



Original article

received 11.10.2025; accepted 08.07.2026; published 30.09.2026

doi: 10.12775/ EiP.2026.19

Natural Resource Funds and Macroeconomic Stabilization: Evidence from Resource-Rich Countries

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Abstract

Motivation: The resource curse is a paradox of economic development often seen in resource-rich countries. A major contributing factor is these economies' reliance on the volatile global commodity market. To address this, many countries have established natural resource funds (NRF) to stabilize revenue. In recent years, the structure and number of such funds - especially in developing countries - have evolved significantly. However, existing research on their stabilization effectiveness remains inconclusive, signalling the need for further analysis.

Aim: This study aims to evaluate the effectiveness of NRF in performing their stabilization function in the context of counteracting the resource curse.

Results: A comprehensive empirical analysis was conducted, covering 49 resource-rich countries and 43 NRF over the period 2000–2023. A panel regression model was applied to assess the impact of these funds on macroeconomic stability. The analysis includes various dimensions, such as public and private expenditures, investment, macroeconomic performance, and trade conditions.

Results show that stabilization funds do not significantly impact the examined variables. In contrast, investment and savings funds exhibit stabilizing effects. Investment funds enhance domestic investment stability, while savings funds help stabilize government spending and terms of trade.

These outcomes indicate a shift in the role of resource funds. Traditional stabilization funds are losing relevance, whereas investment and especially long-term savings funds - often called future generations funds - are gaining prominence. This trend is reflected both in fund structures and founding years, as well as in the empirical findings of this study.

Keywords: natural resource funds, stabilization, resource curse, economic development, resource rich countries

JEL: F21, O11, O23, Q32, Q38

1. Introduction

The resource curse (RC) – the paradox whereby resource-rich countries (RRC) experience slower economic development and poverty reduction than less-endowed nations (Dymitrowska, 2023) – remains a critical issue. Its relevance has intensified amid recent global challenges, including the COVID-19 pandemic, inflation, armed conflicts, and ongoing volatility in strategic commodity prices.

The global commodity market has long been characterized by significant instability, a key macroeconomic driver of the RC. In response to revenue volatility from commodity exports, governments in the 1970s introduced natural resource funds (NRF) as buffers between global markets and domestic economies¹.

The earliest NRF were designed to stabilize domestic economies by shielding them from global market fluctuations, primarily decoupling national performance from external commodity price volatility. Over time, their role and structure evolved, and they are now broadly classified as stabilization (SFs), investment (IFs), or savings/future generation funds (SFGs)² (Table 2). IFs and SFGs have gained prominence, with over half of all SFGs established since 2005 and more than 70% after 2010 (Dymitrowska, 2023). An increasing number of emerging and developing economies are also adopting these funds.

The primary rationale for establishing NRF has been, and remains, the mitigation of the RC. Recently, scholars, international organizations, and RRC governments have shown increasing interest in assessing their effec-

¹ For consistency, the term Natural Resource Fund (NRF) is used throughout to refer collectively to all such funds.

² This is the most widely used NRF classification in the literature (Dymitrowska, 2020, 2023, 2026; Taguchi & Ganbayar, 2022).

tiveness in addressing RC-related challenges (Ouoba, 2020; Sugawara, 2014; Taguchi & Ganbayar, 2022; Tsani, 2015). This growing attention reflects the rising prominence of NRF in the global financial system, as they now constitute over half of all Sovereign Wealth Funds, whose combined assets total approximately USD 16.607 trillion (*SWFI*, n.d.).

The effectiveness of NRF in addressing the RC spans multiple domains - macroeconomic, social, political, institutional, cultural, and historical. In recent years, the institutional dimension has become particularly important, as the literature increasingly emphasizes that the effects of resource abundance depend on the quality of institutions and the political incentives created by resource rents (Mehlum et al., 2006; Robinson et al., 2006). This multidimensional nature of NRF effectiveness is reflected in the diversity of existing research approaches. Research includes broad comparative analyses (e.g., Bagattini, 2011; Ouoba, 2020; Sugawara, 2014; Taguchi & Ganbayar, 2022) and detailed case studies (e.g., Dymitrowska, 2023; Lücke, 2011), employing both qualitative (e.g., Kalyuzhnova, 2006; Le Borgne & Medas, 2021) and empirical (e.g., Bagattini, 2011; Ossowski et al., 2008; Ouoba, 2020; Shabsigh & Ilahi, 2007; Sugawara, 2014; Tsani, 2013, 2015) methods. These studies explore diverse aspects of fund operation, including fund types, governance mechanisms, and core functions.

