The role of domestic and foreign economic uncertainties in determining the foreign exchange rates: an extended monetary approach

S. M. Woahid Murad 1,2

Abstract

This study extends the monetary model of the exchange rate by incorporating news-based domestic and US economic policy uncertainties (EPUs). We consider 12 developed and developing economies and use monthly data covering 2000:M1 to 2017:M2. The extended monetary model is estimated by the panel quantile regression of Machado and Santos Silva (2019) and Pesaran (2006) common correlated effects within linear and nonlinear panel ARDL frameworks. The estimates illustrate the significant effects of EPUs on developed and developing economies. The ARDL models show that the impact of EPUs is mostly a long-run phenomenon. The Wald test statistics confirm asymmetric effects of EPUs at different quantiles. Moreover, the Wald statistics also support the asymmetric effects of increasing and decreasing EPUs. Overall, domestic, and foreign economic uncertainties significantly affect developed and developing economies’ exchange rates, at least in the long run. Therefore, economic uncertainty should be considered in determining the exchange rate. This extended model might be more appropriate in the post-Covid-19 era.

Keywords Exchange rates · Economic policy uncertainty · Quantile regression · Panel ARDL model · Asymmetric effect

JEL classification F31
1 Introduction

In the aftermath of the recent global financial crisis (2007:Q4 to 2009:Q2), economists devote themselves extensively to measuring different sorts of economic uncertainty and analyzing its macroeconomic effects (for instance, Bloom 2009, 2014; Carrière-Swallow and Céspedes 2013; Jurado et al. 2015; Baker et al. 2016; Jo, and Sekkel, 2019; and Ahir et al. 2020). The COVID-19 pandemic intensifies the importance of studying the economic uncertainty further. According to Hassett and Metcalf (1999), macroeconomic policies may not work properly under such uncertain prospects. For instance, Handley and Limão (2017) found that policy uncertainty adversely affects investment in export-oriented firms and technological progress, which diminishes trade and real income. Bloom et al. (2018) examined how uncertainty shaped business cycles and found that uncertainty reduced GDP by almost 2.5%. Moreover, Caggiano et al. (2017) also found that the incremental effect of unpredictable policy uncertainty on unemployment in the US economy is significantly larger during the recession. Likewise, policy uncertainty also affects the short-run and long-run money demand functions (Ivanovski and Churchill 2019; Hossain and Arwatchanakarn 2020; and Murad et al. 2021). Consequently, it is essential to encompass economic uncertainty in the conventional macroeconomic model and estimate its effect in determining macroeconomic variables. Analogously, an exchange rate determination model is not an exception.

Numerous studies examine the effect of economic risks and uncertainty on the exchange rate return and volatility. Most of these studies find a positive and statistically significant effect of economic uncertainty on the exchange rate volatility (Krol 2014; Balcilar et al. 2016; Chen et al. 2020; Bush and López Noria 2021; Abid and Rault 2021). However, such analyses do not explore the direction of movement of the exchange rate, namely, whether economic uncertainty appreciates or depreciates domestic currency. On the contrary, very few empirical works analyze the effect of economic uncertainty on the exchange rate and its expectations (Kido 2016; Beckmann and Czudaj 2017; Abid 2020) finds adverse spillover effects of US economic uncertainty on the high-yielding currencies, while the effect is positive for the Japanese currency. Like Kido (2016), Beckmann and Czudaj (2017) also find that economic, fiscal, and monetary uncertainties adversely affect Euro, Canadian dollar, and British pound sterling against the US dollar, while the Japanese yen appreciates at higher uncertainty. Furthermore, Abid (2020) revisits the determination of the exchange rate. Using a linear ARDL model, the author obtains significant short-run and long-run effects of economic uncertainty on the exchange rate. However, except for Beckmann and Czudaj (2017), most prior studies do not consider a conventional monetary approach to exchange rate determination. Therefore, most of these studies may potentially suffer from model misspecification due to omitting relevant variables. Moreover, Beckmann and Czudaj (2017) include only economic, monetary, and fiscal uncertainty indexes of the US in estimating exchange rates of Canada, Euro

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1 A comprehensive literature survey on COVID-19 and economic uncertainty can be found in Baker et al. (2020).
Area, Japan, and the UK. They do not incorporate the domestic economic uncertainties of the corresponding economies.

The novelty of this study is including both domestic and US economic policy uncertainties (EPUs) within the monetary approach to the exchange rate. Recently developed panel quantile regression with the method of moments and nonlinear panel ARDL models have been employed in the analysis to explore potential asymmetric effects of EPUs on the exchange rates.

The rest of this paper covers the following sections: Sect. 2 describes the specification of the empirical model, sources of data, and methods, while Sect. 3 discusses empirical results obtained from the analysis. Finally, the conclusion and policy recommendations are presented in Sect. 4.

