A Fundamental Connection: Exchange Rates and Macroeconomic Expectations

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Abstract

We disprove the exchange rate macroeconomic disconnect puzzle by showing that macroeconomic news can explain most variation in exchange rates at monthly and quarterly frequencies, accounting for up to 91 percent of the quarterly exchange rate variation during US recessions and 65 percent over all periods. The main driver of the reconnect is exchange rates responding to past news—a result inconsistent with the theory of uncovered interest rate parity under full information rational expectations (UIP-FIRE). We discuss theoretical models that can explain this surprising result, including models featuring currency risk premia, regulatory or institutional frictions, or deviation from FIRE.

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1 Introduction

Currencies are at the center of the global trade of goods and services and cross-country financial flows, playing a key role in the transmission of shocks. Exchange rate fluctuations can have a major impact on domestic inflation, real GDP growth, and financial stability of global economies. For these reasons, exchange rates are also key variables that policy makers target, directly or indirectly, when setting monetary policy and choosing the currency regime of a country. Yet, despite their central role in international economics and finance, exchange rates are some of the least understood variables.

The debate in international economics as to whether exchange rates are disconnected from macroeconomic fundamentals has permeated the field for almost four decades. There is a vast empirical literature devoted to explaining and forecasting exchange rate fluctuations. This literature has generally concluded that exchange rates are largely disconnected from fundamental economic variables such as GDP, interest rates, money aggregates, trade balances, and price levels at short to medium horizons.[1] The empirical exchange rate literature has moved, instead, toward documenting contemporaneous relationships between exchange rates and financial variables.[2] Overall, a perception has emerged that exchange rates are closer to asset prices than to macroeconomic fundamentals.

Using novel econometric techniques and a 2001–2020 sample with nine advanced economy

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[1]See the seminal papers of Meese and Rogoff (1983a;b) and also Frankel and Rose (1995), Obstfeld and Rogoff (2001), Engel and West (2005), and Rogoff and Stavrakeva (2008) for an overview.

[2]Valchev (2020), Jiang, Krishnamurthy, and Lustig (2021), and Engel and Wu (Forthcoming) document a link between exchange rates and convenience yields; Avdjiev et al. (2019) between exchange rates and deviations from covered interest parity; and Adrian and Xie (2020) and Lilley et al. (2022) between exchange rates and cross-border asset holdings.

currency crosses against the USD, we revisit the debate and argue that the notion of such a disconnect between exchange rates and macroeconomic fundamentals is incorrect. We find that macroeconomic news explain the majority of the variation in monthly and quarterly exchange rate changes—50 and 65 percent, respectively, in a panel regression. Macroeconomic news are announcement surprises in a number of indicators defined as the actual released value of each indicator minus the latest consensus professional forecast of that indicator (usually as of at most a few days prior to the announcement). The explanatory power tends to be stronger for currencies of global financial centers with macroeconomic news explaining 73 percent of the EUR/USD quarterly exchange rate change variation. The explanatory power is also higher during US recessions (91 percent of quarterly variation) and periods of high financial uncertainty (73 percent of quarterly variation). As a result, we argue that exchange rates comove very strongly with macroeconomic news even at business cycle frequencies.

Moreover, we find that past surprises play a substantially more important role in explaining exchange rates at monthly and quarterly frequency than their contemporaneous counterparts.[3] This finding explains why the previous literature, which focused only on the contemporaneous correlation between news and exchange rates, failed to establish a strong correlation between exchange rates and macroeconomic news. This discrepancy between our

[3]Considering the impulse responses of exchange rates with respect to various macroeconomic news reveal that the effect is often tens of times larger a month or more after the release of the macroeconomic indicator than on the day of the release itself. It is also not uncommon to find statistically significant reversal in the impulse responses over time. Such a delayed response to news is also present for other asset prices, such as in the post-monetary-policy-announcement drift in government bonds shown by Hanson and Stein (2015), Hanson, Lucca, and Wright (2021) and Brooks, Katz, and Lustig (2020). There is a similar well known post-earnings-announcement drift for equity prices first documented in Bernard and Thomas (1989; 1990) and recently reviewed in Fink (2021).

paper and the previous literature can be traced back to the theory of UIP-FIRE, traditionally at the core of international finance models. Aside from lagged interest rate differentials, which have been shown to have very low explanatory power, UIP-FIRE predicts that exchange rate changes are driven by only contemporaneous news about future interest rates and inflation.[4] As a result, prior research that examined the link between macroeconomic news and exchange rates only focused on the one-day or intra-day movements of the exchange rate around data releases, without considering the delayed responses of exchange rates to macroeconomic news (see Andersen et al. 2003 and Faust et al. 2007, among others).

Currently, it is widely acknowledged that the theory of UIP-FIRE is not the correct model of exchange rate determination. A newer generation of exchange rate models that have the potential to explain currency movements at business cycle frequencies feature either a currency risk premium or deviation from FIRE or both, which allow for past macroeconomic news to be a significant driver of exchange rate changes. Another contribution of the paper is to examine, from the perspective of this new class of models, the potential theoretical channels through which macroeconomic news propagate to exchange rates. More specifically, we decompose exchange rate changes into lagged interest rate differentials, the expected excess return (or currency risk premium), and the exchange rate forecast error. The sum of the last two terms is the realized excess return, which also explains almost all of the exchange rate change variation. Based on this decomposition, we find that the reason why past macroeconomic news explain a large fraction of exchange rate variation is because realized excess returns are strongly correlated with macroeconomic news, with past news being the most important driver.

Under the traditional assumption of FIRE, the forecast error must be orthogonal to past macroeconomic news and, as a result, any correlation between realized excess returns and this past news must reflect a relationship between past news and the objective expected

[4]For a recent review of the literature, see Engel et al. (2022).

excess return. In general, this finding will be consistent with models where the equilibrium rational expected excess return is a function of persistent state variables, which, in turn, will correlate with past macroeconomic news. As we discuss in more detail in Section 3, this can be done through models with time-varying currency risk premium (see Gourinchas, Rey, and Govillot 2018, Itskhoki and Mukhin 2021, Stavrakeva and Tang (Forthcoming), and Kekre and Lenel 2021, among others) or models with regulatory or institutional constraints, such as slow portfolio rebalancing or Value-at-Risk constraints, (see Adrian, Etula, and Muir 2014, Adrian, Etula, and Shin 2015, Bacchetta and van Wincoop 2021, and Bacchetta, van Wincoop, and Young 2023, among others).

Another class of models that can reconcile the link between past macroeconomic news and exchange rate changes are those that feature deviation from FIRE. In these models, the link can be due to the subjective expected excess return and/or the subjective forecast error being correlated with past macroeconomic news. To test which of these two channels is most relevant for the reconnect between past macroeconomic news and exchange rates, we use professional forecasts to proxy for the marginal foreign currency trader's exchange rate expectations.[5,6] Our findings suggest that the link between exchange rates and macroeco-

[5]We are, to our knowledge, the first to use the Consensus Economics *individual-level* professional forecasts of exchange rates. Such data is crucial for analyzing questions of rationality in beliefs.

[6]Stavrakeva and Tang (2023) have shown that professional exchange rate forecasts are inconsistent with FIRE and are consistent with the average futures positions of traders in the OTC forex derivatives market, the largest currency market, thus, justifying the use of professional forecasts as a proxy for the beliefs of the marginal investor. Other papers that conclude that professional exchange rate forecasts are inconsistent with FIRE include Dominguez (1986), Frankel and Froot (1987), Froot and Frankel (1989), Ito (1990), Frankel and Chinn (2002), Chinn and Frankel (2019) and Kalemli-Ozcan and Varela (2022).

nomic news is driven primarily by the subjective forecast error, with past news playing the most important role. The subjective currency risk premium is less strongly correlated with past macroeconomic news. This holds true when using either average or individual-level exchange rate forecasts, indicating that the results are robust to alternative proxies of the marginal trader's beliefs.

A number of theoretical models can generate these findings, such as models where agents do not know the true data-generating process of the endogenous variables (see Gourinchas and Tornell 2004 and Stavrakeva and Tang 2023 for applications in the exchange rate context). Such an assumption can be justified with the agent not having sufficient data to estimate the deep parameters of the model precisely or because she does not know the entire structure of the model that determines equilibrium exchange rates.[7] In these settings, the agent's forecast errors become a function of state variables, which, in the more realistic models, tend to be persistent and, thus, correlated with lagged news. A third class of models that can explain our finding includes those where agents are rational but do not have full information, implying that they might not have access to all macroeconomic news either due an exogenous information constraint or rational inattention (see Sims 2003, Reis 2006, Coibion and Gorodnichenko 2015, and Kamdar 2019, for example). In these models, the forecast error will be also forecastable by lagged macroeconomic news.

We consider a few different empirical approaches to document the link between exchange rate changes and macroeconomic news. The main econometric approach builds on the work of Altavilla, Giannone, and Modugno (2017), who studied the link between macroeconomic news and asset prices at a monthly frequency. Importantly, their study failed to find a reconnect because they did not incorporate lagged dynamics in the relationship between exchange

[7]For the latter point, see the literature on "internal" vs "external" rationality pioneered by Adam and Marcet (2011) and Adam, Beutel, and Marcet (2017) and discussed further in Section 3 of this paper.

rate changes and macroeconomic news. We extend their methodology in the following way. Similarly to their paper, we first construct a macroeconomic news index as the fitted value of a regression of the daily exchange rate change on news, but we crucially also include past macroeconomic news, not just contemporaneous news. We then regress monthly or quarterly changes of the exchange rate on this daily macroeconomic news index aggregated to the relevant frequency. Another contribution relative to Altavilla, Giannone, and Modugno (2017) is that we further tease out the surprises that matter the most as explanatory variables of exchange rates. We do so by constructing macroeconomic news subindices that capture only lagged or contemporaneous surprises and subindices specific to a country or type of news (i.e., inflation, activity, etc).

Given the large number of regressors introduced by adding lags, we avoid overparameterization by imposing restrictions on the regression coefficients in the first-stage regression. As a robustness check, we address the large number of parameters in another way with Bayesian estimation of the first-stage regression, imposing a prior on the macroeconomic surprises' coefficients which is centered around zero and that is tighter the further back in time the lags are. Despite using a prior that effectively biases toward finding no effect of past news on exchange rates, we still find past news to be a very important driver of exchange rate changes. On average, 50 and 47 percent of the exchange rate change variation at monthly and quarterly frequencies, respectively, can be attributed to movements in macroeconomic news indices constructed through Bayesian estimation in the first-stage. Importantly, past news still plays the greatest role, once again confirming the importance of relaxing the assumption that news gets incorporated in exchange rates instantaneously.

Finally, given the finding that lagged macroeconomic surprises drive the majority of the reconnect, we also run predictive in-sample regressions. This is an additional robustness check that allows us both to relax the constraint that macroeconomic news impact the exchange rate subcomponents in the same way they impact the realized exchange rate change and to include additional lags. In this less constrained specification, past news explain, a cross-currency average of 46 percent and 59 percent of exchange rate change variation at one-month and one-quarter ahead horizons, respectively. The adjusted R^2s for the realized excess return are similar, suggesting that around a half of the objective expected excess return can be explained by macroeconomic news. Next, we consider the survey exchange rate expectations, which allow us to decompose realized excess returns into subjective expected excess returns and forecast errors. At the one-month horizon, on average, 30 percent of the variation of the subjective expected excess return and 63 percent of the variation of the forecast error can be attributed to the macroeconomic surprises. The equivalent average adjusted R^2s for the one-quarter horizon are 26 percent and 69 percent, respectively.

The paper's results should be interpreted in the context of a number of other literatures. It links to studies showing that financial market participants interpret news within a broader macroeconomic context. Forex traders, as noted by Cheung and Chinn (2001), have pointed out that market reactions to macroeconomic announcements can be quite nuanced and can depend on the context of the news.[8] This idea of a contextual interpretation of news is also related to the "scapegoat" effect, developed by Bacchetta and van Wincoop (2013) and Fratzscher et al. (2015), positing that macroeconomic fundamentals matter more for exchange rates when they deviate significantly from some fundamental value. Allowing for past and other contemporaneous news is one way to capture such contextual or state-

[8] "[S]ome traders have pointed out that there are some ambiguities in the interpretation of GDP announcements. GDP is the sum of many components, so the growth rate of aggregate output may not be a sufficient statistic, and in fact may require more analysis in order to determine the true impact of the economic release. One concrete example of this factor is the distinction between growth arising from an export surge, versus that arising from inventory accumulation. The former has a positive implication for future output growth, while the latter has the converse and hence the two have different implications on exchange rate movements." (p.457, Cheung and Chinn 2001).

contingent relationships. In addition, to explore the importance of state contingency in a more flexible way, we use an alternative specification that estimates the first-stage regression using recursive windows, thus, constructing the macroeconomic news index in real time. We find that the explanatory power of our macroeconomic news index improves by as much as 29 percentage points at a quarterly frequency, giving support to the idea that the importance of macroeconomics news is time-varying and potentially contextual. controlling for past and contemporaneous news.

The order flow literature also studies the impact of macroeconomic news on exchange rates, though via the market micro-structure. Evans (2010) finds that up to 30 percent of the variation in realized currency returns at a one- to two-month horizon can be traced back to macroeconomic news through its impact on order flows.[9] Finally, relying on a structural estimation of an asset demand model, a paper contemporaneous to ours by Koijen and Yogo (2020) finds that macroeconomic variables explain 36 percent of the monthly exchange rate variation while foreign exchange reserves of central banks account for another 19 percent.

The paper proceeds as follows. Section 2 presents evidence on the importance of macroeconomic news for explaining the variation in the exchange rate changes at lower frequencies. Section 3 explores the theoretical implications of this reconnect between exchange rates and macroeconomic surprises using a decomposition of exchange rate changes into lagged interest rate differentials, expected excess return, and forecast errors. Section 4 reports our in-sample predictive regressions, further providing support for our core results. Section 5 concludes.

[9]See also Bacchetta and van Wincoop (2006), Evans and Lyons (2008), Love and Payne (2008) and Evans and Rime (2012) for further empirical evidence and a discussion of the market micro-structure mechanics of how news affects exchange rates through trading behavior.

2 Exchange Rate News from Macroeconomic Fundamentals

In this section, we present our main empirical exercise, which confirms the link between exchange rate changes and macroeconomic surprises.

We study nine advanced economy currency crosses against the USD: CHF/USD, JPY/USD, EUR/USD, GBP/USD, CAD/USD, AUD/USD, NZD/USD, NOK/USD and SEK/USD. We use news about macroeconomic fundamentals measured with surprises generated by releases of data on macroeconomic variables. These surprises are the differences between actual releases and median forecasts obtained in surveys conducted by Bloomberg and Informa Global Markets (IGM; formerly known as Money Market Services).

In our analysis, we include surprises for a variety of indices for each country chosen, taking into account both sample length and the popularity of each indicator, as measured by Bloomberg's relevance value at the time of data collection. The set of indicators includes measures of activity, inflation, trade, and the labor market.[10] The median forecasts for these indicators are generally measured at most a few days before the data release. In the case of IGM, a survey is conducted each Friday regarding the following week's data releases. For each currency pair, we include the indicators of the two countries.[11]

Given the large number of explanatory variables, particularly because we introduce lags into the estimation, we first reduce the dimensionality of our macroeconomic news by applying a two-stage mixed-frequency analysis that builds on Altavilla, Giannone, and Modugno (2017).[12] In the first stage, we construct an exchange rate macroeconomic news index,

[10]See the Online Appendix, Section D.3, for the full list of surprises.

[11]For the euro, we include euro-area indicators as well as some for Germany, the largest European economy.

[12]Since macroeconomic surprises are not very highly correlated with each other by nature

calculated as the fitted value from a regression of the daily exchange rate changes on contemporaneous and lagged macroeconomic surprises. The benchmark specification is to use OLS to estimate this first regression, where we impose some restrictions on the estimated coefficients, cognizant of the large number of regressors and the possibility of overparameterization. We relax this assumption in a robustness check later on, taking a different approach to the overparameterization problem by estimating this daily regression using Bayesian estimation. In the second stage, we regress a longer-horizon exchange rate change on this macroeconomic news index summed over the corresponding horizon.

To summarize, we estimate:

$$s_{t+h} - s_t = \alpha_2 + \gamma \left(\sum_{i=1}^{h} \widehat{\Delta s_{t+i}}^{macro} \right) + error_{2,t}, \tag{1}$$

where $s_{t+h} - s_t$ is an h-day log exchange rate change, and $\sum_{i=1}^{h} \widehat{\Delta s_{t+i}}^{macro}$ is the sum of the daily exchange rate macroeconomic news index over the same corresponding horizon h. Throughout the paper, exchange rates will be expressed in units of local currency per USD. Thus an increase in s_t would be an appreciation of the USD. This daily macroeconomic news index is constructed from fitted values of the following daily regression (first stage):

$$\Delta s_t = \alpha_1 + \sum_{k=1}^{K} \left(\sum_{j=0}^{126} \beta_j^k Surp_{t-j}^k \right) + error_{1,t}, \tag{2}$$

where t indexes trading days and k indexes the surprises. To avoid overparameterization, we constrain lags beyond the first three to have the same coefficient within months (more specifically, 21 trading days). That is, we impose a step-wise shape on the β_j such that $\beta_j = \delta_1$ for $4 \leq j \leq 21$, $\beta_j = \delta_2$ for $22 \leq j \leq 42$, and so on until $\beta_j = \delta_6$ for $106 \leq j \leq 126$. This set of coefficient restrictions is equivalent to summing up surprises, beyond the first three lags, that occurred one month ago, two months ago, and so on. Since most of the

of being surprises, typical dimension reduction techniques such as principal components or factor analysis are not suitable.

macroeconomic indicators that we consider are released once a month, these sums often just reflect the most recent past surprise, the second most recent surprise, and so on. In other words, for most indicators, our restrictions are similar to constraining a surprise to have the same effect on future one-day exchange rate changes until the next data release.

