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Working Paper/Document de travail
2010-14

International Capital Flows and Bond Risk Premia

by Jesus Sierra

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Bank of Canada Working Paper 2010-14

June 2010

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ISSN 1701-9397

Acknowledgements

This paper is based on chapter 1 of my PhD dissertation at the Marshall School of Business at the University of Southern California. I would like to thank Tobias Adrian, Joshua Aizenmann, Antonio Diez de los Rios, Jean-Marie Dufour, Jean-Sebastian Fontaine, Scott Hendry, Francisco Rivadeneyra, Jun Yang and Fernando Zapatero (dissertation chair) for helpful comments and suggestions. Special thanks go to Grahame Johnson for sharing his views about the SSA market. All errors are mine.

Abstract

This paper studies the impact of international capital flows on asset prices through risk premia. We investigate whether foreign purchases of U.S. Treasury securities significantly contributed to the decline in excess returns on long-term bonds between 1995 and 2008. We run forecasting regressions of realized excess returns on measures of net purchases of treasuries by both foreign official and private agents. We find a clear distinction in the effects of flows on excess returns. Official flows, with a negative and non-linear effect, appear similar to relative supply shocks; private net purchases, with a positive and linear effect, resemble flows that absorb excess supply and are thus compensated in equilibrium for this service, similar to the role of arbitrageurs in preferred-habitat models of the term structure.

JEL classification: G110, G120, G150, F310, F320, F340, C220
Bank classification: Financial markets

Résumé

L'auteur étudie l'incidence des flux internationaux de capitaux sur les prix des actifs sous l'angle des primes de risque. Son objectif est de déterminer si les achats étrangers de titres du Trésor américain ont contribué de façon importante à la baisse des excédents de rendement des obligations à long terme observée entre 1995 et 2008. L'auteur a recours à des analyses de régression pour établir si des mesures des achats nets étrangers, d'origine officielle ou privée, de titres du Trésor peuvent aider à prévoir les excédents de rendement réalisés. Il constate que l'effet des flux de capitaux sur les excédents varie nettement selon leur provenance. Les flux officiels ont une incidence négative et non linéaire analogue à celle de chocs d'offre relative. À l'opposé, les achats nets privés ont un effet positif et linéaire et s'apparentent en cela à des flux qui viennent absorber l'offre excédentaire. Ils sont rémunérés à l'équilibre pour ce service, qui rappelle le rôle joué par les arbitragistes dans les modèles de structure des taux d'intérêt fondés sur la théorie de l'habitat préféré.

Classification JEL : G110, G120, G150, F310, F320, F340, C220
Classification de la Banque : Marchés financiers

1 Introduction

Recently, the high level of foreign exchange reserves by oil and commodity exporting countries, as well as some industrialized countries, has attracted the attention of both the financial press and the academic literature. Specifically, interest centers on the possible impact that purchases of long-term U.S. Treasury securities might have on their yields. For example, it has been suggested that foreign central bank purchases of long-term bonds have been an important factor contributing to the recent "low" level of long term yields.

The question of whether foreign capital flows impact U.S. interest rates is an important one because of its implications. From an academic and practitioner standpoint, if it is found that capital flows can be considered exogenous and impact prices significantly, then they must be included as additional factors in general equilibrium models of the term-structure. From a policy perspective, the same finding would imply that prices can be manipulated by altering relative asset supplies, and this would give an additional channel for policymakers to influence long-term rates.

In this paper, we measure the impact of international capital flows on the prices of long-term U.S. Treasury securities. Although other studies have looked at this issue, they focus on the impact of measures of capital flows on yield levels or changes. This introduces the additional complication of controlling for real growth and inflation expectations, which are both unobservable. We take a different approach: we note that if capital flows have any effect on yields by changing relative asset supplies, it must be through excess returns because short-term interest rates are in control of the monetary authority, which arguably does not set its main policy rate in response to foreign net purchases and sales of bonds. In addition, given that prices and quantities are determined simultaneously in equilibrium, we acknowledge that an exogenous component of demand must be obtained to be able to identify the effect.

These two ideas motivate our empirical strategy, which consists of regressing future realized excess returns on *instrumented* foreign net purchases of U.S. treasuries. The latter is defined as a component of net purchases that is perfectly correlated with factors that shift the demand curve for treasuries. Importantly, in the forecasting regressions, we also control for other factors that have been previously found to predict excess returns, such as linear combinations of forward rates and principal components of macroeconomic variables.

The main results can be summarized as follows. When we use the instrumented data on flows to measure their impact on expected excess returns, we find a clear distinction in the effect of foreign official and private flows on excess returns; that is, the impact of capital flows on excess returns depends on the type of foreign entity. Official flows, with a negative and non-linear effect, appear similar to relative supply shocks that decrease the amount of bonds available, drive up their prices and thus decrease yields through the component related to excess returns. Private net purchases, with a positive and linear effect, resemble flows that absorb excess supply and are thus compensated in equilibrium for this service, similar to the role of (mean-variance) arbitrageurs in the preferred-habitat model of Vayanos and Vila (2009). Or, alternatively, foreign private agents appear as being able to systematically position themselves to exploit low-frequency movements in excess returns. Interestingly, we do not find strong support for the view that international capital flows where among the main drivers in the decrease in the 10-year yield between 1994 and 2007.

We also show that using benchmark-survey consistent data on holdings will result in an inaccurate picture of the impact of foreign purchases on prices. The reason for this is that the numerical procedure commonly used to make accumulated flows consistent with the survey data on the level of holdings uses market prices to make valuation adjustments. Thus, any time we regress market prices on adjusted holdings data, a seemingly significant correlation coefficient will be found, even when the pure flow component of holdings can be weakly or even not correlated with price changes at all. Because of this, we choose not to use this data in our tests.

1.1 Related literature

To our knowledge, we are the first to look at excess returns when trying to measure the impact of capital flows on interest rates. Other studies have looked instead at the effect of foreigner's accumulation of U.S. treasuries on their yields. Bernanke et al. (2004) perform an event-study in which they regress yield changes over a 3-day event window on the dollar volume (billions) of Japan's Ministry of Finance foreign exchange interventions. They find that on days in which there were no major economic news, the 10-year U.S. Treasury yield decreased by about 0.66bp per $1 billion. This way of identifying exogenous shocks is close to ideal, and the effect they find is indeed negative, but small[1].

Another related paper is Warnock and Warnock (2009). They quantify the impact of increases in holdings on yields, using both a linear regression framework and a vector error-correction model. Using benchmark-consistent data on 12-month flows, and including variables designed to proxy for real and inflation expectations, as well as risk premia, they find a negative regression coefficient on accumulated net purchases using restricted least squares. They also find a negative cointegrating vector parameter, as well as a negative short-run coefficient. The main differences with the present paper are that we focus on risk premia instead of yield levels, and that to measure the effect we use an instrumented measure of foreign purchases to proxy for exogenous innovations in demand, instead of the raw data.

Rudebusch et al. (2006) regress macro-finance model residuals[2] on explanatory variables, one of which is the scaled trailing 12-month total foreign official purchases. Interestingly, they also find a *positive* relationship between net purchases and yields, as we do. But, as Detken (2006) points out, they use the data on custodial holdings of foreign official institutions by the New York Fed. In our tests, we use the Treasury International Capital System (TIC) data because it has a broader coverage and, in addition, allows us to analyze private flows[3].

[1]To put these figures into perspective, during the Jan2000-Mar2004 period (the Bernanke et al. (2004) sample), the mean and standard deviation of *daily* changes in the 10-year yield were -0.25 and 6.35 basis points, respectively. Therefore, a -0.66 basis point decrease is not even 1-standard deviation away from the mean. On the other hand, the average *monthly* net purchases of long-term U.S. Treasury bonds and notes by foreign official institutions during the Jan2000-Mar2004 period was 3.65 billion, with a standard deviation of 8.82 Billion. If we assume i.i.d random variables and 30-day month, we get an approximate daily average net purchase of 0.122 billion with a standard deviation of 1.61 billion. So a 1 billion intervention is well within a one standard error confidence interval. Of course, we must always bear in mind that the net purchases data is nominal, noisy and heteroscedastic. See http://www.treas.gov/tic/tressect.txt

[2]From both the Bernanke et al. (2004) and Rudebusch and Wu (2008) specifications.

[3]See http://www.ustreas.gov/tic/faq2.shtml#q10

2 Theoretical framework

The price of an n-period nominal discount bond at time t is given by the first order condition of the representative investor for optimal portfolio choice, as follows:

$$\mathrm{P}_t^{(n)} = \mathbb{E}_t\left[\mathrm{M}_{t+1}^{\$}\mathrm{P}_{t+1}^{(n-1)}\right].$$

$\mathrm{P}_t^{(n)}$ is the price of the bond in units of currency. $\mathrm{M}_{t+1}^{\$} = \mathrm{M}_{t+1} \cdot (1/\Pi_{t+1})$ is the nominal stochastic discount factor; M_{t+1} is the real stochastic discount factor that prices payoffs denominated in units of consumption, and Π_{t+1} is the one-period gross inflation rate, represented as the growth rate in an index of consumer prices. Let lowercase letters denote the natural logarithm of their uppercase counterparts, as in $x_t \equiv \ln X_t$, and define the log yield on the n-period bond as $y_t^{(n)} = -\frac{1}{n}p_t^{(n)}$. Then, if we assume that the conditional distribution of the nominal discount factor and bond prices is joint lognormal, we can express the log-price of the n-period bond as

$$p_t^{(n)} \equiv \ln \mathrm{P}_t^{(n)} = -y_t^{(1)} + \mathbb{E}_t(p_{t+1}^{(n-1)}) + \frac{1}{2}\sigma_t^2(p_{t+1}^{(n-1)}) + \sigma_t(m_{t+1}^{\$}, p_{t+1}^{(n-1)}), \tag{1}$$

where the log one-period yield is given by $y_t^{(1)} = -\mathbb{E}_t(m_{t+1}^{\$}) - \frac{1}{2}\sigma_t^2(m_{t+1}^{\$})$. From this equation, we can derive several equivalent statements about yields and excess returns. Let t denote a year. Define the expected excess return on an n-year bond as the expected return in excess of the one-year rate:

$$\mathbb{E}_t\left(rx_{t+1}^{(n)}\right) = \mathbb{E}_t\left(r_{t+1}^{(n)}\right) - y_t^{(1)} = \mathbb{E}_t\left(p_{t+1}^{(n-1)}\right) - p_t^{(n)} - y_t^{(1)}.$$

Then (1) can be rewritten as:

$$\mathbb{E}_t\left(rx_{t+1}^{(n)}\right) = -\frac{1}{2}\sigma_t^2(p_{t+1}^{(n-1)}) - \sigma_t(m_{t+1}^{\$}, p_{t+1}^{(n-1)}). \tag{2}$$

This equation defines the expected excess return or risk premium. It is composed of the expected one-year ahead volatility of the $(n-1)$-year bond price, and the covariance of the log nominal pricing kernel with the $(n-1)$-year bond price at time $t+1$. Alternatively, we can rewrite (1) as:

$$y_t^{(n)} = \frac{1}{n}y_t^{(1)} + \frac{(n-1)}{n}\mathbb{E}_t(y_{t+1}^{(n-1)}) + \frac{1}{n}\mathbb{E}_t\left(rx_{t+1}^{(n)}\right). \tag{3}$$

As can be seen, foreign capital flows can affect interest rates through their effect on one or all of the following components of yields: the current one-year rate $y_t^{(1)}$; the expected future $(n-1)$-period rate $\mathbb{E}_t(y_{t+1}^{(n-1)})$; or the risk-premium $\mathbb{E}_t\left(rx_{t+1}^{(n)}\right)$. Another, equivalent, multi-period version of (3) obtains if we substitute recursively for $\mathbb{E}_t(y_{t+1}^{(n-1)})$. It states that the n-period yield is the average of future expected one-year rates, plus the average of future risk-premiums on bonds of *decreasing* maturity:

$$y_t^{(n)} = \frac{1}{n}\mathbb{E}_t\left(y_t^{(1)} + y_{t+}^{(1)} + \cdots + y_{t+n-1}^{(1)}\right) + \frac{1}{n}\left(\mathbb{E}_t(rx_{t+1}^{(n)}) + \mathbb{E}_t(rx_{t+2}^{(n-1)}) + \cdots + \mathbb{E}_t(rx_{t+n-1}^{(2)})\right). \tag{4}$$

Equation (4) is the well-known decomposition of yields into expected future short-rates and excess returns that appears, for example, in Ludvigson and Ng (2009) and Cochrane and Piazzesi (2008). The equation says that capital flows can affect interest rates if they affect the whole future path of one-period rates during the life of the bond, or if they affect the *term-structure* of risk premia. Since we can view a 1-year bond as a 4-quarter bond, we can use the same decomposition and eventually obtain that yields are averages of expected future short-rates, like the 3 month yield, and the average of expected future excess returns, over smaller time periods[4].

