



Financial development, international reserves, and real exchange rate dynamics: Insights from the Europe and Central Asia region

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ABSTRACT

This study examines the impact of international reserves on real exchange rate (RER) stability in the Europe and Central Asia (ECS) region, focusing on how financial development levels affect this relationship. Using panel threshold regression, the analysis reveals that international reserves significantly stabilize RER when reserves exceed 17.28 % of GDP, especially in countries with underdeveloped financial systems. The findings suggest that reserves play a more critical role in less developed financial markets, providing insights for policymakers on optimal reserve management and financial development strategies in emerging economies.

1. Introduction

Recently, several emerging market economies have faced severe challenges in maintaining economic stability amid global financial turbulence. A striking example is Turkey's currency crisis in 2018, where the Turkish lira lost nearly 30 % of its value against the U.S. dollar within a few months. This dramatic depreciation was partly attributed to the country's low level of foreign exchange reserves and heightened exposure to external debt. The situation underscored the critical role of international reserves as a buffer against external shocks, particularly in economies where financial markets are underdeveloped and vulnerable to sudden stops in capital flows. The crisis also highlighted the complexities of managing the real exchange rate (RER) in the face of global economic integration and volatility. The Turkish experience is a vivid reminder of the challenges faced by emerging economies in balancing reserve accumulation and financial development to stabilize their currencies.

The case of Turkey is not unique. Across emerging markets, especially in the Europe and Central Asia (ECS) region, countries have grappled with similar issues. For example, Hungary, Croatia, and Bulgaria have all faced pressures on their currencies and financial systems, leading them to reassess their reserve management strategies and levels of financial development (Aizenman et al., 2015). Against this backdrop, this discussion focuses on the implications of varying levels of financial development on the effectiveness of international reserves in stabilizing the RER. Using a panel-threshold regression analysis, this study identifies critical thresholds for financial development indicators, offering insights into how ECS countries manage their reserves to mitigate external shocks. We focus on the ECS region, following the World Bank classification by region.¹ In particular, this region offers some interesting heterogeneity

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¹ Available here: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>, accessed on October 19, 2024.

related to our research question in terms of international reserves holding, financial development, institutional levels and political systems.

2. Data description

Based on Aizenman and Riera-Crichton (2008) and Aizenman et al. (2024), the analysis is based on a comprehensive macroeconomic panel dataset covering 110 countries from 2001 to 2020, with a focus on the ECS region. The dataset includes a range of variables essential for examining the relationship between international reserves, financial development, and the real exchange rate. In Table 1, the key variables used in the analysis are:

Real effective exchange rate (rer): This variable, expressed in logarithmic terms, captures the price competitiveness of a country's goods and services relative to its trading partners. An increase in RER implies appreciation, making domestic goods more expensive abroad.

International reserves (res): Measured as a percentage of GDP and expressed in logarithmic terms, this variable represents the total foreign exchange reserves held by a country, excluding gold.

Financial development indicators: The study utilizes several indices to measure financial development: financial development index (FD): An aggregate measure encompassing both financial institutions and financial markets; financial Institutions Index (FI): Captures the depth, access, and efficiency of financial institutions, such as banks, insurance companies, and pension funds; financial Markets Index (FM): Measures the depth, access, and efficiency of financial markets, including stock and bond markets; financial Market Depth (FMD): Focuses specifically on the size and liquidity of financial markets; Other Macroeconomic Variables: Additional controls include GDP per capita (*gdppk*), government expenditure as a percentage of GDP (*govexp*), and terms of trade (*etot*). These variables help isolate the impact of international reserves and financial development on the exchange rate.

The data for these variables are sourced from international databases, including the International Monetary Fund (IMF), the World Bank, and the Financial Development Index database by Svirydzhenka (2016). The descriptive statistics reveal considerable variation across countries and over time, reflecting the diverse economic environments and policy responses of the ECS region.

3. Methodology

The empirical analysis employs a panel-threshold regression approach to examine the relationship between international reserves and the RER, conditioned on different levels of financial development. The threshold regression model, introduced by Hansen (1999), is particularly well-suited for exploring non-linear relationships and identifying critical threshold values where the relationship between variables changes.