In sum, we capture a dynamic effect of each macroeconomic surprise on exchange rates that is summarized by 10 coefficients; four coefficients for the effect on the day of the announcement and the next three days, and six coefficients that capture the response over the next six months. We leave the coefficients on the contemporaneous and first three daily lags of surprises unconstrained to allow the regression flexibility in accounting for news that, due to differences in time zones, may occur after the time that our end-of-day exchange rates are recorded and sometimes on weekends or holidays. To include all macroeconomic surprises in one daily regression, we follow the literature in setting the surprise measure for an indicator to zero on days with no announcements for that indicator.

Due to the limited availability of expectations data for many of our indicators, the sample starts on October 1, 2001 for the first-stage regressions (not including lags) and ends on December 9, 2020, where for Switzerland, we exclude the period when the CHF was pegged to the euro (from September 6, 2011 through January 14, 2015). The sample for the second-stage regressions starts on March 25, 2002 and ends on November 9, 2020 for the 30-day horizon and September 9, 2020 for the 91-day horizon.[13] In our baseline exercise, we estimate both the regressions (2) and (1) over the full data sample. Later in this section, we also present an exercise in which we estimate the macroeconomic news index (the first stage) in real time, using recursive regressions.

[13]Expectations data for a small number of the indicators starts later than October 2001. In such cases, we use zeros where we do not observe surprises in the early part of our sample for these indicators and recognize that the explanatory power of macroeconomic announcements may be understated due to measurement error.

Table 1 presents unadjusted R^2s from the first-stage daily estimation of regression (2). Macroeconomic surprises do explain some exchange rate variation at the daily frequency, but they are far from explaining a majority of the variation. For example, the two highest unadjusted R^2s across currencies from regressing the daily exchange rate changes on the surprises are 17 and 10 percent. Therefore, high adjusted R^2s in the second-stage regression (1) will not be a mechanical consequence of tightly fitting the daily data in the first stage.

Table 2 shows adjusted R^2s from the second-stage regressions in equation (1) for horizons $h = 30$ and $h = 91$. We present both the bilateral regressions against the USD and the panel version (last column). News about macroeconomic fundamentals can consistently explain the majority of the longer-horizon exchange rate change variation, with an adjusted R^2 of 50 percent and 65 percent in the panel regression for the 30- and 91-day horizons, respectively. The highest adjusted R^2 is for the EUR/USD cross where the respective values are 59 percent and 73 percent for the one-month and one-quarter changes respectively.

The fact that the explanatory power of macroeconomic surprises is significantly higher at a lower frequency than at a daily frequency can be attributed to macroeconomic news having persistent effects on exchange rates while other sources of exchange rate movements have more short-lived effects. This fact is also consistent with the evidence regarding the ability of macroeconomic variables to explain and even forecast exchange rates well at annual and lower frequencies (for a literature review, see Rossi 2013). However, we are the first to show such a strong relationship at business cycle frequencies and, moreover, to explain such a large fraction of monthly and quarterly exchange rate change movements.

To understand the importance of longer-term dynamics in the response of exchange rates to macroeconomic announcements, we can further separate our macroeconomic news index in each of these regressions into the part of the sum $\sum_{i=1}^{h} \widehat{\Delta s_{t+i}}^{macro}$ that stems from surprises that occurred within the $t+1$ through $t+h$ time range, which we call the "contemporaneous" component, and those that occurred on date t or prior, the "lagged" component. For detailed expressions of these components, see Section A in the Online Appendix.

Table 3 presents the unadjusted R^2s from regressing the exchange rate change on each of these components separately and jointly.[14]

Stars denote the significance of the estimated coefficients in the univariate regressions on individual exchange rate macroeconomic index subcomponents. The tables show that the bulk of the macroeconomic news index's explanatory power is due to reactions to lagged macroeconomic surprises.

Also in Table 3, we decompose the exchange rate macroeconomic news index into subindices associated with different types of macroeconomic news: inflation, real economic activity, external sector and monetary policy news. We also do a similar split for local vs. US news.[15] We compute these subindices simply by assigning each macroeconomic indicator into one of these categories and adding up the fitted values from the first-stage regression within each category.[16] For both monthly and quarterly frequencies, real activity news, monetary policy news and inflation news play similar roles, followed by external sector news. Between US vs local news, US news plays a more important role.

In Tables 4 and 5, we report results of two exercises that flexibly illustrate the extent of state- or time-dependence of the value of macroeconomics news in driving exchange rate movements.

First, Table 4 examines the explanatory power of macroeconomic news during periods of high economic or financial uncertainty. Using the same full-sample first-stage estimates, we

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[14]For the remainder of the paper, we focus on the 91-day horizon in the main text but corresponding tables for 30-day changes can be found in Section B in the Online Appendix.

[15]Note that the oil news shocks are placed in external sector news or under US news though we see from the low explanatory power of external sector news that oil news are generally not a main driver of the explanatory power of US news.

[16]See Section D.3 in the Online Appendix for the categorizations of our surprises.

report the adjusted R^2s from second-stage regressions estimated over subsamples when the US is in recession or not or when the VIX is higher or lower than its median value. It becomes clear that exchange rates are more strongly connected to macroeconomic fundamentals during times of economic or financial turmoil, with our macroeconomic news indices explaining 91 percent of the variation in 91-day exchange rate changes in the panel of currencies during US recessions compared with 54 percent during normal times. The respective numbers for the high VIX vs. low VIX regimes for the 91-day exchange rate change are 73 versus 48 percent. Furthermore, this pattern holds in time-series regressions of each bilateral exchange rate as well and when we consider the 30-day horizon. This result is consistent with beliefs being more sensitive to news (public signals) when there is greater uncertainty about the economy, as discussed in Stavrakeva and Tang (Forthcoming).

Table 5 presents the explanatory power of macroeconomic news when we instead construct the news index in real time, using recursive regressions. That is, for the daily macroeconomic news index at each time t, we use estimates of the first-stage regression of equation (2) not over the full sample, as is done in the baseline exercise, but instead using data between time 0 and time t. In the second stage, we again regress $s_{t+h} - s_t$ on the sum of this real-time-estimated daily news index between $t + 1$ and $t + h$. When comparing over the same sample, allowing for real-time estimation of the news index results in a much higher fraction of variation explained of exchange rate movements, with an improvement ranging from 12 to 29 percentage points.[17] The improvement in explanatory power provides evidence of time variation in the relative importance of individual announcements.

Finally, Figure 1 plots the actual 91-day exchange rate changes and the summed macroeconomic news indices estimated over both the full sample and in real-time for the AUD/USD,

[17]The sample with real-time estimates of the news index is from September 30, 2009 to September 9, 2020 to accommodate an initial real-time estimation window for the first-stage daily news index of 8 years.

EUR/USD, GBP/USD, and JPY/USD. Here, we see the close fit over time and that by allowing for the first-stage coefficients to change over time, the real-time news index indeed provides a closer fit of exchange rate fluctuations, particularly during the early-2010s.

2.1 Robustness Checks

Section C of the Online Appendix presents, as a robustness check, a version of this estimation where the macroeconomic news index is created using a Bayesian estimation of the first-stage daily regression. In particular, we estimate equation (2) without restrictions on the coefficients β_j^k on the contemporaneous and lagged macroeconomic surprises. We instead impose an informative prior based on the standard Minnesota prior. More specifically, the prior for the coefficients on the macroeconomic surprises is centered around zero and we choose a shrinkage parameter such that the prior distribution is tighter for longer lags. Essentially, the estimates will be a weighted average between zero and unrestricted OLS estimates so we are biasing ourselves against finding in-sample explanatory power of the macroeconomic surprises for exchange rate changes. All the results are reported in Tables A10-A15.

We find that the unadjusted R^2s for the daily regressions are substantially higher when we use Bayesian estimation, reaching as high as 51 percent. This result implies that the constraints we impose on the estimated OLS coefficients in the daily regression in our benchmark specification significantly decrease the explanatory power of the macroeconomic news at daily frequency.

The explanatory power of the macroeconomic news index in the second-stage regressions remains high using Bayesian estimation in the first stage (albeit a bit lower relative to our benchmark OLS specification) and we still see an overall increase in explanatory power when moving from the daily to lower frequencies. The explanatory power is similar at monthly and quarterly frequencies. Thus, even using Bayesian estimation to construct our macroeconomic news index, we continue to see that there is a high-frequency source of transitory exchange rate fluctuations not attributed to our observed macroeconomic news that cancels out at longer horizons. Furthermore, the result that responses to lagged macroeconomic surprises are relatively more important is also confirmed using this alternate Bayesian estimation of the first-stage regression despite the estimation procedure inherently biasing against this finding. We find similar patterns regarding the relative importance of the various categories of macroeconomic news and the state-dependence of the relevance of macroeconomic news when we partition the second-stage estimation based on periods of US recessions or high versus low uncertainty.

In another important robustness check, we also assess whether our high explanatory power is artificially generated by the large number of surprises, and particularly lags, included in our estimation. To do so, we take random draws across time from our surprises and re-estimate both the first- and second-stage regressions using these randomly drawn surprises. To be more precise, we draw the surprises in blocks of 24 months to preserve any potential autocorrelation patterns within surprises. We also maintain cross-surprise correlations by randomly drawing time periods but using the entire vector of surprises that occurred concurrently at each date. After re-estimating both stages using these randomly drawn surprises, we then compute the percentage of these simulated second-stage adjusted R^2s that are lower than our second-stage adjusted R^2s based on actual data.

The results of this exercise are presented in Table A1 in the Online Appendix. In 15 out of the 18 cases across the 30- and 91-day horizons for nine currency pairs, our actual adjusted R^2s are higher than over 90 percent of the cases with randomly shuffled macroeconomic surprises. In over half of these cases, the percentiles are 97 percent or higher. This shows that the high explanatory power of macroeconomic surprises for exchange rates found in our exercise is not due simply to the large number of variables that are included in the construction of our macroeconomic news index.

2.2 Impulse Responses

In order to shed further light onto why we find past macroeconomic news to be so important for explaining exchange rate changes, we consider the dynamic responses of exchange rates to macroeconomic surprises implied by the Bayesian estimates of equation (2).

The response of the exchange rate level at time $t + h$, relative to the level at time $t - 1$, to a shock to surprise variable k that occurred in time t would be given by the cumulated coefficients $\sum_{j=0}^{h} \beta_j^k$. If the exchange rate only responds to contemporaneous surprises, then the response would be an immediate jump at horizon zero and then a flat line thereafter.

For example, Figures 2 and 3 show the estimated responses of the JPY/USD to local and US macroeconomic surprises, standardized to have a sample mean of zero and a standard deviation of 1 in order to facilitate interpretation of the estimated responses.[18] We note that the credible intervals often include zero at longer lags, a property that may be influenced by our use of a Bayesian prior in the estimation that is more tightly centered around zero for longer lags. Nonetheless, a consistent result is that the response of the exchange rate to surprises in many of these variables grows over time to be many times larger than on the day of the surprise or even a few days after. Moreover, one can also see cases of statistically significant reversals over time in the signs of the estimated coefficients.

As a result, it is clear that there is an important difference between contemporaneous (event-day) and lagged dynamics. Based on these impulse responses, it is not surprising that incorporating past news is crucial for the "reconnect" that we document.

To summarize, while the previous literature finds a tenuous link between exchange rates and macroeconomic variables at policy-relevant frequencies, we show that, at such frequencies, exchange rate changes are indeed predominantly driven by news about macroeconomic fundamentals. Moreover, we show that past macroeconomic news play a crucial role, which

[18] Analogous impulse responses for the AUD/USD, EUR/USD, and GBP/USD exchange rates are given in Tables A2–A7 in the Online Appendix.

can also be confirmed with the impulse responses of exchange rate changes with respect to these macroeconomic news.

3 Theoretical Implications

3.1 UIP-FIRE

The fact that past news (period t and before) explain such a large fraction of exchange rate changes between the ends of periods t and $t+h$ seems surprising if one takes as a starting point the theory of UIP under full information rational expectations (or UIP-FIRE), which implies that contemporaneous macroeconomic news should be the main driver of exchange rate changes. UIP-FIRE assumes traders are risk neutral, markets are frictionless, and FIRE holds. More specifically, UIP-FIRE implies that the objective expected excess currency return from being long the h-period US bond and short the h-period bond of country j, each denominated in the local currency, is equal to zero:

$$E_t s_{t+h} - s_t + \left(i_t^{h,US} - i_t^{h,j} \right) = 0, \tag{3}$$

where $i_t^{h,US}$ is the yield on a h-period US bond, $i_t^{h,j}$ is the yield on a h-period bond of country j and E_t stands for the objective expectations operator. Equation (3) can be re-written as:

$$s_{t+h} - s_t = \underbrace{(s_{t+h} - E_t s_{t+h})}_{\text{objective surprise}} + \left(i_t^{h,j} - i_t^{h,US} \right). \tag{4}$$

According to the theory of UIP-FIRE, there are two components driving realized exchange rate changes—the period t interest rate differential and the objective surprise. The reconnect between exchange rates and past macroeconomic news cannot be attributed to the period t interest rate differential for the following reasons. First, the interest rate differential is significantly less volatile than exchange rate changes and, thus, explains a very small fraction of exchange rate movements.[19] The adjusted R^2s from regressing exchange rate changes on interest rate differentials at one and three month horizons are close to zero.[20] Therefore, even if our lagged macroeconomic news index could fully explain the interest rate differential, this would not contribute meaningfully to their explanatory power for the overall exchange rate change. Second, Table 6 shows that our lagged macroeconomic news index is only very weakly related to the interest rate differential.

The second component, the objective surprise, can be decomposed further as:[21]

$$s_{t+h} - E_t s_{t+h} = (E_{t+h} - E_t) \sum_{k=1}^{\infty} \left(\pi^j_{t+hk} - \pi^{US}_{t+hk}\right) - (E_{t+h} - E_t) \sum_{k=1}^{\infty} \left(i^{h,j}_{t+hk} - i^{h,US}_{t+hk}\right),$$

where π^j_{t+h} and π^{US}_{t+h} are h-period inflation rates between periods t and $t+h$ for currency j and the US, respectively. Thus, macroeconomic news can affect exchange rate changes through revisions in expectations of the relative interest rate and inflation paths. However, under the theory of UIP-FIRE, the objective surprise is orthogonal to all information available as of period t and, hence, cannot be correlated with past macroeconomic news.

Thus, it is clear that the theory of UIP-FIRE is not consistent with the reconnect that we document to the extent that, empirically, past news drive the majority of the macroeconomics news reconnect, while the theory of UIP-FIRE predicts that only contemporaneous news should be an important driver.

Next, we consider the types of models that can potentially be consistent with our empirical findings and discuss the ways in which they deviate from the theory of UIP.

[19]See Itskhoki and Mukhin (2022) for a review of the literature on the Mussa puzzle, which studies the volatility disconnect between macroeconomic variables such as interest rates and exchange rates.

[20]See Burnside (2019) and Engel et al. (2022), for example.

[21]For derivations, see Section A in the Online Appendix.

3.2 UIP-FIRE with a Wedge

The first category of models that can potentially reconcile our findings are models that microfound a UIP wedge. These tend to be models with risk averse agents and/or market frictions. One can augment the UIP equation with a wedge as follows:

$$D_t = E_t s_{t+h} - s_t + \left(i_t^{h,US} - i_t^{h,j}\right), \tag{5}$$

where D_t is the objective expected excess return. Equation (5) can be re-written as:

$$s_{t+h} - s_t = \underbrace{\underbrace{D_t}_{\text{expected excess return}} + \underbrace{\left(s_{t+h} - E_t\left(s_{t+h}\right)\right)}_{\text{objective surprise}}}_{\text{realized excess returns}} - \left(i_t^{h,US} - i_t^{h,j}\right). \tag{6}$$

As discussed in subsection 3.1, even with this wedge, the continued assumption of FIRE means that the objective surprise and the interest rate differential cannot explain the reconnect between past macroeconomic news and exchange rate changes. As a result, the reconnect can only come from the objective expected excess return being correlated with period t and earlier macroeconomic news. We can formally test whether D_t can account for the reconnect with past news as follows. While we do not observe the objective exchange rate expectation, we can use realized excess returns to infer a relationship between past news and the objective expectation of excess returns because objective surprises must be orthogonal to past news under an assumption of FIRE. Table 6 presents the unadjusted R^2 from regressing the realized excess return on contemporaneous, lagged or both components of the exchange rate macroeconomic news index. We find that the realized excess currency return is to a large extent explained by the lagged macroeconomic news index, with the panel R^2 being 37 percent at monthly frequency and 25 percent at quarterly frequency.

A wide variety of models of D_t would potentially generate a correlation between past macroeconomic fundamentals and exchange rates. In these models, the expected excess return is a function of persistent endogenous or exogenous variables which themselves correlate with current and lagged macroeconomic news. These include models where the currency risk premia is time varying due to investors' effective risk aversion being correlated with the state of the macroeconomy (see Campbell and Cochrane 1999, Brandt and Wang 2003, Gourinchas, Rey, and Govillot 2018, Campbell, Pflueger, and Viceira 2020, Stavrakeva and Tang (Forthcoming), and Pflueger and Rinaldi 2022). For example, in Gourinchas, Rey, and Govillot (2018) and Stavrakeva and Tang (Forthcoming), the currency risk premia would correlate with lagged news because it's a function of the time-varying risk aversion of the marginal investor which in turn is driven by a potentially persistent state of the economy. Naturally, news about the economy will be the key driver of the risk premium, D_t, in these models.

Another class of models, where investors are risk averse, generates an expected excess return which is correlated with the bond positions of the foreign exchange rate trader (see Itskhoki and Mukhin 2021 and Kekre and Lenel 2021). In order to obtain such a solution, one needs to solve these model non-linearly or use a higher-order linearization. To the extent that bond positions are endogenous and a function of the same state variables that drive macroeconomic surprises, these models can also potentially rationalize our findings under certain calibrations.

Models with regulatory or other financial frictions such as Value-at-Risk constraints, where the Lagrange multiplier on the binding constraint is a key driver of D_t, can be an alternative explanation of the reconnect that we document. Usually in these models, the constraints are tighter when the economy performs poorly. Models with Value-at-Risk constraints include Adrian, Etula, and Muir (2014), Adrian, Etula, and Shin (2015), and Coimbra and Rey (2021), and examples of models with regulatory constraints can be found in Jiang, Krishnamurthy, and Lustig (2021). Intuitively, in all these models, financiers' demand cannot respond fully and instantaneously to macroeconomic news up to the point where the objective expected excess return equals zero as there is a limit to the size of their balance sheets. This constraint is captured in a time-varying Lagrange multiplier, which introduces a wedge in the Euler equation and, in a model with persistent state variables, will be correlated with lagged macroeconomic news.

Furthermore, models featuring agents who re-balance their portfolios infrequently or other frictions that generate slow moving capital can also potentially generate a UIP wedge that correlates with past macroeconomic news even when agents are risk neutral. Some examples of such models, applied to exchange rate determination, include Bacchetta and van Wincoop (2010), Bacchetta and van Wincoop (2021), and Bacchetta, van Wincoop, and Young (2023).

Regardless of the microfoundation, the interpretation of D_t being correlated with past macroeconomic news is that past macroeconomic news drive the "effective" risk premia and the in-sample "predictability" of exchange rates is due to compensation for some form of risk, broadly defined.

3.3 Deviations from FIRE

A second class of models, which can reconcile our results, is related to the hypothesis that financiers' beliefs are not consistent with FIRE and traders make predictable forecast errors.[22] The subjective expected excess return of trader i from being long the h-period US bond and short the h-period bond of country j is given by:

$$\tilde{D}_{i,t} = \tilde{E}_t^i s_{t+h} - s_t + \left(i_t^{h,US} - i_t^{h,j} \right),$$

where $\tilde{E}_t^i$ is the subjective expectations operator. Using the Froot and Frankel (1989) decomposition of the subjective surprise into an objective surprise and a deviation from FIRE

[22]Notice that the existence of non-zero macroeconomic surprises, surprises on reports of *past* outcomes, already reveals some deviation from FIRE on the part of the forecasters surveyed about their expectations of macroeconomic fundamentals. In the context of our results, we note that these forecasters could potentially be a different set of agents from the marginal forex traders.

component, we obtain:

$$s_{t+h}-s_t = \underbrace{\underbrace{\tilde{D}_{i,t}}_{\text{subjective expected excess return}} + \underbrace{(s_{t+h} - E_t[s_{t+h}])}_{\text{objective surprise}} + \underbrace{\left(E_t s_{t+h} - \tilde{E}_t^i s_{t+h}\right)}_{\text{deviation from FIRE}}}_{\text{realized excess returns}} + \left(i_t^{h,j} - i_t^{h,US}\right). \tag{7}$$

In contrast to the expression in equation (6), equation (7) features an additional term, $E_t s_{t+h} - \tilde{E}_t^i s_{t+h}$, which is the difference between the objective and subjective expectations. Moreover, $\tilde{D}_{i,t}$, is the subjective rather than objective expected excess return. If we deviate from the assumption that agents have beliefs consistent with FIRE, the source of the reconnect between past macroeconomic news and exchange rate changes could be due to correlations between past macroeconomic news and either agents' mistakes, $E_t s_{t+h} - \tilde{E}_t^i s_{t+h}$, or the subjective expected excess return, $\tilde{D}_{i,t}$. Notice that we can measure $\tilde{D}_{i,t}$ directly by using survey data on exchange rate expectations as a proxy for $\tilde{E}_t^i s_{t+h}$. While we do not measure the deviation from FIRE term directly, we observe the subjective forecast error defined as $s_{t+h} - \tilde{E}_t^i s_{t+h}$ which is equal to the sum of the objective surprise and the deviation from FIRE term. As the objective surprise is orthogonal to information available as of period t, the co-movement between the subjective forecast error and the lagged macroeconomic news index can be attributed entirely to the mistakes that forecasters make, relative to the FIRE benchmark, being correlated with the lagged macroeconomic news index.

The beliefs of the marginal forex trader are assumed to be reflected in Consensus Economics professional forecasts, an assumption that is shown to be supported by the data in Stavrakeva and Tang (2023). They found that the average Consensus Economics exchange rate forecasts are correlated with the futures positions of the average trader in one of the largest forex markets, the over-the-counter derivatives market, in a theory-consistent way. Therefore, these forecasts should represent the beliefs of the marginal forex trader. In Table 6, we use mean 3-month-ahead exchange rate Consensus Economics forecasts that are available at the monthly frequency. These forecasts are matched to our daily exchange rate and interest rates data, using the dates on which forecasters were surveyed for their expectations.

Restricting the sample to only days on which we have forecast data, Table 6 clearly shows that, if the beliefs of the marginal trader are consistent with the mean Consensus Economics forecast, the macroeconomic news reconnect is due to the lagged macroeconomic surprises being an important driver of the forecast error rather than the subjective expected excess return. This result implies that the mistakes professional forecasters make are correlated with lagged macroeconomic news.

As a robustness check, we also estimate the same regressions using individual-level subjective expected excess return and subjective surprises, given that it is unclear that the *average* Consensus Economics exchange rate forecast is the best proxy for the beliefs of the marginal trader. For example, a model with trading constraints would imply that not all traders are marginal at every single point of time.

Table 7 presents the evidence regarding forecast error surprises and expected excess returns using forecasts from 38 individuals for whom we observe at least 24 months' worth of forecasts. We report the median unadjusted R^2s and the 5^{th} and 95^{th} percentiles of the unadjusted R^2 in square brackets. For univariate regressions, we also report the percent of individual-level regressions that have regressors significant at the 10 percent level.

A final value that we calculate using the individual-level data is the fraction of the overall explanatory power of macroeconomic news indices for exchange rate changes that can be attributed to the relationship between the news index and each component of the Froot and Frankel (1989) decomposition in equation (6). This fraction comes from the following expression for the unadjusted R^2 for the overall exchange rate change:

$$
\begin{aligned}
R_s^2 &= \frac{Var\left(\widehat{s_{t+h} - s_t}\right)}{Var\left(s_{t+h} - s_t\right)} \\
&= \frac{Cov\left(\widehat{i_t^{h,j} - i_t^{h,US}}, \widehat{s_{t+h} - s_t}\right)}{Var\left(s_{t+h} - s_t\right)} + \frac{Cov\left(\widehat{\tilde{D}_{i,t}}, \widehat{s_{t+h} - s_t}\right)}{Var\left(s_{t+h} - s_t\right)} + \frac{Cov\left(\widehat{s_{t+h} - \tilde{E}_t^i[s_{t+h}]}, \widehat{s_{t+h} - s_t}\right)}{Var\left(s_{t+h} - s_t\right)},
\end{aligned}
$$

where the hat denotes a fitted value from a regression on the relevant macroeconomic news index. This relationship holds for regressions of the exchange rate change and each component of equation (6) measured using individual-level forecasts on the relevant macroeconomic news index *using the same time sample* for which the forecast data is available.

By dividing both sides of this expression by R_s^2, we obtain the fraction of the R^2 for the overall exchange rate change that is explained by the relationship between the macroeconomic news index (or set of indices) and each component of the Froot and Frankel (1989) decomposition. Notice that the last term involving the individual-level forecast error includes both the unobserved objective surprise and unobserved individual-level deviation from FIRE. Table 7 presents the median of this fraction across individual forecasters in angle brackets and we see that the forecast error component tends to explain about all of the explanatory power of macroeconomic news indices for exchange rate changes.[23] Especially for lagged news indices, the median fraction explained is at least .93 and often above 1. This decomposition reveals a fact that R^2s alone do not. While past macroeconomic news can have some explanatory power for expected excess returns, they often move expected excess returns in the opposite direction as the overall exchange rate change, generating a negative covariance between the two fitted values.

These results confirm that, even when using individual-level exchange rate forecasts, rather than the average Consensus Economics forecast, the source of the reconnect is past macroeconomic surprises explaining the deviation from FIRE term, since they explain the

[23]We can compute analogous contributions to the overall exchange rate R^2 for the interest rate differential component based on the same individual-level time samples as in Table 7. As the rate differentials only differ across individual forecasters, the results are quite similar to Table 6 with near-zero R^2s and contributions to the overall R^2 for the full regression and both the contemporaneous and lagged subindices. These are not included in the table for brevity.

forecast errors.

A number of theoretical models can generate this finding, such as models where agents do not know the true data-generating process of endogenous variables, including exchange rates. As a result, the forecast error becomes a function of the deviation between the true and perceived data-generating process of exchange rates which, in turn, depends on persistent state variables, correlated with lagged macroeconomic news.[24] Agents can misperceive the data-generating process of an endogenous variable through lack of knowledge of a particular deep parameter in the model such as the true persistence of an exogenous state variable (see for example, Angeletos, Huo, and Sastry 2020 and Afrouzi et al. 2023 and the applications to the exchange rate context in Gourinchas and Tornell 2004 and Candian and De Leo 2022). As a result, the model again produces a forecast error that is a function of persistent state variables.

A final set of models that can explain our findings include papers where agents are rational but do not have full information (see Sims 2003, Reis 2006, Coibion and Gorodnichenko 2015 and Kamdar 2019, for example). In these models, agents are rational as they process the information available to them optimally but simply do not have access to all available information either due to information constraints or rational inattention, for example. Naturally, the forecast error in these models will be also forecastable by lagged macroeconomic news that are not in the information set of the marginal investor.

[24]One type of model which can generate such implications for forecast errors are those featuring "internal" rationality, pioneered by Adam and Marcet (2011) and Adam, Beutel, and Marcet (2017). According to Adam and Marcet (2011), it is unrealistic to expect investors to know the whole structure of the model, which determines exchange rates, i.e., they are "externally" irrational. However, it is realistic to assume that investors know their own optimization problem, which makes them "internally" rational.

4 In-sample Forecasting with Macroeconomic News

We conclude with an in-sample forecasting exercise that is intended to drive home the point that past macroeconomic surprises matter for exchange rate variation. In this exercise, we now regress future exchange rate changes on the full set of past macroeconomic surprises, rather than on the lagged surprises subindex of our macroeconomic news index. One advantage of this exercise, relative to our main results, is that it allows for more flexibility in how the exchange rate subcomponents of the Froot and Frankel (1989) decomposition depend on each lagged surprise and we effectively allow for more lags relative to the benchmark specification.

We estimate a version of our first-stage regression using future exchange rate changes as the dependent variable:

$$s_{t+h} - s_t = \alpha + \sum_{k=1}^{K} \left(\sum_{j=0}^{126} \beta_j^k Surp_{t-j}^k \right) + error_t, \tag{8}$$

where we maintain the same set of coefficient restrictions that impose a step-wise shape on the β_j such that $\beta_j = \delta_1$ for $4 \leq j \leq 21$, $\beta_j = \delta_2$ for $22 \leq j \leq 42$, and so on until $\beta_j = \delta_6$ for $106 \leq j \leq 126$. Note that we use end-of-day exchange rates in our analysis so that s_t is the market exchange rate recorded after the macroeconomic surprises on day t are observed.

Table 8 reports results from this estimation for 91-day changes while results for 1- and 30-day changes are again in the Online Appendix. Once again, we document that, even with the large number of regressors that we have, there is little short-run predictive power of these surprises for the one-day-ahead change.[25] However, the second row of Table 8 shows that this predictive power increases dramatically at longer horizons. At the 91-day horizon, we see adjusted R^2s of at least 55 percent for all but the CAD/USD pair and up to 65 percent for the JPY/USD pair. Looking at the joint significance of the estimated coefficients of the

[25]Relative to the daily regression specification in Table 1, here the news variables are lagged by 1 additional day and also we report adjusted rather than unadjusted R^2s.

various types of surprises, we find that both US and local surprises are jointly significant and monetary news tends to be the most statistically significant type of news across currencies and horizons, including in the one-day regressions. Inflation and activity news are also significant at the 30-day horizon but not for the other horizons.

Table 9 presents adjusted R^2s of analogous regressions with terms from the Froot and Frankel (1989) decomposition starting with daily-frequency time series regressions for the rate differential and realized excess returns as dependent variables. Unlike in our previous regressions where the lagged news subindex of our exchange rate macroeconomic news index explained little of the interest rate variation, we now see that macroeconomic surprises can explain the vast majority of interest rate variation. This implies that the constraints imposed on the relationship between lagged news and interest rate differentials by using an index that weighed news according to their ability to explain exchange rate changes were very restrictive. Having said that, the interest rate differential explains a very small fraction of the exchange rate change movement (less than 2 percent) and, thus, cannot contribute meaningfully to the macroeconomic reconnect.

We still find that the predictive power of past macroeconomic surprises for future realized excess currency returns is nearly as high as for the exchange rate changes themselves. Under the assumption of rational expectations, the objective surprise cannot be correlated with past news. Therefore, the results imply that about 50 percent of the objective currency risk premium can be explained by macroeconomic surprises.

Lastly, we further relax the assumption of rationality and examine whether past macroeconomic news can predict expected excess returns or forecast errors based on professional forecasts in sample. Since we have a much larger set of coefficients to estimate relative to our previous regressions, based on the lagged news subindex of our macroeconomic news index, and we only have monthly forecast observations, we now use the full panel of individual-level forecasts in a fixed-effect panel regression. The bottom half of Table 9 presents the results and shows that while this more flexible specification can predict expected excess returns reasonably well with adjusted R^2s in the 21-32 percent range for the 91-day horizon, the predictive power is still much stronger for forecast errors. We see adjusted R^2s in excess of 62 percent across all currencies, and as high as 76 percent for the AUD/USD pair.

5 Conclusion

This paper presents evidence countering the commonly held belief that exchange rates are disconnected from macroeconomic fundamentals. Using data on macroeconomic surprises, we show that the new information revealed by announcements about macroeconomic indicators can explain over half of the variation in exchange rate changes at monthly and quarterly frequencies and the vast majority of the variation during times of economic or financial turmoil. Furthermore, the explanatory power, most surprisingly, is primarily driven by past macroeconomic surprises.

If we assume that agents are rational and have full information, the models that would be consistent with our findings will feature an objective expected excess return that correlates with past macroeconomic news. That is, the reconnect that we document can be interpreted as compensation for risk. Alternatively, if we allow for the marginal trader's beliefs to deviate from FIRE and assume that these beliefs are consistent with survey data on exchange rate professional forecasts, we further conclude that the reconnect comes mainly from the link between past macroeconomic surprises and the subjective exchange rate forecast errors. That is, the mistakes that traders make when forecasting exchange rates are correlated with past macroeconomic news. This evidence can be used to motivate theories of exchange rate determination that can potentially empirically account for a very large fraction of exchange rate variation as documented by this paper.

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Tables and Figures

Table 1: R^2s from Daily Regressions of the Exchange Rate Change on Macroeconomic Surprises

# of Local Surp	8	5	6	12	8	11	3	5	6
# of US Surp	21	21	21	21	21	21	21	21	21
# of Obs	4,882	4,882	4,005	4,882	4,882	4,882	4,882	4,882	4,882
R^2	0.09	0.07	0.17	0.10	0.08	0.10	0.09	0.08	0.07

Note: Constrained daily regressions of $s_{t+1} - s_t$ on current and up to a 126-trading-day lag of macroeconomic surprises. The constraints are such that the regression is equivalent to an unconstrained regression on current and up to a three-day lag of macroeconomic surprises and sums of past macroeconomic surprises over each of the previous six months, with months being approximated as 21 trading days.

