

Risk premiums and predictive ability of BAX futures

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ABSTRACT

This paper provides an in-depth analysis of risk premiums in the Canadian Bankers' Acceptances futures (BAX) market. While we find empirical support for a constant risk premium, there appear to be only weak signs of predictability in excess and holding-period returns on BAX futures or time variability in the risk premium. These findings are confirmed using forecast efficiency regressions of spot (Bankers' Acceptances) returns. Interestingly, the out-of-sample forecasts of spot returns demonstrate the excellent predictive ability of simple linear models that exploit the restrictions implied by the unbiasedness hypothesis.

KEYWORDS: Bankers' Acceptances, Bankers' Acceptances futures, risk premiums, efficiency, forecasting, monetary policy.

JEL CODES: G13, G14, G17.

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1. INTRODUCTION

Testing the expectations hypothesis in forward and futures markets has generated substantial research interest in financial economics. While numerous studies focus on testing the expectations hypothesis per se, only recently have researchers turned to establishing the presence and the behaviour of risk premiums.¹ In fact, the rejections of the expectations hypothesis are typically attributed by researchers to the presence of time-varying risk premiums without a complete understanding of the magnitude or determinants of the latent risk premiums. More recently, researchers have employed filtering techniques, factor models, asset pricing models and predictive regressions to identify and estimate these risk premiums. This line of research led to important findings for a number of financial assets and commodities.

Cochrane and Piazzesi (2008) and Ludvigson and Ng (2008, 2009) document the presence of risk premiums in bond markets. Cochrane and Piazzesi (2008) show that bond returns are forecastable with a single factor, while Ludvigson and Ng (2008, 2009) use large datasets and factor models to relate excess bond returns to macroeconomic factors. In the context of commodity futures markets, Gorton, Hayashi and Rouwenhorst (2007) and Szymanowska, de Roon, Nijman and van der Goorbergh (2009) are recent examples of the growing attention that the research on commodity risk premiums is eliciting. The traditional approach to testing efficiency in various futures markets involves testing for cointegration between spot and futures prices as in Antoniou and Holmes (1996) or Brooks, Rew and Ritson (2001) for stock index futures.

The presence of risk premiums in (relatively) longer-term interest rate futures and forwards has also been documented. Hess and Kamara (2003) study risk premiums in U.S. Treasury bill futures and find evidence of a time-varying risk premium. Gospodinov (2002)

shows that forward rates on U.S. bonds display time-varying risk premiums. A parallel literature investigates the presence of risk premiums and efficiency in various shorter-term interest rate futures and forwards. The risk premium analysis proves to be of significant importance for several reasons. First, financial theory entails that efficiency in futures markets should hold. Second, predictability of excess futures (forward) returns implies profit opportunities for investors. Third, and by virtue of such contracts being written on interest rates, efficiency (and thus absence of time-varying risk premiums) in interest rate futures markets allows for the futures rates' natural use as a market-based measure of monetary policy expectations. This is especially true for futures contracts written on short-term interest rates due to the high correlation between the monetary policy rate set by central banks and various short-term interest rates. The presence of risk premiums in short-term interest rate futures has implications for their adequacy as a market gauge of interest rate expectations. In the case when the risk premium is constant, a simple risk adjustment of the rates implied by these futures is sufficient. However, time-varying risk premiums cannot be accommodated in a straightforward manner which in turn distorts the predictive ability of futures contracts.

The findings that emerge from the recent empirical literature on the behaviour of the risk premiums are somewhat mixed. In the U.S. context, Gurkaynak, Sack and Swanson (2007) provide a thorough analysis of the predictive performance and risk premiums of different short-term interest rate futures. The authors also argue that, in contrast with other futures contracts they consider, federal funds futures (which are effectively written on the Federal Reserve monetary policy instrument, the federal funds rate) exhibit a small constant risk premium and are very good predictors of the federal funds rate. A similar conclusion was reached by Kruger and Kuttner (1996) who analyze the efficiency of federal funds futures as predictors of the monetary

policy rate. The authors note that very few variables help in forecasting excess returns on federal funds futures; a point that is indicative of the absence of time-varying risk premiums, but that there is evidence of a constant risk premium. In a daily analysis, Hamilton (2009) also conforms to the view that changes in federal funds futures rates are largely unpredictable. Furthermore, he suggests that the time-varying risk premium found by some researchers, such as Piazzesi and Swanson (2008), could be due to the presence of outliers. Sack (2004) demonstrates how to extract monetary policy expectations from federal funds and Eurodollar futures under the assumption of a constant risk premium. In contrast to the findings of the previous papers, Durham (2003) and Piazzesi and Swanson (2008) find evidence of time-varying risk premiums in federal funds futures. Piazzesi and Swanson (2008) use predictive regressions to assess the magnitude of the risk premium and report sizeable estimates of a constant and time-varying risk premium in federal funds and Eurodollar futures.

The efficiency of Canadian interest rate futures and forwards has also been investigated in several studies. Paquette and Streliski (1998) argue that there is no evidence against the expectations hypothesis for forward rates on Canadian three months Banker Acceptances (BAs). In contrast, Gravelle, Muller and Streliski (1998) find a time-varying risk premium in forwards on three months Banker Acceptances. Gravelle and Morley (2005) use state space methods to characterize the latent risk premium in forwards on three-months Canadian Banker Acceptances. Johnson (2003) surveys a number of Canadian short-term interest forward and futures rates as predictors of monetary policy expectations.

This paper is the first to provide a detailed analysis of the existence and determinants of risk premiums in BAX futures and to report a significant element of out-of-sample predictability in spot Banker Acceptances (BAs) returns. Specifically, unbiasedness and efficiency in the BAX

market are studied using predictive and forecast efficiency regressions. This allows us to impose restrictions on the estimated models and evaluate their out-of-sample forecasting performance. Our results indicate that simple linear models using the futures basis as a predictor variable tend to exhibit substantial out-of-sample predictability of spot (Bankers' Acceptances) returns with an R^2 of 40%. The model that imposes restrictions implied by the unbiasedness hypothesis outperforms autoregressive, random walk and error correction models in terms of forecasting performance. Our findings entail important implications from policy and practical perspectives. First, the absence of a time-varying risk premium in BAX futures implies that they can be used by the central bank and investors to measure monetary policy expectations in Canada. Second, the documented out-of-sample predictability in spot returns suggests a possible profit opportunity for investors.

The rest of the paper is organized as follows. Section 2 introduces BAX futures, Bankers' Acceptances and the computation of excess and holding-period returns. Section 3 discusses the econometric methodology and reports the empirical results. Section 4 offers some concluding remarks.