The baseline model is specified as follows:

$$rer_{it} = \mu + \beta_1 etot_{it} \times I(res_{it-1} \leq \gamma) + \beta_2 etot_{it} \times I(res_{it-1} > \gamma) + \alpha' x_{it} + u_i + \varepsilon_{it} \quad (1)$$

where rer_{it} is the real effective exchange rate for country i in year t ; $etot_{it}$ represents the effective terms of trade; res_{it} is the value of international reserves as a percentage of GDP; $I(\cdot)$ is an indicator function that divides the sample into two regimes, depending on whether the threshold variable res_{it-1} is below or above the estimated threshold γ ; x_{it} is a vector of control variables that include the GDP per capita and government expenditures; u_i represents country-specific fixed effects, and ε_{it} is the error term.

The threshold γ is estimated by minimizing the residual sum of squares (RSS) over possible values of res_{it-1} . The confidence interval for γ is constructed using a likelihood-ratio test, and the significance of the threshold effect is tested against the null hypothesis of no threshold effect.

The model allows for distinct coefficient estimates for the terms-of-trade effect on RER below and above the threshold level of international reserves. A negative and significant coefficient for the interaction term $etot \times I(res > \gamma)$ indicates a stronger buffer effect of reserves in mitigating RER volatility after the threshold is surpassed.

The model is further applied to regional subsamples, including the ECS region, to explore regional variations in the threshold effects. This approach captures the heterogeneity in economic structures, financial development, and policy responses across different groups of countries.

4. Empirical results

The findings reveal that the buffer effect of international reserves is particularly relevant for the ECS region, which includes countries like Hungary, Croatia, Bulgaria, and the Czech Republic. These countries have experienced significant economic volatility in recent decades, especially during the Global Financial Crisis (GFC) and subsequent Eurozone crises. The analysis identifies a threshold of approximately 17.28 % of GDP for international reserves, above which the buffer effect on RER becomes statistically significant. This threshold serves as a critical policy benchmark for reserve management in the region.

Table 2 presents the results of the panel threshold regressions. The table shows the estimated thresholds and coefficients for financial development indicators, such as the Financial Development (FD), Financial Institutions Index (FI), and Financial Market Depth (FMD). It highlights how the buffer effect of reserves is stronger when the financial market is underdeveloped, specifically when indicators like FI are below a certain threshold (approximately 0.48). This suggests that in countries with less developed financial systems, reserves play a more significant role in stabilizing the RER.

Table 1
Descriptive statistics.

	Observations	Mean	Standard deviation	Minimum	Maximum
<i>rer</i>	2200	4.633	0.183	2.847	5.567
<i>to</i>	2200	3.650	0.482	2.378	5.392
<i>tot</i>	2200	−0.015	0.371	−2.112	2.513
<i>res</i>	2200	2.523	0.893	0.093	4.697
<i>govexp</i>	2127	2.696	0.371	−0.050	3.565
<i>gdppk</i>	2200	4.605	0.541	3.159	5.775
<i>fd</i>	2000	0.388	0.243	0.026	0.967
<i>fi</i>	2000	0.459	0.228	0.049	0.978
<i>fmd</i>	2000	0.290	0.298	0.000	1.000
<i>fm</i>	2000	0.302	0.279	0.000	0.949

Source: author's computations.

Fig. 1 illustrates the threshold effect in the ECS region. It compares the mean values of international reserves as a percentage of GDP before and after the GFC for a selection of emerging and developing ECS countries. The figure shows that countries like Hungary, Croatia, and Bulgaria exceeded the threshold level of 17.28 % of GDP after the GFC, indicating a strategic shift in reserve accumulation policy to enhance economic resilience.

Figs. 2 and 3 present the construction of the confidence intervals for the threshold models in the ECS region, focusing on the Financial Markets Index (FM) and Financial Market Depth (FMD). These figures demonstrate that the estimated threshold values are robust, providing further support for the existence of significant threshold effects in the region. For FM and FMD, the buffer effect of international reserves is stronger when these financial development indicators are below their respective thresholds, reinforcing the notion that less developed financial markets necessitate a higher reliance on reserves for stability.

