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1 Introduction

Exchange rate modeling has been one of the greatest challenges to modern macroeconomics and still is today. Initially, the shift from the traditional balance-of-trade approach to the asset-monetary approach in the beginning of the 1970s seemed to be promising. Structural models such as the sticky-price monetary model[1] followed economic intuition and produced satisfactory in-sample results. However, the infamous Meese and Rogoff (1983) paper blatantly laid open the shortcomings of these models in out-of-sample forecasting. Since then a plethora of studies attempting to improve upon these findings has been published. The array of approaches spawns techniques such as vector error correction models that take advantage of cointegration relationships, panel forecasting methods, non-linear specifications, neural networks, new structural models[2], time-varying weights and state space models, as well as the strand of Bayesian Model Averaging, amongst others.

The latter concept takes advantage of a fact that is often underestimated or ignored in the economics profession - inherent model uncertainty. The multitude of existing exchange rate models serves as a case in point. Specifying a single model, though intriguing from an economic theory stand point, entails risks such as overfitting, reliance on less information, higher vulnerability in the presence of structural breaks, and misspecification in general. Bayesian Model Averaging, on the other hand, does not concentrate on a single model. Instead, it combines the predictions of various models. While the idea of combining estimates can be traced back to Laplace[3], it was the seminal papers by Bates and Granger (1969) that sparked off interest in forecast combination, leading to many publications in the 1970s. Leamer (1978) then initiated the paradigm of Bayesian Model Averaging, merging the idea of forecast combination with a Bayesian approach to weight selection. Though theoretically appealing, BMA was not used much in empirical Economics until the 2000s. The reason was of course the high computational burden in performing some of the necessary calculations. With the continuing technological progress and rising computing power, however, BMA has become more accessible and its popularity has been gaining vastly, as evidenced by the increasing amount of literature on the methodology

[1] See Dornbusch (1976). Other prominent cases are the flexible price variant (Frenkel (1976)), and the sticky price asset model (Hooper and Morton (1982)).

[2] In addition to the variables already used in classic exchange rate models, these include, for instance, medium to long-term exchange rate concepts such as the Fundamental Equilibrium Exchange Rate (FEER) or the Behavioral Equilibrium Exchange Rate (BEER), deviations from smoothed trend variables, Taylor-Rule terms, etc.

[3] See Laplace (1818).

as well as the release of packages for software such as R.[4]

The idea of model averaging has in the past repeatedly been shown to improve upon single models in the face of model uncertainty, measurement errors, etc.[5] It takes advantage of the diversification concept, reducing exposure to risks such as overfitting, missspecification, vulnerability to structural breaks, and correlated errors.[6] BMA then, represents a systematic and statistically sound approach to finding plausible weights for the models to be used in forecast combination.[7]

In this thesis paper, I apply Bayesian Model Averaging to out-of-sample exchange rate forecasting. Wright (2003) has shown this to be a potentially rewarding approach. Here, however, I use the concept of predictive likelihood to determine the posterior model weights used in subsequent forecast combinations. By doing so, posterior mass among models is allocated with respect to actual out-of-sample predictive ability. This idea goes back to Eklund and Karlsson (2007) and has recently been employed by Feldkircher (2011) to forecast industrial production. The aim of this paper is to test various model specifications and find out which work best and at which horizons. I will therefore carry out a series of forecasts using level models, difference models, error correction models, and rolling model weights. Furthermore, I analyze the potential gain in leaving the country-specific variables as single variables, rather than combining them to include the cross-country differences. When many variables are included, this can dramatically increase the computational burden. It is therefore of interest whether this pays off in a cost-benefit sense. Finally, I summarize my findings on the relative importance of the variables used.

The structure of the paper is as follows. Section 2 provides an overview of the BMA methodology with a specific focus on the predictive likelihood concept. Section 3 describes the empirical strategy, including data and variable selection, model specifications, and prior assumptions. Section 4 presents the corresponding results and Section 5 concludes.

[4]Particularly the BMA and BMS packages by Adrian Raftery, Jennifer Hoeting, Chris Volinsky, Ian Painter and Ka Yee Yeung (2010) and Feldkircher, M. and S. Zeugner (2009), respectively.

[5]See Clemen(1989) for a more dated summary, Makridakis and Hibon (2000), or Stock and Watson (2004).

[6]See Timmermann (2006) for an excellent treatment.

[7]For a summary of other methods and their applicability see also Timmermann (2006).

2 Bayesian Model Averaging Procedure

2.1 General Procedure and Predictive Likelihood

Bayesian Model Averaging essentially relies on two concepts. The first concept is that of averaging. Instead of using information provided by a single model, and thus ignoring potential model uncertainty, BMA takes the information provided by various models and combines it to make statements and predictions about some quantity of interest. Let Δ be this quantity of interest and let $M_i \in \mathcal{M}$ be the i-th model from model space $\mathcal{M}$ containing all competing models in question. Then the distribution of Δ given some observed data is a weighted average of the posterior distributions obtained from the individual models:

$$P(\Delta|\mathbf{y}) = \sum_{i=1}^{M} P(\Delta|\mathbf{y}, M_i)P(M_i|\mathbf{y}) \tag{1}$$

where $P(\Delta|\mathbf{y}, M_i)$ is the posterior distribution of Δ under model i and $P(M_i|\mathbf{y})$ is the posterior probability of model M_i which is used as the respective weight. In our case the quantity of interest is the h-step ahead prediction of the exchange rate, i.e. $\Delta = y_{t+h}$. Point forecasts for this quantity are obtained by taking expectations:

$$E(y_{t+h}|\mathbf{y}) = \sum_{i=1}^{M} E(y_{t+h}|\mathbf{y}, M_i)P(M_i|\mathbf{y}) \tag{2}$$

The second essential concept is the determination of weights to be given to these models. This task is achieved by employing the Bayes Theorem, which links the conditional probability $p(A|B)$ to $p(B|A)$.[8] In the context of BMA, this means that the probability of a model being the correct model after having observed the data is linked to the likelihood of the observed data being generated by the respective model:

$$P(M_i|\mathbf{y}) = \frac{p(\mathbf{y}|M_i)p(M_i)}{\sum_{j=1}^{M} p(\mathbf{y}|M_j)p(M_j)} \tag{3}$$

where $p(M_i)$[9] is the prior probability of model M_i and

$$P(\mathbf{y}|M_i) = \int L(\mathbf{y}|\theta_i, M_i)p(\theta_i|M_i)d\theta_i \tag{4}$$

is the likelihood of the data vector $\mathbf{y}$ being observed assuming that M_i is the true model. It is also called the integrated or the marginal likelihood. $L(\mathbf{y}|\theta_i, M_i)$ is the likelihood of observing $\mathbf{y}$ under M_i and parameter vector θ_i, and $p(\theta_i|M_i)$ is the prior probability distribution of the coefficient vector under M_i.

[8]See Koop (2003) for a classic reference on Bayesian econometric methods.

[9]See Section 2.3 for the determination of $p(M_i)$.

This specification has often been used in the past, for instance in Wright (2003) when applied to exchange rate forecasting. However, as Eklund and Karlsson (2007) note, the model averaging procedure and resulting forecasts may suffer from in-sample overfitting when uninformative priors are used for the model space.[10] Instead, they propose using what they call the predictive likelihood, which explicitly incorporates an out-of-sample component in the model selection process. They find that doing so improves the robustness of forecasts, especially in the presence of structural breaks in the data. I therefore follow this approach and use the predictive likelihood instead of the marginal likelihood. The procedure consists of splitting the data to be used for weights estimation into a so-called training sample $(\mathbf{y}^*, \mathbf{X}^*)$ and a hold-out sample $(\tilde{\mathbf{y}}, \tilde{\mathbf{X}})$:

$$\mathbf{y}_{T\times 1} = \begin{bmatrix} \mathbf{y}^*_{N\times 1} \\ \tilde{\mathbf{y}}_{l\times 1} \end{bmatrix}, \qquad \mathbf{X}_{T\times k} = \begin{bmatrix} \mathbf{X}^*_{N\times k} \\ \tilde{\mathbf{X}}_{l\times k} \end{bmatrix} \tag{5}$$

where $N + l = T$.

The training sample is first used to transform the priors on the coefficient vectors, $p(\theta_i|M_i)$, into the posterior distributions $p(\theta_i|\mathbf{y}^*, M_i)$. Given these, we can then use the hold-out sample to evaluate how well these model-specific posterior distributions match up with the data.[11] The *predictive likelihood* of data $\tilde{\mathbf{y}}$ being generated given the respective model-specific posterior distribution can be calculated as:

$$p(\tilde{\mathbf{y}}|\mathbf{y}^*, M_i) = \int_{\theta_i} L(\tilde{\mathbf{y}}|\theta_i, \mathbf{y}^*, M_i)p(\theta_i|\mathbf{y}^*, M_i)d\theta_i \tag{6}$$

This is then the quantity that replaces the marginal likelihood in (3) which now becomes:

$$P(M_i|\tilde{\mathbf{y}}, \mathbf{y}^*) = \frac{p(\tilde{\mathbf{y}}|\mathbf{y}^*, M_i)p(M_i)}{\sum_{j=1}^{M} p(\mathbf{y}|M_j)p(M_j)} \tag{7}$$

Models with higher predictive likelihoods, i.e. better forecast performances over the hold-out sample, will thus be assigned higher weights in the actual forecast combination. In order to perform the actual forecast, parameter values for the individual models are reestimated using the whole estimation sample, i.e. training sample + hold-out sample.

2.2 Model weight determination for large model spaces

As discussed in the previous section, the weights to be assigned to the models can be calculated as in (3) or (7), depending on whether one uses the marginal or the predictive

[10] Defining uninformative priors is a conventional approach that I also follow in this paper. For the corresponding discussion see Section 2.3.

[11] Eklund and Karlsson (2007) recommend saving 75% of the data for evaluation, i.e. including it in the hold-out sample. I also take that approach in this paper.

likelihood. These weights are then used in (1) to determine the distribution of the quantity of interest. While this works fine when the model space is not too large, it can become computationally intractable for very large model spaces. This can happen quickly when there are many potentially helpful explanatory variables such as in growth regressions (for instance Ley and Steel (2009)) or when one incorporates additional lags. Fortunately, various algorithms have been devised that can be used to solve or ameliorate the problem. Among them are algorithms such as Occam's Window, Leaps and Bounds methods, coin flip importance sampling, Markov Chain Monte Carlo Model Composite (MC^3), and other stochastic search variable selection (SSVS) methods. Of these methods I use MC^3 in this paper, which has been shown to have favorable properties in the context of BMA.[12]

3 Empirical Setup

3.1 Data

I conduct the exchange rate forecasting and subsequent analysis for all possible cross rates to be obtained from the US Dollar, the British Pound, the Swiss Franc, and the Canadian Dollar on a monthly basis. The data set for these currencies starts in January 1980 and ends in May 2011. I also perform forecasts for the exchange rates of these currencies versus the Euro and the Deutsche Mark. However, I refrain from constructing a synthetic Euro rate or using the Deutsche Mark as a proxy for the Euro. Cases can be made for employing either of the two strategies. In fact, the European Central Bank (2002) advocates using German data as a proxy for pre-EMU euro data, given the Mark's role as the de facto anchor currency since the demise of the Bretton Woods system. In addition, the European Central Bank borrows heavily from the model of the Bundesbank, especially with respect to the goal of price stability. One could therefore argue that the Euro is to some extent seen as a successor of the German Mark. This would imply that there should be some similarity in the way it is affected by market forces in the foreign exchange market. At the same time, however, the European Central Bank bases its monetary policy actions not only on German but on aggregated European data. Thus using a weighted average of the history of European currencies might still be preferable. In fact, Nautz and Offermanns (2006) use a monetary model of exchange rates to find that, while far from perfect, a synthetic Euro currency seems to be a closer approximation than the German Mark. Brüggemann and Lütkepohl (2006), on the other hand, employ vector error correction methods to estimate a long-run money demand function and argue that

[12] See Appendix C for a description of the algorithm.

using German data works reasonably well. Brüggemann, Lütkepohl and Marcellino (2008) find that the effectiveness of either proxy depends on the similarity of the levels of the German and European variables in question. When similar, the German proxy supposedly works better. Nevertheless, in order to avoid any bias or uncertainty involving a possibly suboptimal choice of proxy, I keep Eurozone and German data separate and limited to the time when these currencies were in place. As a result, the data set for the Deutsche Mark forecasts starts in January 1980 and ends in December 1998, marking the end of the pre-EMU phase. The Euro data set starts the following month and is therefore the shortest of all currencies.

The focus of this exchange rate forecasting exercise lies in the short to medium term. Forecast horizons thus include all horizons between one and six months, as well as the 9- and 12-month horizons. Estimation and subsequent forecasting is done using two different time windows. The first starts in January 1980, the second in June 1990. This allows to check whether results are robust using different time frames.[13] This is especially important in exchange rate forecasting exercises, as exchange rate regimes and the behavior of central banks can vary over time. An example would be the Louvre accord of 1987, a concerted effort of central banks to intervene in the currency markets on a significant scale. Furthermore, it enables the inclusion of variables that were not available before 1990, such as the CBOE Volatility Index (VIX).

The time series used as potential covariates include standard economic variables suggested by the classic exchange rate models, such as money supply, interest rates, and prices, which enter as inflation and level variables. As a proxy for output I include industrial production as well as the OECD composite leading indicator. Central bank reserves are added to the set of regressors, as they provide an indication of central bank interference in the exchange rate market, as well as an indication of the monetary policy at the respective point in time. Stock prices can be linked to exchange rates in various ways, which is intuitive given that stock prices are fundamentally supposed to reflect expected economic performance and various kinds of risk.[14] This, in turn, can be linked to the attractiveness of domestic stocks for foreign investors and vice versa and can therefore influence exchange rates through the demand for the currency necessary to invest in the

[13] To be sure, there is considerable overlap between the two time windows. Still, the second time window excludes over ten years of data from the first time window, which is a substantial amount. If the main results do not change despite this difference, it is at least an indication of robustness in the results.

[14] Conventional asset pricing models usually relate stock prices to expected performance, for instance in form of dividend yields, as well as systemic risk factors that are supposedly priced in order to compensate the investor for his risk taking. For a classic overview see Cochrane, J. Asset Pricing (Revised Edition). Princeton University Press, 2005.

respective stocks. Since equities are assets, they may also influence exchange rates through the wealth channel and the demand for imports. Stock indices are therefore also part of the regressor set. Other variables include consumer sentiment, dividend yields as a measure of profitability and attractiveness of a country's industry, as well as forward rates. The relationship between the latter variable and future spot rates is well documented in the extensive literature on the forward premium puzzle[15], which is that forward rates turn out to be biased predictors of future spot rates. While this is a problem conceptually and theoretically, it does not preclude the potentially rewarding use of forwards in a forecasting exercise, especially when model weights are determined by out-of-sample forecasting performance. Finally, I also include the Chicago Board Options Exchange Volatility Index (VIX) as a measure of uncertainty in the markets. While the index is determined through the implicit volatility in US options, the VIX is also a good measure of global uncertainty and risk aversion.[16] This is not surprising given the still dominant role of the US economy with potential spill-over effects to the whole world and its strong financial centers. High uncertainty in the markets can trigger a flight into bonds of countries perceived to be safe havens and should thus have a direct impact on exchange rates where one of the two currencies is perceived to be markedly riskier.
Further information regarding the data set as well as the time periods of estimation are provided in Appendix C.

3.2 Models

As stated in the introduction, many techniques have been applied to exchange rate modeling. This includes attempts to use models that capture nonlinearities. Indeed, some authors have found that there is a non-linear adjustment of the exchange rate[17] to economic fundamentals. However, despite producing good results in in-sample forecasting, this has not proven to be a superior approach when it comes to out-of-sample forecasting[18]. I will therefore use a standard linear regression model of the conventional form:

$$\mathbf{y}_t = \mathbf{X}_{t-h}\beta + \mathbf{u}_t \tag{8}$$

where $\mathbf{y}_t$ is a $T \times 1$ vector of of log exchange rates, and $\mathbf{X}_{t-h} = (\mathbf{1}, \mathbf{x}_{1,t-h}, ...\mathbf{x}_{k,t-h})$ is a $T \times K$ matrix[19] , including the column vector of ones corresponding to the intercept term,

[15]See Engel (1996) for a somewhat dated literature survey.

[16]See, for instance, Matsumoto (2011)

[17]For instance, see De Grauwe and Vansteenkiste (2001).

[18]See Meese and Rose (1991), Stock and Watson (1998).

[19]Realistically, some of the variables in the regressor matrix have to be thought of as endogenous. It might therefore make sense to use instrumental variables. However, results of applying such a procedure

and k regressors. Further, $\beta = (\beta_0\ \beta_1\ ...\ \beta_k)'$ is a $K \times 1$ coefficient vector and the error term $\mathbf{u}$ is a $T \times 1$ vector where it is assumed that $\mathbf{u} \sim N(\mathbf{0}, \sigma\mathbf{I})$. The subscripts t and $t - h$ indicate the date of the latest observation of the respective vectors and matrices. Defining the model this way does not preclude the use of various lags in the regressor matrix. Indeed, I also estimate (8) with an additional lag in the regressor matrix. That is, the latest observations of the additional set of regressors will be made at time $t-h-1$. Since many of the variables employed in exchange rate forecasting are integrated of order one and thus have unit roots, I will further estimate a model in differences:

$$\Delta_h \mathbf{y}_t = \Delta_h \mathbf{X}_{t-h} \beta + \mathbf{u}_t \tag{9}$$

where $\Delta_h \mathbf{z}_t \equiv \mathbf{z}_t - \mathbf{z}_{t-h}$. These are the two baseline models of this paper. I use them to forecast a whole set of exchange rates over various periods (see next section) and identify at which periods they work best. Forecasts are obtained using the direct method, i.e.

$$\hat{y}_{t+h} = \mathbf{X}_t \hat{\beta} \tag{10}$$

for the baseline model in levels and

$$\hat{y}_{t+h} = y_t + \Delta_h \mathbf{X}_t \hat{\beta} \tag{11}$$

for the baseline model in differences. Forecasts in all cases are made using rolling regressions, as in Meese and Rogoff (1983).

In addition, I use three alternative specifications in order to check for possible improvements over these baseline models. The first has to do with the treatment of domestic and foreign variables. In past studies, the regressors used in exchange rate forecasting usually consisted of the difference between the domestic and the foreign value of some economic or financial variable.[20] This is a sensible approach as it relates directly to traditional economic theory. In addition, it means a 50% reduction in regressors and a potentially large reduction in estimation time. It can, however, also be argued, that including domestic and foreign variables seperately allows for additional explanatory power of the variables. For instance, a one percentage point change in the interest rate of one country will most likely have a different effect on the economy than a corresponding change in another country (leaving aside the issue of the business cycle dependence of such a change). If this effect translates to the exchange rate but is not captured by other variables in the model

in Chinn and Meese (1995) indicate that the gains in consistency are outweighed by the loss in predictive ability. I therefore keep with the OLS method.

[20] Crespo Cuaresma (2007) being a notable exception.

then keeping the variables seperate might be able to improve inference and forecast performance. Even simpler, if income from domestic and foreign investments (e.g. interest payments) is taxed differently, then interest rate movements in the respective countries might have asymmetric effects, which would warrant the seperate treatment. Therefore, in order to provide maximal flexibiliy in the estimation procedure, I include both country variables as single covariates in the baseline regression models. In order to investigate the question of whether this pays off or not, I also forecast exchange rates using country differentials versions:

$$\mathbf{y}_t^{AB} = (\mathbf{X}_{t-h}^{A} - \mathbf{X}_{t-h}^{B})\beta + \mathbf{u}_t \tag{12}$$

and

$$\Delta_h \mathbf{y}_t^{AB} = (\Delta_h \mathbf{X}_{t-h}^{A} - \Delta_h \mathbf{X}_{t-h}^{B})\beta + \mathbf{u}_t \tag{13}$$

where A and B stand for country A and B, indicating the country-specific regressor matrices.

Models frequently estimated in exchange rate forecasting exercises include Vector Error Correction (VEC) models. These models take advantage of one or more cointegrating relationships between I(1) integrated regressors. The deviation from this supposedly stable long-term relationship is then included as an additional variable in the model of differences. Often, cointegration vectors are estimated over the entire sample, thus using data in out-of-sample forecasting that would not have been available at the time of the forecast[21]. Such an approach is debatable. On the one hand, one would want to use as much data as possible in order to estimate the cointegration relationship as precisely as possible. On the other hand it distorts comparisons with models producing true ex ante forecasts, presumably by leading to an upward bias in forecast accuracy for the model using future information. Recognizing this, Cheung, Chinn and Pascual (2005) for instance use rolling estimates of the cointegration vector. Nonetheless, I follow the practice of estimating the cointegration relationship over the whole sample. If this yields worse results than the baseline models, then the same is to be expected of true ex ante forecasts. Otherwise, it would indicate a potential gain in actually performing true out-of-sample forecasts.

In a first step I use the Johansen procedure to identify the long run cointegration relationship. For simplicity, I only use the cointegration relationship between the exchange rate and the remaining variables. In the second step, I estimate the model of the following form:

$$\Delta_h \mathbf{y}_t = \gamma \mathbf{X}_{t-h}\hat{\phi} + \Delta_h \mathbf{X}_{t-h}\beta + \mathbf{u}_t \tag{14}$$

[21] For instance MacDonald and Taylor (1993).

where $\hat{\phi}$ is the $K \times 1$ vector estimated to identify the cointegration relationship.
Forecasts are then made using:

$$\hat{y}_{t+h} = y_t + \hat{\gamma}\mathbf{X}_t\hat{\phi} + \Delta_h\mathbf{X}_t\hat{\beta} \tag{15}$$

Finally, one could ask why the posterior model probabilities and thus the weights used for combining model forecasts should be estimated over only one time period and fixed for the remainder of the forecasting exercise. Instead, one might resort to time-varying weights. Such an approach should reduce dependence on a particular time window employed for weights estimation and reduce vulnerability in the face of structural breaks. To see how much merit this approach has, I reestimate the baseline model weights over rolling time windows of T observations, subject to the usual split in training and hold-out sample.[22] However, instead of reestimating model weights every period, I do so every twelve months, resulting in $N/12 + 1$ forecast windows.[23]

3.3 Prior Assumptions

The last section discussed the model specifications to be employed and analyzed for predictive performance. For each specification, the BMA procedure described in Section 2 is followed in order to derive posterior distributions for the parameters as well as posterior model probabilities, which are then used as weights in the actual forecasting exercise. However, the procedure was only specified in a general sense. To perform the necessary calculations, some prior assumptions need to be made. In this section, I summarize the prior assumptions used throughout the paper.
As described in the last section, I use conventional, normal linear regression models for all specifications. The regressor matrix has $1 + k = K$ columns, thus the total number of models under consideration is 2^K. The parameters for which prior assumptions in such a framework must be made include the intercept, the regression coefficients, and the error variance. All remaining calculations then follow by using the formulas in Section 2. It is customary for situations where one does not have strong a priori knowledge on the regressor coefficients or model size to specify the priors in a way that exerts as little as possible influence on the posterior values. This essentially amounts to letting the data decide and it is the approach I follow in this paper. Thus, for the priors on the intercept and the

[22]For an overview of other suggestions, dating back to Bates and Granger (1969) and Newbold and Granger(1974) see Timmermann (2006).