Table 2: Regressions of Exchange Rate Changes on a Macroeconomic News Index

Panel A. 30-Day Changes

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
Exch Rate News Index	1.04***	1.04***	0.88***	1.03***	0.97***	0.97***	1.04***	1.03***	1.04***	1.01***
	(0.06)	(0.08)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.04)
Constant	-0.00	-0.01	-0.07	-0.01	-0.01	0.00	-0.01	-0.02	-0.01	-0.01
	(0.12)	(0.10)	(0.11)	(0.09)	(0.10)	(0.09)	(0.12)	(0.13)	(0.11)	(0.07)
# of Obs.	4860	4860	3962	4860	4860	4860	4860	4860	4860	42842
Adjusted R^2	0.54	0.40	0.48	0.59	0.46	0.52	0.51	0.50	0.50	0.50

Panel B. 91-Day Changes

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
Exch Rate News Index	1.06***	1.07***	0.90***	1.04***	1.03***	0.98***	1.06***	1.02***	1.06***	1.03***
	(0.07)	(0.09)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.05)	(0.04)
Constant	0.02	0.01	-0.09	0.03	-0.01	0.01	0.01	0.04	0.00	0.02
	(0.32)	(0.29)	(0.25)	(0.21)	(0.25)	(0.25)	(0.31)	(0.36)	(0.27)	(0.19)
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817	42411
Adjusted R^2	0.68	0.52	0.60	0.73	0.63	0.66	0.66	0.63	0.67	0.65

Note: Regressions of $s_{t+h} - s_t$ on the daily macroeconomic news index correspondingly summed from $t+1$ through $t+h$. The daily macroeconomic news index is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. Newey-West standard errors are in parentheses.
$^{*}\, p < 0.10$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$

Table 3: R^2s from Regressions of 91-day Exchange Rate Changes on Macroeconomic News Subindices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817	42411
Full	0.68	0.52	0.60	0.73	0.63	0.66	0.66	0.63	0.67	0.65
Contemp	0.05	0.06*	0.01	0.01	0.13**	0.04**	0.00	0.03	0.01	0.02
Lags	0.21***	0.18***	0.17***	0.19***	0.33***	0.29***	0.29***	0.20***	0.29***	0.23***
Full	0.68	0.52	0.61	0.74	0.63	0.66	0.66	0.64	0.67	0.65
Inflation	0.05	0.02	0.15***	0.03**	0.13***	0.08***	0.18***	0.04*	0.20***	0.09***
Activity	0.07*	0.05*	0.07***	0.05**	0.06*	0.18***	0.05**	0.07*	0.14***	0.08**
External	0.01	0.01	0.03*	0.03**	0.00	0.05***	0.01	0.04**	0.01	0.01***
Monetary	0.19***	0.08***	0.01	0.14***	0.24***	0.04**	0.13***	0.13***	0.13***	0.12***
Full	0.68	0.52	0.60	0.73	0.63	0.66	0.66	0.63	0.67	0.65
US	0.28***	0.20***	0.09***	0.11***	0.31***	0.35***	0.34***	0.42***	0.35***	0.27***
Local	0.09***	0.00	0.06***	0.17***	0.10**	0.05**	0.04**	0.02	0.08***	0.06***

Note: Each row presents R^2s from regressions of $s_{t+91} - s_t$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news, different economic concepts, or US versus local news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+91$. The daily macroeconomic news subindices are constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. A subset of macroeconomic surprises or lags is included in the construction of each fitted value for subindices. For regressions on a single subindex, stars denoting the significance of the regressor based on Newey-West standard errors are included next to the R^2 value.

$^{*}\, p < 0.10$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$

Table 4: Adjusted R^2s from Regressions of 91-day Exchange Rate Changes on a Macroeconomic News Index in Recessions and High Financial Volatility Periods

Horizon		AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
$h = 91$	US Recession	0.94	0.89	0.85	0.90	0.95	0.83	0.88	0.93	0.91	0.91
	Non-Recession	0.50	0.39	0.55	0.69	0.43	0.63	0.56	0.51	0.55	0.54
	High VIX	0.79	0.65	0.67	0.81	0.76	0.67	0.72	0.69	0.77	0.73
	Low VIX	0.38	0.33	0.45	0.59	0.37	0.63	0.54	0.51	0.46	0.48

Note: Each row presents the adjusted R^2s from a regression of 91-day exchange rate changes on the daily macroeconomic news index correspondingly summed from $t+1$ through $t+91$ for over a specified subsample of dates. The daily macroeconomic news index is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. We use NBER recession dates, and the VIX is split by the median value over the full regression sample.

Table 5: Regressions of 91-day Exchange Rate Changes on a Macroeconomic News Index Estimated in Real Time

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
Exch Rate News Index	0.86***	0.82***	0.91***	0.94***	0.94***	0.91***	0.99***	1.02***	1.01***	0.94***
	(0.06)	(0.12)	(0.06)	(0.05)	(0.05)	(0.04)	(0.07)	(0.07)	(0.06)	(0.03)
Constant	0.24	0.08	-0.00	0.01	-0.03	0.15	-0.02	-0.88***	-0.18	-0.06
	(0.36)	(0.35)	(0.30)	(0.22)	(0.29)	(0.21)	(0.34)	(0.29)	(0.33)	(0.18)
# of Obs.	2856	2856	1914	2856	2856	2856	2856	2856	2856	24762
Adjusted R^2	0.65	0.44	0.73	0.79	0.59	0.84	0.66	0.70	0.67	0.68
Adjusted R^2 of baseline estimate over same sample	0.45	0.28	0.52	0.64	0.38	0.66	0.53	0.41	0.53	0.50

Note: Regressions of $s_{t+91} - s_t$ on the recursively-estimated daily macroeconomic news index correspondingly summed from $t+1$ through $t+91$. The daily macroeconomic news index at time t is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises that are estimated using data between time 0 and time t. Newey-West standard errors are in parentheses. For comparison of fit, the last row presents the adjusted R^2 from regressions of $s_{t+91} - s_t$ on the daily macroeconomic news index estimated over the full sample, also correspondingly summed from $t+1$ through $t+91$. This estimation is over the September 30, 2009 to September 9, 2020 subsample so that the first real-time estimation window for the daily news index contains 8 years worth of data.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Actual 91-Day Exchange Rate Changes and Macroeconomic News Indices

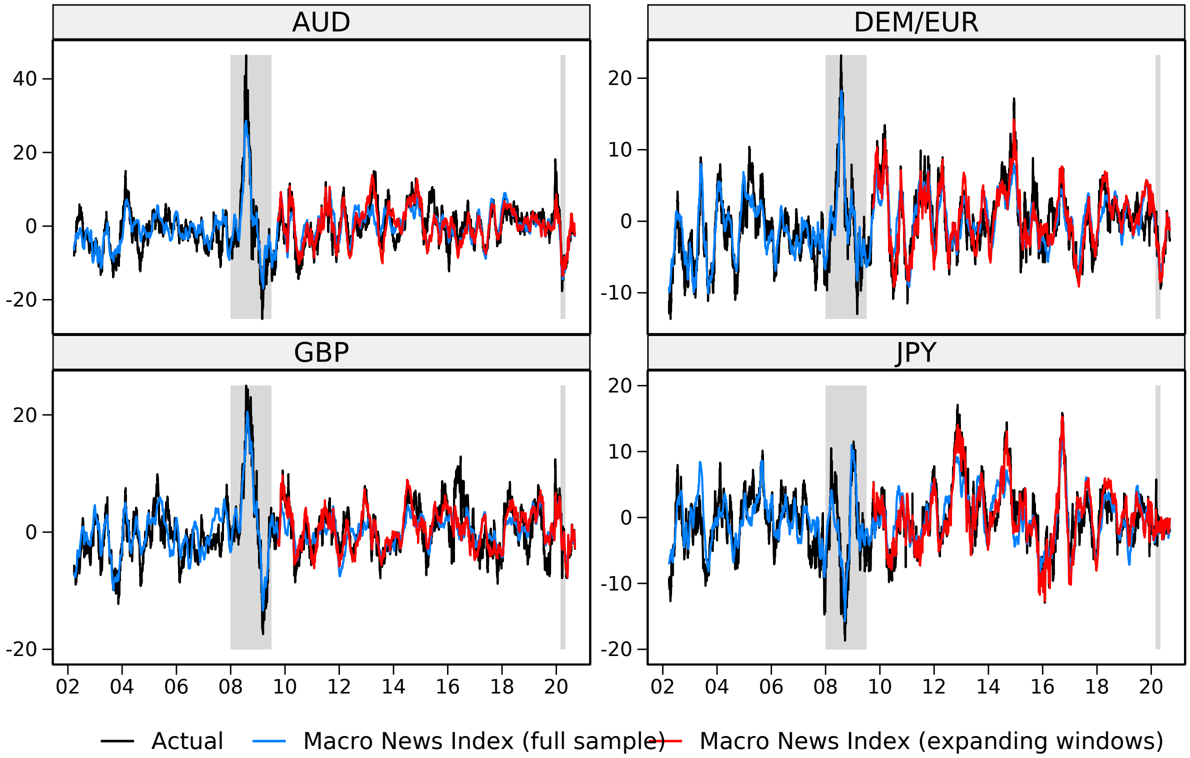
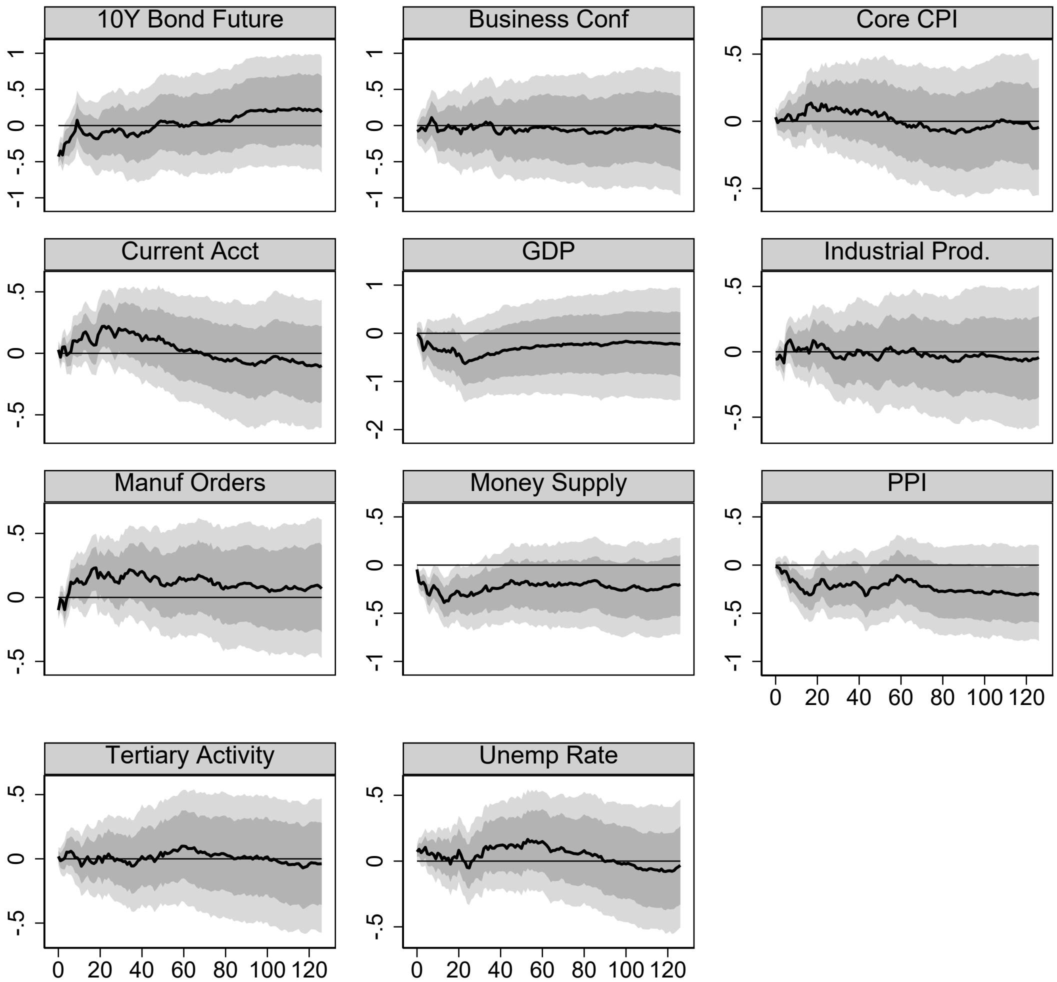
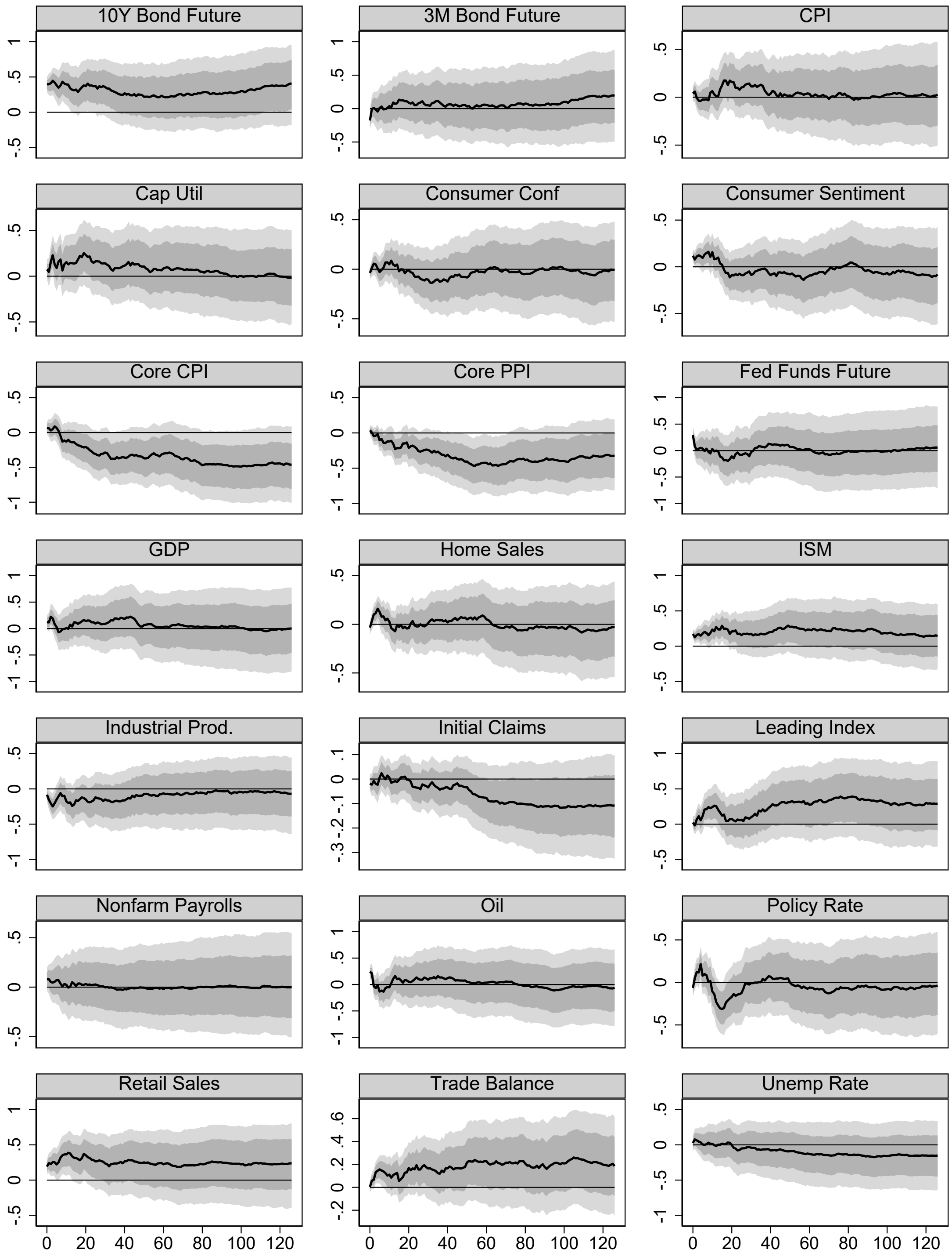


Figure 2: Bayesian Estimates of Impulse Responses of the JPY/USD Exchange Rate to Japan Macroeconomic Surprises



Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Figure 3: Bayesian Estimates of Impulse Responses of the JPY/USD Exchange Rate to US Macroeconomic Surprises



Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Table 6: R^2s from Regressions of 91-day Exchange Rate Change Subcomponents on Macroeconomic News Subindices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
# of Obs.	221	221	177	221	221	221	221	221	221	1945
					Rate Differential					
Full	0.01	0.02	0.06	0.00	0.02	0.01	0.01	0.03	0.00	0.01
Contemp	0.00	0.02	0.06**	0.00	0.01	0.00	0.01	0.02	0.00	0.00
Lags	0.01	0.00	0.03	0.00	0.00	0.01	0.01	0.02	0.00	0.00
					Realized Excess Return					
Full	0.70	0.55	0.60	0.72	0.62	0.65	0.65	0.65	0.68	0.66
Contemp	0.07	0.06**	0.04**	0.02	0.11**	0.04**	0.00	0.06	0.01	0.03***
Lags	0.26***	0.22***	0.13***	0.22***	0.39***	0.28***	0.32***	0.22***	0.33***	0.25***
					Expected Excess Return					
Full	0.01	0.02	0.02	0.00	0.02	0.00	0.00	0.01	0.00	0.00
Contemp	0.01	0.02	0.02*	0.00	0.01	0.00	0.00	0.01	0.00	0.00*
Lags	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
					Forecast Error					
Full	0.60	0.49	0.59	0.68	0.59	0.51	0.60	0.57	0.61	0.58
Contemp	0.04	0.03*	0.06***	0.02	0.12***	0.04**	0.00	0.04	0.01	0.02***
Lags	0.26***	0.22***	0.10***	0.20***	0.35***	0.21***	0.30***	0.22***	0.30***	0.22***

Note: Each row presents R^2s from regressions of the separate components of the expression $s_{t+91} - s_t = (i_t^{3M,j} - i_t^{3M,US}) + \tilde{E}_t[s_{t+91} - s_t + i_t^{3M,US} - i_t^{3M,j}] + (s_{t+91} - \tilde{E}_t[s_{t+91}])$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+91$. The daily macroeconomic news subindices are constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. The contemporaneous news subindex contains surprises that occurred from $t+1$ through $t+91$ while the lagged news subindex contains surprises that occurred in period t or earlier. For regressions on a single subindex, stars denoting the significance of the regressor based on Newey-West standard errors are included next to the R^2 value.