5. Policy implications and relevant literature

The identification of thresholds for financial development indicators provides policymakers with actionable benchmarks for reserve adequacy. Maintaining reserves above 17.28 % of GDP is recommended for countries in the ECS region to enhance economic stability in the face of external shocks. This finding is consistent with the precautionary motive for holding reserves, as outlined in studies by Aizenman and Lee (2007) and Ghosh et al. (2017), which suggest that countries with less developed financial systems rely more on reserves to stabilize their economies. Besides, these countries can use a clever management of international reserves to limit the exchange rate appreciation following capital inflows in the context of the international diffusion of technological progress, as explained by Lartey (2008).

Moreover, the results indicate that as financial markets and institutions develop, the marginal effectiveness of reserves as a buffer diminishes. In more advanced financial systems, alternative mechanisms, such as deeper financial markets and better access to international capital, play a more significant role in stabilizing the economy (Chinn and Ito, 2006; Svirydzenka, 2016). Therefore, for countries with higher levels of financial development, policy focus should shift from mere reserve accumulation to enhancing financial market depth and integration. In a recent study, Aizenman and Saadaoui (2024) explore the resilience of CESEE countries² during ECB monetary cycles. They provide empirical evidence that financial development and central bank independence provide buffers against financial and monetary spillovers. By increasing financial depth, less developed ECS countries can increase the resilience of their economies.

6. Conclusion

The analysis of financial development, international reserves, and the real exchange rate underscores the importance of tailored reserve management strategies for countries with varying financial market development. The evidence from the ECS region strongly suggests that the buffer effect of reserves is most pronounced in countries with less developed financial systems, highlighting the need for differentiated policy approaches. The identified threshold effects provide valuable guidance for policymakers on the optimal levels of reserve holdings and the importance of developing robust financial infrastructures.

This study contributes to the literature on international finance by highlighting the conditional effectiveness of international reserves and offering practical policy insights for emerging and developing economies. By integrating these findings with existing theories on reserve accumulation and financial development, the study provides a comprehensive framework for understanding how countries can navigate global financial integration while ensuring economic stability. For economies at the early stages of financial development, overreliance on the holding of international reserves may be too costly in terms of social welfare (Rodrik, 2006). My research indicates that a more nuanced strategy that relies on increasing financial depth and managing strategically the stock of international reserves would allow less advanced countries in the ECS region to smooth the negative consequences of external finance

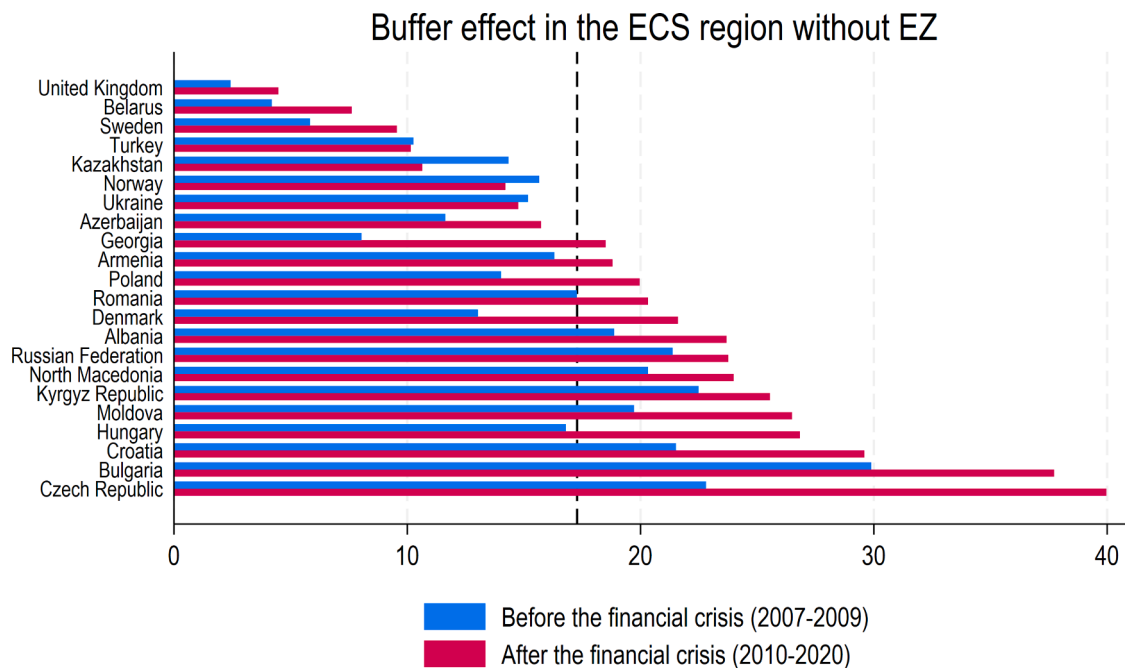
² The CESEE country group is defined by the IMF: <https://www.imf.org/en/Publications/REO/EU/Issues/2017/01/07/Central-Eastern-and-Southeastern-Europe>, accessed on October 19, 2024. The overlap between CESEE countries and less developed ECS countries is important.