Since the 3-month yield is effectively linked to the policy rate which is under the control of the monetary authorities, we are left with the conclusion that if capital flows have any effect on yields, it must be through their effect on excess returns[5]. Indeed, as Cochrane and Piazzesi (2008) state, citing a speech by Fed Chairman Bernanke[6]: "... stories about "demands" by various agents are the same thing as a risk premium". Thus, in this paper, we focus on the impact of capital flows on risk-premia.

2.1 Empirical model

In the empirical tests that follow, we assume rational expectations and then regress realized excess returns at time $t+1$ on time t measures of capital flows f_t and control variables x_t:

$$rx_{t+1}^{(n)} = \alpha + \beta' x_t + \gamma' f_t + e_{t+1}$$

The controls in x_t are variables that have been found to have predictive power for future bond excess returns, while f_t contains measures of both foreign official and private net purchases of long-term U.S. Treasury securities.

3 Data

In this section we explain the construction of the series used in this paper and our choice of sample period.

3.1 Capital flows

Our measures of foreign capital flows into the U.S. Treasury market are the net purchases of long-term U.S. Treasury securities by both foreign official and private agents, shown in Figure 1. These series are available at a monthly frequency from the Treasury International Capital System (TIC) of the U.S. Department of the Treasury[7]. In the regressions, we normalize the

[4]Appendix A presents an example of this point using the 10-year bond, with each time period representing a quarter, over a 4-quarter holding period.

[5]Unless one is willing to entertain the possibility that the Fed's policy actions react to capital flows, in which case capital flows could also affect expected future short rates. A possibility that seems less extreme is that the U.S. Treasury issuance decision reacts in some way to expected capital flows (demand). We do not investigate this issue here.

[6]Remarks by Chairman Ben S. Bernanke before the Economic Club of New York, New York, New York, New York, March 20, 2006.

[7]Available at www.treas.gov/tic/

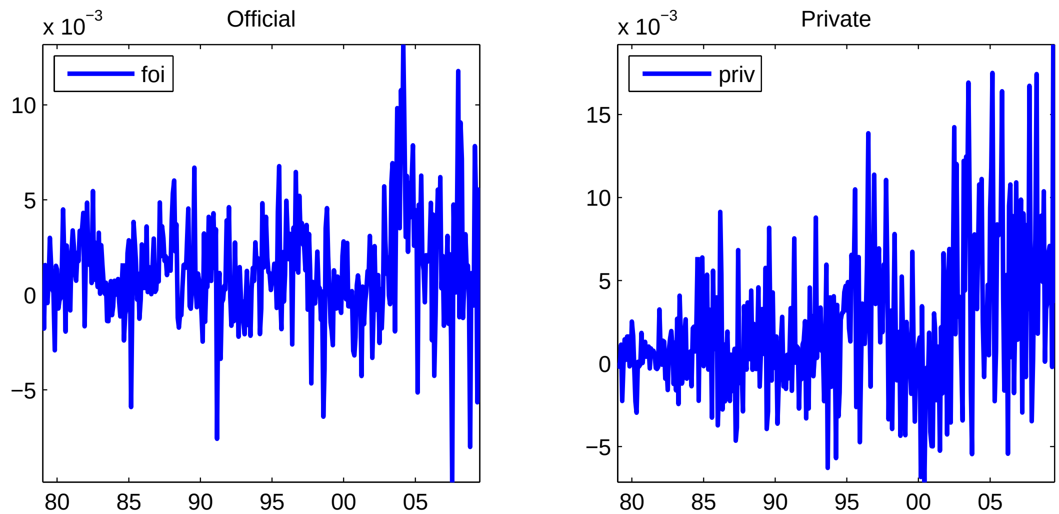

Figure 1: Foreign Net Purchases of long-term U.S. Treasury securities as a percentage of outstanding notes and bonds. Jan1979-Jul2009.

net purchases series by the total amount outstanding (book value) of U.S. Treasury Notes and Bonds, obtained from the Monthly Statement of the Public Debt, for all months from December 1978 to July 2007. In section 5, we explain why we choose not to use data on the level of holdings to perform our tests.

To get a sense of what types of maturities do foreign agents hold, Table 1 presents data on the maturity structure of foreign holdings of long-term U.S. Treasury securities. As can be seen, while official institutions concentrate their holdings in 1-6 year maturity range, private agents hold comparatively more long-term (6-10 year) bonds. Indeed, as stated in the June 2008 Report on Foreign Portfolio Holdings of U.S. Securities: "Foreign official holdings have a much shorter average maturity than do foreign private holdings (defined as total holdings less official holdings)".

Hence, one could expect that if there is any relative-supply induced effect on yields due to capital flows, they should be localized around the maturities these agents (official or private) hold the most. Therefore, we expect that if foreign official flows have any effect on risk premiums, it should be on the excess returns of bonds of maturities shorter than, say, 6 years. On the other hand, we expect private flows to affect premia on bonds of maturities longer than 6 years. Because of this, we need data on excess returns of bonds of medium (1-5 year) and long-term (6-10 year) maturities.

3.1.1 Structural break in foreign official holdings

Figure 2 shows that there is a structural break in the dynamics of total foreign holdings around May 1994, which can be specifically traced to the behavior of foreign official holdings. This break coincides with the change in the Yuan/U.S. dollar exchange rate that happened on February 1994. In that month, the exchange rate was increased from 5.82 to 8.72CNY per

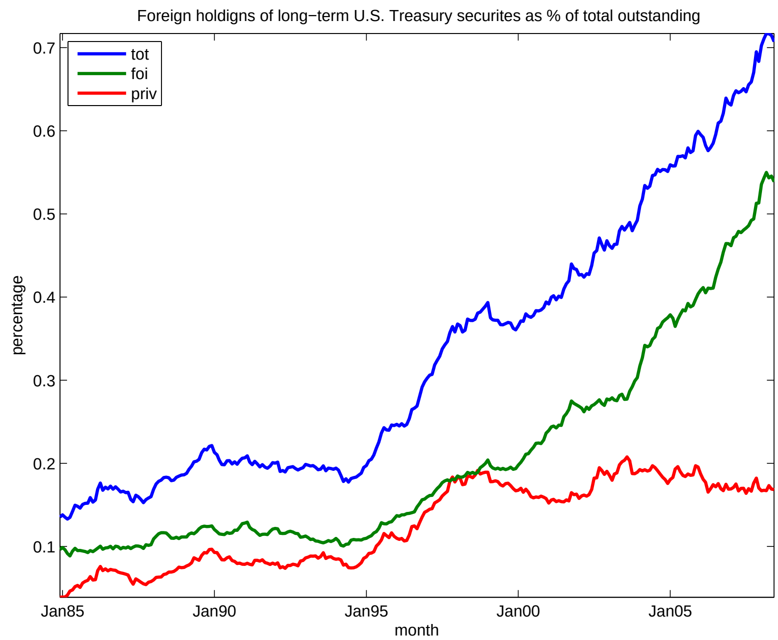

Figure 2: Foreign holdings of long-term U.S. Treasury securities as a percentage of outstanding notes and bonds. Dec1984-Jun2008.

USD, which is about a 49% devaluation. Three months after this policy change, its effects are clearly reflected in the increase in foreign official reserves. Because of this structural break, it is natural to expect that the effect of flows on prices, if any, should be stronger in the post-1994 sample. Hence, we concentrate on the May1994-Dec2008 period when we run the forecasting regressions.

3.2 Excess-returns

We use two datasets to construct excess returns. One is the Fama Bliss dataset that includes bonds of maturities from 1 to 5 years. Its main advantage is that it allows a direct comparison of our results with other studies. Its only disadvantage is the specific maturities it includes. We need data on excess returns of maturities longer than 5 years because, as mentioned before, the data on foreign holdings shows that foreign private agents hold a significant amount of long maturity bonds. To be able to study excess returns on bonds of longer maturities, we use the Gurkaynak et al. (2006) (GSW) dataset. This gives us monthly observations on prices of artificial zero-coupon securities of maturities from 6 to 10 years. From prices, we obtain forward rates and excess returns.

3.3 Control variables

There is ample evidence that risk premia in the term structure are time-varying. For example, Fama and Bliss (1987) find that the n-year forward spread forecasts excess returns on the n-year bond. Campbell and Shiller (1991) find that the n-year yield spread forecasts the change in yield of the n-year bond is excess of the one-year yield, with a coefficient that is significantly less than 1, and negative for most maturities. Stambaugh (1988) finds, after controlling for measurement error, that the 4 and 5-month forward premiums predict excess returns on bonds of maturities up to 6 months[8]. More recently, Cochrane and Piazzesi (2005) (CP) found that the same linear combination of 2-5 year forward rates forecasts excess returns on bonds of maturities from 2 to 5 years. In addition, their factor drives out yield or forward spreads in regressions in which both variables are present. Thus, given that previous research has identified variables that predict excess returns, in order to measure the marginal forecasting power of any additional variable, like foreign capital flows, we must first control for the information content in variables that are already known to predict excess returns.

The three control variables employed in this paper, to be explained in the next sections, include two factors that have been previously identified in the literature as containing useful information in forecasting excess bond returns, and a new variable that is specifically designed to summarize the information about expected excess returns on long-term bonds.

3.3.1 Medium-term forward rates

Following CP, the first control variable we use, $\mathrm{cp9407}_t$ is a factor constructed as the fitted value in a forecasting regression of average (across the 2 to 5 year maturity range) realized excess return at time $t+12$ on time t forward rates, but using data from May1994-Dec2007 for forward rates, and May1995-Dec2008 for excess returns. In these regressions, we use the Fama-Bliss dataset.

3.3.2 Principal components of macroeconomic variables

Ludvigson and Ng (2009)(LN) find that principal components of macroeconomic indices have significant forecasting power for excess returns, and that the information they contain is different than that in the CP factor. The second control variable we employ, $\mathrm{ln9407}_t$ is a factor constructed as the fitted value in a forecasting regression of average (across the 2 to 5 year maturity range) realized excess return at time $t+12$ on time t principal components

[8]The tests in Fama and Bliss (1987) derive from a manipulation of (3) that looks like:

$$\mathbb{E}_t(rx_{t+1}^{(n)}) = \mathbb{E}_t(\Delta p_{t+1}^{(n-1)}) + (f_t^{(n)} - y_t^{(1)})$$

Hence, if the forward spread forecasts realized excess returns, risk-premia are time-varying. Likewise, the tests in Campbell and Shiller (1991) derive from a manipulation of (3) that looks like:

$$\mathbb{E}_t(y_{t+1}^{(n-1)}) - y_t^{(n)} = \frac{1}{(n-1)}(y_t^{(n)} - y_t^{(1)}) - \frac{1}{(n-1)}\mathbb{E}_t(rx_{t+1}^{(n)})$$

If excess returns are not time-varying, then the coefficient on $\frac{1}{(n-1)}(y_t^{(n)} - y_t^{(1)})$ should be equal to 1. Finally, an equation can be derived from (3) that relates n-period bond excess returns to initial forward rates *of at most* n-period maturity, similar to the regression equation in Stambaugh (1988). It is:

$$\mathbb{E}_t(rx_{t+1}^{(n)}) = \mathbb{E}_t(p_{t+1}^{(n-1)}) + (f_t^{(n)} + f_t^{(n-1)} + \cdots + f_t^{(2)})$$

of macro variables, as in LN, but using data from May1994-Dec2007 for the macro factors, and May1995-Dec2008 for the average excess return. In these regressions, we again use the Fama-Bliss dataset.