2 DATA AND VARIABLE DESCRIPTION

2.1 Bankers' acceptances (BA) and bankers' acceptances futures (BAX)

Bankers' acceptances (BAs) are one of the most widely used money market instruments in Canada. As described by the Montreal Exchange (2008a) circulars, they constitute short-term commercial debt obligations issued by one of Canada's major banks on behalf of a customer.

The issuing bank ensures that the principal and interest are repaid in full so that default risk in these instruments is negligible. Futures contracts written on three months Bankers' Acceptances are known as BAX futures. These futures contracts started trading on the Montreal Exchange² in April 1988 and have quarterly expirations. The contract size is one million Canadian dollars (the futures contract is written on an underlying one million dollars Banker's Acceptance). The Montreal Exchange lists, at all times, three years of quarterly contracts. Settlement of BAX futures occurs two business days prior to the third Wednesday of the contract month, based on the prevailing three month Banker's Acceptance rate. As noted by the Montreal Exchange (2008b) and the academic literature, trading volume, open interest and liquidity in BAX contracts increased considerably starting 1994 as they have become a popular tool for short-term interest rate hedging.

Gagnon and Lypny (1995) note that BAX futures share the same characteristics as Eurodollar (time deposit) futures.³ In fact, BAX contracts have been modeled after Eurodollar contracts (in terms of expiration, maturity and settlement) due to the latter's wide success in financial markets. Previous BA and BAX studies focus on the use of these contracts for interest rate hedging and optimal hedge ratio estimation [see, for example, Gagnon and Lypny (1995), Watt (1996), and Siam (2000)] or the tests of efficiency of the BAX market [Johnson (2003)].

We follow Piazzesi and Swanson (2006) and consider only quarterly data in order to match the expiration cycle of BAX contracts. Our estimation results are reported for two samples. The full sample covers the period from the second quarter of 1988 to the second quarter of 2008. We also use the 1994Q4 - 2008Q2 subsample (corresponding to the period in which BAX contracts have become more liquid) to sidestep any issues of liquidity and market depth in BAX futures.

Data on BAX futures is obtained from the Commodity Research Bureau (CRB). The series for the BA rates, real output, consumer price index (CPI), commercial paper rate and three-month Treasury bill rate are downloaded from Statistics Canada's CANSIM database. One- and ten-year zero coupon yields are obtained from the Bank of Canada's website [see Bolder, Johnson and Metzler (2004) for methodology description].

2.2 Excess and holding-period returns on BAX futures

Denote by f_t^1 and f_t^2 the rates on the first (nearest) and second (next-to-nearest) BAX futures contracts in quarter t (end of quarter). We use Piazzesi and Swanson's (2006) definitions of excess returns. Since there is no cost for entering into a futures position, an investor who is long in a BAX contract and holds the contract until maturity registers a profit of rx_{t+1} :

$$rx_{t+1} = f_t^1 - r_{t+1}, \quad (1)$$

where r_{t+1} denotes the banker's acceptance rate on the day of expiration of the BAX contract. Furthermore, returns realized by holding the BAX contract for one period are computed for the full sample (1988Q2 to 2008Q2) as:

$$hpr_{t+1} = f_t^2 - f_{t+1}^1. \quad (2)$$

BAX futures are marked to market daily and an investor holding the futures contract for one period can realize the profits (or losses) associated with his trading position.

Quarterly data are used to compute excess and holding-period returns defined in equations (1) and (2). The use of quarterly data is motivated by several reasons. First, time-varying risk premiums are mostly pronounced at business-cycle frequencies. Second, by

computing excess and holding-period returns as in equations (1) and (2), the time to maturity of the futures contract is kept constant. Third, recent studies in the literature, such as Piazzesi and Swanson (2006, 2008), use quarterly data to investigate risk premiums in similar contracts. Due to the availability of daily BA data⁴ excess returns in equation (1) are computed starting 1994Q4. The time series dynamics of the returns defined in equations (1) and (2) are plotted in Figure 1.

[Figure 1 about here]

Casual inspection of the graph shows a decrease in the volatility of holding-period returns starting around 1994 which marks the beginning of the period of significant increases in trading volume and open interest in BAX markets.

3 ECONOMETRIC METHODOLOGY AND RESULTS

3.1 Average Returns and Business-Cycle Behaviour of Returns

3.1.1 Constant risk premium

Using returns on BAX futures defined in equations (1) and (2), simple regression equations including only a constant are estimated to check for evidence of a constant risk premium. Specifically, the estimated equations are:

$$rx_{t+1} = \alpha + \varepsilon_{t+1} \quad (3)$$

and

$$hpr_{t+1} = \alpha + \varepsilon_{t+1} \quad (4)$$

for the two returns defined in equations (1) and (2). Table I reports the estimation results from equations (3) and (4) with Newey and West (1987) heteroskedasticity and autocorrelation consistent (HAC) standard errors.

[Table I about here]

The results indicate the presence of a constant risk premium since the constant is significant across the different samples. Average excess and holding-period returns are positive and range between 15 and 22 basis points depending on the definition of returns and the estimation sample. Positive average excess (and holding-period) returns suggest that investors are demanding compensation for holding the BAX futures contract. This, in turn, is indicative of the presence of a constant risk premium.

3.1.2 Behaviour of BAX Futures Returns over the Business-Cycle

The behaviour of excess and holding-period returns on BAX futures over the business-cycle is investigated. Different behaviour of excess and holding-period returns over economic contractions and expansions can be suggestive of a time-varying risk premium.

In order to assess the behaviour of returns over the business-cycle, a recession dummy variable, D_t^R , taking a value of one, when the quarterly growth rate in real output is negative for two consecutive periods, is defined. The analysis is restricted to holding-period returns in order to provide enough usable observations (when the dummy is different from zero) and the estimated equation is:

$$hpr_{t+1} = \alpha + \beta^R D_t^R + \varepsilon_{t+1}. \quad (5)$$

Similarly, we construct a dummy variable, D_t^C , taking a value of one, when quarterly output growth contracts, and estimate the following model:

$$hpr_{t+1} = \alpha + \beta^C D_t^C + \varepsilon_{t+1}. \quad (6)$$

Estimation results from regressions (5) and (6) are reported in Tables II and III.

[Tables II and III about here]

The results indicate that the returns on BAX futures increase during recessions and economic contractions. Holding-period returns on BAX futures increase by 14 basis points during recessions, while they are 42 basis points higher during contractions. We note that while the coefficient of the recession dummy is not significant, the corresponding coefficient of the contraction dummy is significant at the 5% level. However, the R^2 from both regressions is very close to zero. The low R^2 combined with the finding that recession and contraction dummies are not useful real-time predictor variables cast doubt on the significance of the countercyclical variation in excess and holding-period returns.