Table 2

Panel threshold regressions and financial development.

	(1)	(2)	(3)	(4)	(5)
Variables	<i>FD</i> <i>rer</i>	<i>FI</i> <i>rer</i>	<i>FM</i> <i>rer</i>	<i>FM – ECS</i> <i>rer</i>	<i>FMD – ECS</i> <i>rer</i>
Estimated threshold	–	0.4806**	–	0.0217**	0.0234**
95 % confidence interval	–	[0.479; 0.4814]	–	[0.0210; 0.0220]	[0.0173; 0.0249]
<i>gdppk</i>	0.6930*** (0.0552)	0.7113*** (0.0548)	0.7140*** (0.0552)	0.6172*** (0.0633)	0.5810*** (0.0632)
<i>gov</i>	0.1470*** (0.0218)	0.1538*** (0.0217)	0.1441*** (0.0218)	0.1521*** (0.0409)	0.1585*** (0.0409)
$etot \times L.res \times I(L2.k \leq \gamma)$	0.0035 (0.0034)	–0.0096*** (0.0014)	–0.0044*** (0.0015)	–0.0135*** (0.0030)	–0.0128*** (0.0028)
$etot \times L.res \times I(L2.k > \gamma)$	–0.0089*** (0.0014)	0.0078*** (0.0029)	–0.0145*** (0.0022)	0.0144*** (0.0027)	0.0125*** (0.0025)
Constant	1.0207*** (0.2654)	0.9178*** (0.2637)	0.9325*** (0.2651)	1.0763*** (0.3554)	1.1239*** (0.3552)
Observations	1800	1800	1800	720	720
Observation below threshold	–	1180	–	122	119
Number of countries	100	100	100	42	42
RMSE	0.117	0.116	0.117	0.0866	0.0866

Note: Bootstrapped standard errors in parentheses where 10,000 replications have been used. Fixed effects are included, but not shown. ***, **, * indicate statistical significance at the 1 %, 5 % and 10 % levels, respectively. *L2* is the second lag operator. We tested the different types of financial indicators. Source: author's estimates.



Source: see the main text.

Fig. 1. Threshold effect in the ECS region.

Note: We use a selection of emerging and developing ECS countries to compare the value of the threshold (17.28 % of GDP) found in this region with the evolution of international reserves holding (mean value) before and after the GFC. Source: author's estimates.