Table 7: Distribution of R^2s from Regressions of 91-day Individual-Level Expected Excess Returns and Exchange Rate Forecast Errors on Contemporaneous vs Lagged Macroeconomic News Indices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
				Expected Excess Return					
Full	0.03	0.03	0.05	0.02	0.01	0.02	0.02	0.03	0.02
	[0.00, 0.19]	[0.01, 0.13]	[0.00, 0.15]	[0.00, 0.10]	[0.00, 0.27]	[0.00, 0.08]	[0.00, 0.20]	[0.00, 0.16]	[0.00, 0.09]
	⟨−0.03⟩	⟨0.01⟩	⟨−0.11⟩	⟨−0.02⟩	⟨−0.04⟩	⟨0.02⟩	⟨−0.03⟩	⟨−0.05⟩	⟨−0.02⟩
Contemp	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
	[0.00, 0.17]	[0.00, 0.07]	[0.00, 0.06]	[0.00, 0.03]	[0.00, 0.23]	[0.00, 0.07]	[0.00, 0.09]	[0.00, 0.12]	[0.00, 0.03]
	⟨0.09⟩	⟨0.18⟩	⟨−0.29⟩	⟨0.02⟩	⟨−0.12⟩	⟨−0.19⟩	⟨−0.10⟩	⟨0.09⟩	⟨0.15⟩
	29%	15%	29%	9%	18%	33%	17%	22%	6%
Lags	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	[0.00, 0.15]	[0.00, 0.10]	[0.00, 0.06]	[0.00, 0.07]	[0.00, 0.12]	[0.00, 0.04]	[0.00, 0.13]	[0.00, 0.12]	[0.00, 0.07]
	⟨−0.10⟩	⟨−0.14⟩	⟨0.04⟩	⟨−0.05⟩	⟨−0.02⟩	⟨0.01⟩	⟨−0.07⟩	⟨−0.10⟩	⟨−0.06⟩
	37%	18%	6%	15%	9%	6%	21%	28%	19%
				Forecast Error					
Full	0.48	0.34	0.41	0.51	0.41	0.36	0.44	0.44	0.45
	[0.21, 0.74]	[0.19, 0.55]	[0.24, 0.55]	[0.32, 0.73]	[0.24, 0.67]	[0.16, 0.60]	[0.30, 0.62]	[0.16, 0.74]	[0.25, 0.70]
	⟨1.02⟩	⟨1.00⟩	⟨1.13⟩	⟨1.03⟩	⟨1.03⟩	⟨0.98⟩	⟨1.02⟩	⟨1.04⟩	⟨1.02⟩
Contemp	0.07	0.03	0.04	0.04	0.08	0.04	0.02	0.04	0.02
	[0.00, 0.39]	[0.00, 0.07]	[0.00, 0.12]	[0.00, 0.28]	[0.02, 0.29]	[0.01, 0.13]	[0.00, 0.26]	[0.00, 0.31]	[0.00, 0.17]
	⟨0.91⟩	⟨0.84⟩	⟨1.36⟩	⟨0.98⟩	⟨1.10⟩	⟨1.23⟩	⟨1.06⟩	⟨0.94⟩	⟨0.88⟩
	53%	30%	58%	55%	65%	58%	31%	44%	39%
Lags	0.21	0.18	0.09	0.19	0.22	0.15	0.26	0.17	0.25
	[0.06, 0.49]	[0.03, 0.30]	[0.02, 0.28]	[0.09, 0.35]	[0.02, 0.52]	[0.03, 0.26]	[0.14, 0.46]	[0.04, 0.32]	[0.13, 0.45]
	⟨1.08⟩	⟨1.13⟩	⟨0.93⟩	⟨1.06⟩	⟨1.01⟩	⟨0.98⟩	⟨1.07⟩	⟨1.07⟩	⟨1.04⟩
	95%	85%	87%	97%	88%	88%	97%	94%	100%

Note: Each set of rows first presents the median, across individual forecasters, of R^2s from regressions of either $\tilde{D}_{i,t}$ or $s_{t+91} - \tilde{E}_t^i[s_{t+91}]$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+91$. The daily macroeconomic news index is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. The contemporaneous news subindex contains surprises that occurred from $t+1$ through $t+91$ while the lagged news subindex contains surprises that occurred in period t or earlier. 5th and 95th percentiles are presented in brackets below the medians. The contribution to the R^2 of total exchange rate change regressed on each set of these subindices (see text for definition) is presented in angle brackets. Lastly, for univariate regressions, we also report the percent of individual-level regressions that have regressors significant at the 10 percent level based on Newey-West standard errors below these percentiles.

$^{*}\, p < 0.10$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$

Table 8: Adjusted R^2s from Regressions of 91-day Exchange Rate Change and Subcomponents on Past Macroeconomic News

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817
Full	0.56	0.41	0.64	0.64	0.61	0.65	0.62	0.55	0.59
Inflation	0.02***	0.02***	0.06***	0.00***	0.01***	0.04***	0.01***	0.00***	0.07***
Activity	0.14***	0.00***	0.02***	0.15***	0.03***	0.12***	0.04***	0.03***	0.01***
External	0.01***	0.00***	0.03***	0.03***	0.04***	0.03***		0.04***	0.01***
Monetary	0.06***	0.05***	0.08***	0.06***	0.13***	0.04***	0.09***	0.01***	0.10***
US	0.46***	0.37***	0.49***	0.46***	0.50***	0.42***	0.50***	0.46***	0.48***
Local	0.23***	0.09***	0.18***	0.26***	0.24***	0.25***	0.13***	0.09***	0.19***

Note: Each row presents adjusted R^2s from constrained regressions of $s_{t+91} - s_t$ on past macroeconomic surprises announced at time t through $t-126$. The constraints are such that the regression is equivalent to an unconstrained regression on surprises at times $\{t, t-1, t-2, t-3\}$ and sums of past surprises over each of the previous six months, with months being approximated as 21 trading days. The regressions use either the full set of surprises or subsets of surprises defined by different economic concepts or US versus local news. For regressions on subsets of news, stars denoting the joint significance of the surprises are included next to the adjusted R^2 value. Newey-West standard errors are used to determine joint significance.

$^{*}\, p < 0.10$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$

Table 9: Adjusted R^2s from Regressions of 91-day Rate, Differentials, Realized Excess Returns, and Individual-Level Expected Excess Returns and Exchange Rate Forecast Errors on Past Macroeconomic News

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
				Rate Differential					
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817
Adjusted R^2	0.73	0.67	0.78	0.80	0.76	0.80	0.68	0.67	0.65
				Realized Excess Return					
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817
Adjusted R^2	0.55	0.41	0.63	0.64	0.61	0.65	0.62	0.54	0.58
				Expected Excess Return					
# of Obs.	4713	4277	3137	4424	4419	4481	3752	4250	3955
Adjusted R^2	0.32	0.25	0.24	0.28	0.25	0.29	0.21	0.27	0.30
				Forecast Error					
# of Obs.	4713	4277	3137	4424	4419	4481	3752	4250	3955
Adjusted R^2	0.75	0.61	0.65	0.71	0.70	0.69	0.62	0.66	0.70

Note: Adjusted R^2s from time series constrained regressions of $i_t^{3M,j}$ and $s_{t+91} - s_t + i_t^{3M,US} - i_t^{3M,j}$ as well as fixed effect panel constrained regressions of individual forecaster level $\tilde{E}_t^i[s_{t+91} - s_t + i_t^{3M,US} - i_t^{3M,j}]$ and $s_{t+91} - \tilde{E}_t^i[s_{t+91}]$ on macroeconomic surprises announced at time t through $t-126$. The constraints are such that the regression is equivalent to an unconstrained regression on surprises at times $\{t, t-1, t-2, t-3\}$ and sums of past surprises over each of the previous six months, with months being approximated as 21 trading days. The time series regressions use daily observations while the panel regressions use individual-level observations on days when forecasts are collected, which occurs once a month.

Online Appendix

A Derivations

A.1 Decomposing the Macroeconomic News Index

$\mathbf{\Pi}_{t_d-j}$ is a column vector of period t surprises $\left[Surp^1_{t_d-j}, ..., Surp^K_{t_d-j}\right]$ while β_j is a column vector of the associated coefficients in the first-stage regression $[\beta^1_j, ...\beta^K_j]$ so that

$$\Delta s_{t_d} = \alpha_1 + \sum_{j=0}^{J} \beta'_j \mathbf{\Pi}_{t_d-j} + error_{1,t_d}$$

Assuming the lags in the first-stage regression are more than the horizons over which we sum, $J > h$, the second-stage regression can be re-written as:

$$\begin{aligned}
s_{t+h} - s_t &= \sum_{k=1}^{h} (s_{t+k} - s_{t+k-1}) = h\alpha_1 + \sum_{k=1}^{h} (\beta'_0 \mathbf{\Pi}_{t+k} + \beta'_1 \mathbf{\Pi}_{t+k-1} + ... + \beta'_J \mathbf{\Pi}_{t+k-J}) + \sum_{k=1}^{h} error_{1,t_d+k} \\
&= h\alpha_1 + \beta'_0 \mathbf{\Pi}_{t+h} + (\beta'_0 + \beta'_1)\, \mathbf{\Pi}_{t-1+h} + ... + \left(\beta'_0 + ... + \beta'_{J-1} + \beta'_J\right) \mathbf{\Pi}_{t-J+h} \\
&\quad + \beta'_J \mathbf{\Pi}_{t+1-J} + \left(\beta'_J + \beta'_{J-1}\right) \mathbf{\Pi}_{t+2-J} + ... + \left(\beta'_0 + ... + \beta'_{J-1} + \beta'_J\right) \mathbf{\Pi}_{t-(J+1)+h} + \sum_{k=1}^{h} error_{1,t_d+k} \\
&= h\alpha_1 + \left(\left(\sum_{i=1}^{i=h} \beta'_i \right) \mathbf{\Pi}_t + \left(\sum_{i=2}^{i=h+1} \beta'_i \right) \mathbf{\Pi}_{t-1} + ... + \left(\sum_{i=J-h+1}^{i=J} \beta'_i \right) \mathbf{\Pi}_{t+h-J} \right) \\
&\quad + \left(\left(\sum_{i=J-h+2}^{i=J} \beta'_i \right) \mathbf{\Pi}_{t+h-J-1} + \left(\sum_{i=J-h+3}^{i=J} \beta'_i \right) \mathbf{\Pi}_{t+h-J-2} + ... \beta'_J \mathbf{\Pi}_{t+1-J} \right) \\
&\quad + \left(\sum_{i=0}^{i=h-1} \beta'_i \right) \mathbf{\Pi}_{t+1} + \left(\sum_{i=0}^{i=h-2} \beta'_i \right) \mathbf{\Pi}_{t+2} + \left(\sum_{i=0}^{i=h-3} \beta'_i \right) \mathbf{\Pi}_{t+3} + ... \beta'_0 \mathbf{\Pi}_{t+h} + \sum_{k=1}^{h} error_{1,t_d+k} \\
&= h\alpha_1 + \underbrace{\sum_{j=1}^{j=h} \left(\sum_{i=0}^{i=h-j} \beta'_i \right) \mathbf{\Pi}_{t+j}}_{\text{Contemp Surprise Macroeconomic News Index, } \Lambda^{c,news}_{t+1,t+h}} \\
&\quad + \underbrace{\sum_{j=0}^{j=J-h} \left(\sum_{i=j+1}^{i=h+j} \beta'_i \right) \mathbf{\Pi}_{t-j} + \sum_{j=J-h+1}^{j=J-1} \left(\sum_{i=j+1}^{i=J} \beta'_i \right) \mathbf{\Pi}_{t-j}}_{\text{Lagged Surprise Macroeconomic News Index, } \Lambda^{l,news}_{t-J,t}} + \sum_{k=1}^{h} error_{1,t_d+k}
\end{aligned}$$

A.2 Decomposing the Objective Surprise under UIP

First, we iterate the UIP equation, based on h-period short-term interest rates, forward and take changes between t and $t+h$:

$$s_t = E_t s_{t+hK} + \sum_{k=1}^{K-1} E_t \left(i_{t+hk}^{h,US} - i_{t+hk}^{h,j} \right) + \left(i_t^{h,US} - i_t^{h,j} \right),$$

$$s_{t+h} = \sum_{k=1}^{K-1} E_{t+h} \left(i_{t+hk}^{h,US} - i_{t+hk}^{h,j} \right) + E_{t+h} s_{t+hK},$$

$$s_{t+h} - s_t = \underbrace{\sum_{k=1}^{K-1} \left(E_{t+h} - E_t \right) \left(i_{t+hk}^{h,US} - i_{t+hk}^{h,j} \right) + E_{t+h} s_{t+hK} - E_t s_{t+hK}}_{\text{objective surprise}} - \left(i_t^{h,US} - i_t^{h,j} \right)$$

Define the real exchange rate as $RER_t = \frac{S_t P_t^{US}}{P_t^j}$, where P_t^j is the price index in country j and P_t^{US} is the price index in the US. Therefore, again denoting logs of variables with lower case,

$$s_{t+hK} = rer_{t+hK} - \left(p_{t+hK}^{US} - p_{t+hK}^{j} \right).$$

The future log price level can be expressed in terms of inflation rates and the current log price level:

$$p_{t+hK}^{US} = \left(\pi_{t+hK}^{US} + \pi_{t+h(K-1)}^{US} + ... + \pi_{t+h}^{US} \right) + p_t^{US},$$

and similarly for p_{t+hK}^j. As a result, we can re-write $\lim_{K\to\infty} \left(E_{t+h} - E_t \right) s_{t+hK}$ as:

$$\begin{aligned} \lim_{K\to\infty} \left(E_{t+h} - E_t \right) s_{t+hK} &= \lim_{K\to\infty} \left(E_{t+h} - E_t \right) rer_{t+hK} - \left(\left(E_{t+h} - E_t \right) p_{t+hK}^{US} - \left(E_{t+h} - E_t \right) p_{t+hK}^{j} \right) \\ &= \lim_{K\to\infty} \left(E_{t+h} - E_t \right) rer_{t+hK} - \lim_{K\to\infty} \left(E_{t+h} - E_t \right) \sum_{k=1}^{K} \left(\pi_{t+hk}^{US} - \pi_{t+hk}^{j} \right). \end{aligned}$$

Thus, if expectation revisions on nominal rates and inflation converge and the real exchange rate reverts to a deterministic trend in the long run such that $\lim_{K\to\infty} \left(E_{t+h} - E_t \right) rer_{t+hK} = 0$, one can derive the following decomposition of the exchange rate change under UIP:

$$s_{t+h} - s_t = \underbrace{- \left(E_{t+h} - E_t \right) \sum_{k=1}^{\infty} \left(\pi_{t+hk}^{US} - \pi_{t+hk}^{j} \right) + \left(E_{t+h} - E_t \right) \sum_{k=1}^{\infty} \left(i_{t+hk}^{h,US} - i_{t+hk}^{h,j} \right)}_{\text{objective surprise}} - \left(i_t^{h,US} - i_t^{h,j} \right).$$

B Additional Tables and Figures

Table A1: Percentiles of Actual Adjusted R^2s from Regressions of 30- and 91-day Exchange Rate Changes on a Macroeconomic News Index Within a Distribution of Adjusted R^2s Estimated Using Random Surprises

Horizon	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
30	1.00	0.83	0.94	1.00	0.92	0.97	1.00	1.00	1.00
90	0.96	0.69	0.94	1.00	0.85	0.92	1.00	0.97	0.99

Note: Each row presents the percentiles of our actual adjusted R^2 estimates from Table 2 within a distribution of adjusted R^2s obtained from repeating the same two-step estimation using a set of surprises drawn randomly from the actual surprises. The surprises are drawn as entire vectors of surprises in each time period in blocks of 24 months to preserve cross-sectional and cross-time correlations.

Table A2: R^2s from Regressions of 30-day Exchange Rate Changes on Macroeconomic News Subindices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
# of Obs.	4860	4860	3962	4860	4860	4860	4860	4860	4860	42842
Full	0.54	0.40	0.48	0.59	0.47	0.52	0.51	0.50	0.50	0.50
Contemp	0.06***	0.05***	0.01**	0.02**	0.06***	0.02**	0.01	0.05***	0.02*	0.03**
Lags	0.31***	0.26***	0.34***	0.38***	0.36***	0.38***	0.34***	0.29***	0.36***	0.33***
Full	0.54	0.41	0.49	0.59	0.46	0.52	0.51	0.50	0.50	0.50
Inflation	0.04***	0.01	0.12***	0.04***	0.07***	0.08***	0.13***	0.03***	0.12***	0.07***
Activity	0.09***	0.08***	0.09***	0.09***	0.10***	0.12***	0.09***	0.08***	0.15***	0.10***
External	0.02***	0.02***	0.01**	0.01*	0.00	0.03***	0.01	0.03***	0.02**	0.01***
Monetary	0.15***	0.06***	0.05***	0.11***	0.16***	0.05***	0.09***	0.13***	0.08***	0.10***
Full	0.54	0.40	0.48	0.59	0.47	0.52	0.51	0.50	0.50	0.50
US	0.27***	0.17***	0.14***	0.16***	0.22***	0.23***	0.28***	0.33***	0.29***	0.24***
Local	0.05***	0.01	0.06***	0.09***	0.09***	0.08***	0.05***	0.04***	0.08***	0.05***

Note: Each row presents R^2s from regressions of $s_{t+30} - s_t$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news, different economic concepts, or US versus local news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+30$. The daily macroeconomic news subindices are constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. A subset of macroeconomic surprises or lags is included in the construction of each fitted value for subindices. For regressions on a single subindex, stars denoting the significance of the regressor based on Newey-West standard errors are included next to the R^2 value.