[23]This introduces some asymmetry into the way forecasts are obtained at different points in time. The reason is that forecasts obtained from model averaging are based on model weights estimated w months before. However, w varies between one and twelve months, depending on the time of the forecast.

error variance, I use the non-informative benchmark priors as defined in Fernandez, Ley, and Steel (2001a,b), i.e.

$$p(\sigma^2) \propto \frac{1}{\sigma^2} \tag{16}$$

for the error variance and

$$p(\beta_0) \propto 1 \tag{17}$$

for the intercept. For the prior on the regression coefficients I use Zellner's popular g-prior:

$$\beta|\sigma^2 \sim N(\mathbf{0}, \sigma^2 [g\mathbf{X}'\mathbf{X}]^{-1}) \tag{18}$$

This leaves the task of choosing a value for the hyperparameter g. Deciding on the value of g means specifying how much weight to give to the prior information. The greater is g, the surer one is a priori that the regression coefficients are indeed zero. Choosing a small value of g, on the other hand, puts more weight on the data in determining the posterior values. Fernández et al. (2001) investigate various different choices for g and find that choosing $g = \frac{1}{\max\{n,k^2\}}$ leads to reasonable results. I therefore specify g accordingly. Doing so implies a greater model penalty than, for instance, setting $g = \frac{1}{n}$ which would be in the vein of the original g-prior in Zellner (1986). By setting $g = \frac{1}{n}$, the logarithm of the Bayes factor[24] behaves asymptotically like the Schwarz-Bayes information criterion.[25] Since the Bayes factor enters the posterior odds ratio[26] this means that models that perform better according to the Schwarz-Bayes criterion will tend to have higher posterior model probabilities. For $g = \frac{1}{k^2}$, the log Bayes factor resembles the Risk Inflation Criterion (RIC) as suggested in Foster and George (1994). Thus, specifying $g = \frac{1}{\max\{n,k^2\}}$ relates to either one of the two information criteria, depending on N and k. For the models discussed in the last section, $k^2 > N$ holds in all cases, except for the alternative specification using cross-country differentials. It should be emphasized that the relationships between specifications for g and information criteria just described hold true when dealing with the Bayes factor. The Bayes factor, however, is a ratio of marginal likelihoods while I use predictive likelihoods. The said relationships can therefore not be expected to hold. Nevertheless, results from a simulation study performed in Feldkircher (2011) indicate setting $g = \frac{1}{\max\{n,k^2\}}$ leads to good results for BMA models with a 75% hold-out ratio. Since this is the relevant case for this paper, it makes sense to keep the specification for g.

Finally, we also need an assumption for the prior model probabilities, $p(M_i)$. A conventional method of doing this entails mapping the number of variables included in the model

[24]The Bayes factor is defined as $BF_{ij} = \frac{p(\mathbf{y}|M_i)}{p(\mathbf{y}|M_j)}$

[25]See Fernández et al. (2001).

[26]See Section E

to the probability of that model. Past studies often specified a fixed inclusion probability, say ψ, for each variable[27], amounting to a prior model probability of:

$$p(M_i) = \psi^{k_i}(1-\psi)^{k-k_i} \tag{19}$$

and leading to a Binomial prior model size distribution. Here k_i is the number of regressors included in model M_i. A common choice is to set $\psi = 0.5$. This assigns equal prior probabilities to each model, which seems to allow one to remain in a highly non-informative setting. However, Ley and Steel (2009) demonstrate that doing so gives greater weight to models concentrated around a model size of $k/2$ regressors. Instead, they suggest making ψ random with a $Beta(a,b)$ probability distribution where the hyperparameter a is set equal to 1 and $b = \frac{k-m}{m}$ where m is the prior mean model size. Thus, all that needs to be done for the random ψ variant is specify a prior mean model size. This approach leads to a much more spread out prior model size distribution. If $m = k/2$ the prior model size distribution is in fact uniform. For $m < k/2$, more mass is put on smaller models. As Ley and Steel (2009) argue, the exact choice for m is very much secondary, though they recommend using reasonable values. In order to stay in a non-informative setting, I thus specify ψ as random and select $m < k/2$, which amounts to a slightly conservative setting in terms of prior model size.[28]

4 Results

4.1 Forecast Evaluation

The forecasting results are presented in Appendix C and D. Appendix C contains statistics involving averages over a subset of or all currencies, in order to provide an overall view of the results, and compare different model specifications. Appendix D presents the results in more detail, i.e. separately for each currency pair. Forecasts are made using the BMA-methodology, as well as the best and the median model. The best model here refers to the model with the highest posterior model probability. In contrast, the median model focuses on posterior inclusion probabilities, including all variables for which $PIP \geq 0.5$.[29]

[27]The prior inclusion probabilities here are assumed to be independent of the inclusion probabilities of the other regressors.

[28]Specifically, I set $m = 7$ as this is roughly half the number of available variables. Note, however, that it is clearly less than $k/2$, since in the baseline models, k includes country-specific variables twice - once for each country.

[29]The posterior inclusion probability for variable x_i is defined as the sum of posterior model probabilities over all models that include x_i: $PIP_i \equiv \sum_{j:x_i \in M_j} p(M_j|\tilde{\mathbf{y}}, \mathbf{y}^*)$. For the calculations, I do not distinguish between the cases where a variable enters a model for either one, or both countries.

Barbieri and Berger (2004) show that under certain conditions the median probability model is optimal in a predictive sense. Even if these conditions don't exactly apply, they argue, the median probability should be quite successful, and thus recommend reporting its results in addition to that of the model with the highest posterior probability.
The two statistics used to evaluate forecasting performances are Theil's U and the Direction of Change (DOC) statistic. The former compares the root mean squared forecasting error (RMSFE) of the respective model to the RMSFE of the random walk. If this ratio is smaller than 1, this indicates a superior forecasting performance by the respective model, while a value above 1 indicates the opposite. The DOC statistic gives the percentage of times the direction of change in the forecast resembled the direction of change of the exchange rate. The Diebold-Mariano (DM) test statistic is used to gauge whether the obtained RMSFE ratio is significantly different from 1[30], while the Binomial test statistic is used to test whether the DOC statistic is significantly different from 0.5. For the cross-exchange rate averages in Appendix C, the Welch-Test is employed to determine whether the means of the models to be compared (either Baseline Model vs. Random Walk or Baseline Model vs. Alternative Specification) differ significantly or not. This approach is feasible in principle, as a Kolmogoroff-Smirnoff test does not reject the null hypothesis of normality with respect to the set of Theil's U and DOC values. Furthermore, the Binomial test statistic is again used to test whether the number of outperformances of either model is different from 0.5.

4.2 BMA vs. Single Model Specifications

From Table C.1 one can infer the performance of the baseline model in levels, using one lag, averaged over all currency pairs and time windows. One result that is immediately obvious, is that the BMA technique clearly leads to better forecasts in terms of RMSFE ratios than the respective single best or median model, which perform about equally. Only at a forecast horizon of one month is it slightly worse (by the fourth digit) than the median model. At all other horizons, it performs better, often by a relatively large margin. This general result holds across all time windows and model specifications. Only occasionally does it do slightly worse for some forecast horizon. The same, however, cannot be said of the DOC statistics. Here the situation is much more varied, with the BMA forecasts more often than not achieving a lower DOC statistic than either the best or the median model. However, the differences are only marginal and are by far outweighed by the magnitude

[30]The Clark-West test has gained much popularity when evaluating nested vs. nesting models. However, as Rogoff and Stavrakeva (2008) argue, it should not be used as a substitute but rather a complimenting for the DM-test. For simplicity, therefore, I keep only the more conservative DM-test statistic.

in RMSFE ratio. This suggests that when the BMA specification gets the direction right, it does much better, and when it gets it wrong it does not do much worse, or perhaps even better (if the other models get the direction wrong too) than the best and median models. This contrasts the finding of Feldkircher (2011), where BMA improves upon the single model specifications in terms of DOC statistic, while the median probability model performs best in terms of RMSFE ratio.

4.3 Baseline Models vs. Random Walk

The fact that the random walk is tough to beat remains true. As can be seen from Table C.1, for forecast horizons of 1 to 6 months the (BMA) baseline model in levels performs slightly worse than the random walk forecast. However, this result is only significant at a 5% level for lags 2, 3, and 4. For the 9 and 12 month ahead forecasts, the random walk is clearly outperformed with p-values close to zero. These are exactly the time horizons at which the PIP of the exchange rate falls down to the level of the other variables (see Figure B.1). Of course, the averaged result in Table C.1 hides some of the diversity to be found in Appendix D. For some currency pair - time window combinations, the BMA forecasts does much better than for others. For instance, Table D.11b, which presents the results for the German Mark/Japanese Yen exchange rate between 1990 and 1998, sees the BMA baseline model forecast outperform the random walk at all lags by a significant margin. The same is true for the USD/CAD exchange rate between 1980 and 2011 (see Table D.2). Nevertheless, the general picture is that the random walk tends to slightly outperform the BMA specification at shorter lags, while BMA surpasses the random walk pretty clearly at longer horizons. It is also interesting to note, that the procedure seems to work better over the more recent time window, starting in 1990. Table C.5 shows that, averaged over all currencies, the BMA baseline model in levels is not significantly outperformed at any horizon. At the same time, it again does clearly and significantly better than the random walk at horizons of 9 and 12 months. For the baseline model in differences, the results are somewhat different, as shown in Table C.7. With this model specification, the random walk is not outperformed over 9 or 12 months. Instead, however, it is outperformed at a 5% significance level over a forecasting horizon of one month. Again, results are somewhat better for the time window starting in 1990. Here, the random walk is outperformed at the one- and two-month horizon, though only significantly again at the one month horizon. Other than that, the results are not too different from the level specification. Overall, based on the results just discussed, it would make sense to use the differences specification for forecasting periods of horizons up to 4 months and the model in levels for horizons 9 and 12. For 5 and 6 months, either one of the two can be used, though the results would slightly favor the model in differences.

4.4 Baseline Models vs. Alternative Specifications

The comparisons of the baseline models against the alternative specification models described in the Section 3.2 is based on averages over four currency pairs: USD/GBP, USD/CHF, USD/CAD, and GBP/JPY, which are reported for all lags. Due to the limited size of number of currency pairs used, averages are then taken across all lags to allow for testing which model performs better overall. It should be taken into account that this procedure puts more weight on shorter forecasting horizons, given that no forecasts at 7, 8 or 10 month horizons are included.

Table C.11 and Table C.12 compare the baseline models against the same models using cross-country differential variables, rather than keeping domestic and foreign variables separate. Inspecting the results for the levels specification in Table C.11, it turns out that the model using country differentials does only slightly worse overall in terms of RMSFE in the case of the BMA variant. The difference is not significant at any conventional level. For the best and median models, the differentials version is actually somewhat better. Again, this difference is not significant. The results for the DOC statistic are even closer. Finally, the differentials version outperforms the baseline model exactly 50% of the time in terms of RMSFE, and slightly above that number for the best and the median model. The overall takeaway from this is that both models basically forecast equally well. Roughly the same picture emerges when looking at the differences specification in Table C.12. However, in this case the country differentials version actually performs somewhat better than the baseline specification in terms of RMSFE. Again, the differences is more pronounced for the best and median models. Given these results, the conclusion is that it does not pay off to include country-specific variables in the model rather country differentials.

Table C.13 compares the forecasting results of the cointegration and the baseline model in differences. No comparison with the level model is made, as the cointegration model is much closer in concept to the differences model. The results show that the cointegration model performs better (averaged across all lags) for the BMA, Best, and Median models, for both the RMSFE ratios and DOC statistics. While improvement in the latter is negligible, the difference in RMSFE ratio averages is statistically significant at the 10% level. The performance of the cointegration model is not just good when compared with the baseline model, but also when compared with the random walk model. It outperforms the latter in five out of eight cases, with the remaining three cases being very close, the differences being in the third digit. This suggests that the cointegration specification should be preferred over the differences model (at long horizons, the levels model still remains the best). However, as mentioned in Section 3, the question remains whether true ex ante forecasts using cointegration models would really do better. Given the results just presented, one can at least not exclude that possibility.

Table C.14 and Table C.15 present the results of the baseline models versus baseline models with rolling weights. No forecasts were made at four or five month horizons using the rolling model weights method. Thus, these horizons are not part of the comparison. As for the results: for the level specification using rolling model weights does not pay off. RMSFE is higher at all forecasting horizons, and the DOC ratio is lower for all except the 9 month horizon. This finding essentially holds for the single model specifications as well. For the difference specification, the results are somewhat different. At shorter forecasting horizons (1, 3, and 6 months) the baseline model with fixed weights again does better. For longer horizons, however, the rolling model weights method seems to pay off. Averaged over all lags, the rolling model does somewhat better in terms of RMSFE ratios and slightly worse with respect to the DOC statistics. The differences are not significant in either case. It is interesting to note, that the number of times that the rolling version outperforms the baseline model is well below 50%, despite performing better overall in terms of RMSFE. Of course, it should not be forgotten that the sample is rather small, thus such results are not that unlikely. Overall, it seems that the rolling model weights method has little merit. It only improves upon the fixed model for the difference specification at longer forecasting horizons. These, however, are exactly the horizons at which level models tend to do better than the difference models. It should be noted, though, that reestimating the model weights yearly was an ad hoc decision. Other roll frequencies might yield markedly better results.

4.5 1 Lag vs. 2 Lags

Finally, Table C.16 compares the baseline model in levels using one lag and the same model using two lags. In the former case coefficient estimates are formed using variables with only an h-month lag, while in the latter case coefficient estimates are formed using variables with an h- and an $h+1$ month lag. Here, h denotes the forecast horizon. As is shown in the table, the version involving only one lag easily outperforms the model involving two lags in terms of RMSFE ratios for the BMA specification. Only at the one-month horizon does the two-lag version prevail. In most other cases the version with one lag does far better. For the best and the median model, the one-lag version is only slightly better. In terms of DOC statistics, both versions perform similarly for all specifications. With regard to the BMA specification, this is therefore a strong case to use only one instead of two lags. This is especially true, given that using two lags involves a potentially large increase in computation time. These results are in line with Crespo Cuaresma (2007) who finds very high posterior inclusion probabilities of models with one lag, and rather negligible inclusion probabilities for greater lag lengths.

4.6 Posterior Inclusion Probabilities

Table B.1 and B.2 present the posterior inclusion probabilities of the variables used in the baseline models. Figure B.1 and B.2 display these graphically for the time window starting in 1980. For the level specification, it is apparent that the past exchange rate is the by far most important variable over the short term. Its PIP is in fact equal to 1 for forecast horizons of up to three months. From then on, however, its predictive ability and thus its PIP diminishes continuously. At a forecast horizon of 9 months, it loses its position as the variable with the highest PIP. At 12 months, the only regressor with a lower PIP is the industrial production variable. However, as noted in the data description, the industrial production time series was not available for the Swiss Franc. Consequently, it is also not included in any of the currency pairs involving the Swiss Franc and the results for the PIP of the industrial production variable are biased downward by an expected factor of 11/15.[31] Taking this into account, the past exchange rate in fact has the lowest PIP of all variables at a horizon of 12 months. Incidentally, forecast horizons 9 and 12 are also the horizons at which the BMA specification significantly outperforms the random walk when results are averaged over all currencies.

Another interesting pattern is that for all other variables include, PIPs tend to increase with the forecasting horizon. This is not surprising, especially for fundamental variables such as money supply, as their effects usually take some time to manifest themselves. M1, for instance, starts with a low PIP of 0.12 as one of the regressors with less predictive power. However, at the 12-month forecast horizon it has the second highest PIP with 0.72. Also notable: the price related variables - either inflation at horizons up to 5 months or the CPI at longer horizons - are constantly among the top 3 covariates. At a forecast horizon of 12 months, the CPI even has the highest PIP. This is consistent with classic economic theory that usually includes price levels or inflation as one of the most important determinants of the exchange rate. Interest rates have somewhat lower PIPs across all horizons. Yet, apart from the one-month horizon, their inclusion probabilities are at least above the 50% mark. Perhaps they would have been even higher, had they been specified in terms of real interest rates, rather than nominal interest rates. It also

[31] Only 15 currency pairs were included in calculating the PIPs. The five Euro-related exchange rates were not included due to their markedly different time windows.

appears that including reserves in exchange rate models has some merit - its PIPs lie above the 50% mark for forecast horizons greater than 2 months and it has the highest PIP for the 9-month horizon. Results are rather mixed for the consumer confidence and the cyclical leading indicator. Their inclusion probabilities rise somewhat for longer forecasting horizons. Stock indices do pretty well over horizons up to five months, after which they fall somewhat in the relative ranking. Industrial production, as a gauge for GDP, would be in the lower ranks, even if adjusted for the non-presence in Swiss Franc-related exchange rates.

Overall, there is no variable - except for the exchange rate at shorter horizons - with PIPs above 0.80. And while there is a general upward trend in PIPs for all variables except the past exchange rate, there is quite some fluctuation in the relative rankings of the variables. Economic variables that are usually included in exchange rate models, such as money supply, interest rates, and prices are more often than not included in the respective model at longer horizons. The results are similar for the period of 1990-2011, the main difference being that the past exchange rate has a lower inclusion probability, and falls down the PIP ranking ladder quicker. It is likely that this is at least in part because of the inclusion of forward rates, which most likely captures some of the effects that the exchange rate would have captured otherwise. On that note, the forward rate has relatively low inclusion probabilities, and usually does worse in that respect than the past exchange rate. This is consistent with many studies that have found the forward rate to have rather disappointing forecasting qualities. As for the VIX, its posterior inclusion probabilities are below-average for most forecast horizons. This is not surprising, given that the currencies included in the forecasting exercise are of the more stable type. If used for exchange rates involving a relatively weak currency, including it in the set of regressors might make more sense. In any case, it does seem to have some predictive ability for certain horizons.

For the difference specification, presented in Figure B.2 and Table B.2, the exchange rate only has the highest inclusion probability at a one-month horizon and is relegated to the group of variables with lower inclusion probabilities thereafter. Other than that, the general results from the baseline specification in levels hold. The tendency of PIPs to rise with forecast horizon is still present, though they are not as high as in the case of the level specification.

5 Conclusion

In this paper I use the Bayesian Model Averaging methodology to perform forecasts for 20 different exchange rates, over two different main time windows, eight forecasting horizons and for various model specifications. The model weights are hereby determined using the concept of predictive likelihood, rather than the more standard marginal likelihood, since it has been shown to reduce the problem of overfitting and is more robust to structural breaks. In addition, I perform forecasts employing the best model according to posterior model probability, as well as the median model, which includes all variables with a posterior inclusion probability of 50% or above. The forecast performances are then analyzed in order to find implications of which models work best at which time horizons.

The results of this extensive analysis point strongly to one fact - Bayesian Model Averaging forecasts clearly outperform both the single best and the median model forecasts in terms of root mean squared forecast error. This result generally holds across all model specifications, time windows and forecasting horizons. In terms of Direction of Change statistic, all three variants perform very similarly.

It also remains true that Random Walk forecasts are hard to beat. Nevertheless, averaged across all currencies and over the whole sample period, Bayesian Model Averaging leads to significantly better results at 9 and especially 12 month forecasting horizons. For shorter horizons it still performs somewhat worse, this result being significant at the 5% level for forecasting horizons of 2, 3, and 4 months. However, for the second time window starting in 1990, the BMA forecasts are not outperformed significantly at any lag while still again doing significantly better than the random walk at the 9 and 12 month horizon. Estimating the model in differences produces better forecasts than the level version at shorter horizons. In particular, the difference version significantly outperforms the random walk at the one-month horizon. Comparing the levels and the difference versions of the baseline model, it seems to make sense to use the latter for forecasting horizons of up to four months, and the latter for nine and twelve months. For the other months, results are quite similar.

Comparing the baseline models with the alternative specifications yields three implications. First, including cross-country differentials in the model instead of using domestic and foreign variables separately is advisable. Forecasts are not worse in general and computational time can be reduced significantly. Thus, such an approach ought to pay off in a cost-benefit sense, especially when estimating models of larger size. Second, cointegration models can potentially improve forecasting results somewhat over those of difference models. However, the results for the cointegration model are not exactly comparable, as the long-term cointegration relationship was identified by using data that would have not been available at the time of the forecasts. Thus, whether this result holds up for true out-of-sample forecasts made with cointegration models remains in doubt. Third, rolling model weights do not seem to have much merit. They do lead to better results for the difference specification at longer horizons. However, these are precisely the horizons at which level models tend to do better than difference models. Thus the value of such an improvement is limited. However, more analysis is needed when it comes to the optimal rolling frequencies.

As for the relative importance and predictive value of the various regressors used in the forecasting exercise, two main results emerge. One, the lagged exchange rate is the regressor with the highest predictive ability in the short term as implied by the posterior inclusion probability. For the baseline model in levels, this refers to the first six months, for the baseline model in differences, it refers to the one-month horizon. Two, the predictive ability of all other regressors rises with the forecasting horizon. Price-related variables (price level, inflation) seem to do particularly well. Other economic variables used in classic exchange rate models such as interest rates and money supply are also rather valuable in prediction for longer forecasting horizons. However, no variable, except for the exchange rate for shorter horizons, achieves posterior inclusion probabilities of above 80%. This uncertainty regarding which variables to include in the forecasting model is precisely why using Bayesian Model Averaging seems to make sense in this context.

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A Appendix

A.1 Data Set

The data set used in this paper spans the period from January 1980 to May 2011, i.e. 377 months. It consists of various economic and financial country variables as presented in Table A.1. Forward Rate and VIX series are used from 1990 onwards due to lack of previous availability. Countries covered include the United States, Great Britain, Switzerland, Japan, and Canada. For these countries the full data set is used. The exception is Switzerland, for which the industrial production variable was not available. Germany and the Eurozone are also covered. However, they are treated separately, with the date of the introduction of the Euro as an accounting unit in January 1999 serving as the dividing line. As a result, the German data set ends ins December 1998, while the Eurozone data set starts the following month.

A.2 Data Operations

Information on data transformations can also be inferred from Table A.1. In addition, all data series in index form are adjusted so that 2005 is the base year. A few missing data points include M1 and M3 data of Switzerland for the months April and May of 2011, as well as Germany M1 data and Japan M3 data for January and February 1980. These missing data points were substituted by the predictions of a simple AR(1) process using the rest of the respective data series. Finally, forward exchange rates were not available for all prediction horizons (usually for 1, 2, 3, 6, 9, and 12 months). The remaining forward rates were obtained by linear interpolation from the available rates.

A.3 Time frames used in estimation and prediction

Nearly all estimations and predictions use two main time frames. The first time frame includes the whole data set, i.e. January 1980 to May 2011. The estimation period, including training and hold-out sample, ends in December 2003. The remaining dates are used for out-of-sample forecasting. The second time frame goes from June 1990 until May 2011. This allows for the use of additional variables (i.e. VIX and forward rates) and enables a check on the robustness of results using different time frames. For Germany, the first time frame ends in 1998, with the estimation period ending in December 1993. The second one ends in June 1996. For the Eurozone there is only one time frame and the estimation period ends in December 2006.

Table A.1: *Variables*

Variable	Description	Statistical Transformation	Shift (months)	Source
Exchange Rate	Monthly average exchange rates (cross rates via USD)	logged	-	OECD
Short Term Interest Rate	3 month interbank offered rate	-	-	OECD
Long Term Interest Rate	10 year government bond yields	-	-	OECD
Central Bank Reserves	Reserve assets measured in SDR, index form	logged, SA	1	OECD
Money Supply M1	End of month figures in index form, M0 for UK	logged, SA	2	OECD, DBB[1], BoE
Money Supply M3	End of month figures in index form, M4 for UK	logged, SA	2	OECD
Stocks	Monthly average stock index figures, index form	logged	-	OECD
Inflation	Annual percentage change in CPI	-	1	OECD
Industrial Production	Output generated by production in industrial sectors, index form	logged, SA	2	OECD
Composite Leading Indicator (CLI)	Aggregate of series used to gauge turning points	logged, AA[2]	2	OECD
Consumer Confidence Index (CC)	Aggregate of national sentiment indicators	logged, SA	1	OECD
Dividend Yields	Monthly dividend yields as obtained from MSCI and FTSE indices	-	-	MSCI, own calc.[3]
Consumer Price Index (CPI)	Consumer price indices as calculated by OECD	logged	1	OECD
Forward Exchange Rates	Mid-month forward exchange rates, interpolated	-	-	Datastream
Volatility Index (VIX)	CBOE volatility index	logged	-	Datastream

[1] DBB = Deutsche Bundesbank

[2] AA = Amplitude adjusted. For the various other transformations see the OECD website.

[3] Where available, MSCI dividend yields were obtained directly. From 2001 on dividend yields were implicitly computed using country FTSE price and total return indices.