3.3.3 Longer-term forward rates

Together, the CP and LN factors have been found to have substantial predictive power for excess returns, and can be used as a benchmark to measure the forecasting power of other regressors. Both contain, by construction, information useful in predicting excess returns on bonds of maturities from 2 to 5 years. However, given that foreign agents hold a significant amount of their treasury portfolio in longer-term maturity bonds, i.e. greater than 5 years, it is also necessary to include a factor that summarizes information about excess returns on long-maturity (6-10 years) bonds[9]. To obtain such a variable, we follow an approach similar to Cochrane and Piazzesi (2005) and construct a third control variable, gsw9407_t, as the fitted value in a forecasting regression of average (across the 6 to 10 year maturity range) realized excess return at time $t+12$ on time t forward rates of maturities of 6, 8 and 10 years[10], using data from May1994-Dec2007 for forward rates, and May1995-Dec2008 for excess returns. In the construction of this factor, we use the Gurkaynak et al. (2006) dataset. In addition, given that this factor will be correlated with cp9407_t, in the tests in the paper we use $\widetilde{\text{gsw9407}}_t$, the orthogonalized gsw factor obtained as the residual in a regression of gsw9407_t on a constant and cp9407_t.

3.3.4 The gsw9407_t factor and stock returns

If $\widetilde{\text{gsw9407}}_t$ is indeed related to risk premia, it should also forecast excess stock returns, in the same way that the Cochrane and Piazzesi (2005) factor forecasts excess stock returns in the presence of the dividend yield or term spread[11]. Table 2 presents forecasting regressions in which the 3, 6 and 12 month excess return on the CRSP Value-weighted index is regressed on $\widetilde{\text{gsw9407}}_t$, d/p and term. In these regressions, d/p is the natural log of the dividend yield (all firms continuously listed on NYSE, AMEX, or NASDAQ) from Boudoukh et al. (2007), and downloaded from Michael R. Robert's website, while term, the term spread, is the difference between the 10-year Treasury constant maturity rate and the 3-month Treasury Bill Secondary Market rate. As can be seen, for the period May1994-December2007 in which the independent variables are measured, the gsw factor predicts stock returns, and with a

[9] Indeed, Cochrane and Piazzesi (2008) suggest that long-term forwards might contain additional useful information. On pp. 15 they write: "We do not get to learn how longer maturity forward rates might enter into the return-forecasting function, i.e. how the tent-shape pattern across the first five forward rates is modified by or extended to longer maturities, but it is clear from Table 1 that there are not enough degrees of freedom left in the GSW data for us to do that". As we will explain later, we try to overcome the multicollinearity problem by excluding adjacent forward rates, and creating the gsw factor by regressing only long-term gsw returns on long-term gsw forwards only, without including FB data. In a second step, we orthogonalize the gsw factor with respect to the cp factor, and in this way we can be sure that whatever is left is not-related to the information in risk premia already contained in the cp factor.

[10] We use only 3 forward rates as right-hand side variables because all the 6,7,8,9, and 10 year forward rates are very highly correlated. We hope that excluding the 7 and 9 year forwards helps to mitigate somehow the multicollinearity problem in the forecasting regressions.

[11] See Table 3 in their paper

statistically significant coefficient. Thus, it is indeed related to compensation for bearing risk.

Finally, in an appendix available upon request, we present a series of results that show that this "gsw" factor constructed using long-term forward rates from the GSW dataset has predictive power for excess bond returns, and that this forecasting power is weak in the pre-1979 sample, stronger in the post-1979 sample, and strongest after 1994. An explanation for this is that the regime change in the conduct of U.S. monetary policy changed the information content in long-term forward rates. In sum, we believe the gsw factor is a legitimate control variable to include in the regressions using capital flows.

4 Un-instrumented net purchases and excess bond returns

In this section, we present the results of a series of regressions that investigate the effect of foreign official and private flows on excess returns. We first discuss the evidence when the raw normalized foreign flows data are employed in the regressions. Then, in the next section, we explain the strategy that we use to deal with the endogeneity bias, given that here we are regressing prices on quantities.

4.1 Regression results

Table 3 presents the results of forecasting regressions of one-year ahead excess returns on time t control variables and measures of both foreign official (foi) and private (priv) capital flows into long-term U.S. Treasury securities. Notice that official flows enter nonlinearly, while private flows enter linearly in the regressions. Before we discuss the estimation results below, we briefly explain why this is done.

The rationale for considering non-linear effects is as follows. Krishnamurthy and Vissing-Jorgensen (2010) show that a significant component of the corporate spread that is unrelated to default risk is negatively correlated with the stock of U.S. Treasury debt outstanding. They explain this finding by arguing that the negative correlation between the corporate spread and the stock of U.S. Treasury debt outstanding reflects a demand for "convenience" services that is unique to U.S. Treasury bonds. They illustrate this idea in a simple representative agent economy by including real bond holdings in the utility function. Then, an implication of the first-order condition for optimal bond holdings in that model is that a nonlinear function of the holdings of debt is related to future excess returns. Because of this, we first ran regressions in which both official and private flows enter linearly or nonlinearly. The results of this exercise appear in Table 4, and the main conclusion from that table is that the effect of official flows seems to be greater and estimated with more precision when they are included in non-linear form, while the opposite holds for private flows. Thus, we chose to include squared official flows together with linear private flows. And, as will be seen later, this same pattern arises when we employ instrumental variables methods to measure the impact of exogenous flows on excess returns.

The estimates in Table 3 suggest that the relationship between official flows and excess returns is different than that of private flows. The estimated coefficients in the column labeled foi_t^2 (official flows squared) are all negative but only the first two, which correspond to the two and three year bonds, are marginally significant. On the other hand, for all bonds of maturities greater than two years, the estimated coefficients in the column labeled priv_t (private flows) are positive and significant. For private flows, the magnitude of the estimated coefficients increases monotonically with maturity, while for official flows the correlations increase with maturity, reach a peak, and then decay. The fact that the strongest correlation for official flows is concentrated in the 2-5 year maturity range while that of private flows on the 6-10 year range is consistent with the evidence in Table 1 that official institutions hold most of their treasury portfolio in medium-term (between 0 and 6 years) securities, while private agents hold comparatively more long-term (6year+) bonds.

In sum, until now, the evidence suggests that official flows have a negative and nonlinear impact on excess returns, while private flows have a positive and linear effect. At this stage, however, we must be careful in interpreting these results (we do provide an interpretation in section 6). As mentioned before, here we are regressing prices on quantities, and in this case, it is possible[12] that an endogeneity bias is present and the coefficient estimates are biased. Because of this, in the next section we use an alternative approach to better measure the impact of exogenous changes in demand on prices.

5 Identification

It is possible that the regressions in Table 3 underestimate the effect of foreign net purchases on yields, as both variables are endogenous in equilibrium. Moreover, in general, to be able to determine a causal effect, we need to identify a component or innovation to net purchases that is exogenous to changes in supply.

In order to obtain such an exogenous component, we use Instrumental Variables(IV) in its two-stage least squares (2SLS) version. In the first step, we regress net purchases on *lagged* values of variables that are thought to influence capital flows and that are presumably exogenous to time t's changes in supply (primary or secondary). The fitted values of these regressions then become our measure of the exogenous component of demand. In the second step, we regress future realized excess returns on these fitted values, which we now call "instrumented" net purchases. The rationale for this is that at least part of the net amount purchased in any given month depends on variables that can be considered exogenous, either because they are influenced by other factors unrelated to the U.S. economy, or measure the return on a substitute asset, or simply because they occur in the past. Then, changes over time in these variables should (slowly) shift the *net* foreign demand curve for treasuries in such a way that the resulting changes in the quantity demanded are unrelated to time t's shocks to the available supply (either new auctions or secondary market)

[12]We say "possible" because the estimated parameter will be a weighted average of demand and supply elasticities, were the weights are given by the relative volatilities of the supply and demand shifters. It is always possible that one volatility dominates the other, in which case the estimate can be "close" to the true parameter.

5.1 Approximate country attribution of net purchases

Although, in general, the international asset allocation strategies of both foreign official and private institutions, is difficult to determine[13], we can gain some insight into the variables that might be driving flows into the U.S. Treasury market by analyzing their approximate country attribution. Table 5 presents parameter estimates in regressions that explain aggregate official and private net purchases using individual country net purchase data. The regressions only report those countries for which the estimated coefficient was significant in a first-stage regression in which all countries were included.

As can be seen, the top five countries whose flows correlate the most with aggregate official flows are Japan, Norway, China, Oil Exporters and Brazil. Except for Norway and Brazil (important commodity exporters), the appearance of Japan, China and Oil-exporting countries is hardly surprising, given the size of their foreign exchange reserves (Japan), or the importance of both their reserves and Sovereign Wealth Funds (China and Oil Exporters, as well as Norway). Thus, the country attribution results seem to suggest that foreign exchange reserves management, and diversification of investments, but in the narrow asset class typically employed by central banks (like sovereign bonds), might be important factors driving official flows into long-term U.S. Treasury notes.

On the other hand, we can see that the top five "countries" whose flows correlate the most with aggregate private flows are the U.K., Caribbean Banking Centers, Japan, Canada and the Netherlands. That Japan, the U.K. and Caribbean are indicated by the data as important sources of private flows into the U.S. Treasury market is not surprising, given that they are major financial centers, and in the case of Japan, important exporters. In addition, notice that out of the 13 countries that explain private flows, 6 belong to the euro area: the Netherlands, France, Ireland, Belgium, Luxembourg and Germany. This evidence suggests that, at a minimum, the performance over time of the CAD, JPY, EUR and GBP against the US dollar might be an important driver of flows.

5.1.1 Financial center reporting bias

In the next section, we will present our choice of instruments based in part on the information given by the regression evidence on the country attribution of official and private net purchases. But before proceeding, some caution must be exerted in interpreting such evidence. The TIC data possesses a well known limitation[14] that must be considered. As explained in Griever et al. (2001) and Bertaut et al. (2006), the data features a "financial center reporting bias" or "custodial bias": a large amount of holdings or net purchases is attributed to countries that are major custodial, investment management or security depository centers, like the UK or Cayman Islands. This has two implications: the level of holdings and net purchases by official institutions are probably under-estimated, and private flows and holdings attributed to the U.K. or Caribbean are not really "native" to these countries, in the sense that they do not correspond to excess national savings. Nevertheless, as long as the *investment decisions* respond to variables that would be deemed important for any international investor in any country we can guide our choice of instrumental variables at

[13]Specially, given their size and aggregation.

[14]Because the system follows Balance of Payments conventions.

least in part by analyzing with which countries does the aggregate flow data correlate the most. For example, even if the money is not from UK residents, if the investment decisions are made by UK-based investment management firms that take into consideration, say, the USD/GBP exchange rate, then it is reasonable to think that flows from the UK to the US will respond to exchange rate movements.

5.2 Instruments for official flows

In their study of the determinants of the corporate spread, Krishnamurthy and Vissing-Jorgensen (2010) point out that the surety and neutrality motives are important considerations for official holders of U.S. Treasury notes. This suggests that sovereign, supranational and government agency bonds, not necessarily from the U.S. government or even dollar denominated, could be a preferred asset class to corporate bonds when these agents consider diversifying their portfolios. This is because these obligations also carry an implicit or explicit federal or state government guarantee[15], and in this sense, they might be the closest "substitutes" to U.S. treasuries[16]. Motivated by this idea, we include as instrumental variables for official flows the yield spreads on bonds that are either denominated in U.S. dollars and are not issued by the U.S. Treasury but carry an explicit government guarantee, or that are denominated in foreign currency but are issued by their respective fiscal authorities and are thus guaranteed by the government.