3.2 Predictive Regressions: Is The Risk Premium Time-Varying?

Recent studies relate predictability in excess and holding-period returns on futures contracts to time-varying risk premiums. The following predictive regression is employed to uncover possible predictability in excess and holding-period returns in BAX futures:

$$rx_{t+1} = \alpha + \beta' X_t + \varepsilon_{t+1} \quad (7)$$

for excess returns and

$$hpr_{t+1} = \alpha + \beta' X_t + \varepsilon_{t+1} \quad (8)$$

for holding-period returns, where X_t denotes a vector of macroeconomic or interest rate variables observed by the market participants at time t . The analysis that follows entertains a number of Canadian macroeconomic and interest rate variables as possible predictors of excess and holding-period returns on BAX futures.

3.2.1 The Predictive Content of Canadian Output Growth and Inflation

In the first set of regressions that we consider, X_t consists of quarterly real output growth and consumer price inflation in Canada.⁵ The estimation results from this specification are presented in Table IV.

[Table IV about here]

In line with the findings of Piazzesi and Swanson (2008), excess and holding-period returns are countercyclical and the estimated regressions reveal a negative relationship between returns and output growth.

A percentage point drop in output growth leads to a 15 to 30 basis point increase in returns. While the effect of output growth on excess and holding-period returns is strongly significant over the 1994Q4 - 2008Q2 subsample, the magnitude and significance drops to a 15

basis point increase in returns due to a percentage point decrease in output growth with holding-period returns over the full (1988Q2 - 2008Q2) sample. Inflation does not appear to be a significant predictor of returns. The R^2 of the regressions ranges from 2% for holding-period returns over the full sample to 13% for holding-period returns over the 1994Q4 - 2008Q2 subsample.

The results are suggestive of a role for output growth in forecasting returns. However, futures markets participants observe output and CPI numbers with a delay that is not accounted for in equations (7) and (8). According to the website of Statistics Canada, output (and employment) numbers are released with a delay of around two months. In contrast, the consumer price index is released with a shorter delay of two weeks. Since output and employment numbers become known to futures markets participants only with a time lag,⁶ output growth and inflation are subjected to a more stringent predictability test by re-estimating models (7) and (8) with lagged output growth and inflation that are available to markets participants at the time they take a certain position in the futures contract. The results obtained from these “real-time” regressions⁷ are presented in Table V.

[Table V about here]

Although the returns still tend to exhibit countercyclical behaviour, output growth and inflation do not appear to be useful predictors of excess or holding-period returns. While there is one significant coefficient associated with inflation, the significance of this coefficient dissipates completely when the full sample is used. Overall, these results cast serious doubt over the significance and predictive ability of output growth and inflation.

3.2.2 Predictive Content of Canadian Employment Growth

In their investigation of risk premiums in Eurodollar futures, Piazzesi and Swanson (2006) find that the growth in nonfarm payroll employment is an important predictor for federal funds and Eurodollar futures returns. Given the similarity between BAX and Eurodollar futures, models (7) and (8) are estimated with X_t that consists of only Canadian employment growth. Due to the limited availability of employment numbers, the full sample is confined to start in 1991Q2. The results from estimating equations (7) and (8) with employment growth are presented in Table VI.

[Table VI about here]

Excess and holding-period returns tend to be countercyclical and one percentage point drop in employment growth leads to a 16 (32) basis point increase in holding-period (excess) returns over the 1994Q4 - 2008Q2 sample. Employment growth does not appear to be a significant predictor of returns over the full sample but is significant in the subsample at 10% and 5% significance level. The R^2 of the regressions varies between 1% and 7%. The insignificance of employment growth over the full sample combined with the low R^2 implies that the predictive ability of employment growth is fairly weak.

3.2.3 Predictive Power of Interest Rate Spreads

We next consider the predictive power of a number of interest rate spreads. Interest rate data are readily available to futures markets participants on a daily basis. This, in turn, implies that

interest rate variables are in the investors' information sets contemporaneously and can be included on the right hand side of equations (7) and (8) without lagging. The following interest rate variables are used in equations (7) and (8): the spread between the ten year zero coupon yield and the three months Treasury bill rate, the spread between the one year zero coupon yield and the three month Treasury bill rate and the spread between the commercial paper rate and the three month Treasury bill rate. Results from estimating equations (7) and (8) with interest rate spreads are reported in Table VII.

[Table VII about here]

As Table VII shows, none of the interest rate spreads are useful in predicting holding-period or excess returns. In addition, while returns exhibit countercyclical dynamics over the business cycle, no clear relationship seems to exist between returns and the interest rate spreads used in our analysis.

3.3 Forecast Efficiency Regression

The evidence obtained thus far in the paper points to a presence of a constant risk premium in BAX futures but lack of strong support for time-varying risk premiums. Our analysis proceeds by considering forecast efficiency regressions of the type analyzed previously in the literature [as in Gospodinov (2009), Chernenko, Schwarz and Wright (2004), and Inci and Lu (2007)]. Let $\Delta r_{t+1} = r_{t+1} - r_t$ denote the spot returns from Bankers' Acceptances. The futures basis is given by

$f_t^1 - r_t$ where r_t denotes the BA rate sampled at the end of the quarter, and f_t^1 denotes the rate from the nearest futures contract. The following regression model is considered:

$$r_{t+1} - r_t = \alpha_1 + \beta_1(f_t^1 - r_t) + \varepsilon_{t+1}. \quad (9)$$

The unbiasedness hypothesis and economic theory stipulate that equation (9) should satisfy the restrictions $H_0 : \alpha_1 = 0, \beta_1 = 1$. Usual tests of efficiency in futures and forward markets consider regressions in levels and test for cointegration between the future and spot rates. Gospodinov (2009) notes that equation (9) constitutes a restricted error correction formulation of such tests. Researchers typically view rejecting $\beta_1 = 1$ as evidence of a time-varying risk premium and the forward exchange literature [Fama (1984), among others] has documented puzzling estimates of the parameters, especially in the case of exchange rates. These anomalous results have been largely attributed to the presence of a time-varying risk premium in foreign exchange markets. The results from estimating model (9) are presented in Table VIII.