B Appendix

Table B.1: *Average PIPs for different horizons*

(a) Average PIPs: 1980-2011 - levels

Variable	lag 1	Variable	lag 2	Variable	lag 3	Variable	lag 4	Variable	lag 5	Variable	lag 6	Variable	lag 9	Variable	lag 12
ex_rate	1.00	ex_rate	1.00	ex_rate	1.00	ex_rate	0.97	ex_rate	0.88	ex_rate	0.75	reserves	0.83	cpi	0.74
infl	0.35	stocks	0.55	infl	0.63	infl	0.66	stocks	0.66	cpi	0.72	cli	0.70	m1	0.72
stocks	0.30	infl	0.50	lr	0.59	stocks	0.65	infl	0.64	sr	0.68	cpi	0.70	cci	0.68
div_yield	0.26	lr	0.50	stocks	0.59	lr	0.60	reserves	0.63	m1	0.66	infl	0.66	reserves	0.66
sr	0.23	reserves	0.43	reserves	0.50	m1	0.58	m1	0.61	cli	0.66	m1	0.60	div_yield	0.64
lr	0.22	div_yield	0.43	m1	0.48	sr	0.53	sr	0.59	stocks	0.63	ex_rate	0.60	sr	0.64
cci	0.14	sr	0.38	div_yield	0.47	reserves	0.51	lr	0.57	reserves	0.60	cci	0.60	infl	0.62
reserves	0.13	cci	0.35	sr	0.46	cpi	0.49	cpi	0.55	infl	0.59	stocks	0.56	lr	0.56
m1	0.12	cpi	0.35	cci	0.43	cci	0.49	div_yield	0.49	div_yield	0.58	sr	0.54	stocks	0.55
cli	0.11	m1	0.31	cpi	0.40	div_yield	0.45	cci	0.47	lr	0.55	div_yield	0.52	cli	0.47
cpi	0.09	cli	0.28	cli	0.38	cli	0.37	cli	0.41	cci	0.52	lr	0.51	m3	0.43
indust	0.08	indust	0.23	indust	0.31	m3	0.36	m3	0.38	m3	0.42	m3	0.48	ex_rate	0.40
m3	0.08	m3	0.20	m3	0.30	indust	0.33	indust	0.37	indust	0.38	indust	0.40	indust	0.37

(b) Average PIPs: 1990-2011 - levels

Variable	lag 1	Variable	lag 2	Variable	lag 3	Variable	lag 4	Variable	lag 5	Variable	lag 6	Variable	lag 9	Variable	lag 12
ex_rate	0.92	ex_rate	0.79	ex_rate	0.70	ex_rate	0.54	infl	0.66	infl	0.77	cli	0.68	cli	0.68
fwd1	0.40	div_yield	0.43	reserves	0.51	reserves	0.52	m3	0.53	m3	0.58	m3	0.63	infl	0.56
infl	0.15	fwd2	0.40	lr	0.48	infl	0.49	cli	0.53	cli	0.58	infl	0.63	cci	0.56
div_yield	0.12	infl	0.37	div_yield	0.47	div_yield	0.48	reserves	0.48	reserves	0.53	m1	0.58	reserves	0.56
stocks	0.10	cpi	0.33	infl	0.47	cpi	0.47	cpi	0.48	m1	0.51	vix	0.58	stocks	0.55
vix	0.08	m1	0.30	m1	0.42	m3	0.47	lr	0.48	stocks	0.50	cci	0.57	m3	0.55
sr	0.06	stocks	0.29	stocks	0.41	lr	0.45	stocks	0.47	lr	0.48	reserves	0.57	sr	0.54
m1	0.06	cci	0.26	m3	0.40	m1	0.41	div_yield	0.47	cpi	0.47	sr	0.54	m1	0.48
lr	0.05	sr	0.22	fwd3	0.38	cli	0.40	m1	0.42	cci	0.45	stocks	0.49	cpi	0.47
cci	0.04	reserves	0.22	cpi	0.36	sr	0.39	cci	0.37	div_yield	0.41	fwd9	0.46	div_yield	0.44
cpi	0.03	lr	0.22	sr	0.34	stocks	0.31	sr	0.35	sr	0.38	cpi	0.44	lr	0.41
reserves	0.03	m3	0.19	vix	0.33	cci	0.30	ex_rate	0.34	vix	0.37	div_yield	0.42	ex_rate	0.36
cli	0.03	vix	0.16	cci	0.22	fwd4	0.28	vix	0.28	ex_rate	0.25	ex_rate	0.36	vix	0.36
indust	0.03	cli	0.12	cli	0.21	vix	0.24	fwd5	0.19	fwd6	0.21	indust	0.35	indust	0.32
m3	0.02	indust	0.09	indust	0.16	indust	0.19	indust	0.16	indust	0.16	lr	0.31	fwd12	0.30

Table B.2: *Average PIPs for different horizons*

(a) Average PIPs: 1980-2011 - differences

Variable	lag 1	Variable	lag 2	Variable	lag 3	Variable	lag 4	Variable	lag 5	Variable	lag 6	Variable	lag 9	Variable	lag 12
ex_rate	0.72	stocks	0.39	infl	0.50	infl	0.60	infl	0.68	infl	0.61	reserves	0.72	cpi	0.80
stocks	0.44	ex_rate	0.37	sr	0.46	sr	0.50	stocks	0.55	sr	0.60	m1	0.68	m1	0.79
sr	0.43	lr	0.35	stocks	0.40	lr	0.45	sr	0.55	lr	0.60	cpi	0.63	infl	0.72
lr	0.39	div_yield	0.34	cli	0.38	stocks	0.42	lr	0.48	stocks	0.54	lr	0.62	div_yield	0.66
div_yield	0.30	sr	0.32	m1	0.33	m1	0.38	m1	0.44	m1	0.52	sr	0.56	sr	0.60
m1	0.20	cli	0.28	lr	0.31	cli	0.35	cli	0.43	reserves	0.45	div_yield	0.55	lr	0.59
cci	0.20	cci	0.23	div_yield	0.27	div_yield	0.30	div_yield	0.40	cpi	0.44	m3	0.52	reserves	0.58
cpi	0.20	m1	0.22	ex_rate	0.26	cpi	0.30	reserves	0.35	div_yield	0.43	infl	0.47	cci	0.53
cli	0.20	cpi	0.21	cci	0.26	cci	0.29	indust	0.32	cli	0.41	stocks	0.47	ex_rate	0.53
infl	0.16	infl	0.18	reserves	0.20	ex_rate	0.27	cci	0.31	ex_rate	0.38	cli	0.37	cli	0.52
reserves	0.15	reserves	0.14	indust	0.19	reserves	0.24	ex_rate	0.30	indust	0.35	cci	0.35	stocks	0.51
m3	0.12	indust	0.10	cpi	0.18	indust	0.22	cpi	0.29	m3	0.32	indust	0.30	indust	0.49
indust	0.10	m3	0.08	m3	0.16	m3	0.18	m3	0.27	cci	0.28	ex_rate	0.24	m3	0.43

(b) Average PIPs: 1990-2011 - differences

Variable	lag 1	Variable	lag 2	Variable	lag 3	Variable	lag 4	Variable	lag 5	Variable	lag 6	Variable	lag 9	Variable	lag 12
ex_rate	0.65	stocks	0.33	stocks	0.35	infl	0.44	infl	0.51	infl	0.56	cli	0.70	m1	0.73
fwd	0.45	div_yield	0.32	infl	0.33	m1	0.38	m1	0.48	lr	0.46	reserves	0.56	cli	0.73
div_yield	0.28	sr	0.28	div_yield	0.32	lr	0.34	m3	0.38	m1	0.45	sr	0.54	reserves	0.60
cci	0.22	cci	0.24	sr	0.29	reserves	0.34	reserves	0.35	cci	0.43	infl	0.48	cci	0.60
sr	0.22	cli	0.24	cli	0.24	m3	0.31	stocks	0.30	reserves	0.42	m3	0.46	cpi	0.58
stocks	0.20	vix	0.21	vix	0.23	indust	0.26	indust	0.29	m3	0.42	cci	0.46	m3	0.54
cli	0.20	infl	0.18	lr	0.23	cci	0.26	cci	0.28	cli	0.39	cpi	0.35	sr	0.48
lr	0.17	ex_rate	0.17	cci	0.23	sr	0.25	cli	0.28	stocks	0.38	lr	0.30	infl	0.47
infl	0.17	cpi	0.14	m1	0.21	cli	0.25	lr	0.26	div_yield	0.32	ex_rate	0.29	ex_rate	0.42
reserves	0.13	m1	0.13	cpi	0.19	div_yield	0.25	cpi	0.24	ex_rate	0.29	vix	0.29	fwd	0.41
cpi	0.12	reserves	0.11	indust	0.18	ex_rate	0.23	ex_rate	0.24	indust	0.28	m1	0.28	div_yield	0.40
indust	0.11	lr	0.11	m3	0.17	cpi	0.22	div_yield	0.23	cpi	0.26	stocks	0.27	stocks	0.39
m1	0.11	fwd	0.10	reserves	0.16	stocks	0.22	fwd	0.23	vix	0.21	div_yield	0.25	vix	0.37
m3	0.08	m3	0.09	ex_rate	0.15	fwd	0.20	sr	0.19	fwd	0.21	fwd	0.22	lr	0.29
vix	0.07	indust	0.07	fwd	0.10	vix	0.16	vix	0.06	sr	0.21	indust	0.20	indust	0.21

Figure B.1: *PIPs across lags: 1980 - 2011, levels*

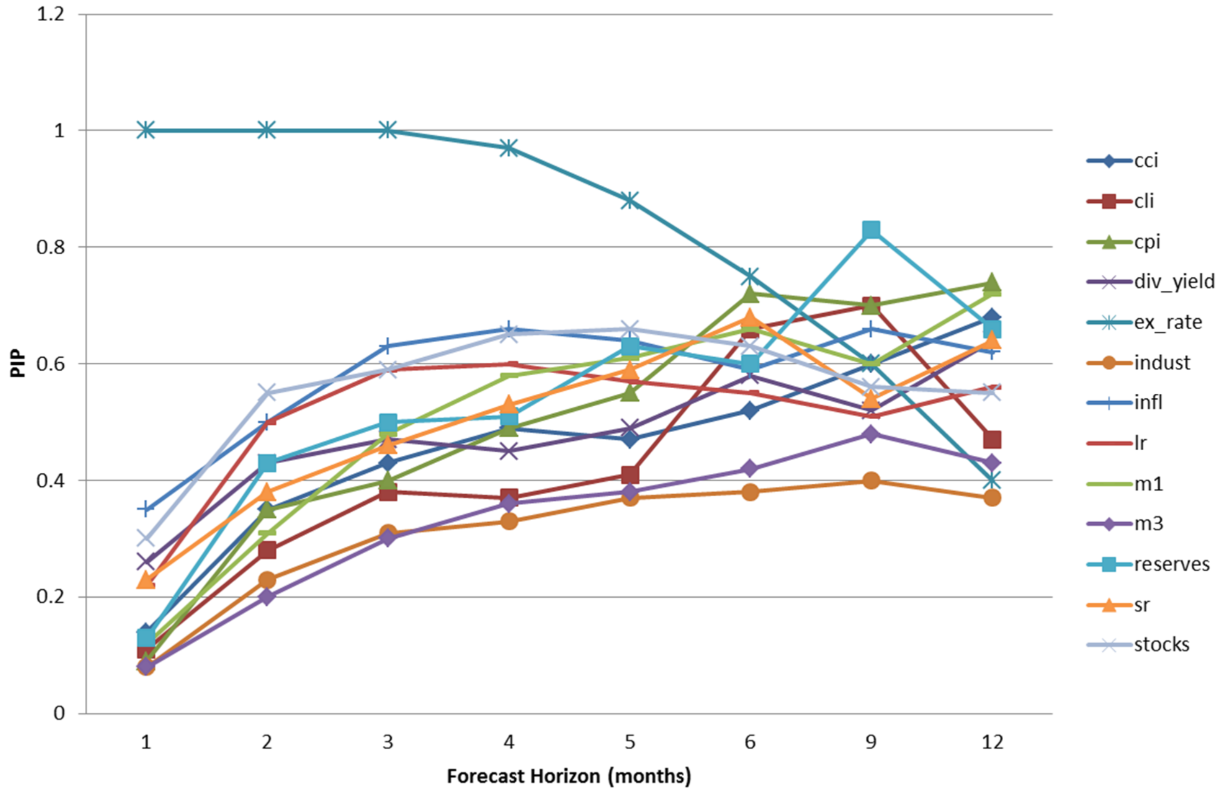
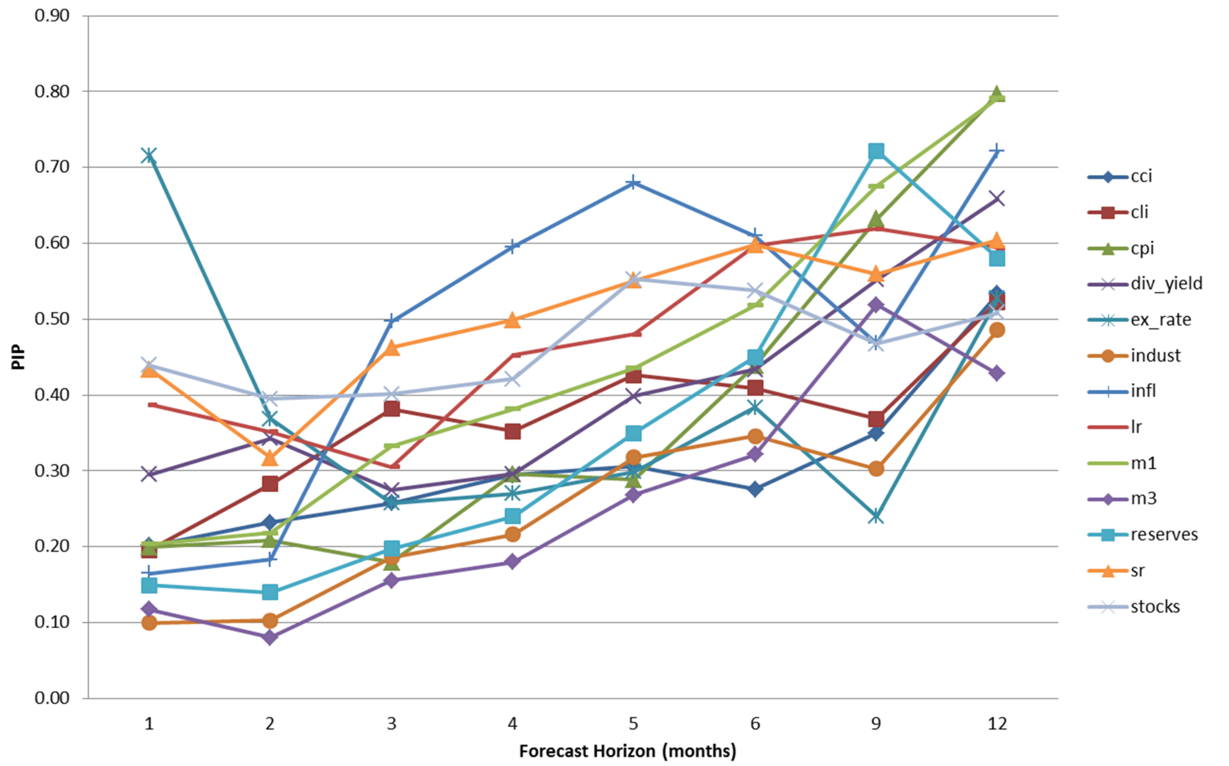


Figure B.2: *PIPs across lags: 1980 - 2011, differences*



C Appendix

Table C.1: *Baseline Model - Levels (All Exchange Rates): Total*

Performances for full sample, baseline model in levels, 1 lag

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Median
1	1.0120*	1.0135**	1.0119*	0.5223	0.5235	0.5236*
	(0.0895)	(0.0477)	(0.0734)	(0.1009)	(0.0804)	(0.0806)
2	1.0459***	1.0788***	1.0731***	0.4984	0.5043	0.5011
	(0.0042)	(0.0001)	(0.0002)	(0.8689)	(0.6977)	(0.9075)
3	1.0658***	1.1500***	1.1539***	0.4964	0.4972	0.4886
	(0.0053)	(0.0015)	(0.0023)	(0.7883)	(0.8050)	(0.3912)
4	1.0750**	1.1607***	1.1295***	0.5094	0.5056	0.5052
	(0.0488)	(0.0028)	(0.0036)	(0.2809)	(0.5358)	(0.5974)
5	1.0417	1.1269**	1.1777***	0.4939	0.4935	0.4979
	(0.2963)	(0.0318)	(0.0052)	(0.6442)	(0.5878)	(0.8839)
6	1.0274	1.0951**	1.1310**	0.4779	0.4894	0.4762*
	(0.4102)	(0.0203)	(0.0370)	(0.0480)	(0.3864)	(0.0559)
9	0.8833***	0.9469	0.9983	0.5018	0.5193**	0.5107
	(0.0038)	(0.1987)	(0.9683)	(0.8596)	(0.0649)	(0.2570)
12	0.7951***	0.8830***	0.9067**	0.4976	0.5029	0.5014
	(0.0000)	(0.0025)	(0.0355)	(0.8446)	(0.8287)	(0.9059)

The Welch test is used to test whether the averaged RMSFE ratios differ significantly from 1.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.2: *Baseline Model - Levels, Outperformances: Total*

Models, exchange rates and sample as in Tabel C.3 - percentage of times the random walk is outperformed

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Med
1	31.43%**	31.43%**	28.58%**	65.71%*	65.71%*	65.71%*
	(0.0351)	(0.0351)	(0.0162)	(0.0719)	(0.0719)	(0.0719)
2	37.14%	20.00%	28.57%	45.71%	48.57%	45.71%
	(0.1377)	(0.0012)	(0.0162)	(0.6155)	(0.8668)	(0.6155)
3	31.43%	8.57%	11.43%	45.71%	54.29%	51.43%
	(0.0351)	(0.0000)	(0.0001)	(0.6155)	(0.6155)	(0.8668)
4	40.00%	17.14%	22.86%	54.29%	54.29%	48.57%
	(0.2452)	(0.0005)	(0.0029)	(0.6155)	(0.6155)	(0.8668)
5	48.57%	37.14%	25.71%	48.57%	48.57%	45.71%
	(0.8668)	(0.1377)	(0.0070)	(0.8668)	(0.8668)	(0.6155)
6	54.29%	34.29%	34.29%	31.43%	31.43%	28.57%
	(0.6155)	(0.0719)	(0.0719)	(0.0351)	(0.0351)	(0.0162)
9	77.14%	71.43%	62.86%	48.57%	54.29%	57.14%
	(0.0029)	(0.0162)	(0.1377)	(0.8668)	(0.6155)	(0.4041)
12	91.43%	71.43%	74.29%	54.29%	51.43%	42.86%
	(0.0000)	(0.0162)	(0.0070)	(0.6155)	(0.8668)	(0.4041)

The binomial test is used to test whether the number of outperformances differs significantly from 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.3: *Baseline Model - Levels: 1980-2011*

Performances for period 1980-2011, baseline model in levels, 1 lag, no EUR or DM exchange rates

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Median
1	1.0257**	1.0217**	1.0218***	0.5337**	0.5360**	0.5360**
	(0.0407)	(0.0221)	(0.0087)	(0.0682)	(0.0535)	(0.0545)
2	1.0721	1.0946*	1.1010**	0.5034	0.5011	0.5056
	(0.1008)	(0.0610)	(0.0432)	(0.8627)	(0.9525)	(0.7718)
3	1.0839**	1.1143**	1.1265**	0.4854	0.4876	0.4877
	(0.0495)	(0.0161)	(0.0210)	(0.1832)	(0.3189)	(0.1879)
4	1.0718*	1.1165**	1.1401**	0.5023	0.5056	0.5146
	(0.0785)	(0.0189)	(0.0229)	(0.8879)	(0.7459)	(0.4942)
5	1.0507	1.1300**	1.1248**	0.4984	0.4950	0.4883
	(0.2559)	(0.0207)	(0.0200)	(0.9487)	(0.8459)	(0.6580)
6	1.0659	1.1395	1.1149	0.4647*	0.4681	0.4647**
	(0.3688)	(0.1313)	(0.1933)	(0.0508)	(0.1004)	(0.0614)
9	1.1098	1.1693	1.1706	0.5360*	0.52584	0.5360*
	(0.2133)	(0.1158)	(0.1044)	(0.0923)	(0.1963)	(0.0705)
12	0.9483	1.0104	0.9933	0.5275	0.5162	0.5252*
	(0.3634)	(0.8562)	(0.9072)	(0.1293)	(0.4189)	(0.0872)

The Welch test is used to test whether the averaged RMSFE ratios differ significantly from 1.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.4: *Baseline Model - Levels, Outperformances: 1980-2011*

Models, exchange rates and sample as in Tabel C.3 - percentage of times the random walk is outperformed

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Med
1	10.00%**	30.00%	20.00%*	70.00%	70.00%	70.00%
	(0.0353)	(0.2415)	(0.0943)	(0.2415)	(0.2415)	(0.2415)
2	30.00%	20.00%*	20.00%	40.00%	40.00%	50.00%
	(0.2415)	(0.0943)	(0.0943)	(0.5447)	(0.5447)	(1.0000)
3	20.00%*	10.00%**	10.00%**	40.00%	40.00%	50.00%
	(0.0943)	(0.0353)	(0.0353)	(0.5447)	(0.5447)	(1.0000)
4	20.00%*	10.00%**	10.00%**	50.00%	50.00%	60.00%
	(0.0943)	(0.0353)	(0.0353)	(1.0000)	(1.0000)	(0.5447)
5	30.00%	10.00%**	10.00%**	60.00%	40.00%	40.00%
	(0.2415)	(0.0353)	(0.0353)	(0.5447)	(0.5447)	(0.5447)
6	50.00%	20.00%*	30.00%	20.00%*	30.00%	30.00%
	(1.0000)	(0.0943)	(0.2415)	(0.0943)	(0.2415)	(0.2415)
9	40.00%	40.00%	40.00%	80.00%*	60.00%	80.00%*
	(0.5447)	(0.5447)	(0.5447)	(0.0943)	(0.5447)	(0.0943)
12	70.00%	40.00%	50.00%	70.00%	70.00%	60.00%
	(0.2415)	(0.5447)	(1.0000)	(0.2415)	(0.2415)	(0.5447)

The binomial test is used to test whether the number of outperformances differs significantly from 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.5: *Baseline Model - Levels: 1990-2011*

Performances for period 1990-2011, baseline model in levels, 1 lag, no EUR or DM exchange rates

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Median
1	1.0012	1.0044	1.0044	0.5314	0.5299	0.5299
	(0.9106)	(0.5881)	(0.5881)	(0.1471)	(0.1265)	(0.1265)
2	1.0203	1.0576**	1.0529**	0.5231	0.5400*	0.5354*
	(0.1753)	(0.0378)	(0.0268)	(0.2755)	(0.0632)	(0.0833)
3	1.0242	1.0848***	1.0650**	0.5148	0.5271	0.5117
	(0.3062)	(0.0076)	(0.0130)	(0.5027)	(0.1349)	(0.5619)
4	1.0655	1.1160	1.0962	0.5246	0.5061	0.5092
	(0.3386)	(0.1027)	(0.1764)	(0.1618)	(0.6773)	(0.6165)
5	1.0211	1.0288	1.1288	0.5185	0.5092	0.5231
	(0.7027)	(0.6400)	(0.1287)	(0.4955)	(0.6671)	(0.3851)
6	1.0901	1.1891**	1.1664*	0.4791	0.4930	0.4715
	(0.1501)	(0.0187)	(0.0842)	(0.3861)	(0.7646)	(0.3585)
9	0.8095***	0.8973**	0.8997**	0.4938	0.5136	0.4983
	(0.0008)	(0.0301)	(0.0318)	(0.6218)	(0.4013)	(0.9116)
12	0.7825***	0.8708**	0.8632***	0.4985	0.5046	0.5000
	(0.0003)	(0.0389)	(0.0078)	(0.9234)	(0.7265)	(0.9995)

