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How Do Event Studies Capture Impact of Macroeconomic News in Forex Market? A meta-Analysis

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Abstract:
We perform a quantitative synthesis of 807 estimates of the effect of macroeconomic news announcements on exchange rates, as reported in 25 studies. Estimates are tested for publication selection using visual examination of funnel plots, linear asymmetry tests, and recent non-linear testing techniques. Our analysis reveals that after the inclusion of the moderator variables, publication bias has a moderate but statistically significant effect on the reported estimates, although it does not strongly influence their magnitude. The primary sources of heterogeneity are driven by economic conditions, particularly interest rate differentials and inflation regimes. Surprisingly, the type of macroeconomic announcement does not systematically affect the variation in estimated effects, indicating that differences in the nature of the announcements have little impact on the reported results.

JEL: C52, F31, F36, G15
Keywords: foreign exchange markets, macroeconomic announcements, event study, meta-analysis, publication bias

1 Introduction

The world's financial markets are responsive to a multitude of information in the form of news that is incorporated into prices at different speeds (Fedyk, 2024). Although it is evident that all financial assets are influenced by macroeconomic news developments, some of them are more sensitive to economic fundamentals than others (Andersen *et al.* 2007; Bartolini *et al.* 2008; Goldberg & Grisse 2013). Forex markets have been shown to respond to various macroeconomic news announcements, as currencies are closely related to the economic health of the countries involved (Baruník *et al.*, 2017). Currencies are shown to react to interest rates and inflation announcements, GDP and employment news, trade balance, and political stability indicators. For example, Anderson *et al.* (2003) show significant reactions in the forex markets to employment and trade balance surprises, while Ehrmann & Fratzscher (2005) emphasize the role of interest rate and inflation data in the governing of exchange rate movements. Evans & Lyons (2008) further highlight how GDP and employment surprises impact exchange rates via market order flows. However, the literature does not always provide unambiguous guidance on the impact of news and its extent. For that, our objective is to provide comprehensive evidence based on a widely conducted meta-analysis (Stanley & Doucouliagos, 2012; Havránek *et al.*, 2020; Geyer-Klingeberg, 2022) and according to common standards (Havranek *et al.*, 2024). This approach has recently produced a number of useful empirical works with clear guidance.[1]

Since the early 1980s scholars have studied the reaction of currencies traded on the foreign exchange markets to macroeconomic news announcements, which reflect the development in fundamentals and policy decisions. Specifically, there has been substantial growth in the attempts of researchers to investigate the relationship between central bank communications and high-frequency market reactions over the last decade, since macroeconomic news releases produce substantial exchange rate variation (Fratzscher *et al.*, 2016; Laakkonen, 2007). Although the Efficient Market Hypothesis suggests that financial markets accurately incorporate all relevant information and therefore it might be difficult for investors to consistently achieve above-average returns by predicting market movements, the results of seminal work by Kuttner (2001), for example, suggest that the Federal Reserve's monetary policy decisions are not always fully anticipated by the market. Exchange rates are known to be particularly sensitive to mon-

[1]The meta-analytic studies directly related to the foreign exchange cover issues as, for example, international trade (Rose & Stanley, 2005), FX interventions (Brychka *et al.*, 2019; Arango-Lozano *et al.*, 2024), forecasting (Ayitey Junior *et al.*, 2023), forward premium puzzle (Zigraiova *et al.*, 2021), foreign investments (Tokunaga & Iwasaki, 2017), and point out the critical advantages and challenges of this type of research (Geyer-Klingeberg *et al.*, 2020)

etary policy announcements since a tightening or loosening of monetary policy via interest rate policies can have a significant impact on the currency's value, and in open economies, it directly influences key economic variables such as inflation, interest rates, and overall economic activity. Much of the research relates to the literature on monetary policy shocks, e.g. (e.g., Romer & Romer, 2004; Gürkaynak *et al.*, 2005; Altavilla *et al.*, 2019; Swanson, 2021; Leombroni *et al.*, 2021). According to scholars' expectations, higher interest rates attract foreign capital seeking better returns, leading to appreciation of the currency (e.g., Anderson *et al.*, 2003; Kearns & Manners, 2006; Faust *et al.*, 2007a; Ferrari *et al.*, 2021). In contrast, lower interest rates can lead to currency depreciation as investors look for higher returns elsewhere. This mechanism is essential for carry-traders, who exploit interest rate differentials by leveraging currencies with lower interest rates to invest in currencies with higher rates. However, the actual impact of monetary policy announcements often depends on the extent to which financial markets anticipate the central bank's decision. If the announcement corresponds to market expectations, the impact can be mitigated, whereas surprises can lead to sudden and substantial movements in exchange rates.[2]

Depending on the type of economy, the results of market reactions might also differ significantly. The empirical evidence available comes mainly from developed markets. For example, Faust *et al.* (2004), Anderson *et al.* (2003), and Rosa (2012) provide evidence of the importance of U.S. news releases. The opportunity to study the effect of US announcements on foreign exchange rates is facilitated by the fact that the announcements are scheduled and expectations of those announcements and accompanying exchange rate data are widely available. Fatum *et al.* (2012), and Rosa (2012) proved that the Bank of England's monetary announcements and Japanese industrial, manufacturing, and spending announcements are also economically significant. However, Ehrmann & Fratzscher (2005) noted that news from the United States seems to be more significant than news from Europe. Previous research showed low or non-existent responses for emerging markets to central bank announcements when daily returns were used (Kohlscheen & Andrade, 2014), which was called an exchange rate puzzle in emerging markets. These results raise the question of whether their central banks influence their currencies. The only study that confirms that the emerging economy is influenced by its domestic announce-

[2]Surprise announcements and news, in general, produce substantial movements in exchange rates and prompt transfers of volatility among currencies. Among key global currencies, such volatility spillovers are more impactful in the event of negative shocks and news and are affected by the dynamics of US monetary policy (Albrecht & Kočenda, 2025).

ments is the work of Kočenda & Moravcová (2018), who reported statistically significant results for the Czech Republic.

This research aims to quantitatively review the empirical literature, focusing on the following questions: (1) How do the magnitude and significance of the estimated effects of macroeconomic news announcements on exchange rates differ between studies? (2) To what extent does publication bias affect the estimated effects of macroeconomic news announcements on exchange rates in the empirical literature? (3) What methodological, market-specific and announcement-specific factors explain the differences in the estimated effects across studies? Studying how the effects of the development of macroeconomic fundamentals materialize in financial markets is crucial since it helps investors, policymakers, and analysts make informed investment, monetary policy, and risk management decisions. Macroeconomic news is an important process mechanism since the world forex markets are responsive to the vast amount of information, and understanding of financial market reactions is essential for achieving policy objectives. To address these questions, modern meta-analysis techniques have been applied. The presence of publication selection was examined both visually, using the funnel plot introduced by Egger *et al.* (1997)), and formally, employing funnel tests suggested by Stanley (2005), as well as alternative linear and non-linear approaches (Eicher *et al.* (2011), Cazachevici *et al.* (2020),Havranek *et al.* (2024)). Focusing on data specifications, characteristics, and methodologies, a set of 33 explanatory variables was collected. To address inherent model uncertainty, Bayesian model averaging was utilized, building on the framework proposed by Raftery (1995) and later applied by Moral-Benito (2012),Havranek *et al.* (2015)). This was followed by a frequentist check of the variables with the highest posterior inclusion probability. Additionally, A robustness check was conducted using frequency model averaging, as proposed by (Wang *et al.*, 2009) and subsequently employed by (Havranek *et al.*, 2017), (Ehrenbergerova *et al.*, 2023).

Finally, we analyze 807 estimates from 25 studies that investigate the effect of macroeconomic news announcements on exchange rates. The mean reported effect, recalculated as the percentage change in exchange rate following a one-standard-deviation increase in positive policy surprise, is -0.2% . Our analysis highlights several key findings. First, we find that publication bias plays a moderate but significant role in explaining variation in the reported effects, as indicated by the positive and significant coefficient in the FMA results. Second, our results indicate that the sources of heterogeneity in the estimates are primarily driven by underlying economic conditions as well as by methodological and technical differences across studies. Third,

in particular, variables such as interest rate differentials and inflation regimes have a significant impact on exchange rate responses to macroeconomic news.

Surprisingly, our results show that the type of macroeconomic announcement does not systematically influence the variation in estimates, suggesting that differences in the nature of the announcements, whether related to the real economy, inflation, or monetary policy, do not significantly alter the size of the reported effects. Besides, we find that the Euro and Japanese Yen are more volatile to positive policy surprises than the US dollar and that the publication characteristics produce only a minor effect on the explanation of the macroeconomic news puzzle. However, authors with limited experience in macroeconomics provide substantially higher results than those with experience. We also find that the results are affected by the diverse methodologies used by the authors. Last but not least, we computed implied estimates for the 1pp and 0.25pp positive shocks in the monetary policy announcement. Such shocks are linked to zero or negligible reactions in exchange rates during periods of monetary policy tightening, but prompt a moderate reaction during the recovery periods.

The remainder of the paper is structured as follows. In Section 2, a discussion of the theoretical mechanisms that researchers use to measure the reaction of the forex markets to macroeconomic news is provided. Section 3 outlines the data collection process. In Section 4, the presence of publication bias in the literature is tested. Section 5 focuses on explaining the heterogeneity between the beauty effect estimates. In the following Section 6, we compute implied estimates given the best knowledge in the field, our results and expertise. Section 7 concludes the paper, and the Appendix Appendix A section provides the list of the studies included in the dataset and additional important tables.

2 Theoretical mechanisms

2.1 High-frequency event study methodology

For our analysis, we focus on studies that analyze the effects of macroeconomic announcements and policy settings on exchange rates using the event study methodology, as outlined in Fama *et al.* (1969), which laid the foundation for the event study approach in finance. Cook & Hahn (1989) subsequently described the event study methodology as a widely used approach in finance and economics to assess the impact of specific events or announcements on the value of financial

assets. The event study methodology relies on several assumptions, including the Efficient Market Hypothesis, which posits that the prices fully reflect all available information.

The event study methodology has been widely used to analyze forex markets Anderson *et al.* (2003); Égert (2007); Evans & Lyons (2008) with various data frequencies (Poole *et al.*, 2005; Menkhoff, 2013), including high-frequency intraday data (Ranaldo & Rossi, 2010; Kočenda & Moravcová, 2018). The popularity of using the event study approach with high-frequency data can be explained by the fact that this procedure in finance can effectively help to overcome endogeneity problems, since it isolates the surprise component of policy decisions (according to Gürkaynak & Wright 2013; Nakamura & Steinsson 2018). Event study methodology is recognized by its precision in identifying the reaction of financial assets following an event. To conduct an event study, one needs to define the event of interest and determine the period (event window) over which an asset price will be examined. The approach utilizes the situation when the news enters the market and prevents the examination of extended periods without announcements (Swanson, 2011). The opportunity to use the advantages of the event study methodology to study the effects of policy decisions on asset prices is based on the regularity and scheduled timing of macroeconomic announcements. For our meta-analysis, the assets are currency prices (exchange rates), and the events are defined as the unexpected component of macroeconomic news announcements.

2.2 Identification of policy surprises

The unexpected component of the macroeconomic announcement or the surprise component associated with policy-related events is usually measured using two different methodologies: the survey-based approach and the market-based approach. The survey-based approach gauges the policy surprise as a difference between the actual policy rate and the median (or sometimes average) of the survey expectations reported by experts, divided by the associated sample standard deviation, as outlined by Anderson *et al.* (2003):

$$S_{it} = \frac{A_{it} - E_{t-1}[A_{it}]}{\sigma_i} \tag{1}$$

In Equation 1, S_{it} is a news surprise variable, A_{it} represents the value of the Reuters/Bloomberg scheduled announcement i at time t, $E_{t-1}[sn_{it}]$ represents the value of the announcement at time t of market consensus for time $t-1$, and the σ_i represents the sample standard deviation of an-

nouncement i. The surprise component S_{it} can take positive, negative, or zero values, depending on whether the actual announcement exceeds, falls below, or matches the market expectations.

The market-based approach uses changes in asset prices or yield spreads to indicate market reactions to unexpected policy decisions. According to the results of previous studies (Kuttner, 2001; Gürkaynak *et al.*, 2005), the correlation between the market-based and survey-based measures is strong (it is usually above 0.9). Sometimes in practice, researchers and policymakers use a combination of these two approaches to receive a more comprehensive understanding of how policy surprises are perceived and priced in by financial markets and the broader economy. For example, in Solis (2023) the author utilizes the swap rates to assess surprises in the policy rate and also applies an alternative measure of the difference between the actual policy rate change and the average of survey expectations reported by Bloomberg.

In his seminal work, Gürkaynak (2005) proposed the concept that monetary policy announcements can be multidimensional, where one factor captures the surprise in the policy action (target) and another the surprise in the policy communication (path). In the context of monetary policy, "target surprise" typically refers to the unexpected change in the target interest rate set by a central bank, for example, by the Federal Reserve in the United States or the European Central Bank in the Eurozone. On the other hand, "path surprise" relates to the unanticipated changes or shifts in the expected future path of monetary policy, which includes the anticipated future target interest rates set by a central bank. The concepts are essential in the analysis of the impact of central bank decisions and monetary policy on financial markets, as they help market participants to assess the reactions of currencies, to unexpected changes in interest rates and policy guidance. Rosa (2012) also highlighted the so-called LSAP shock of monetary policy announcements. LSAP shock in the context of a policy announcement surprise typically refers to the unexpected announcement or implementation of a large-scale asset purchase program by a central bank. The LSAP surprise component implies that the market participants and financial analysts do not fully anticipate the central bank taking drastic or unconventional policy action. In the context of economic implications, central banks stimulate borrowing, spending, and investment, thereby supporting economic growth by influencing interest rates and financial conditions. Another example of decomposition of news surprise variable in an event study approach was proposed by Gnan *et al.* (2022). The authors utilized three sets of shocks, depending on the change in tone of a specific variable. The shocks differ in their high-frequency market reactions in interest rates, the entire term structure, or the joint response in interest rates and

stock prices. The authors identify either a single interest rate, the full-term structure of interest rates, or the joint dynamics of interest rates and stocks, respectively.

A vast majority of studies included in the meta-analysis use the model that regresses the percentage change in the exchange rate on the surprise move in the central bank's policy action in the event window around the corresponding announcement:

$$\Delta(e_i) = \beta_0 + \beta_1 PS_t + \epsilon_i \tag{2}$$

where $\Delta(e_i)$ denotes the change in the exchange rate in the event window on the policy surprise; ΔPS_t indicates the policy rate surprise; and ϵ_i is the error term.

The relationship considered can be estimated using different strategies. The model with a target, path, and long-term components of a news surprise proposed by Gürkaynak *et al.* (2005) was used by Rosa (2012); Ferrari *et al.* (2021); Glick & Leduc (2012); Fawley *et al.* (2014) and Gürkaynak *et al.* (2007).

The model assumes that when the central bank makes a policy announcement, financial markets and economists have specific expectations or forecasts regarding whether the central bank will raise, lower, or maintain its target interest rate in the case of a monetary policy announcement. A "target surprise" then occurs when the central bank's actual decision deviates from what was expected (for example, if the market expected a 0.25% interest rate hike, but the central bank instead announces a 0.50% hike, it would be considered a positive "target surprise"). Path surprise component occurs since central banks often provide forward guidance, outlining their expectations for future interest rate movements over a specific time horizon. If the central bank's future path diverges from market expectations, it results in a "path surprise." The model is often represented in the following form:

$$\Delta(e_i) = \beta_0 + \beta_{TS} TS_t + +\beta_{NS} NS_t + \epsilon_i \tag{3}$$

For Equation 3 $\Delta(e_i)$ denotes the the (log) exchange rate change ; aTS_t indicates "target" policy surprise ; NS_t indicates "path" policy surprise ; and ϵ_i is the error term.

3 Data

In this section, we describe the data collection process, the adjustments made to the collected dataset, and the descriptive statistics of the collected data. Following the approach proposed by Havránek *et al.* (2020) in the "Reporting Guidelines for Meta-analysis in Economics", we compile a list of primary studies using Google Scholar at the first step of our data collection. The studies were identified through searches for references to "foreign exchange" or "forex", and "news announcement", combined with such keywords as "event study", "trade news", "monetary policy" "interest rate", "Consumer Price Index", "Producer Price Index" and "Gross Domestic Product". We examined the abstracts and results of the first 500 studies to determine the presence of relevant estimates. Additionally, employing the snowballing method, we reviewed the references of the most cited studies to augment the list of literature. The search was conducted using English keywords and terminated in May 2024.

Only literature reporting any measure of precision, such as standard errors, t-statistics, or p-values, was considered for further analysis to allow the use of modern meta-analysis techniques and to control for publication bias. All studies were checked at the second stage to determine whether they used an event study approach to assess the influence of news surprise explanatory variable on changes in exchange rate returns. The selection criteria identified 25 primary studies listed in Table 1, which collectively produce 807 estimates of the impact of macroeconomic announcements on exchange rates. Figure 1 presents a box plot of the reported estimates.

The earliest study included in the meta-analysis was published in 1998 (Almeida, Goodhart, & Payne), and the most recent one was published in 2023 (Solis). Based on the Google Scholar citation numbers, the most cited papers are Kearns & Manners (2006) with 137 citations and Fatum & Scholnick (2008) with 58 citations.

The dataset demonstrates substantial heterogeneity in terms of the surprise component identification, news types, origin of news, and the currencies pairs analyzed, it also varies in the estimation techniques employed in primary studies and the economic conditions experienced by the markets. To assign a pattern to these differences, we collect a set of 33 explanatory variables describing various characteristics of the data, methodologies, currency pairs, news announcements and publication qualities for each estimate collected of the announcement effect. Table 2 summarizes the variation in the effects of news announcements on exchange rates, which we further explore in Section 5. The results indicate that the type of surprise measure —composite,

non-composite, or survey-based—has minimal impact on estimated effects, with non-composite measures yielding effects closer to zero. Estimation techniques, such as ordinary least squares, weighted least squares, and maximum likelihood estimation, also produce similar estimates, with only slight differences in magnitude. Currency pairs demonstrate consistent responses overall, though pairs involving the Japanese Yen show minor deviation. News characteristics reveal that U.S. announcements tend to have less pronounced effects compared to those announcements from the EU. For comparability purposes, we recalculated all estimates to reflect the percentage increase in exchange rate returns resulting from a one-standard-deviation rise in positive policy announcement surprise.

Table 1: The studies included in the meta-analysis

Authors and Year	**Authors and Year**	**Authors and Year**
Almeida *et al.* (1998)	Ferrari *et al.* (2021)	May *et al.* (2018)
Antal & Kaszab (2022)	Frömmel *et al.* (2011)	Muhtar (2020)
Baum *et al.* (2015)	Glick & Leduc (2018)	Rogers *et al.* (2014)
Coleman & Karagedikli (2010)	Gnan *et al.* (2022)	Rosa (2011)
Ehrmann & Fratzscher (2005)	Gürkaynak *et al.* (2021)	Rosa (2012)
Farrell *et al.* (2011)	Hashimoto & Ito (2010)	Rosa (2013)
Fatum *et al.* (2012)	Jarociński (2022)	Solis (2023)
Fatum & Scholnick (2008)	Kearns & Manners (2006)	
Fawley *et al.* (2014)	Kiss *et al.* (2004)	

Notes: Details on the literature search and inclusion criteria are provided in Appendix A. The search was completed in May 2024.

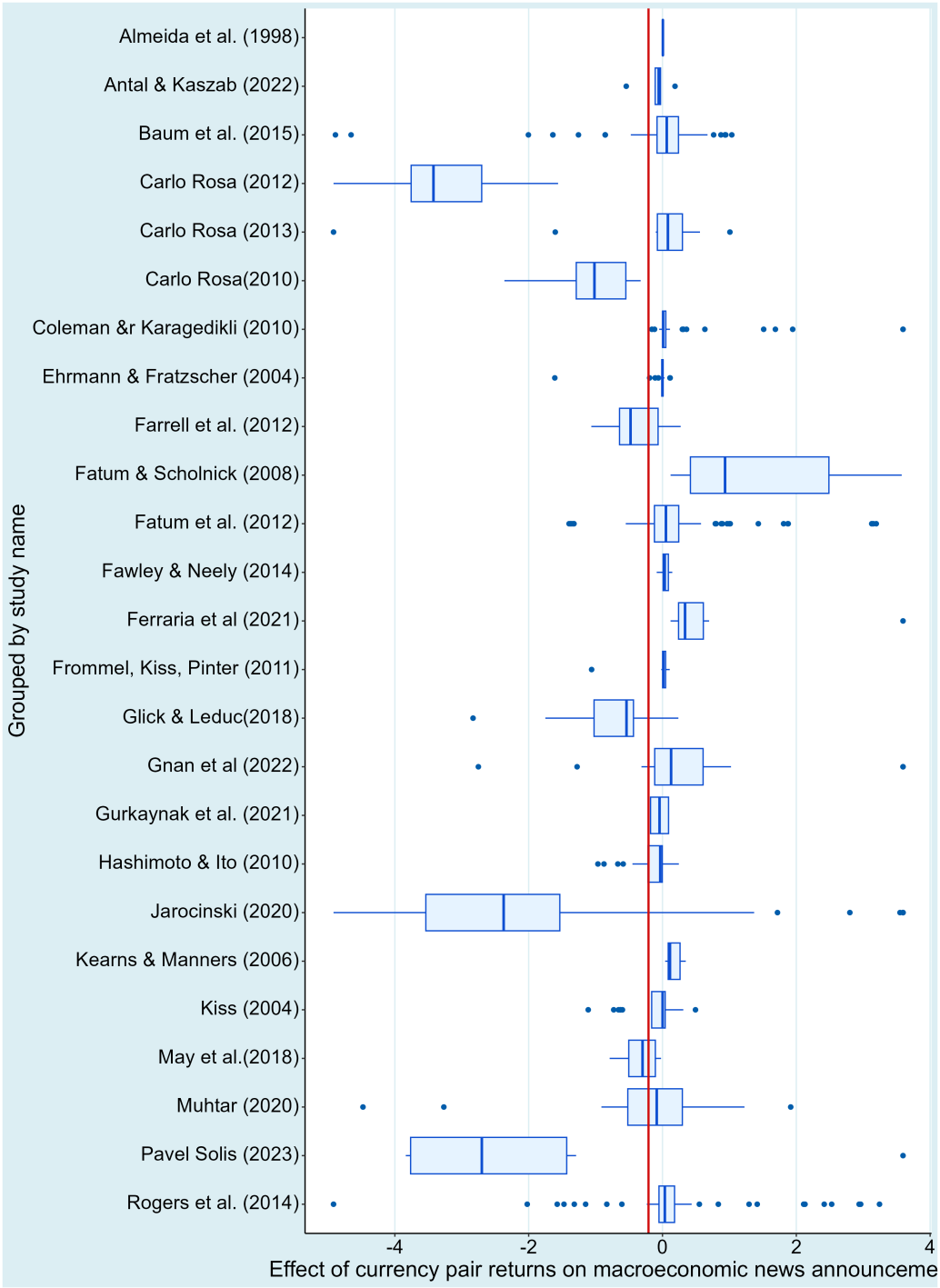


Figure 1: Estimates vary both within and across studies

Notes: The figure shows a box plot of the estimated news effects. All estimates are recalculated to represent the percent increase in exchange rate returns following a one-standard-deviation increase in positive policy surprise. The mean reported news effect is denoted as a solid vertical line.

Table 2: News announcements effects in different contexts

		Unweighted		Weighted	
	Est.	**Mean**	**95% conf. int.**	**Mean**	**95% conf. int.**
Currency pair					
Base currency is USD	352	-0.158	[-2.079, 1.763]	-0.434	[-2.355, 1.487]
Base currency is Euro	130	-0.963	[-4.861, 2.935]	-0.391	[-4.289, 3.507]
Base currency is other in EU	91	-0.205	[-2.765, 2.355]	-0.392	[-2.952, 2.168]
Base currency is Japanese Yen	150	0.166	[-1.271, 1.603]	0.156	[-1.281, 1.593]
Base currency is other	84	0.07	[-1.306, 1.446]	-0.146	[-1.522, 1.230]
Quote currency is USD	370	-0.253	[-3.085, 2.579]	-0.308	[-3.140, 2.524]
Quote currency is Euro	100	-0.164	[-1.499, 1.171]	-0.378	[-1.713, 0.957]
Quote currency is other in EU	91	-0.148	[-1.986, 1.690]	-0.264	[-2.102, 1.574]
Quote currency is Japanese Yen	151	-0.236	[-2.692, 2.220]	-0.298	[-2.754, 2.158]
Quote currency is other	95	-0.099	[-2.030, 1.832]	-0.547	[-2.478, 1.384]
Announcement characteristics					
Country of announcement is US (*)	241	0.108	[-2.277, 2.493]	-0.280	[-2.665, 2.105]
Country of announcement belongs to EU	225	-0.744	[-3.931, 2.443]	-0.504	[-3.691, 2.683]
Country of announcement is China	72	0.038	[-0.991, 1.067]	0.038	[-0.991, 1.067]
Country of announcement is Japan	177	-0.155	[-1.286, 0.976]	0.158	[-0.973, 1.289]
Country of announcement is other	92	-0.028	[-2.106, 2.05]	-0.38	[-2.458, 1.698]
Announcement is about real economy (*)	312	0.099	[-1.443, 1.641]	0.059	[-1.483, 1.601]
Announcement is about prices	68	-0.067	[-0.610, 0.476]	-0.137	[-0.680, 0.406]
Announcement is about business climate	65	-0.106	[-1.641, 1.429]	-0.101	[-1.636, 1.434]
Announcement is about monetary policy	351	-0.537	[-3.710, 2.636]	-0.574	[-3.747, 2.599]
Data and estimation characteristics					
Surprise measure is non-composite (*)	614	0.001	[-1.818, 1.820]	-0.183	[-2.002, 1.636]
Surprise measure is composite	193	-0.876	[-4.294, 2.542]	-0.603	[-4.021, 2.815]
Surprise measure is monetary-based (*)	275	-0.514	[-3.623, 2.595]	-0.409	[-3.518, 2.700]
Surprise measure is survey-based	532	-0.051	[-1.948, 1.846]	-0.294	[-2.191, 1.603]
Ordinary least square is used (*)	581	-0.299	[-2.965, 2.367]	-0.401	[-3.067, 2.265]
Other estimation method is used	226	0.023	[-1.494, 1.540]	-0.178	[-1.695, 1.339]
Study utilizes intra-day data (*)	696	-0.082	[-2.005, 1.841]	-0.275	[-2.198, 1.648]
Study utilizes daily data	111	-1.007	[-5.076, 3.062]	-0.693	[-4.762, 3.376]
Immediate event window (*)	235	-0.068	[-1.599, 1.463]	-0.144	[-1.675, 1.387]
Narrow event window	320	-0.480	[-3.665, 2.705]	-0.469	[-3.654, 2.716]
Hourly event window	202	-0.025	[-1.646, 1.596]	-0.339	[-1.960, 1.282]
Daily event window	51	0.117	[-2.064, 2.298]	-0.284	[-2.465, 1.897]
Economic conditions characteristics					
Monetary policy stance: tightening (*)	359	-0.427	[-3.567, 2.713]	-0.661	[-3.801, 2.479]
Monetary policy stance: loosening	448	-0.034	[-1.575, 1.507]	0.059	[-1.482, 1.600]
Inflation regime: high (*)	157	-0.500	[-3.183, 2.183]	-0.867	[-3.550, 1.816]
Inflation regime: low	650	-0.139	[-2.467, 2.189]	-0.098	[-2.426, 2.230]
Business cycle: recession (*)	501	-0.284	[-3.132, 2.564]	-0.465	[-3.313, 2.383]
Business cycle: recovery	306	-0.086	[-1.511, 1.339]	-0.102	[-1.527, 1.323]
Interest rate differential: high (*)	700	-0.253	[-2.730, 2.224]	-0.371	[-2.848, 2.106]
Interest rate differential: low	107	0.082	[-1.805, 1.969]	-0.137	[-2.024, 1.750]
Global risk sentiment: stable period (*)	617	-0.286	[-2.977, 2.405]	-0.488	[-3.179, 2.203]
Global risk sentiment: unstable	190	0.042	[-0.954, 1.038]	0.045	[-0.951, 1.041]
Publication characteristics					
Published study	452	-0.046	[-1.769, 1.677]	-0.214	[-1.937, 1.509]
Unpublished study (*)	355	-0.416	[-3.452, 2.620]	-0.532	[-3.568, 2.504]
Expertise (*)	307	-0.211	[-2.524, 2.102]	-0.630	[-2.943, 1.683]
Limited experience	500	-0.208	[-2.687, 2.271]	-0.089	[-2.568, 2.390]
Central Bank (*)	366	-0.424	[-3.376, 2.528]	-0.431	[-3.383, 2.521]
Academia	441	-0.031	[-1.820, 1.758]	-0.244	[-2.033, 1.545]

Notes: The table reports summary statistics of the estimated news effects for subsets of the literature. Est. = estimates. In the left-hand panel (unweighted), simple means and the corresponding 95% confidence intervals are reported; each estimate is assigned the same weight. In the right-hand panel (weighted), estimates are weighted by the inverse of the number of estimates reported per study.

4 Publication Bias

Publication bias occurs when the distribution of the research results differs from the distribution of the results published. Bruns *et al.* (2019) idenify several reasons for this, for example, authors finding certain directions of effects counterintuitive, or preferring to publish only significant results. The first problem reflects the situation where researchers are reluctant to challenge the generally accepted narratives. The second problem is usually called the Lombard effect (McCloskey & Ziliak, 2019). Lombard effect, as it comes from biology, describes a situation in which one makes more noise to be heard. In economics, it refers to efforts to achieve the desired (significant) result, often due to the virtually infinite options available in both study design and estimation approaches (Card & Krueger, 1995).

Such selections may lead to an exaggeration of the studied effects in academic articles. In recent years this type of selection has been idenified in several fields of economics (e.g., Blanco-Perez & Brodeur, 2020; Brown *et al.*, 2023; Campos *et al.*, 2019; Malovaná *et al.*, 2022, 2024) and finance (Bajzik, 2021; Geyer-Klingeberg *et al.*, 2018; Zigraiova & Havranek, 2016). Publication bias may also be a concern in the context of the macroeconomic news announcements and forex exchange markets. For instance, when analyzing impact of the Japanese macro news, Fatum *et al.* (2012, Table 3) suggest that the negative coefficient for the shock is indeed the *correct* one.

On the one hand, publishing papers with unlikely results makes little sense; on the other hand, systematically ignoring certain results may lead to an upward bias of the reported effects. Ioannidis *et al.* (2017) concludes that the results published in economics research journals suggest effects that are, on average, twice as large as the reality. Identifying potential publication bias is one of the most crucial tasks of meta-analysis. The meta-analytic approach is considered robust against publication selection problem, allowing for precise conclusions. The most commonly used technique to detect publication bias is a graphical analysis, which involves the visual examination of a funnel plot.

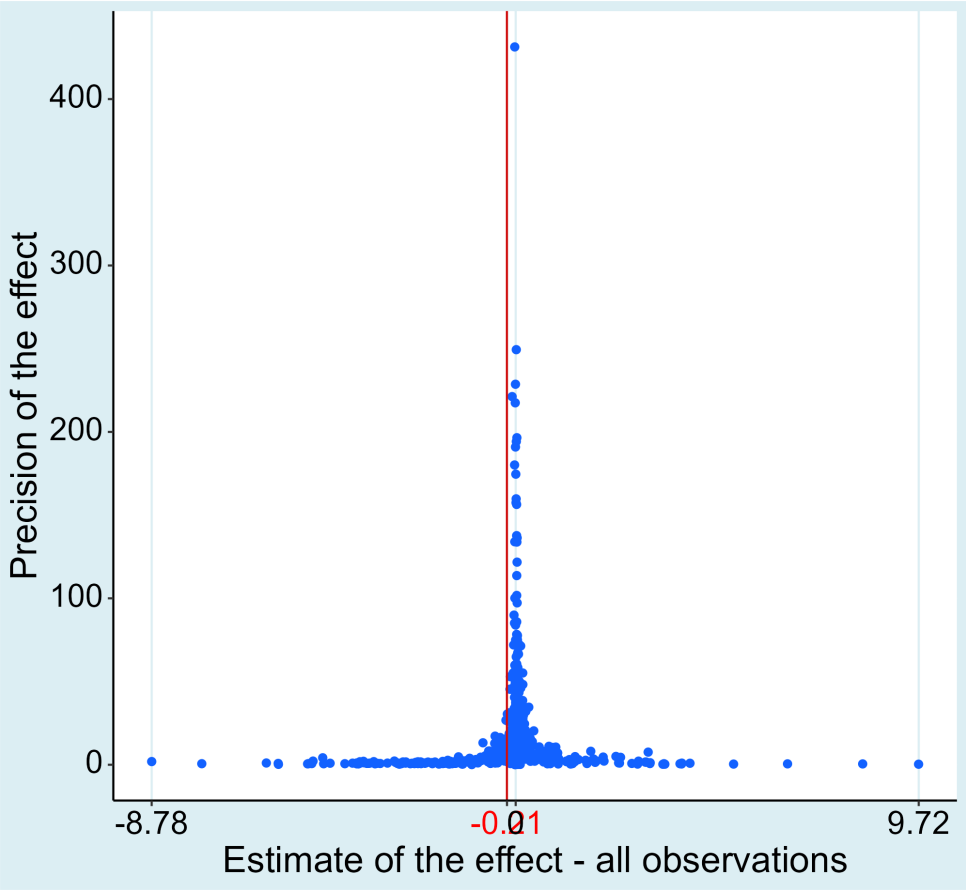


Figure 2: Funnel plot of publication bias estimation.

Notes: The most precise estimates of news effect are expected to cluster near the mean, represented by the vertical line, in the absence of publication bias, while less precise estimates should be symmetrically distributed around the mean. The plot suggests that negative, less precise estimates are under-reported compared to similarly imprecise but positive estimates. Extreme outliers are excluded from the plot but are included in all statistical tests for publication bias detection.

The Figure 2 presents a funnel plot visualizing the precision of the estimated effects of policy announcements on exchange rate returns. The x-axis represents the estimated effects, while the y-axis shows the corresponding precision, measured as the inverse of the standard errors. In the plot, imprecise estimates farther from the mean (around -0.2) cluster more on the positive side, suggesting that smaller or negative estimates may be underreported. This pattern is consistent with potential publication bias, where studies with statistically significant positive results are more likely to be published, leading to an over-representation of larger positive estimates. At the top of the plot, with higher precision, the estimates appear more symmetrically distributed, indicating that publication bias primarily affects the imprecise estimates of macroeconomic news announcements of forex market returns.

Table 3: Linear and nonlinear techniques detecting publication bias

	OLS	**FE**	**BE**	**RE**	**Weighted**
Publication bias	-0.324*	0.266***	-0.569	0.173**	-0.454
(standard error)	(0.103)	(0.082)	(0.276)	(0.0079)	(0.232)
Effect beyond bias	-0.083*	-0.312	-0.017	-0.392	0,012***
(constant)	(0.033)	(0.047)	(0.223)	(0.152)	(0.043)
Observations	807	807	807	807	807
	Precision-weighted	**WAAP**	**Top10**	**Selection**	**Kink**
Effect beyond bias	0.004***	0.004**	0.005**	0.001**	0.004***
(standard error)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Observations	807	807	807	807	807

Notes: Panel A shows the results of the estimation of $\beta_{ij} = \beta_0 + \beta \cdot SE(\beta_{ij}) + \varepsilon_{ij}$, where β_{ij} denotes the i- effect of the news announcements estimated in the j-th study, and $SE(\beta_{ij})$ denotes its standard error. FE = study-level fixed effects, BE = study-level between effects, RE = study-level random effects. Weighted = the inverse of the number of estimates per study is used as weight. In Panel B, all models are weighted by inverse variance. The first column shows an estimation similar to that in the last column of Panel A, weighted by the inverse variance. WAAP = Weighted Average of the Adequately Powered estimates (Ioannidis *et al.*, 2017); Top10 = the model by Andrews & Kasy (2019); Selection = the model by Andrews & Kasy (2019).; Kink = the model by Bom & Rachinger (2019). Standard errors are clustered at the study level and are reported in parentheses.

Panel A of Table 3 presents the results of the estimation of linear tests for publication bias detection clustered by study. The OLS regression results in the first column show a negative publication bias estimate of -0.324 (significant at the 1% level), with a confidence interval of [-0.595, -0.123]. The corrected effect beyond bias is -0.083 and statistically significant, implying that after accounting for publication bias, the impact of positive news surprises on forex returns is slightly negative. The fixed effects model indicates a positive publication bias of 0.266 (significant at the 1% level), with a corrected effect beyond bias of -0.312. This result suggests that within-study variations can overestimate the impact of news surprises, which implies the potential

presence of p-hacking, when researchers manipulate results to obtain significant findings. Often related to selective reporting, p-hacking can lead to an overestimation of the true effect of news surprises on forex returns. The between-effects model, which captures the so-called selection bias or publication bias between studies, shows a large but insignificant negative value of publication bias (-0.569), with a corrected effect of -0.017, highlighting that selection between studies has little impact on the estimated effect. The random effects model reveals a positive publication bias of 0.173 (significant at the 5% level), with a corrected effect beyond bias of -0.392, suggesting that publication bias may exaggerate the reported effect of news surprises on forex returns. This model's results support that studies reporting larger significant effects might be overrepresented in the literature, even if those effects do not reflect reality. Finally, the study-weighted OLS and precision-weighted OLS show publication bias estimates of -0.454 and -0.004, respectively, with corrected effect sizes of 0.112 and 0.004, indicating small positive effects after adjusting for bias. These results suggest that p-hacking and selective reporting can inflate the impact of macroeconomic announcements on forex returns, and when biases are corrected, the true effect appears close to zero.

In Panel B of Table 3, we examine models weighted by inverse variance as well as recently developed non-linear techniques to correct for publication bias, including WAAP (Weighted Average of Adequately Powered Studies), Top10, and hierarchical and endogenous kink models. The first method, labeled "WAAP" relies only on the estimates that are "adequately" statistically powered.Previously, Ioannidis *et al.* (2017) documented that the median statistical power among published results in economics is 18%. The authors show that low power is associated with publication bias and propose a simple correction procedure that uses estimates with power above 80%. The second method, labeled "Top10" was developed by Stanley *et al.* (2010), and works on similar basis. It estimates the "true effect" based on the 10% most precise observations collected from primary studies. The authors argue that these observations are unlikely to be severely affected by selective reporting. The WAAP and Top10 methods perform well, when the sample includes strongly statistically significant estimates These two methods are less effective with samples containing estimates that are not statistically significant. On the other hand, statistical (in)significance is not a limitation for the selection model ("Selection") by Andrews & Kasy (2019), which assumes that the probability of publishing an estimate depends on its statistical significance. The model assigns the likelihood to an estimate that falls within various intervals determined by critical values of the t statistics, giving more weight to the intervals

that are underrepresented. The fourth model used in our analysis, the endogenous kink model ("Kinked") by Bom & Rachinger (2019), assumes the existence of an endogenously determined threshold, called the "kink". At such threshold, the relationship between an estimate and its standard error changes in the presence of the publication bias.

The WAAP model and the Top10 model estimation results show a small positive publication bias of 0.004 and 0.005 (both significant at the 5% level). This means that after accounting for publication bias, the models suggest a small positive effect of news surprises on exchange rate returns, though the magnitude of this effect is minimal. The Stem and Hierarchical Selection models similarly report minimal corrected effects (0.001 and 0.004, respectively), supporting the idea that, after correcting for publication bias, the true effect of macroeconomic announcements on forex returns is negligible. All techniques in panel B show minimal corrected estimates, indicating that the initial perceived effects of news surprises are largely driven by publication bias. Further robustness checks, using different thresholds and caliper widths, confirm these results. The caliper tests show that regardless of the chosen threshold (e.g., 1.645, 1.96, or 2.58), the estimates of the effect of news surprises remain small but statistically significant, supporting the presence of bias. On the other hand, there might be other factors that influence the studied effect – we will explore them in the next section 5.

5 Heterogeneity

5.1 Variables

At the next step of our meta-analysis, we need to capture the main differences in the estimation context. For ease of exposition, the variables are divided into five groups: currency pair characteristics, announcement characteristics, data and estimation characteristics, publication characteristics, and economic conditions characteristics. These groups help categorize the key features of the studies, allowing a comprehensive understanding of the literature examining the effect of macroeconomic announcements on exchange rate returns in the forex market.

Currency pair. A significant portion of the studies focus on currency pairs that involve major global currencies. About 43% of the estimates use the USD as the base currency, while 16% involves the EUR and 18% focus on JPY as the base currency. On the quote side, 46% of the studies involve pairs where USD is the quote currency, with 12% focused on EUR and 18% on JPY. This suggests a strong emphasis on pairs involving the USD, which dominate

international currency trading. Based on the current empirical evidence, such as the works by Anderson *et al.* (2003), Faust *et al.* (2007b) and Rosa (2012), we assume that the choice of base and quote currencies can significantly influence the estimated effects. Rosa's studies, for example, demonstrate that currency pairs such as EUR/USD and GBP/USD react differently to similar announcements (Rosa, 2012). For the same type of macroeconomic announcements from the US, the EUR/USD pair tends to exhibit a stronger reaction than the GBP/USD pair, according to the author.

Announcement characteristics. The types of macroeconomic announcements vary, with 39% of the estimates related to the real economy, such as GDP or employment data. 43.5% of the announcements concern monetary policy. It is widely documented in the empirical literature (Almeida *et al.*, 1998; Rosa, 2012; Kearns & Manners, 2006) that real economy announcements, such as GDP and employment data, tend to elicit stronger reactions in currency pairs compared to other types of macroeconomic announcements (for example, monetary policy announcements), which might reflect their more immediate impact on market expectations of economic growth. Announcements from the US and the EU are the most common, accounting for 30% and 28%, respectively, while 22% of the announcements come from Japan, with the remaining 11% from other countries, including China. Empirical evidence suggests that the same currency pair can react differently to macroeconomic announcements depending on the country of origin. For example, Jarociński & Karadi (2020) and Ehrmann & Fratzscher (2005) showed that US monetary policy news tends to have a stronger influence on EUR/USD exchange rate returns compared to ECB announcements, suggesting the greater global economic influence of the Federal Reserve and the market's sensitivity to US news.

Our analysis focuses on studies employing the event study approach, and common intuition suggests that the length of the event window might influence the estimated effects of macroeconomic news announcements. Shorter windows tend to capture stronger and more immediate reactions as forex markets quickly adjust to new information. In contrast, longer windows, such as hourly or daily, generally show more moderated responses as the market absorbs and reassesses the news over time, potentially resulting in smaller but more stable effects.

Data and estimation characteristics. We assume that the structure of the surprise measure can significantly influence the estimated sensitivity of exchange rates to policy announcements. In our analysis, some estimates are based on noncomposite surprise measures, which capture the immediate market response, while other estimates rely on the target com-

ponent of composite surprise measures, as originally proposed by Gürkaynak *et al.* (2005). We hypothesize that differences in estimates may arise from the way in which a target surprise is defined and calculated within the models with composite surprise measures. In some cases, the target surprise is specifically designed to capture precise deviations in expected interest rate changes, whereas non-composite surprise measures may generalize this effect, often making it smaller. Market-based and survey-based surprise measures are widely used in the empirical literature and have proven to be strongly correlated, yet they may capture different dimensions of market expectations. Market-based measures are more responsive to immediate market reactions, potentially leading to larger and more volatile estimates, while survey-based measures provide a more structured reflection of expert consensus. These differences support the inclusion of both types of surprise measures as moderator variables in heterogeneity analysis.

Regarding estimation characteristics, a dominant share of the studies (72%) employs OLS for estimation, while 7.4% use WLS and 1.7% rely on MLE. About 18.7% of the studies use other methods, demonstrating some methodological diversity in the field, though OLS remains the most popular approach for estimating the impact of policy surprises on forex returns. Empirical literature shows that the choice of estimation technique can influence the estimated effects of macroeconomic news on exchange rates. For example, Rosa (2012) found that MLE provides more efficient estimates than OLS, particularly for models with nonnormally distributed errors and non-linear effects. Andersen *et al.* (2007) demonstrated that WLS improves efficiency under heteroscedasticity, while Glick & Leduc (2012) highlighted MLE's ability to model asymmetric responses to different news types. Both MLE and WLS can produce larger estimates under conditions such as nonlinearities, asymmetries, or varying volatility, which OLS cannot capture as effectively.Next, about 86% of the studies utilize high-frequency data, focusing on short-term responses to announcements. Both intuition and empirical evidence (Anderson *et al.*, 2003; Hashimoto & Ito, 2010) suggest that high-frequency data is likely to show stronger and more volatile estimated effects of macroeconomic news announcements, as it captures immediate market reactions, while daily data tend to reflect more moderated longer-term adjustments. Including both types of data as moderator variables in heterogeneity analysis is essential to understand the full range of market responses to macroeconomic news.

Economic conditions characteristics. We collect a set of moderator variables that represent general economic conditions that can influence the magnitude of the estimated effects. First, we assume that during periods of monetary tightening, exchange rates' sensitivity to policy

news tends to increase as markets demonstrate more pronounced reactions to information that could affect future rate decisions. In contrast, during a loosening cycle, the impact may be less pronounced as markets anticipate continued expansionary policies. Our intuition is repeatedly confirmed and validated in reports by the Federal Reserve Board (Curcuru, 2017; Yoldas, 2024) and in empirical academic studies (Hnatkovska *et al.*, 2016; Camara, 2022).

For the inflation regime, exchange rates may be more sensitive to macroeconomic news in high-inflation regimes, as macroeconomic announcements imply potential policy decisions to control inflation. Market reactions to announcements may be weaker in a low-inflation setting, as significant policy initiatives are less likely. Engel *et al.* (2007) empirically confirmed that in economies where inflationary pressures are a concern, exchange rates are more sensitive to macroeconomic announcements that could influence monetary policy.

Regarding the business cycle, we anticipate that during recession periods, exchange rates might demonstrate more pronounced reactions to macroeconomic announcements as investors and policymakers closely monitor trends of recovery or further decline. However, in a recovery period, the reactions of exchange rates may be less pronounced, as markets already expect continued growth. Empirical results generally support our intuition. For instance, Stavrakeva & Tang (2024) show that during U.S. recession periods, macroeconomic news accounts for 84 percent of the variation in quarterly exchange rate changes, compared with 65 percent during normal times. The findings of Narayan *et al.* (2021) confirm that the exchange rate reactions to negative news affecting the USD/GBP currency pair are more pronounced during periods of recession. Finally, Égert & Kočenda (2014) show that during standard market conditions, exchange rates react to a set of macroeconomic news, but during distress periods, they react primarily to the news on aggregate output. Correspondingly, the responsiveness of the currencies to central bank verbal interventions becomes important only during the crisis period.

According to the previous findings of Chinn & Meredith (2005) and Engel (2016) interest rate differentials between two economies may play an important role in driving exchange rates' movements. Based on this, we hypothesize that when the interest rate differential is high, forex markets tend to be more sensitive to news that could affect this spread. In contrast, a low differential may result in a less pronounced response to similar news.

Regarding global risk sentiment, our intuition suggests that exchange rates react primarily to country-specific news in periods of financial stability when global risk sentiment remains neutral. However, during unstable periods, currency markets can experience greater volatility

and sensitivity to macroeconomic news could vary depending on the prevailing risk-off or risk-on sentiment. Our intuition is supported by the previous findings of Avdjiev *et al.* (2019) and Eguren-Martin & Sokol (2022).

Publication characteristics. Consistent with previous meta-analyses, which have shown that publication characteristics can influence estimated effects, we include publication characteristics in our heterogeneity analysis to account for potential correlations between primary study estimates and unobserved factors related to study quality. The variables considered include publication year, impact factor, annualized number of citations, and dummy indicators for whether the study was published in a journal. Approximately 56% of the studies are published in journals with an impact factor, indicating a substantial proportion of high-quality peer-reviewed publications. 38% of the authors have prior expertise in the field, and 46% of the studies are published by a central bank. Hence, we also include dummy variables for author expertise and whether the study was published by a central bank to explore their potential influence on the estimated effects. Based on prior evidence, authors with previous work in the field may produce more precise estimates. Similarly, studies published by central banks might report greater effect magnitudes, as suggested by Fabo *et al.* (2021), who highlight the tendency of central banks to emphasize the impact of their policies more strongly than academics.

Table 4: Description and summary statistics of variables reflecting context (continued on next page)

Variable	Description	Mean	SD
Effect	Reported estimate recalculated to represent percentage increase in exchange rate returns resulting from a one-standard deviation rise in policy announcement surprise	-0.209	1.233
Value of the SE	Standard errors of the partial correlation coefficients	0.388	0.693
Study size	The logarithm of the number of estimates collected from the study	3.969	0.905
Currency pair			
Currency pair: base currency is USD (*)	= 1 if base currency is USD	0.436	0.496
Currency pair: base currency is Euro	= 1 if base currency is Euro	0.161	0.368
Currency pair: base currency is other in EU	= 1 if base currency is Other	0.113	0.316
Currency pair: base currency is Japanese Yen	= 1 if base currency is Japanese yen	0.186	0.389
Currency pair: base currency is other	= 1 if base currency is other	0.104	0.306
Currency pair: quote currency is USD (*)	= 1 if quote currency is USD	0.367	0.483
Currency pair: quote currency is Euro	= 1 if quote currency is Euro	0.13	0.337
Currency pair: quote currency is other in EU	= 1 if quote currency is Other	0.061	0.24
Currency pair: quote currency is Japanese Yen	= 1 if quote currency is Japanese yen	0.161	0.368
Currency pair: quote currency is other	= 1 if quote currency is other	0.096	0.295
Announcement characteristics			
News: country of announcement is US (*)	= 1 if country of announcement is US	0.299	0.458
News: country of announcement belongs to EU	= 1 if country of announcement belongs to EU	0.279	0.449
News: country of announcement is China	= 1 if country of announcement is China	0.089	0.285
News: country of announcement is Japan	= 1 if country of announcement is Japan	0.219	0.414
News: other country of announcement	= 1 if country of announcement is other than US/EU/China/Japan	0.114	0.318
News type: announcement is about Real Economy (*)	=1 if the announcement is about Real Economy (Industrial Production, GDP, Retail Sales, Trade Balance)	0.387	0.487
News type: announcement is about prices	= 1 if the announcement is about Prices (CPI, PPI)	0.084	0.278
News type: announcement is about business climate	=1 if the announcement is about Business Climate (PMI, Climate Indexes)	0.081	0.272
News type: announcement is about monetary policy	=1 if the announcement is of Monetary Policy or Monetary Type Indicator	0.435	0.496
Data and estimation characteristics			
IV is non-composite (*)	=1 if surprise measure is non-composite	0.761	0.427
IV is composite	=1 if surprise measure is composite	0.239	0.427
IV is monetary-based (*)	= 1 if surprise measure is monetary-based	0.341	0.474
IV is survey-based	= 1 if surprise measure is survey-based	0.659	0.474
Model: Gurkaynak et al (2005) model is used	= 1 if model proposed by Gurkaynak et al.(2005) is used	0.094	0.302
Model: other type of model is used (*)	= 1 if more-equation model is used	0.906	0.44
Method: OLS (*)	= 1 if OLS estimator used	0.72	0.449
Method: other method	= 1 if the estimation methodology used is other than OLS, WLS and MLE.	0.28	0.449
Data: study utilizes intraday data	=1 if the returns values used in the study are intraday	0.862	0.345
Data: study utilizes daily data (*)	=1 if the returns values used in the study are daily	0.138	0.345
Event Window: study utilizes immediate event window (*)	=1 if the event window is less than 30 minutes	0.291	0.455
Event Window: study utilizes narrow event window	=1 if the event window is between 30 minutes and 1 hour	0.397	0.489
Event Window: study utilizes hourly event window	=1 if the event window is more than 1 hour	0.25	0.433
Event Window: study utilizes daily event window	=1 if the event window is 1 or 2 days	0.063	0.243

Continued on the next page.

Table 5: Description and summary statistics of variables (continued)

Variable	Description	Mean	SD
Economic conditions characteristics			
External variable for 3 months interest rate	Three months interest rate	2.637	2.856
External variable for spread	Spread value	1.267	1.111
Monetary policy stance: tightening (*)	= 1 if the central bank of the news economy is in a tightening cycle (raising rates)	0.445	0.497
Monetary policy stance: loosening	=1 if the news economy is in a loosening cycle	0.555	0.497
Inflation regime: high (*)	= 1 if the inflation rate in the news economy is above a certain threshold	0.195	0.396
Inflation regime: low	= 1 if the inflation rate in the news economy is below a certain threshold	0.805	0.396
Business cycle: recession (*)	= 1 if the news economy is in a recession (negative GDP growth)	0.621	0.485
Business cycle: recovery	= 1 if the news economy is in a recovery (positive GDP growth)	0.379	0.485
Interest rate differential: high (*)	= 1 if the interest rate differential between the base currency and the quote currency is above a certain threshold	0.867	0.339
Interest rate differential: low	= 1 if the interest rate differential between the base currency and the quote currency is below a certain threshold	0.133	0.339
Global risk sentiment: stable period (*)	= 1 if global financial markets are in a risk-off period	0.765	0.425
Global risk sentiment: unstable	= 1 if global financial markets are in an unstable period	0.235	0.425
Publication characteristics			
Study: published	= 1 if the article was published in journal (all WPs, DPs = 0)	0.56	0.497
Study: unpublished (*)	= 1 if the article was not published in journal (all WPs, DPs)	0.44	0.497
Publication Year	The year of publication	0.755	0.283
Impact Factor	Indicators of the quality of the article, JIF	1.419	2.588
Citations	Indicators of the quality of the article, Citations	1.618	1.649
Expertise (*)	=1 if author(s) has other publications on this topic	0.38	0.486
Limited experience	=1 if author(s) had not had other publications on this topic	0.62	0.486
Central Bank (*)	=1 if the article is published by central bank	0.454	0.499
Academia	=1 if the article is published by academic institution	0.546	0.498

Notes: SD = standard deviation

5.2 Estimation

All factors included in the analysis have the potential to influence the reported estimates of macroeconomic news announcements on exchange rates, although only a few will likely have a systematic importance in practice. This leads to significant model uncertainty: including all variables in a single regression may result in highly imprecise estimates, even for the most crucial variables. A natural response to model uncertainty in a Bayesian framework is Bayesian model averaging (BMA). BMA allows us to avoid estimating all 2^{26} potential models (after removing baseline categories) and instead focus on the most relevant ones. As a Bayesian method that employs the Markov chain Monte Carlo algorithm, BMA requires priors. First, we choose the unit information prior for estimation, which assigns the prior that each coefficient is zero the same weight as one data point. Additionally, we applied the dilution model prior, which penalized models with high collinearity. In practice, BMA assigns weights to models based on their fit and parsimony. For each variable, the sum of the weights of the models that include the variable is known as a posterior inclusion probability (PIP). Variables with a high PIP are effective in explaining the differences in reported effects of macroeconomic news announcements on exchange rates.

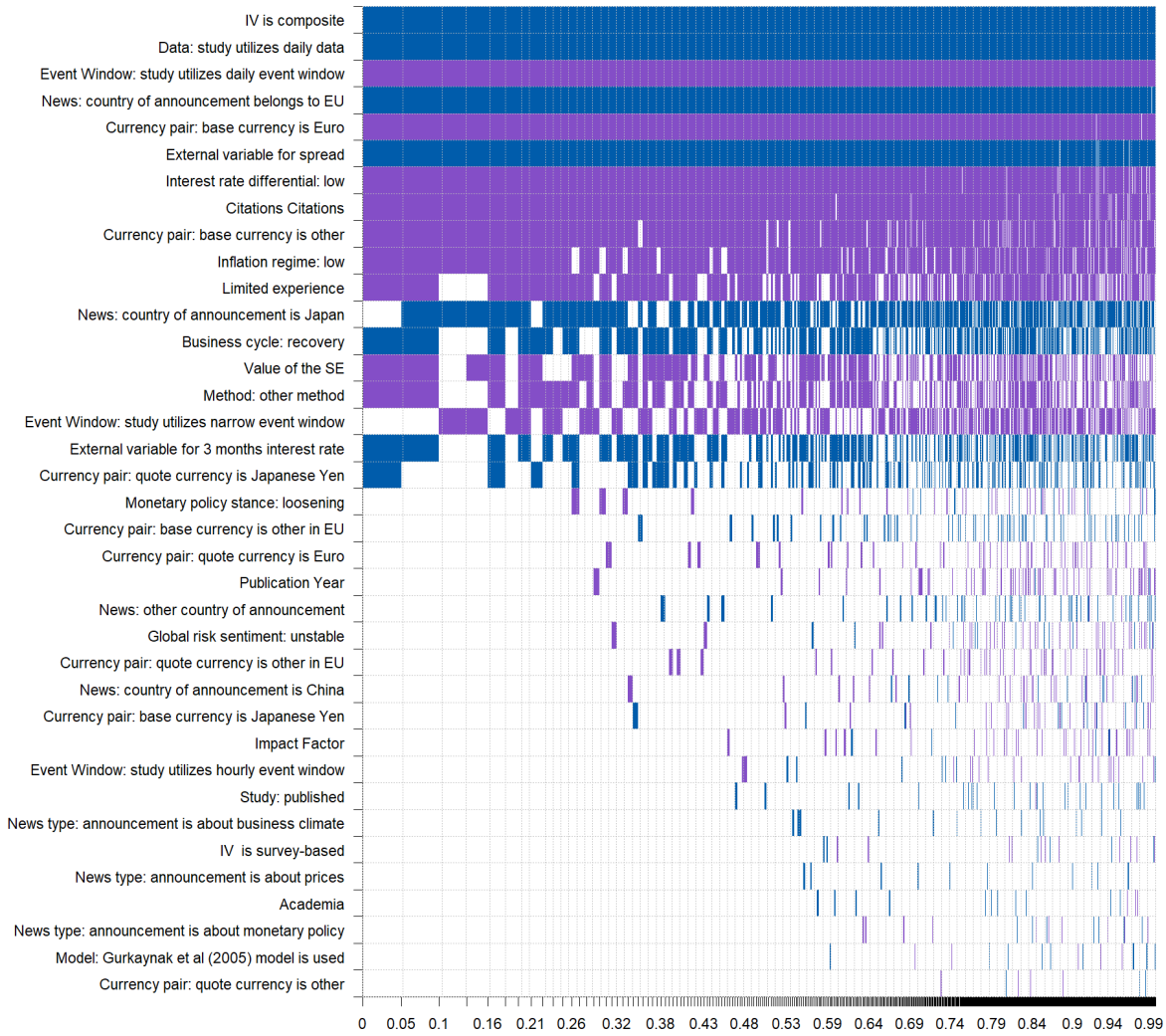
The Figure 3 provides a graphical summary of the Bayesian model averaging (BMA) results. On the vertical axis, the explanatory variables are ranked according to their posterior inclusion probabilities (PIP), with the highest at the top and the lowest at the bottom. This means that the variables listed at the top are the most effective in explaining variations in the reported estimates of macroeconomic news announcements on exchange rates. The horizontal axis represents the cumulative posterior model probability, which reflects the weight assigned to each model in the BMA framework. The color coding in the figure conveys the direction of the estimated parameters: blue color indicates a positive effect of the corresponding explanatory variable, while violet represents a negative effect. Variables with no color were not included in the model.The figure highlights that only a few variables among those considered are robustly associated with the effects of macroeconomic news announcements on exchange rates. Specifically, variables such as Euro base currency, ECB announcements, using intraday data, and daily event window are most strongly associated with the outcomes, as indicated by their high posterior inclusion probabilities and dominant presence across the best-fitting models. In contrast, many other variables, particularly those toward the bottom of the figure, show low posterior inclusion probabilities and are either weakly associated or not included in the most relevant models.

The analysis of heterogeneity reveals the following key insights. First, the evidence of publication bias is moderate but robust, as indicated by its statistical significance in both Bayesian Model Averaging (BMA) and Frequentist Model Averaging (FMA). Higher standard errors are consistently associated with an increase in the estimated effect, implying the presence of publication bias, although it does not dominate the magnitude of the outcomes. Second, variables related to the estimation context appear to have a systematic impact on variation in exchange rate effects. Third, and unsurprisingly, the most substantial variation in the reported effects is driven by macroeconomic fundamentals, particularly variables like interest rate differentials and inflation regimes. For instance, in the case of the base Euro currency, ECB news announcements show strong effects across both BMA and FMA estimations, indicating their robustness in explaining variations in the outcome. This underscores the importance of underlying economic conditions rather than technical or methodological differences across studies.

The Table 6 shows the numerical results of Bayesian model averaging and Frequentist model averaging. The results indicate that publication bias plays a moderate role in explaining the variation in the estimated effects, as evidenced by the Bayesian Model Averaging (BMA) results, which highlight its moderate importance. The BMA shows posterior mean of only 0.139 with the PIP 0.643, which is considered as only "weak" effect according to Eicher *et al.* (2011). In contrast, the positive and significant Frequentist Model Average (FMA) coefficient (0.197, p = 0.034) suggests that higher standard errors are associated with an increase in the result, reinforcing the presence of publication bias. These results just underscore the conclusions of Section 4, where the publication bias was not rejected or confirmed by the results. So, while the bias remains statistically significant, it does not exert the strongest influence on the magnitude of the estimated effect, especially when compared to other more impactful variables.

Currency pair. Both the base euro currency and ECB news announcements show strong effects across BMA and FMA estimations, indicating their robustness in explaining variations in exchange rate outcomes. The consistent impact of EU news announcements on exchange rates in both models suggests cautious investor sentiment toward the Eurozone, with macroeconomic news from the region often being interpreted differently compared to other regions in the sample. This likely reflects concerns about the economic and political stability of the EU. At the same time, currency pairs with the euro as the base currency tend to show a stronger reaction to macroeconomic news compared to other currencies in the sample. This can be attributed to the euro's central role in the global financial system, its significance in cross-border trade, and its

Figure 3: Model inclusion in Bayesian model averaging (using unit information prior)



Notes: On the vertical axis the explanatory variables are ranked according to their posterior inclusion probabilities from the highest at the top to the lowest at the bottom. In other words, the variables shown at the top are the ones most useful in explaining differences in the reported beauty effects. The horizontal axis shows the values of cumulative posterior model probability. In other words, the models on the left display the best combination of data fit and parsimony. Blue color = the estimated parameter of a corresponding explanatory variable is positive. Purple color = the estimated parameter of a corresponding explanatory variable is negative. No color = the corresponding explanatory variable is not included in the model.

Table 6: Bayesian Model Averaging and Frequentist Model Averaging for Macroeconomic News Effects

Variable	**BMA P. Mean**	**BMA SD**	**BMA PIP**	**FMA Coef**	**FMA SE**	**FMA p-val**
Constant	-0.745	NA	1	-0.615	0.324	0.057
Value of the SE	0.124	0.114	0.610	0.182	0.083	0.028
Currency pair						
Currency pair: base currency is Euro	0.895	0.193	0.999	0.899	0.260	0.001
Currency pair: base currency is other in EU	-0.036	0.153	0.072	0.000	0.043	0.000
Currency pair: base currency is Japanese Yen	0.003	0.073	0.037	0	0.012	0
Currency pair: base currency is other	0.804	0.312	0.940	0.838	0.532	0.115
Currency pair: quote currency is Euro	0.014	0.064	0.066	0	0.289	0
Currency pair: quote currency is other in EU	0.009	0.050	0.048	0	0.284	0
Currency pair: quote currency is Japanese Yen	-0.115	0.186	0.322	-0.198	0.188	0.293
Currency pair: quote currency is other	0.000	0.013	0.007	0	0.290	0
Announcement Characteristics						
News: country of announcement belongs to EU	-0.557	0.131	1	-0.536	0.260	0.040
News: country of announcement is China	0.007	0.067	0.040	0	0.037	0
News: country of announcement is Japan	-0.284	0.195	0.755	-0.288	0.161	0.075
News: other country of announcement	-0.019	0.104	0.051	0	0.403	0
News type: announcement is about prices	-0.002	0.021	0.016	0	0.119	0
News type: announcement is about business climate	-0.002	0.026	0.019	0	0.122	0
News type: announcement is about monetary policy	0.000	0.015	0.014	0	0.055	0
Data and estimation characteristics						
IV is composite	-0.607	0.113	1	-0.612	0.1118	0
IV is survey-based	-0.006	0.0020	0.016	0	0.050	0
Model: Gurkaynak et al (2005) model is used	-0.001	0.019	0.011	0.00	0.058	0.000
Method: other method	0.232	0.220	0.590	0.316	0.149	0.034
Data: study utilizes daily data	-2.313	0.254	1	-2.130	0.395	0
Event Window: study utilizes narrow event window	0.218	0.221	0.552	0.186	0.132	0.158
Event Window: study utilizes hourly event window	0.003	0.046	0.029	0	0.106	0
Event Window: study utilizes daily event window	2.411	0.299	1	2.448	0.422	0
Economic conditions characteristics						
External variable for 3 months interest rate	-0.054	0.057	0.537	0	0.039	0.038
External variable for spread	-0.408	0.170	0.996	-0.452	0.138	0.001
Monetary policy stance: loosening	0.018	0.099	0.072	0.064	0.219	0.772
Inflation regime: low	0.743	0.372	0.933	0.600	0.235	0.011
Business cycle: recovery	-0.279	0.253	0.621	-0.394	0.236	0.095
Interest rate differential: low	0.602	0.180	0.985	0.544	0.210	0.010
Global risk sentiment: unstable	0.007	0.058	0.049	0	0.192	0
Publications characteristics						
Study: published	-0.005	0.043	0.027	0	0.107	0
Publication Year	0.029	0.136	0.063	0	0.120	0.000
Impact Factor	0.001	0.009	0.034	0.000	0.011	0.000
Citations	0.244	0.076	0.985	0.274	0.084	0.001
Limited experience	0.479	0.334	0.766	0.607	0.258	0.019
Academia	-0.001	0.022	0.014	0	0.056	0

Notes: In Bayesian Model Averaging (BMA), the posterior mean reflects the partial derivative of the reported news effect with respect to its associated study characteristic. The abbreviations are as follows: P. mean = posterior mean, P. SD = posterior standard deviation, PIP = posterior inclusion probability, and SE = standard error. The BMA analysis uses the unit information prior suggested by Eicher *et al.* (2011). Descriptions of all variables can be found in Table 4, while technical details and diagnostics of the BMA exercise are provided in the Appendix Appendix A.

sensitivity to ECB policies and global risk sentiment. Although EU news may generate a cautious market response, the status of the euro as a global reserve currency and a key benchmark in the forex markets amplifies its reactions to macroeconomic announcements, resulting in a stronger association when the euro is the base currency in exchange rate movements.

Our results are similar to those of Rosa (2012, 2013). He shows that the EUR-USD pair has a much more significant effect than the GBP-USD pair with respect to the monetary policy shock. Similarly to us, he shows that the reaction of the pair with the EUR involved is stronger. On the other hand, in his case, the quote matters; in ours, the base is important. This difference might be explained in our next paragraph with respect to *announcement characteristics*.

Announcement characteristics. With regard to the characteristics of the announcement, we study two perspectives. First is the *country* of the announcement, and the second is the *type* of the announcement. The first phenomenon explains our deflection of Rosa (2012). In his study, he used US federal funds rate shock, and hence, he shows the volatility of the EUR (quote currency). In our sample, we show high volatility of EUR, when it is base currency. This dissimilarity – EUR as a base or EUR as a quote – might be explained by the fact that most of our observation of EUR base reaction comes from the ECB announcements, thus from shocks to EUR, not to the US dollar. Furthermore, following Jarociński & Karadi (2020), we show that the US monetary news announcement has a stronger effect than the ECB announcement, confirming the greater global economic influence of the Federal Reserve and the market's sensitivity to US news. In addition, we find that the announcement of the Bank of Japan lies in the middle of these effects.

Regarding the *type* of announcement, we cannot confirm the results provided by Rosa (2012); Kearns & Manners (2006) that real economy announcements, such as GDP and employment data, tend to elicit stronger reactions in currency pairs compared to other types of macroeconomic announcements (for example, monetary policy announcements), which might reflect their more immediate impact on market expectations of economic growth. We found all types of announcement, as is for prices, business climate, monetary policy or for real economy of similar value. Nothing creates a stronger effect on the exchange rates.

Data and estimation characteristics. Regarding the data and methodology, we find that it does matter whether the IV is composite, survey-based, or non-composite, as the composite IV provides strongly positive statistically significant results. The difference might be caused by the fact that the target surprise is specifically designed to capture precise deviations in expected

interest rate changes, whereas non-composite surprise measures may generalize this effect, often making it smaller (Gürkaynak *et al.*, 2005).

Next, in terms of the model used in the estimation, we find no difference between the various models. However, with respect to the estimation characteristics, we find that *another method* than OLS provides significantly higher estimates than the OLS estimation technique. As the category *other method* in addition to the other estimation method includes the MLE and WLS estimation techniques, our finding is in line with the literature that claims that MLE and WLS may yield larger estimates under conditions like nonlinearities, asymmetries, or variable volatility, which OLS may not capture as effectively (Rosa, 2012; Andersen *et al.*, 2007; Glick & Leduc, 2012).

Next, we consider the data frequency and the event window. The Table 6 shows that the studies using daily data has strongly negative statistically significant effect. It might indicate that the effect of the announcement grew stronger during the day, that it absorbs even other effects, or that it counterweights the strongly positive daily event window effect. Besides, following Altavilla *et al.* (2019), we distinguish between immediate effect, narrow and hourly event window effect, and contrary to Altavilla *et al.* (2019) we find almost no difference among them.

Economic conditions characteristics. The less negative or even zero impacts of low inflation regimes (BMA result 0.743, PIP 0.933, which is a strong result according to Eicher *et al.* (2011)) are something we expected (Engel *et al.*, 2007). Similar conclusion we find for low interest rate differentials economies (BMA result 0.602, PIP 0.985) on exchange rates. Again, it is in line with the literature (Chinn & Meredith, 2005; Engel, 2016) and might be explained by the perception of economic stability, policy flexibility, and favorable investment conditions. These conditions allow for clearer market signals, more predictable central bank policies, and a stronger focus on economic fundamentals, ultimately leading to more pronounced reactions in exchange rates. These conclusions are further supported by the finding for the spread variable (BMA result -0.408, PIP 0.996). This result indicates that the reaction of the exchange rates increases with a larger spread. On the other hand, at the lower spread indicating the higher economic stability, the effect of the surprise on an exchange rate is lower.

Similarly, exchange rate reactions are less pronounced in the periods of recovery of the business cycle (Stavrakeva & Tang, 2024; Narayan *et al.*, 2021), as expected. The variable for the recovery of the business cycle has a negative coefficient of -0.279 and has PIP 0.621, which is still "weak" according to Eicher *et al.* (2011). This conclusion is in line with our intuition, as

well as with the reports from the Federal Reserve Board reports (Curcuru, 2017; Yoldas, 2024) and academic papers (Hnatkovska *et al.*, 2016; Camara, 2022).

Despite common knowledge, we find only "weak" evidence for exchange rates' sensitivity increase during the monetary tightening periods. Moreover, we find that the global sentiment for risk, with the coefficient 0.007 and PIP 0.049, does not affect the reactions of the exchange rates to country-specific news.

Publication characteristics. Regarding publication characteristics, the results show that it does not matter whether the study is published or not, what is the publication year, or what is the impact factor of the given journal. These two observations are in line with the conclusions from Malovaná *et al.* (2022) and Ehrenbergerova *et al.* (2023) studying the same field. On the other hand, the results presented in Table 6 indicate that the number of citations of the given study matters.

Next, we compared the results provided by academics and central bankers and show that the groups do not differ in their conclusions. It is in line with Malovaná *et al.* (2024) and is opposite to Fabo *et al.* (2021). Furthermore, we examine the difference between authors who wrote only one paper on the given phenomena or are more experienced in the given area. Unsurprisingly, we found that the effect is stronger for authors who wrote just one article on the given topic. It might be caused by their inexperience or sensationalism (Hanssen & Jørgensen, 2015).

6 Implied Elasticity

Until now, the presented results indicate the following: i) publication bias plays a moderate but statistically significant role in explaining variation in the reported effects; ii) the sources of heterogeneity in the estimates are primarily driven by underlying economic conditions, rather than methodological or technical differences across studies; and iii) namely, variables such as interest rate differentials and inflation regimes have a significant impact on exchange rate responses to macroeconomic news.

Now, we move on to our final section. Based on the knowledge we gained, we are interested in uncovering the implications of the unexpected shock to the foreign exchange rates. Although the estimation reveals several key drivers of heterogeneity, the question of the "true" effect remains open. Therefore, we decide to compute such estimates for the three most common currency pairs – EUR/USD, JPY/USD, and JPY/EUR.

For all of these most common currency pairs, we will compute the implied estimates using two different scenarios. In the first, we consider a period of monetary loosening that coincides with low inflation during a business recovery. In such a setting, we count on low interest rate differentials and stable global risk sentiment that can also characterize such phases. The second setting is just the reversed one. It is a period of monetary tightening, with high inflation, business contraction, high interest rate differentials, and unstable risk sentiment.

For the computation, we start with the setting traditionally used in the literature (Bajzik *et al.*, 2020; Ehrenbergerova *et al.*, 2023). We choose the workhorse articles and their models to provide the baseline model and data specification settings. We set Fatum & Scholnick (2008), Rosa (2012), Baum *et al.* (2015), Gürkaynak *et al.* (2021). These are the newest studies or the most seminal ones in the area. The implied estimates captured in Table 7 are based on a linear combination of the model characteristics. We set the iv_c, iv_survey, other model used for estimation, intraday data and immediate effect on exchange rates.

Besides, we set (i) the effect of the standard error to be zero, indicating no publication bias, (ii) the method of estimation as other method, indicating the WLS or MLE was used, and (iii) the news type as a monetary policy news, as it is most often announced news. For publication characteristics, we prefer the newer articles published by experienced authors in high-quality journals that are properly cited. The article should not be from a central bank to be completely independent (Fabo *et al.*, 2021).

Table 7: Implied estimates

	Recovery			Tightening		
Currency pair	Estimate	Lower CI	Upper CI	Estimate	Lower CI	Upper CI
EUR/USD	1.326	-0.823	3.474	-0.045	-1.041	0.951
JPY/USD	0.962	-1.138	3.063	-0.408	-1.266	0.450
JPY/EUR	1.923	-0.253	4.098	0.552	-0.454	1.559

Notes: The values suggest the implied estimates as described in the text. The standard errors reported in parentheses are derived from OLS estimates. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

From the results summarized in Table 7, it is visible that a 1pp positive shock in the monetary policy announcement causes, during the recovery period, a 1.326 SD reaction for the EUR/USD, a 0.962 SD reaction for the JPY/USD, and a 1.923 SD reaction for the JPY/EUR. During the monetary policy tightening period, the 1pp shock causes reactions of -0.045 SD, -0.408 SD, and 0.552 SD, respectively. The 1pp positive shock is the standard way the literature approaches

this subject (Gürkaynak *et al.*, 2021). As we need the result to be the most accessible to the reader as possible, we recalculate our implied elasticities into the exchange rate changes in the tables Table 8, and Table 9.

Table 8: Exchange rates reactions for recovery period

Currency pair	Mean	SD	Rec. reaction	Result	Rec. reaction 0.25pp	Result 0.25pp
EUR/USD	0.783	0.165	1.326	0.219 EUR/USD	0.332	0.055 EUR/USD
JPY/USD	4.657	0.134	0.962	0.129 JPY/USD	0.241	0.032 JPY/USD
JPY/EUR	4.879	0.033	1.923	0.063 JPY/EUR	0.481	0.016 JPY/EUR

Notes: The first two columns of the table indicate the mean value and standard deviation of the given currency pair exchange rate. The next two columns show the magnitude of the reaction given the Table 7 and the final reaction of the currency pair to the 1pp shock of the monetary policy. In the last two columns, the results are recalculated for the most common 0.25pp shock. Estimates are computed for the data spans used in the primary studies but can also be expanded for the current data periods of tightening and recovery.

Table 9: Exchange rates reactions for tightening period

Currency pair	Mean	SD	Tight. reaction	Result	Tight. r. 0.25pp	Result 0.25pp
EUR/USD	0.783	0.165	-0.045	-0.007 EUR/USD	-0.011	-0.002 EUR/USD
JPY/USD	4.657	0.134	-0.408	-0.055 JPY/USD	-0.102	-0.014 JPY/USD
JPY/EUR	4.879	0.033	0.552	0.018 JPY/EUR	0.138	0.005 JPY/EUR

Notes: The first two columns of the table indicate the mean value and standard deviation of the given currency pair exchange rate given the data. The next two columns show the magnitude of the reaction given the Table 7 and the final reaction of the currency pair to the 1pp shock of the monetary policy. In the last two columns, the results are recalculated for the most common 0.25pp shock. Estimates are computed for the data spans used in the primary studies but can also be expanded for the current data periods of tightening and recovery.

From Table 8 it is visible that during the recovery period, the 0.25pp positive shock in the monetary policy announcement causes a reaction of +0.055 EUR / USD, a reaction of +0.032 JPY / USD and a reaction of +0.016 JPY / EUR. During the tightening period, there are changes of -0.002 EUR / USD, -0.014 JPY / USD and +0.005 JPY / EUR.

7 Concluding Remarks

An analysis of 807 estimates from 25 studies investigates the effect of macroeconomic news announcements on exchange rates. The mean reported effect, recalculated as the percentage change in exchange rate following a one-standard-deviation increase in positive policy surprise, is -0.2%

Our analysis highlights several key findings. First, publication bias plays a moderate but significant role in explaining variation in reported effects, as indicated by the positive and sig-

nificant coefficient in the FMA results. However, it does not have the strongest influence on the magnitude of the estimated effects. The sources of heterogeneity in the estimates are primarily driven by underlying economic conditions, as well as by the methodological and technical differences across studies. In particular, variables such as interest rate differentials and inflation regimes have a significant impact on exchange rate responses to macroeconomic news.

Surprisingly, our results show that the type of macroeconomic announcement does not systematically influence the variation in estimates, suggesting that differences in the nature of the announcements, whether related to the real economy, inflation, or monetary policy, do not significantly alter the size of the reported effects. In addition, we find that the euro and the Japanese yen are more volatile to surprise shocks of the announcements than the US dollar and that the publication characteristics have only a minor effect on the explanation of the macroeconomic news puzzle.

However, authors with limited experience in macroeconomics provide substantially higher results than those with experience. In addition, we show that the results are affected by the various methodologies used by researchers. Last but not least, we computed implied estimates for the 1pp and 0.25pp positive shocks in the monetary policy announcement. Such shocks are linked to zero or negligible reactions in exchange rates during periods of monetary policy tightening, but prompt a moderate reaction during the recovery periods.

All of our results might be used as a reference point for future research in the area of the effect of macroeconomic news on exchange rates. Our results might also help decision-makers to correctly and realistically approach the outcomes of the empirical literature.

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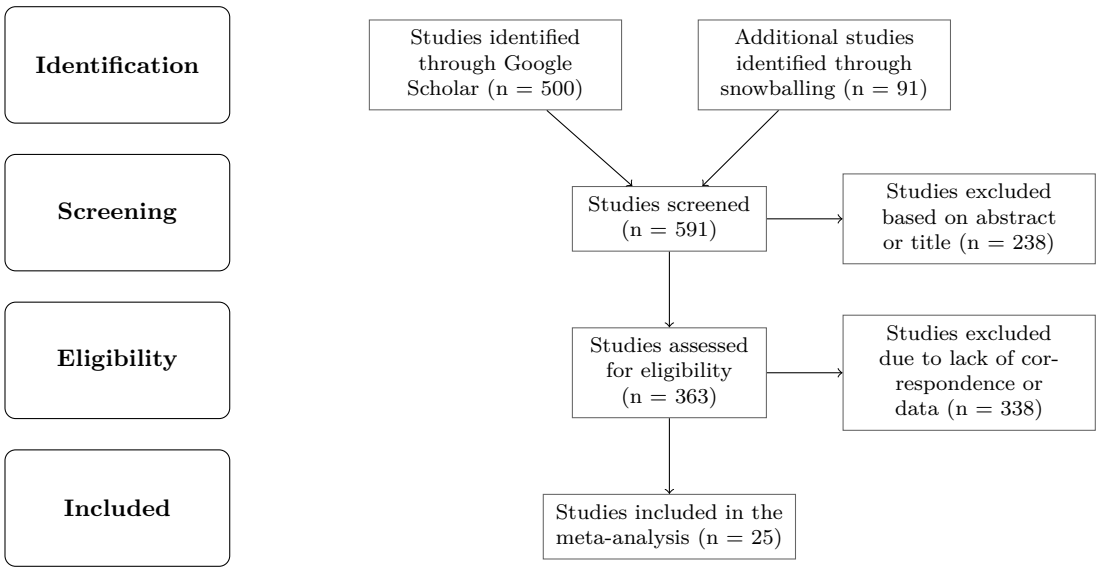
Appendix A

Figure A1: Schematics of study inclusion and exclusion (PRISMA)



Note: The figure presents a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram illustrating the process we followed to identify the relevant estimates from primary studies included in the sample.

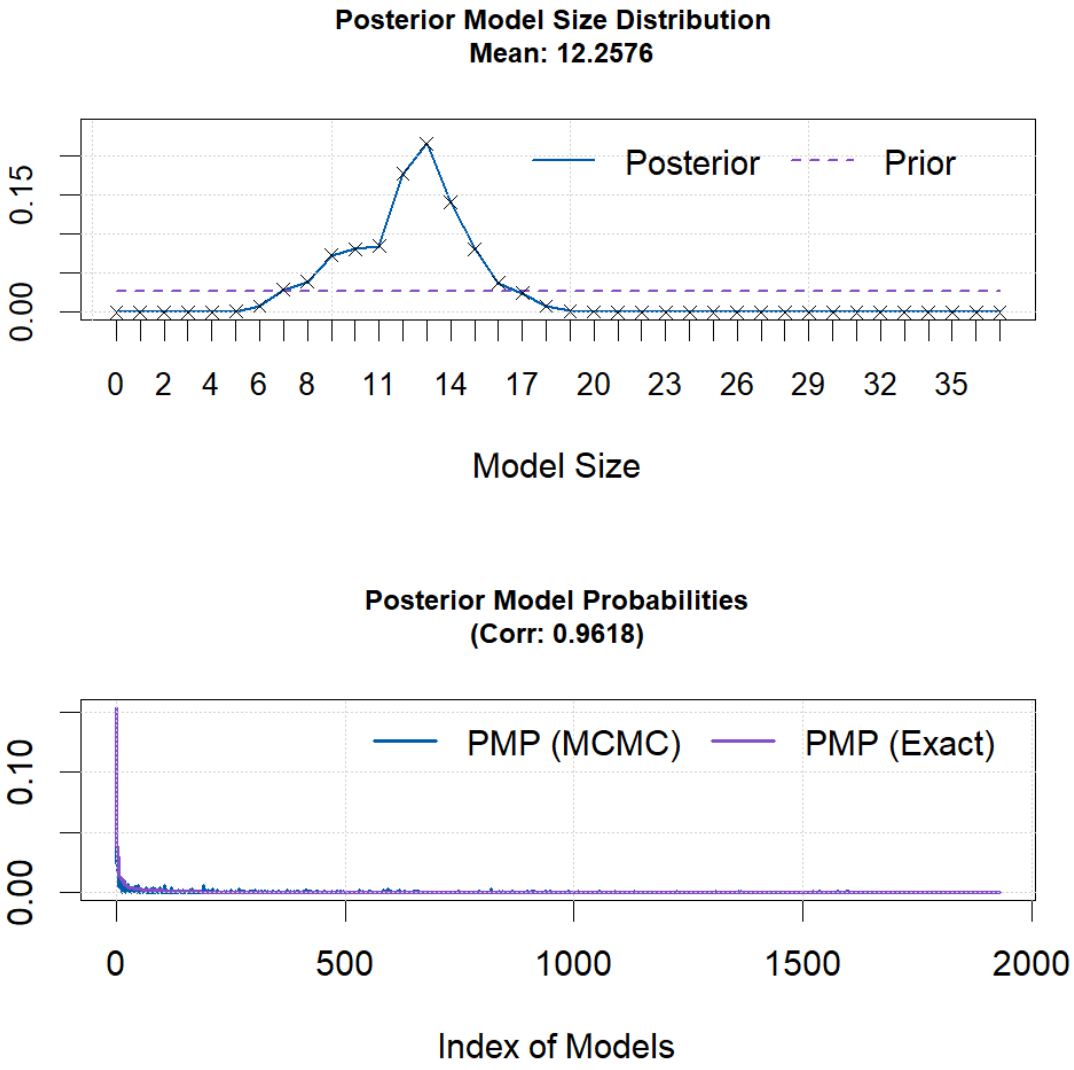


Figure A2: Model size and convergence of the BMA estimation(BRIC and random priors)

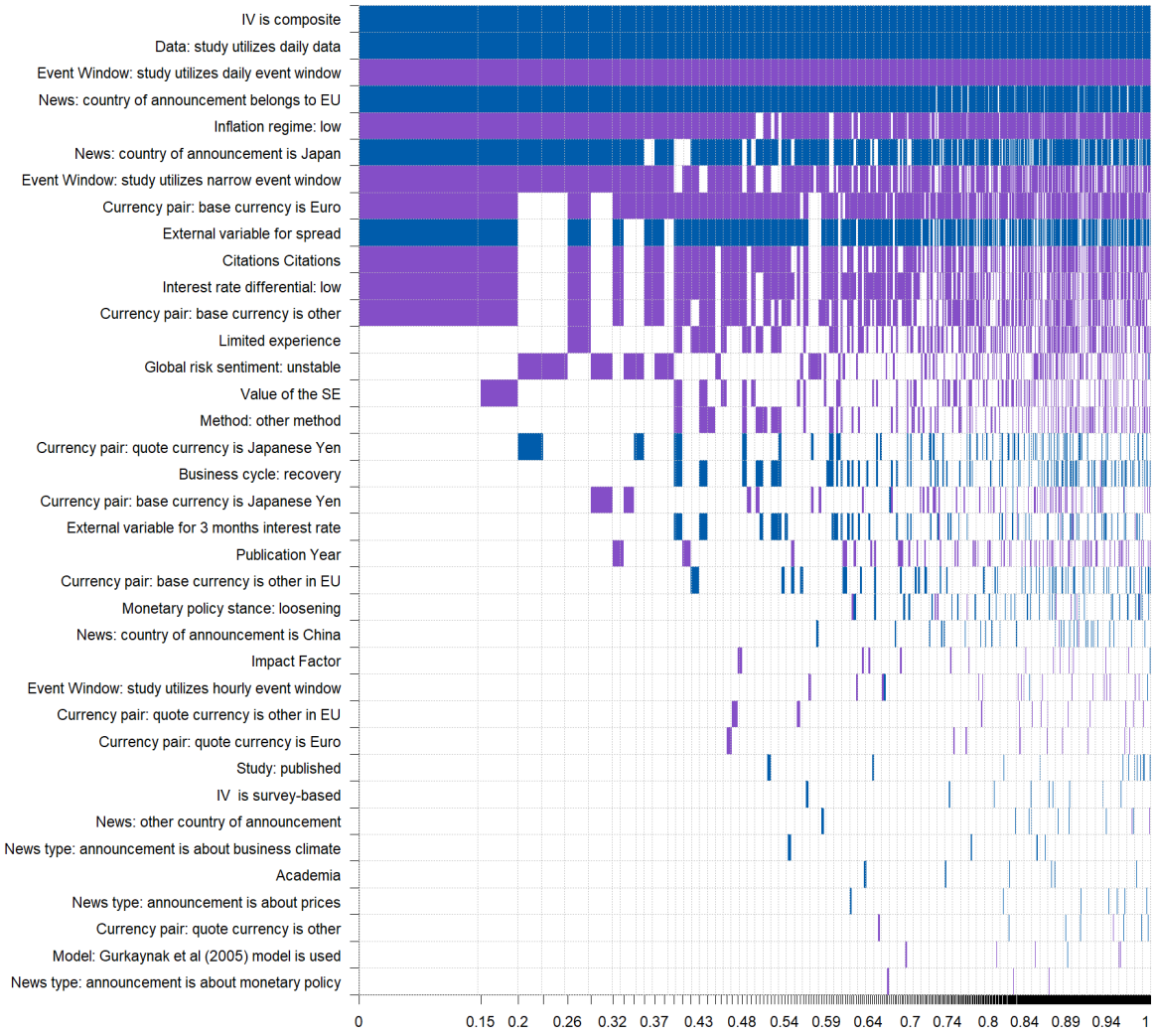


Figure A3: Model inclusion results (BRIC and random priors).

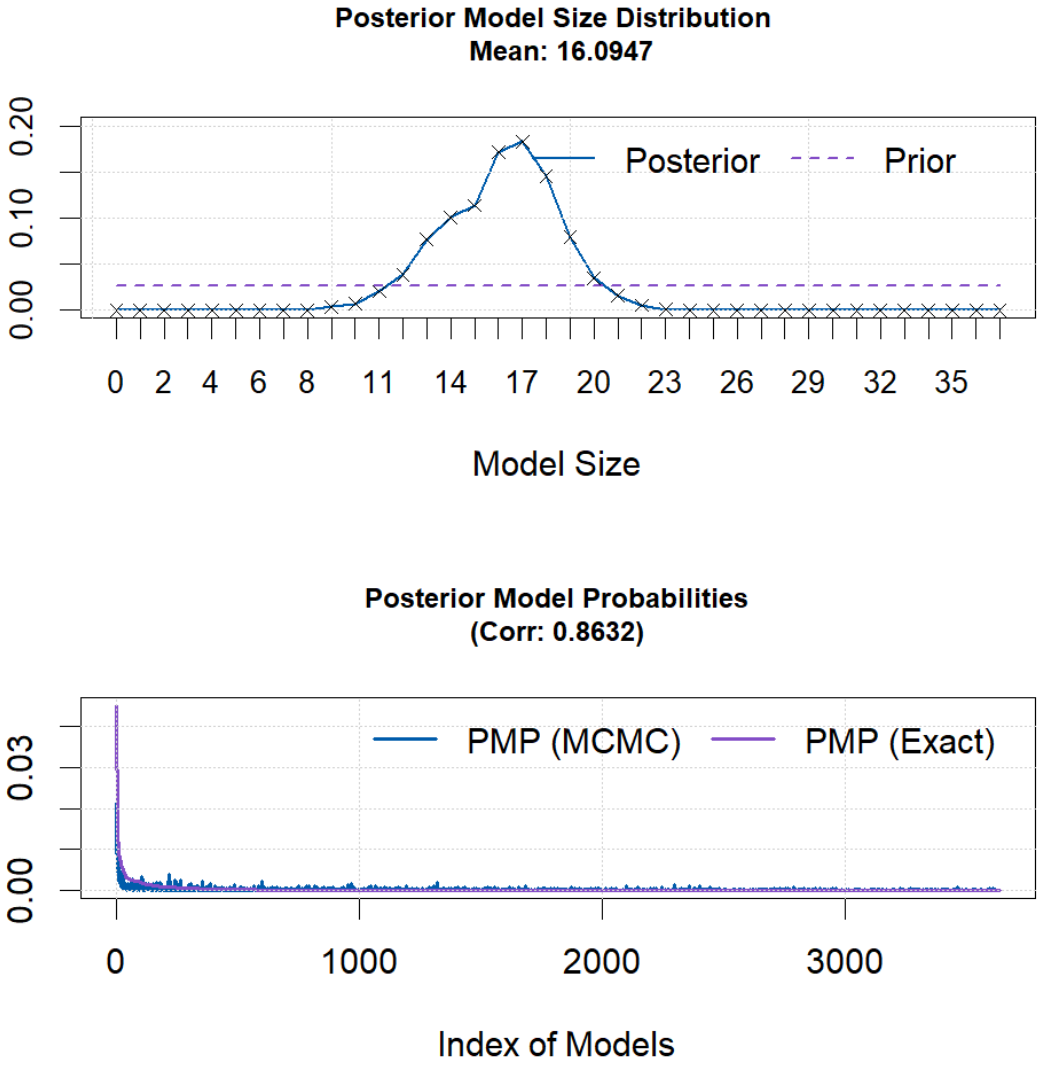


Figure A4: Model size and convergence of the BMA estimation (Hannan-Quinn priors).

Figure A5: Model inclusion results (Hannan-Quinn priors).

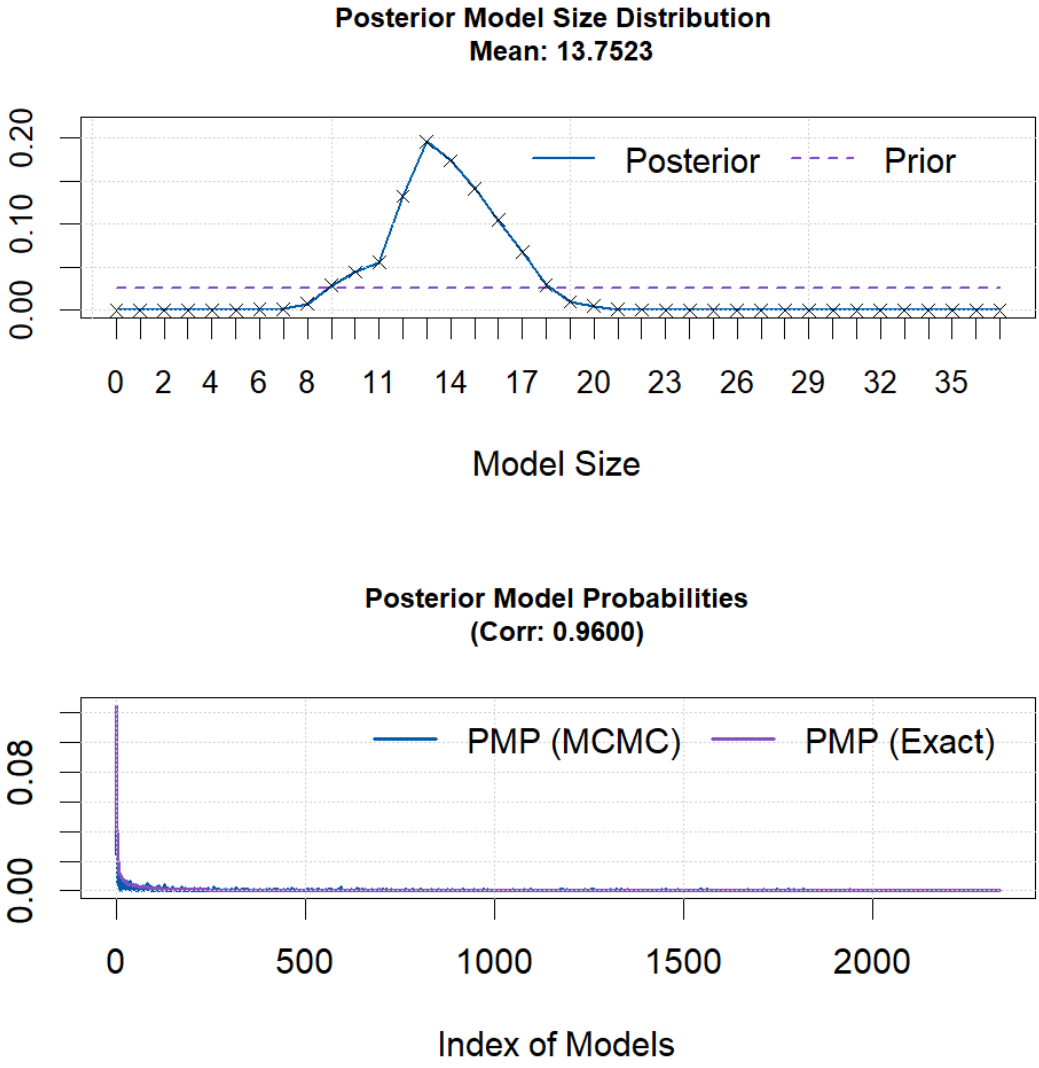


Figure A6: Model size and convergence of the BMA estimation (dilution priors).

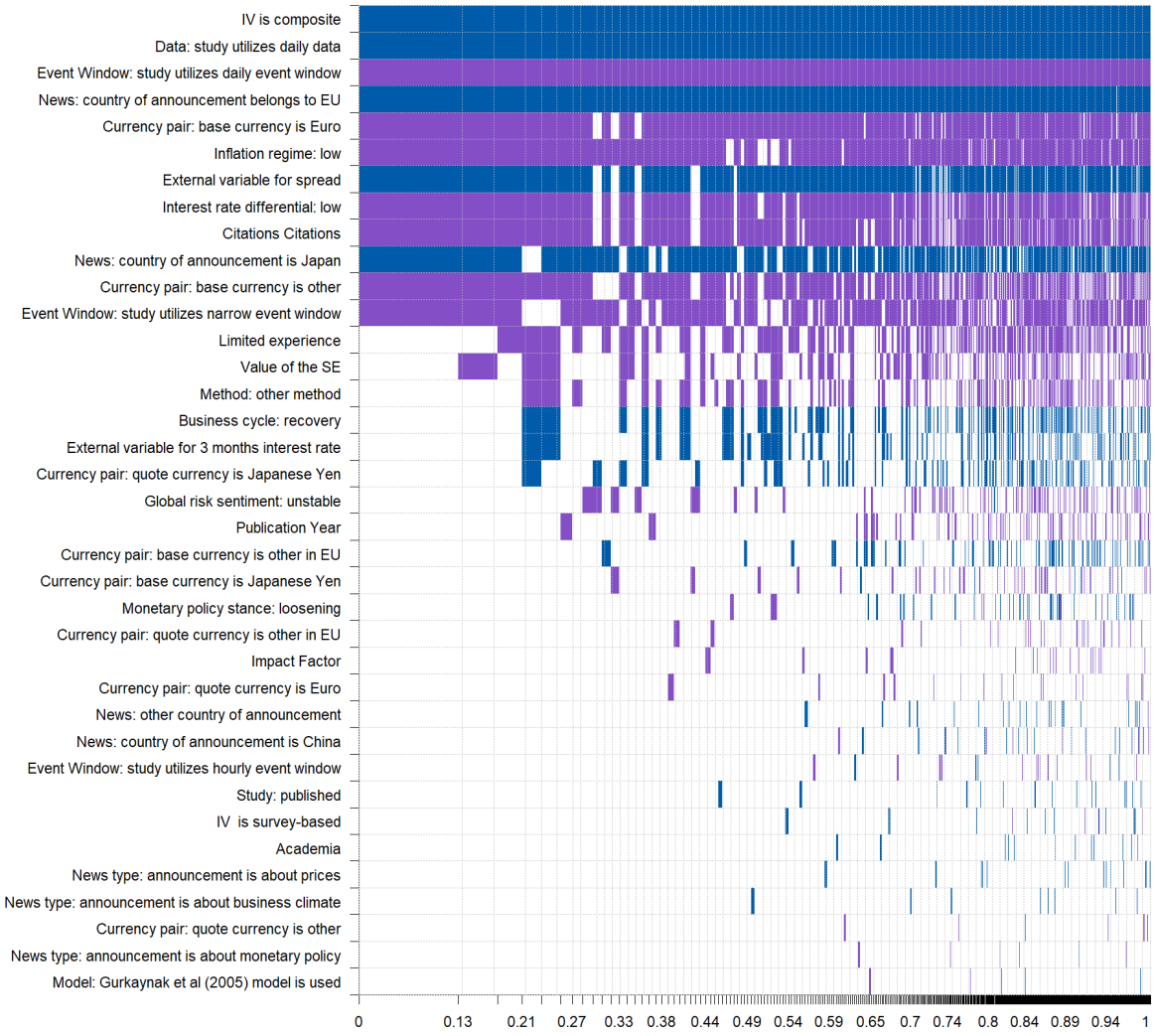


Figure A7: Model inclusion results (dilution priors).

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