2 Model specification, data, and methods

Considering the purchasing power parity, money market equilibrium, and the uncovered interest parity, the monetary model of exchange rate can be expressed as

\[ s_{i,t} = \lambda_0 + \lambda_1 (m_{i,t} - m^*_{i,t}) + \lambda_2 (y_{i,t} - y^*_{i,t}) + \lambda_3 (i_{i,t} - i^*_{i,t}) + u_{i,t} \]  

(1)

where \( s \) is the exchange rate of corresponding domestic currency against the US dollar; \( m \) and \( m^* \) are domestic and the US money supplies; \( y \) and \( y^* \) are domestic and the US incomes; \( i \) and \( i^* \) are domestic, and the US interest rates, and finally, \( u \) is the white noise error term. \( i \) and \( t \) denote \( i \) th economy and time, respectively. All the variables are transformed in natural log. Now, including EPUs, an extended monetary model can be obtained from Eqs. (1),

\[ s_{i,t} = \beta_0 + \beta_1 (m_{i,t} - m^*_{i,t}) + \beta_2 (y_{i,t} - y^*_{i,t}) + \beta_3 (i_{i,t} - i^*_{i,t}) + \beta_4 epu_{i,t} + \beta_5 epu^*_{i,t} + \epsilon_{i,t} \]  

(2)

where \( epu \) and \( epu^* \) are domestic and the US economic policy uncertainty, respectively. These two variables are also converted in natural log. According to the prior studies, it is expected that \( \beta_1 = 1 \), implying that if the domestic money supply increases relative to the US money supply, the exchange rate will proportionately increase. Similarly, if domestic income relatively increases or the domestic interest rate relatively decreases, the domestic demand for holding money will increase. Therefore, \( \beta_2 \) is likely to be negative and \( \beta_3 \) is likely to be positive. Moreover, domestic EPU and the US EPU are expected to have negative and positive effects on the exchange rate, respectively.

This study considers five developed countries and regions, namely, Canada, Euro, Japan, Sweden, UK, and seven developing countries, i.e., Brazil, Chile, China, India, 2 Bilson (1978) and Frankel (1979) are among the classic articles on the monetary approach to exchange rates. For a comprehensive literature survey including recent studies, see Xie and Chen (2019).

3 These hypotheses are derived from Bilson (1978). However, Dornbusch (1976) and Frankel (1979) argue that if interest rates differential rises, capital inflow will also increase in the domestic economy. Therefore, the interest rate differential and exchange rate are expected to move in opposite direction, i.e., \( \beta_3 \) is supposed to be negative.
Korea, Mexico, and Russia. The period covered in the study is from 2000:M1 to 2017:M2. The countries, regions and the period of this study have been selected based on the availability of data of the considered variables. Except for EPUs, the data of all variables is collected from International Financial Statistics (IFS) published by the IMF. The domestic and the US EPUs are news-based economic uncertainty measures developed by Baker et al. (2016). They are collected from the authors’ website.4

Equation (2) is estimated using the panel quantile regression model of Machado and Santos Silva (2019). One advantage of this method is that it does not rely on conditional means; it is based on the method of moments. Therefore, endogenous variables can be easily accommodated in this method. To check the robustness of the findings obtained from panel quantile regression, the linear and nonlinear ARDL models are employed. Both linear and nonlinear autoregressive distributed lag (ARDL) models are estimated using Pesaran (2006). Shin et al. (2014) postulate the nonlinear ARDL model for time series analysis. However, after decomposing the policy variables in positive and negative cumulative sums, the linear ARDL model of Pesaran (2006) can be augmented in the asymmetric ARDL model (for instance, Eberhardt and Presbitero 2015; Salisu and Isah 2017). For estimating the nonlinear panel ARDL model, the domestic EPU is decomposed in the following way,

\[
epu_{i,t}^{pos} = \sum_{j=1}^{t} \Delta epu_{i,j}^{pos} = \sum_{j=1}^{t} \max (\Delta epu_{i,j}, 0)
\]

\[
epu_{i,t}^{neg} = \sum_{j=1}^{t} \Delta epu_{i,j}^{neg} = \sum_{j=1}^{t} \min (\Delta epu_{i,j}, 0)
\]

Analogously, the US EPU is decomposed as

\[
epu_{i,t}^{*pos} = \sum_{i=1}^{t} \Delta epu_{i,t}^{*pos} = \sum_{i=1}^{t} \max (\Delta epu_{i,t}^*, 0)
\]

\[
epu_{i,t}^{*neg} = \sum_{i=1}^{t} \Delta epu_{i,t}^{*neg} = \sum_{i=1}^{t} \min (\Delta epu_{i,t}^*, 0)
\]