The Welch test is used to test whether the averaged RMSFE ratios differ significantly from 1.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.6: *Baseline Model - Levels, Outperformances: 1990-2011*

Models, exchange rates and sample as in Tabel C.5 - percentage of times the random walk is outperformed

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Med
1	60.00%	30.00%	30.00%	70.00%	70.00%	70.00%
	(0.5447)	(0.2415)	(0.2415)	(0.2415)	(0.2415)	(0.2415)
2	40.00%	20.00%*	20.00%*	60.00%	80.00%*	70.00%
	(0.5447)	(0.0943)	(0.0943)	(0.5447)	(0.0943)	(0.2415)
3	40.00%	10.00%**	10.00%**	40.00%	70.00%	60.00%
	(0.5447)	(0.0353)	(0.0353)	(0.5447)	(0.2415)	(0.5447)
4	60.00%	20.00%*	30.00%	70.00%	50.00%	40.00%
	(0.5447)	(0.0943)	(0.2415)	(0.2415)	(1.0000)	(0.5447)
5	50.00%	40.00%	20.00%*	60.00%	60.00%	70.00%
	(1.0000)	(0.5447)	(0.0943)	(0.5447)	(0.5447)	(0.2415)
6	30.00%	10.00%**	20.00%	40.00%	40.00%	30.00%
	(0.2415)	(0.0353)	(0.0943)	(0.5447)	(0.5447)	(0.2415)
9	90.00%**	80.00%*	80.00%*	50.00%	50.00%	40.00%
	(0.0353)	(0.0943)	(0.0943)	(1.0000)	(1.0000)	(0.5447)
12	100.00%**	90.00%**	90.00%**	50.00%	50.00%	40.00%
	(0.0133)	(0.0353)	(0.0353)	(1.0000)	(1.0000)	(0.5447)

The binomial test is used to test whether the number of outperformances differs significantly from 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.7: *Baseline Model - Differences (All Exchange Rates): Total*

Performances for total sample, baseline model in differences, 1 lag

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Median
1	0.9848	0.9921	0.9881	0.5199	0.5168	0.5216
	(0.0248)	(0.2308)	(0.0801)	(0.1669)	(0.1989)	(0.0881)
2	1.0004	1.0124	1.0133	0.5085	0.4993	0.5093
	(0.9537)	(0.0321)	(0.1597)	(0.4542)	(0.9422)	(0.4121)
3	1.0318	1.0543	1.0484	0.5080	0.5113	0.5115
	(0.0113)	(0.0008)	(0.0023)	(0.4039)	(0.2446)	(0.2263)
4	1.0362	1.0597	1.0559	0.5018	0.5040	0.4992
	(0.0142)	(0.0002)	(0.0006)	(0.8739)	(0.7582)	(0.9541)
5	1.0563	1.0858	1.0866	0.4894	0.4988	0.4932
	(0.0015)	(0.0001)	(0.0000)	(0.3840)	(0.9227)	(0.5704)
6	1.0576	1.0912	1.0866	0.4690	0.4706	0.4696
	(0.0018)	(0.0000)	(0.0000)	(0.0022)	(0.0036)	(0.0031)
9	1.0205	1.0658	1.0464	0.5161	0.5036	0.5086
	(0.4490)	(0.0143)	(0.0958)	(0.1972)	(0.7863)	(0.4933)
12	1.0056	1.0789	1.0766	0.5004	0.5034	0.4997
	(0.8948)	(0.0727)	(0.0697)	(0.9710)	(0.8138)	(0.9815)

The Welch test is used to test whether the averaged RMSFE ratios differ significantly from 1.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.8: *Baseline Model - Differences, Outperformances: Total*

Models, exchange rates and sample as in Tabel C.7 - percentage of times the random walk is outperformed

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Med
1	60.00%	51.43%	65.71%	68.57%	71.43%	74.29%
	(0.2452)	(0.8668)	(0.0719)	(0.0351)	(0.0162)	(0.0070)
2	48.57%	34.29%	37.14%	51.43%	45.71%	45.71%
	(0.8668)	(0.0719)	(0.1377)	(0.8668)	(0.6155)	(0.6155)
3	37.14%	20.00%	28.57%	45.71%	45.71%	42.86%
	(0.1377)	(0.1377)	(0.0162)	(0.6155)	(0.6155)	(0.6155)
4	34.29%	22.86%	20.00%	60.00%	57.14%	54.29%
	(0.0719)	(0.0029)	(0.0012)	(0.2452)	(0.4041)	(0.6155)
5	28.57%	22.86%	22.86%	54.29%	51.43%	48.57%
	(0.0162)	(0.0029)	(0.0029)	(0.6155)	(0.8668)	(0.8668)
6	31.43%	20.00%	20.00%	25.71%	25.71%	31.43%
	(0.0351)	(0.0012)	(0.0012)	(0.0070)	(0.0070)	(0.0351)
9	37.14%	25.71%	31.43%	68.57%	51.43%	62.86%
	(0.1377)	(0.0070)	(0.0351)	(0.0351)	(0.8668)	(0.1377)
12	45.71%	28.57%	28.57%	48.57%	45.71%	48.57%
	(0.6155)	(0.0162)	(0.0162)	(0.8668)	(0.6155)	(0.8668)

The binomial test is used to test whether the number of outperformances differs significantly from 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.9: *Baseline Model - Differences: 1990-2011*

Performances for total sample, baseline model in differences, 1 lag, no EUR or DM exchange rates

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Median
1	0.9597	0.9712	0.9666	0.5308	0.5292	0.5246
	(0.0121)	(0.0795)	(0.0307)	(0.1481)	(0.1584)	(0.2209)
2	0.9890	0.9983	1.0111	0.5354	0.5292	0.5431
	(0.3211)	(0.7566)	(0.5007)	(0.1684)	(0.1333)	(0.1030)
3	1.0100	1.0307	1.0390	0.5246	0.5339	0.5354
	(0.3795)	(0.0519)	(0.0199)	(0.1656)	(0.0659)	(0.0582)
4	1.0181	1.0353	1.0403	0.5061	0.5123	0.5108
	(0.3146)	(0.0488)	(0.0263)	(0.7688)	(0.6040)	(0.6568)
5	1.0241	1.0487	1.0400	0.4892	0.5123	0.4954
	(0.3324)	(0.0769)	(0.1633)	(0.6537)	(0.5989)	(0.8091)
6	1.0665	1.0921	1.0893	0.4600	0.4508	0.4554
	(0.0329)	(0.0087)	(0.0161)	(0.1371)	(0.0353)	(0.0308)
9	1.0369	1.0968	1.0557	0.5092	0.4923	0.5077
	(0.4898)	(0.1185)	(0.3764)	(0.6098)	(0.6233)	(0.6655)
12	1.0542	1.1201	1.1114	0.5262	0.5246	0.5216
	(0.8948)	(0.0727)	(0.0697)	(0.9710)	(0.8138)	(0.9815)

The Welch test is used to test whether the averaged RMSFE ratios differ significantly from 1.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.10: *Baseline Model - Differences, Outperformances: 1990-2011*

Models, exchange rates and sample as in Tabel C.9 - percentage of times the random walk is outperformed

Step	BMA	Best	Median	DOC BMA	DOC Best	DOC Med
1	0.9597	0.9712	0.9666	0.5308	0.5292	0.5246
	(0.0121)	(0.0795)	(0.0307)	(0.1481)	(0.1584)	(0.2209)
2	0.9890	0.9983	1.0111	0.5354	0.5292	0.5431
	(0.3211)	(0.7566)	(0.5007)	(0.1684)	(0.1333)	(0.1030)
3	1.0100	1.0307	1.0390	0.5246	0.5339	0.5354
	(0.3795)	(0.0519)	(0.0199)	(0.1656)	(0.0659)	(0.0582)
4	1.0181	1.0353	1.0403	0.5061	0.5123	0.5108
	(0.3146)	(0.0488)	(0.0263)	(0.7688)	(0.6040)	(0.6568)
5	1.0241	1.0487	1.0400	0.4892	0.5123	0.4954
	(0.2415)	(0.2415)	(0.5447)	(1.0000)	(0.2415)	(0.5447)
6	1.0665	1.0921	1.0893	0.4600	0.4508	0.4554
	(0.0943)	(0.0943)	(0.0943)	(0.0943)	(0.2415)	(0.2415)
9	1.0369	1.0968	1.0557	0.5092	0.4923	0.5077
	(0.5447)	(0.0943)	(0.2415)	(0.2415)	(0.5447)	(0.5447)
12	1.0542	1.1201	1.1114	0.5262	0.5246	0.5216
	(0.5447)	(0.0943)	(0.0943)	(0.5447)	(0.5447)	(0.5447)

The binomial test is used to test whether the number of outperformances differs significantly from 50%.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table C.11: *Baseline Model vs. Country Differentials (Levels)*

(a) Baseline model in levels - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	1.0049	1.0144	1.0193	0.5702	0.5730	0.5730
2	0.9936	1.0092	1.0272	0.5084	0.5084	0.5056
3	1.0054	1.0402	1.0267	0.5141	0.5197	0.5141
4	0.9851	1.0468	1.0208	0.5197	0.5225	0.5365
5	0.9597	1.0297	1.0353	0.5084	0.4972	0.4916
6	0.9470	1.0263	0.9903	0.4607	0.4635	0.4551
9	0.9117	0.9269	0.9359	0.5169	0.5000	0.5225
12	0.8739	0.9141	0.9245	0.5309	0.5281	0.5141

(b) Country differentials model in levels - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	1.0801	1.0032	1.0092	0.5674	0.5618	0.5618
2	1.0168	1.0212	1.0121	0.5169	0.5225	0.5028
3	1.0026	1.0155	1.0155	0.5197	0.5141	0.5141
4	0.9754	0.9950	0.9927	0.5253	0.5197	0.5197
5	0.9527	0.9639	0.9639	0.5141	0.5169	0.5197
6	0.9312	0.9513	0.9423	0.4691	0.4607	0.4635
9	0.8995	0.9114	0.9481	0.4860	0.5056	0.4888
12	0.9375	0.9806	0.9796	0.5112	0.5028	0.5056

(c) Average Ratios over all Forecast Horizons

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Baseline Model	0.9601	1.0010	0.9975	0.5162	0.5140	0.5140
Countrydiff	0.9745	0.9803	0.9829	0.5137	0.5130	0.5095
P-value (Welch)	(0.5333)	(0.3458)	(0.4665)	(0.8636)	(0.9406)	(0.7502)

(d) Percentage of times Country Differential Model outperforms Baseline Model

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Outperformance	50.00%	56.25%	62.50%	45.31%	50.00%	48.44%
P-value (Binom.)	(1.0000)	(0.4850)	(0.1676)	(0.5998)	(1.0000)	(0.8609)

The four currency pair average refers to the average of the following currency pairs: USD/GBP, USD/CHF, USD/CAD, GBP/JPY.

Table C.12: *Baseline Model vs. Country Differentials (Differences)*

(a) Baseline model in differences - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	0.9525	0.9547	0.9548	0.5549	0.5492	0.5549
2	1.0095	1.0331	1.0424	0.4932	0.4932	0.5015
3	1.0398	1.0605	1.0408	0.5168	0.5113	0.5169
4	1.0233	1.0314	1.0314	0.4972	0.5085	0.5085
5	1.0266	1.0576	1.0510	0.5056	0.5113	0.5169
6	1.0122	1.0183	1.0252	0.4494	0.4579	0.4719
9	1.0606	1.0754	1.0966	0.5197	0.5028	0.5028
12	1.1080	1.1267	1.1407	0.4944	0.5000	0.4888

(b) Country differentials model in differences, 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	0.9595	0.9695	0.9568	0.5414	0.5414	0.5414
2	0.9896	1.0061	1.0000	0.5000	0.4972	0.5000
3	1.0074	1.0069	1.0109	0.5337	0.5365	0.5337
4	1.0092	1.0150	1.0164	0.5028	0.5000	0.5028
5	1.0135	1.0115	1.0182	0.5112	0.5112	0.5084
6	1.0168	1.0208	1.0163	0.4551	0.4382	0.4495
9	1.0501	1.0647	1.0457	0.4691	0.4635	0.4635
12	1.0207	1.0443	1.0516	0.5450	0.5394	0.5450

(c) Average Ratios over all Forecast Horizons

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Baseline Model	1.0290	1.0447	1.0478	0.5039	0.5043	0.5078
Countrydiff	1.0084	1.0173	1.0145	0.5073	0.5034	0.5055
P-value (Welch)	(0.3168)	(0.2074)	(0.1437)	(0.8184)	(0.9564)	(0.8840)

(d) Percentage of times Country Differentials Model outperforms Baseline Model

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Outperformance	56.25%	54.69%	56.25%	53.13%	45.31%	48.44%
P-value (Binom.)	(0.4850)	(0.5998)	(0.4850)	(0.7261)	(0.5998)	(0.8609)

The four currency pair average refers to the average of the following currency pairs: USD/GBP, USD/CHF, USD/CAD, GBP/JPY.

Table C.13: *Baseline Model in Differences vs. Cointegration*

(a) Baseline model in differences - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	0.9525	0.9547	0.9548	0.5549	0.5492	0.5549
2	1.0095	1.0331	1.0424	0.4932	0.4932	0.5015
3	1.0398	1.0605	1.0408	0.5168	0.5113	0.5169
4	1.0233	1.0314	1.0314	0.4972	0.5085	0.5085
5	1.0266	1.0576	1.0510	0.5056	0.5113	0.5169
6	1.0122	1.0183	1.0252	0.4494	0.4579	0.4719
9	1.0606	1.0754	1.0966	0.5197	0.5028	0.5028
12	1.1080	1.1267	1.1407	0.4944	0.5000	0.4888

(b) Cointegration Model - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	0.9502	0.9675	0.9550	0.5562	0.5506	0.5449
2	1.0027	1.0232	1.0219	0.4888	0.4860	0.4832
3	0.9983	0.9935	1.0164	0.5225	0.5225	0.5169
4	1.0009	1.0281	1.0270	0.5056	0.4888	0.4944
5	0.9973	1.0051	1.0080	0.5112	0.5084	0.5141
6	1.0036	1.0067	1.0066	0.4410	0.4494	0.4466
9	0.9660	0.9914	0.9802	0.4831	0.4691	0.4719
12	0.9754	0.9727	0.9891	0.5000	0.5085	0.5028

(c) Average Ratios over all Forecast Horizons

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Baseline Model	1.0290	1.0447	1.0476	0.5039	0.5043	0.5074
Cointegraton	0.9884	1.0005	1.0025	0.5009	0.4976	0.4966
P-value (Welch)	(0.0988)	(0.0861)	(0.1012)	(0.8438)	(0.6546)	(0.4757)

(d) Percentage of times Cointegration Model outperforms Baseline Model

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Outperformanc	62.50%	62.50%	68.75%	45.31%	43.75%	45.31%
P-value (Binom.)	(0.1676)	(0.1676)	(0.0423)	(0.5998)	(0.4850)	(0.5998)

The four currency pair average refers to the average of the following currency pairs: USD/GBP, USD/CHF, USD/CAD, GBP/JPY.

Table C.14: *Baseline Model vs. Rolling Model Weights (Levels)*

(a) Baseline model in levels - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	1.0049	1.0144	1.0193	0.5702	0.5730	0.5730
3	1.0054	1.0402	1.0267	0.5141	0.5197	0.5141
6	0.9470	1.0263	0.9903	0.4607	0.4635	0.4551
9	0.9117	0.9269	0.9359	0.5169	0.5000	0.5225
12	0.8739	0.9141	0.9245	0.5309	0.5281	0.5141

(b) Baseline Level Model with rolling weights - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	1.0359	1.0249	1.0231	0.5618	0.5618	0.5702
3	1.0688	1.1042	1.1262	0.4916	0.5084	0.5000
6	1.0225	1.0713	1.0438	0.4551	0.4270	0.4466
9	0.9448	0.9531	0.9531	0.5281	0.5197	0.5084
12	0.8865	0.9514	0.9349	0.5000	0.5085	0.4832

(c) Average Ratios over all Forecast Horizons

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Baseline Model	0.9486	0.9844	0.9793	0.5185	0.5169	0.5157
Rolling Weights	0.9917	1.0210	1.0162	0.5073	0.5051	0.5017
P-value (Welch)	0.3481	0.4700	0.4336	0.4904	0.5182	0.4258

(d) Percentage of times Rolling Weights Model outperforms Baseline Model

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Updating/Baseline	20.00%	25.00%	25.00%	40.00%	35.00%	37.50%
P-value (Binomial)	(0.0125)	(0.0341)	(0.0341)	(0.3793)	(0.1913)	(0.2738)

The four currency pair average refers to the average of the following currency pairs: USD/GBP, USD/CHF, USD/CAD, GBP/JPY.

Table C.15: *Baseline Model vs. Rolling Model Weights (Differences)*

(a) Baseline model in differences - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	0.9525	0.9547	0.9548	0.5549	0.5492	0.5549
3	1.0398	1.0605	1.0408	0.5168	0.5113	0.5169
6	1.0122	1.0183	1.0252	0.4494	0.4579	0.4719
9	1.0606	1.0754	1.0966	0.5197	0.5028	0.5028
12	1.0512	1.1267	1.1407	0.4944	0.5000	0.4888

(b) Baseline Difference Model with rolling weights - 4 currency pair average, 1 lag

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Median
1	0.9669	0.9717	0.9752	0.5521	0.5408	0.5493
3	1.0756	1.0907	1.0861	0.5084	0.5141	0.5028
6	1.0263	1.0659	1.0416	0.4354	0.4298	0.4270
9	1.0365	1.0586	1.0593	0.4775	0.4916	0.4775
12	0.9883	0.9857	0.9951	0.5084	0.5112	0.5056

(c) Average Ratios over all Forecast Horizons

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Baseline Model	1.0232	1.0471	1.0516	0.5070	0.5042	0.5070
Rolling Weights	1.0187	1.0345	1.0314	0.4964	0.4975	0.4924
P-value (Welch)	(0.8940)	(0.7521)	(0.6195)	(0.5326)	(0.6757)	(0.3821)

(d) Percentage of times Rolling Weights Model outperforms Baseline Model

	BMA	Best	Median	DOC - BMA	DOC - Best	DOC - Med.
Outperformance	35.00%	35.00%	35.00%	42.50%	45.00%	30.00%
P-value (Binom.)	(0.1909)	(0.1909)	(0.1909)	(0.5080)	(0.6583)	(0.0849)

The four currency pair average refers to the average of the following currency pairs: USD/GBP, USD/CHF, USD/CAD, GBP/JPY.

Table C.16: *Baseline Model 1 lag vs. 2 lags*

Performances for total sample, all exchange rates, Baseline Model 1 & 2 lags

Step	Category	BMA	W	Best	W	Median	W	DOC BMA	W	DOC Best	W	DOC Median	Win
1	1 lag	1.0120		1.0135		1.0119		0.5223		0.5235		0.5236	
	2 lags	0.9912		0.9971		0.9985		0.5307		0.5300		0.5327	
	p-value (Welch)	(0.0966)	2	(0.1713)	2	(0.3315)	2	(0.6386)	2	(0.7173)	2	(0.5935)	2
	p-value (Bin.)	(0.0728)	2	(0.0728)	2	(0.1387)	2	(0.4047)	2	(0.6158)	2	(0.6158)	1
2	1 lag	1.0459		1.0788		1.0731		0.4984		0.5043		0.5011	
	2 lags	1.0656		1.0875		1.0995		0.4963		0.4958		0.4960	
	p-value (Welch)	(0.3965)	1	(0.7460)	1	(0.4850)	1	(0.8868)	1	(0.5794)	1	(0.7392)	1
	p-value (Bin.)	(0.0728)	1	(0.8669)	2	(0.8669)	1	(0.8669)	2	(0.1387)	1	(0.1864)	1
3	1 lag	1.0658		1.1500		1.1539		0.4964		0.4972		0.4886	
	2 lags	1.1146		1.1739		1.1357		0.5080		0.5036		0.5134	
	p-value (Welch)	(0.2215)	1	(0.6686)	1	(0.7706)	1	(0.5015)	2	(0.6916)	2	(0.1174)	2
	p-value (Bin.)	(0.0031)	1	(0.0167)	1	(0.4047)	2	(0.1387)	2	(0.2460)	2	(0.2460)	2
4	1 lag	1.0750		1.1607		1.1295		0.5094		0.5056		0.5052	
	2 lags	1.1327		1.1563		1.3370		0.4937		0.4973		0.4925	
	p-value (Welch)	(0.2888)	1	(0.9449)	2	(0.0274)	1	(0.2460)	1	(0.6086)	1	(0.4443)	1
	p-value (Bin.)	(0.0359)	1	(0.6158)	1	(0.2460)	1	(0.2460)	1	(0.6158)	1	(0.7377)	1
5	1 lag	1.0417		1.1269		1.1777		0.4939		0.4935		0.4979	
	2 lags	1.1013		1.1773		1.2330		0.5086		0.5052		0.5209	
	p-value (Welch)	(0.3404)	1	(0.5093)	1	(0.5632)	1	(0.3683)	2	(0.4645)	2	(0.1820)	2
	p-value (Bin.)	(0.0728)	1	(0.1387)	1	(0.8669)	2	(0.4047)	2	(0.1864)	2	(0.2460)	2
6	1 lag	1.0274		1.1081		1.1462		0.4779		0.4894		0.4762	
	2 lags	1.0626		1.1441		1.1258		0.4807		0.4636		0.4727	
	p-value (Welch)	(0.4966)	1	(0.5506)	1	(0.7801)	2	(0.8528)	2	(0.1111)	1	(0.8188)	1
	p-value (Bin.)	(0.0728)	1	(0.0359)	1	(0.2460)	1	(0.5041)	1	(0.1387)	1	(0.7377)	1
9	1 lag	0.8833		0.9469		0.9903		0.5018		0.5193		0.5107	
	2 lags	0.9240		1.0148		1.0802		0.5152		0.4920		0.4856	
	p-value (Welch)	(0.4774)	1	(0.2587)	1	(0.1651)	1	(0.3666)	2	(0.1007)	1	(0.0753)	1
	p-value (Bin.)	(0.0359)	1	(0.0167)	1	(0.2460)	1	(0.7377)	1	(0.0515)	1	(0.1013)	1
12	1 lag	0.7951		0.8830		0.9067		0.4976		0.5029		0.5014	
	2 lags	0.7963		0.8310		0.8959		0.4893		0.5001		0.4974	
	p-value (Welch)	(0.9792)	1	(0.3009)	2	(0.8638)	2	(0.5943)	1	(0.8731)	1	(0.8089)	1
	p-value (Bin.)	(0.8669)	2	(0.1387)	2	(0.4047)	2	(0.3186)	1	(0.8669)	2	(0.8669)	1

This table compares the forecasting performances of the baseline model in levels using 1 and 2 lags. The entries in the *Win* columns refer to whether the 1 or 2 lag version performs better. Whether this better performance is significant or not can be inferred from the adjacent p-values. The *p-value (Bin.)* entries refer to whether the number of outperformances is different from 50%, though the actual number of outperformances is not reported.