As an example of the first type of asset, we use the government-related yield spread, which is the difference between the redemption yield of the Barclays Capital Government-Related Index and the average of the 1, 3 and 5 year Treasury Constant Maturity rates. The asset classes that are included in the government-related index are agency[17], sovereign, supranational and local authority bonds (SSA bonds). As representatives of the second category, we include the bund-spreads, which are the difference between the yield to maturity of the Bank of America Merrill Lynch German Federal Governments 5-10 Yrs and 10+Yrs indices (in local currency), respectively, and the yield to maturity on the U.S. Treasuries 5-10 Yrs and 10+Yrs indices, respectively.

In Figure 3, we plot the yield spreads used as instruments for official net purchases, as well as the corporate spread. As can be inferred from the size of the spread relative to treasuries, the bonds included in the government-related index are closer to being "substitutes' for treasuries than corporate bonds, as the spreads are closer to zero and smaller than the corporate spread for most of the sample. And this should come as no surprise, given the explicit government guarantee.

In addition to yield spreads, we also consider foreign exchange intervention operations as a possible driver of flows into long-term U.S. Treasury Bonds. Notice that in Panel A of Table 5, Japan is one of the countries whose net purchases correlate the most with aggregate official

[15]For example, while the obligations of The International Bank for Reconstruction and Development (IBRD) are not guaranteed by any specific government, they are backed by the pool of capital commitments of its member countries. On the other hand, the bonds of Spain's Instituto de Crédito Oficial (ICO), the International Finance Corporation (IFC), or Germany's Kreditanstalt für Wiederaufbau (KFW) are government-guaranteed.

[16]I thank Grahamne Johnsonn for pointing this out.

[17]Both native and non-native currency agency bonds are included. Native currency issues include Fannie Mae, Freddie Mac and the Federal Home Loan Bank

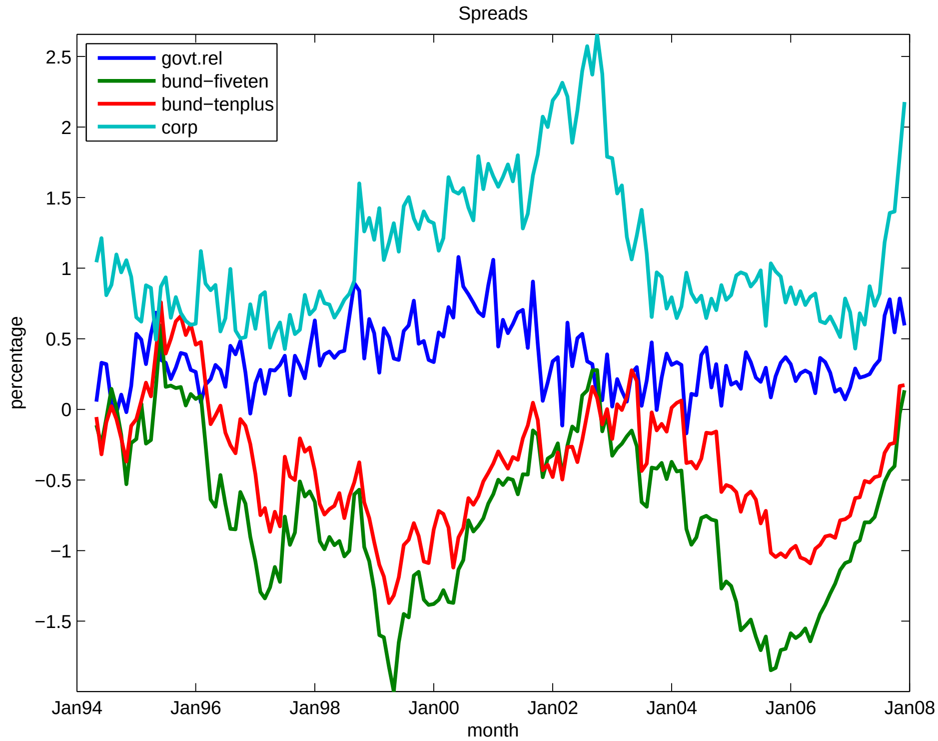

Figure 3: Government-related, bund and corporate yield spreads. May1994-Dec2007.

flows. Indeed, in part as a result of a policy that aims to keep the exchange rate competitive in order to boost exports, Japan has accumulated vast foreign exchange reserves and, in the past, foreign exchange interventions have been common. If the intervention operations are large, occur during consecutive months and at least part of them involve buying and selling U.S. Treasuries, it is natural to expect that FX interventions might explain or even forecast official flows into the U.S. Treasury market. Thus, we include Japan's Ministry of Finance interventions as an additional forecasting variable for official flows. Finally, to proxy for short-term flows sensitive to short-term stock market trends, we also include the returns on the S&P 500 index as a forecasting variable.

5.2.1 First-stage results: instrumental variables

Panel A of Table 6 presents the results of regressing foreign official net purchases on lagged values of all the instruments. The empirical model with lagged variables can explain close to a third of the variation in official net purchases. Most of the coefficients have the correct sign: for example, since the government-related and the five-ten year bund spreads represent the return on "substitute" goods, we expect them to have a negative sign, as they would lead to a portfolio reallocation away from U.S. treasuries. Also, Japan's Ministry of Finance interventions, which correspond to a purchase of foreign currency against the yen, are estimated to have a positive effect on net purchases. Interestingly, the ten-plus bund spread is estimated to have a positive effect on official flows, instead of negative as we had hypothesized. This points to the possibility that, conditional on the value of the five-ten year bund spread, in the short-run long-term German bonds might instead be "complements" to long-term U.S. Treasuries. Finally, the past return on the S&P 500 Index forecasts positive flows into long-term U.S. Treasury bonds, and this can be explained if official agents purchase bonds when their price has temporarily decreased as other (private) investors sell bonds and invest in stocks after past good stock market returns.

Overall, the results show that the instruments employed capture a substantial portion of the variation in official flows. In addition, the F-statistics for joint significance are all well above 10, which is the threshold suggested by Staiger and Stock (1997) when trying to determine if the instruments are weak. In the next section, we use the fitted values from this regression as our measure of "instrumented" foreign official net purchases to estimate the impact of exogenous variation in these flows on excess returns.

5.3 Instruments for private flows

As instruments for foreign private flows, we use currency depreciations against the dollar. The idea here is that foreign private portfolios should respond to past changes in exchange rates.

Our choice of currencies is in part motivated by the results in Table 5. As mentioned before, 6 out the 13 countries that explain private flows belong to the euro area. Hence, it is natural to consider changes in the USD/EUR exchange rate as a possible driver of flows into the U.S. Treasury market. Also, flows from Japan, Canada and the U.K. also appear to correlate significantly with aggregate private flows: because of this, we also consider changes in the CAD/USD, JPY/USD and USD/GBP rates. With respect to the other countries in the table, recall that most of the Caribbean Banking center countries as well as China and Hong Kong have fixed exchange rates against the U.S. dollar.

Figure 4 plots the instruments for foreign private flows. Except for the USD/EUR rate, these currency movements will explain low-frequency changes in demand.

5.3.1 First-stage results: instrumental variables

Panel B of Table 6 presents the results of regressing foreign private net purchases on lagged values of all the instruments. The results indicate that long-term appreciation of the Canadian dollar (negative CAD/USD growth rate), short-term appreciation of the euro (positive USD/EUR growth rate), and long-term appreciation of the British pound (positive USD/GBP growth rate) all forecast inflows into long-term U.S. Treasury notes. While it is outside of the scope of the present paper to provide a detailed explanation of the portfolio strategies followed by the foreign private institutions that invest in the long-term US treasury market, we note that from the point of view of foreign investors, past domestic currency appreciations increase the domestic currency value of their U.S. investments. During 1994-2008, US treasury bonds had a low CAPM beta[18], so it is then conceivable that, faced with

[18] In a recent study of the risks in nominal U.S. bonds, Campbell et al. (2010) note that between 1994 and 2008 (our sample), the CAPM beta of the 10-year nominal zero-coupon Treasury bond decreased sharply from a value close to 1 to a negative figure during most of the 2000-2009 period. Indeed, between May1994 and December 2007, the average CAPM beta of the 10-year bond was close to 0.2. This implies that bonds

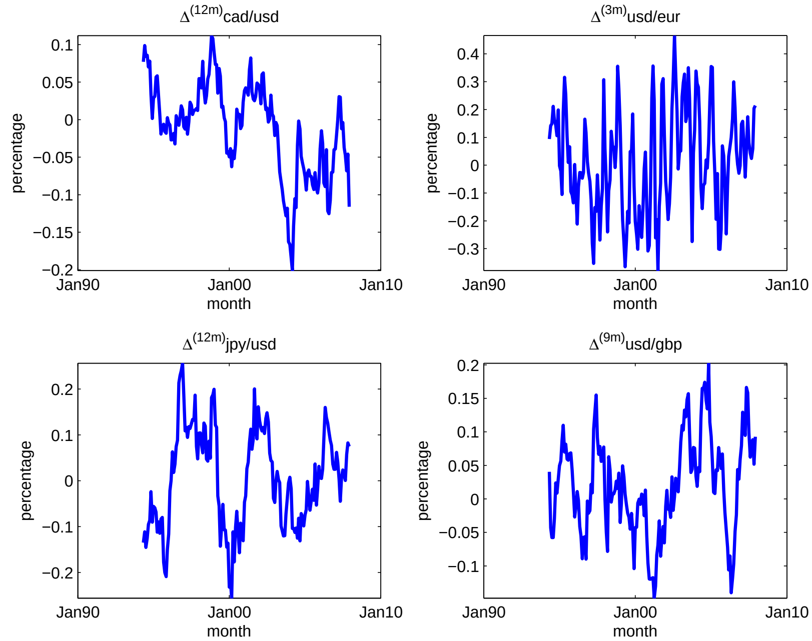

Figure 4: Log-growth rates in nominal exchange rates. May1994-Dec2007.

an increase in their capital, at least some conservative foreign private investors might chose to rebalance their portfolios and invest more in US bonds.

On the other hand, the results suggest that long-term depreciations of the Japanese Yen (positive JPY/USD growth rate) are associated with private inflows into U.S. bonds. This can be partially explained if the money obtained from exports as a consequence of benign currency trends is recycled into U.S. bonds.

Overall, the regression explains close to 24% of the variation in private flows. As before, the F-statistics for joint significance are all well above 10, which is the threshold suggested by Staiger and Stock (1997) when trying to determine if the instruments are weak. In the second stage regressions, we use the fitted values from this regression as our measure of "instrumented" foreign private net purchases.

6 Instrumented net purchases and excess bond returns

In this section, we discuss the main results of the paper. As before, we concentrate on a specification that includes squared official flows together with linear private flows. Additional results in which both flows enter either linearly or nonlinearly are presented in Table 8, which shows that the main conclusions do not change.

would have been close to hedges against stock market risk.

6.1 In-sample results

Table 7 shows the results of regressing one-year ahead excess returns on time t instrumented net purchases and controls. The signs of the estimated coefficients are similar to those obtained using un-instrumented flows, and show a clear distinction in the effect of foreign official and private flows on excess returns. With respect to official purchases we see that the estimated coefficients on $\widehat{\text{foi}}_t^2$ are again all negative, but bigger in magnitude and estimated with greater precision: all coefficients up to that for the 8-year bond are highly significant. For private flows, the coefficients on $\widehat{\text{priv}}_t$ are again all positive, but now, as in the case of official flows, larger and estimated with more precision. Thus, the extraction of a component of flows that is perfectly correlated with past information clearly helps to improve the precision of the estimates.