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CRedit authorship contribution statement

Jamel Saadaoui: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

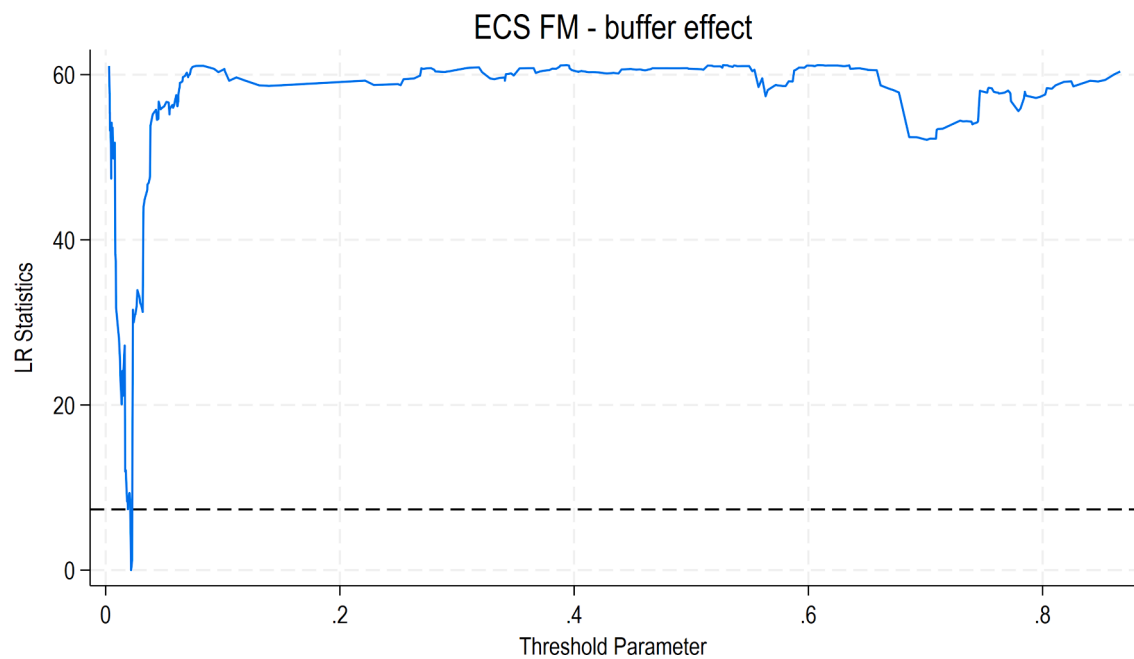


Fig. 2. Construction of the confidence interval in the threshold model – FM, region ECS.

Notes: The estimation for the threshold value is the point where LR statistic is equal to zero. When the LR curve crosses the horizontal line for the first time, the lower limit of the CI is obtained. When the LR curve crosses the horizontal line for the second time, the upper limit of the CI is obtained. Source: author's estimates.