After replacing \( epu \) and \( epu^* \) by their positive and negative partial sums in Eq. (2), an asymmetric ARDL model is obtained, which is.

\[
s_{i,t} = \gamma_0 + \gamma_1 (m_{i,t} - m_{i,t}^*) + \gamma_2 (y_{i,t} - y_{i,t}^*) + \gamma_3 (i_{i,t} - i_{i,t}^*) + \gamma_4 epu_{i,t}^{pos} + \gamma_5 epu_{i,t}^{neg} + \gamma_6 epu_{i,t}^{neg} + \gamma_7 epu_{i,t}^{neg} + \nu_{i,t}
\]

Like Eq. (2), Eq. (5) is also estimated using Pesaran (2006). The statistical significance of the asymmetric effect is justified using the Wald test. However, the panel unit root tests of all the variables are estimated before going to the panel ARDL model. Using Herwartz and Siedenburg (2008), Demetrescu and Hanck (2012), and

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4 For detail about the construction of EPU index and the database see www.policyuncertainty.com.
Herwartz et al. (2019) unit root tests, it is found that all variables are integrated of order 1.\textsuperscript{5}

\section{Analysis and discussion}

Table 1 reports the method of moments quantile regression (MM-QR). The MM-QR shows that all macroeconomic variables of the monetary model are statistically significant, and hold expected signs for the overall economies. Income and interest rate differentials have an asymmetric effect on the exchange rates. The coefficients of these variables decline as they move to higher quantile. Like Abid (2020), it is found that domestic EPU adversely affects the exchange rate at each quantile. However, the asymmetric effect is not justified by the Wald test. Unlike domestic EPU, the US EPU has no significant impact on the exchange rates. Such outcomes may appear due to aggregation bias. After reexamining the model for developed and developing economies, it is found that domestic EPU negatively and the US EPU positively affect the exchange rates. Beckmann and Czudaj (2016) also find an instantaneous positive effect of the US EPU on the developed countries’ exchange rates.

The coefficients of both EPU\textsc{\textregistered}s increase at higher quantiles. Hence, the asymmetric effects are significant. Notably, the impact of domestic EPU is larger than the US EPU at each quantile, i.e., the influence of domestic economic uncertainty is harsher than the foreign economic uncertainty in developed countries and regions.

In the case of developing countries, money supply and income differentials are significant and retain expected signs. However, the interest rate differentials are positive at lower quantiles and negative at higher quantiles. Higher interest rate differentials may lead to higher capital inflow in the economy (Dornbusch 1976; Frankel 1979). It may have a substantial influence on the domestic currencies of developing countries to be appreciated. Unlike developed economies, the EPU\textsc{\textregistered}s significantly affect the exchange rate only at the lowest and highest quantiles in the developing countries. At the lowest quantiles ($\tau = 0.1$), the coefficients both domestic and the US EPU\textsc{\textregistered}s are negative, while they are positive at the highest quantiles ($\tau = 0.9$).

The Wald test statistics show significant asymmetric effects of the EPU\textsc{\textregistered}s on the exchange rates. In contrast to the developed countries and region, the coefficients of the US EPU exceed the coefficients of domestic EPU within the same quantiles, implying that the US economic uncertainty plays a dominant role in developing countries. Regarding the effects of economic uncertainty, Carrière-Swallow and Céspedes (2013) unveil that foreign uncertainty shocks’ spillover effect is severe on emerging economies than developed countries because of credit constraints.

To check the robustness of these findings, this study further estimates the linear and nonlinear ARDL models. According to Table 2, the extended monetary approach to exchange rates is mostly a long-run phenomenon. The money supply and income differentials are significant, and hold expected signs in the long run. The results are consistent with the MM-QR models. However, after considering nonstationary pan-

\textsuperscript{5} To save the space, the results of unit root test are not presented in the paper. However, the results are available from the author upon request.
### Table 1: Determination of nominal exchange rate using the method of moments-quantile regression (MM-QR)