Interestingly, the term structure of estimated coefficients differs across types of flows. For private flows, the coefficients increase monotonically with maturity, as the highest coefficient is that of the 10-year bond. On the other hand, for official flows, the coefficients increase (in absolute value) with maturity up to the 6 year bond, and then decay; that is, they feature a hump-shaped pattern. Notice that, in particular, the coefficient for the 10 year bond is not the highest or even statistically significant. Thus, the results do not lend strong support for the view that international capital flows where among the main drivers in the decrease in the 10-year yield between 1994 and 2007.

Overall, the most important finding is that the results suggest that the impact of capital flows on excess returns depends on the type of foreign entity. Official flows, with a negative and non-linear effect, appear similar to relative supply shocks that decrease the amount of bonds available, drive up their prices and thus decrease yields through the component related to excess returns. Private net purchases, with a positive and linear effect, resemble flows that absorb excess supply and are thus compensated in equilibrium for this service, similar to the role of arbitrageurs in the preferred-habitat model of Vayanos and Vila (2009)[19]. Or, along these lines, we can also think of foreign private agents as simply having a mean-variance objective for their optimal portfolio allocation (both explanations are equivalent). Finally, it could also be the case that the positive correlation reflects the fact that foreign private agents are able to systematically position themselves to exploit low-frequency movements in excess returns.

6.2 Out-of-sample tests

In the last section, we showed evidence that foreign official and private flows forecast future excess returns in-sample. In this section, we present the results of out-of-sample forecasting exercises. In particular, we gauge the forecasting ability of foreign net purchases by calcu-

[19]In that model, an increase in the relative supply must be absorbed by arbitrageurs and, in equilibrium, forecasts positive excess returns. This is because arbs are mean-variance optimizers, and the only way they are willing to take positive positions in bonds is if these promise positive excess returns. Also, because of the single-factor Vasicek-type structure of the model, risks are perfectly correlated across maturities. This implies that, in order for arbs to absorb the excess supply of, say, 6-year bonds, the excess returns (compensation) of all adjacent bonds must also go up, since by accumulating more 6-year bonds, arbs are now exposed to more short-rate risk, and will try to diversify across maturities. So, in the end, the effect of relative supply shocks are not concentrated in the maturity in which they occur.

lating the MSE-ratio criterion, and the forecast encompassing test proposed by Clark and McCracken (2001).

Columns (5) and (6) of Table 9 present the mean-squared error ratio, and the enc-new statistic for forecast encompassing, respectively. Each row corresponds to a specific bond: for example, the third row presents the results of the out of sample tests when the dependent variable is the 4-year bond excess return. In general, we see that the conclusions about forecasting performance from out-of-sample tests are consistent with the in-sample regressions. All of the mean-squared error ratios are below one, and the enc-new statistics are much higher than the 99% critical value when there are two additional regressors to test. In sum, the out-of-sample test indicates that foreign flows would have helped to improve forecasts of excess returns.

7 The problem with benchmark-consistent data on holdings

In this paper, we have used data on foreign net purchases to test if they have any impact on risk premia. It is well known that the TIC data on *flows* is imperfect, because when this data is used to obtain the level of *holdings*, the resulting estimate rarely matches the figures reported in the comprehensive (but infrequent) security-level annual benchmark surveys of foreign holdings[20]. In principle, these two sources can be combined to obtain a better monthly measure of the level of foreign holdings (and net purchases) of U.S. Treasury securities. For example, Bertaut and Tryon (2007), extending the methodology originally used in Thomas et al. (2004) and Warnock and Warnock (2009), construct monthly estimates of U.S. cross-border securities positions obtained by combining the benchmark surveys with monthly transactions data. Thus, this new series, which uses the primitive data on net purchases but performs additional manipulations in order to make it "consistent" with the surveys would seem to be a better source of information about foreign flows into the U.S. Treasury market. However, as we show next, the problem with this approach is that the adjusted data will then mix the effects of market prices on capital flows, and this can create a spurious strong negative relationship between flows and yields.

[20]Although this is mostly true for the UK, given the financial center reporting bias. For other countries, the discrepancies between flows-based estimates of holdings and reported holdings are small. See, for example, the document "Major Foreign Holders of Treasury Securities", available at http://www.treas.gov/tic/mfhhis01.txt. Indeed, the reporting error is small for the major holders of treasury debt: China and Japan. For example, as of June 2008, the flows-based estimate of holdings for China was 503.8 billion, while the survey figure was 535.1 billion; this represents a reporting error of (535.1-503.8)/503.8 = 0.0621, or 6%. For Japan, the reporting error is (628.0-580.4)/580.4 = 0.0820, or 8%. On the other hand, for the U.K. the reporting error is (279.1-55.0)/55.0 = 4.0745, or 407%. Thus, if the goal is to study the importance of flows across countries, the net purchase data can give an incomplete picture. But if the goal is to study broad aggregates, and most importantly, their relationship to market prices, the net purchase data, while still containing reporting errors, is at least free of any additional manipulation that introduces endogenous noise into the figures.

Bertaut and Tryon (2007) construct measures of holdings (positions) $\tilde{S}_t$ from data on net purchases and market prices using the formula[21]:

$$\tilde{S}_t = \tilde{S}_{t-1}(1+\hat{\pi}_t) + \hat{N}_t + \frac{\lambda_t G_T}{\pi_{t,T}}. \tag{5}$$

where

$$\lambda_t = \lambda(\{\tilde{S}_i\}_{i=1}^T, \{\tilde{\pi}_i\}_{i=1}^T, \{\tilde{N}_i\}_{i=1}^T, \{\tilde{\varepsilon}_i\}_{i=1}^T, \{\tilde{\beta}_i\}_{i=1}^T)$$

$\tilde{\pi}_{i,t}$ is the rate of increase in the price of securities from i to t, and $\tilde{N}_i$ is observed net flows, both assumed to be observed with error. ε represents measurement error in security prices, while β is measurement error in the flows data, as well as transaction costs. $\tilde{G}_T = S_T - \tilde{S}_T$, is the "gap" or difference between actual and estimated survey positions. Notice that λ_t, an adjustment factor, depends on the (future) history of market value adjustments. Given that holdings are measured in nominal terms, to eliminate concerns about the stationarity of the data, if we take first differences of (5), we can decompose the change in holdings in 3 parts:

$$\begin{aligned} \Delta\tilde{S}_t \equiv \tilde{S}_t - \tilde{S}_{t-1} &= \underbrace{\tilde{S}_{t-1}\hat{\pi}_t} + \underbrace{\hat{N}_t} + \underbrace{\frac{\lambda_t G_T}{\pi_{t,T}}} \\ &= \text{val}_t + \text{flow}_t + \text{gap}_t. \end{aligned} \tag{6}$$

That is, the change in estimated holdings comes from either a valuation change, a "pure" net flow, or an allocation of the final gap. To get a sense of how strong is the correlation of $\Delta\tilde{S}_t$, as well as each component, with $\Delta y_t^{(10)}$, the ten-year treasury constant maturity rate, in Table 10 we present such correlations at various leads and lags. As can be seen, changes in holdings are negatively correlated with changes in interest rates, both contemporaneously as well as at several leads and lags. But a glance at the last three rows shows where the correlation is coming from. Most of the contemporaneous (as well as lagged) correlation of $\Delta\tilde{S}_t$ with $\Delta y_t^{(10)}$ comes from the negative correlation that val_t has with $\Delta y_t^{(10)}$. It is because of this shortcoming in the construction of "benchmark-consistent" flows that we chose to use the raw net purchase data.

8 Conclusion

In this paper, we measure the impact of international capital flows on the prices of long-term U.S. Treasury securities. We argue that if there is any effect of foreign net purchases of the prices of long-term U.S. Treasury bonds, it must be through risk-premia because short-rates are controlled by the Central Bank which does not respond to foreign purchases of long-term bonds. Hence, our empirical methodology consists of regressing future realized excess returns on time t measures of official and private flows. We address the problem of endogeneity by extracting a component of net purchases that is perfectly correlated with lagged instruments, and thus potentially uncorrelated to time t's shocks in relative supply.

[21]This is equation (5) in their paper. The description of the variables follows Bertaut and Tryon (2007) closely.

The most important finding is that the results suggest that the influence of capital flows on excess returns depends on the type of foreign entity; that is, we find a clear distinction in the nature of the impact of foreign flows on excess returns. Official flows, with a negative and non-linear effect, appear similar to relative supply shocks that decrease the amount of bonds available, drive up their prices and thus decrease yields through the component related to excess returns. Private net purchases, with a positive and linear effect, resemble flows that absorb excess supply and are thus compensated in equilibrium for this service, similar to the role of arbitrageurs in preferred-habitat models of the term structure. Or, alternatively, we could think of foreign private agents as having the skill to systematically position themselves to exploit low-frequency movements in excess returns.

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Appendices

A Holding period returns

Consider a 10-year nominal discount bond. If each time period is a quarter, then it is a 40-quarter bond. The Euler equation is:

$$\mathrm{P}_t^{(40)} = \mathbb{E}_t\left[\mathrm{M}_{t+1}^{\$}\mathrm{P}_{t+1}^{(39)}\right]$$

Under joint lognormality, we have that the log-bond price is

$$\begin{aligned} p_t^{(40)} &= -y_t^{(1)} + \mathbb{E}_t(p_{t+1}^{(39)}) + \tfrac{1}{2}\sigma_t^2(p_{t+1}^{(39)}) \quad +\sigma_t(m_{t+1}^{\$}, p_{t+1}^{(39)}) \\ &= -y_t^{(1)} + \mathbb{E}_t(p_{t+1}^{(39)}) - \mathbb{E}_t(rx_{t+1}^{(40)}) \end{aligned} \tag{7}$$

If we use (9) and substitute for $p_{t+1}^{(39)}$, we obtain:

$$p_t^{(40)} = -(y_t^{(1)} + \mathbb{E}_t(y_{t+1}^{(1)})) + \mathbb{E}_t(p_{t+2}^{(38)}) - \mathbb{E}_t(rx_{t+2}^{(39)}) - \mathbb{E}_t(rx_{t+1}^{(40)})$$

If we perform the same substitution, first with $p_{t+2}^{(38)}$ and then with $p_{t+3}^{(37)}$, we obtain:

$$\begin{aligned} p_t^{(40)} &= -\Big(y_t^{(1)} + \mathbb{E}_t(y_{t+1}^{(1)}) + \mathbb{E}_t(y_{t+2}^{(1)}) + \mathbb{E}_t(y_{t+3}^{(1)})\Big) + \mathbb{E}_t(p_{t+4}^{(36)}) \\ &\quad - \Big(\mathbb{E}_t(rx_{t+4}^{(37)}) + \mathbb{E}_t(rx_{t+3}^{(38)}) + \mathbb{E}_t(rx_{t+2}^{(39)}) + \mathbb{E}_t(rx_{t+1}^{(40)})\Big) \end{aligned} \tag{8}$$

That is, over the next year, the bond "collects" 4 one-period short rates, and 4 excess returns (which can be positive or negative). Notice that $p_{t+4}^{(36)}$ embeds short-rates and excess returns that happen after $t+4$. Therefore, concentrating at a one-year horizon, since short-rates are controlled by the monetary authority, then any impact of large purchases by foreign agents must happen through risk premiums.