D Appendix

Table D.1: *USD/GBP Exchange Rate - Levels and Differences*

(a) USD/GBP - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0134	1.0036	1.0133	0.5281	0.5281	0.5281
2	0.9433	0.9379	0.9640	0.4719	0.4719	0.4831
3	0.9846	1.0093	1.0093	0.4831	0.5056	0.5056
4	0.9867	1.0735	1.0735	0.5393	0.5281	0.5281
5	0.9216	1.0629	1.0629	0.4607	0.4494	0.4494
6	0.9713	1.0669	0.9718	0.4831	0.4944	0.4382
9	0.9385	0.9573	0.9512	0.4944	0.4831	0.5056
12	0.8782	0.9292	0.9029	0.4831	0.4607	0.4719

(b) USD/GBP - 1990-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9950	1.0018	1.0018	0.4615	0.4615	0.4615
2	0.9758	1.0371	1.0008	0.4923	0.5538	0.5385
3	0.9514	1.0257	1.0165	0.5231	0.5231	0.4769
4	0.8928	1.0018	0.9305	0.6154	0.5692	0.6000
5	0.7375	0.7324	0.7281	0.5231	0.5077	0.5385
6	0.8708	1.2141	0.8143	0.4219	0.4688	0.4844
9	0.7825	0.8292	0.8193	0.5385	0.4769	0.4923
12	0.9035	0.9509	0.9509	0.5385	0.5231	0.5231

(c) USD/GBP - 1980-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9395	0.9379	0.9446	0.5056	0.5056	0.5169
2	1.0072	1.0122	1.0125	0.4045*	0.4157	0.4045*
3	1.1382	1.1487	1.1487	0.5056	0.4944	0.4944
4	1.0918	1.1145	1.1145	0.5169	0.5506	0.5506
5	1.0407	1.1087	1.0575	0.4719	0.4944	0.4944
6	0.9580	0.9762	0.9762	0.4607	0.4607	0.4607
9	1.1158	1.1201	1.1201	0.4494	0.4045*	0.4045*
12	1.1842	1.1779	1.2341	0.4270	0.4382	0.3933**

(d) USD/GBP - 1990-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9055	0.9166	0.9393	0.4154	0.4154	0.4154
2	1.0035	0.9949	1.0073	0.5077	0.5077	0.4769
3	0.9887	0.9912	0.9912	0.5077	0.5231	0.5231
4	0.9247	0.9421	0.9415	0.6000	0.6000	0.6308**
5	0.9143	0.9344	0.9059	0.4615	0.5077	0.4462
6	0.9325	0.9550	0.9513	0.4000	0.4154	0.4308
9	0.9740	0.9880	0.9880	0.5077	0.4923	0.4923
12	1.0674	1.0809	1.0809	0.5846	0.5231	0.5231

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.2: *USD/CAD Exchange Rate - Levels and Differences*

(a) USD/CAD - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9867	0.9920	1.0052	0.5843	0.5843	0.5843
2	0.9429	0.9547	1.0161	0.5393	0.5281	0.5169
3	0.8859**	0.8817*	0.9175	0.5281	0.5618	0.5169
4	0.8245**	0.8370*	0.8244*	0.5618	0.5730	0.5730
5	0.8838*	0.9013	0.9290	0.5056	0.4831	0.4831
6	0.7653**	0.7651**	0.7698**	0.4382	0.4270	0.4494
9	0.8121	0.8112	0.8243	0.5056	0.4831	0.5169
12	0.8236***	0.8919*	0.8987*	0.5169	0.5169	0.4944

(b) USD/CAD - 1990-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0092	1.0141	1.0141	0.5909	0.5758	0.5758
2	1.0281	1.0473	1.0499	0.5385	0.5692	0.5692
3	1.0216	1.0240	1.0258	0.6562**	0.6250**	0.5938
4	0.9735	1.0347	1.0741	0.6000	0.5385	0.5692
5	0.8977	0.8968	1.0097	0.5538	0.5077	0.5846
6	0.8201	0.8417	0.7804**	0.4308	0.4308	0.4154
9	0.7252**	0.9388	0.9321	0.5231	0.4923	0.4923
12	0.7083***	0.8844***	0.8844***	0.4769	0.4462	0.4462

(c) USD/CAD - 1980-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9540	0.9589	0.9524	0.5730	0.5506	0.5618
2	0.9985	1.0069	1.0069	0.5281	0.5281	0.5281
3	0.9585	0.9553	0.9550	0.5730	0.5506	0.5618
4	0.9714	0.9754	0.9754	0.5281	0.5393	0.5393
5	0.9617	0.9611	0.9611	0.5056	0.5169	0.5169
6	0.9021	0.8958	0.9187	0.4157	0.4382	0.4719
9	0.8717	0.9495	0.9495	0.5393	0.5169	0.5169
12	0.8932	0.8919	0.8919	0.4719	0.4831	0.4831

(d) USD/CAD - 1990-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9616	0.9988	0.9410	0.5385	0.5692	0.5231
2	1.0007	0.9958	1.0037	0.5231	0.5385	0.5538
3	1.0029	0.9939	1.0200	0.6308**	0.6154*	0.6154*
4	1.0348	1.0630	1.0571	0.5231	0.5077	0.5077
5	1.0378	1.0668	1.0270	0.5385	0.6000	0.5385
6	1.1075	1.1642	1.1642	0.3846*	0.4000	0.4000
9	0.7386**	0.7399*	0.7399*	0.4308	0.4769	0.4769
12	0.9427	1.0623	1.0623	0.4923	0.4615	0.4615

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(*), (**), and (* * *) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.3: *USD/CHF Exchange Rate - Levels and Differences*

(a) USD/CHF - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0062	1.0196	1.0196	0.6067**	0.6067**	0.6067**
2	1.0117	1.0288	1.0132	0.4382	0.4494	0.4382
3	1.0842	1.1521**	1.0758	0.5169	0.4944	0.5169
4	1.0659	1.1783*	1.0868	0.5506	0.5730	0.6292**
5	1.0031	1.0826	1.0772	0.5618	0.5730	0.5506
6	1.0654	1.2004	1.1468	0.4157	0.4045*	0.4045*
9	1.0659	1.0873	1.0873	0.5056	0.4944	0.4944
12	1.0432	1.0299	1.0907	0.5955*	0.6067**	0.5618

(b) USD/CHF - 1990-2011: 1 Lag, Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9420	0.9459	0.9459	0.6000	0.6000	0.6000
2	1.0208	1.1024	1.0713	0.4462	0.4308	0.4615
3	1.0836	1.1785	1.0604	0.4769	0.5231	0.5231
4	1.2048	1.2300	1.2300	0.5538	0.5538	0.5538
5	1.1247	1.1186	1.1186	0.5385	0.5385	0.5385
6	1.2367	1.3144	1.2446	0.5077	0.5385	0.4923
9	0.9311	1.0352	1.0427	0.4769	0.5538	0.5385
12	0.8966	1.2064	1.0476	0.5385	0.5692	0.5538

(c) USD/CHF - 1980-2011: 1 Lag, First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0079	1.0036	1.0036	0.5955*	0.6180**	0.6180**
2	1.0546	1.0928	1.1297	0.4333	0.4222	0.4667
3	0.9979	1.0680	0.9893	0.4494	0.4719	0.4831
4	0.9580	0.9542	0.9542	0.5506	0.5506	0.5506
5	1.0226	1.0882	1.0677	0.5393	0.5393	0.5618
6	1.0818	1.0892	1.0938	0.4719	0.4831	0.5056
9	1.1899*	1.1587	1.2436	0.4944	0.5169	0.5169
12	1.4074***	1.4655***	1.4655***	0.4944	0.5056	0.5056

(d) USD/CHF - 1990-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9322	0.9252	0.9252	0.6308**	0.6154*	0.6154*
2	0.9970	0.9919	0.9889	0.4462	0.4615	0.4615
3	1.0354	1.0625	1.0562	0.4769	0.4923	0.4923
4	1.0490	1.0360	1.0508	0.5538	0.6000	0.5692
5	0.9742	0.9746	0.9746	0.5538	0.5538	0.5538
6	0.9888	0.9767	1.0062	0.4923	0.4154	0.4923
9	1.1114	1.2706*	1.2706*	0.4923	0.4462	0.4462
12	1.0917	1.2784	1.3274*	0.5846	0.6154*	0.5692

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.4: *USD/JPY Exchange Rate - Levels and Differences*

(a) USD/JPY - 1980-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0178	1.0172	1.0243	0.5281	0.5281	0.5169
2	1.1250*	1.0998	1.1304	0.4607	0.4607	0.4607
3	1.1382	1.1807	1.1807	0.4494	0.4607	0.4607
4	1.1388	1.1457	1.1787	0.4494	0.4719	0.4382
5	1.0755	1.1719	1.2942	0.4494	0.4157	0.3708**
6	1.4967*	1.6661*	1.6661*	0.5506	0.5506	0.5506
9	1.4670**	1.7132***	1.6910***	0.4494	0.4607	0.4719
12	0.8690	1.0887	0.9197	0.4494	0.4382	0.4719

(b) USD/JPY - 1990-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9783	1.0298	1.0298	0.5231	0.5231	0.5231
2	1.0083	1.0536	1.0884	0.4462	0.5231	0.4769
3	1.0330	1.1546	1.1379	0.4769	0.4462	0.4615
4	1.1794	1.2382*	1.2119*	0.5077	0.5077	0.4308
5	1.1971	1.2777*	1.2777*	0.4000	0.4462	0.4462
6	1.0993	1.1710	1.1710	0.5846	0.6154*	0.6154*
9	0.6970***	0.8595	0.8605	0.4308	0.4769	0.4462
12	0.6827*	0.7693	0.7467	0.4615	0.4923	0.4615

(c) USD/JPY - 1980-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0504	1.0677	1.0677	0.4944	0.5169	0.5169
2	0.9455	0.9858	0.9693	0.4494	0.4831	0.4719
3	1.0270	1.0439	1.0439	0.4382	0.4157	0.4157
4	1.0613	1.1054	1.1050	0.5056	0.5056	0.4607
5	1.1236	1.1155	1.1426	0.4382	0.4382	0.4157
6	1.1144	1.1886**	1.1355	0.4944	0.5056	0.5618
9	1.1530	1.0352	1.2070	0.4157	0.3820**	0.4157
12	1.3056***	1.3716***	1.3297***	0.5056	0.4944	0.4944

(d) USD/JPY - 1990-2011: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9698	0.9989	0.9889	0.5538	0.5385	0.5692
2	0.9654	0.9973	1.0783	0.5077	0.5077	0.5231
3	1.0139	1.0895	1.0895	0.4769	0.4769	0.4769
4	0.9845	1.0023	1.0023	0.4769	0.5231	0.5231
5	1.0312	1.1407	1.0932	0.4923	0.4923	0.4769
6	1.0108	1.0456	1.0456	0.6000	0.5077	0.5077
9	1.2523	1.3461*	1.2782	0.4000	0.4154	0.4000
12	0.8616	0.8896	0.9519	0.4769	0.4769	0.4462

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.5: *USD/DM Exchange Rate - Levels and Differences*

(a) USD/DM - 1980-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0754	0.9944	1.1323*	0.4861	0.4861	0.4861
2	1.1306	1.1864*	1.2263*	0.4167	0.4306	0.4167
3	1.0521	1.1048	1.1048	0.4444	0.4444	0.4444
4	0.9883	1.0515	0.9638	0.4583	0.4861	0.4722
5	0.9825	1.0240	1.0240	0.5556	0.4861	0.4861
6	0.9579	0.9801	0.9801	0.4444	0.4167	0.4167
9	0.8718	0.8700	0.8528	0.5556	0.5278	0.5278
12	0.8666	1.3167	0.8270	0.5556	0.4722	0.5972*

(b) USD/DM - 1990-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0500	1.0231	1.0231	0.4000	0.4000	0.4000
2	1.1205	1.2700**	1.1985	0.5333	0.4000	0.4667
3	1.4828*	2.4678**	2.5429***	0.5000	0.3000**	0.2667**
4	1.4951**	1.7235**	1.7038**	0.4333	0.4000	0.4333
5	1.7874***	2.1711***	2.1711***	0.4667	0.5000	0.5000
6	1.0754	1.0340	1.0340	0.4333	0.4667	0.4667
9	0.5814*	0.6849	0.6704	0.4333	0.4333	0.3667
12	0.7356***	1.0315	1.0315	0.4000	0.3667	0.3667

(c) USD/DM - 1980-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9662	1.0117	0.9732	0.5694	0.4861	0.5972*
2	1.0307	1.0245	1.1066**	0.4028*	0.4028*	0.3889*
3	1.0961	1.1287	1.0815	0.4306	0.4167	0.4306
4	0.9760	1.0140	1.0140	0.5278	0.5556	0.5556
5	1.1478	1.2510*	1.2510*	0.5139	0.5417	0.5417
6	1.1460	1.2939**	1.1569	0.4444	0.4583	0.4722
9	1.1819	1.1682	1.1682	0.4444	0.4167	0.4167
12	1.1078	1.2479***	1.1702	0.5556	0.5833	0.5833

(d) USD/DM - 1990-1999: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0165	1.0140	0.9996	0.3333*	0.3667	0.4000
2	1.0272	1.0238	1.0139	0.4667	0.4667	0.4667
3	1.2999**	1.4608**	1.4423**	0.4000	0.4333	0.4333
4	1.1283	1.2616***	1.2616***	0.3333*	0.3333*	0.3333*
5	1.1898***	1.2618***	1.2275***	0.5000	0.4667	0.4333
6	1.2073	1.1435	1.3248	0.4000	0.3667	0.3667
9	1.0136	1.0534	1.0534	0.3000**	0.3000**	0.3000**
12	0.9913	1.0437	1.0437	0.4074	0.4074	0.4074

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(*), (**), and (* * *) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.6: *USD/EUR Exchange Rate - Levels and Differences*

(a) USD/EUR - 1999-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9873	0.9899	0.9899	0.6415^{**}	0.6415^{**}	0.6415^{**}
2	0.9923	0.9712	0.9712	0.5094	0.5283	0.5283
3	1.0388	1.0883	1.0923	0.5472	0.5094	0.5660
4	1.0203	1.0871	1.1029	0.4717	0.5094	0.4340
5	0.8272^{*}	0.8366^{**}	1.1790	0.5660	0.5283	0.6981^{***}
6	0.8555	0.9069	0.9069	0.4340	0.4340	0.4340
9	0.7512^{*}	0.7386^{**}	0.8550	0.4340	0.5094	0.4528
12	0.7143^{***}	0.7486^{***}	1.8910^{*}	0.5472	0.5472	0.4151

(b) USD/EUR - 1999-2011: 1 Lag - Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9765	0.9790	0.9790	0.6415^{**}	0.5849	0.5849
2	1.0072	1.0142	1.0026	0.5472	0.5472	0.5472
3	0.9907	1.0620	1.0409	0.5849	0.6038	0.6226^{*}
4	1.1617	1.2037	1.2037	0.6038	0.6415^{**}	0.6415^{**}
5	1.1285^{**}	1.2072^{*}	1.2118^{**}	0.5660	0.5283	0.5283
6	0.9844	1.0053	1.0053	0.5283	0.5283	0.5283
9	0.7500^{***}	0.9649	0.7326^{***}	0.4906	0.4906	0.5283
12	1.1173	1.3321	1.3449	0.4906	0.5660	0.5094

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.7: *EUR/GBP and EUR/CHF Exchange Rates - Levels and Differences*

(a) EUR/GBP - 1999-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0072	1.0276	1.0276	0.5472	0.5472	0.5472
2	0.9440	1.0639	1.0065	0.5094	0.5472	0.4906
3	0.9380	1.1106	1.1039	0.3962	0.4717	0.4340
4	0.9306	0.9589	0.9589	0.5094	0.5094	0.5094
5	0.8066	0.9023	2.1071**	0.6226*	0.5660	0.4906
6	0.7868*	0.8494	2.6450***	0.5849	0.6981***	0.5283
9	0.7573***	0.8409***	1.2934	0.4906	0.4340	0.5283
12	0.3488*	0.3552*	0.3552*	0.5283	0.4906	0.4906

(b) EUR/GBP - 1999-2011: 1 Lag - Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9846	0.9935	0.9804	0.5472	0.5472	0.5283
2	0.9658	0.9815	0.9694	0.5094	0.4906	0.4906
3	0.9556	0.9956	0.9872	0.4717	0.5094	0.4717
4	0.9137	0.9520	0.9201	0.5283	0.4906	0.4340
5	0.9159	0.9875	0.9858	0.5472	0.4906	0.5283
6	0.9383	1.1057	1.0214	0.5283	0.4906	0.5472
9	0.6812	0.8143	0.8036	0.5472	0.6038	0.5094
12	0.3765*	0.4756	0.4660	0.6038	0.6226*	0.5849

(c) EUR/CHF - 1999-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0324	1.0225	1.0225	0.5472	0.5660	0.5660
2	1.0592	1.0736	1.0736	0.5094	0.5094	0.5094
3	1.0728	1.0884	1.0884	0.5472	0.5849	0.5849
4	1.0805	1.0920	1.0920	0.5660	0.5660	0.5660
5	1.0665	1.0845	1.0845	0.5660	0.5472	0.5472
6	0.9819	1.0744	1.0744	0.5283	0.4906	0.4906
9	0.6275**	0.6325**	0.8567***	0.6038	0.6226*	0.5094
12	0.6389*	0.6083*	0.6420	0.5472	0.5283	0.5472

(d) EUR/CHF - 1999-2011: 1 Lag - Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9927	0.9977	0.9917	0.5849	0.5283	0.5472
2	0.9886	0.9931	0.9857	0.5849	0.5849	0.5849
3	0.9796	0.9877	0.9826	0.6038	0.6038	0.6038
4	0.9752	0.9854	0.9755	0.6038	0.6038	0.5849
5	0.9666	0.9775	0.9659	0.5849	0.5849	0.5849
6	0.9312	0.9665	0.9665	0.5094	0.5283	0.5283
9	0.8306	0.9257	0.8806	0.5849	0.5849	0.5660
12	0.4940*	0.5388*	0.5675*	0.4151	0.4717	0.4528

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(*), (**), and (* * *) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.8: *EUR/JPY and EUR/CAD Exchange Rates - Levels and Differences*

(a) EUR/JPY - 1999-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0377	1.1066*	1.0148	0.5472	0.5472	0.5660
2	1.0516	1.0751	1.1016	0.5094	0.5472	0.5094
3	0.9988	1.0524	1.0217	0.5849	0.5660	0.5472
4	0.9554	1.0602***	1.1338**	0.5849	0.5849	0.6038
5	0.7372	0.8947	0.8947	0.5283	0.5472	0.5472
6	0.8105	0.9039	1.0113	0.4717	0.4717	0.4906
9	0.6804***	0.9339***	0.9339***	0.4151	0.4717	0.4717
12	0.6439***	0.7676***	0.9052	0.4528	0.4906	0.4528

(b) EUR/JPY - 1999-2011: 1 Lag - Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0132	1.0204	1.0092	0.5472	0.5472	0.5472
2	1.0227	1.0239	1.0123	0.5660	0.5472	0.5472
3	1.0006	1.0545	0.9677	0.5660	0.5472	0.5283
4	1.0107	1.0274	1.0274	0.5094	0.5094	0.5094
5	0.8965	0.9230	1.0026	0.5094	0.5472	0.4528
6	0.9366	1.0360	1.0083**	0.5472	0.5660	0.5283
9	0.9070***	1.0400***	0.9995	0.5094	0.4151	0.4906
12	0.7858***	0.9054***	0.9025***	0.6038	0.6792***	0.6415**

(c) EUR/CAD - 1999-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0024	1.0065	1.0065	0.5283	0.5283	0.5283
2	0.9795	1.0702	1.0702	0.4528	0.4906	0.4906
3	1.0235	1.0653	1.4346	0.5094	0.5283	0.4528
4	0.9387	1.0430	1.0430	0.5094	0.5094	0.5094
5	0.8695	0.9295	0.9295	0.4151	0.3774*	0.3774*
6	0.7544	0.8159	0.8538	0.6038	0.5472	0.5283
9	0.6685	0.7577	0.7866	0.4717	0.4528	0.5094
12	0.6500***	0.7391***	0.7621***	0.4717	0.4340	0.4151

(d) EUR/CAD - 1999-2011: 1 Lag - Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0120	1.0060	0.9930	0.5283	0.5283	0.5283
2	0.9958	1.0000	0.9865	0.4717	0.4717	0.4906
3	0.9858	0.9945	0.9830	0.4906	0.4906	0.4906
4	0.9554	0.9947	1.0198	0.4528	0.4717	0.4340
5	0.9806	1.0741	1.0741	0.3962	0.4528	0.4528
6	0.9642	1.0178	1.0178	0.5094	0.4906	0.4906
9	0.9597	1.0054	1.0054	0.4717	0.4717	0.4717
12	0.7191***	1.0077	1.0591*	0.5094	0.4906	0.4906

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.9: *DM/GBP Exchange Rate - Levels and Differences*

(a) DM/GBP - 1980-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0209	1.0021	1.0021	0.4861	0.4861	0.4861
2	1.1913^{**}	1.1051	1.2084^{**}	0.4167	0.4028^{*}	0.4028^{*}
3	1.3239^{**}	1.3817^{***}	1.3166^{**}	0.4861	0.4861	0.5000
4	1.2990^{**}	1.2583^{*}	1.3561^{**}	0.5000	0.5417	0.4861
5	1.1877	1.2886^{*}	1.2886^{*}	0.4722	0.5139	0.5139
6	1.2471	1.3159	1.3159	0.4722	0.4861	0.4861
9	0.9724	0.9902	1.2463	0.4444	0.4444	0.4583
12	0.7617^{**}	0.8779	0.8160^{*}	0.4583	0.4861	0.4722

(b) DM/GBP - 1990-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0408	1.0716	1.0716	0.3667	0.3667	0.3667
2	1.2119	1.2547^{*}	1.2547^{*}	0.5000	0.4667	0.4667
3	1.2615	1.4638	1.4638	0.5000	0.5500	0.5500
4	1.7931^{***}	2.1455^{***}	1.9310^{***}	0.5000	0.4667	0.4667
5	1.5876^{*}	2.0148^{*}	2.1175	0.4000	0.4000	0.4333
6	1.3432	1.6701	1.6701	0.4000	0.4333	0.4333
9	0.8443	0.8948	0.9152	0.5000	0.5000	0.5333
12	0.4362^{**}	0.5352^{**}	0.5557^{**}	0.5333	0.6333	0.5333

(c) DM/GBP - 1980-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0156	1.0188	1.0138	0.4722	0.4861	0.4861
2	1.0352	1.0368	1.0308	0.4583	0.4583	0.4583
3	1.0886^{*}	1.0791	1.1043^{*}	0.4861	0.4722	0.4861
4	1.0722^{**}	1.0671^{*}	1.0671^{*}	0.4722	0.5000	0.5000
5	1.1365	1.1904	1.1926	0.5833	0.6111^{*}	0.6389^{**}
6	1.0838	1.1443	1.1460	0.4861	0.5000	0.4861
9	0.8258	0.7712	0.7944^{*}	0.5139	0.4861	0.5278
12	0.8169	0.8411	0.8494	0.4444	0.4167	0.4167

(d) DM/GBP - 1990-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0232	1.0274	1.0135	0.3000^{**}	0.3000^{**}	0.3000^{**}
2	1.1329	1.1425	1.1425	0.5000	0.4667	0.4667
3	1.0640	1.0641	1.0641	0.4667	0.5000	0.5000
4	1.1038	1.1148	1.0864	0.4333	0.4333	0.4333
5	1.1893^{*}	1.2153	1.2392^{*}	0.5333	0.4667	0.5000
6	1.0923	1.1734^{***}	1.1606	0.4000	0.4000	0.4000
9	0.8223	0.9491	0.9491	0.5333	0.4667	0.4667
12	0.3952^{**}	0.4267^{**}	0.4267^{**}	0.3667	0.3667	0.3667

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.10: *DM/CHF Exchange Rate - Levels and Differences*

(a) DM/CHF - 1980-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0456	1.0934	0.9882	0.4722	0.4861	0.4722
2	0.9892	0.9727	0.9727	0.4583	0.4722	0.4722
3	0.9622	0.9646	0.9646	0.4306	0.4444	0.4444
4	1.0377	1.1455	1.0856	0.5139	0.5972^{*}	0.5417
5	0.8924	0.9222	0.9234	0.4722	0.4861	0.4722
6	0.9803	1.1285	0.8411^{*}	0.4583	0.5000	0.4583
9	0.8133^{*}	0.8455	0.8657	0.4583	0.4444	0.4861
12	0.6894^{**}	0.6898^{**}	0.7447^{**}	0.4167	0.3750^{**}	0.4444