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Table A3: Adjusted R^2s from Regressions of 30-day Exchange Rate Changes on a Macroeconomic News Index in Recessions and High Financial Volatility Periods

Horizon		AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
$h = 30$	US Recession	0.78	0.65	0.76	0.77	0.78	0.66	0.62	0.78	0.72	0.73
	Non-Recession	0.44	0.32	0.41	0.53	0.36	0.49	0.47	0.41	0.43	0.43
	High VIX	0.62	0.51	0.56	0.66	0.59	0.53	0.57	0.56	0.60	0.58
	Low VIX	0.35	0.23	0.34	0.43	0.29	0.49	0.41	0.38	0.33	0.37

Note: Each row presents the adjusted R^2s from a regression of 30-day exchange rate changes on the daily macroeconomic news index correspondingly summed from $t+1$ through $t+30$ for over a specified subsample of dates. The daily macroeconomic news index is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. We use NBER recession dates, and the VIX is split by the median value over the full regression sample.

Table A4: Regressions of 30-day Exchange Rate Changes on a Macroeconomic News Index Estimated in Real Time

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
Exch Rate News Index	0.86***	0.79***	0.87***	0.93***	0.93***	0.89***	0.94***	0.94***	0.92***	0.90***
	(0.06)	(0.07)	(0.05)	(0.05)	(0.06)	(0.04)	(0.07)	(0.05)	(0.06)	(0.03)
Constant	0.04	0.00	-0.04	0.01	-0.01	0.08	-0.01	-0.37***	-0.05	-0.04
	(0.14)	(0.12)	(0.12)	(0.09)	(0.11)	(0.09)	(0.14)	(0.13)	(0.13)	(0.07)
# of Obs.	2899	2899	2001	2899	2899	2899	2899	2899	2899	25193
Adjusted R^2	0.57	0.39	0.61	0.67	0.54	0.70	0.55	0.57	0.55	0.57
Adjusted R^2 of baseline estimate over same sample	0.42	0.25	0.38	0.49	0.34	0.49	0.44	0.35	0.40	0.40

Note: Regressions of $s_{t+30} - s_t$ on the recursively-estimated daily macroeconomic news index correspondingly summed from $t+1$ through $t+30$. The daily macroeconomic news index at time t is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises that are estimated using data between time 0 and time t. Newey-West standard errors are in parentheses. For comparison of fit, the last row presents the adjusted R^2 from regressions of $s_{t+30} - s_t$ on the daily macroeconomic news index estimated over the full sample, also correspondingly summed from $t+1$ through $t+30$.
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Figure A1: Actual 30-Day Exchange Rate Changes and Macroeconomic News Indices

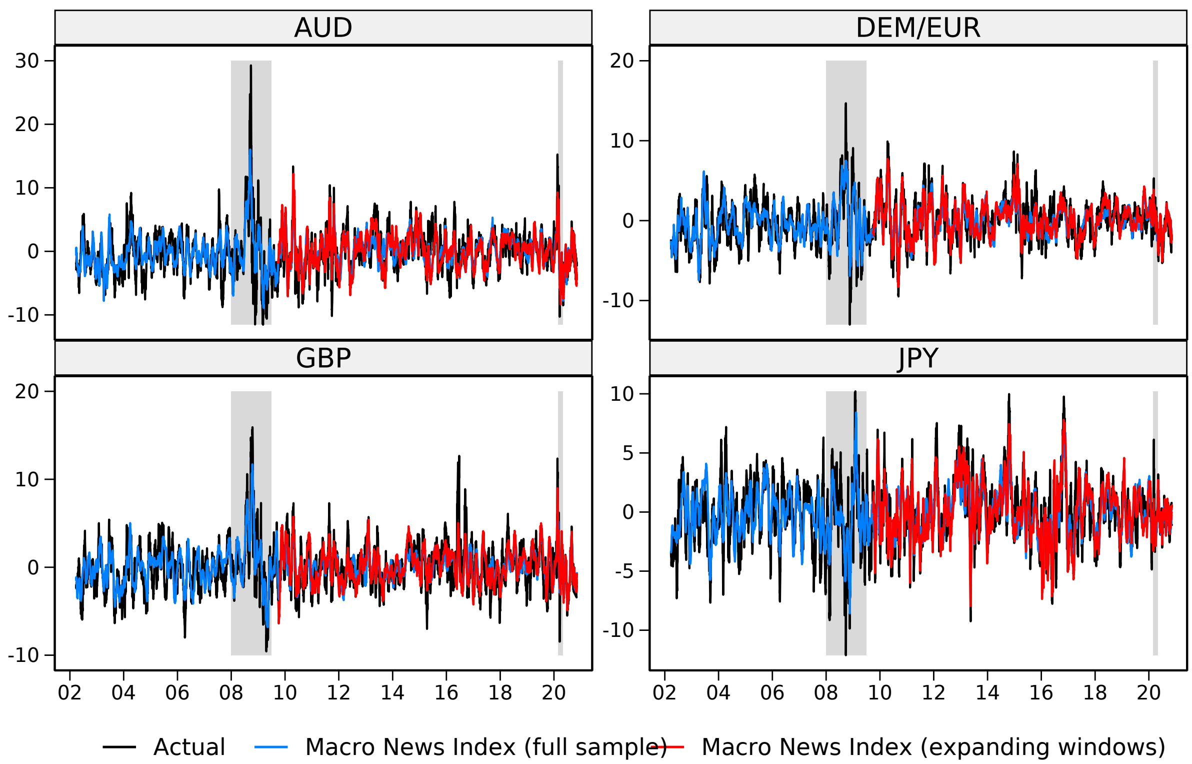


Table A5: R^2s from Regressions of 30-day Exchange Rate Change Subcomponents on Macroeconomic News Subindices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
# of Obs.	224	224	182	224	224	224		209	224	1735
				Rate Differential						
Full	0.01	0.01	0.03	0.00	0.00	0.01		0.00	0.01	0.00
Contemp	0.01	0.00	0.03**	0.00	0.00	0.00		0.00	0.01	0.00*
Lags	0.00	0.01	0.00	0.00	0.00	0.01		0.00	0.00	0.00
				Realized Excess Return						
Full	0.59	0.45	0.50	0.60	0.53	0.52		0.51	0.54	0.53
Contemp	0.10**	0.07***	0.02**	0.01	0.05	0.02**		0.09***	0.03**	0.04***
Lags	0.41***	0.28***	0.34***	0.44***	0.44***	0.38***		0.30***	0.43***	0.37***
				Expected Excess Return						
Full	0.03	0.04	0.02	0.05	0.01	0.01		0.03	0.02	0.02
Contemp	0.00	0.00	0.00	0.01	0.00	0.00		0.00	0.00	0.00
Lags	0.02*	0.04*	0.01	0.05***	0.01	0.01		0.03**	0.02*	0.02***
				Forecast Error						
Full	0.49	0.39	0.46	0.61	0.48	0.46		0.46	0.47	0.48
Contemp	0.08**	0.04***	0.02**	0.00	0.03	0.02*		0.06**	0.01	0.03***
Lags	0.34***	0.28***	0.31***	0.48***	0.42***	0.34***		0.31***	0.39***	0.34***

Note: Each row presents R^2s from regressions of the separate components of the expression $s_{t+30} - s_t = (i_t^{1M,j} - i_t^{1M,US}) + \tilde{E}_t[s_{t+30} - s_t + i_t^{1M,US} - i_t^{1M,j}] + (s_{t+30} - \tilde{E}_t[s_{t+30}])$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+30$. The daily macroeconomic news subindices are constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. The contemporaneous news subindex contains surprises that occurred from $t+1$ through $t+30$ while the lagged news subindex contains surprises that occurred in period t or earlier. For regressions on a single subindex, stars denoting the significance of the regressor based on Newey-West standard errors are included next to the R^2 value.

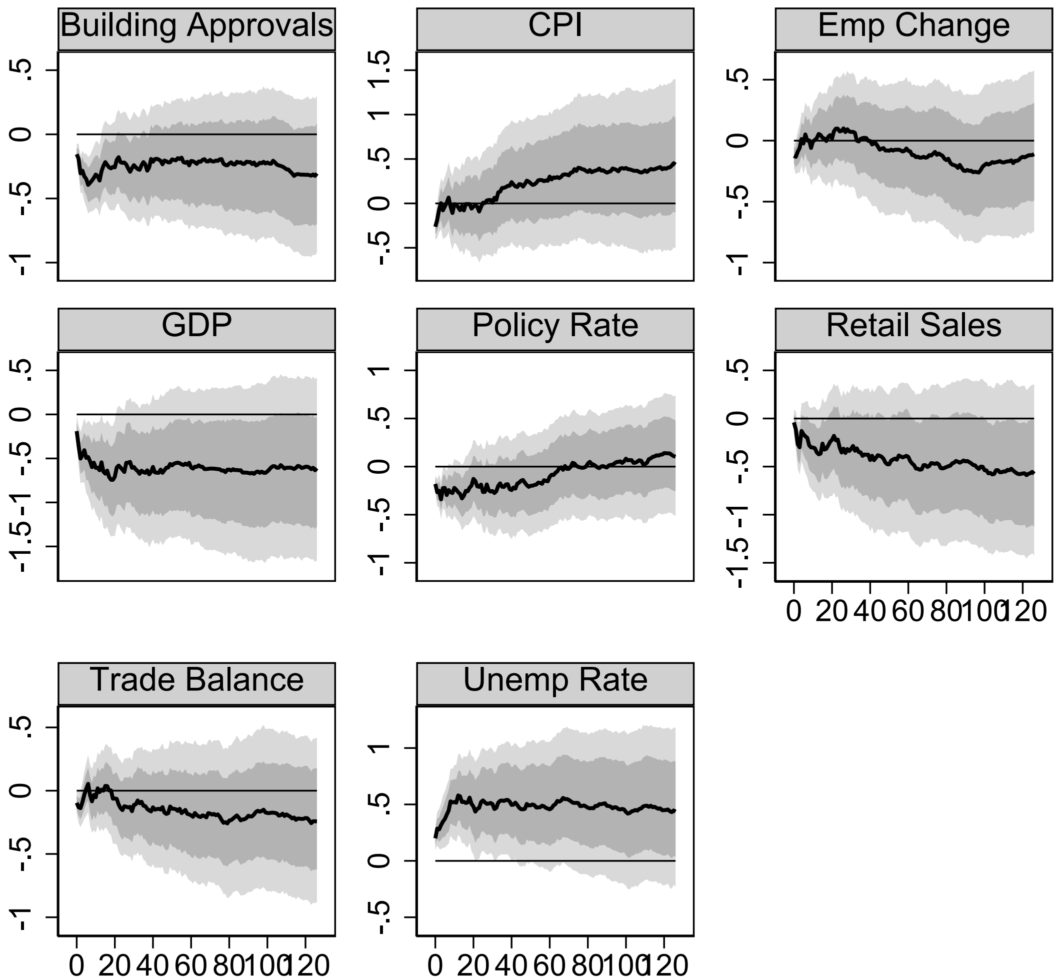
Table A6: Distribution of R^2s from Regressions of 30-day Individual-Level Expected Excess Returns and Exchange Rate Forecast Errors on Contemporaneous vs Lagged Macroeconomic News Indices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
				Expected Excess Return					
Full	0.03	0.03	0.04	0.03	0.02	0.01		0.03	0.02
	[0.00, 0.13]	[0.00, 0.12]	[0.00, 0.08]	[0.00, 0.09]	[0.00, 0.13]	[0.00, 0.08]		[0.00, 0.18]	[0.00, 0.06]
	⟨−0.19⟩	⟨−0.17⟩	⟨−0.12⟩	⟨−0.13⟩	⟨−0.05⟩	⟨−0.09⟩		⟨−0.12⟩	⟨−0.08⟩
Contemp	0.01	0.00	0.01	0.01	0.00	0.00		0.01	0.00
	[0.00, 0.07]	[0.00, 0.04]	[0.00, 0.04]	[0.00, 0.04]	[0.00, 0.09]	[0.00, 0.04]		[0.00, 0.07]	[0.00, 0.03]
	⟨−0.17⟩	⟨0.07⟩	⟨−0.06⟩	⟨0.38⟩	⟨0.18⟩	⟨−0.08⟩		⟨0.04⟩	⟨0.18⟩
	11%	6%	24%	12%	27%	3%		11%	10%
Lags	0.01	0.02	0.00	0.02	0.00	0.01		0.01	0.01
	[0.00, 0.08]	[0.00, 0.09]	[0.00, 0.05]	[0.00, 0.08]	[0.00, 0.07]	[0.00, 0.05]		[0.00, 0.11]	[0.00, 0.06]
	⟨−0.18⟩	⟨−0.26⟩	⟨−0.06⟩	⟨−0.19⟩	⟨−0.06⟩	⟨−0.11⟩		⟨−0.21⟩	⟨−0.11⟩
	28%	28%	7%	44%	15%	19%		34%	17%
				Forecast Error					
Full	0.36	0.28	0.29	0.41	0.28	0.35		0.32	0.28
	[0.20, 0.61]	[0.15, 0.45]	[0.21, 0.44]	[0.26, 0.61]	[0.12, 0.58]	[0.17, 0.49]		[0.14, 0.55]	[0.17, 0.51]
	⟨1.19⟩	⟨1.17⟩	⟨1.12⟩	⟨1.13⟩	⟨1.05⟩	⟨1.09⟩		⟨1.12⟩	⟨1.08⟩
Contemp	0.06	0.02	0.02	0.00	0.03	0.01		0.03	0.01
	[0.00, 0.15]	[0.00, 0.07]	[0.00, 0.06]	[0.00, 0.11]	[0.00, 0.12]	[0.00, 0.11]		[0.00, 0.14]	[0.00, 0.05]
	⟨1.16⟩	⟨0.94⟩	⟨1.15⟩	⟨0.62⟩	⟨0.81⟩	⟨1.09⟩		⟨0.96⟩	⟨0.81⟩
	72%	62%	45%	9%	42%	31%		46%	24%
Lags	0.24	0.21	0.20	0.33	0.24	0.23		0.20	0.23
	[0.10, 0.51]	[0.06, 0.33]	[0.11, 0.30]	[0.21, 0.46]	[0.12, 0.51]	[0.08, 0.39]		[0.06, 0.37]	[0.13, 0.48]
	⟨1.18⟩	⟨1.26⟩	⟨1.05⟩	⟨1.19⟩	⟨1.05⟩	⟨1.10⟩		⟨1.20⟩	⟨1.11⟩
	100%	97%	97%	100%	97%	97%		97%	100%

Note: Each set of rows first presents the median, across individual forecasters, of R^2s from regressions of $s_{t+30} - \tilde{E}^i_t[s_{t+30}]$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+30$. The daily macroeconomic news index is constructed as fitted values from constrained daily OLS regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. The contemporaneous news subindex contains surprises that occurred from $t+1$ through $t+30$ while the lagged news subindex contains surprises that occurred in period t or earlier. 5th and 95th percentiles are presented in brackets below the medians. The contribution to the R^2 of total exchange rate change regressed on each set of these subindices (see text for definition) is presented in angle brackets. Lastly, for univariate regressions, we also report the percent of individual-level regressions that have regressors significant at the 10 percent level based on Newey-West standard errors below these percentiles.