Notice that (8) uses quarterly sampled data, while in the empirical implementation of the paper, we use annual yields; i.e., instead of 4 expected future short-rates, we had the 1-year yield. However, it can be shown that (8) is equivalent to (**??**), with a slight modification of the risk premium term. Consider a 1-year (4-quarter) nominal bond. It's euler equation is:

$$\mathrm{P}_t^{(4)} = \mathbb{E}_t\left[\mathrm{M}_{t+1}^{\$}\mathrm{P}_{t+1}^{(3)}\right].$$

Again, assuming joint lognormality of the nominal stochastic discount factor and bond prices, we get that the log-bond price is:

$$p_t^{(4)} = -y_t^{(1)} + \mathbb{E}_t(p_{t+1}^{(3)}) - \mathbb{E}_t(rx_{t+1}^{(4)}) \tag{9}$$

Doing the same substitutions for $p_{t+1}^{(3)}$, $p_{t+2}^{(2)}$, and noting that $p_{t+3}^{(3)} = -y_{t+3}^{(1)}$, we arrive at:

$$\begin{aligned} p_t^{(4)} &= -\Big(y_t^{(1)} + \mathbb{E}_t(y_{t+1}^{(1)}) + \mathbb{E}_t(y_{t+2}^{(1)}) + \mathbb{E}_t(y_{t+3}^{(1)})\Big) \\ &\quad - \Big(\mathbb{E}_t(rx_{t+3}^{(2)}) + \mathbb{E}_t(rx_{t+2}^{(3)}) + \mathbb{E}_t(rx_{t+1}^{(4)})\Big) \end{aligned} \tag{10}$$

Notice there is no term with expected future bond price at time $t+4$ since the bond matures in $t+4$, and that the bond only collects 3 risk premiums, since at the 4th period, there is no "excess" return over the 3-month rate. If we solve (10) for the term involving the sum of the expected future short rates and substitute into (8), we get:

$$\begin{aligned} p_t^{(40)} &= p_t^{(4)} + \mathbb{E}_t(p_{t+4}^{(36)}) - \mathbb{E}_t(rx_{t+4}^{(37)}) - \Big(\mathbb{E}_t(rx_{t+3}^{(38)}) - \mathbb{E}_t(rx_{t+3}^{(2)})\Big) \\ &\quad - \Big(\mathbb{E}_t(rx_{t+2}^{(39)}) - \mathbb{E}_t(rx_{t+2}^{(3)})\Big) - \Big(\mathbb{E}_t(rx_{t+1}^{(40)}) - \mathbb{E}_t(rx_{t+1}^{(4)})\Big) \end{aligned} \tag{11}$$

Remember that $p_t^{(4)}$ is exactly the one-year yield. So, if we measure excess returns at the 1-year horizon, the "risk premium" term is the difference between excess returns realized at each quarter between the long bond and the bond of the same maturity as the holding period. But the same conclusion applies: any effect of capital flows on prices has to be on risk premiums. It is because of this that we look directly at realized excess returns and relate them to measures of net purchases, using a particular identification strategy, to gauge any causal effects.

Table 1: Maturity structure of foreign holdings of long-term U.S. Treasury securities.

This table presents the maturity distribution of foreign holdings of long-term U.S. Treasury securities. As indicated in the benchmark surveys, in the "time to maturity" column, "1-2" should be read as holdings that will mature between a year and a day, and two years after June 30 of the survey year. Source: Report on Foreign Portfolio Holdings of U.S. Securities, Department of the Treasury, 2002-2008.

Time to maturity range (years)	Survey year						
	2002	2003	2004	2005	2006	2007	2008
	Panel A: Total						
≤ 1	14.8	14.2	16.3	16.2	16.7	15.7	15.7
1-2	24.5	24.3	20.3	20.6	20.4	21.1	22.4
2-3	8.5	8.0	11.2	12.2	11.8	12.7	8.7
3-4	7.9	7.6	9.5	10.4	10.4	8.7	8.5
4-5	8.6	11.7	12.7	11.1	8.8	8.3	11.1
5-6	5.1	3.3	2.7	2.3	2.4	3.3	5.5
6-7	3.8	3.6	2.7	2.4	3.4	5.3	5.5
7-8	3.6	3.8	2.3	3.7	5.7	5.5	5.3
8-9	4.2	3.5	4.6	6.2	6.1	6.1	5.0
9-10	3.8	6.0	7.7	6.0	6.6	5.3	5.1
10-15	2.6	2.7	2.8	2.7	2.4	2.6	2.4
15-20	4.1	4.5	3.1	2.6	2.3	2.5	2.4
≥ 20	8.6	6.7	4.0	3.6	3.0	2.8	2.4
	Panel B: official						
≤ 1	-	-	19.6	19.2	18.9	17.4	16.9
1-2	-	-	23.7	23.1	22.1	22.7	24.1
2-3	-	-	11.7	12.7	12.8	13.6	9.4
3-4	-	-	9.3	11.3	11.6	9.5	9.1
4-5	-	-	12.8	11.5	8.7	8.3	11.1
5-6	-	-	2.8	2.3	2.3	2.9	5.8
6-7	-	-	2.9	1.9	3.0	5.6	5.6
7-8	-	-	2.0	2.8	6.1	5.5	5.3
8-9	-	-	4.1	7.0	5.9	5.9	4.6
9-10	-	-	7.3	5.1	5.5	4.5	4.0
10-15	-	-	1.0	0.8	1.4	1.8	1.8
15-20	-	-	1.4	1.1	0.9	1.2	1.0
≥ 20	-	-	1.4	1.1	0.8	1.0	1.2
	Panel C: Private						
≤ 1	-	-	10.7	10.1	11.2	11.0	11.7
1-2	-	-	14.5	15.2	16.4	16.2	16.5
2-3	-	-	10.3	11.3	9.4	10.0	6.4
3-4	-	-	9.8	8.7	7.5	6.4	6.7
4-5	-	-	12.5	10.3	8.9	8.2	11.2
5-6	-	-	2.6	2.4	2.5	4.5	4.4
6-7	-	-	2.5	3.5	4.3	4.6	5.1
7-8	-	-	2.9	5.5	4.6	5.4	5.4
8-9	-	-	5.5	4.7	6.7	6.6	6.3
9-10	-	-	8.5	7.6	9.5	7.6	8.5
10-15	-	-	5.8	6.4	4.9	4.9	4.3
15-20	-	-	6.0	5.5	5.7	6.3	7.0
≥ 20	-	-	8.3	8.8	8.3	8.3	6.5

Table 2: Forecasts of excess stock returns

This table presents parameter estimates of forecasting regressions of excess returns on the CRSP Value-weighted stock price index. The dependent variable $rx_{t+k}^{(vw)}$ is the realized return on the VW index in excess of the k-month treasury rate observed in month t. $\widetilde{\text{gsw9407}}_t$ is the residual in a regression of gsw9407_t on a constant and cp9407_t. cp9407_t is a factor constructed as the fitted value in a forecasting regression of average (across the 2 to 5 year maturity range) realized excess return at time $t+1$ on time t forward rates, as in Cochrane and Piazzesi (2005), but using data from May1994-Dec2007 for forward rates, and May1995-Dec2008 for excess returns. gsw9407_t is a factor constructed as the fitted value in a forecasting regression of average (across the 6 to 10 year maturity range) realized excess return at time $t+1$ on time t forward rates of maturities of 6, 8 and 10 years, using data from May1994-Dec2007 for forward rates, and May1995-Dec2008 for excess returns. d/p is the natural log of the dividend yield (all firms continuosly listed on NYSE, AMEX, or NASDAQ) from Boudoukh et al. (2007), and downloaded from Michael R. Robert's website. term, the term spread, is the difference between the 10-year Treasury constant maturity rate and the 3-month Treasury Bill Secondary Market rate. Data is sampled at a monthly frequency, with explanatory variables measured during the period May1994-December2007. Hansen and Hodrick (1980) AC t-statistics of lag order 3, 6 and 12 are in parentheses. Coefficient estimates that are significant at the 95% confidence level or better are highlighted in boldface.

	constant (t-stat)	$\widetilde{\text{gsw9407}}_t$ (t-stat)	d/p (t-stat)	term (t-stat)	adjR^2
$rx_{t+3}^{(vw)}$	0.302	**-0.863**	**0.080**	0.010	0.242
	(1.823)	(-3.672)	(2.025)	(1.403)	
$rx_{t+6}^{(vw)}$	**0.673**	**-1.479**	**0.164**	0.014	0.422
	(2.412)	(-4.035)	(2.480)	(1.135)	
$rx_{t+12}^{(vw)}$	**1.204**	**-2.312**	0.280	0.017	0.410
	(2.031)	(-3.452)	(1.984)	(0.666)	

Table 3: Excess returns and un-instrumented net purchases: baseline results

This table presents parameter estimates of forecasting regressions of one-year ahead excess returns on lagged variables. The dependent variable, $rx_{t+1}^{(n)}$ is the realized excess return on an n-year bond, with the specific maturity indicated in column 1. In constructing all excess returns and factors, returns for the 2 to 5 year maturity range are from the Fama-Bliss dataset, while those of the 6 to 10 year maturity range are from the Gurkaynak et al. (2006) dataset. ln9407_t is a factor constructed as the fitted value in a forecasting regression of average (across the 2 to 5 year maturity range) realized excess return at time $t+1$ on time t principal components of macro variables, as in Ludvigson and Ng (2009), but using data from May1994-Dec2007 for the macro factors, and May1995-Dec2008 for the average excess return. cp9407_t is a factor constructed as the fitted value in a forecasting regression of average (across the 2 to 5 year maturity range) realized excess return at time $t+1$ on time t forward rates, as in Cochrane and Piazzesi (2005), but using data from May1994-Dec2007 for forward rates, and May1995-Dec2008 for excess returns. $\widetilde{\text{gsw9407}}_t$ is the residual in a regression of gsw9407_t on a constant and cp9407_t, where gsw9407_t is a factor constructed as the fitted value in a forecasting regression of average (across the 6 to 10 year maturity range) realized excess return at time $t+1$ on time t forward rates of maturities of 6, 8 and 10 years, using data from May1994-Dec2007 for forward rates, and May1995-Dec2008 for excess returns. foi_t is foreign official net purchases of long-term U.S. Treasury securities, normalized by the total amount outstanding of treasury notes and bonds. priv_t is foreign private net purchases of long-term U.S. Treasury securities, normalized by the total amount outstanding of treasury notes and bonds. Data is sampled at a monthly frequency, with explanatory variables measured during the period May1994-December2007, and excess returns (dependent variables) during the May1995-December2008 period. Hansen and Hodrick (1980) AC t-statistics of lag order 12 are in parentheses. Coefficient estimates that are significant at the 95% confidence level or better are highlighted in boldface.

	constant (t-stat)	ln9407_t (t-stat)	cp9407_t (t-stat)	$\widetilde{\text{gsw9407}}_t$ (t-stat)	foi_t^2 (t-stat)	priv_t (t-stat)	$\bar{R}^2$	χ^2 F
Fama-Bliss 2-5yr mat. bonds								
$rx_{fb,t+1}^{(2)}$	-0.003	**0.294**	**0.404**	**0.200**	**-0.009**	0.002	0.668	477.072
	(-1.088)	(2.946)	(4.093)	(5.510)	(-2.111)	(1.294)		95.414
$rx_{fb,t+1}^{(3)}$	-0.005	**0.475**	**0.784**	**0.411**	-0.016	0.006	0.661	319.112
	(-0.875)	(2.409)	(4.020)	(5.859)	(-1.916)	(1.978)		63.822
$rx_{fb,t+1}^{(4)}$	-0.006	0.526	**1.068**	**0.585**	-0.020	**0.011**	0.639	228.076
	(-0.688)	(1.902)	(3.898)	(5.946)	(-1.695)	(2.481)		45.615
$rx_{fb,t+1}^{(5)}$	-0.007	0.464	**1.335**	**0.775**	-0.020	**0.015**	0.636	196.903
	(-0.674)	(1.360)	(3.949)	(6.388)	(-1.366)	(2.886)		39.381
Gurkaynak, Sack and Wright 6-10yr mat. bonds								
$rx_{gsw,t+1}^{(6)}$	-0.006	0.369	**1.642**	**0.888**	-0.019	**0.019**	0.615	148.019
	(-0.508)	(0.921)	(4.139)	(6.178)	(-1.093)	(3.005)		29.604
$rx_{gsw,t+1}^{(7)}$	-0.005	0.225	**1.901**	**1.002**	-0.016	**0.022**	0.598	122.091
	(-0.374)	(0.498)	(4.248)	(6.122)	(-0.852)	(3.141)		24.418
$rx_{gsw,t+1}^{(8)}$	-0.004	0.050	**2.145**	**1.097**	-0.014	**0.025**	0.577	105.080
	(-0.246)	(0.100)	(4.322)	(5.994)	(-0.640)	(3.215)		21.016
$rx_{gsw,t+1}^{(9)}$	-0.002	-0.145	**2.373**	**1.177**	-0.011	**0.028**	0.554	96.008
	(-0.125)	(-0.263)	(4.349)	(5.803)	(-0.459)	(3.238)		19.202
$rx_{gsw,t+1}^{(10)}$	-0.000	-0.353	**2.584**	**1.243**	-0.008	**0.030**	0.529	93.152
	(-0.011)	(-0.586)	(4.332)	(5.569)	(-0.309)	(3.227)		18.630