[Table VIII about here]

The results from estimating model (9) indicate that the unbiasedness hypothesis is not rejected at the 10% for the full sample but is rejected at the 5% level for 1994Q4 to 2008Q2 subsample. The parameter estimates show that the intercept is relatively large, negative and significantly different from zero over the 1994Q4 to 2008Q2 period (but not significantly different from zero over the full sample). The rejection of the unbiasedness hypothesis as well as the magnitude and significance of the intercept parameter (over the 1994 - 2008 period) can be viewed as a manifestation of the presence of a constant risk premium. The null hypothesis that the slope

parameter is equal to one is not rejected for the full sample or the 1994Q4 - 2008Q2 subsample suggesting possible absence of a time-varying risk premium. The results obtained from the forecast efficiency regression (9) are in agreement with the previous findings in this paper. In fact, Table I establishes the presence of a highly statistically significant constant risk premium over the 1994Q4 - 2008Q2 period, while the evidence for a constant risk premium over the full sample is weaker. The inability to reject the null of a unity slope parameter is also in accordance with the predictive regressions (7) and (8) that detect weak evidence of predictability in excess and holding-period returns.

3.4 Out-of-sample Forecasting and Forecast Evaluation

3.4.1 Out-of-sample predictability of spot (BA) returns

Forecasting asset returns is of foremost importance to investors. As a result, our analysis proceeds by assessing the out-of-sample forecasting performance of different models in predicting spot (BA) returns. To this end, a number of models are employed to obtain one-step-ahead forecasts of spot returns. For all the models considered, the initial in-sample (estimation) period is 1988Q2 to 1998Q2, while the out-of-sample forecasting period is 1998Q3 to 2008Q2.

A starting point for the out-of-sample forecasting exercise is the forecast efficiency regression (9). Equation (9) is estimated over the 1988Q2 - 1998Q2 sample and a series of one-step-ahead forecasts is produced for the period 1998Q3 to 2008Q2. The one-step-ahead forecasts from model (9) are computed in two ways: (i) recursive one-step-ahead forecasts, referred to as “recursive regression forecasts”, are obtained by estimating (9) over the 1988Q2 to

1998Q2 and producing a forecast for 1998Q3, then re-estimating (9) over the 1988Q2 to 1998Q3 and obtaining a forecast for 1998Q4 and so on; (ii) rolling one-step-ahead forecasts, referred to as “rolling regression forecasts”, which use a moving window that adds one observation and drops the first observation in the estimation sample. Specifically, rolling one-step-ahead forecasts are obtained by estimating (9) over the 1988Q2 - 1998Q2 sample and forecasting one-step-ahead, and then re-estimating over the 1988Q3 - 1998Q3 period and producing a forecast for 1998Q4 and so forth. Forecasts from model (9) are also produced by imposing a unit slope and estimating the intercept parameter over the recursive and rolling samples. The former set of forecasts is referred to as “Recursive intercept, unit slope” and the latter is referred to as “Rolling intercept, unit slope”. The final set of forecasts is obtained by imposing restrictions on (9) implied by economic theory: in particular, imposing the restrictions of the unbiasedness hypothesis of a zero intercept and unit slope parameter. The forecasts from this model are referred to as “restricted forecasts”.

The forecasting ability of these three models is compared to a benchmark autoregressive model for the spot (BA) rate. The specification checks (lag length selection by Akaike and Bayesian information criteria, test for any remaining autocorrelation) indicate that the spot rate can be modeled accurately using an autoregressive model of order one (AR(1)). Therefore, the spot rate is modeled using an AR(1) process:

$$r_{t+1} = \alpha + \phi r_t + \varepsilon_{t+1} \quad (10)$$

that can be re-written in terms of the spot returns as:

$$r_{t+1} - r_t = \alpha + \rho r_t + \varepsilon_{t+1}, \quad (11)$$

where $\rho = (\phi - 1)$. This model is then used to produce recursive and rolling one-step-ahead forecasts of spot returns for the 1998Q3 - 2008Q2 period. We refer to these forecasts as

“recursive AR(1) forecasts” and “rolling AR(1) forecasts”, respectively. Estimation of equation (11) indicates that the autoregressive parameter ϕ is very close to unity (the coefficient is 0.98). In fact, the augmented Dickey-Fuller test (ADF) cannot reject the null of a unit root in the spot rate series. In light of this evidence, the unit root null is imposed and random walk forecasts of the spot returns are produced over the 1998Q3 - 2008Q2 period.

The last forecasting model employed exploits the cointegration between the spot and nearest futures rates. Gospodinov (2009) argues that equation (9) is a restricted error correction representation where the short and long-run behaviour of the variables is constrained. The forecasting performance of an unconstrained error correction model is compared to forecasts from model (9). Testing for unit roots in the spot and futures rates indicates that the null of a unit root cannot be rejected at conventional levels in both series and both series can be characterized as integrated of order one. The futures efficiency and economic theory require that the two series be cointegrated. We test for cointegration between the spot and futures rates using the Engle and Granger (1987) two-step procedure. Namely, a linear regression model relating the spot rate to the futures rate is estimated and the residuals from this regression are tested for a unit root. The null of a unit root in the residuals is rejected at any conventional level, and we conclude that the spot and nearest futures rates are cointegrated. Thus, an error correction model (ECM) is used to model the relationship between the spot and nearest futures rates:

$$r_{t+1} - r_t = \beta_0 + \delta \cdot \hat{z}_t + \sum_{i=0}^p \beta_i \Delta r_{t-i} + \sum_{j=0}^q \gamma_j \Delta f_{t-i}^1 + \varepsilon_{t+1}, \quad (12)$$

where \hat{z}_t denotes the residuals from the cointegrating regression of spot returns on the nearest futures. The lag length in equation (12) is set to 3 as selected by the Akaike Information Criterion (AIC). Out-of-sample “recursive ECM forecasts” are produced from equation (12) by

recursively estimating the cointegrating relationship and model (12) and forecasting one-step-ahead, while “rolling ECM forecasts” are obtained by estimating the cointegrating relationship and equation (12) with a rolling window and forecasting one-step-ahead.

Figure 2 presents the spot (BA) returns and the recursive, rolling and restricted forecasts from equation (9). Figure 3 plots the random walk, recursive AR(1) and rolling AR(1) forecasts whereas Figure 4 displays the “rolling ECM” and “recursive ECM” forecasts.

[Figures 2, 3 and 4 about here]

Visual inspection of Figures 2, 3 and 4 reveals the good performance of the forecast efficiency regression (9) when compared to the random walk or AR(1) forecasts. Since this is not a formal test for forecast comparison, we next employ some statistical criteria for forecast evaluation.