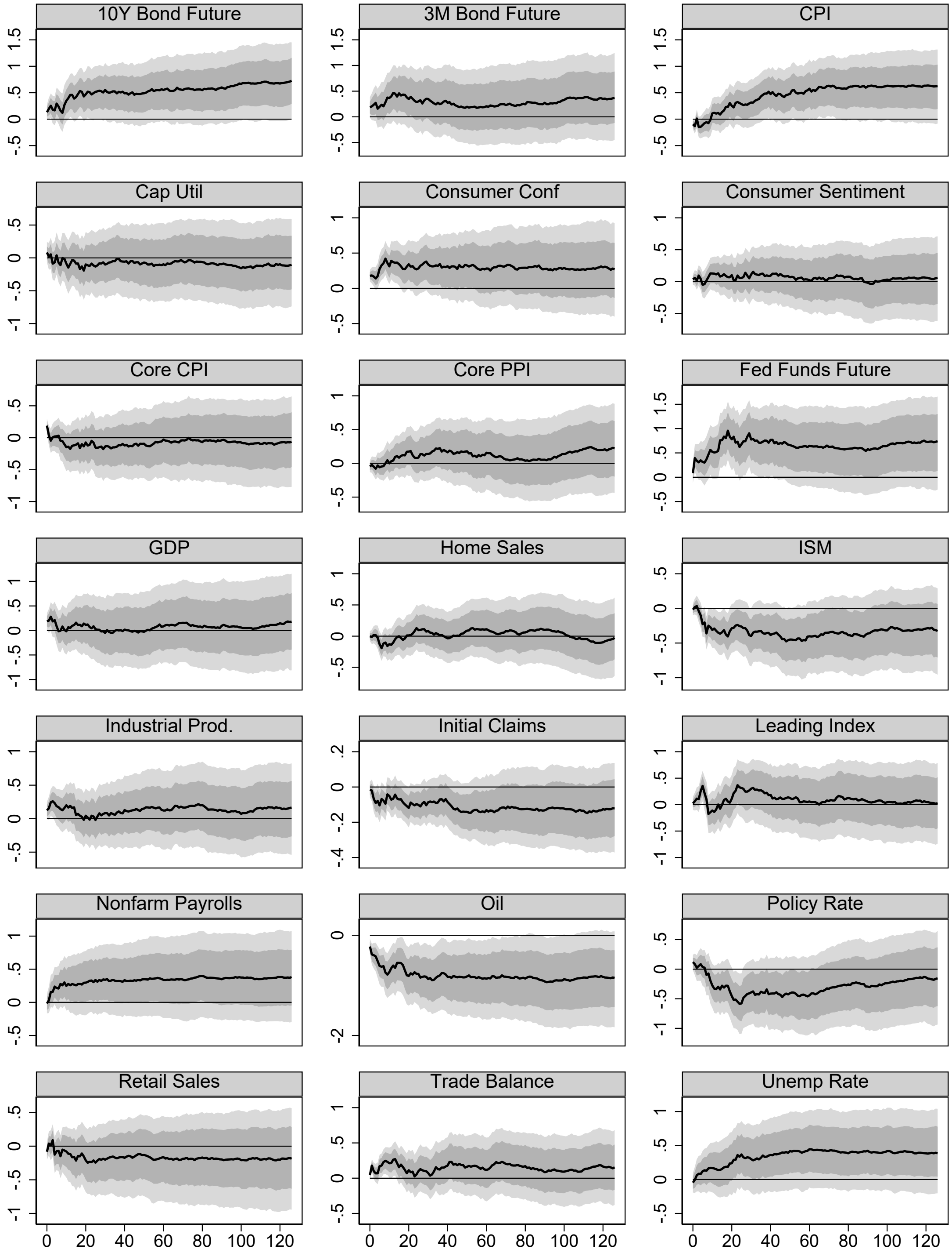
$^{*}\,p < 0.10$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$

Figure A2: Bayesian Estimates of Impulse Responses of the AUD/USD Exchange Rate to Australia Macroeconomic Surprises



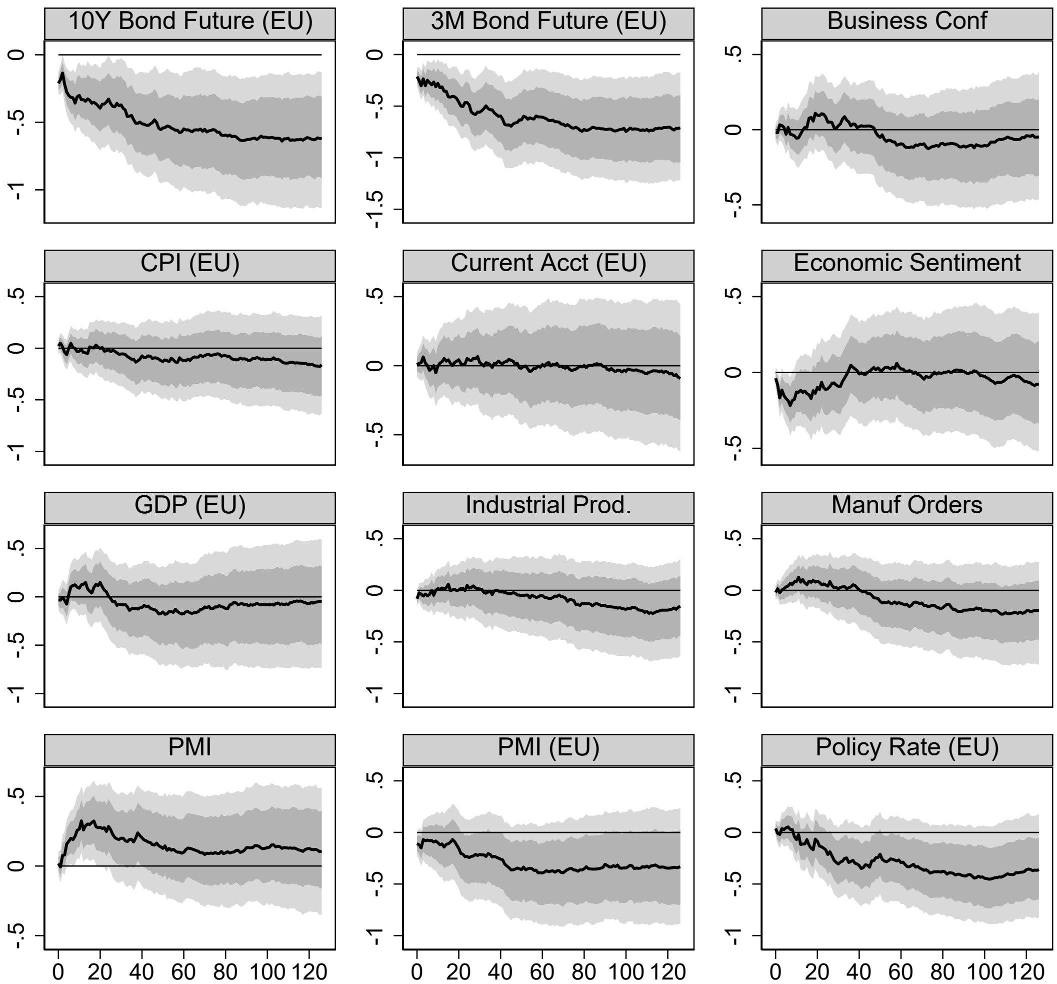
Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Figure A3: Bayesian Estimates of Impulse Responses of the AUD/USD Exchange Rate to US Macroeconomic Surprises



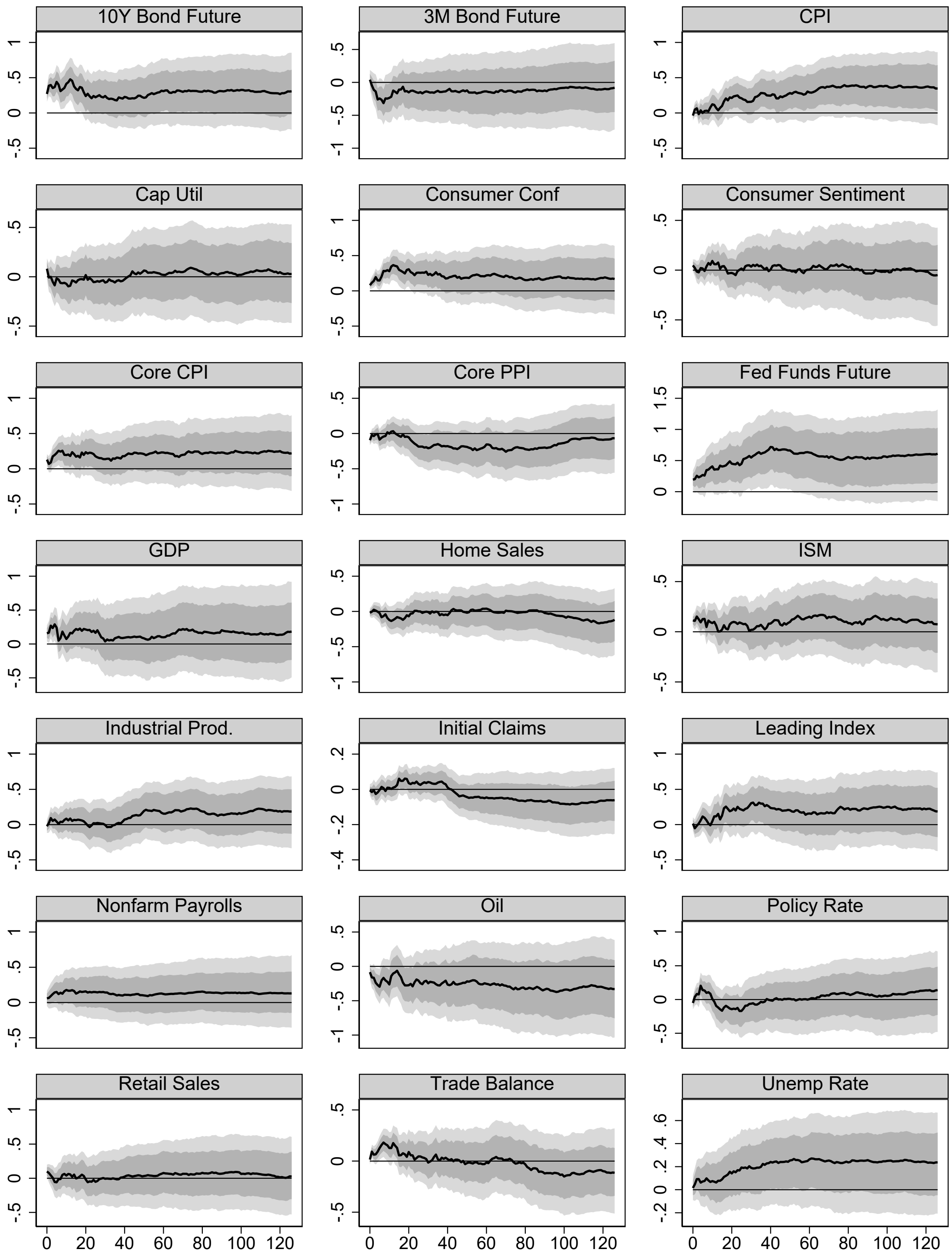
Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Figure A4: Bayesian Estimates of Impulse Responses of the EUR/USD Exchange Rate to Euro Area or German Macroeconomic Surprises



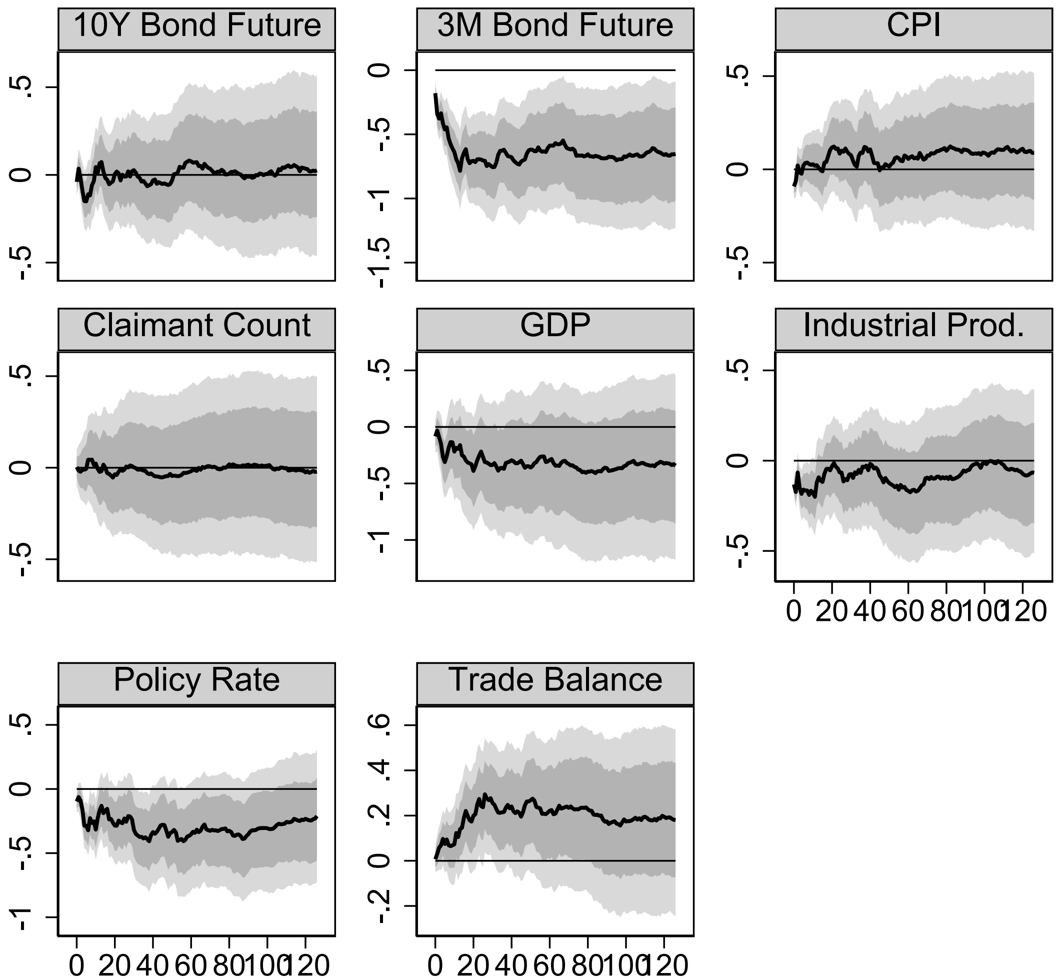
Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Figure A5: Bayesian Estimates of Impulse Responses of the EUR/USD Exchange Rate to US Macroeconomic Surprises



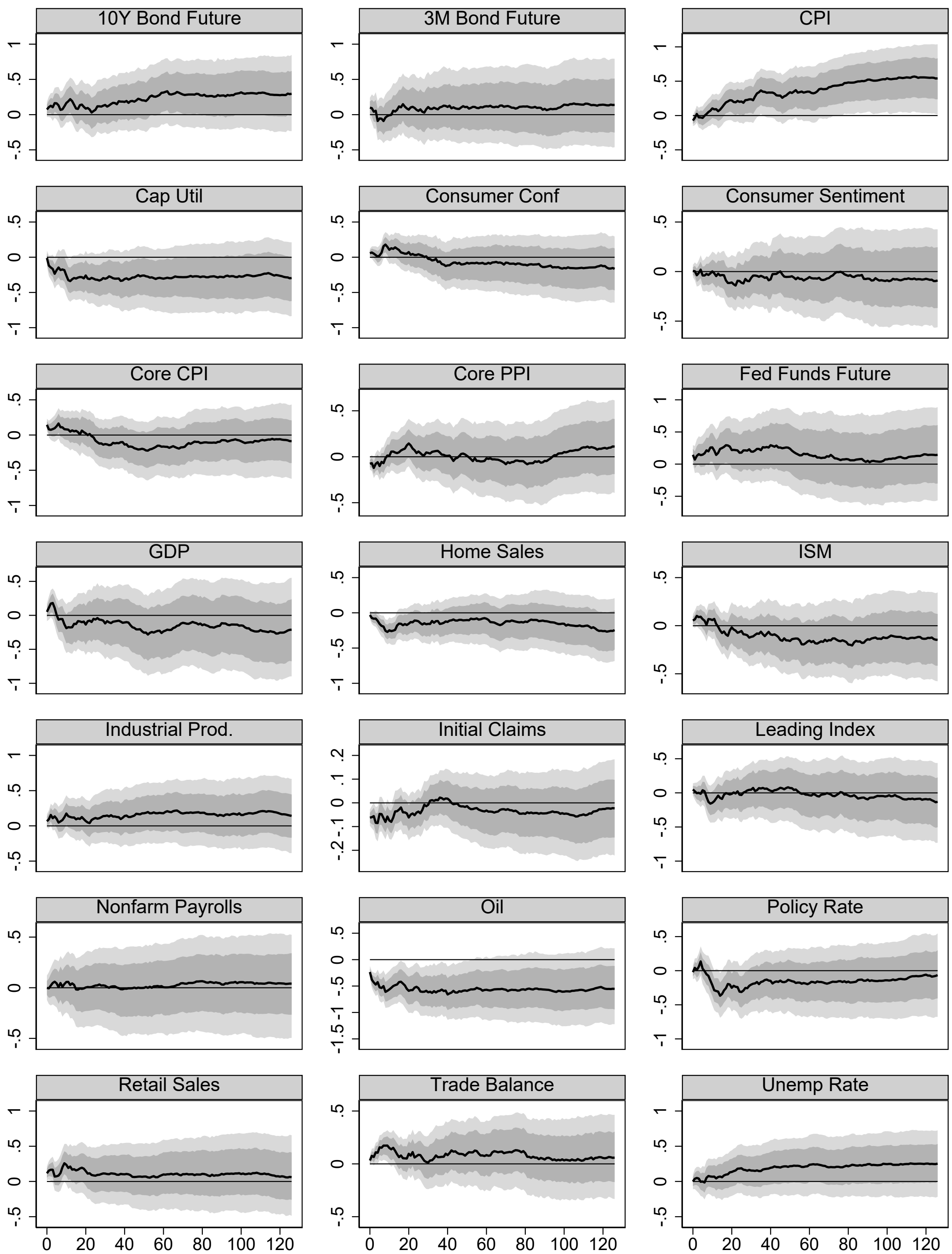
Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Figure A6: Bayesian Estimates of Impulse Responses of the GBP/USD Exchange Rate to UK Macroeconomic Surprises



Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Figure A7: Bayesian Estimates of Impulse Responses of the GBP/USD Exchange Rate to US Macroeconomic Surprises



Note: Shaded areas are 16th to 84th and 5th to 95th percentile credible intervals.

Table A7: Adjusted R^2s from Regressions of 1-day Exchange Rate Change and Subcomponents on Past Macroeconomic News

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
# of Obs.	4882	4882	4005	4882	4882	4882	4882	4882	4882
Full	0.01	0.01	0.02	0.01	0.01	0.01	0.04	0.00	0.01
Inflation	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00
Activity	-0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	-0.00	-0.00
External	-0.00	-0.00	-0.00	-0.00	-0.00	0.00		0.00	-0.00
Monetary	0.00*	0.00*	0.01*	0.01*	0.01*	0.00*	0.00*	0.00*	0.00*
US	0.01***	0.01***	0.01***	0.01***	0.00***	0.01***	0.03***	0.00***	0.01***
Local	0.00*	-0.00*	0.01*	0.00*	0.01*	0.00*	0.01*	0.00*	0.01*

Note: Each row presents adjusted R^2s from constrained regressions of $s_{t+1} - s_t$ on past macroeconomic surprises announced at time t through $t-126$. The constraints are such that the regression is equivalent to an unconstrained regression on surprises at times $\{t, t-1, t-2, t-3\}$ and sums of past surprises over each of the previous six months, with months being approximated as 21 trading days. The regressions use either the full set of surprises or subsets of surprises defined by different economic concepts or US versus local news. For regressions on subsets of news, stars denoting the joint significance of the surprises are included next to the adjusted R^2 value. Newey-West standard errors are used to determine joint significance.