Scholars remain divided on the effectiveness of NRF. Some confirm their success in achieving specific objectives (Bagattini, 2011; Sugawara, 2014; Taguchi & Ganbayar, 2022), while others contend that effectiveness depends on certain conditions (Allegret et al., 2018; Le Borgne & Medas, 2021). Others deem them largely ineffective (Davis et al., 2001; Ouoba, 2016) or express uncertainty (Barnett & Ossowski, 2021; Ossowski et al., 2008).

Given its significance for RRC economic development and global market stability, further detailed and methodologically rigorous research in this area is essential.

This study makes an initial attempt to assess the effectiveness of NRF in mitigating the RC. It constitutes the first stage of a broader research project by the author, outlined in Figure 1.

Key macroeconomic causes of the RC include commodity price volatility, Dutch disease, and economic dependence on resource extraction and exports. In this context, NRF are expected to fulfil core functions mitigating the RC – stabilization, investment, savings, and economic diversification³ (Figure 1).

This study focuses on assessing the stabilization function of NRF in mitigating the RC, with particular attention to differences across fund types. Its objective is to evaluate the effectiveness of NRF in performing this function.

³ The implementation of specific fund functions in mitigating the RC is discussed in detail by Dymitrowska (2020).

The empirical analysis focuses on the macroeconomic stabilization channel of the RC, reflected in the volatility of fiscal and private expenditure, investment, macroeconomic performance, and terms of trade. Institutional mechanisms, including rent-seeking, weak property rights, political instability, and governance failures, are acknowledged as important, but are not examined as separate dependent mechanisms. Instead, institutional quality is included through control variables, while the detailed role of institutional design and governance arrangements is left for future research.

Within this analytical scope, the study distinguishes between three main types of NRF – SFs, IFs, and SFGs – whose potential stabilizing effects may operate through different mechanisms. SFs mitigate economic fluctuations by saving surplus revenues from resource exports when prices exceed a threshold, later using the accumulated – typically short-term and liquid – assets to cover budget shortfalls when prices decline. In contrast, IFs and SFGs focus on long-term wealth creation through domestic and foreign investments. Although not primarily designed for stabilization, they indirectly strengthen fiscal resilience by generating returns that diversify income and build capital for the post-resource era.

Given the growing importance of IFs and SFGs – especially in emerging and developing economies – it is essential to determine whether these funds also perform a stabilization role. Accordingly, this study examines the effectiveness of both the general presence of NRF in a country and specific fund types.

In this study, an RRC is defined as a country specializing in the extraction and export of natural resources or whose economy is fundamentally resource-based. Following a critical literature review (Auty, 2004; Stevens, 2003; van der Ploeg, 2011), the RC is assumed to occur exclusively in such countries.

The study covers 49 RRC and 43 NRF (Tables 1 and 2) using a panel data econometric approach for 2000–2023. The funds were classified by type.

The main contribution of this study is its evaluation of specific fund types in fulfilling a particular function – the stabilization function. Previous research has largely focused on individual countries or regions, often examining NRF without differentiating between fund types.

Recent studies distinguishing between fund types typically assess each in relation to its intended function, such as whether SFs effectively stabilize the economy (Sugawara, 2014; Taguchi & Ganbayar, 2022). However, with the growing prominence of IFs and especially SFGs, and given the centrality of commodity price volatility to the RC, it is crucial to evaluate whether these funds also enhance economic stability. Theoretically, they should. This study thus tests whether funds not explicitly designed for stabilization nonetheless produce stabilizing effects in practice.

Another key contribution of this study is its econometric approach. Most prior research on NRF effectiveness has been qualitative, comparative, or conceptual (e.g., Luecke, 2011; Tsani, 2013), with only a few studies employ-

ing quantitative methods at the macroeconomic level (e.g., Bagattini, 2011; Ouoba, 2016; Shabsigh & Ilahi, 2007; Taguchi & Ganbayar, 2022).

The paper consists of three main sections, preceded by an introduction and followed by a conclusion. The literature review examines previous research on NRF effectiveness in fulfilling their stabilization function, while highlighting this study's contribution. The next section presents the research methodology, followed by the empirical results and their discussion.