Table 4: Excess returns and un-instrumented net purchases: alternative specifications

This table presents parameter estimates of forecasting regressions of one-year ahead excess returns on lagged variables. It includes alternative specifications to the main results on Table 3. The variables employed and their construction are explained in that table. Data is sampled at a monthly frequency, with explanatory variables measured during the period May1994-December2007, and excess returns (dependent variables) during the May1995-December2008 period.

	constant (t-stat)	ln9407_t (t-stat)	cp9407_t (t-stat)	$\widetilde{\text{gsw9407}}_t$ (t-stat)	foi_t (t-stat)	priv_t (t-stat)	foi_t^2 (t-stat)	priv_t^2 (t-stat)	adjR2	χ^2 F
					Fama-Bliss 2-5yr mat. bonds					
	-0.003	**0.279**	**0.414**	**0.199**	**-0.006**	0.002			0.666	365.361
$rx^{(2)}_{fb,t+1}$	(-1.053)	(2.819)	(4.247)	(5.537)	(-2.119)	(1.039)				73.072
	-0.003	**0.294**	**0.403**	**0.197**			**-0.009**	0.001	0.665	420.161
	(-1.035)	(2.934)	(4.084)	(5.401)			(-2.039)	(1.170)		84.032
	-0.005	**0.452**	**0.801**	**0.408**	-0.011	0.005			0.658	292.300
$rx^{(3)}_{fb,t+1}$	(-0.863)	(2.298)	(4.127)	(5.854)	(-1.780)	(1.731)				58.460
	-0.005	**0.476**	**0.778**	**0.399**			-0.015	0.004	0.654	314.355
	(-0.771)	(2.373)	(3.939)	(5.602)			(-1.789)	(1.690)		62.871
	-0.006	0.518	**1.087**	**0.584**	-0.011	**0.010**			0.632	242.559
$rx^{(4)}_{fb,t+1}$	(-0.754)	(1.861)	(3.956)	(5.911)	(-1.269)	(2.222)				48.512
	-0.004	0.530	**1.049**	**0.564**			-0.018	0.006	0.625	217.132
	(-0.507)	(1.848)	(3.711)	(5.536)			(-1.506)	(1.848)		43.426
	-0.008	0.483	**1.352**	**0.777**	-0.007	**0.014**			0.629	250.596
$rx^{(5)}_{fb,t+1}$	(-0.810)	(1.403)	(3.980)	(6.359)	(-0.711)	(2.644)				50.119
	-0.005	0.470	**1.305**	**0.746**			-0.018	**0.008**	0.617	161.326
	(-0.448)	(1.308)	(3.682)	(5.833)			(-1.148)	(2.062)		32.265
					GSW 6-10yr mat. bonds					
	-0.008	0.398	**1.656**	**0.891**	-0.006	**0.018**			0.609	229.028
$rx^{(6)}_{gsw,t+1}$	(-0.652)	(0.987)	(4.163)	(6.160)	(-0.459)	(2.799)				45.806
	-0.003	0.379	**1.592**	**0.852**			-0.016	0.009	0.590	116.817
	(-0.230)	(0.889)	(3.787)	(5.572)			(-0.857)	(1.870)		23.363
	-0.007	0.276	**1.912**	**1.006**	-0.002	**0.021**			0.593	213.585
$rx^{(7)}_{gsw,t+1}$	(-0.553)	(0.608)	(4.274)	(6.129)	(-0.138)	(2.965)				42.717
	-0.001	0.239	**1.835**	**0.959**			-0.013	0.010	0.568	88.719
	(-0.064)	(0.492)	(3.828)	(5.462)			(-0.608)	(1.802)		17.744
	-0.007	0.124	**2.152**	**1.104**	0.002	**0.024**			0.575	187.286
$rx^{(8)}_{gsw,t+1}$	(-0.456)	(0.248)	(4.356)	(6.031)	(0.148)	(3.071)				37.457
	0.001	0.068	**2.062**	**1.048**			-0.009	0.011	0.545	72.177
	(0.085)	(0.126)	(3.849)	(5.306)			(-0.396)	(1.715)		14.435
	-0.006	-0.048	**2.375**	**1.185**	0.007	**0.027**			0.554	155.013
$rx^{(9)}_{gsw,t+1}$	(-0.362)	(-0.087)	(4.397)	(5.871)	(0.396)	(3.126)				31.003
	0.004	-0.123	**2.274**	**1.122**			-0.006	0.011	0.519	64.984
	(0.219)	(-0.205)	(3.840)	(5.110)			(-0.220)	(1.620)		12.997
	-0.005	-0.231	**2.581**	**1.254**	0.011	**0.030**			0.531	124.961
$rx^{(10)}_{gsw,t+1}$	(-0.271)	(-0.389)	(4.396)	(5.665)	(0.609)	(3.143)				24.992
	0.006	-0.328	**2.470**	**1.182**			-0.002	0.011	0.493	63.922
	(0.336)	(-0.497)	(3.804)	(4.889)			(-0.078)	(1.528)		12.784

Table 5: Approximate country attribution of Net Purchases

This table presents estimated coefficients in regressions of **aggregate** foreign official and private net purchases of long-term U.S. Treasury securities on individual country net purchases. foi_t is net purchases by official institutions of all countries, and priv_t is net purchases by non-official institutions of all countries. The individual country net purchase data represents the sum of both official and non-official flows for that country and is standardized to be able to compare the magnitudes of the coefficients across countries. The regressions only report those countries for which the estimated coefficient was significant in a first-stage regression is which all countries were included. Newey and West (1987) HAC t-statistics of lag order 3 are in parentheses.

Panel A: foreign official flows: foi_t			Panel B: foreign private flows: priv_t		
country	coeff.	nw-tstat	country	coeff	nw-tstat
constant	0.154	13.615	constant	0.336	22.252
japan	0.154	8.121	uk	0.342	29.049
norway	0.143	11.083	caribbean	0.315	21.983
china	0.092	5.457	japan	0.136	5.122
oil exporters	0.088	6.225	canada	0.071	3.774
brazil	0.076	6.046	netherlands	0.068	6.053
taiwan	0.068	4.855	china	0.048	2.945
singapore	0.064	7.140	hong kong	0.046	4.166
mexico	0.051	5.648	france	0.045	3.763
germany	0.042	3.036	ireland	0.041	3.146
israel	0.041	3.849	bel-lux	0.039	2.326
turkey	0.039	4.164	germany	0.037	2.531
egypt	0.031	2.365	thailand	0.032	2.596
switz	0.025	2.372	russia	0.026	1.997
philipines	-0.027	-2.391			
adjR^2		0.776	adjR^2		0.890

Table 6: Regressions of foreign net purchases on lagged instruments

This table presents parameter estimates in regressions that forecast foreign net purchases of U.S. Treasuries with lagged values of instruments. The variables used to forecast foreign official net purchases, foi_t, are as follows. The government-related yield spread, $\text{govt-related}_{t-3}$, is the difference between the redemption yield (in USD) of the Barclays Capital Government-Related Index and the average of the 1, 3 and 5 year Treasury Constant Maturity rates. The bund-spreads, $\text{bund-spread}_{t-1}^{(5-10)}$ and $\text{bund-spread}_{t-1}^{(10+)}$, are the difference between the yield to maturity of the Bank of America Merrill Lynch German Federal Governments 5-10 Yrs and 10+Yrs indices (in local currency), respectively, and the yield to maturity on the U.S. Treasuries 5-10 Yrs and 10+Yrs indices, respectively. The U.S. dollar volume (in billions) of Japan's Ministry of Finance (MOF) interventions, MoF-int_{t-2}, is constructed as the sum of all daily intervention operations during the month, where each intervention amount in Yen on day t is converted to U.S. dollars using the closing JPY/USD exchange rate on the last trading day before intervention day. ret-sp500_{t-2} is the return on the S&P 500 index. For foreign private net purchases, priv_t, the instruments are: $\Delta^{(12m)}e_{\text{cad},t-3}$, the 12-month depreciation of the CAD against the USD; $\Delta^{(3m)}e_{\text{eur},t-2}$, the 3-month depreciation of the USD against the EUR; $\Delta^{(12m)}e_{\text{jpy},t-6}$, the 12-month depreciation of the JPY against the USD; $\Delta^{(9m)}e_{\text{gbp},t-6}$, the 9-month depreciation of the USD against the GBP. Both net purchases series are normalized by the total amount outstanding of treasury notes and bonds. The sample is monthly from May1994 to December2007 for the dependent variables. In the columns labeled "t-stats", nw and hh denote test statistics constructed using Newey and West (1987) HAC and Hansen and Hodrick (1980) AC standard errors, with lag order 14 for regressions of official net purchases, and 1 for private net purchases. The 90, 95 and 99 percent critical values for the F distribution with (5,158) degrees of freedom are 1.88, 2.27 and 3.14, respectively.

		t-stat		
Regressors	estimate	ols	nw	hh
Panel A: foreign official flows: foi_t				
constant	0.179	3.574	4.336	3.047
$\text{govt-related}_{t-3}$	-0.270	-3.061	-4.412	-2.754
$\text{bund-spread}_{t-1}^{(5-10)}$	-0.302	-3.432	-3.323	-2.880
$\text{bund-spread}_{t-1}^{(10+)}$	0.500	4.366	3.139	3.699
MoF-int_{t-2}	0.010	4.445	4.182	4.142
ret-sp500_{t-2}	0.145	3.423	3.903	3.415
F-stat		16.294	16.173	12.444
adjR^2	0.319			
Panel B: foreign private flows: priv_t				
constant	0.261	7.148	8.198	7.259
$\Delta^{(12m)}e_{\text{cad},t-3}$	-2.375	-3.966	-3.662	-4.028
$\Delta^{(3m)}e_{\text{eur},t-2}$	0.568	2.952	3.158	2.998
$\Delta^{(12m)}e_{\text{jpy},t-6}$	1.223	3.601	4.286	3.657
$\Delta^{(9m)}e_{\text{gbp},t-6}$	1.669	3.352	3.838	3.404
F-stat		13.728	14.382	14.160
adjR^2	0.238			

Table 7: Excess returns and instrumented net purchases: baseline results.