#### Panel A: All Economies

| Variable | Quantile levels | Wald test for equality at different quantiles |
|----------|-----------------|-----------------------------------------------|
|          | 0.1  | 0.2  | 0.3  | 0.4  | 0.5  | 0.6  | 0.7  | 0.8  | 0.9  | 0.5  | 0.9  |
| \(m - m^*\) | 0.834*** | 0.83*** | 0.826*** | 0.824*** | 0.821*** | 0.818*** | 0.815*** | 0.81*** | 0.802*** | 2.19 | 2.19 |
|          | (0.011) | (0.01) | (0.01) | (0.01) | (0.01) | (0.011) | (0.012) | (0.014) | (0.018) |        |        |
| \(y - y^*\) | -2.619*** | -2.461*** | -2.32*** | -2.214*** | -2.12*** | -2.017*** | -1.886*** | -1.716*** | -1.41*** | 20.73*** | 20.82*** |
|          | (0.138) | (0.123) | (0.116) | (0.116) | (0.12) | (0.128) | (0.143) | (0.169) | (0.221) |        |        |
| \(i - i^*\) | 0.651*** | 0.615*** | 0.583*** | 0.559*** | 0.538*** | 0.514*** | 0.484*** | 0.446*** | 0.376*** | 22.18*** | 22.28*** |
|          | (0.03) | (0.027) | (0.025) | (0.025) | (0.026) | (0.028) | (0.031) | (0.037) | (0.049) |        |        |
| \(epu\) | -0.448*** | -0.438*** | -0.43*** | -0.424*** | -0.418*** | -0.412*** | -0.404*** | -0.394*** | -0.376*** | 0.47 | 0.47 |
|          | (0.054) | (0.048) | (0.045) | (0.046) | (0.047) | (0.05) | (0.056) | (0.066) | (0.087) |        |        |
| \(epu^*\) | -0.059 | -0.058 | -0.057 | -0.056 | -0.056 | -0.055 | -0.054 | -0.053 | -0.05 | 0.00 | 0.00 |
|          | (0.081) | (0.072) | (0.068) | (0.068) | (0.07) | (0.075) | (0.084) | (0.098) | (0.129) |        |        |
| \(cons.\) | 2.384*** | 2.781*** | 3.134*** | 3.399*** | 3.635*** | 3.895*** | 4.222*** | 4.648*** | 5.414*** | 18.38*** | 18.51*** |
|          | (0.368) | (0.326) | (0.308) | (0.308) | (0.319) | (0.34) | (0.38) | (0.447) | (0.588) |        |        |

#### Panel B: Developed Economies

| Variable | Quantile levels | Wald test for equality at different quantiles |
|----------|-----------------|-----------------------------------------------|
|          | 0.1  | 0.2  | 0.3  | 0.4  | 0.5  | 0.6  | 0.7  | 0.8  | 0.9  | 0.5  | 0.9  |
| \(m - m^*\) | 0.8*** | 0.76*** | 0.723*** | 0.668*** | 0.636*** | 0.599*** | 0.565*** | 0.53*** | 0.497*** | 113.99*** | 130.50*** |
|          | (0.02) | (0.018) | (0.017) | (0.016) | (0.015) | (0.016) | (0.017) | (0.018) | (0.019) |        |        |
| \(y - y^*\) | 0.678 | 0.176 | -0.282 | -0.97** | -1.374*** | -1.835*** | -2.253*** | -2.7*** | -3.103*** | 25.33*** | 26.07*** |
|          | (0.564) | (0.507) | (0.471) | (0.44) | (0.434) | (0.45) | (0.477) | (0.518) | (0.564) |        |        |
| \(i - i^*\) | 0.475*** | 0.423*** | 0.376*** | 0.305*** | 0.264*** | 0.217*** | 0.174** | 0.128 | 0.087 | 10.25*** | 10.37*** |
|          | (0.092) | (0.083) | (0.076) | (0.071) | (0.071) | (0.073) | (0.078) | (0.085) | (0.092) |        |        |
| \(epu\) | 0.019 | -0.171* | -0.344*** | -0.604*** | -0.756*** | -0.93*** | -1.088*** | -1.257*** | -1.409*** | 83.91*** | 92.54*** |
|          | (0.111) | (0.1) | (0.095) | (0.091) | (0.087) | (0.09) | (0.095) | (0.102) | (0.11) |        |        |
| \(epu^*\) | 0 | 0.094 | 0.179 | 0.306*** | 0.381*** | 0.467*** | 0.544*** | 0.627*** | 0.702*** | 12.99*** | 13.18*** |