(b) DM/CHF - 1990-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.8782	0.8836	0.8836	0.2632^{**}	0.2632^{**}	0.2632^{**}
2	0.9489	0.9646	0.9646	0.4211	0.4211	0.4211
3	0.9026	1.0118	0.9235	0.1667^{***}	0.3667	0.2333^{***}
4	0.7996^{***}	0.8098^{***}	0.8098^{***}	0.4000	0.3667	0.3667
5	0.7389^{**}	0.7738^{*}	0.7738^{*}	0.4333	0.4667	0.4667
6	0.7619	0.8124	0.8124	0.4000	0.4333	0.4333
9	0.7022^{**}	0.7172^{*}	0.7172^{*}	0.5000	0.6000	0.6000
12	0.7494^{***}	0.7483^{***}	0.7199^{***}	0.2333^{***}	0.2667^{**}	0.4667

(c) DM/CHF - 1980-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0090	1.0281	1.0237	0.3472^{***}	0.3611^{**}	0.4167
2	0.9763	0.9786	0.9789	0.4722	0.4722	0.4861
3	0.9856	1.0027	0.9971	0.5000	0.4861	0.4861
4	1.0174	1.0392	1.0392	0.5417	0.5417	0.5417
5	1.1071	1.1915	1.1708	0.3750^{**}	0.3889^{*}	0.3472^{***}
6	1.1896	1.2288	1.2288	0.5278	0.5000	0.5000
9	1.1011^{***}	1.1499^{***}	1.1499^{***}	0.5139	0.5278	0.5278
12	1.1185	1.1690	1.1535	0.5000	0.5000	0.5417

(d) DM/CHF - 1990-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0087	1.0087	0.9939	0.4000	0.4000	0.4000
2	1.0483	1.0599	1.0599	0.4667	0.4333	0.4333
3	1.0089	1.0047	1.0047	0.6333	0.6333	0.6333
4	0.9363	0.9379	0.9379	0.5667	0.5667	0.5667
5	0.9989	1.0078	1.0078	0.3333^{*}	0.3333^{*}	0.3333^{*}
6	0.9548	0.9974	0.9307	0.5000	0.5000	0.5000
9	1.0890	1.0715	1.0715	0.6000	0.6333	0.6333
12	0.8999	1.1306	1.1306	0.5000	0.5667	0.5667

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.11: *DM/JPY Exchange Rate - Levels and Differences*

(a) DM/JPY - 1980-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0268	1.0235	1.0235	0.5417	0.5417	0.5417
2	1.0017	1.0196	0.9992	0.4861	0.4861	0.4861
3	1.0715	1.0649	1.0869	0.5833	0.5278	0.5417
4	1.0409	1.0734	1.0499	0.5000	0.5139	0.5278
5	0.9732	0.9913	0.9242	0.4167	0.4028^{*}	0.4583
6	0.9454	0.9093	0.8894	0.4306	0.4444	0.4444
9	0.8878	0.9461	0.8549	0.5972^{*}	0.5833	0.5694
12	0.8707	1.0290	1.1444^{*}	0.5556	0.5833	0.5417

(b) DM/JPY - 1990-1999: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9399	0.9707	0.9707	0.6000	0.6000	0.6000
2	0.9886	1.1234	0.9597	0.5667	0.6333	0.5667
3	0.8600	1.0924	1.0247	0.5667	0.3667	0.4333
4	0.6156^{***}	0.6845^{**}	0.6845^{**}	0.6000	0.5000	0.5000
5	0.7036^{**}	0.6560^{***}	0.7277^{**}	0.4333	0.5333	0.6000
6	0.8367	0.9195	0.9164	0.5000	0.5000	0.4667
9	0.7999	1.0252	1.0040	0.4000	0.6000	0.5667
12	0.7451	0.7976	0.9278	0.4333	0.5333	0.3667

(c) DM/JPY - 1980-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9976	0.9993	0.9935	0.5417	0.5417	0.5556
2	0.9900	0.9982	0.9828	0.5278	0.5000	0.5278
3	1.0224	1.0449	1.0449	0.5417	0.5278	0.5278
4	1.0105	0.9933	1.0130	0.4583	0.4583	0.4444
5	1.0080	1.0500	1.0191	0.4583	0.4722	0.4583
6	1.0311	1.0517	1.0517	0.4444	0.4167	0.4167
9	1.0115	1.1028	1.1028	0.5694	0.5556	0.5556
12	0.9400	1.0096	1.0096	0.4722	0.4583	0.4583

(d) DM/JPY - 1990-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9980	1.0115	1.0036	0.6000	0.6000	0.6000
2	1.0194	1.0253	1.0112	0.5000	0.4667	0.4667
3	0.9712	1.0353	1.0183	0.5000	0.5000	0.5000
4	0.8742	1.0421	0.8941	0.4667	0.3667	0.4000
5	0.9109	0.8014^{***}	0.8344	0.4333	0.4667	0.5000
6	1.0039	1.0254	1.0600	0.4667	0.5333	0.5333
9	1.1324	1.3461	1.1258	0.7000^{**}	0.7333^{**}	0.6667^{*}
12	0.8828	0.9202	0.9428	0.4000	0.3000^{**}	0.3333^{*}

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.12: *DM/CAD Exchange Rate - Levels and Differences*

(a) DM/CAD - 1980-1998: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0105	1.0034	1.0034	0.5694	0.5694	0.5694
2	1.0633	1.0349	1.0349	0.3889*	0.4028*	0.4028*
3	1.1732	1.2290	1.2290	0.5417	0.5417	0.5417
4	1.1913	1.2242	1.2242	0.5139	0.5278	0.5278
5	1.3574*	1.5281**	1.3606**	0.3699**	0.3425***	0.3562**
6	1.1553	1.2502	1.2502	0.5278	0.5278	0.5278
9	1.0491	1.0055	1.4026	0.5278	0.5556	0.4861
12	0.8097**	0.8488***	0.8488***	0.4583	0.4861	0.4861

(b) DM/CAD - 1990-1999: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9956	0.9935	0.9935	0.6333	0.6333	0.6333
2	1.0106	1.0498	0.9776	0.5000	0.5000	0.5000
3	1.0599	1.0742	1.0742	0.5667	0.5667	0.5667
4	1.0650	1.0296	1.0296	0.5000	0.5000	0.5000
5	1.1685**	1.8350***	1.1777*	0.4000	0.5333	0.3667
6	0.9075	0.9253	1.1024	0.6000	0.6667*	0.7000**
9	0.7167**	0.5908***	0.7019*	0.4333	0.6000	0.4667
12	0.8608	0.9994	0.9994	0.5667	0.7000**	0.7000**

(c) DM/CAD - 1980-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9897	1.0024	0.9978	0.5833	0.5694	0.5694
2	1.0183	1.0065	0.9999	0.4167	0.3889*	0.3889*
3	1.0231	1.0158	1.0361	0.5278	0.5694	0.5139
4	1.1194	1.1262	1.1262	0.5694	0.5972*	0.5972*
5	1.2308	1.2480	1.2089	0.5278	0.5417	0.5417
6	1.1966	1.1798**	1.1804	0.4722	0.5000	0.4444
9	1.1209	1.0462	1.1095	0.6250**	0.5417	0.5972*
12	1.0600	1.1393	1.1393	0.4167	0.3750**	0.3750**

(d) DM/CAD - 1990-1998: 1 Lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0125	1.0145	1.0042	0.6333	0.6333	0.6333
2	1.0242	1.0284	1.0155	0.4333	0.4333	0.4667
3	1.0995**	1.0420	1.0276	0.4333	0.4333	0.4667
4	1.2246*	1.2295*	1.1834	0.3667	0.3667	0.3333*
5	1.1335	1.1860	1.1946	0.5333	0.5667	0.5667
6	0.8879	0.9471	0.9378	0.4667	0.5000	0.4667
9	0.8037***	0.7756***	0.7756***	0.5333	0.5667	0.5667
12	1.2388*	1.3357*	1.3357*	0.4667	0.4333	0.4333

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.13: *GBP/CHF Exchange Rate - Levels and Differences*

(a) GBP/CHF - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0321	1.0607	1.0607	0.4607	0.4607	0.4607
2	1.0419	1.0791*	1.1186*	0.4719	0.4831	0.4831
3	1.0179	1.0447	1.0447	0.5056	0.5056	0.5056
4	1.0035	1.0403	1.0403	0.4333	0.4556	0.4556
5	0.9871	1.0373	1.0629	0.5955*	0.5730	0.5955*
6	0.9976	1.0092	1.0092	0.4944	0.5056	0.5056
9	1.3939*	1.4555*	1.4555*	0.5169	0.5281	0.5281
12	1.0216	1.1005	1.0227	0.6067**	0.5618	0.5730

(b) GBP/CHF - 1990-2011: 1 lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9923	1.0030	1.0030	0.4923	0.4923	0.4923
2	0.9706	1.0101	1.0780	0.5231	0.5385	0.5231
3	0.9402	1.1023	0.9857	0.4923	0.4923	0.5385
4	0.8977	0.8975	0.8975	0.4615	0.4615	0.4615
5	0.9430	0.8368	0.8935	0.4923	0.5692	0.5846
6	1.2175	1.5485*	1.6636**	0.5077	0.5231	0.5231
9	0.8192	0.9077	0.9077	0.5152	0.5606	0.5606
12	0.6552**	0.6850**	0.6979**	0.5385	0.5538	0.5538

(c) GBP/CHF - 1980-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9674	0.9760	0.9760	0.4494	0.4831	0.4831
2	0.9150	0.9795	0.8839	0.5506	0.5281	0.5506
3	1.0072	1.0319	1.0319	0.4831	0.4719	0.4719
4	1.0203	1.0378	1.0378	0.4382	0.4494	0.4494
5	1.0153	1.0163	1.0163	0.4944	0.4831	0.4831
6	1.0164	1.0041	1.0041	0.5506	0.5730	0.5730
9	1.1288	1.1410*	1.1422	0.5393	0.5281	0.5506
12	1.0813***	1.1463***	1.0655**	0.5393	0.5955*	0.6067**

(d) GBP/CHF - 1990-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9323	0.9189	0.9499	0.4923	0.5077	0.5231
2	0.9635	0.9772	1.0286	0.5692	0.5692	0.5538
3	0.9941	1.0051	1.0051	0.5231	0.5077	0.5077
4	0.9933	1.0630	1.0630	0.4615	0.4462	0.4462
5	0.9661	0.9745	0.9979	0.5077	0.5231	0.5077
6	1.0885***	1.1161***	1.1161***	0.4462	0.4308	0.4308
9	1.1533	1.1906	1.1906	0.5538	0.5385	0.5385
12	0.9928**	1.0615	1.0966**	0.5692	0.6154*	0.5846

Table D.14: *GBP/JPY Exchange Rate - Levels and Differences*

(a) GBP/JPY - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0131	1.0424	1.0392	0.5618	0.5730	0.5730
2	1.0766	1.1154*	1.1154*	0.5843	0.5843	0.5843
3	1.0667	1.1177**	1.1041*	0.5281	0.5169	0.5169
4	1.0634	1.0985**	1.0985**	0.4270	0.4157	0.4157
5	1.0301	1.0720	1.0720	0.5056	0.4831	0.4831
6	0.9858	1.0727	1.0727	0.5056	0.5281	0.5281
9	0.8303*	0.8519	0.8809*	0.5618	0.5393	0.5730
12	0.7507	0.8055	0.8055	0.5281	0.5281	0.5281

(b) GBP/JPY - 1990-2011: 1 lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9888	1.0140	1.0140	0.6000	0.5846	0.5846
2	0.9906	0.9905	0.9730	0.6154*	0.6154*	0.6154*
3	1.0010	1.0818	1.0818	0.5846	0.5846	0.5846
4	0.9705	1.1076	1.0407	0.5077	0.4462	0.4923
5	1.0018	1.0668***	1.1380**	0.6308**	0.4769	0.5846
6	1.0029	1.0642	1.0534***	0.5692	0.5692	0.5692
9	0.8869	0.9571	0.9751	0.4462	0.4769	0.4769
12	0.6747*	0.6808*	0.7543	0.5538	0.5231	0.4923

(c) GBP/JPY - 1980-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9086	0.9184	0.9184	0.5455	0.5227	0.5227
2	0.9776	1.0203	1.0203	0.6067**	0.6067**	0.6067**
3	1.0646	1.0700	1.0700	0.5393	0.5281	0.5281
4	1.0721	1.0814	1.0814	0.3933**	0.3933**	0.3933**
5	1.0812	1.0722	1.1177	0.5056	0.4944	0.4944
6	1.1067	1.1119	1.1119	0.4494	0.4494	0.4494
9	1.0649	1.0733	1.0733	0.5955*	0.5730	0.5730
12	0.9472	0.9714	0.9714	0.5843	0.5730	0.5730

(d) GBP/JPY - 1990-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9225	0.9368	0.9368	0.5692	0.5692	0.5692
2	0.9727	1.0025	0.9811	0.6308**	0.6154*	0.6308**
3	0.9678	1.0199	1.0199	0.5846	0.6154*	0.6154*
4	0.9837	1.0093**	1.0041	0.4000	0.4154	0.4154
5	1.0263	1.0712	1.0577	0.5692	0.5846	0.5538
6	1.0445	1.1121	0.9964	0.4769	0.4923	0.4462
9	1.0139***	1.0201***	1.0201***	0.5231	0.5231	0.5231
12	0.9533	0.9737***	0.9704	0.6769***	0.6462**	0.6462**

Table D.15: *GBP/CAD Exchange Rate - Levels and Differences*

(a) GBP/CAD - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0253	1.0380	1.0380	0.4831	0.4944	0.4944
2	1.3509**	1.4193**	1.4193**	0.5056	0.5056	0.5056
3	1.3161	1.3337	1.4416**	0.4607	0.4382	0.4607
4	1.2140	1.3333	1.3896*	0.4944	0.4607	0.5506
5	1.1833	1.3129	1.2360	0.4000*	0.4222	0.4444
6	1.0934	1.2864**	1.1454	0.4719	0.4607	0.4494
9	1.0534	1.1708	1.1708	0.5393	0.5730	0.5730
12	0.9275	1.0119	1.0392	0.5169	0.5281	0.5618

(b) GBP/CAD - 1990-2011: 1 lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0241	1.0359	1.0359	0.4154	0.4308	0.4308
2	1.0841	1.2129**	1.1454	0.5231	0.5231	0.5231
3	1.1822	1.1979	1.1979	0.4923	0.5231	0.5231
4	1.5515	1.5869	1.5869	0.4923	0.4615	0.4615
5	1.3218	1.3047	1.3047	0.5538	0.5538	0.5538
6	1.3115	1.3654	1.3654	0.4615	0.4615	0.4615
9	0.7653***	0.7746***	0.7746***	0.5455	0.5758	0.5758
12	0.8626	0.9923	0.9333	0.5385	0.5231	0.5846

(c) GBP/CAD - 1980-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0373	1.0143	1.0718	0.5056	0.5056	0.5056
2	1.0168	1.0015	1.0911**	0.4831	0.5056	0.4944
3	1.1923**	1.2060**	1.2074**	0.4831	0.4719	0.4719
4	1.2353*	1.2458	1.2632*	0.5618	0.5506	0.5506
5	1.2104	1.2524	1.2563**	0.3596***	0.3371***	0.4045*
6	1.1800	1.1691	1.1746	0.4494	0.4944	0.4382
9	1.0333	1.0833	1.0373	0.4157	0.4607	0.3933**
12	1.1224	1.1572	1.1572	0.5169	0.5393	0.5393

(d) GBP/CAD - 1990-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0268	1.0283	1.0283	0.4615	0.4462	0.4462
2	1.0610	1.0321	1.1052	0.4615	0.4462	0.4769
3	1.0924	1.1006	1.0708	0.5538	0.5692	0.5692
4	1.1271	1.1244	1.1081	0.5846	0.6154*	0.6154*
5	1.1979	1.1706	1.2079	0.3077***	0.3538**	0.3846*
6	1.2135	1.2359	1.2359	0.5077	0.5077	0.5077
9	0.8638	1.0546	0.8065***	0.5692	0.4923	0.5385
12	1.0670*	1.1071*	1.0692	0.4308	0.4462	0.4462

Table D.16: *CHF/JPY Exchange Rate - Levels and Differences*

(a) CHF/JPY - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.1036	0.9994	0.9994	0.5843	0.5843	0.5843
2	1.0628	1.1046**	0.9843	0.4944	0.4944	0.5281
3	1.1508*	1.1300*	1.1300*	0.4719	0.4719	0.4719
4	1.1778*	1.1509*	1.1509*	0.5000	0.5000	0.5000
5	1.0179	1.0561	1.0561	0.5955*	0.6067**	0.6067**
6	1.0261	1.0523	1.0523	0.4607	0.4719	0.4719
9	1.2828**	1.2645**	1.2645**	0.6629***	0.6629***	0.6629***
12	0.9967	1.0096	1.0096	0.5618	0.5618	0.5618

(b) CHF/JPY - 1990-2011: 1 lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0689	1.0076	1.0076	0.5692	0.5692	0.5692
2	1.0323	1.0082	1.0082	0.5846	0.5846	0.5846
3	0.9916	1.0437	1.0437	0.5538	0.5538	0.5538
4	0.9649	1.0364	1.0364	0.5077	0.4769	0.4769
5	0.9440	1.0122	1.0717	0.6308**	0.6308**	0.6000
6	0.9708	1.0167	1.0557	0.4769	0.4615	0.4462
9	1.0455	1.1288	1.1288	0.4769	0.4308	0.4308
12	0.9567	0.9454	0.9987	0.4462	0.4615	0.4769

(c) CHF/JPY - 1980-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9795	0.9802	0.9802	0.6023*	0.6023*	0.6023*
2	0.9316*	1.0067	0.9292*	0.5169	0.5056	0.5506
3	0.9982	1.0120	0.9941	0.4944	0.4944	0.4831
4	1.0496	1.0576	1.0576	0.5169	0.5169	0.5169
5	1.0656	1.0562	1.0562	0.5843	0.5843	0.5843
6	1.0938	1.0519	1.0909	0.4607	0.4607	0.4494
9	1.3023	1.3160	1.3133	0.5393	0.5393	0.5281
12	1.4436	1.5148	1.5148	0.5393	0.5281	0.5281

(d) CHF/JPY - 1990-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9616	0.9736	0.9417	0.5692	0.5538	0.5077
2	1.0095	1.0106	1.0063	0.5538	0.5692	0.5692
3	1.0026	1.0143	1.1065	0.5077	0.5385	0.5538
4	1.0076	1.0155	1.0786	0.5385	0.5077	0.4923
5	1.0277	1.0880	1.0880	0.4923	0.5231	0.5231
6	1.0380	1.0937	1.0820	0.4923	0.5385	0.5385
9	1.2432	1.2385	1.2385	0.5538	0.5692	0.5692
12	1.3367**	1.4727***	1.2518**	0.4000	0.4154	0.4769

Table D.17: *CHF/CAD Exchange Rate - Levels and Differences*

(a) CHF/CAD - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0012	0.9962	0.9962	0.4719	0.4719	0.4719
2	1.1771^{**}	1.1898^{**}	1.1889^{**}	0.4494	0.4270	0.4382
3	1.1364	1.1236	1.1917^{*}	0.4494	0.4494	0.4494
4	1.1256	1.1428	1.3177^{*}	0.5169	0.5393	0.5281
5	1.3406^{*}	1.3843^{*}	1.3843^{*}	0.3820^{**}	0.3820^{**}	0.3820^{**}
6	1.3777^{*}	1.4061^{*}	1.4061^{*}	0.4494	0.4607	0.4607
9	1.4044	1.4746	1.4746	0.5281	0.5169	0.5169
12	1.3487	1.4168^{*}	1.4168^{*}	0.5444	0.5444	0.5444

(b) CHF/CAD - 1990-2011: 1 lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9919	0.9933	0.9933	0.5231	0.5385	0.5385
2	0.9929	0.9780	0.9780	0.4615	0.4615	0.4615
3	0.9919	0.9590	1.0099	0.4308	0.5231	0.4000
4	0.9315	0.9342	0.9342	0.4769	0.4923	0.4923
5	0.9309	0.9079	1.6116	0.4000	0.4308	0.3692^{**}
6	1.3281	1.2976	1.3871^{*}	0.4923	0.4923	0.4308
9	0.7759^{***}	0.8264	0.8037^{*}	0.5077	0.5538	0.5077
12	0.7802^{**}	0.8846	0.8846	0.4769	0.4769	0.4769

(c) CHF/CAD - 1980-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0502	1.0522	1.0644	0.4607	0.4719	0.4494
2	1.0034	1.0016	1.0101	0.5169	0.4607	0.5169
3	1.0503	1.0778	1.0778	0.4719	0.4719	0.4719
4	1.1316^{**}	1.1532^{***}	1.1723^{**}	0.5281	0.4831	0.5056
5	1.2391^{***}	1.2483^{***}	1.2483^{***}	0.5281	0.5506	0.5506
6	1.2878^{***}	1.3511^{***}	1.3435^{***}	0.4382	0.4382	0.3820^{**}
9	1.1253^{**}	1.1425^{***}	1.1530^{***}	0.5056	0.4719	0.4607
12	1.2030	1.2093	1.2093	0.5169	0.4944	0.4944

(d) CHF/CAD - 1990-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0194	1.0400	1.0400	0.5385	0.5385	0.5385
2	0.9712	0.9737	0.9777	0.4769	0.4923	0.4923
3	1.0111	1.0508^{**}	1.0508^{**}	0.4769	0.5077	0.5077
4	1.0376^{**}	1.0395^{*}	1.0395^{*}	0.4615	0.4615	0.4615
5	1.0172	1.0053	0.9870	0.4615	0.4462	0.4308
6	1.1523^{***}	1.0778^{***}	1.2050^{**}	0.4769	0.4615	0.4308
9	1.0186	1.0107	1.0068	0.5385	0.5231	0.5231
12	1.1994	1.2261	1.2544	0.5385	0.5077	0.5231

Table D.18: *JPY/CAD Exchange Rate - Levels and Differences*

(a) JPY/CAD - 1980-2011: 1 Lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0574	1.0480	1.0223	0.5281	0.5281	0.5393
2	0.9895	1.0167	1.0597	0.6180^{**}	0.6067^{**}	0.6180^{**}
3	1.0582	1.1699^{*}	1.1699^{*}	0.4607	0.4719	0.4719
4	1.1178^{*}	1.1651^{*}	1.2408^{**}	0.5506	0.5393	0.5281
5	1.0644	1.2190^{*}	1.0729	0.5281	0.5618	0.5169
6	0.8793	0.8704	0.9091	0.3778^{**}	0.3778^{**}	0.3889^{**}
9	0.8499	0.9068	0.9068	0.5955^{*}	0.5169	0.5169
12	0.8241	0.8201	0.8274	0.4719	0.4157	0.4831

(b) JPY/CAD - 1990-2011: 1 lag - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0217	0.9984	0.9984	0.5385	0.5231	0.5231
2	1.0997	1.1359^{*}	1.1359^{*}	0.6000	0.6000	0.6000
3	1.0452	1.0802	1.0903	0.4615	0.4769	0.4615
4	1.0882^{*}	1.0929	1.0193	0.5231	0.5538	0.5538
5	1.1128	1.1339	1.1339	0.4615	0.4308	0.4308
6	1.0435	1.0574	1.1284	0.3385^{***}	0.3692^{**}	0.2769^{***}
9	0.6659^{*}	0.7156	0.7520^{*}	0.4769	0.5385	0.4615
12	0.7041	0.7089	0.7332	0.4154	0.4769	0.4308

(c) JPY/CAD - 1980-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9604	0.9694	0.9694	0.5281	0.5393	0.5393
2	0.9909	1.0068	1.0028	0.6292^{**}	0.5955^{*}	0.5955^{*}
3	1.0077	1.0069	1.0030	0.4607	0.4607	0.4719
4	1.0166	1.0227	1.0227	0.5281	0.5393	0.5393
5	1.0296	1.0233	1.1214^{***}	0.4157	0.4382	0.3933^{**}
6	1.0633	1.1178	1.0917	0.3933^{**}	0.3820^{**}	0.3820^{**}
9	1.1349	1.1311	1.1040	0.5393	0.5169	0.5393
12	1.1205^{*}	1.1306^{*}	1.1878	0.5056	0.4831	0.4944

