)	(-0.92)	(-1.38)
Debt.US	0.00000199	0.00000530	0.00000773
	(0.62)	(1.15)	(1.40)
Constant	-0.0998**	0.00888	0.0691
	(-2.16)	(0.14)	(0.92)
Observations	85	84	83

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+4.Jap	Exc.ret.t+5.Jap	Exc.ret.t+6.Jap
(r*-r) Japan	0.644***	0.675***	0.721***
	(3.07)	(3.10)	(3.39)
Rel.debt.innov.Jap	-0.0000215	-0.00000932	-0.00000535
	(-1.01)	(-0.40)	(-0.23)
Debt.Jap	-0.0000309+	-0.0000427**	-0.0000531***
	(-1.76)	(-2.32)	(-2.97)
Debt.US	0.0000108+	0.0000140**	0.0000168***
	(1.76)	(2.19)	(2.70)
Constant	0.108	0.168+	0.223**
	(1.26)	(1.80)	(2.40)
Observations	82	81	80

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 53: Equation 12a. Japan.

	(1)	(2)	(3)
	Exc.ret.t+7.Jap	Exc.ret.t+8.Jap	Exc.ret.t+9.Jap
(r*-r) Japan	0.736***	0.608**	0.586**
	(3.01)	(2.54)	(2.48)
Rel.debt.innov.Jap	-0.0000129	-0.00000303	-0.00000370
	(-0.49)	(-0.10)	(-0.11)
Debt.Jap	-0.0000612***	-0.0000675***	-0.0000773***
	(-3.40)	(-3.31)	(-3.64)
Debt.US	0.0000191***	0.0000214***	0.0000242***
	(3.13)	(3.37)	(3.74)
Constant	0.265***	0.282**	0.330**
	(2.70)	(2.37)	(2.61)
Observations	79	78	77

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+10.Jap	Exc.ret.t+11.Jap	Exc.ret.t+12.Jap
(r*-r) Japan	0.587**	0.463+	0.322
	(2.33)	(1.70)	(1.21)
Rel.debt.innov.Jap	-0.00000250	0.00000304	0.00000357
	(-0.08)	(0.09)	(0.11)
Debt.Jap	-0.0000869***	-0.0000915***	-0.0000967***
	(-4.00)	(-3.76)	(-3.94)
Debt.US	0.0000267***	0.0000285***	0.0000307***
	(3.99)	(3.94)	(4.19)
Constant	0.381***	0.392***	0.405***
	(3.08)	(2.77)	(2.86)
Observations	76	75	74

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 54: Equation 12. United Kingdom.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.(t+1) UK	Exc.ret.t+2.UK	Exc.ret.t+3.UK	Exc.ret.t+4.UK	Exc.ret.t+5.UK	Exc.ret.t+6.UK
(r*-r) UK	0.341	0.367	0.441^{+}	0.485^{+}	0.561^{+}	0.654^{+}
	(1.46)	(1.32)	(1.72)	(1.71)	(1.92)	(1.95)
Constant	0.0110	0.00904	0.00725	0.00472	0.000215	-0.00392
	(1.30)	(0.75)	(0.48)	(0.26)	(0.01)	(-0.16)
Observations	76	75	74	73	72	71

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)	(6)
	Exc.ret.t+7.UK	Exc.ret.t+8.UK	Exc.ret.t+9.UK	Exc.ret.t+10.UK	Exc.ret.t+11.UK	Exc.ret.t+12.UK
(r*-r) UK	0.697^{+}	0.787^{+}	0.987^{**}	1.184^{***}	1.158^{**}	1.285^{**}
	(1.88)	(1.87)	(2.16)	(2.65)	(2.47)	(2.36)
Constant	-0.00819	-0.0139	-0.0220	-0.0296	-0.0338	-0.0426
	(-0.31)	(-0.49)	(-0.72)	(-0.96)	(-1.05)	(-1.25)
Observations	70	69	68	67	66	65

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 55: Equation 12a. United Kingdom.

	(1)	(2)	(3)
	Exc.ret.(t+1) UK	Exc.ret.t+2.UK	Exc.ret.t+3.UK
(r*-r) UK	-0.0546	-0.0456	0.0657
	(-0.27)	(-0.21)	(0.49)
Rel.debt.innov.UK	0.0000360^{+}	0.0000252	0.0000122
	(1.96)	(0.60)	(0.27)
Debt.UK	-0.0000338	-0.0000899**	-0.000157**
	(-1.25)	(-2.06)	(-2.55)
Debt.US	-0.00000359	0.00000266	0.0000112
	(-0.95)	(0.45)	(1.27)
Constant	0.113***	0.129***	0.134***
	(5.18)	(5.70)	(4.80)
Observations	76	75	74

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+4.UK	Exc.ret.t+5.UK	Exc.ret.t+6.UK
(r*-r) UK	0.0447	0.114	0.235
	(0.38)	(0.74)	(0.95)
Rel.debt.innov.UK	0.0000339	0.0000405	0.0000429
	(1.05)	(1.29)	(1.35)
Debt.UK	-0.000222***	-0.000263***	-0.000311***
	(-2.72)	(-2.70)	(-2.95)
Debt.US	0.0000188	0.0000239	0.0000305^{+}
	(1.56)	(1.60)	(1.84)
Constant	0.143***	0.144***	0.137**
	(3.68)	(2.68)	(2.06)
Observations	73	72	71

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 56: Equation 12a. United Kingdom.

	(1)	(2)	(3)
	Exc.ret.t+7.UK	Exc.ret.t+8.UK	Exc.ret.t+9.UK
(r*-r) UK	0.291	0.324	0.532
	(0.96)	(0.90)	(1.32)
Rel.debt.innov.UK	0.0000283	0.0000517	0.0000785
	(0.78)	(1.19)	(1.57)
Debt.UK	-0.000367***	-0.000421***	-0.000467***
	(-3.25)	(-3.56)	(-3.72)
Debt.US	0.0000386**	0.0000457**	0.0000527**
	(2.11)	(2.31)	(2.54)
Constant	0.131+	0.128	0.107
	(1.71)	(1.49)	(1.17)
Observations	70	69	68

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1)	(2)	(3)
	Exc.ret.t+10.UK	Exc.ret.t+11.UK	Exc.ret.t+12.UK
(r*-r) UK	0.849**	0.801+	0.899+
	(2.02)	(1.92)	(1.96)
Rel.debt.innov.UK	0.0000456	0.0000319	0.0000568
	(0.82)	(0.60)	(1.23)
Debt.UK	-0.000501***	-0.000509***	-0.000523***
	(-3.85)	(-3.97)	(-4.17)
Debt.US	0.0000595***	0.0000604***	0.0000627***
	(2.81)	(2.89)	(3.08)
Constant	0.0771	0.0785	0.0640
	(0.80)	(0.78)	(0.63)
Observations	67	66	65

t statistics in parentheses

$^{+}$ $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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