3.4.2 Forecast Evaluation: Statistical criteria and Mincer-Zarnowitz Regressions

Economic and financial forecasts can be evaluated in various ways. In this paper, we use statistical criteria and Mincer-Zarnowitz [Mincer and Zarnowitz (1969)] regressions to rank the forecasting performance of the competing models. In terms of statistical criteria, we use two popular loss functions: the Mean Absolute Error (MAE) and the Root Mean Square Error (RMSE). The expressions for the MAE and RMSE are given by:

$$MAE = \frac{1}{h} \sum_{t=T+1}^{T+h} |\Delta r_t - \Delta \hat{r}_t| \quad (13)$$

$$RMSE = \sqrt{\frac{\sum_{t=T+1}^{T+h} (\Delta r_t - \Delta \hat{r}_t)^2}{h}}, \quad (14)$$

where $j = T + 1, \dots, T + h$ is the forecast sample, Δr_t is the actual spot return and $\Delta \hat{r}_t$ is the forecast of the spot return obtained from one of the competing models.

The regression based framework of Mincer and Zarnowitz (1969) is employed to test forecast unbiasedness. The approach consists of estimating a linear regression model of the actual spot returns on the forecasts from each model and allows for a simple test of forecast unbiasedness. Specifically, the Mincer-Zarnowitz regression has the form:

$$\Delta r_t = a_0 + a_1 \Delta \hat{r}_t + error \quad (15)$$

for the forecast sample $j = T + 1, \dots, T + h$. The forecast unbiasedness can be tested using the null hypothesis $H_0 : a_0 = 0, a_1 = 1$. Testing the null $H_0 : a_1 = 1$ also carries useful information about the efficiency of the forecasts. Finally, the R^2 from the Mincer-Zarnowitz regressions proves to be an informative tool for evaluating the forecast accuracy.

Table IX reports the MAE and RMSE of the different forecasts and ranks the competing models.

[Table IX about here]

Both statistical criteria confirm our conjecture from the visual inspection of Figures 3, 4 and 5. Namely, the forecast efficiency regression whose slope and intercept coefficients are restricted by the unbiasedness hypothesis (referred to as “restricted forecasts”) outperforms all the competing models. The unrestricted forecast efficiency regressions (rolling and recursive) closely follow. Regardless of the method or the statistical criterion, the forecasts from model (9)

always outperform the random walk forecasts. The error correction model and the AR(1) produce inferior forecasts to the random walk model which could be attributed to additional sampling uncertainty associated with parameter estimation.

Tables Xa, Xb and Xc report the results from the Mincer-Zarnowitz regressions.

[Tables Xa, Xb and Xc about here]

The results indicate that the null of unbiasedness for the AR(1) cannot be rejected, while unbiasedness is rejected for most of the regression and ECM forecasts. A closer inspection of the regression results reveals that the inability to reject the null of unbiasedness for the AR(1) forecasts is attributable to the large standard errors associated with the slope and intercept parameters. The only instance in which the null of unbiasedness is not rejected (at the 1% level) is for the “restricted forecast” case. Recall that this is the forecast obtained by restricting the intercept parameter in equation (9) to zero and the slope to unity. With the exception of the recursive regression forecasts, all forecasts obtained from model (9) are efficient. In addition, the R^2 from the Mincer-Zarnowitz regression shows an excellent out-of-sample forecasting performance of the various versions of model (9). All forecasts obtained from equation (9) have impressive R^2 ranging from 37% to 41% (for the “restricted forecast”). The ECM forecasts have significantly lower R^2 with a maximum of 8% while the AR(1) forecasts have an R^2 close to zero. In contrast to the forward exchange rate literature [Kilian and Taylor (2003), among others] where it is typically found that linear predictive models cannot outperform the random walk specification in terms of out-of-sample forecasting, the findings of this research are indicative of an important element of predictability in spot returns using simple linear models.

4. Conclusion

This study provides evidence of a constant risk premium in BAX futures. Contrary to the U.S. Eurodollar futures analyzed by Piazzesi and Swanson (2006), predictive regression techniques uncover countercyclical behaviour in excess and holding-period returns on BAX contracts but fail to detect time-varying risk premiums. The evidence in favour of predictability in excess returns remains weak, since a number of important macroeconomic variables and interest rate spreads do not appear to be robust predictors. In light of these findings, it seems that there is no empirical support for the existence of time-varying risk premiums in BAX futures returns. We also find that the evidence from the forecast efficiency regressions relating spot (Bankers' Acceptances) returns to the futures basis is in agreement with the predictive regressions results. In fact, while the unbiasedness is sometimes rejected using the forecast efficiency regressions, we find that the efficiency is not rejected. The rejection of the unbiasedness hypothesis is attributed to the presence of the constant risk premium. The out-of-sample forecasting exercise of spot (BA) returns reveals that forecasts imposing unbiasedness in the relationship between spot returns and the futures basis statistically outperform autoregressive, random walk and error correction models. Further, the forecasting exercise demonstrates the excellent performance of simple linear predictive models which yield an impressive R^2 of around 40%.

The results of this paper have interesting practical implications. From a policy perspective, the evidence suggesting the lack of a time-varying risk premium in the most liquidly traded Canadian short-term interest rate futures implies that, once the constant risk premium is accounted for, the Bank of Canada and investors can use BAX futures as market-based measures of interest rate expectations. For instance, the Bank of Canada would be able to use BAX futures

to assess the impact of its policies and efforts for greater transparency on market expectations of interest rates. The Bank of Canada can also use BAX futures to infer the market's expectations of its actions. In this context, the Bank of Canada introduced a fixed announcement dates (FAD) regime in September 2000. According to this new policy and in a bid to make monetary policy more transparent, the dates on which the Bank of Canada can potentially change the monetary policy rate are scheduled in advance. It would be interesting to investigate whether this change in the conduct of monetary policy improved the BAX futures' ability to forecast the monetary policy rate. From a trading perspective, the out-of-sample forecasting results are suggestive of a possible profit opportunity for investors. This paper shows that market participants can use the futures basis as a reliable predictor to forecast spot returns out-of-sample. In fact, an interesting exercise to undertake would consist of calculating profits generated by trading based on the different models proposed in this research. It is possible that, with this significant element of predictability, investors would be able to generate profits by trading based on such forecasts even when trading costs are accounted for.

NOTES

1. Risk premiums can be studied using several approaches. In the context of asset pricing models, the risk premiums are typically estimated using the Fama and McBeth (1973) procedure. Recent research, such as Piazzesi and Swanson (2008), view predictability in excess asset returns as evidence of risk premiums. Still, other studies model the risk premium as a latent (unobservable) process. This specification is arguably more coherent with the theoretical fact that risk premiums are unobservable. Theoretically, Cochrane (2001, p.17) explains how an asset's risk premium depends on the correlation between asset returns and the stochastic discount factor (pricing kernel).
2. The Montreal Exchange is Canada's derivative exchange. Equity derivatives, options on exchange traded funds, index derivatives and interest rate derivatives are traded on the Montreal Exchange.
3. The Montreal Exchange also introduced the 30 day overnight repo rate futures (ONX) as the Canadian counterpart of the U.S. 30 day interest rate futures (federal funds futures). However, open interest and trading volume in these contracts have remained very low. The exchange also lists futures on Government of Canada bonds which have been more successful.
4. Daily data on Bankers Acceptances rates are available only starting in the fourth quarter of 1994. Equation (1) uses the BA rate on the day of settlement and thus daily data on BA rates is needed for accurate timing.
5. We also undertake the estimation with annual growth rates for real output and the CPI. The results are similar and are not reported.