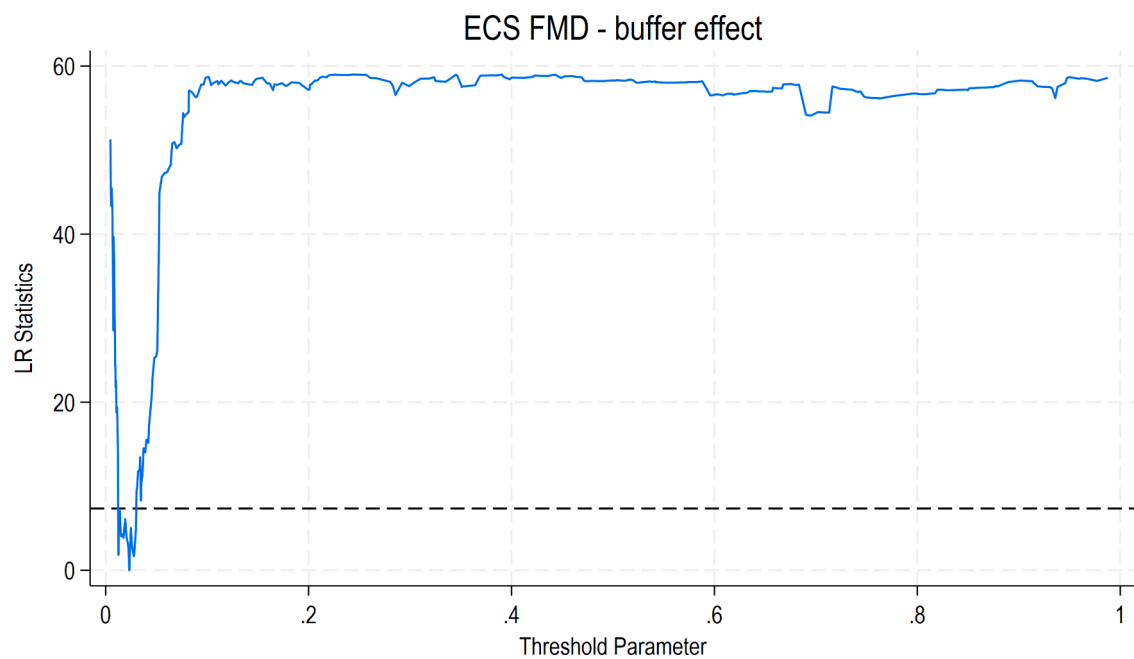


Fig. 3. Construction of the confidence interval in the threshold model – FMD, region ECS.

Notes: The estimation for the threshold value is the point where LR statistic is equal to zero. When the LR curve crosses the horizontal line for the first time, the lower limit of the CI is obtained. When the LR curve crosses the horizontal line for the second time, the upper limit of the CI is obtained. Source: author's estimates.

Conflict of interest

The author, Jamel Saadaoui, has declared no conflict of interest.

Appendix A. Robustness checks

In this [appendix A](#), we proposed two additional robustness checks for the financial market debt threshold, that we show in [Table 1](#) and [Fig. 2](#). [Fig. A1](#) uses the third lag for the threshold variable instead of the second lag to further control for the potential endogeneity of the Financial Market Depth (FMD) threshold. The FMD threshold has a value of 0.0268 very close to the one in [Fig. 2](#) (0.0234) and the bootstrapped p-value is equal to 0.0133. In [Fig. A2](#), we use a double-threshold model to further test the robustness of the results. The double threshold model indicates that only the first threshold is significant, with a value of 0.0282 for the FMD threshold and a bootstrapped p-value of 0.0300. The second threshold has a value of 0.2857 and a bootstrapped p-value of 0.5400. Taken together, these results show the robustness of the FMD threshold. All the computations have been conducted with StataNow/SE 18.5.

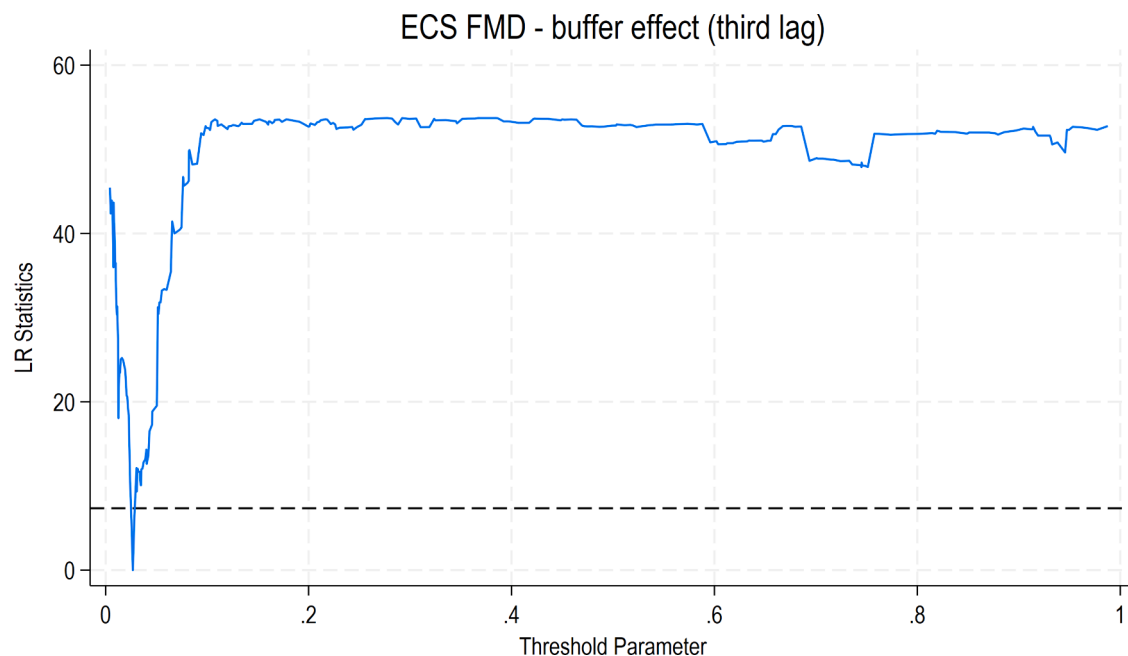


Fig. A1. Construction of the confidence interval in the threshold model – FMD, region ECS