(d) JPY/CAD - 1990-2011: 1 lag - First Differences

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9654	0.9746	0.9746	0.5385	0.5385	0.5385
2	0.9459	1.0071	0.9338	0.6769^{***}	0.5846	0.6923^{***}
3	0.9911	0.9796	0.9796	0.5077	0.4923	0.4923
4	1.0390	1.0583^{*}	1.0583^{*}	0.4615	0.4462	0.4462
5	1.0480	1.0607	1.0607	0.5077	0.5385	0.5385
6	1.0886	1.1434	1.0902	0.3231^{***}	0.3385^{***}	0.3692^{**}
9	0.9994	1.1087^{*}	1.0182	0.5231	0.4462	0.5692
12	1.0297	1.0486	1.0486	0.5077	0.5385	0.5385

Table D.19: *USD/GBP, USD/CHF, USD/CAD, GBP/JPY Exchange Rates - Levels: Country Differentials*

(a) USD/GBP - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0234	1.0036	1.0036	0.5281	0.5281	0.5281
2	0.9866	1.0483	1.0177	0.4607	0.5056	0.4270
3	1.0023	1.0279	1.0279	0.4607	0.4494	0.4494
4	0.9619	0.9860	0.9860	0.5506	0.5618	0.5618
5	0.9276	0.9496	0.9496	0.4494	0.4494	0.4494
6	0.8983	0.9188	0.9188	0.4831	0.4831	0.4831
9	0.8459	0.8640	0.8640	0.5056	0.4944	0.4944
12	0.9861	1.0019	1.0019	0.4607	0.4494	0.4494

(b) USD/CHF - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9890	1.0111	1.0111	0.5955^{*}	0.5955^{*}	0.5955^{*}
2	0.9919	1.0110	1.0072	0.4157	0.4157	0.4270
3	0.9978	1.0122	1.0122	0.5169	0.5169	0.5169
4	0.9745	0.9918	0.9918	0.6404^{***}	0.6067^{**}	0.6067^{**}
5	0.9473	0.9607	0.9607	0.5618	0.5506	0.5506
6	0.9271	0.9548	0.9232	0.4270	0.3933^{**}	0.4382
9	0.9890	0.9376	1.0817	0.4157	0.4719	0.4157
12	1.0466	1.0786	1.0786	0.4944	0.4944	0.4944

(c) USD/CAD - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9952	0.9801	1.0038	0.5730	0.5618	0.5618
2	0.9969	1.0060	1.0060	0.5730	0.5618	0.5618
3	0.9914	1.0051	1.0051	0.5730	0.5618	0.5618
4	0.9794	0.9979	0.9886	0.5056	0.5056	0.5056
5	0.9627	0.9493	0.9495	0.5281	0.5393	0.5506
6	0.9463	0.9435	0.9435	0.4719	0.4607	0.4607
9	0.9387	0.9443	0.9443	0.5169	0.5056	0.5056
12	0.9207	0.9512	0.9512	0.4494	0.4719	0.4719

(d) GBP/JPY - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.3127^{***}	1.0181	1.0181	0.5730	0.5618	0.5618
2	1.0918	1.0194	1.0174	0.6180^{**}	0.6067^{**}	0.5955^{*}
3	1.0187	1.0166^{*}	1.0166^{*}	0.5281	0.5281	0.5281
4	0.9858	1.0044	1.0044	0.4045^{*}	0.4045^{*}	0.4045^{*}
5	0.9733	0.9958	0.9958	0.5169	0.5281	0.5281
6	0.9529	0.9881	0.9838	0.4944	0.5056	0.4719
9	0.8245	0.8998	0.9024	0.5056	0.5506	0.5393
12	0.7967	0.8906^{*}	0.8866^{*}	0.6404^{***}	0.5955^{*}	0.6067^{**}

Table D.20: *USD/GBP, USD/CHF, USD/CAD, GBP/JPY Exchange Rates - Differences: Country Differentials*

(a) USD/GBP - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9382	0.9379	0.9379	0.5056	0.5056	0.5056
2	1.0107	1.0123	1.0089	0.4382	0.4157	0.4157
3	1.0401	1.0442	1.0442	0.5169	0.5056	0.5056
4	1.0432	1.0464	1.0519	0.4944	0.4831	0.4944
5	1.0305	1.0247	1.0359	0.4831	0.4831	0.4944
6	1.0127	1.0154	1.0154	0.4382	0.4382	0.4382
9	0.9996	1.0621**	0.9859	0.4719	0.4494	0.4494
12	1.0292	1.0962	1.0962	0.5169	0.5169	0.5169

(b) USD/CHF - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9839	1.0172	0.9830	0.6180**	0.6067**	0.6180**
2	0.9714	0.9869	0.9691	0.4607	0.4494	0.4607
3	0.9746	0.9802	0.9789	0.5281	0.5281	0.5281
4	0.9974	1.0115	1.0115	0.6067**	0.6292**	0.6292**
5	0.9980	0.9954	0.9954	0.5393	0.5393	0.5393
6	1.0642	1.0905	1.0726	0.4494	0.4157	0.4607
9	1.0077	0.9862	0.9862	0.4270	0.4382	0.4382
12	0.9310	0.9505	0.9799	0.4831	0.4719	0.4944

(c) USD/CAD - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9536	0.9615	0.9450	0.5393	0.5506	0.5393
2	0.9928	0.9983	0.9951	0.5169	0.5169	0.5169
3	0.9956	1.0034	1.0034	0.5730	0.5730	0.5730
4	0.9881	0.9929	0.9929	0.5056	0.5056	0.5056
5	0.9955	0.9978	0.9978	0.5169	0.4944	0.4944
6	0.9641	0.9375	0.9375	0.4157	0.4045*	0.4045*
9	1.0609	1.0655	1.0655	0.4494	0.4270	0.4270
12	1.1055	1.1107	1.1107	0.5169	0.5169	0.5169

(d) GBP/JPY - 1980-2011: Country Differentials

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9623	0.9614	0.9614	0.5026	0.5026	0.5026
2	0.9836	1.0270*	1.0270*	0.5843	0.6067**	0.6067**
3	1.0194	0.9997	1.0170	0.5169	0.5393	0.5281
4	1.0080	1.0092	1.0092	0.4045*	0.3820**	0.3820**
5	1.0300	1.0282	1.0435	0.5056	0.5281	0.5056
6	1.0260	1.0397	1.0397	0.5169	0.4944	0.4944
9	1.1323	1.1450*	1.1450*	0.5281	0.5393	0.5393
12	1.0172	1.0197	1.0197	0.6629***	0.6517***	0.6517***

Table D.21: *USD/GBP, USD/CHF, USD/CAD, GBP/JPY Exchange Rates - Cointegration Models*

(a) USD/GBP - 1980-2011: Cointegration

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9364	0.9379	0.9379	0.5056	0.5056	0.5056
2	1.0041	1.0123	1.0089	0.4270	0.4157	0.4157
3	1.0182	1.0442	0.9990	0.4944	0.5056	0.4944
4	1.0195	1.0113	1.0070	0.5056	0.4831	0.5056
5	0.9979	0.9842	0.9958	0.4831	0.4944	0.5169
6	0.9767	0.9703	0.9703	0.4157	0.4494	0.4494
9	0.9956	1.0621^{**}	1.0708^{***}	0.4831	0.4494	0.4382
12	0.9919	0.9996	1.0144	0.4831	0.4719	0.4719

(b) USD/CHF - 1980-2011: Cointegration

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9887	1.0544	1.0215	0.6180^{**}	0.6067^{**}	0.6067^{**}
2	1.0543	1.0811	1.0791	0.4157	0.4157	0.4045^{*}
3	1.0290	0.9803	1.1170	0.5169	0.5281	0.5169
4	1.0502	1.1444	1.1444	0.6067^{**}	0.5843	0.5843
5	1.0804	1.1286	1.1286	0.5843	0.5506	0.5506
6	1.1586	1.1684	1.1700	0.4270	0.4157	0.4157
9	1.0301	1.0410	1.0410	0.4270	0.4270	0.4270
12	1.0510	1.0228	1.0736	0.4382	0.4607	0.4382

(c) USD/CAD - 1980-2011: Cointegration

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9546	0.9589	0.9464	0.5506	0.5506	0.5393
2	0.9915	0.9991	0.9991	0.5169	0.5169	0.5169
3	1.0001	1.0016	1.0016	0.5618	0.5506	0.5506
4	1.0029	1.0017	1.0017	0.5056	0.5056	0.5056
5	1.0106	1.0098	1.0098	0.4944	0.5056	0.5056
6	1.0082	1.0112	1.0112	0.4382	0.4382	0.4382
9	1.0614	1.0655	1.0655	0.4494	0.4270	0.4270
12	1.1052	1.1107	1.1107	0.5169	0.5169	0.5169

(d) GBP/JPY - 1980-2011: Cointegration

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9210	0.9186	0.9142	0.5506	0.5393	0.5281
2	0.9607^{**}	1.0003	1.0003	0.5955^{*}	0.5955^{*}	0.5955^{*}
3	0.9460	0.9478	0.9478	0.5169	0.5056	0.5056
4	0.9311^{***}	0.9550^{*}	0.9550^{*}	0.4045^{*}	0.3820^{**}	0.3820^{**}
5	0.9001	0.8979	0.8979	0.4831	0.4831	0.4831
6	0.8710	0.8768	0.8749	0.4831	0.4944	0.4831
9	0.7770	0.7968	0.7436	0.5730	0.5730	0.5955^{*}
12	0.7536	0.7576	0.7576	0.5618	0.5843	0.5843

Table D.22: *USD/GBP, USD/CHF, USD/CAD, GBP/JPY Exchange Rates - Weight Updating*

(a) USD/GBP - 1980-2011: Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0310	1.0599	1.0329	0.4944	0.4944	0.5281
3	1.1015	1.2049	1.2116	0.4382	0.4607	0.4494
6	1.0057	1.0965	1.0295	0.4607	0.4382	0.4607
9	1.0425	1.0746	1.0704	0.5506	0.5393	0.5056
12	0.9619	0.9817	1.0009	0.5169	0.5618	0.5056

(b) USD/CHF - 1980-2011: Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9990	0.9882	0.9891	0.6067^{**}	0.6067^{**}	0.6067^{**}
3	1.0907	1.0839	1.1380	0.4719	0.4831	0.4607
6	1.3191	1.3375	1.3262	0.3708^{**}	0.3483^{***}	0.3483^{***}
9	1.1928^{*}	1.2068	1.2150	0.5056	0.4944	0.5056
12	1.1523	1.2996^{*}	1.1921^{*}	0.4944	0.5169	0.5281

(c) USD/CAD - 1980-2011: Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0100	1.0029	1.0247	0.5843	0.5843	0.5843
3	0.9719	0.9756	1.0056	0.5281	0.5281	0.5169
6	0.7428^{**}	0.7321^{***}	0.7416^{**}	0.4719	0.4719	0.4494
9	0.6680^{***}	0.6519^{***}	0.6506^{***}	0.5056	0.5056	0.4944
12	0.6747^{***}	0.6956^{***}	0.7032^{***}	0.4607	0.4382	0.4382

(d) GBP/JPY - 1980-2011: Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.1035	1.0486	1.0457	0.5618	0.5618	0.5618
3	1.1110	1.1525	1.1496	0.5281	0.5618	0.5730
6	1.0223	1.1189^{***}	1.0786^{***}	0.5169	0.4494	0.5281
9	0.8759	0.8792	0.8764	0.5506	0.5393	0.5281
12	0.7572^{*}	0.8285	0.8434	0.5281	0.5169	0.4607

Table D.23: *USD/GBP, USD/CHF, USD/CAD, GBP/JPY Exchange Rates - Differences, Weight Updating*

(a) USD/GBP - 1980-2011: Differences, Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9648	0.9748	0.9745	0.5056	0.5056	0.5056
3	1.1495	1.1548*	1.1760*	0.5056	0.5281	0.5169
6	1.0503	1.0877	1.0974	0.4045*	0.4157	0.4157
9	0.9709	1.0160	1.0288	0.4831	0.5056	0.4944
12	1.0337	1.0767	1.0733	0.4831	0.4831	0.4944

(b) USD/CHF - 1980-2011: Differences, Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9978	0.9868	0.9976	0.5955*	0.5843	0.5955*
3	1.0386	1.0558	1.0286	0.4719	0.4719	0.4831
6	1.0087	1.0231	1.0205	0.4831	0.4494	0.4494
9	1.2011	1.2361	1.2473	0.4719	0.4719	0.4719
12	1.1773**	1.1386**	1.1316**	0.4944	0.4944	0.4719

(c) USD/CAD - 1980-2011: Differences - Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9601	0.9589	0.9595	0.5618	0.5506	0.5618
3	1.0131	1.0132	1.0180	0.5169	0.5393	0.5169
6	0.9623	0.9827	0.9679	0.4157	0.4045*	0.4157
9	0.8454	0.8400	0.8433	0.4494	0.4607	0.4494
12	0.7489***	0.7489***	0.7519***	0.4944	0.4944	0.4944

(d) GBP/JPY - 1980-2011: Weights Updating

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9449	0.9664	0.9693	0.5455	0.5227	0.5341
3	1.1011	1.1389**	1.1217*	0.5393	0.5169	0.4944
6	1.0839	1.1700	1.0804	0.4382	0.4494	0.4270
9	1.1286	1.1424	1.1179	0.5056	0.5281	0.4944
12	0.9934	0.9784	1.0234	0.5618	0.5730	0.5618

Table D.24: *USD/GBP and USD/CAD Exchange Rates - 2 Lags, Levels*

(a) USD/GBP - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9494	0.9504	0.9373	0.4886	0.5000	0.4886
2	0.9908	0.9641	1.0537	0.4318	0.3864^{**}	0.4205
3	1.0031	0.9911	1.0389	0.4773	0.5000	0.4659
4	1.0226	0.9688	1.1021	0.5000	0.4773	0.5000
5	0.8855	0.8821	0.8821	0.4886	0.5114	0.5114
6	0.8799	0.8785	0.9505	0.5227	0.5000	0.5114
9	0.9766	1.0107	1.0563	0.4659	0.4318	0.4659
12	0.8508	0.8460	0.8991	0.4545	0.4545	0.4432

(b) USD/GBP - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9253	0.9102	0.9102	0.4615	0.4769	0.4769
2	0.9877	1.0600^{**}	1.0240	0.4923	0.4769	0.4769
3	0.9624	0.9162	1.0523	0.5538	0.6000	0.5846
4	0.8899	0.9037	1.0218	0.5231	0.5385	0.5231
5	0.7936	0.8132	1.3341	0.5077	0.5077	0.4923
6	1.0504	1.1113	1.0971	0.4769	0.4769	0.4923
9	0.9835	1.1326	1.4397^{*}	0.5385	0.5077	0.4462
12	0.8700	0.8851	0.8780	0.5231	0.4923	0.5077

(c) USD/CAD - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9625	0.9631	0.9631	0.5395	0.5395	0.5395
2	0.9044^{**}	0.9261^{*}	0.9421	0.5132	0.5132	0.5000
3	0.9343	0.9381	0.9377	0.5844	0.5714	0.5584
4	0.8512^{*}	0.8349^{*}	0.8718^{*}	0.5714	0.5974^{*}	0.6364^{**}
5	0.8282^{*}	0.8527	0.8470^{*}	0.5325	0.5195	0.5455
6	0.8232^{*}	0.9103	0.9103	0.4382	0.4270	0.4270
9	0.8265	0.8326	0.8736	0.4494	0.4831	0.5056
12	0.8576	0.8800^{**}	1.0513	0.5169	0.5169	0.4831

(d) USD/CAD - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9837	1.0135	1.0135	0.5385	0.5692	0.5692
2	1.0313	1.0245	1.0793	0.5538	0.5538	0.5846
3	0.9917	0.9767	0.9431	0.6615^{***}	0.6923^{***}	0.5692
4	0.9775	1.0066	0.9825	0.5846	0.5692	0.6000
5	0.9143	0.9151	0.9041	0.5538	0.5231	0.5538
6	0.7935^{*}	0.8548	0.8673	0.4462	0.4462	0.5077
9	0.5505^{***}	0.5676^{***}	0.5513^{**}	0.5846	0.5846	0.5231
12	0.7146^{***}	0.7617^{***}	0.8523^{*}	0.4769	0.4615	0.4615

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.25: *USD/CHF and USD/JPY Exchange Rates - 2 lags, Levels*

(a) USD/CHF - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0004	1.0155	1.0085	0.5843	0.5843	0.5843
2	1.0501	1.1162**	1.0089	0.4382	0.4494	0.4382
3	1.1050*	1.1452**	1.0070	0.4831	0.4719	0.4831
4	1.0762	1.1596*	1.0483	0.5843	0.5730	0.5955*
5	1.0839	1.1997	1.1079	0.5506	0.5506	0.5618
6	1.1787	1.2252	1.0183	0.4831	0.4719	0.4382
9	1.2608*	1.3593**	1.1318	0.4607	0.4607	0.4944
12	1.2921	1.3125	1.3809*	0.4944	0.5281	0.5056

(b) USD/CHF - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9291	0.9282	0.9282	0.6154*	0.6154*	0.6154*
2	1.2080**	1.2648***	1.2245**	0.4923	0.4923	0.4769
3	1.2882*	1.2823**	1.3301*	0.5538	0.5385	0.5846
4	1.4266**	1.3347*	1.8589**	0.5385	0.6308**	0.6308**
5	1.2590	1.2118	1.1712	0.4923	0.5385	0.5077
6	1.1876	1.3343	1.3017	0.3846*	0.3846*	0.3692**
9	0.9772	1.1505	1.1537	0.4308	0.5231	0.5231
12	0.8450	0.9296	1.1096	0.5077	0.6000	0.5231

(c) USD/JPY - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0153	1.0268	1.0312	0.5056	0.5169	0.5169
2	1.1197	1.1822*	1.0086	0.4719	0.4607	0.4944
3	1.1963*	1.2027*	1.2027*	0.5056	0.5169	0.5169
4	1.1892	1.2015	1.1625	0.4831	0.4382	0.4607
5	1.4711*	1.7305**	1.6997*	0.4944	0.5056	0.4831
6	1.5505*	1.6512*	1.5619*	0.5056	0.5056	0.5393
9	1.5489**	1.6916***	1.6197**	0.4494	0.5056	0.4719
12	0.9986	1.0757	1.0663	0.4719	0.4831	0.4719

(d) USD/JPY - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9976	1.0411	1.0411	0.5385	0.5231	0.5231
2	1.0234	1.0477	1.0686	0.5077	0.5231	0.5231
3	1.0550	1.1753	1.0813	0.4615	0.4462	0.4615
4	1.1837	1.2495**	1.2608*	0.5077	0.4615	0.4462
5	1.2562*	1.2836**	1.2858**	0.5077	0.5077	0.5385
6	1.1382	1.1879*	1.3271*	0.5538	0.4769	0.5077
9	0.8208*	0.8503*	1.0117	0.5385	0.4308	0.5231
12	0.7652	0.8313	1.0188	0.5538	0.5385	0.5538

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.26: *USD/DM and USD/EUR Exchange Rates - 2 lags, Levels*

(a) USD/DM - 1980-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0708	0.9942	1.1519**	0.5000	0.4861	0.4861
2	1.1550*	1.2267**	1.2137**	0.4861	0.4861	0.4167
3	1.1632	1.2915*	1.2838**	0.5000	0.4583	0.5139
4	1.1933	1.6090*	2.0968**	0.4722	0.4722	0.3472***
5	1.1510	1.2368	1.2158	0.5139	0.5278	0.5000
6	0.9811	0.9684	0.9684	0.4583	0.4583	0.4583
9	1.1579	1.1526	1.2770**	0.5139	0.5000	0.5139
12	0.7116*	0.7665*	0.7765	0.4583	0.3889*	0.5417

(b) USD/DM - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0453	1.0262	1.0262	0.4000	0.3667	0.3667
2	1.2000**	1.1819	1.2315*	0.4667	0.4000	0.5000
3	1.3729**	1.5510***	1.5404***	0.3333*	0.3667	0.4000
4	1.7174***	1.7078**	1.4971*	0.4667	0.5000	0.4333
5	1.5959***	1.4145***	2.0944***	0.4000	0.4333	0.5000
6	1.1166	1.2192**	1.2715***	0.4333	0.4333	0.4667
9	0.5651***	0.9381	0.9201	0.5667	0.3000**	0.4667
12	0.5976***	0.6531**	0.6531**	0.4667	0.5000	0.5000

(c) USD/EUR - 1999-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9461	0.9555	0.9555	0.6415**	0.6038	0.6038
2	1.0277	0.9737	0.9737	0.5283	0.5094	0.5094
3	1.0650	1.1006	0.9609	0.5472	0.5283	0.5094
4	1.0333	1.0690	2.6631**	0.4717	0.4717	0.4906
5	0.8963	0.9893	1.0896	0.5849	0.4528	0.5660
6	0.8495	0.9910	0.9323	0.5472	0.6226*	0.4528
9	0.6724***	1.1746	1.4481	0.4151	0.4340	0.4906
12	0.7660***	0.8051***	0.7686***	0.5283	0.5660	0.4906

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

$(*)$, $(**)$, and $(***)$ indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.27: *EUR/GBP, EUR/CHF, EUR/JPY, EUR/CAD Exchange Rates - 2 lags, Levels*

(a) EU/GBP - 1999-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0117	1.0262	1.0262	0.5472	0.5472	0.5472
2	0.9592	1.0079	1.0024	0.4340	0.4717	0.4528
3	1.0979	1.1188	1.1188	0.5660	0.5283	0.5283
4	1.0764	1.3321	2.0478	0.4400	0.4800	0.5200
5	0.8209	0.8916	2.9991	0.6226	0.6415	0.5660
6	1.1822	1.0757	1.3996	0.4906	0.4151	0.4906
9	0.7770	0.8848	1.0745	0.4528	0.4528	0.5283
12	0.3568	0.3885	0.3647	0.4717	0.4906	0.5283

(b) EUR/CHF - 1999-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0501	1.0625	1.0625	0.5660	0.5660	0.5660
2	1.0788	1.0837	1.0837	0.5094	0.5094	0.5094
3	1.0798	1.0853	1.0853	0.5283	0.5283	0.5283
4	0.7869**	0.8154	0.9671	0.5472	0.5472	0.5660
5	0.8493**	1.0857	1.0221	0.4906	0.5283	0.4717
6	0.7836**	0.7320**	0.8709**	0.4906	0.5094	0.5094
9	0.7665**	0.7650	1.5039	0.6226*	0.6038	0.5660
12	0.3793*	0.4008*	0.4456*	0.5094	0.4717	0.5660

(c) EUR/JPY - 1999-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0434	1.0943	1.0190	0.5472	0.5472	0.5472
2	1.0692	1.0794	1.0191	0.5660	0.5472	0.5472
3	1.0580	1.1290	1.0190	0.5472	0.5849	0.5283
4	1.2161*	1.2492**	1.4058**	0.5283	0.6038	0.5849
5	0.7786	0.8496	1.1271	0.4340	0.4340	0.4717
6	0.8209	0.9576	1.1046	0.4717	0.3774*	0.3774*
9	0.5958**	1.0415	0.6633*	0.5094	0.5472	0.5472
12	0.7494***	0.7645***	0.7716***	0.5849	0.5283	0.5472

(d) EUR/CAD - 1999-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9960	1.0048	1.0048	0.5283	0.5283	0.5283
2	0.9227**	0.9246	0.9841	0.4528	0.4340	0.4717
3	1.2326	1.4103*	1.5629**	0.5660	0.5283	0.6038
4	0.9025	1.0851	1.4023**	0.3962	0.3962	0.4528
5	0.7998	0.9003	0.9482	0.4717	0.4340	0.4717
6	0.7971*	0.9679	0.9385	0.4528	0.5094	0.4906
9	0.6812***	0.8927	0.8927	0.4906	0.4151	0.4151
12	0.7041***	0.7753***	0.7753***	0.4340	0.4340	0.4340