6. Another potential difficulty for using output and employment as predictor variables is that they are often subjected to substantial revisions.
7. Referring to these regressions as “real-time” regressions is also due to the lack of a real-time dataset for Canada.

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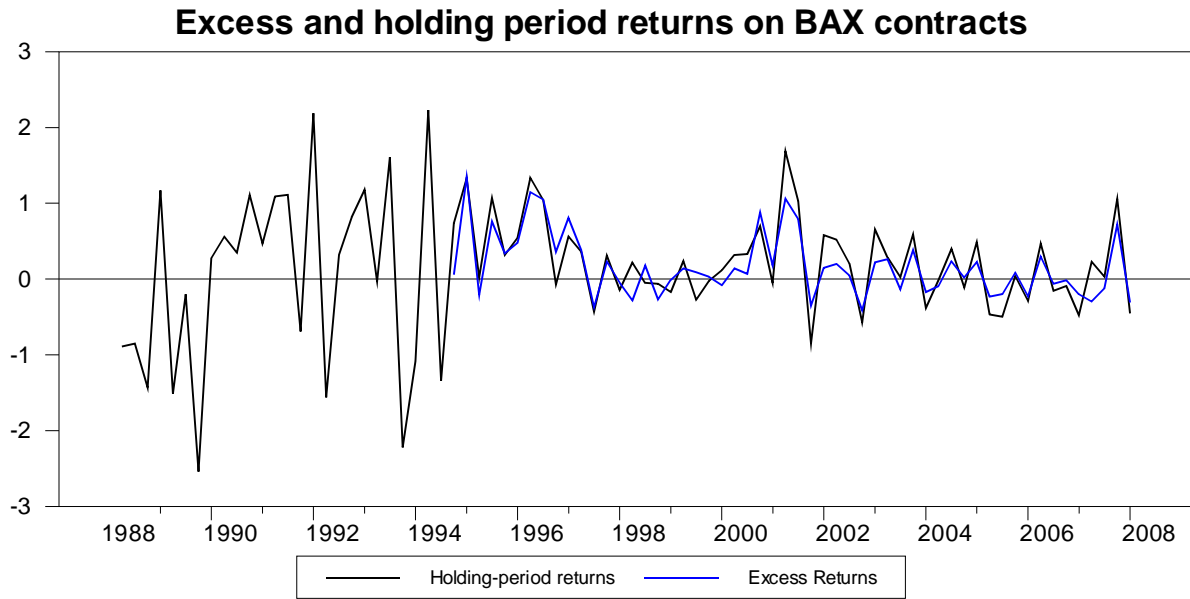


Figure 1: Time series of excess and holding-period returns on BAX futures (in percent).

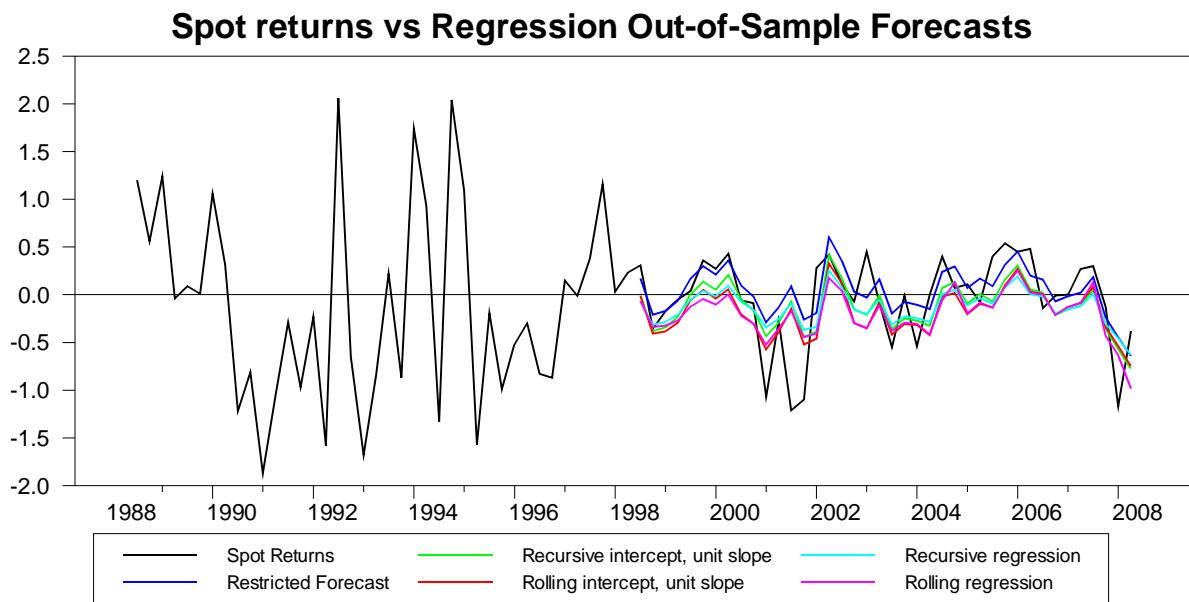


Figure 2: Spot (BA) returns and out-of-sample forecasts obtained from forecast efficiency regressions.