To achieve its objective, the study primarily draws on English-language literature and materials from major international institutions, including the World Bank (WB), International Monetary Fund (IMF), Organization for Economic Co-operation and Development (OECD), World Economic Outlook, Natural Resource Governance Institute (NRGI), International Forum of Sovereign Wealth Funds (IFSWF), and the Sovereign Wealth Fund Institute (SWFI).

2. Literature review

To prepare for the empirical analysis, a separate methodological groundwork was conducted. A detailed critical literature review, consistent with the Systematic Literature Review (SLR) approach, was undertaken to align with the study's empirical focus and research objective. The review covered key publications from 1990 to 2025, encompassing both qualitative and quantitative studies on NRF effectiveness, particularly their stabilization function. In total, 211 publications were examined. In the final stage, eight empirical studies were analyzed in depth, five of which were identified as most representative (Table 3). These core studies were assessed in terms of methodology, including indicators of fund effectiveness, defined dependent variables, independent and control variables, research periods, main findings, and implications for future research.

All studies identified in the final SLR stage used panel data econometrics but varied considerably in sample size. The broadest scope was in Sugawara (2014), who analyzed 68 RRC and 32 NRF. Taguchi and Ganbayar (2022) examined 41 RRC and 54 NRF, reflecting the rapid rise in newly established NRF. Taguchi further emphasized the importance of classifying funds by their intended function, highlighting the increasing relevance of diverse fund types in development policy.

Earlier studies often focused on oil exporters (Ossowski et al., 2008; Shabsigh & Ilahi, 2007), aligning with broader analyses of fund performance (e.g., Allegret et al., 2018). However, as the RC affects both fuel- and mineral-dependent economies, including both improves comparative analysis.

Across the literature, NRF are viewed as countercyclical instruments that buffer commodity price shocks. Researchers have typically analyzed their

role in reducing macroeconomic volatility, using fiscal (Bagattini, 2011; Ossowski et al., 2008; Sugawara, 2014; Taguchi & Ganbayar, 2022) or monetary indicators (Shabsigh & Ilahi, 2007), consistent with the macroeconomic dimension of RC theory.

Most analyses examined the stability of government expenditure, occasionally including the primary balance (Ossowski et al., 2008; Taguchi & Ganbayar, 2022). Bagattini (2011) developed a composite SF Success Variable, while Shabsigh and Ilahi (2007) assessed monetary stability via money supply, CPI, and exchange rates. Measures of volatility also varied: Sugawara (2014) used discretionary spending volatility, whereas Taguchi and Ganbayar (2022) evaluated deviations from the mean expenditure-to-GDP ratio.

Several authors (Sugawara, 2014; Taguchi & Ganbayar, 2022; Ouoba, 2016) observed that funds must operate for five to ten years before their effects can be reliably assessed, yet only a few studies explicitly accounted for this lag.

Some studies focused specifically on SFs (Sugawara, 2014; Taguchi & Ganbayar, 2022), while others examined NRF more broadly. Bagattini (2011) distinguished between stabilization and savings purposes but offered no detailed comparison.

In all studies, the key independent variable was the existence of a resource fund, accompanied by controls capturing economic, structural, and institutional factors. Institutional quality consistently proved decisive in shaping fund effectiveness.

Most studies confirm that SFs reduce volatility. Bagattini (2011) associated their presence with improved fiscal performance; Sugawara (2014) and Taguchi and Ganbayar (2022) highlighted their stabilizing impact on expenditure; and Shabsigh and Ilahi (2007) noted moderate effects on monetary stability. Conversely, Ossowski et al. (2008) found no clear link between NRF presence and fiscal performance, indicating a lack of consensus in the literature. The results are mixed, underscoring the need for further empirical testing.

In recent years, there has been a clear trend toward establishing more IFs and especially SFGs. Several countries have restructured existing funds, shifting from traditional stabilization models to savings-oriented ones (e.g., Iran) or dividing a single fund into two (e.g., Chile) – and in some cases three (e.g., Nigeria).

Since commodity market volatility remains a key driver of the RC, it is crucial to assess whether these restructured funds continue to perform a stabilization function, regardless of type. Comparing the effects of different fund types further extends this inquiry and represents a distinctive contribution of this study. