

IMPACT OF BEHAVIOURAL ATTENTION ON THE HOUSEHOLDS' FOREIGN CURRENCY SAVINGS AS A RESPONSE TO THE EXTERNAL MACROECONOMIC SHOCKS

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Abstract

This paper investigates the impact of behavioural attention on the households' foreign currency savings as a response to the external macroeconomic shocks. The information that the households acquire *via* different communication channels is expected to influence their decisions regarding their savings' allocation into different currencies. This study has applied the fundamental macroeconomic models by including individuals' attention to the specific risks and search interest in specific keywords on Google in order to assess the impact of acquired information and its communication channel on the households' foreign currency savings. We employed a two-level mixed effects model including macroeconomic fundamentals and individuals' attention to the information determinants. We solved a problem of a long list of potential explanatory variables (keywords) by employing the Bayesian Model Averaging. This study assumes that households are more sensitive to the macroeconomic shocks (factors) if they search simultaneously for information on Google about these factors or specific related risks. The results emphasize the role behavioural attention during financial turmoil and economic downturn periods, especially in the environment of very low interest rates.

Keywords: foreign exchange, macroeconomic shocks, households, behavioural attention, Google Trends, Bayesian Model Averaging

JEL Classifications: F31, F62, D14, G11, C23, C11

1. Introduction

Traditional economic theory posits that individuals make investment decisions by maximizing a profit function and relying on macroeconomic fundamentals. However, the role of information and behavioural attention prevails in the environment of very low interest rates.

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Behavioural economists and policy makers are interested in how information that the households acquire via different communication channels influences their saving behaviour.

The importance of understanding the impact of behavioural attention on the households' foreign currency savings lies in a number of reasons. First, Schlueter *et al.* (2015) argue that a significant share of foreign currency savings creates a transmission channel of external monetary disturbances. External macroeconomic shocks increase the pressure on the monetary authorities to adjust these macroeconomic shocks using foreign reserves which in turns create the risk of national currency devaluation or speculative attacks regarding the national currency. Secondly, Allen and Saunders (2014) highlight that sudden decisions of households to reallocate savings in foreign currencies increase net foreign exchange position(s) of commercial banks resulting in an increase of foreign exchange risk. Thirdly, in Central and Eastern European countries (CEECs) the share of foreign currency deposits is significant. For example, in 2014 this share accounted for almost 40 *per cent* in Romania and almost 50 *per cent* in Bulgaria, while these countries are one of the most dependent economies on international remittances in the EU. In other CEECs (Hungary and Lithuania) the share of deposits in foreign currency is about 15–20 *per cent*, while in the Czech Republic, Poland, Estonia, and Latvia is less than 10 *per cent*. Fourthly, Olgu (2011) stresses that in selected CEECs (Latvia and Lithuania) the share of foreign currency deposits increased significantly in 2008–2009 in relation to the external macroeconomic shocks and domestic banking crisis suggesting that aggregate households' foreign currency savings are affected by different types of shocks. Finally, despite the importance of investigating and understanding the impact of behavioural attention on the households' foreign currency savings from a macroeconomic policy perspective, the behavioural attention and its impact on households' foreign currency savings has been investigated only in a few studies (Arifovic, 2001; Sharma *et al.*, 2005; Bresser-Pereira *et al.*, 2014; Kapounek *et al.*, 2016b).

This paper essentially improves our knowledge about the impact of behavioural attention on aggregate households' foreign currency savings and contributes to the literature on the behavioural attention of individuals in a few ways. First, this empirical study is a first cross-country study investigating the impact of behavioural attention on aggregate households' foreign currency savings. Previous empirical studies on the households' decisions regarding their savings currency have focussed only on one or several countries (Arifovic, 2001; Sharma *et al.*, 2005; Bresser-Pereira *et al.*, 2014). Secondly, this study focuses not only on macroeconomic fundamentals, but also includes individuals' attention's determinants potentially influencing their preferences to savings currency. The behavioural attention aspects of the households' saving decisions have not been investigated so far to our knowledge. Thirdly, this empirical study applies a novel manner to investigate the impact of behavioural attention on aggregate households' foreign currency savings using Google Trends data. The empirical findings contribute to the literature on the individuals' behavioural attention explanation using Google Trends data (Da *et al.*, 2011; Vlastakis and Markellos, 2012; Saxa, 2014; Irresberger *et al.*, 2015; Yang *et al.*, 2015; Kapounek *et al.*, 2016a). Finally, this study provides new insights on the impact of behavioural

attention on aggregate households' foreign currency savings and assumes that households are more sensitive to macroeconomic shocks (factors) if they search simultaneously for information on Google about these factors or specific related risks.

We employed a unique dataset constructed from domestic and foreign currency deposits' data, macroeconomic fundamentals, and Google's search keywords translated to different languages on 10 EU countries outside the euro area with their own currencies.

The empirical findings suggest that households' foreign currency savings are affected mostly by exchange rates movements and economic shocks, while the effect of inflation and interest rate shocks is very limited. We can assume that households' foreign currency savings could be influenced by individuals' more intense attention in specific risks and higher search interest on Google for specific keywords. The results emphasize the changes in the role of macroeconomic determinants on foreign currency savings during the times changing attention in these specific risks.

The organization of the paper is as follows. Section 2 provides theoretical background of the paper. Section 3 describes data and determinants used in macroeconomic models. Section 4 describes research strategy and methodology. Section 5 provides the empirical results, while Section 6 provides the results of robustness analysis. Section 7 discusses the main empirical findings and concludes.

2. Theoretical Background

While the paper investigates the impact of behavioural attention on aggregate households' foreign currency savings, the appropriate macroeconomic approach and model should be applied in order to determine the macroeconomic factors influencing households' foreign currency savings. Literature provides different macroeconomic approaches regarding the exchange rate determination (Boughton, 1988; Rogoff, 1996; Harvey, 1996; Nag and Mitra, 1998; Yuan, 2011).

The monetary approach originated from the traditional approach to the balance of payments explains the foreign exchange rate in terms of money supply and demand, level of real income, and interest rate both domestic and foreign using these variables for determination of the domestic and foreign price levels (Polak, 1957). According to the monetary approach, the exchange rate is determined by the ratio of the domestic and foreign price levels. A rise in foreign interest rate would lower the demand for cash of foreign currency and create an excess money supply of foreign currency, and consequently would cause a rise in foreign prices, followed by a depreciation of the foreign currency. However, the monetary approach does not incorporate the role of capital market in the exchange rate determination, despite the inclusion of interest rate, which role is limited to the effect on the price level.

In contrast to the monetary approach, the trade flows approach explains the foreign exchange rate in terms of international trade flows and current account. According to the trade flows approach, changes in monetary or fiscal policies or other shocks affect country's international trade flows through shifts in the terms of trade or in the relation between country's domestic consumption and output. The increased demand for imports will raise the demand for foreign exchange and consequently the exchange rate will tend to depreciate,

and conversely. In general, a strengthening of country's current account balance will cause an appreciation of the exchange rate, and *vice versa* (Isard, 1978; Mussa, 1979; Kenen, 1985).

While the portfolio balance approach developed by Tobin (1969) explains exchange rates movements by international capital flows changes; the portfolio balance approach assumes that investors have three different investment opportunities: domestic currency, foreign bonds, and domestic bonds. Whereas domestic and foreign bonds are not perfect investment substitutes, therefore, domestic and foreign bonds' yields can differ. According to the portfolio balance approach, the changes of investor's portfolio structure are caused either by country's current account imbalances or government policy decisions. When a particular country experiences a current account deficit, it disposes of foreign bonds creating an excess supply of foreign bonds, consequently foreign currency will depreciate, and conversely. The depreciation of foreign currency will eliminate the country's current account surplus, and *vice versa*. According to the portfolio balance approach, the current account is the main driving force resulting exchange rate movements, while capital market readjustments are short-term and only in response to changes in the current account.

Investigation of the impact of behavioural attention on aggregate households' foreign currency savings is based on two leading macroeconomic models grounded on competing macroeconomic approaches to exchange rates: (1) Monetary Model presented by Mark (1995), and (2) Portfolio Balance Model introduced by Hooper and Morton (1982).

Behavioural economists (Tversky and Kahneman, 1981; Knoll, 2010; Lee *et al.*, 2011, *etc.*) argue that different form of the information leads to different investment decisions by individuals. Moreover, Stanovich and West (2000) emphasize that the interpretation of information by investment decision makers leads to investment decision differences. In summary, Knoll (2010) provides a number of empirical findings in the judgment and decision making as well as in behavioural economics literatures and demonstrates that various aspects of the decision context can significantly affect the households' savings.

We assume that internet search data explain behavioural attention of economic individuals in different risk factors. Moreover, the households can reallocate their savings according to the changes of their attention to the risks. In addition, the sensitivity of households on macroeconomic fundamentals changes according to the behavioural attention.

The information that the households acquire *via* different communication channels is expected to influence their savings' allocation into different currencies. For this reason, we will also extend the fundamental macroeconomic models by including individuals' attention to the specific risks and search interest in specific keywords on Google in order to assess the impact of acquired information and its communication channel on households' foreign currency savings.

The usefulness of internet search data in forecasting of economic indicators has been confirmed in many empirical studies (Bulut, 2015; Guzi and de Pedraza García, 2015; Kapouněk *et al.*, 2016a), while scientists have only recently begun to use the Internet search data in explanation of individuals' behaviour. Previous empirical studies provide

substantial evidence about the usefulness of internet search data in explaining individuals' behaviour. Da *et al.* (2011) provided evidence that Google search data can capture investors' attention more efficiently comparing to other measures of investors' attention. Vlastakis and Markellos (2012) confirmed usefulness of Google Trends data for assessment of investors' information demand at the company and market level. Saxa (2014) examined the usefulness of Google Trends data for forecasting of individuals' behaviour and confirmed that internet search data improved forecasting results significantly. Irresberger *et al.* (2015) investigated investors' sentiments using Google Trends data and confirmed that some stock prices were significantly affected by investors' irrational sentiments irrespective of macroeconomic determinants. Yang *et al.* (2015) analysed the usefulness of search data for forecasting purposes of individuals' future behaviour and confirmed that search data significantly improved the forecasting performance. Kapounek *et al.* (2016a) provide evidence that individuals' behaviour was affected by their perception about specific risks and Google Trends data was useful in explaining individuals' saving decisions.

3. Data

The dataset in quarterly frequency covers 10 EU countries outside the euro area with their own currencies: Bulgaria, the Czech Republic, Hungary, Poland, Romania, Sweden, the United Kingdom, Estonia, Latvia, and Lithuania for the period 2004 Q1–2014 Q4. Denmark was not included in the data sample due the data unavailability, while Croatia joined the EU only on 1st July 2013. The ratio of households' deposits in foreign currency to total households' deposits¹ is used as a dependent variable in all estimations, while macroeconomic determinants (regressors) are derived from two macroeconomic models explaining the exchange rates movements and described in Section 2. The definition of all macroeconomic determinants is presented in Appendix 1.

The dataset is completed with keywords from Google Trends database (the publicly available web facility provided by Google Inc.), which represents the frequency of searching information about specific keywords on Google. Google Trends data represents an index calculated as the frequency of particular searches on Google relative to the total search volumes. The dataset includes the Google Trends keywords in national languages reflecting different risks including geopolitical risk, political risk, financial risk, currency risk, credit risk, and general economic situation. A comprehensive list of Google Trends keywords including their translations into national languages is presented in Appendix 2.

4. Methodology

First, we provide baseline estimations of two leading macroeconomic models explaining the exchange rates: Monetary Model (MM) (1), and Portfolio Balance Model (PBM) (2). Foreign currency savings, $SAVE_{it}$, represent share of aggregate households' deposits

1 In order to avoid the changes in foreign deposits caused by mechanical converting to national currency we used foreign deposits at the value of the exchange rate in the year 2009.

in foreign currency to total households' deposits held at the monetary financial institutions in country i and time t :

$$SAVE_{it} = \beta_0 + \beta_e NEER_{it} + \beta_m (M_{it} - M_{EAit}) + \beta_g (GDP_{it} - GDP_{EAit}) + \mu_i + \theta_t + \varepsilon_{it}, \quad (1)$$

$$SAVE_{it} = \beta_0 + \beta_e NEER_{it} + \beta_r (IR_{it} - IR_{EAit}) + \beta_p (\pi_{it} - \pi_{EAit}) + \beta_m (M_{it} - M_{EAit}) + \beta_g (GDP_{it} - GDP_{EAit}) + \beta_c CA + \mu_i + \theta_t + \varepsilon_{it}, \quad (2)$$

where variable $NEER$ represents nominal effective exchange rate, IR is a market interest rate, π represents an inflation rate, variable M is a monetary aggregate M1, GDP represents economic activity, and variable CA represents current account balance of a country i at time t , including fixed effects β . All the differentials are calculated in relation to the euro area, denoted by EA . Finally, we include random effects μ , time dummies θ , and a possibly heteroscedastic residual ε . Thus, we consider a two-level mixed effects model with a random-intercept term at the country level. All presented macroeconomic models consider with non-lagged and lagged regressors (for one-quarter).

While the CEECs are the most dependent economies on international remittances in the EU and our data sample contains 8 CEECs, we have also modified the basic Portfolio Balance Model by including personal remittances instead of current account balance in Equation 2. Our data sample contains three Baltic countries that have recently adopted the euro (Estonia in 2011, Latvia in 2014, and Lithuania in 2015), therefore we deal with the problem of joining the Eurozone and fix the exchange rate on central parity.

Second, we provide augmented regressions and include individuals' attention to the information and search interest in specific keywords on Google related to the specific risks including geopolitical risk, political risk, financial risk, currency risk, credit risk, and general economic situation denoted by variable $ATTENTION$, which represents the frequency of searching information about specific keywords on Google by individuals. The selected keywords (Table A2) were identified as the most popular topics related to phrases "foreign saving", "foreign deposit", "domestic saving", and "domestic deposit". The keywords can be considered as specific information that individuals want to learn or it is a matter of their concerns:

$$SAVE_{it} = \beta_0 + \sum_{s=1}^S \beta_s SHOCKS_{sit} + \sum_{l=1}^L \beta_l ATTENTION_{lit} + \mu_i + \theta_t + \varepsilon_{it}, \quad (3)$$

where the first set of variables, denoted by $SHOCKS$, represents selected macroeconomic determinants (shocks) specified in Equations (1)–(2). Due to the absence of the appropriate theoretical background we solve the problem of a long list of potential explanatory variables (keywords) and selection of the appropriate keywords of individuals' search interest by applying the Bayesian Model Averaging. Therefore, we reduce the uncertainty in the model by using Bayesian Model Averaging and estimate the probability of regressors to be included in the model. The Bayesian Model Averaging methodology is specified in Appendix 3.

Third, we interacted macroeconomic determinants with dummies and differentiate between the low and the high individuals' attention to the keywords related to specific risks, where the higher attention is represented by searches over the average in the country *i*.

We apply maximum likelihood estimator and provide logs of likelihood statistics, fixed effects are tested by the Wald test and random effects for each country are tested by the likelihood-ratio test to compare the model with a one-level ordinary linear regression.

5. Empirical Results

First, we perform baseline estimates for three different macroeconomic models with non-lagged regressors (Models 1–3) and lagged regressors (Models 4–5) (Table 1). The empirical results of the baseline regressions' with non-lagged regressors indicate that macroeconomic determinants derived from the Monetary Model and Portfolio Balance Model are statistically significant in explaining households' foreign currency savings. While the basic and modified Portfolio Balance Models provide the most comprehensive explanation of the impact of macroeconomic determinants on households' foreign currency savings comparing to other macroeconomic models. The empirical findings suggest that GDP differential has a significant impact on the share of foreign currency deposits in all macroeconomic models. These empirical findings demonstrate that a more intense domestic economic growth motivates households to increase the share of deposits in national currency suggesting about increased confidence in national currency related with the improving economic situation in country. The appreciation of the national currency affects negatively returns on foreign currency deposits and causes reallocation in favour on deposits in national currency, and conversely. In addition, the higher inflation differential motivates households to save more in foreign currencies. On the contrary, we cannot confirm a robust significant impact of both the interest rate differential as well as money supply differential. In addition, we can state that households' foreign currency savings are affected mostly by economic shocks and exchange rates movements, while the effect of money supply and interest rate shocks is very limited.

The empirical findings of the baseline regressions' with lagged regressors confirm the negative effect of the increased money supply on share of foreign currency deposits. These results suggest that households prefer to save money for short-term consumption in national currency rather than in foreign currency due to the conversion costs or short-term exchange rate fluctuations.

The results of augmented regressions including individuals' attention to selected keywords related to the specific risks are presented in Table 2. The selected keywords were identified by posterior inclusion probability assessed using Bayesian Model Averaging (see Appendix 4). However, we can assume a significant impact only of nine keywords related to political risk ("political", "parliament", "premier"), financial risk ("money", "risk"), currency risk (currency code), unemployment risk ("employment"), credit risk ("debt"), and general economic situation ("growth").

Table 1 | Determinants of Households' Foreign Currency Savings: Baseline Regressions

	Dependent variable: foreign currency deposits to total deposits (ln)					
	Basic models with non-lagged regressors			Basic models with lagged regressors		
Independent variables	MM	PBM	PBM (1)	MM	PBM	PBM (1)
	(1)	(2)	(3)	(4)	(5)	(6)
<i>NEER</i>	−0.288* (0.153)	−0.343* (0.188)	0.076 (0.155)	−0.260 (0.167)	−0.364** (0.185)	0.074 (0.176)
$M1_{local} - M1_{EA}$	0.077 (0.239)	0.277 (0.382)	0.215 (0.233)	−1.386*** (0.262)	0.057 (0.377)	−1.394*** (0.266)
$GDP_{local} - GDP_{EA}$	−2.776*** (0.544)	−2.329*** (0.637)	−1.991*** (0.532)	−2.337*** (0.597)	−2.496*** (0.628)	−1.950*** (0.606)
$IR_{local} - IR_{EA}$	– –	−0.004 (0.009)	−0.010 (0.007)	– –	−0.003 (0.008)	−0.019** (0.008)
$\pi_{local} - \pi_{EA}$	– –	0.008*** (0.002)	0.007*** (0.001)	– –	0.010*** (0.002)	0.005*** (0.001)
<i>CA</i>	– –	−0.073*** (0.014)	– –	– –	−0.064*** (0.014)	– –
<i>REM</i>	– –	– –	−0.020 (0.031)	– –	– –	−0.007 (0.035)
Constant	−1.213 (0.910)	−0.870 (1.056)	−2.954*** (0.891)	−1.314 (0.963)	−0.824 (1.041)	−2.911*** (0.974)
Random effects	Country	Country	Country	Country	Country	Country
LRL	88.21	71.40	115.2	57.06	74.86	71.25
Wald Test (χ^2)	136.2	193.1	198.2	186.7	206.0	218.4
LR Test ($\bar{\chi}^2$)	1462	861.0	1281	1401	866.5	1199
Time dummies	YES	YES	YES	YES	YES	YES
Number of observations	350	234	346	350	234	346
Number of countries	10	10	10	10	10	10

Note: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Source: own calculation

Table 2 | Determinants of Households' Foreign Currency Savings: Augmented Regressions

Independent variables	Dependent variable: foreign currency deposits to total deposits (ln)					
	Augmented models with non-lagged regressors			Augmented models with lagged regressors		
	MM	PBM	PBM (1)	MM	PBM	PBM (1)
	(1)	(2)	(3)	(4)	(5)	(6)
<i>NEER</i>	-0.520*** (0.147)	-0.098 (0.168)	-0.377** (0.153)	-0.584*** (0.184)	-0.138 (0.166)	-0.362* (0.197)
$M1_{local} - M1_{EA}$	-0.073 (0.191)	0.276 (0.282)	0.016 (0.188)	-1.675*** (0.238)	-0.022 (0.279)	-1.684*** (0.242)
$GDP_{local} - GDP_{EA}$	-2.301*** (0.432)	-2.113*** (0.452)	-1.783*** (0.430)	-2.115*** (0.538)	-2.260*** (0.447)	-1.856*** (0.552)
$IR_{local} - IR_{EA}$	- (0.006)	-0.004 (0.006)	0.001 (0.006)	- (0.006)	-0.002 (0.006)	-0.010 (0.008)
$\pi_{local} - \pi_{EA}$	- (0.002)	0.016*** (0.002)	0.009*** (0.002)	- (0.002)	0.019*** (0.002)	0.008*** (0.002)
<i>CA</i>	- (0.010)	-0.044*** (0.010)	- (0.010)	- (0.010)	-0.036*** (0.010)	- (0.010)
<i>REM</i>	- (0.025)	- (0.025)	-0.013 (0.025)	- (0.025)	- (0.025)	-0.011 (0.033)
Currency code	0.200*** (0.032)	0.330*** (0.041)	0.264*** (0.033)	0.186*** (0.040)	0.301*** (0.040)	0.225*** (0.042)
"Debt"	0.021 (0.025)	0.008 (0.030)	0.053** (0.025)	0.059* (0.032)	0.028 (0.030)	0.094*** (0.032)
"Money"	0.137** (0.061)	0.119* (0.067)	0.154*** (0.059)	-0.018 (0.076)	0.145** (0.066)	-0.010 (0.076)
"Growth"	-0.215*** (0.028)	-0.153*** (0.029)	-0.182*** (0.027)	-0.163*** (0.035)	-0.143*** (0.029)	-0.135*** (0.035)
"Employment"	-0.116*** (0.025)	-0.226*** (0.037)	-0.088*** (0.024)	-0.067** (0.031)	-0.228*** (0.037)	-0.038 (0.031)
"Political"	-0.037 (0.044)	0.150*** (0.055)	0.022 (0.044)	-0.011 (0.055)	0.181*** (0.054)	0.036 (0.057)
"Parliament"	0.046 (0.039)	0.005 (0.043)	0.052 (0.038)	-0.008 (0.049)	0.013 (0.043)	0.000 (0.049)
"Premier"	-0.058** (0.026)	-0.067** (0.030)	-0.083*** (0.026)	-0.063* (0.033)	-0.060** (0.030)	-0.079** (0.033)
"Risk"	-0.147*** (0.048)	0.005 (0.057)	-0.048 (0.050)	-0.110* (0.060)	-0.042 (0.057)	-0.027 (0.065)
Constant	0.022 (0.902)	-3.167*** (1.038)	-1.759* (0.952)	0.594 (1.062)	-3.107*** (1.024)	-1.317 (1.162)
Random effects	Country	Country	Country	Country	Country	Country
LRL	177.2	154.3	192.3	103.6	156.8	109.4
Wald Test (χ^2)	485.9	691.7	534.5	367.2	711.5	375.2
LR Test (χ^2)	1029	666.1	981.7	884.6	666.9	823.2
Time dummies	YES	YES	YES	YES	YES	YES
Number of observations	343	227	339	343	227	339
Number of countries	10	10	10	10	10	10

Note: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Source: own calculation

The empirical estimations of augmented regressions' with non-lagged regressors provide evidence that macroeconomic determinants derived from both the basic and modified Portfolio Balance Models are significant in explaining households' foreign currency savings. In addition, the empirical findings suggest that inflation differential has a statistically significant impact on the share of foreign currency deposits in all macroeconomic models. These results suggest that a higher inflation differential motivate households to prefer saving in foreign currencies due to the decreasing real return on domestic currency deposits.

The results of augmented regressions' with non-lagged regressors confirm a robust significant impact of three keywords such as currency code, "growth", and "premier" in all macroeconomic models. The provided empirical estimations allow us to assume that exchange rates movements and more intense domestic economic growth have a significant impact on the share of foreign currency deposits in all macroeconomic models due to the individuals' more intense attention and higher search interest in currency code and keyword "growth" in Google respectively. In addition, individuals' higher search interest in currency code has a significant positive effect on the share of foreign currency deposits, while an opposite effect of search interest in keywords "growth" and "premier" was identified.

Thus, we can summarize that aggregate households' foreign currency savings could be influenced by individuals' more intense attention in specific risks and higher search interest in Google for specific keywords. We can assume that households' reaction to the external macroeconomic shocks (exchange rates and economic shocks) could be affected by their search activities in Google. These empirical findings suggest that the communication strategy (including the communication channels) of the public authorities during financial turmoil and economic downturn periods could affect aggregate households' foreign currency savings. The results of augmented regressions' with lagged regressors confirmed the empirical findings of the augmented regressions' with non-lagged regressors.

Table 3 demonstrates different impact of macroeconomic shocks on the households' foreign currency savings if individuals' attention (frequency of searches) to specific risks and specific keywords on Google is above or below the average. The previous empirical results did not provide a significant and robust effect of interest rate differential on the share of foreign currency deposits. The empirical estimations of augmented Portfolio Balance Model's confirm that interest rate differential is a significant macroeconomic determinant resulting households' deposits reallocation if frequency of searches in keyword "money" and currency code exceeds the average. These empirical findings suggest that events related to the national currency changes and disclosed by the media *via* internet channel increase the attention of households and motivate households to reallocate their deposits in relation to interest rate differential changes. In addition, these findings suggest that a higher interest rate differential motivate households to prefer saving in national currency rather than in foreign currencies due to the earning motives.

The regression results of augmented Portfolio Balance Model's provide substantial evidence that aggregate households' foreign currency savings are affected by exchange rate movements, more intense domestic economic growth, higher inflation differential, and changes in domestic current account balance despite the level of their attention. However, we assume that increased

individuals' attention to the specific risks and more intense search interest on Google plays a crucial role in the foreign currency deposits reallocation and emphasizes the role of policy makers' communication strategy, especially in the environment of very low interest rates.

Table 3 | Determinants of Households' Foreign Currency Savings: Augmented Portfolio Balance Model

Independent variables	Dependent variable: foreign currency deposits to total deposits (ln)								
	Google keywords								
	Currency code	"Debt"	"Money"	"Growth"	"Employment"	"Political"	"Parliament"	"Premier"	"Risk"
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>NEER</i> (>A)	-0.782*** (0.181)	-0.449** (0.190)	-0.444** (0.198)	-0.078 (0.167)	-0.289 (0.191)	-0.419** (0.177)	-0.347* (0.181)	-0.249 (0.217)	-0.410** (0.184)
<i>NEER</i> (<A)	-0.637*** (0.171)	-0.402** (0.185)	-0.408** (0.190)	-0.044 (0.169)	-0.264 (0.196)	-0.477*** (0.182)	-0.382** (0.185)	-0.341 (0.211)	-0.420** (0.188)
<i>M1_{loc}</i> - <i>M1_{EA}</i> (>A)	-0.279 (0.531)	-0.574 (0.505)	0.156 (0.477)	-0.316 (0.421)	0.245 (0.467)	0.294 (0.406)	0.379 (0.423)	-0.180 (0.503)	0.237 (0.444)
<i>M1_{loc}</i> - <i>M1_{EA}</i> (<A)	0.649 (0.418)	1.123** (0.464)	0.999** (0.463)	-0.210 (0.452)	0.518 (0.543)	0.492 (0.590)	0.143 (0.543)	0.026 (0.447)	0.451 (0.499)
<i>GDP_{loc}</i> - <i>GDP_{EA}</i> (>A)	-3.810*** (0.813)	-1.935* (1.102)	-1.292 (0.882)	-2.297** (0.923)	-1.976** (0.946)	-1.463** (0.741)	-1.693** (0.804)	-3.540*** (1.065)	-1.782* (0.969)
<i>GDP_{loc}</i> - <i>GDP_{EA}</i> (<A)	-0.354 (0.857)	-2.482*** (0.748)	-2.748*** (0.800)	-1.462** (0.720)	-2.674*** (0.824)	-3.941*** (0.904)	-3.303*** (0.871)	-1.291* (0.705)	-2.549*** (0.776)
<i>IR_{loc}</i> - <i>IR_{EA}</i> (>A)	-0.039*** (0.009)	-0.011 (0.010)	-0.026** (0.012)	-0.001 (0.009)	-0.004 (0.011)	0.011 (0.009)	0.006 (0.009)	0.001 (0.009)	-0.001 (0.010)
<i>IR_{loc}</i> - <i>IR_{EA}</i> (<A)	0.014 (0.009)	0.010 (0.010)	0.014 (0.010)	0.016* (0.009)	0.000 (0.010)	-0.049*** (0.012)	-0.042*** (0.012)	-0.008 (0.011)	-0.013 (0.009)
$\pi_{loc} - \pi_{EA}$ (>A)	0.008*** (0.002)	0.009*** (0.002)	0.011*** (0.003)	0.006*** (0.002)	0.011*** (0.003)	0.006** (0.003)	0.007** (0.003)	0.007*** (0.002)	0.009*** (0.003)
$\pi_{loc} - \pi_{EA}$ (<A)	0.001 (0.003)	0.007*** (0.002)	0.008*** (0.003)	0.000 (0.002)	0.008*** (0.002)	0.010*** (0.002)	0.008*** (0.003)	0.010*** (0.002)	0.006*** (0.002)
<i>CA</i> (>A)	-0.038*** (0.014)	-0.043** (0.018)	-0.056*** (0.019)	-0.043*** (0.016)	-0.067*** (0.018)	-0.112*** (0.019)	-0.113*** (0.020)	-0.121*** (0.020)	-0.100*** (0.024)
<i>CA</i> (<A)	-0.177*** (0.023)	-0.088*** (0.016)	-0.082*** (0.016)	-0.030* (0.017)	-0.079*** (0.018)	-0.051*** (0.015)	-0.059*** (0.015)	-0.042*** (0.015)	-0.062*** (0.015)
Constant	1.089 (1.033)	-0.507 (1.051)	-0.510 (1.073)	-2.163** (0.973)	-1.235 (1.079)	-0.300 (1.031)	-0.717 (1.040)	-1.083 (1.159)	-0.489 (1.055)
Random effects	Country	Country	Country	Country	Country	Country	Country	Country	Country
LRL	99.68	79.51	84.11	106.4	73.25	87.78	82.60	85.52	80.15
Wald Test (χ^2)	313.7	224.4	242.9	346.3	199.9	259.1	237.3	249.2	227.3
LR Test (χ^2)	868.7	868.9	879.2	913.0	846.5	868.5	860.1	835.1	839.9
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	234	234	234	234	234	234	234	234	234
Number of countries	10	10	10	10	10	10	10	10	10

Note: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. > A denotes the cases when frequency of searching in events is above the average, while < A denotes the cases when frequency of searching in events is below the average.

Source: own calculation

6. Robustness Analysis

Tables 4 to 5 show the results of our robustness checks in relation to the positive (Tables 4) and negative (Table 5) changes in share of foreign currency deposits. The results of robustness analysis presented in Tables 4 to 5 are very similar suggesting about the robustness of augmented Portfolio Balance Model's results in relation to the positive and negative changes in share of foreign currency deposits. However, we can state that increased individuals' attention to the specific risks and search interest for specific keywords on Google results negative changes in share of foreign currency deposits. These empirical results suggest that households are more confident in national currency in the context of external macroeconomic shocks.

In addition, we can state that interest rate differential is a significant macroeconomic determinant affecting aggregate households' foreign currency savings when individuals increase search attention in keywords such as currency code, money. These results suggest that households take into account the differences in interest rates only if they search simultaneously for information on Google on exchanges rate changes. We can also state that the reaction of households to the information related to the political situation in country is not affecting their saving decisions.

Table 4 | Robustness of Augmented Portfolio Balance Model: Positive Changes of Foreign Currency Deposits' Ratio

	Dependent variable: Δ of foreign currency deposits to total deposits (ln) ($\Delta > 0$)								
	Google keywords								
	Currency code	"Debt"	"Money"	"Growth"	"Employment"	"Political"	"Parliament"	"Premier"	"Risk"
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>NEER</i> ($>A$)	-0.404 (0.282)	-0.261 (0.279)	-0.246 (0.402)	0.230 (0.250)	0.101 (0.290)	-0.115 (0.303)	0.123 (0.302)	-0.254 (0.349)	0.096 (0.301)
<i>NEER</i> ($<A$)	-0.216 (0.264)	-0.205 (0.272)	-0.161 (0.374)	0.256 (0.246)	0.152 (0.297)	-0.194 (0.319)	0.047 (0.312)	-0.311 (0.331)	0.066 (0.308)
$M1_{loc} - M1_{EA}$ ($>A$)	-0.312 (0.706)	-1.428** (0.676)	0.196 (0.870)	-0.850 (0.520)	-0.388 (0.616)	0.159 (0.552)	0.124 (0.603)	-1.640** (0.759)	-0.269 (0.668)
$M1_{loc} - M1_{EA}$ ($<A$)	0.128 (0.564)	1.314** (0.634)	0.515 (0.593)	0.139 (0.668)	0.643 (0.782)	-0.685 (1.178)	0.695 (0.818)	-0.331 (0.616)	0.544 (0.668)
$GDP_{loc} - GDP_{EA}$ ($>A$)	-5.553*** (1.087)	-3.589** (1.545)	-2.694* (1.495)	-3.892*** (1.163)	-2.010 (1.404)	-1.410 (1.012)	-0.869 (1.038)	-2.736 (1.695)	-1.279 (1.277)
$GDP_{loc} - GDP_{EA}$ ($<A$)	1.461 (1.080)	-2.454*** (0.880)	-1.943* (1.152)	-2.915*** (1.036)	-2.748** (1.127)	-5.458*** (1.583)	-4.933*** (1.161)	-1.595* (0.844)	-3.628*** (1.016)
$IR_{loc} - IR_{EA}$ ($>A$)	-0.044*** (0.013)	-0.013 (0.017)	-0.009 (0.020)	-0.017 (0.014)	0.008 (0.018)	0.008 (0.014)	0.007 (0.013)	0.014 (0.015)	0.007 (0.020)
$IR_{loc} - IR_{EA}$ ($<A$)	-0.010 (0.015)	0.005 (0.013)	-0.004 (0.020)	-0.015 (0.012)	-0.001 (0.016)	-0.038** (0.018)	-0.034* (0.019)	-0.001 (0.017)	-0.022 (0.016)
$\pi_{loc} - \pi_{EA}$ ($>A$)	0.004 (0.003)	0.007* (0.003)	0.008* (0.004)	0.001 (0.003)	0.004 (0.004)	0.003 (0.005)	0.004 (0.004)	0.000 (0.004)	0.003 (0.005)
$\pi_{loc} - \pi_{EA}$ ($<A$)	-0.002 (0.004)	0.008** (0.003)	0.009* (0.005)	0.003 (0.004)	0.009** (0.004)	0.006* (0.003)	0.006 (0.004)	0.004 (0.003)	0.006 (0.004)
<i>CA</i> ($>A$)	-0.034** (0.016)	-0.031 (0.024)	-0.042 (0.031)	-0.063*** (0.021)	-0.069*** (0.026)	-0.143*** (0.029)	-0.146*** (0.030)	-0.125*** (0.030)	-0.126*** (0.037)
<i>CA</i> ($<A$)	-0.204*** (0.033)	-0.097*** (0.018)	-0.088*** (0.022)	-0.057*** (0.021)	-0.117*** (0.027)	-0.053*** (0.019)	-0.074*** (0.017)	-0.053*** (0.019)	-0.080*** (0.018)
Constant	-0.664 (1.442)	-1.454 (1.408)	-1.612 (1.897)	-3.515*** (1.306)	-3.096** (1.501)	-1.584 (1.590)	-2.793* (1.556)	-1.070 (1.694)	-2.725* (1.549)
Random effects	Country	Country	Country	Country	Country	Country	Country	Country	Country
LRL	56.91	45.39	43.99	54.77	37.75	43.55	42.35	44.75	39.38
Wald Test (χ^2)	377.3	273.9	262.6	355.8	219.5	260.9	252.2	270.3	231.6
LR Test (χ^2)	398.8	397.2	402.6	409.5	384.5	383.1	387.4	365.7	364.8
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	106	106	106	106	106	106	106	106	106
Number of countries	10	10	10	10	10	10	10	10	10

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. $>A$ denotes the cases when frequency of searching in events is above the average, while $<A$ denotes the cases when frequency of searching in events is below the average.

Source: own calculation

Table 5 | Robustness of Augmented Portfolio Balance Model: Negative Changes of Foreign Currency Deposits' Ratio

	Dependent variable: Δ of foreign currency deposits to total deposits (ln) ($\Delta < 0$)								
	Google keywords								
	Currency code	"Debt"	"Money"	"Growth"	"Employment"	"Political"	"Parliament"	"Premier"	"Risk"
Independent variables	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
$NEER(>A)$	-0.793*** (0.253)	-0.227 (0.256)	-0.335 (0.242)	-0.228 (0.211)	-0.083 (0.257)	-0.433* (0.235)	-0.278 (0.235)	-0.211 (0.265)	-0.380 (0.258)
$NEER(<A)$	-0.705*** (0.239)	-0.202 (0.246)	-0.318 (0.230)	-0.212 (0.217)	-0.065 (0.264)	-0.482** (0.241)	-0.294 (0.238)	-0.349 (0.262)	-0.422 (0.261)
$M1_{loc} - M1_{EA}(>A)$	0.015 (0.706)	0.241 (0.649)	0.047 (0.519)	-0.011 (0.668)	1.426** (0.618)	0.586 (0.576)	0.870 (0.540)	0.060 (0.629)	0.965 (0.610)
$M1_{loc} - M1_{EA}(<A)$	0.654 (0.606)	1.138* (0.651)	2.967*** (0.726)	-0.263 (0.563)	0.036 (0.803)	1.083 (0.734)	0.301 (0.746)	0.977* (0.585)	0.710 (0.732)
$GDP_{loc} - GDP_{EA}(>A)$	-1.809 (1.150)	2.154 (1.601)	-0.575 (1.123)	-2.078* (1.230)	-1.806 (1.366)	-1.584 (1.258)	-2.826* (1.444)	-3.078** (1.315)	-3.252** (1.388)
$GDP_{loc} - GDP_{EA}(<A)$	-2.473** (1.238)	-4.100*** (1.112)	-5.607*** (1.220)	-1.730* (1.007)	-3.410*** (1.275)	-2.203* (1.169)	-0.985 (1.223)	-0.969 (1.140)	-2.000* (1.150)
$IR_{loc} - IR_{EA}(>A)$	-0.043*** (0.013)	-0.016 (0.013)	-0.033** (0.015)	0.017* (0.010)	-0.004 (0.014)	0.011 (0.011)	0.007 (0.011)	0.007 (0.011)	0.008 (0.013)
$IR_{loc} - IR_{EA}(<A)$	0.017 (0.011)	0.010 (0.013)	0.024* (0.012)	0.029** (0.012)	0.009 (0.013)	-0.066*** (0.017)	-0.059*** (0.019)	-0.013 (0.014)	-0.014 (0.013)
$\pi_{loc} - \pi_{EA}(>A)$	0.011*** (0.003)	0.010*** (0.003)	0.015*** (0.003)	0.003 (0.003)	0.014*** (0.004)	0.007** (0.003)	0.011*** (0.004)	0.009*** (0.003)	0.008** (0.004)
$\pi_{loc} - \pi_{EA}(<A)$	0.003 (0.004)	0.011*** (0.003)	0.014*** (0.004)	-0.004 (0.003)	0.010*** (0.003)	0.011*** (0.003)	0.012*** (0.003)	0.014*** (0.003)	0.007* (0.003)
$CA(>A)$	-0.092*** (0.024)	-0.069** (0.028)	-0.081*** (0.027)	-0.094*** (0.025)	-0.101*** (0.030)	-0.132*** (0.026)	-0.119*** (0.024)	-0.161*** (0.027)	-0.156*** (0.033)
$CA(<A)$	-0.177*** (0.030)	-0.102*** (0.028)	-0.103*** (0.024)	-0.054** (0.025)	-0.098*** (0.029)	-0.075*** (0.029)	-0.068** (0.031)	-0.037 (0.025)	-0.101*** (0.027)
Constant	1.508 (1.317)	-1.336 (1.318)	-0.795 (1.249)	-0.990 (1.190)	-1.815 (1.374)	-0.035 (1.266)	-0.712 (1.266)	-0.929 (1.362)	-0.121 (1.372)
Random effects	Country	Country	Country	Country	Country	Country	Country	Country	Country
LRL	57.80	50.66	59.42	67.60	45.20	54.06	52.21	58.86	46.41
Wald Test (χ^2)	255.5	211.4	263.0	322.9	182.2	232.1	220.7	260.8	189.8
LR Test (χ^2)	418.1	436.0	439.4	469.2	420.3	442.5	426.4	438.7	407.2
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	128	128	128	128	128	128	128	128	128
Number of countries	10	10	10	10	10	10	10	10	10

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. > A denotes the cases when frequency of searching in events is above the average, while <A denotes the cases when frequency of searching in events is below the average.

Source: own calculation

7. Conclusions

The paper investigates the impact of behavioural attention on the households' foreign currency savings as response to the external macroeconomic shocks. We apply two leading macroeconomic models based on competing macroeconomic approaches to exchange rate: Monetary Model, and Portfolio Balance Model. We have also extended the macroeconomic models by including individuals' attention to the specific risks and search interest in specific keywords on Google in order to assess the impact of information's communication channel on the aggregate households' foreign currency savings.

The empirical estimations provide substantial evidence that macroeconomic determinants derived from the basic and modified Portfolio Balance Models are significant in explaining aggregate households' foreign currency savings. The empirical findings suggest that exchange rate movements have a significant impact on the share of foreign currency deposits, while the appreciation of the national currency affects negatively returns on foreign currency deposits and causes reallocation in favour on deposits in national currency, and conversely. The empirical findings also demonstrate that a more intense domestic economic growth motivates households to increase the share of deposits in national currency suggesting about increased confidence in national currency related with the improving economic situation in country. In summary, aggregate households' foreign currency savings are affected mostly by exchange rates movements and economic shocks, while the effect of inflation and interest rate shocks is very limited.

We can assume that households' reaction to the external macroeconomic shocks (exchange rates and economic shocks) could be affected by their search activities on Google. Thus, we can summarize that aggregate households' foreign currency savings could be influenced by individuals more intense attention in specific risks and higher search interest on Google for specific keywords. In other words, households are more sensitive to macroeconomic factors when they search for information on Google about these factors or related risks. In addition, we assume that increased households' attention to the specific risks and more intense search interest on Google plays a crucial role in the portfolio rebalancing.

Our findings could be used for policy makers' communication strategy, especially in the environment of very low interest rates. The empirical findings suggest that the communication strategy (including the communication channels) of the central banks and governments during financial turmoil and economic downturn periods could affect the households' foreign currency savings.

Appendices

Appendix 1 | Definition of Variables

Variable	Definition	Source
SAVE	Households' deposits in foreign currency to total households' deposits held at the monetary financial institutions (MFIs) ratio	Bank of Estonia, Bank of Lithuania, Bank of Latvia, Czech National Bank, Bulgarian National Bank, National Bank of Poland, National Bank of Hungary, Swedish National Bank, National Bank of Romania, Bank of England
NEER	Nominal effective exchange rate as the weighted average of bilateral nominal exchange rates against the currencies of selected 42 trading partners (chain index)	Eurostat
IR	Short-term (3 months) money market interest rate (%)	Eurostat, OECD (Main Economic Indicators), IMF (International Financial Statistics), Czech National Bank
GDP	Gross domestic product in current prices (chain index)	Eurostat
M	Money supply M1 (currency in circulation and demand deposits) (chain index)	IMF (International Financial Statistics), OECD (Main Economic Indicators)
CA	Current account balance (chain index)	Eurostat, Bulgarian National Bank
REM	Workers' remittances (chain index)	IMF (Balance of Payments)
π	Inflation measured by GDP deflator (%)	Eurostat
Google keywords	Google Trends keywords in national languages reflecting different risks: geopolitical risk ("attack", "war", "freedom"), political risk ("political", "corruption", "election", "president", "parliament", "senate", "premier"), financial risk ("money", "bank", "risk", "loss"), currency risk (currency code, currency name), unemployment risk ("employment", "unemployment", "job"), credit risk ("debt", "indebtedness"), and general economic situation ("inflation", "growth", "competitiveness", "recession", "crisis")	Google Trends database

Note: Data on GDP and M1 are seasonally adjusted.

Source: own processing

Appendix 2 | Google Keywords

Google keyword	Translation to the local languages
Currency code	CZK, PLN, HUF, LTL, GBP, BGN, SEK, RON, EEK, LVL
Currency name	koruna, złoty, forint, litas, pound, лев, krona, leu, kroon, lats
“Crisis”	krize, kryzys, válság, krizè, crisis, криза, kris, criză, kriis, krize
“Inflation”	inflace, inflacja, infláció, inflacija, inflation, инфляция, inflation, umflare, inflatsioon, inflācija
“Debt”	dluh, dług, adósság, skola, debt, дълг, skuld, datorie, völg, parāds
“Indebtedness”	zadlužení, zadlženie, eladósodottság, įsiskolinimas, indebtedness, задълженост, skuldsātnīng, îndatorare, völgnevus, parādsaistības
“Money”	peníze, pieniądze, pénz, pinigai, money, пари, pengar, bani, raha, nauda
“Bank”	banka, bankovní, banky, banku, bankowy, banki, bank, banki, bank, bankas, bankininkystė, bankai, bank, banking, banks, банкови, банково, дело, банки, bank, bank, banker, bancare, servicii, bancare, băncile, pank, pangandus, pankade, banku, banku, bankas
“Growth”	růst, wzrost, növekedés, augimas, growth, растеж, tillväxt, creștere, kasv, pieaugums
“Employment”	zaměstnanost, zatrudnienie, foglalkoztatás, užimtumas, employment, наемане на работа, sysselsättning, ocuparea, forței de muncă, tööhõive, nodarbinātība
“Unemployment”	nezaměstnanost, bezrobocie, munkanélküliség, nedarbas, unemployment, безработица, arbetslöshet, șomaj, tööpuudus, bezdarbs
“Job”	práce, praca, munka, darbas, job, работа, arbete, lucru, töö, darbs
“Competitiveness”	konkurenceschopnost, konkurencyjność, versenyképesség, Konkurencingumas, competitiveness, конкурентоспособност, konkurrenskraft, competitivitate, konkurentsivõime, konkurētspēja
“Recession”	recese, recesja, recessió, nuosmukis, recession, спад, recession, recesiune, langus, lejupslīde
“Attack”	útok, atak, támadás, ataka, attack, атака, attack, atac, rünnak, uzbrukums
“War”	válka, wojna, háború, karas, war, война, krig, război, sõda, karš
“Corruption”	korupce, korupcja, vesztegetés, korupcija, corruption, корупция, korruption, corupție, korruptsioon, korupcija
“Political”	politický, politická, politika, polityczne, polityczne, polityka, politikai, politikai, politika, politinė, politinė, Politika, political, political, politics, политическа, политическа, политика, politiskt, politiskt, politik, politik, politic, politic, politica, poliitilise, poliitilise, poliitika, politiskā, politiskā, politika
“Election”	volby, wyborczy, választási, rinkimai, election, избори, val, alegere, valimised, vēlēšanas
“Freedom”	svoboda, wolność, szabadság, laisvė, freedom, свобода, frihet, libertate, vabadus, brīvība
“President”	prezident, prezes, elnök, prezidentas, president, президент, president, Președintele, president, prezidents
“Parliament”	parlament, parlament, parlament, parlamentas, parliament, парламент, parlament, parliament, parlament, parlaments
“Senate”	senát, senat, szenátus, senatas, senate, сенат, senat, senat, senat, senāts
“Premier”	premier, premier, miniszterelnök, pirmaeilis, premier, премьер, premier, premier, peaminister, pirmais
“Risk”	riziko, ryzyko, kockázat, rizika, risk, риск, risk, risc, risk, risks
“Loss”	ztráta, strata, veszteség, praradimas, loss, зaryба, förlust, pierdere, kaotus, zaudējums

Source: own processing

Google keywords are specific type of the data called as Fat Data where the number of variables is large. Moreover, we have no appropriate theoretical background to reduce uncertainty in the model selection. Therefore, we follow Bayesian Model Averaging approach, special framework provided by De Luca and Magnus (2011) where a regression model is defined by the form:

$$y_{it} = X_{1it}\beta_1 + X_{2it}\beta_2 + u_{it} \quad (1)$$

where y_{it} represents a share of deposits in foreign currency in a country $i = 1, \dots, n$ and time t . We assume that $k_1 \geq 1, k_2 \geq 0, k = k_1 + k_2 \leq n - 1$ and the design matrix $\mathbf{X} = (\mathbf{X}_1, \mathbf{X}_2)$ has full column-rank k . The deterministic regressors X_j represents $n \times k_j$ matrices of observations on two subsets of regressors X_1 and X_2 . β_1 and β_2 are unknown regression parameters and $u \sim N(0, \sigma^2)$. The first subset of regressors X_1 contains macroeconomic determinants of the Portfolio Balance Model introduced by Hooper and Morton (1982) and X_2 contains frequencies of selected keyword searches (auxiliary variables) to which model uncertainty is confined.

There are 2^{k_2} possible models, thus, there are 2^{k_2} possible choices for X_2 . We consider up to 26 regressors to be included in the model that means 2^{26} , that is 67,108,864 individual models. A model-averaging estimate of β_1 is given by:

$$\hat{\beta}_1 = \sum_{i=1}^I \lambda_i \hat{\beta}_{1i} \quad (2)$$

Where λ_i represent non-negative random weights which reflect our confidence in model M_i based on prior beliefs. We combine prior beliefs on the unknown elements of the model with the additional information coming from the data. We employed estimator developed by Magnus *et al.* (2010) based on the distinction between focus and auxiliary regressors. Prior beliefs are given by non-informative priors on the focus parameters β_1 , the error variance σ^2 , and informative Gaussian prior on the auxiliary parameters β_2 . The conditional posterior distribution $p(\beta_1, \beta_2, \sigma^2 | y, M_i)$ is given by sample likelihood function:

$$p(y | \beta_1, \beta_2, \sigma^2, M_i) \propto (\sigma^2)^{-n/2} \exp\left(-\frac{\varepsilon_i^T \varepsilon_i}{2\sigma^2}\right) \quad (3)$$

with the conditional joint prior distribution:

$$p(\beta_1, \beta_2, \sigma^2 | M_i) \propto (\sigma^2)^{(k_2+2)/2} \exp\left(-\frac{\beta_{2i}^T V_{0i}^{-1} \beta_{2i}}{2\sigma^2}\right) \quad (4)$$

where $V_{0i}^{-1} = gX_{2i}M_1X_{2i}$ was proposed by Zellner (1986) and Fernández *et al.* (2001) and $g = 1/\max(n, k_2^2)$ is a constant scalar for each model M_i . Then we obtain results for every model under consideration and average them where the weights in the averaging are the posterior model probabilities:

$$\lambda_i = p(M_i | y) = \frac{p(M_i)p(y|M_i)}{\sum_{j=1}^I p(M_j)p(y|M_j)} \quad (5)$$

where $p(M_i)$ is the prior probability of model M_i and $p(y | M_i)$ is the marginal likelihood of y given model M_i . The unconditional estimates of β_1 and β_2 are computed as:

$$\hat{\beta}_1 = E(\beta_1 | y) = \sum_{i=1}^I \lambda_i \hat{\beta}_{1i} \quad (6)$$

and

$$\hat{\beta}_2 = E(\beta_2 | y) = \sum_{i=1}^I \lambda_i T_i \hat{\beta}_{2i} \quad (7)$$

where the T_i are $k_2 \times k_{2i}$ matrices defined by $T_i^r = (I_{k_{2i}}, 0)$, that transform the conditional estimates $\hat{\beta}_{2i}$ in $k_2 \times 1$ vectors by setting to zero the elements of β_2 , which are excluded from model M_i .

Appendix 4 | Bayesian Model Averaging Results (foreign currency deposits to total deposits (ln) as a dependent variable (2004–2014))

	Basic models with non-lagged regressors			Basic models with lagged regressors		
	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Error	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Error
Time dummies	Yes			Yes		
Constant	1.00	−6.6037	3.8413	1.00	−5.9503	3.5369
NEER	1.00	−0.2152	0.6774	1.00	−0.3535	0.6109
$\pi_{\text{local}} - \pi_{\text{EA}}$	1.00	0.0589	0.0080	1.00	0.0565	0.0076
$\text{GDP}_{\text{local}} - \text{GDP}_{\text{EA}}$	1.00	−4.9153	1.7952	1.00	−5.0017	1.8217
CA	1.00	0.0887	0.0382	1.00	0.0886	0.0380
Currency code	1.00	0.6176	0.1164	1.00	0.6642	0.1402
Currency name	0.31	−0.1039	0.1765	0.55	−0.2165	0.2206
“Crisis”	0.04	−0.0012	0.0238	0.04	−0.0007	0.0230
“Inflation”	0.08	−0.0184	0.0898	0.06	−0.0117	0.0709
“Debt”	0.99	−0.5624	0.18	0.98	−0.5358	0.1733
“Indebtedness”	0.06	−0.0044	0.0397	0.05	−0.0034	0.0370
“Money”	0.99	0.9281	0.2647	0.99	0.9660	0.2541
“Bank”	0.40	0.1352	0.1892	0.29	0.0930	0.1655
“Growth”	0.78	−0.3181	0.2064	0.87	−0.3717	0.1880
“Employment”	1.00	0.5386	0.0973	1.00	0.5219	0.1049
“Unemployment”	0.06	0.0054	0.0400	0.05	0.0024	0.0305
“Job”	0.06	0.0135	0.1162	0.06	0.0159	0.1162
“Competitiveness”	0.51	0.1879	0.2108	0.46	0.1752	0.2130
“Recession”	0.50	0.1312	0.1501	0.28	0.0607	0.1136
“Attack”	0.16	0.0261	0.0710	0.18	0.0313	0.0777
“War”	0.05	0.0004	0.0440	0.05	−0.0006	0.0412
“Corruption”	0.04	0.0017	0.0212	0.04	0.0013	0.0206
“Political”	1.00	1.2545	0.2444	1.00	1.3677	0.2432
“Election”	0.06	−0.0023	0.0132	0.08	−0.0037	0.0164
“Freedom”	0.10	0.0105	0.0386	0.11	0.0115	0.0401
“President”	0.21	0.0462	0.1036	0.31	0.0740	0.1255
“Parliament”	0.92	−0.5364	0.2376	0.88	−0.4954	0.2450
“Senate”	0.07	−0.0071	0.0412	0.08	−0.0093	0.0458
“Premier”	1.00	−0.5180	0.1031	1.00	−0.5040	0.0969
“Risk”	0.99	−0.9834	0.2023	1.00	−0.9877	0.1984
“Loss”	0.14	0.0360	0.1069	0.11	0.0220	0.0813
No. of observations	162			162		
k1	45			45		
k2	26			26		

Source: own calculation

References

- Allen, L., Saunders, A. (2014). Risk Management in Banking. In *The Oxford Handbook of Banking*. Editors Allen N. Berger, Philip Molyneux and John O.S. Wilson. Oxford University Press, Oxford, p. 1104.
- Arifovic, J. (2001). Evolutionary Dynamics of Currency Substitution. *Journal of Economic Dynamics and Control*, 25(3–4), 395–417, [https://doi.org/10.1016/s0165-1889\(00\)00031-2](https://doi.org/10.1016/s0165-1889(00)00031-2)
- Boughton, J. M. (1988). *The Monetary Approach to Exchange Rates: What Now Remains?* International Finance Section. ISBN 978-0-881-65078-5.
- Bresser-Pereira, L. C., Araújo, E., Gala, P. (2014). An Empirical Study of the Substitution of Foreign for Domestic Savings in Brazil. *Economia*, 15(1), 54–67, <https://doi.org/10.1016/j.econ.2014.04.001>
- Bulut, L. (2015). *Google Trends and Forecasting Performance of Exchange Rate Models*. IPEK University Department of Economics. Working Paper No. 15–05, <https://doi.org/10.2139/ssrn.2641796>
- Choi, H., Varian, H. (2012). Predicting the Present with Google Trends. *The Economic Record*, 88, 2–9, <https://doi.org/10.1111/j.1475-4932.2012.00809.x>
- Da, Z., Engelberg, J., Gao, P. (2011). In Search of Attention. *The Journal of Finance*, 66, 1461–1499, <https://doi.org/10.1111/j.1540-6261.2011.01679.x>
- De Luca, G., Magnus, J. R. (2011). Bayesian Model Averaging and Weighted–Average Least Squares: Equivariance, Stability, and Numerical Issues. *Stata Journal*, 11(4), 518–544.
- Dornbusch, R. (1976). Expectations and Exchange Rate Dynamics. *Journal of Political Economy*, 84(6), 1161–1176, <https://doi.org/10.1086/260506>
- Fernández, C., Ley, E., Steel, M. F. J. (2001). Model Uncertainty in Cross–Country Growth Regressions. *Journal of Applied Econometrics*, 16(5), 563–576, <https://doi.org/10.1002/jae.623>
- Frankel, J. (1979). On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials. *American Economic Review*, 69, 610–622.
- Guzi, M., de Pedraza García, P. (2015). A Web Survey Analysis of Subjective Well–Being. *International Journal of Manpower*, 36(1), 48–67, <https://doi.org/10.1108/ijm-12-2014-0237>
- Harvey, J. T. (1996). Orthodox Approaches to Exchange Rate Determination: A Survey. *Journal of Post Keynesian Economics*, 18, 567–583, <https://doi.org/10.1080/01603477.1996.11490087>
- Hooper, P., Morton, J. E. (1982). Fluctuations in the Dollar: A Model of Nominal and Real Exchange Rate Determination. *Journal of International Money and Finance*, 1, 39–56, [https://doi.org/10.1016/0261-5606\(82\)90004-3](https://doi.org/10.1016/0261-5606(82)90004-3)
- Irresberger, F., Mühlhnickel, J., Weiß, G. N. F. (2015). Explaining Bank Stock Performance with Crisis Sentiment. *Journal of Banking & Finance*, 59, 311–329, <https://doi.org/10.1016/j.jbankfin.2015.06.001>
- Isard, P. (1978). Exchange Rate Determination: A Survey of Popular Views and Recent Models. *Princeton Studies in International Finance*, 42.
- Kapounek, S., Deltuvaitė, V., Koráb, P. (2016a). Determinants of Foreign Currency Savings: Evidence from Google Search Data. *Procedia – Social and Behavioral Sciences*, 220, 166–176, <https://doi.org/10.1016/j.sbspro.2016.05.481>

- Kapounek, S., Korab, P., Deltuvaite, V. (2016b). (Ir)rational Households' Saving Behavior? An Empirical Investigation. *Procedia Economics and Finance*, 39, 625–633, [https://doi.org/10.1016/S2212-5671\(16\)30309-4](https://doi.org/10.1016/S2212-5671(16)30309-4)
- Kenen, P. B. (1985). Macroeconomic Theory and Policy: How the Closed Economy Was Opened. *Handbook of International Economics*, 2, 625–677, [https://doi.org/10.1016/s1573-4404\(85\)02004-4](https://doi.org/10.1016/s1573-4404(85)02004-4)
- Knoll, M. A. Z. (2010). The Role of Behavioral Economics and Behavioral Decision Making in Americans' Retirement Savings Decisions. *Social Security Bulletin*, 70(4).
- Lee, T. D., Haley, E., Woong, Y. T., Chung, W. (2011). US Retirement Financial Services Advertising's Financial Information Provisions, Communication Strategies and Judgmental Heuristic Cues. *Journal of Consumer Affairs*, 45(3), 391–418, <https://doi.org/10.1111/j.1745-6606.2011.01210.x>
- Magnus, J. R., Powell, O., Prüfer, O. (2010). A Comparison of Two Model Averaging Techniques with an Application to Growth Empirics. *Journal of Econometrics*, 154(2), 139–153, <https://doi.org/10.1016/j.jeconom.2009.07.004>
- Mark, N. C. (1995). Exchange Rates and Fundamentals: Evidence on Long Horizon Predictability. *American Economic Review*, 85, 201–218.
- Mussa, M. (1979). Empirical Regularities in the Behavior of the Foreign Exchange Market. *Carnegie–Rochester Conference Series on Public Policy*, 11, 9–57, [https://doi.org/10.1016/0167-2231\(79\)90034-4](https://doi.org/10.1016/0167-2231(79)90034-4)
- Nag, A. K., Mitra, A. (1998). Exchange Rate of the Rupee and Purchasing Power Parity. *Economic and Political Weekly*, 33(25), 1525–1532.
- Olgu, Ö. (2011). *European Banking: Enlargement, Structural Changes and Recent Developments*. London: Palgrave Macmillan, p. 263.
- Polak, J. J. (1957). Monetary Analysis of Income Formation and Payments Problems. Staff Papers (International Monetary Fund), 6, 1–50. <https://doi.org/10.2307/3866128>
- Risk Management in Banking
- Rogoff, K. (1996). The Purchasing Power Parity Puzzle. *Journal of Economic Literature*, 34(2), 647–668.
- Saxa, B. (2014). *Forecasting Mortgages: Internet Search Data as a Proxy for Mortgage Credit Demand*. Czech National Bank. Working Paper No. 2014/14.
- Schlueter, T., Sievers, S., Hartmann–Wendels, T. (2015). Bank Funding Stability, Pricing Strategies and the Guidance of Depositors. *Journal of Banking & Finance*, 51, 43–61, <https://doi.org/10.1016/j.jbankfin.2014.10.007>
- Sharma, S. C., Kandil, M., Chaisrisawatsuk, S. (2005). Currency Substitution in Asian Countries. *Journal of Asian Economics*, 16(3), 489–532, <https://doi.org/10.1016/j.asieco.2005.04.013>
- Stanovich, K. E., West, R. F. (2000). Individual Differences in Reasoning: Implications for the Rationality Debate? *Behavioral and Brain Sciences*, 23(5), 645–665, <https://doi.org/10.1017/s0140525x00003435>
- Tobin, J. (1969). A General Equilibrium Approach to Monetary Theory. *Journal of Money, Credit and Banking*, 1(1), 15–29, <https://doi.org/10.2307/1991374>
- Tversky, A., Kahneman, D. (1981). The Framing of Decisions and the Psychology of Choice. *Science*, 211(4481), 453–458, <https://doi.org/10.1126/science.7455683>
- Vlastakis, N., Markellos, R. N. (2012). Information Demand and Stock Market Volatility. *Journal of Banking & Finance*, 36(6), 1808–1821, <https://doi.org/10.1016/j.jbankfin.2012.02.007>

- Yang, X., Pan, B., Evans, J. A., Lv, B. (2015). Forecasting Chinese Tourist Volume with Search Engine Data. *Tourism Management*, 46, 386–397, <https://doi.org/10.1016/j.tourman.2014.07.019>
- Yuan, C. (2011). The Exchange Rate and Macroeconomic Determinants: Time-Varying Transitional Dynamics. *North American Journal of Economics and Finance*, 22(2), 197–220, <https://doi.org/10.1016/j.najef.2011.01.005>
- Zellner, A. (1986). On Assessing Prior Distributions and Bayesian Regression Analysis with G–Prior Distributions. In *Bayesian Inference and Decision Techniques: Essays in Honor of Bruno de Finetti*, ed. Goel, P. K., Zellner, A., 233–243. Amsterdam: North–Holland. ISBN 978–0–444–87712–3.