| Variable | Quantile levels | Wald test for equality at different quantiles |
|----------|-----------------|-----------------------------------------------|
|          | 0.1  | 0.2  | 0.3  | 0.4  | 0.5  | 0.6  | 0.7  | 0.8  | 0.9  | 0.5  | 0.9  |
| \(m - m^*\) | 0.8*** | 0.76*** | 0.723*** | 0.668*** | 0.636*** | 0.599*** | 0.565*** | 0.53*** | 0.497*** | 113.99*** | 130.50*** |
|          | (0.02) | (0.018) | (0.017) | (0.016) | (0.015) | (0.016) | (0.017) | (0.018) | (0.019) |        |        |
| \(y - y^*\) | 0.678 | 0.176 | -0.282 | -0.97** | -1.374*** | -1.835*** | -2.253*** | -2.7*** | -3.103*** | 25.33*** | 26.07*** |
|          | (0.564) | (0.507) | (0.471) | (0.44) | (0.434) | (0.45) | (0.477) | (0.518) | (0.564) |        |        |
| \(i - i^*\) | 0.475*** | 0.423*** | 0.376*** | 0.305*** | 0.264*** | 0.217*** | 0.174** | 0.128 | 0.087 | 10.25*** | 10.37*** |
|          | (0.092) | (0.083) | (0.076) | (0.071) | (0.071) | (0.073) | (0.078) | (0.085) | (0.092) |        |        |
| \(epu\) | 0.019 | -0.171* | -0.344*** | -0.604*** | -0.756*** | -0.93*** | -1.088*** | -1.257*** | -1.409*** | 83.91*** | 92.54*** |
|          | (0.111) | (0.1) | (0.095) | (0.091) | (0.087) | (0.09) | (0.095) | (0.102) | (0.11) |        |        |
| \(epu^*\) | 0 | 0.094 | 0.179 | 0.306*** | 0.381*** | 0.467*** | 0.544*** | 0.627*** | 0.702*** | 12.99*** | 13.18*** |
### Table 1 (continued)

#### Panel A: All Economies

| Variable | Quantile levels | Wald test for equality at different quantiles |
|----------|-----------------|---------------------------------------------|
| cons.    |                 |                                             |
|          | (0.148)         |                                             |
|          | (0.133)         |                                             |
|          | (0.122)         |                                             |
|          | (0.114)         |                                             |
|          | (0.113)         |                                             |
|          | (0.117)         |                                             |
|          | (0.125)         |                                             |
|          | (0.136)         |                                             |
|          | (0.148)         |                                             |
|          |                 |                                             |
|          | 0.12            |                                             |
|          | 0.664           |                                             |
|          | 1.38***         |                                             |
|          | 2.455***        |                                             |
|          | 3.086***        |                                             |
|          | 3.805***        |                                             |
|          | 4.458***        |                                             |
|          | 5.157***        |                                             |
|          | 5.786***        |                                             |
|          | 46.30***        |                                             |
|          | 48.76***        |                                             |

#### Panel B: Developing Economies

| Variable | Quantile levels | Wald test for equality at different quantiles |
|----------|-----------------|---------------------------------------------|
|          |                 |                                             |
|          | (0.023)         |                                             |
|          | (0.019)         |                                             |
|          | (0.017)         |                                             |
|          | (0.016)         |                                             |
|          | (0.015)         |                                             |
|          | (0.015)         |                                             |
|          | (0.016)         |                                             |
|          | (0.017)         |                                             |
|          | (0.025)         |                                             |
|          |                 |                                             |
|          | 0.849***        |                                             |
|          | 0.844***        |                                             |
|          | 0.841***        |                                             |
|          | 0.838***        |                                             |
|          | 0.835***        |                                             |
|          | 0.834***        |                                             |
|          | 0.832***        |                                             |
|          | 0.828***        |                                             |
|          | 0.818***        |                                             |
|          | 0.74            |                                             |
|          | 0.74            |                                             |
|          |                 |                                             |
|          | (0.023)         |                                             |
|          | (0.017)         |                                             |
|          | (0.152)         |                                             |
|          | (0.146)         |                                             |
|          | (0.137)         |                                             |
|          | (0.132)         |                                             |
|          | (0.138)         |                                             |
|          | (0.205)         |                                             |
|          | (0.222)         |                                             |
|          |                 |                                             |
|          | 0.562***        |                                             |
|          | 0.365***        |                                             |
|          | 0.246***        |                                             |
|          | 0.141***        |                                             |
|          | 0.016           |                                             |
|          | 0.035           |                                             |
|          | 0.105**         |                                             |
|          | 0.256***        |                                             |
|          | 0.638***        |                                             |
|          | 73.40***        |                                             |
|          | 89.02***        |                                             |
|          |                 |                                             |
|          | (0.083)         |                                             |
|          | (0.064)         |                                             |
|          | (0.057)         |                                             |
|          | (0.055)         |                                             |
|          | (0.051)         |                                             |
|          | (0.049)         |                                             |
|          | (0.052)         |                                             |
|          | (0.076)         |                                             |
|          | (0.083)         |                                             |
|          |                 |                                             |
|          | 0.405           |                                             |
|          | 0.735***        |                                             |
|          | 0.321           |                                             |
|          | 77.77***        |                                             |
|          | 94.94***        |                                             |
|          |                 |                                             |
|          | 0.562           |                                             |
|          | 0.365           |                                             |
|          | 0.246           |                                             |
|          | 0.141           |                                             |
|          | 0.016           |                                             |
|          | 0.035           |                                             |
|          | 0.105           |                                             |
|          | 0.256           |                                             |
|          | 0.638           |                                             |
|          | 73.40           |                                             |
|          | 89.02           |                                             |