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.28: *DM/GBP and DM/CHF Exchange Rates - 2 lags, Levels*

(a) DM/GBP - 1980-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0306	1.0020	1.0020	0.4658	0.4658	0.4658
2	1.1513^{**}	1.1545^{**}	1.1562^{**}	0.4658	0.4658	0.4795
3	1.3844^{**}	1.4882^{**}	1.4989^{**}	0.4932	0.4384	0.4521
4	1.4308^{**}	1.4536^{**}	1.4965^{**}	0.4658	0.4932	0.4795
5	2.0519^{*}	2.1903^{*}	2.1542^{*}	0.5342	0.5068	0.5205
6	1.7652	1.8681	1.8621	0.4384	0.3973^{*}	0.4384
9	1.3140	1.3323	1.3374^{*}	0.4521	0.4110	0.3562^{**}
12	0.6778^{**}	0.6612^{*}	0.8734	0.4384	0.4658	0.4521

(b) DM/GBP - 1990-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9823	1.0391	0.9721	0.3448^{*}	0.3103^{**}	0.4483
2	1.1950	1.1761	2.0257^{***}	0.5172	0.4483	0.6207
3	1.9255^{***}	1.9561^{*}	2.0906^{***}	0.5172	0.4138	0.5517
4	1.3469	1.3521	1.7224^{**}	0.5862	0.5517	0.4828
5	1.2013	1.3496	1.3496	0.4483	0.5172	0.5172
6	0.7318	0.8855	0.8037	0.4828	0.4483	0.5172
9	0.5291^{*}	0.4169^{*}	0.4326^{*}	0.6552^{*}	0.5862	0.5862
12	0.4787^{***}	0.5063^{***}	0.5063^{***}	0.5517	0.5517	0.5517

(c) DM/CHF - 1980-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0427	1.0751	1.0751	0.4384	0.4110	0.4110
2	1.0244	1.0090	1.0090	0.4521	0.4521	0.4521
3	0.9743	0.9813	0.9444	0.4521	0.4795	0.4521
4	0.9457	0.9841	1.1257	0.4932	0.4795	0.4658
5	1.0892	1.0836	1.1790	0.5068	0.4932	0.4658
6	1.0124	1.1639	1.2475	0.4384	0.4384	0.4521
9	0.8015	0.8159	0.8090	0.4247	0.4384	0.4384
12	0.7226^{*}	0.7392^{*}	0.7185^{**}	0.5479	0.5342	0.5342

(d) DM/CHF - 1990-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.7915	0.7850	0.7850	0.4667	0.5000	0.5000
2	1.0656	1.1877	1.0477	0.2667^{**}	0.3667	0.3333^{*}
3	0.9211	1.0226	0.9473	0.3333^{*}	0.3333^{*}	0.4667
4	0.8128^{**}	0.8988	0.8599^{*}	0.3667	0.4333	0.4667
5	0.7230^{**}	0.7548^{**}	0.7841^{**}	0.4483	0.4828	0.4828
6	0.7689	0.8040	0.8555	0.4828	0.4138	0.4138
9	0.7247^{**}	0.8336	1.3441	0.4483	0.5172	0.4828
12	0.7948^{***}	0.8141^{***}	0.8184^{***}	0.3000^{**}	0.3333^{*}	0.3000^{**}

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.29: *DM/JPY and DM/CAD Exchange Rates - 2 lags, Levels*

(a) DM/JPY - 1980-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0138	1.0368	1.0087	0.5479	0.5616	0.5479
2	1.0072	1.0038	0.9914	0.4932	0.4795	0.4795
3	1.1107	1.1226	1.0687	0.4932	0.5068	0.5205
4	1.0323	1.0480	1.0485	0.5479	0.5616	0.5068
5	1.0871	1.0955	1.0329	0.4658	0.4110	0.4521
6	0.9415	0.9917	0.9719	0.3973*	0.3699**	0.3836**
9	0.9191	1.0708	1.3470***	0.5068	0.5068	0.4658
12	0.9715	1.0366	0.9483	0.5616	0.5616	0.6438**

(b) DM/JPY - 1990-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9194	0.9654	0.9654	0.6207	0.6207	0.6207
2	0.9275	0.9134	0.9134	0.5517	0.5862	0.5862
3	0.8444	1.2761	0.8589	0.5517	0.5517	0.5517
4	0.8627	0.8972	0.8483	0.4138	0.4483	0.5172
5	0.8941***	0.9138	0.9035***	0.5517	0.5517	0.5862
6	0.8992	0.9037	0.8331	0.4483	0.4138	0.4483
9	0.8938	0.9829	0.8948	0.6207	0.5517	0.4483
12	0.7074	0.7865	0.7865	0.4138	0.3793	0.3793

(c) DM/CAD - 1980-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0359	1.0254	1.0748	0.5616	0.5753	0.5616
2	1.1140	1.2463**	1.1020	0.4247	0.4247	0.3973*
3	1.2374	1.2389	1.2574	0.4658	0.4658	0.4932
4	1.2333	1.2318	2.7514***	0.5068	0.5205	0.4384
5	1.3457	1.4085	1.4154	0.5205	0.5342	0.5205
6	1.1725	1.3010	1.1587	0.5068	0.5342	0.4795
9	1.0615	1.1469	1.4021	0.4658	0.5068	0.4795
12	0.8073	0.7687	0.8964	0.5068	0.5205	0.4658

(d) DM/CAD - 1990-1998: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0014	0.9998	0.9998	0.6333	0.6333	0.6333
2	1.0928*	1.1021**	1.1856	0.5333	0.5667	0.4333
3	1.0732	1.0753*	1.0753*	0.4667	0.4667	0.4667
4	1.5269***	1.0372	1.6815**	0.4333	0.3000**	0.3000**
5	0.9517	1.4137	0.8583	0.5333	0.4333	0.6000
6	1.2386	1.3970*	1.3970*	0.6667*	0.6000	0.6000
9	0.8000	0.9026	0.9026	0.5667	0.3333*	0.3333*
12	0.8131***	0.9031***	1.1056	0.4667	0.6000	0.5333

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.30: *GBP/CHF and GBP/JPY Exchange Rates - 2 lags, Levels*

(a) GBP/CHF - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0067	1.0056	1.0153	0.4286	0.4675	0.4675
2	1.0363	1.0526	1.1752***	0.5065	0.5065	0.5195
3	1.0673	1.0427	1.1711*	0.5065	0.5195	0.5584
4	1.0778	1.2157	1.0039	0.3766**	0.3636**	0.3896*
5	1.0892	1.1306	1.0568	0.5065	0.4935	0.5325
6	1.0034	0.9990	1.1436	0.5065	0.4935	0.5065
9	1.4261**	1.4389**	1.4403**	0.4805	0.4805	0.4675
12	0.9623	0.8991	1.1263	0.4156	0.4026*	0.3636**

(b) GBP/CHF - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9725	0.9975	0.9975	0.5231	0.4923	0.4923
2	0.9938	0.9611	1.0411	0.5692	0.5692	0.6000
3	1.0601	1.1082	1.0168	0.5692	0.5846	0.5692
4	1.1755	1.2113	1.1232	0.4308	0.4769	0.4000
5	1.1186	1.1624	1.6647*	0.5077	0.5231	0.4923
6	1.2489	1.4860	1.4860	0.5077	0.4923	0.4923
9	0.8418	0.8641	0.8824	0.5692	0.5538	0.5846
12	0.7105	1.0484	0.6654	0.5846	0.5846	0.4769

(c) GBP/JPY - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9209	0.9225	0.9148	0.5506	0.5281	0.5393
2	1.0607	1.0772*	1.0338	0.5843	0.5955*	0.5955*
3	1.1092*	1.1785**	1.0051	0.5056	0.5169	0.4944
4	1.1514	1.1765*	1.1765*	0.4607	0.4607	0.4607
5	1.0299	1.0557	1.0419	0.5169	0.5281	0.4831
6	0.9924	1.1133	0.9866	0.4607	0.4494	0.5618
9	0.8779	0.8808	1.0348	0.5393	0.5506	0.5393
12	0.8480	0.9488	0.8441	0.4157	0.4944	0.4382

(d) GBP/JPY - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9457	1.0145	0.9314	0.5938	0.5938	0.5781
2	1.0536	1.1221	1.0378	0.5846	0.5692	0.6308**
3	1.0709	1.0832	1.1079	0.6154*	0.5692	0.6000
4	1.0753	1.1291	1.1177	0.5538	0.5846	0.5385
5	1.0326	1.0496	1.0525	0.6154*	0.6462**	0.6154*
6	0.9576	0.9344	1.3912**	0.5231	0.5231	0.4769
9	1.0221	1.0700	1.0700	0.5385	0.5692	0.5692
12	0.6514**	0.6571**	0.6572**	0.6000	0.6154*	0.6000

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.31: *GBP/CAD and CHF/JPY Exchange Rates - 2 lags, Levels*

(a) GBP/CAD - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.1568*	1.0997	1.2069**	0.4944	0.5056	0.5056
2	1.4367***	1.4791***	1.4730***	0.4831	0.4831	0.4944
3	1.3588*	1.4540**	1.3761**	0.4719	0.4607	0.4607
4	1.3147	1.5054*	1.2704*	0.5843	0.5955*	0.5506
5	1.4028	1.4959*	1.2266	0.4045*	0.4157	0.3933**
6	1.2659*	1.3339**	1.2161	0.4831	0.4607	0.3708**
9	1.1779	1.2790	1.2790	0.5056	0.5393	0.5393
12	0.8960	0.8773	1.7687**	0.4944	0.4494	0.5393

(b) GBP/CAD - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0401	1.0420	1.0420	0.4615	0.4308	0.4308
2	1.1686	1.1880	1.1880	0.4769	0.4615	0.4615
3	1.2139	1.2156	1.2156	0.5231	0.5385	0.5385
4	1.6033	1.6046	1.6090	0.5077	0.5538	0.4923
5	1.4452	1.5023	1.4889	0.5385	0.5538	0.5692
6	1.4032	1.6893	0.9334	0.4462	0.4308	0.4923
9	0.8770*	0.9234	0.8991	0.4769	0.4923	0.5231
12	0.7414**	0.7588*	0.7763**	0.5538	0.5538	0.5077

(c) CHF/JPY - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9786	0.9629	0.9629	0.5843	0.5843	0.5843
2	1.0001	0.9637	0.9898	0.5281	0.5393	0.5169
3	1.0840	1.0875*	1.0835	0.4831	0.4831	0.5056
4	1.1320*	1.1248**	1.1248**	0.4607	0.4494	0.4494
5	1.1581*	1.1597*	1.1514*	0.5843	0.6292**	0.6180**
6	1.1786**	1.1789**	1.1693*	0.4382	0.4382	0.4607
9	1.0379	1.0661	1.0810	0.5843	0.5730	0.5393
12	0.9744	1.0137	0.9510	0.5056	0.4944	0.5281

(d) CHF/JPY - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9841	0.9714	0.9714	0.5692	0.5538	0.5538
2	0.9970	1.0078	1.0078	0.5846	0.5692	0.5692
3	1.0148	1.0631	0.9849	0.5231	0.5538	0.5538
4	1.0078	1.0598	1.0598	0.4923	0.5231	0.5231
5	0.9594	1.0393	1.0678	0.5846	0.5692	0.5846
6	0.9945	1.1855	1.0417	0.5077	0.5077	0.4769
9	0.8010	0.7313	0.7730	0.4462	0.4615	0.4308
12	0.7357	0.7771	0.7313	0.4769	0.5231	0.4923

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

($*$), ($**$), and ($***$) indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.32: *CHF/CAD and JPY/CAD Exchange Rates - 2 lags, Levels*

(a) CHF/CAD - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0157	1.0128	1.0128	0.4831	0.5056	0.5056
2	1.1425**	1.1655***	1.1188**	0.4382	0.4494	0.4270
3	1.0718	1.1124	1.0455	0.4831	0.4831	0.4719
4	1.1237	1.1579	1.0509	0.5169	0.5281	0.5506
5	1.3834*	1.3880*	1.3806*	0.4045*	0.3933**	0.4045*
6	1.1265	1.1696	1.1270	0.4494	0.4382	0.5056
9	1.4560*	1.5451	1.5195*	0.5169	0.4607	0.4831
12	1.4578*	1.4691*	1.4639*	0.5393	0.5506	0.5281

(b) CHF/CAD - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0005	1.0046	1.0046	0.5231	0.5385	0.5385
2	0.9741	0.9758	0.9758	0.4308	0.4154	0.4154
3	0.9459	0.9600	0.9600	0.5231	0.5385	0.5385
4	0.9366	0.9334	0.9334	0.4769	0.4923	0.4923
5	1.4186	1.5217	1.4675	0.4462	0.4615	0.4769
6	1.4195*	1.5555*	1.4132	0.4615	0.4462	0.4462
9	0.9243	0.9215	0.9658	0.5538	0.5692	0.5231
12	0.8328*	0.8667	0.8383	0.4769	0.4769	0.5077

(c) JPY/CAD - 1980-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	0.9773	0.9564	0.9564	0.5506	0.5393	0.5393
2	1.1018	1.1571*	1.0338	0.6180**	0.6067**	0.6067**
3	1.0806	1.0634	0.9584	0.4831	0.4270	0.4382
4	1.0985	1.1997**	0.9957	0.5730	0.5618	0.5281
5	1.0512	1.0696	1.0535	0.4607	0.4607	0.4831
6	1.0498	1.2022*	1.0997	0.4157	0.3933**	0.4270
9	0.8432	0.8297	0.8606	0.5730	0.6067**	0.5281
12	0.8186	0.8348	0.8439	0.5281	0.5618	0.5730

(d) JPY/CAD - 1990-2011: 2 Lags - Levels

Step	Theil's U BMA	Theil's U Best	Theil's U Median	DOC Ratio BMA	DOC Ratio Best	DOC Ratio Median
1	1.0014	0.9998	0.9998	0.6333	0.6333	0.6333
2	1.0928*	1.1021**	1.1856	0.5333	0.5667	0.4333
3	1.0732	1.0753*	1.0753*	0.4667	0.4667	0.4667
4	1.5269***	1.0372	1.6815**	0.4333	0.3000**	0.3000**
5	0.9517	1.4137	0.8583	0.5333	0.4333	0.6000
6	1.2386	1.3970*	1.3970*	0.6667*	0.6000	0.6000
9	0.8000	0.9026	0.9026	0.5667	0.3333*	0.3333*
12	0.8131***	0.9031***	1.1056	0.4667	0.6000	0.5333

The Diebold-Mariano test statistic is used to test for smaller RMSFE and the Binomial Test is used to test whether the direction of change in the exchange rate was predicted significantly more or less often than 50%.

(∗), (∗∗), and (∗ ∗ ∗) indicate significance at the 10%, 5%, and 1% level, respectively.

E Appendix

MC^3 Sampler

The algorithm I use in this paper to determine the posterior model weights is the birth/death Markov Chain Monte Carlo Model Composite (MC^3) method, as proposed by Madigan and York (1995). It is a search algorithm in the vein of the Metropolis-Hastings algorithm, designed to move through the model space in a fast and efficient manner. This is done by defining the algorithm in such a way that it primarily visits regions of the model space with high posterior mass. Instead of having to calculate posterior model probabilities for all possible models, these posterior probabilities are obtained as the relative frequency with which the MC^3 algorithm visits the respective model. For a sufficiently long chain, i.e. a sufficiently large number of steps through the model space, the frequencies should converge to the actual posterior probabilities.

In short, the algorithm works in the following way. We want to construct a chain, i.e. a stochastic process moving in each step from one state (= model) to another state. The probability of a transition to another state will depend only on the current state. The chain is therefore a Markov chain. Let $\mathcal{M}$ be the model space and $M_i \in \mathcal{M}$ be the current state. Define $NBD(M_i)$ as the neighborhood of model M_i, i.e the class of models containing one additional variable or one variable less than model M_i, as well as M_i itself. Draw regressor k_j from the k regressors with probability $k_j \sim U(1,k)$. If the regressor is already included in model M_i, then drop the variable from model M_i (=death step). If it is not already included, add it to M_i (=birth step). The resulting model $M_j \in NBD(M_i)$ is the new candidate model which is to be evaluated against M_i. Instead of comparing the posterior model probabilities of the two models, we can simply look at the posterior odds ratio[32] defined as:

$$\text{Posterior odds ratio} = \frac{p(\mathbf{y}|M_j)p(M_j)}{p(\mathbf{y}|M_i)p(M_i)} \tag{20}$$

since the denominator in (3) cancels out when comparing posterior model probabilities. If this ratio is greater than 1, implying that the candidate model M_j has a higher posterior model probability than model M_i, then the chain moves to the new state M_j, which is then the current model or state. If, on the other hand, the posterior odds ratio is smaller than 1, then M_j is accepted as the new state space with a probability equal to the posterior odds ratio. More compactly, the transition probability of accepting the candidate model,

[32] For this paper I actually use the *predictive odds ratio*, which incorporates predictive instead of marginal likelihoods.

i.e. the chain moving to state M_j is:

$$p_{ij} = \min\left[1, \frac{p(\mathbf{y}|M_j)p(M_j)}{p(\mathbf{y}|M_i)p(M_i)}\right] \tag{21}$$

Abstract

In this study I apply Bayesian Model Averaging to out-of-sample exchange rate forecasting. Following Eklund and Karlsson (2007) I employ *predictive likelihoods* rather than marginal likelihoods to determine posterior model probabilities. Forecasting results are evaluated relative to the standard random walk benchmark, as well as the *best* and *median* models. The latter two are the models with the highest posterior model probability and the model including all variables with a posterior inclusion probability above 50%, as suggested by Barbieri and Berger (2004), respectively. The main aim of this paper is to test various model specifications and find out which work best at what horizons. Specifications include level, difference, and error correction models. Furthermore, I examine the merit of using rolling model weights in forecast combination, and compare results for models using one and two lags, as well as models that include country specific variables versus cross-country differentials. Forecasts are performed for 8 different horizons and a set of 20 exchange rates. This extensive empirical analysis allows for a more reliable evaluation of various model specifications and forecasting performance over different horizons, reducing the influence of idiosyncratic movements in certain exchange rates on overall results. I also check for robustness of the results by performing forecasts over two different time windows. The main results are the following: one, Bayesian Model Averaging clearly outperforms single models (best or median) across all model specifications, time windows, and forecasting horizons in terms of RMSFE. Two, Bayesian model Averaging outperforms the random walk benchmark in terms of RMSFE significantly at longer horizons (9 and 12 months) but in general tends to do worse at shorter horizons. Three, level specifications appear to work somewhat better at longer horizons while difference specifications tend to do better at shorter horizons. Four, alternative specifications point to potential improvement. This is particularly true for the cointegration specification. However, it remains to be seen whether these results hold when estimating the cointegration relationship on a rolling basis, using only the data at hand at the time of the forecast. The rolling model weights specification offers some improvement at longer horizons for the difference specification. However, since level models tend to do better than difference models at these horizons, the approach does not appear particularly promising. Finally, the results do not indicate any systematic improvement in including country-specific variables compared to cross-country differentials. At the same time it entails using twice the number of variables and longer estimation time. From this standpoint it is therefore clearly advisable to use differentials. Using one lag instead of two leads to better results and is therefore also to be preferred, especially considering the reduction in estimation time.

Abstract

In dieser Arbeit verwende ich Bayesian Model Averaging um out-of-sample Wechselkursprognosen durchzuführen. Dabei folge ich dem Ansatz von Eklund und Karlsson (2007) und verwende *predictive likelihoods* zur Bestimmung der a-posteriori Modellwahrscheinlichkeiten. Zur Evaluierung der Prognosgüte ziehe ich den random walk, sowie das *beste* Einzelmodell und das *Medianmodell* als Vergleichsmaßstab heran. Bei den letzteren beiden handelt es sich um das Modell mit der höchsten a-posteriori Modellwahrscheinlichkeit, bzw. das von Baribieri und Berger (2004) propagierte Modell welches alle Variablen mit einer a-posteriori Modellinklusionswahrscheinlichkeit von zumindest 50% enthält. Das Ziel der Arbeit ist es herauszufinden welche Modellspezifikationen für welche Prognosehorizonte am besten geeignet sind. Dazu schätze ich zunächst einmal lineare Regressionsmodelle in Niveaus und Differenzen. Weiters untersuche ich den potentiellen Nutzen der Verwendung von Kointegrationsbeziehungen sowie rollierenden Modellgewichten bei der Bildung der gewichteten Durchschnittsprognosen. Schließlich vergleiche ich Ergebnisse für Modelle mit ein und zwei Lags pro Variable, sowie Modelle die länderspezifische Variablen verwenden versus solche die nur die Differenz dieser heranziehen. Prognosen werden für 8 verschiedene Prognosehorizonte und 20 verschiedene Wechselkurse durchgeführt. Diese ausgiebige empirische Analyse erlaubt es zuverlässigere Schlussfolgerungen hinsichtlich der Prognosequalität verschiedener Modelle über diverse Horizonte zu ziehen. Der idiosynkratische Einfluss einzelner Wechselkursbewegungen auf die Gesamtresultate wird hierbei reduziert. Die Verwendung zwei verschiedener Zeitfenster für Modellschätzungen und Prognosen erlaubt es zusätzlich die Robustheit der Ergebnisse zu überprüfen. Die Haupterkenntnisse der empirischen Analyse fassen sich wie folgt zusammen. Erstens, Bayesian Model Averaging führt zu besseren Prognoseresultaten als das Modell mit der höchsten a-posteriori Modellwahrscheinlichkeit oder das Medianmodell. Dies gilt im Wesentlichen für alle Modellspezifikationen, Zeitfenster und Prognosehorizonte. Zweitens, bei längeren Prognosehorizonten (9 und 12 Monate) führt Bayesian Model Averaging zu signifikant besseren Prognoseergebnissen als die random walk benchmark. Für kürzere Horizonte jedoch schneidet das random walk Modell insgesamt etwas besser ab. Drittens, Modelle in Niveaus führen bei längeren, Modelle in Differenzen tendenziell bei kürzeren Prognosehorizonten zu besseren Ergebnissen. Viertens, alternative Modellspezifikationen deuten teilweise auf Verbesserungsmöglichkeiten bezüglich Prognosequalität hin. Speziell Fehlerkorrekturmodelle schneiden vergleichsweise gut ab. Es bleibt jedoch abzuwarten, ob dies auch für den Fall gilt, dass die Kointegrationsbeziehung rollierend mit den jeweils verfügbaren Daten geschätzt wird. Rollierende Modellgewichtungen führen hingegen nur in der Differenzen-Spezifikation zu etwas besseren Resultaten, und dies auch nur für längere Horizonte. Da es aber

gerade die längeren Prognosehorizonte sind bei denen ohnehin Modelle in Niveaus bessere Ergebnisse liefern, scheint der Ansatz nicht sonderlich vielversprechend zu sein. Schließlich lassen die Ergebnisse keinen Vorteil aus der Verwendung länderspezifischer Variablen gegenüber deren Differenzen erkennen. Gleichzeitig führt die Verdoppelung der Variablenanzahl naturgemäß zu einer mitunter deutlichen Erhöhung der Rechenzeit. Unter diesen Gesichtspunkten ist daher die herkömmliche Variante mit Differenzen länderspezifischer Variablen klar zu bevorzugen. Auch die Verwendung zweier anstatt einem Lag führt zu keiner Verbesserung der Resultate - im Gegenteil. Es ist daher wiederum das sparsamere Modell vorzuziehen.

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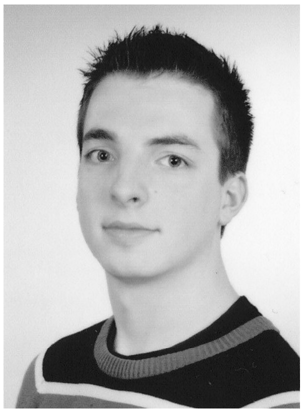

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