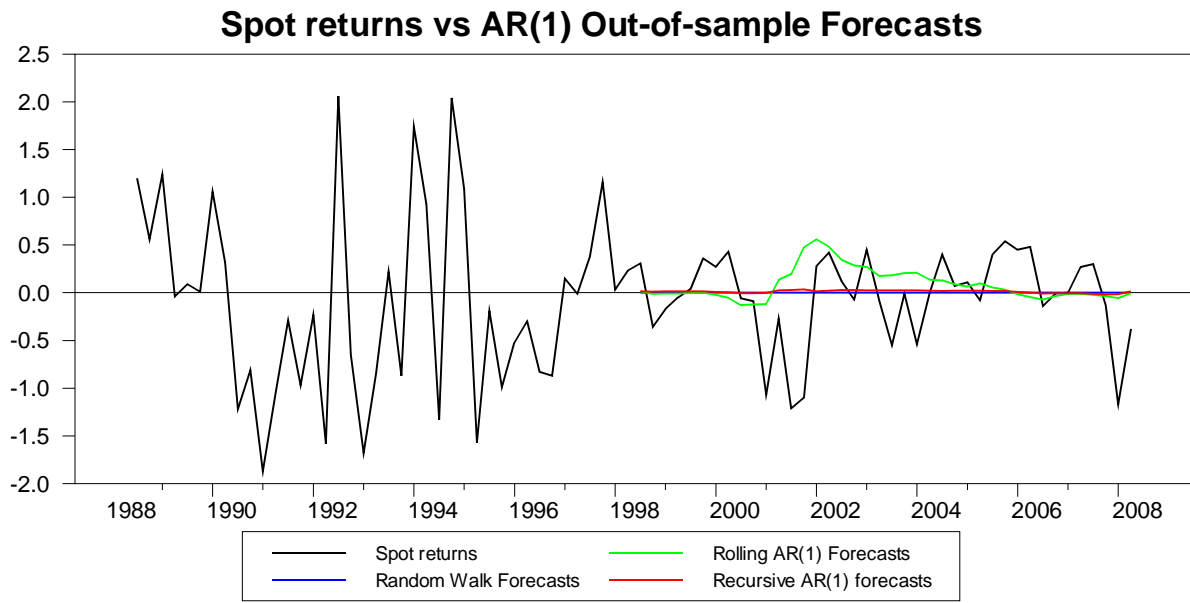


Figure 3: Spot (BA) returns and out-of-sample forecasts obtained from AR(1) models.

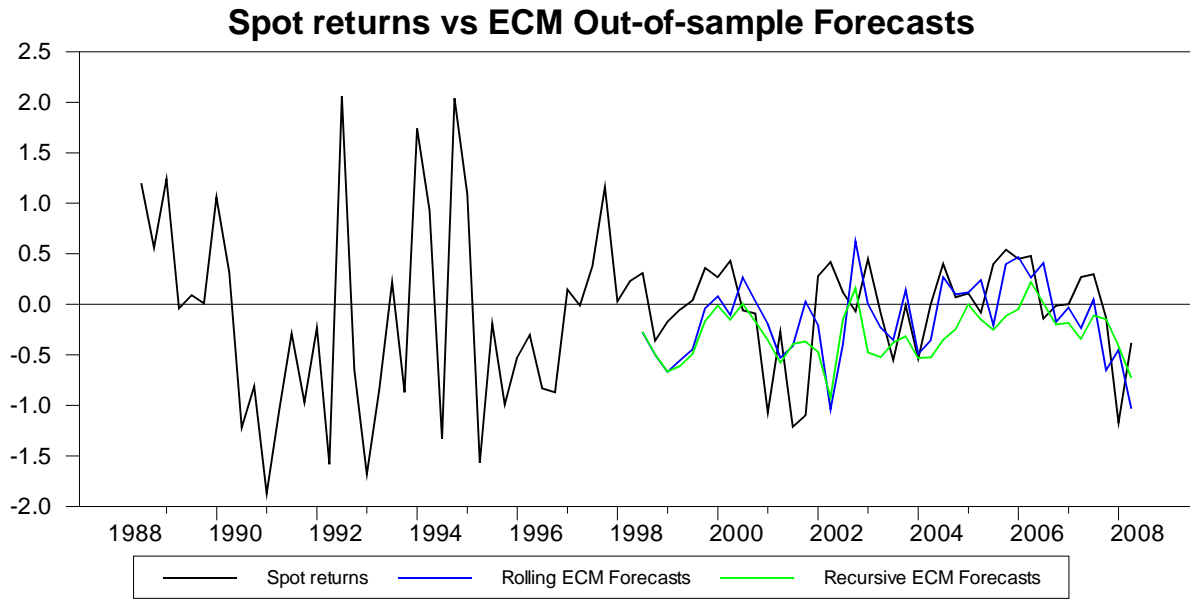


Figure 4: Spot (BA) returns and out-of-sample forecasts obtained from ECM models.

Table I

Average Excess and Holding-Period Returns

	Dependent Variable		
	Excess returns	Holding Period Returns	Holding Period Returns
Constant	0.17*** (0.06)	0.22*** (0.07)	0.15* (0.08)
Sample period	94Q4-08Q2	94Q4-08Q2	88Q2-08Q2

Notes: The table reports the results from estimating equations (3) and (4). Excess and holding period-returns are regressed on a constant. Newey and West's (1987) heteroskedasticity and autocorrelation consistent (HAC, 2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table II**Holding-Period Returns and Recessions**

	Dependent Variable
	Holding Period Returns
Constant	0.16* (0.09)
Recession Dummy	0.14 (0.36)
R ²	0.00
Sample period	88Q2-08Q2

Notes: This table provides the results from estimating equation (5). Holding-period returns are regressed on a constant and recession dummy. Newey and West's (1987) heteroskedasticity and autocorrelation consistent (HAC, 2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table III

Holding-Period Returns and Contractions

	Dependent Variable
	Holding-Period Returns
Constant	0.10 (0.09)
Contraction Dummy	0.42** (0.17)
R ²	0.03
Sample period	88Q2-08Q2

Notes: The table reports the results from estimating equation (5). Holding-period returns are regressed on a constant and regression dummy. Heteroskedasticity and autocorrelation consistent (HAC, 2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table IV

Predictive Regressions for Excess and Holding-Period Returns

	Dependent Variable		
	Excess Returns	Holding-Period Returns	Holding- Period Returns
Constant	0.29*** (0.08)	0.35*** (0.09)	0.20* (0.10)
Output growth	-0.23** (0.09)	-0.30*** (0.09)	-0.15* (0.08)
Inflation	0.06 (0.08)	0.18 (0.14)	0.11 (0.10)
R ²	0.08	0.13	0.02
Sample period	94Q4-08Q2	94Q4-08Q2	88Q2-08Q2

Notes: This table provides the results from estimating equations (7) and (8). Excess and holding-period returns are regressed on a constant, inflation and output growth. HAC (2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table V

Predictive Regressions for Excess and Holding-Period Returns: Lagged output growth and inflation

	Dependent Variable		
	Excess Returns	Holding-Period Returns	Holding-Period Returns
Constant	0.21** (0.10)	0.24* (0.12)	0.30** (0.12)
Lagged output growth	-0.11 (0.09)	-0.13 (0.13)	-0.13 (0.11)
Lagged inflation	0.10 (0.06)	0.15** (0.07)	-0.06 (0.14)
R ²	0.03	0.04	0.01
Sample period	94Q4-08Q2	94Q4-08Q2	88Q2-08Q2

Notes: This table provides the results from estimating equations (7) and (8). Excess and holding-period returns are regressed on a constant and employment growth. HAC (2 lags) standard errors in parentheses.

*denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table VI

Predictive Regressions for Excess and Holding-Period Returns: Employment growth

	Dependent Variable		
	Excess Returns	Holding Period Returns	Holding Period Returns
Constant	0.30*** (0.11)	0.38*** (0.11)	0.29*** (0.10)
Employment growth	-0.26* (0.14)	-0.32** (0.14)	-0.16 (0.15)
R ²	0.07	0.06	0.01
Sample period	94Q4-08Q2	94Q4-08Q2	91Q2-08Q2

Notes: This table provides the results from estimating equations (7) and (8). Excess and holding-period returns are regressed on a constant and employment growth. HAC (2 lags) standard errors in parentheses.

*denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table VII**Predictive Regressions for Excess and Holding-Period Returns: Interest Rate Spreads**

	Dependent Variable		
	Excess Returns	Holding-Period Returns	Holding-Period Returns
Constant	0.04 (0.10)	0.11 (0.14)	0.21 (0.15)
1 year -Tbill spread	-0.19 (0.15)	0.01 (0.20)	0.36 (0.27)
10 year -Tbill spread	0.11 (0.06)	0.06 (0.08)	-0.03 (0.10)
Commercial Paper- Tbill spread	0.11 (0.24)	0.17 (0.38)	-0.29 (0.28)
R ²	0.05	0.02	0.03
Sample period	94Q4-08Q2	94Q4-08Q2	88Q2-08Q2

Notes: This table provides the results from estimating equations (7) and (8). Excess and holding-period returns are regressed on a constant, the spread between the yields of one year zero-coupon bond and three months T-Bill, the spread between the ten year zero-coupon bond and three months T-Bill and the spread between the commercial paper rate and the three months T-Bill. HAC (2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level.

Table VIII

Forecast Efficiency Regression

	Dependent Variable	
	Spot Returns	Spot Returns
Constant (α_1)	-0.13 (0.08)	-0.18*** (0.06)
Futures basis (β_1)	0.76 (0.20)	1.26 (0.20)
F-test ($H_0: \alpha_1=0, \beta_1=1$)	2.32	3.79
P-value (F-test)	0.10	0.02
t-test ($H_0: \beta_1=1$)	-1.17	1.23
P-value (t-test)	0.24	0.20
Sample period	88Q2-08Q2	94Q4-08Q2

Notes: This table provides the results from the forecast efficiency regression in equation (9). Spot (BA) returns are regressed on a constant and the futures basis. The first F-test refers to the null of unbiasedness and the t-test refers to the null of efficiency. HAC (2 lags) standard errors in parentheses. *denotes significance at the 10% level, ** at the 5% level and *** at the 1% level.

Table IX

Statistical Forecast Evaluation

Forecast Obtained From:	Forecast Evaluation Criterion	
	MAE	RMSE
Recursive Regression	0.2922 (3)	0.3802 (4)
Rolling Regression	0.3230 (5)	0.3937 (5)
Recursive intercept, unit slope	0.2742 (2)	0.3610 (2)
Rolling intercept, unit slope	0.3037 (4)	0.3792 (3)
Restricted Regression	0.2490 (1)	0.3610 (1)
Recursive AR(1)	0.3315 (7)	0.4602 (7)
Rolling AR(1)	0.3577 (8)	0.5074 (8)
Random Walk	0.3312 (6)	0.4585 (6)
Recursive ECM	0.4332 (10)	0.5196 (10)
Rolling ECM	0.4048 (9)	0.5094 (9)

Notes: This table reports the Mean Absolute Error and Root Mean Squared Error of the different forecasts. The number in parenthesis indicates the rank of the model/forecast in terms of the criterion considered. The in-sample period is 1988Q2 to 1998Q2 and the forecasting period runs from 1998Q3 to 2008Q2.

Table Xa

Mincer-Zarnowitz Regressions

	Forecast From:		
	Recursive Regression	Rolling Regression	Restricted Regression
Intercept (a_0)	0.171*** (0.050)	0.189*** (0.052)	-0.089 (0.056)
slope (a_1)	1.627 (0.236)	1.185 (0.211)	1.195 (0.171)
P-value ($H_0: a_1=1$)	0.007	0.382	0.253
P-value($H_0: a_0=0, a_1=1$)	0.000	0.001	0.253
R^2	0.40	0.37	0.41

Notes: This table provides the results of the Mincer-Zarnowitz regression in equation (15). The actual spot return is regressed on a constant and the forecast spot return of one of the competing models. HAC (2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level (for intercept). First p-value corresponds to Wald test for the null of efficiency $H_0: a_1=1$ and the second p-value corresponds to the null of unbiasedness $H_0: a_0=0, a_1=1$.

Table Xb

Mincer-Zarnowitz Regressions

	Forecast From:	
	Recursive Intercept, Unit Slope	Rolling Intercept, Unit Slope
Intercept (a_0)	0.101** (0.049)	0.185*** (0.046)
slope (a_1)	1.203 (0.168)	1.246 (0.181)
P-value ($H_0: a_1=1$)	0.228	0.172
P-value ($H_0: a_0=0, a_1=1$)	0.057	0.000
R^2	0.41	0.41

Notes: This table provides the results of the Mincer-Zarnowitz regression in equation (15). The actual spot return is regressed on a constant and the forecast spot return of one of the competing models. HAC (2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level (for intercept). First p-value corresponds to Wald test for the null of efficiency $H_0: a_1=1$ and the second p-value corresponds to the null of unbiasedness $H_0: a_0=0, a_1=1$.

Table Xc

Mincer-Zarnowitz Regressions

	Forecast From:			
	Rolling AR(1)	Recursive AR(1)	Rolling ECM	Recursive ECM
Intercept (a_0)	-0.038 (0.097)	-0.040 (0.114)	0.008 (0.076)	0.104 (0.096)
slope (a_1)	-0.095 (0.526)	-0.445 (6.743)	0.359 (0.191)	0.507 (0.294)
P-value ($H_0: a_1=1$)	0.037	0.830	0.000	0.094
P-value ($H_0: a_0=0, a_1=1$)	0.049	0.805	0.003	0.006
R^2	0.00	0.00	0.08	0.07

Notes: This table provides the results of the Mincer-Zarnowitz regression in equation (15). The actual spot return is regressed on a constant and the forecast spot return of one of the competing models. HAC (2 lags) standard errors in parentheses. *denotes significance at the 10% level, **at the 5% and ***at the 1% level (for intercept). First p-value corresponds to Wald test for the null of efficiency $H_0: a_1=1$ and the second p-value corresponds to the null of unbiasedness $H_0: a_0=0, a_1=1$.