Notes: (i) Figures in parentheses are standard errors. (ii) *, **, and *** denote the significance level at 10%, 5%, and 1%, respectively, and (iii) the statistically significant Wald test results show that the estimated slope coefficients and intercepts for lower quantile ($\tau = 0.1$) are statistically different across medium ($\tau = 0.5$) and upper quantiles ($\tau = 0.9$).
Table 2 Panel ARDL model

| Coefficient | All     | Developed | Developing | Coefficient | All     | Developed | Developing |
|-------------|---------|-----------|------------|-------------|---------|-----------|------------|
| \( (m - m^*) \) | 0.660*** | 0.248*** | 0.0127*** | \( (m - m^*) \) | 0.719*** | 0.0452*** | -0.858*** |
| (0.0026)    | (0.0025) | (0.0027)  |            | (0.0035)    | (0.0044) | (0.0034)  |            |
| \( (y - y^*) \) | -1.582*** | -1.532*** | -1.457***  | \( (y - y^*) \) | -1.537*** | -1.444*** | -0.866*** |
| (0.0045)    | (0.0072) | (0.0063)  |            | (0.0044)    | (0.0052) | (0.0064)  |            |
| \( (i - i^*) \) | 0.231*** | -0.243*** | 0.909***   | \( (i - i^*) \) | 0.345*** | -0.181*** | 0.666***   |
| (0.0019)    | (0.0009) | (0.0027)  |            | (0.0020)    | (0.0018) | (0.0029)  |            |
| \( epu \) | 1.195*** | 0.272***  | 1.151***   | \( epu^{pos} \) | 1.211*** | 0.347***  | 0.919***   |
| (0.0020)    | (0.0026) | (0.0027)  |            | (0.0020)    | (0.0036) | (0.0022)  |            |
| \( epu^* \) | 0.139*** | 0.198***  | -0.236***  | \( epu^{neg} \) | 1.234*** | 0.354***  | 0.826***   |
| (0.0013)    | (0.0024) | (0.0017)  |            | (0.0021)    | (0.0040) | (0.0025)  |            |
| \( epu^{pos} \) | -0.104*** | 0.0511*** | -0.297***  | \( epu^{neg} \) | -0.133*** | 0.0612*** | -0.200***  |
| (0.0014)    | (0.0033) | (0.0015)  |            | (0.0015)    | (0.0035) | (0.0015)  |            |

**Linear Short-run Coefficients and the Speed of Adjustment**

| Coefficient | All     | Developed | Developing | Coefficient | All     | Developed | Developing |
|-------------|---------|-----------|------------|-------------|---------|-----------|------------|
| \( ECM \)  | -0.0045 | -0.0124*** | -0.0049    | \( ECM \)  | -0.0046 | -0.0158** | -0.0078    |
| (0.0034)    | (0.0036) | (0.0067)  |            | (0.0031)    | (0.0059) | (0.0056)  |            |
| \( \Delta(m - m^*) \) | 0.1060 | 0.1510 | 0.0742    | \( \Delta(m - m^*) \) | 0.1070 | 0.1550 | 0.0698    |
| (0.0919)    | (0.1290) | (0.1370)  |            | (0.0891)    | (0.1250) | (0.1320)  |            |
| \( \Delta(y - y^*) \) | -0.0073 | 0.0158** | -0.0201   | \( \Delta(y - y^*) \) | -0.0072 | 0.0180*** | -0.0194   |
| (0.0092)    | (0.0058) | (0.0137)  |            | (0.0091)    | (0.0044) | (0.0139)  |            |
| \( \Delta(i - i^*) \) | 0.0232 | -0.0131 | 0.0531*   | \( \Delta(i - i^*) \) | 0.0241 | -0.0146 | 0.0520*   |
| (0.0185)    | (0.0187) | (0.0240)  |            | (0.0181)    | (0.0160) | (0.0248)  |            |
| \( \Delta epu \) | 0.0161 | 0.0329 | 0.0050    | \( \Delta epu^{pos} \) | 0.0928 | 0.2050 | 0.0080*** |
| (0.0185)    | (0.0187) | (0.0240)  |            | (0.0181)    | (0.0160) | (0.0248)  |            |
| Test of asymmetric effects | All | Developed | Developing |
|-----------------------------|-----|-----------|------------|
| \( \omega^{LR} \)          | 6889*** | 22,971*** | 192***     |
| \( \omega^{SR} \)          | 1.07 | 4.65**    | 1.01       |

Notes: ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively. The parentheses values show the standard errors. Westerlund et al. (2019) proposed a fixed-T variance estimator that has been used for pooled coefficients in Pesaran (2006). This estimator corrects the heteroscedasticity problem and considers fixed time variance for panels.
els, the long-run coefficients of interest rate differentials of advanced economies become negative, implying that higher interest rate in advanced economies relative to the US interest rate attracts foreign investors to invest in these advanced economies and domestic investors retain themselves to invest in their own territory. Prior studies find that the interest rate differentials become an integral part of determining the international capital flow during high economic uncertainty.\(^6\)

Furthermore, the linear ARDL model shows that domestic and the US EPUs depreciate domestic currencies of advanced economies in the long run. The nonlinear ARDL model also estimates positive coefficients positive and negative cumulative sums of EPUs, implying that the exchange rate always increases in the long run when domestic and the US economic uncertainties increase or decrease. Although these uncertainty coefficients hold the same sign, their magnitudes are statistically different according to the Wald test. Like the quantile regression, the ARDL models also show that the effect of domestic EPU is larger than the US EPU in the advanced economies. However, domestic EPU has no significant impact on the exchange rates in developed economies during the short run. In the short run, only the US EPU appreciates domestic currencies when the US EPU decreases. The Wald test reports that only the US EPU has an asymmetric effect on the exchange rate in the short run.

On the contrary to the advanced economies, the linear and nonlinear panel ARDL models for developing countries show that domestic EPU positively and the US EPU negatively affect the exchange rates in the long run. The Wald test justifies the asymmetric long-run effects of domestic and foreign EPUs on the exchange rate. In the short run, domestic EPU depreciates the domestic currencies of developing countries when the EPU increases. The foreign EPU positively impacts the exchange no matter whether the US EPU increases or decreases in the short run. However, the Wald test only supports the short-run asymmetric effect of domestic EPU. The adjustment parameters hold the expected sign and are also statistically significant only for advanced economies, and the value is higher in the nonlinear ARDL model.

4 Conclusions

This study attempts to extend the monetary model to exchange rates by encompassing the domestic and the US economic uncertainties. Relying on the monthly data of advanced and developing economies over 2000:M1 to 2017:M2, it is found that both domestic and foreign economic uncertainties significantly affect the equilibrium exchange rates, at least in the long run. In the case of advanced economies, the effect of domestic EPU exceeds the foreign EPU. In contrast, the foreign EPU is more influential in developing countries. Therefore, economic uncertainty may be considered as a ‘scapegoat’ in the model of Bacchetta and van Wincoop (2004, 2013). After considering the effects of economic uncertainty in the monetary model, all the macroeconomic variables are statistically significant, and hold expected signs in most cases. It supports Engel et al. (2008) findings that the monetary model still has

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\(^6\) However, numerous studies postulate that the interest rate differentials do not determine the international capital flow (Grubel 1968; Haynes 1988).
explanatory power in determining exchange rates. According to the findings of this study, economic uncertainty emerges as an integral part of exchange rate determination. The notion would be more relevant in the post-Covid-19 era.

However, Caggiano et al. (2014) and Kido (2016) find the spillover effects of uncertainty shocks severe during the recessionary period. Therefore, this extended monetary model can be reinvestigated after considering economic recessions.

**Funding** Open Access funding enabled and organized by CAUL and its Member Institutions

**Declarations**

**Competing interests** I, hereby, declare that no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work; no other relationships or activities that could appear to have influenced the submitted work.

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**References**

Abid A (2020) Economic policy uncertainty and exchange rates in emerging markets: Short and long runs evidence. Finance Res Lett 37:101378

Abid A, Rault C (2021) On the Exchange Rates Volatility and Economic Policy Uncertainty Nexus: A Panel VAR Approach for Emerging Markets. J Quant Econ 19:403–425

Ahir H, Bloom N, Furceri D (2020) The World Uncertainty Index. ASSA 2020 Annual Meeting, January 3–5, San Diego, CA

Bacchetta P, van Wincoop E (2004) A scapegoat model of exchange-rate fluctuations. Am Econ Rev 94:114–118

Bacchetta P, van Wincoop E (2013) On the unstable relationship between exchange rates and macro-economic fundamentals. J Int Econ 91:18–26

Baker SR, Bloom N, Davis SJ, Terry SJ (2020) COVID-Induced Economic Uncertainty, Working Paper No. 26983, National Bureau of Economic Research

Baker SR, Bloom N, Davis SJ (2016) Measuring economic policy uncertainty. Q J Econ 131(4):1593–1636

Balcilar M, Gupta R, Kyei C, Wohar ME (2016) Does economic policy uncertainty predict exchange rate returns and volatility? Evidence from a nonparametric causality-in-quantiles test. Open Economic Review 27(2):229–250

Beckmann J, Czudaj R (2017) Exchange rate expectations and economic policy uncertainty. Eur J Political Econ 47:148–162

Bilson J (1978) The monetary approach to the exchange rate: some empirical evidence. IMF Staff Paper 25(1):48–75