This table presents parameter estimates of forecasting regressions of one-year ahead excess returns on lagged variables. The dependent variable, $rx_{t+1}^{(n)}$ is the realized excess return on an n-year bond, with the specific maturity indicated in column 1. In constructing all excess returns and factors, returns for the 2 to 5 year maturity range are from the Fama-Bliss dataset, while those of the 6 to 10 year maturity range are from the Gurkaynak et al. (2006) dataset. The construction of the control variables cp9407_t, ln9407_t and $\widetilde{\text{gsw9407}}_t$ is explained in Table 3. $\widehat{\text{foi}}_t$, *instrumented* foreign official net purchases, is the fitted value in a regression of foi_t on lagged values of instruments and corresponds to the fitted value of the regression in Panel A of Table 6. $\widehat{\text{priv}}_t$, *instrumented* foreign private net purchases, is the fitted value in a regression of priv_t on lagged values of instruments and corresponds to the fitted value of the regression in Panel B of Table 6. Data is sampled at a monthly frequency. Hansen and Hodrick (1980) AC t-statistics of lag order 12 are in parentheses. Coefficient estimates that are significant at the 95% confidence level or better are highlighted in boldface.

	constant (t-stat)	ln9407_t (t-stat)	cp9407_t (t-stat)	$\widetilde{\text{gsw9407}}_t$ (t-stat)	$\widehat{\text{foi}}_t^2$ (t-stat)	$\widehat{\text{priv}}_t$ (t-stat)	adjR2	χ^2 F
				Fama-Bliss 2-5yr mat. bonds				
$rx_{fb,t+1}^{(2)}$	-0.004	**0.308**	**0.437**	**0.195**	**-0.028**	0.005	0.685	621.814
	(-1.380)	(3.484)	(4.674)	(5.832)	(-2.898)	(1.004)		124.363
$rx_{fb,t+1}^{(3)}$	-0.009	**0.489**	**0.892**	**0.402**	**-0.061**	0.017	0.692	501.696
	(-1.589)	(2.996)	(5.228)	(6.605)	(-3.379)	(1.932)		100.339
$rx_{fb,t+1}^{(4)}$	-0.013	**0.534**	**1.260**	**0.577**	**-0.083**	**0.031**	0.677	394.205
	(-1.696)	(2.402)	(5.369)	(6.890)	(-3.351)	(2.570)		78.841
$rx_{fb,t+1}^{(5)}$	-0.018	0.458	**1.610**	**0.770**	**-0.094**	**0.045**	0.676	348.336
	(-1.901)	(1.691)	(5.600)	(7.521)	(-3.107)	(3.072)		69.667
				Gurkaynak, Sack and Wright 6-10yr mat. bonds				
$rx_{gsw,t+1}^{(6)}$	-0.020	0.351	**1.970**	**0.884**	**-0.100**	**0.055**	0.654	273.469
	(-1.737)	(1.088)	(5.697)	(7.165)	(-2.749)	(3.128)		54.694
$rx_{gsw,t+1}^{(7)}$	-0.021	0.195	**2.278**	**1.001**	**-0.099**	**0.064**	0.634	238.689
	(-1.615)	(0.528)	(5.697)	(7.001)	(-2.378)	(3.178)		47.738
$rx_{gsw,t+1}^{(8)}$	-0.022	0.010	**2.560**	**1.099**	**-0.095**	**0.072**	0.610	214.938
	(-1.469)	(0.024)	(5.623)	(6.741)	(-2.011)	(3.142)		42.988
$rx_{gsw,t+1}^{(9)}$	-0.022	-0.194	**2.818**	**1.181**	-0.089	**0.079**	0.583	194.534
	(-1.313)	(-0.413)	(5.492)	(6.419)	(-1.675)	(3.055)		38.907
$rx_{gsw,t+1}^{(10)}$	-0.021	-0.411	**3.055**	**1.250**	-0.082	**0.084**	0.555	175.273
	(-1.162)	(-0.783)	(5.329)	(6.072)	(-1.383)	(2.945)		35.055

Table 8: Excess returns and instrumented net purchases: alternative specifications

This table presents parameter estimates of forecasting regressions of one-year ahead excess returns on lagged variables. It includes alternative specifications to the main results on Table 7. The variables employed and their construction are explained in that table. Data is sampled at a monthly frequency, with explanatory variables measured during the period May1994-December2007, and excess returns (dependent variables) during the May1995-December2008 period. Hansen and Hodrick (1980) AC t-statistics of lag order 12 are in parentheses. Coefficient estimates that are significant at the 95% confidence level or better are highlighted in boldface.

	constant (t-stat)	$\ln9407_t$ (t-stat)	$cp9407_t$ (t-stat)	$gsw9407_t$ (t-stat)	$\widehat{\text{foi}}_t$ (t-stat)	$\widehat{\text{priv}}_t$ (t-stat)	$\widehat{\text{foi}}_t^2$ (t-stat)	$\widehat{\text{priv}}_t^2$ (t-stat)	adjR2	χ^2 F
					Fama-Bliss 2-5yr mat. bonds					
	-0.003	**0.278**	**0.434**	**0.191**	**-0.014**	0.005			0.675	444.947
$rx^{(2)}_{fb,t+1}$	(-0.988)	(3.009)	(4.538)	(5.518)	(-2.223)	(1.025)				88.989
	-0.003	**0.311**	**0.422**	**0.190**			**-0.028**	0.005	0.682	537.217
	(-1.205)	(3.442)	(4.573)	(5.647)			(-2.833)	(0.783)		107.443
	-0.007	**0.426**	**0.886**	**0.393**	**-0.030**	0.017			0.677	480.581
$rx^{(3)}_{fb,t+1}$	(-1.118)	(2.450)	(4.958)	(6.114)	(-2.467)	(1.870)				96.116
	-0.006	**0.499**	**0.838**	**0.385**			**-0.061**	0.017	0.681	459.708
	(-1.068)	(2.890)	(4.785)	(6.082)			(-3.174)	(1.395)		91.942
	-0.011	0.467	**1.243**	**0.568**	**-0.036**	**0.030**			0.653	333.162
$rx^{(4)}_{fb,t+1}$	(-1.234)	(1.916)	(4.941)	(6.280)	(-2.103)	(2.312)				66.632
	-0.007	**0.553**	**1.162**	**0.544**			**-0.082**	0.031	0.656	324.420
	(-0.940)	(2.270)	(4.689)	(6.092)			(-3.048)	(1.805)		64.884
	-0.016	0.398	**1.583**	**0.763**	-0.036	**0.043**			0.652	302.160
$rx^{(5)}_{fb,t+1}$	(-1.460)	(1.330)	(5.110)	(6.861)	(-1.742)	(2.693)				60.432
	-0.010	0.484	**1.480**	**0.722**			**-0.095**	**0.047**	0.652	250.968
	(-1.030)	(1.604)	(4.804)	(6.520)			(-2.827)	(2.246)		50.194
					GSW 6-10yr mat. bonds					
	-0.018	0.300	**1.935**	**0.880**	-0.035	**0.052**			0.631	243.781
$rx^{(6)}_{gsw,t+1}$	(-1.378)	(0.848)	(5.235)	(6.615)	(-1.416)	(2.728)				48.756
	-0.009	0.383	**1.802**	**0.827**			**-0.099**	**0.056**	0.625	186.940
	(-0.798)	(1.052)	(4.832)	(6.140)			(-2.441)	(2.192)		37.388
	-0.019	0.163	**2.234**	**1.000**	-0.030	**0.060**			0.613	217.823
$rx^{(7)}_{gsw,t+1}$	(-1.338)	(0.405)	(5.273)	(6.549)	(-1.065)	(2.758)				43.565
	-0.009	0.233	**2.080**	**0.933**			**-0.098**	**0.064**	0.602	150.834
	(-0.647)	(0.555)	(4.816)	(5.973)			(-2.091)	(2.204)		30.167
	-0.021	0.001	**2.508**	**1.103**	-0.023	**0.066**			0.592	197.784
$rx^{(8)}_{gsw,t+1}$	(-1.275)	(0.002)	(5.250)	(6.397)	(-0.729)	(2.721)				39.557
	-0.008	0.053	**2.336**	**1.023**			-0.093	**0.072**	0.576	127.391
	(-0.504)	(0.111)	(4.761)	(5.753)			(-1.757)	(2.167)		25.478
	-0.021	-0.179	**2.758**	**1.190**	-0.015	**0.071**			0.568	179.292
$rx^{(9)}_{gsw,t+1}$	(-1.196)	(-0.358)	(5.176)	(6.179)	(-0.425)	(2.643)				35.858
	-0.006	-0.148	**2.572**	**1.099**			-0.087	**0.078**	0.549	111.103
	(-0.370)	(-0.278)	(4.675)	(5.498)			(-1.458)	(2.103)		22.221
	-0.022	-0.370	**2.986**	**1.263**	-0.006	**0.076**			0.544	160.567
$rx^{(10)}_{gsw,t+1}$	(-1.110)	(-0.671)	(5.065)	(5.922)	(-0.165)	(2.546)				32.113
	-0.005	-0.361	**2.789**	**1.161**			-0.079	**0.083**	0.521	99.090
	(-0.251)	(-0.611)	(4.568)	(5.227)			(-1.202)	(2.032)		19.818

Table 9: Out-of-sample forecasts: Instrumented foreign net purchases

This table presents the results of out-of-sample forecast comparisons of nested regression models for excess bond returns. The dependent variable is the n-period excess bond return. The forecasting variables, for each bilateral comparison, are indicated in column(4). The vector x_t contains the control variables and is defined as: $x_t = (1, \text{cp9407}_t, \text{ln9407}_t, \widetilde{\text{gsw9407}_t})$. The vector y_t contains the additional forecasting variables and is defined as: $y_t = (\widehat{\text{foi}}_t^2, \widehat{\text{priv}}_t)$. All variables are defined in Table 7. MSE_u is the mean-squared error of the unrestricted model that includes y_t as additional regressors; MSE_r is the mean-squared error of the restricted model that excludes y_t, and hence is equivalent to the restriction that the estimated coefficient on y_t is zero. In column (5) a number less than one means that the unrestricted model has lower mean-squared forecasting error. "enc-new" is the statistic for the test of encompassing in Clark and McCracken (2001); the null hypothesis is that the restricted model encompasses the unrestricted model with additional regressors. The 99% asymptotic critical value is obtained as the average of the values for $\pi = 0.5$ and $\pi = 0.6$ (given that, in our case, $\pi = 0.53$) with $k_2 = 2$.

Dependent variable	Initial estimation period (2)	Forecast sample (3)	Comparison (4)	$\text{MSE}_u/\text{MSE}_r$ (5)	enc-new: Statistic (6)	enc-new: 99% asympt. CV (7)
Fama-Bliss 2-5yr mat. bonds						
$rx^{(2)}_{fb,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.8273	9.5920	2.89
$rx^{(3)}_{fb,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.8113	12.0021	2.89
$rx^{(4)}_{fb,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.8010	12.6208	2.89
$rx^{(5)}_{fb,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.7604	15.6165	2.89
Gurkaynak, Sack and Wright 6-10yr mat. bonds						
$rx^{(6)}_{gsw,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.7643	16.6391	2.89
$rx^{(7)}_{gsw,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.7631	17.9168	2.89
$rx^{(8)}_{gsw,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.7723	18.4204	2.89
$rx^{(9)}_{gsw,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.7905	18.0904	2.89
$rx^{(10)}_{gsw,t+1}$	1994:05-2002:08 (100 obs)	2004:08-2008:12 (53 obs)	$y_t + x_t$ vs. x_t	0.8124	17.2151	2.89

Table 10: Correlation between components of holdings and yield changes

This table presents correlation coefficients for lags $k = 0, 1, 2$ of changes in the 10-year treasury yield $\Delta y_t^{(10)}$ with components of *adjusted* foreign holdings of long-term U.S. Treasury series, as defined in equation (6) in the text. The holdings series and its components are from Bertaut and Tryon (2007), and are normalized by quarterly GDP interpolated to the monthly frequency using a linear function. The sample is monthly from 1985:01 to 2005:03.

				$\rho(x_t, \Delta y_{t+k}^{(10)})$			
x_t	$k=-3$	$k=-2$	$k=-1$	$k=0$	$k=1$	$k=2$	$k=3$
$\Delta y_t^{(10)}$	0.015	-0.092	0.311	1	0.311	-0.092	0.015
$\Delta \hat{S}_t$	-0.027	-0.017	-0.095	-0.412	-0.269	0.085	0.006
val_t	-0.041	0.079	0.012	-0.612	-0.552	0.029	0.059
gap_t	-0.022	0.002	-0.008	0.053	0.015	0.006	-0.053
flow_t	0.030	-0.064	-0.096	0.039	0.156	0.103	-0.009