$^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$

Table A8: Adjusted R^2s from Regressions of 30-day Exchange Rate Change and Subcomponents on Past Macroeconomic News

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
# of Obs.	4860	4860	3962	4860	4860	4860	4860	4860	4860
Full	0.46	0.36	0.53	0.52	0.45	0.46	0.44	0.41	0.48
Inflation	0.01***	0.02***	0.02***	0.00***	0.01***	0.03***	0.03***	0.01***	0.04***
Activity	0.10***	0.01***	0.02***	0.11***	0.04***	0.08***	0.02***	0.02***	0.03***
External	0.01***	0.01***	0.02***	0.01***	0.02***	0.02***		0.02***	0.02***
Monetary	0.03***	0.02***	0.10***	0.06***	0.07***	0.03***	0.04***	0.03***	0.09***
US	0.35***	0.30***	0.40***	0.36***	0.36***	0.33***	0.36***	0.35***	0.35***
Local	0.16***	0.08***	0.16***	0.19***	0.14***	0.16***	0.08***	0.08***	0.17***

Note: Each row presents adjusted R^2s from constrained regressions of $s_{t+30} - s_t$ on past macroeconomic surprises announced at time t through $t-126$. The constraints are such that the regression is equivalent to an unconstrained regression on surprises at times $\{t, t-1, t-2, t-3\}$ and sums of past surprises over each of the previous six months, with months being approximated as 21 trading days. The regressions use either the full set of surprises or subsets of surprises defined by different economic concepts or US versus local news. For regressions on subsets of news, stars denoting the joint significance of the surprises are included next to the adjusted R^2 value. Newey-West standard errors are used to determine joint significance.

$^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$

Table A9: Adjusted R^2s from Regressions of 30-day Rate, Differentials, Realized Excess Returns, and Individual-Level Expected Excess Returns and Exchange Rate Forecast Errors on Past Macroeconomic News

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
				Rate Differential					
# of Obs.	4860	4860	3962	4860	4860	4860		4541	4860
Adjusted R^2	0.71	0.62	0.75	0.79	0.74	0.79		0.67	0.65
				Realized Excess Return					
# of Obs.	4860	4860	3962	4860	4860	4860		4541	4860
Adjusted R^2	0.46	0.36	0.53	0.52	0.45	0.46		0.43	0.48
				Expected Excess Return					
# of Obs.	4453	4063	3016	4180	4172	4242		3791	3778
Adjusted R^2	0.36	0.29	0.26	0.29	0.28	0.31		0.30	0.30
				Forecast Error					
# of Obs.	4453	4063	3016	4180	4172	4242		3791	3778
Adjusted R^2	0.69	0.56	0.65	0.65	0.63	0.60		0.62	0.60

Note: Adjusted R^2s from time series constrained regressions of $i_t^{1M,j}$ and $s_{t+30} - s_t + i_t^{1M,US} - i_t^{1M,j}$ as well as fixed effect panel constrained regressions of individual forecaster level $\tilde{E}_t^i[s_{t+30} - s_t + i_t^{1M,US} - i_t^{1M,j}]$ and $s_{t+30} - \tilde{E}_t^i[s_{t+30}]$ on macroeconomic surprises announced at time t through $t-126$. The constraints are such that the regression is equivalent to an unconstrained regression on surprises at times $\{t, t-1, t-2, t-3\}$ and sums of past surprises over each of the previous six months, with months being approximated as 21 trading days. The time series regressions use daily observations while the panel regressions use individual-level observations on days when forecasts are collected, which occurs once a month.

C Bayesian Estimation of the First-Stage Regression

This section considers a robustness check featuring Bayesian estimates of the first-stage regression that's used to create the macroeconomic news indices. In particular, we estimate

$$\Delta s_{t_d} = \alpha + \sum_{k=1}^{K} \left(\sum_{j=0}^{126} \beta_j^k Surp_{t_d-j}^k \right) + error_{t_d}, \tag{9}$$

for each country in our sample. Unlike our baseline specification, we do not impose any constraints on the β_j^k. However, given that this results in thousands of coefficients to be estimated, we impose some structure through an informative prior based on the often-used Minnesota prior which in our case simply translates to zero coefficients on the surprises (i.e., that s_t is a random-walk independent of the macroeconomic surprises). We choose a value of 0.2 for the hyperparameter controlling overall tightness of the prior, 3 degrees of freedom for the error variance, and a prior standard deviation of .001; all of these parameters are values standard in the Bayesian VAR literature. However, we use a hyperparameter of 1 for controlling the exponential tightening of the prior. This is looser than values used in typical macroeconomic applications with monthly or quarterly VARs since our lags are specified at a daily frequency.

Unadjusted R^2s from these first-stage regressions are presented in Table A10 below. With the vast amount of flexibility allowed in this regression, the unadjusted R^2s are as high as 51 percent.

Table A10: R^2s from Daily Bayesian Regressions of the Exchange Rate Change on Macroeconomic News Indices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK
# of Obs	4,882	4,882	4,005	4,882	4,882	4,882	4,882	4,882	4,882
R^2	0.43	0.38	0.51	0.45	0.41	0.43	0.38	0.38	0.40

Note: Each row presents R^2s from daily Bayesian regressions of exchange rate changes on macroeconomic news surprises. The regressors include current and up to a 126-trading-day lag of macroeconomic surprises.

At longer horizons, using these news indices generally still produces a higher fraction of explained exchange rate change variation. For example, Tables A11 and A12 show that the adjusted R^2 in the

91-day horizon regression is up to 14 percentage points higher than the unadjusted R^2 in the first-stage daily regression.

Table A11: Adjusted R^2s from Regressions of 30-day Exchange Rate Changes on a Macroeconomic News Index

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
Exch Rate News Index	1.59***	1.67***	1.59***	1.64***	1.49***	1.73***	1.63***	1.67***	1.73***	1.63***
	(0.11)	(0.13)	(0.10)	(0.07)	(0.07)	(0.09)	(0.12)	(0.08)	(0.09)	(0.07)
Constant	0.07	0.06	0.24*	0.07	-0.02	0.08	-0.01	0.12	0.05	0.07
	(0.14)	(0.10)	(0.13)	(0.10)	(0.11)	(0.11)	(0.14)	(0.14)	(0.12)	(0.09)
# of Obs.	4860	4860	3962	4860	4860	4860	4860	4860	4860	42842
Adjusted R^2	0.54	0.44	0.47	0.59	0.49	0.49	0.46	0.51	0.52	0.50

Note: Each row presents adjusted R^2s from regressions of $s_{t+30} - s_t$ on the daily macroeconomic news index correspondingly summed from $t+1$ through $t+30$. The macroeconomic news index is constructed as fitted values from daily Bayesian regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises.

Table A12: Adjusted R^2s from Regressions of 91-day Exchange Rate Changes on a Macroeconomic News Index

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
Exch Rate News Index	1.57***	1.67***	1.65***	1.70***	1.45***	1.81***	1.72***	1.69***	1.85***	1.67***
	(0.23)	(0.24)	(0.23)	(0.11)	(0.14)	(0.20)	(0.23)	(0.19)	(0.20)	(0.15)
Constant	0.21	0.19	0.92**	0.29	-0.03	0.28	0.03	0.43	0.21	0.26
	(0.48)	(0.36)	(0.44)	(0.30)	(0.35)	(0.37)	(0.44)	(0.49)	(0.38)	(0.31)
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817	42411
Adjusted R^2	0.51	0.36	0.36	0.59	0.46	0.44	0.44	0.46	0.53	0.47

Note: Each row presents adjusted R^2s from regressions of $s_{t+91} - s_t$ on the daily macroeconomic news index correspondingly summed from $t+1$ through $t+91$. The macroeconomic news index is constructed as fitted values from daily Bayesian regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises.

Tables A13 and A14 present the R^2s of the contemporaneous and lagged news index components. In particular, our conclusions about the relative importance of the lag terms continue to hold in this case. Moreover, the same tables present the split into types of news and by region. It still appears that activity, monetary policy and inflation news play the most important role and US news tend to be more important than local news.

Lastly, we again split the second-stage quarterly regression sample into periods of US recessions versus other periods or periods when the VIX is above versus below its median. The results are consistent

Table A13: R^2s from Regressions of 30-day Exchange Rate Changes on Macroeconomic News Subindices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
# of Obs.	4860	4860	3962	4860	4860	4860	4860	4860	4860	42842
Full	0.55	0.46	0.48	0.60	0.50	0.52	0.47	0.53	0.52	0.52
Contemp	0.20***	0.13***	0.07***	0.15***	0.15***	0.05***	0.10***	0.16***	0.13***	0.13***
Lags	0.36***	0.34***	0.42***	0.42***	0.36***	0.41***	0.33***	0.35***	0.42***	0.37***
Full	0.54	0.45	0.48	0.59	0.49	0.50	0.46	0.52	0.52	0.51
Inflation	0.07***	0.05***	0.12***	0.06***	0.11***	0.13***	0.10***	0.05***	0.11***	0.09***
Activity	0.21***	0.19***	0.20***	0.27***	0.16***	0.23***	0.15***	0.22***	0.21***	0.20***
External	0.05***	0.06***	0.05***	0.06***	0.06***	0.06***	0.08***	0.05***	0.06***	0.06***
Monetary	0.20***	0.16***	0.19***	0.25***	0.20***	0.09***	0.13***	0.18***	0.20***	0.18***
Full	0.54	0.44	0.48	0.59	0.49	0.50	0.46	0.51	0.52	0.50
US	0.42***	0.39***	0.41***	0.33***	0.35***	0.33***	0.41***	0.40***	0.39***	0.38***
Local	0.11***	0.05***	0.16***	0.24***	0.20***	0.18***	0.07***	0.13***	0.18***	0.14***

Note: Each row presents R^2s from regressions of $s_{t+30} - s_t$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news, different economic concepts, or US versus local news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+30$. The daily macroeconomic news subindices are constructed as fitted values from daily Bayesian regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. A subset of macroeconomic surprises or lags is included in the construction of each fitted value for subindices. For regressions on a single subindex, stars denoting the significance of the regressor are included next to the R^2 value.

Table A14: R^2s from Regressions of 91-day Exchange Rate Changes on Macroeconomic News Subindices

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
# of Obs.	4817	4817	3875	4817	4817	4817	4817	4817	4817	42411
Full	0.53	0.38	0.39	0.59	0.48	0.47	0.45	0.49	0.53	0.48
Contemp	0.28***	0.19***	0.11***	0.26***	0.29***	0.12***	0.19***	0.21***	0.28***	0.22***
Lags	0.30***	0.20***	0.27***	0.31***	0.30***	0.31***	0.27***	0.24***	0.31***	0.28***
Full	0.53	0.36	0.41	0.59	0.48	0.44	0.46	0.47	0.53	0.47
Inflation	0.14**	0.05*	0.13***	0.05***	0.20***	0.13***	0.14***	0.11***	0.16***	0.12***
Activity	0.17***	0.13***	0.14***	0.20***	0.12***	0.22***	0.08***	0.17***	0.18***	0.15***
External	0.07***	0.07***	0.08***	0.07***	0.06***	0.08***	0.11***	0.07***	0.06***	0.07***
Monetary	0.18***	0.10***	0.08***	0.28***	0.21***	0.04***	0.13***	0.14***	0.20***	0.15***
Full	0.51	0.36	0.37	0.59	0.46	0.44	0.45	0.46	0.53	0.47
US	0.41***	0.33***	0.32***	0.21***	0.37***	0.34***	0.36***	0.34***	0.37***	0.34***
Local	0.15***	0.02**	0.10***	0.32***	0.20***	0.12***	0.10***	0.14***	0.19***	0.15***

Note: Each row presents R^2s from regressions of $s_{t+91} - s_t$ on either the full set of subindices or individual subindices defined by contemporaneous versus lagged news, different economic concepts, or US versus local news. The daily macroeconomic news subindices are correspondingly summed from $t+1$ through $t+91$. The daily macroeconomic news subindices are constructed as fitted values from daily Bayesian regressions of exchange rates on the current and up to a 126-trading-day lag of macroeconomic surprises. A subset of macroeconomic surprises or lags is included in the construction of each fitted value for subindices. For regressions on a single subindex, stars denoting the significance of the regressor are included next to the R^2 value.

with those in the main text with macroeconomic surprises being more important for explaining variation in exchange rate changes during US recessions and times of financial turmoil.

Table A15: Adjusted R^2s From Regressions of 30- and 91-day Exchange Rate Changes on Macroeconomic News Indices with the Sample Split by Recessions and High Financial Volatility Periods

Horizon		AUD	CAD	CHF	DEM/EUR	GBP	JPY	NOK	NZD	SEK	Panel
$h = 30$	US Recession	0.85	0.72	0.76	0.85	0.86	0.74	0.65	0.84	0.83	0.79
	Non-Recession	0.41	0.35	0.38	0.50	0.36	0.44	0.42	0.40	0.42	0.41
	High VIX	0.63	0.54	0.55	0.67	0.62	0.54	0.54	0.57	0.62	0.59
	Low VIX	0.31	0.26	0.30	0.40	0.28	0.43	0.32	0.37	0.31	0.33
$h = 91$	US Recession	0.88	0.72	0.51	0.90	0.94	0.79	0.66	0.82	0.87	0.81
	Non-Recession	0.31	0.25	0.34	0.50	0.19	0.36	0.36	0.32	0.37	0.33
	High VIX	0.61	0.46	0.40	0.70	0.66	0.46	0.51	0.52	0.63	0.56
	Low VIX	0.20	0.20	0.22	0.35	0.11	0.41	0.30	0.30	0.27	0.26

Note: Each row presents the adjusted R^2s from a regression of 30- or 91-day exchange rate changes on the daily macroeconomic news index correspondingly summed from $t+1$ through $t+30$ or $t+91$ for over a specified subsample of dates. The daily macroeconomic news index is constructed as fitted values from daily Bayesian regressions of exchange rates and yield curve factors on the current and up to a 126-trading-day lag of macroeconomic surprises. We use NBER recession dates, and the VIX is split by the median value over the full regression sample.

D Data Details

D.1 Macroeconomic and Financial Variables

- *Exchange rates*: Daily data from Global Financial Data.
- *Short-term rates*:
  - Australia, Canada, New Zealand, Norway, Sweden, Switzerland, United Kingdom, and United States: Central bank data obtained through Haver Analytics.
  - Germany: Reuters data obtained through Haver Analytics. German three-month bill rates are replaced with three-month EONIA OIS swap rates starting in 1999:Q1.
  - Japan: Bloomberg

- *US VIX and NBER Recession Indicators:* Federal Reserve Bank of St. Louis FRED database.

D.2 Exchange Rate Forecast Survey Data Details

Consensus Economics

- Country coverage: Australia, Canada, Germany/euro area, Japan, Norway, New Zealand, Sweden, Switzerland, United Kingdom, United States
- Date range: 1997 through 2020
- Horizons: 1- and 3-months-ahead.
- Other details: Forecasts for the DEM are replaced with EUR forecasts as they become available. Some forecasts are published only with the DEM/EUR as the base currency and we convert these to exchange rates with a USD base using forecasts for the DEM/EUR.

D.3 Macroeconomic Announcement Surprises

We use surprises for the following indicators for each country. When both Bloomberg and Informa Global Markets (IGM) publish expectations for the same indicator, we choose the source based on data availability. In a few rare cases in which indicators are discontinued, we splice the surprise series with a close substitute.

- Australia: (Inflation) CPI all groups goods component; (Activity) employment change, unemployment rate, GDP, building approvals, retail sales; (External) trade balance, (Monetary) RBA cash rate target
- Canada: (Inflation) CPI; (Activity) unemployment rate, GDP; (External) trade balance; (Monetary) Bank of Canada overnight lending rate
- Euro area:
  - Germany: (Activity) ifo Business Climate Index, industrial production, total manufacturing new orders, manufacturing PMI, ZEW Indicator of Economic Sentiment

  - Euro area: (Inflation) CPI; (Activity) GDP, manufacturing PMI; (External) current account balance, (Monetary) ECB main refinancing operations announcement rate, 3-month and 10-year interest rate futures

- Japan: (Inflation) Tokyo core CPI, PPI; (Activity) unemployment rate, industrial production, GDP, core machinery orders, tertiary industry activity, manufacturing PMI, (External) current account balance; (Monetary) M2 money supply, 10-year interest rate futures
- New Zealand: (Inflation) CPI; (Activity) GDP, unemployment rate, (External) trade balance, (Monetary) Reserve Bank of New Zealand official cash rate
- Norway: (Inflation) CPI; (Activity) unemployment rate; (Monetary) Norges bank deposit rate
- Sweden: (Inflation) CPI; (Activity) unemployment rate; (External) trade balance; (Monetary) Sweden repo rate, 3-month and 10-year interest rate futures
- Switzerland: (Inflation) CPI; (Activity) procure.ch PMI; (External) trade balance; (Monetary) policy rate (LIBOR target rate spliced with the interest rate on sight deposits), 3-month and 10-year interest rate futures
- United Kingdom: (Inflation) CPI; (Activity) claimant count rate, GDP, industrial production; (External) trade balance; (Monetary) Bank of England official bank rate, 3-month and 10-year interest rate futures
- United States: (Inflation) CPI, core CPI, core PPI; (Activity) capacity utilization, Conference Board consumer confidence, University of Michigan consumer sentiment, new home sales, initial jobless claims, industrial production, leading indicators index, nonfarm payrolls, ISM manufacturing index, unemployment rate, GDP, retail sales; (External) trade balance, oil surprises from Känzig (2021); (Monetary) federal funds target rate, 3-month fed funds rate futures, 4-quarter eurodollar futures, and 10-year Treasury yields