Bloom N, Floetotto M, Jaimovich N, Saporta-Eksten I, Terry S (2018) Really Uncertain Business Cycles. Econometrica 86(3):1031–1065

Bloom N (2009) The impact of uncertainty shocks. Econometrica 77(3):623–685

Bloom N (2014) Fluctuations in Uncertainty. J Economic Perspect 28:153–176

Bush G, López Noria G (2021) Uncertainty and exchange rate volatility: Evidence from Mexico. Int Rev Econ Finance 75:704–722

Caggiano G, Castelnuovo E, Figueres JM (2017) Economic Policy Uncertainty and Unemployment in the United States: A Nonlinear Approach. Econ Lett 151:31–34
Caggiano G, Castelnuovo E, Groshenny N (2014) Uncertainty shocks and unemployment dynamics in US recessions. J Monet Econ 67:78–92

Carrière-Swallow Y, Cespedes LF (2013) The impact of uncertainty shocks in emerging economies. J Int Econ 90(2):316–325

Chen L, Du Z, Hu Z (2020) Impact of economic policy uncertainty on exchange rate volatility of China. Finance Res Lett 32:101266

Demetrescu M, Hanck C (2012) A simple nonstationary-volatility robust panel unit root test. Econ Lett 117:10–13

Dornbusch R (1976) Expectations and exchange rate dynamics. J Polit Econ 84(6):1161–1176

Eberhardt M, Presbitero AF (2015) Public debt and growth: heterogeneity and non-linearity. J Int Econ 97(1):45–58

Engel C, Mark NC, West KD (2007) Exchange Rate Models Are Not as Bad as You Think. NBER Macroeconomics Annual 22:381–441

Frankel JA (1979) On the mark: a theory of exchange rates based on real interest differentials. Am Econ Rev 69(4):610–622

Grubel HG (1968) Internationally diversified portfolios: Welfare gains and capital flows. Am Econ Rev 58:1299–1314

Handley K, Limão N (2017) Policy Uncertainty, Trade, and Welfare: Theory and Evidence for China and the United States. Am Econ Rev 107(9):2731–2783

Hassett KA, Metcalf GE (1999) Investment with uncertain tax policy: does random tax policy discourage investment? Econ J 109:372–393

Haynes SE (1988) Identification of interest rates and international capital flows. Rev Econ Stat 70(1):103–111

Herwartz H, Maxand S, Walle YM (2019) Heteroskedasticity-Robust Unit Root Testing for Trending Panels. J Time Ser Anal 40:649–664

Herwartz H, Siedenburg F (2008) Homogenous panel unit root tests under cross-sectional dependence: Finite sample modifications and the wild bootstrap. Comput Stat Data Anal 53:137–150

Hossain AA, Arwatchanakarn P (2020) The effect of economic uncertainty on narrow money demand and its stability in New Zealand: An empirical investigation. Econ Anal Policy 68:88–100

Ivanovski K, Churchill SA (2019) Economic policy uncertainty and demand for money in Australia. Appl Econ 51(41):4516–4526

Jo S, Sekkel. R (2019) Macroeconomic uncertainty through the lens of professional forecasters. J Bus Economic Stat 37(3):436–446

Jurado K, Ludvigson SC, Ng S (2015) Measuring Uncertainty. Am Econ Rev 105(3):1177–1216

Kido Y (2016) On the link between the US economic policy uncertainty and exchange rates. Econ Lett 144:49–52

Krol R (2014) Economic Policy Uncertainty and Exchange Rate Volatility. Int Finance 17:241–256

Machado JAF, Santos Silva JMC (2019) Quantiles via moments. J Econ 213(1):145–173

Murad SMW, Salim R, Kibria MG (2021) Asymmetric Effects of Economic Policy Uncertainty on the Demand for Money in India. J Quant Econ 19(3):451–470

Nier E, Sedik TS, Mondino T (2014) Gross Private Capital Flows to Emerging Markets: Can the Global Financial Cycle be Tamed? IMF Working Paper, WP/14/196

Pesaran MH (2006) Estimation and inference in large heterogeneous panels with a multifactor error structure. Econometrica 74(4):967–1012

Salisu AA, Isah KO (2017) Revisiting the oil price and stock market nexus: a nonlinear panel ARDL approach. Econ Model 62:258–271

Shin Y, Yu B, Greenwood-Nimmo M (2014) Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. Festschrift in Honor of Peter Schmidt. Springer, New York, pp 281–314

Westerlund J, Perova Y, Norkute M (2019) CCE in fixed-T panels. J Appl Econom 34:746–761

Xie Z, Chen SW (2019) Exchange rates and fundamentals: A bootstrap panel data analysis. Econ Model 78:209–224

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