Notes: The estimation for the threshold value is the point where LR statistic is equal to zero. When the LR curve crosses the horizontal line for the first time, the lower limit of the CI is obtained. When the LR curve crosses the horizontal line for the second time, the upper limit of the CI is obtained. Source: author's estimates.

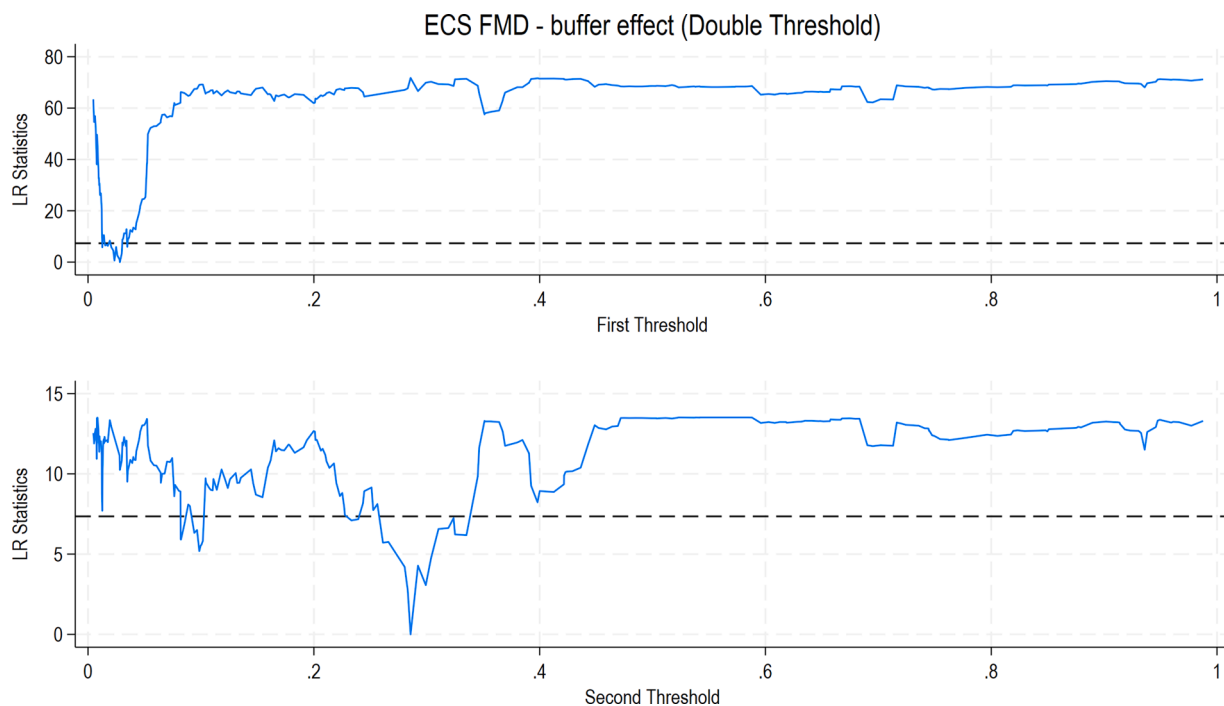


Fig. A2. Construction of the confidence interval in the double threshold model – FMD, region ECS

Notes: The estimation for the threshold value is the point where LR statistic is equal to zero. When the LR curve crosses the horizontal line for the first time, the lower limit of the CI is obtained. When the LR curve crosses the horizontal line for the second time, the upper limit of the CI is obtained. Source: author's estimates.

Data availability

Data will be made available on request.

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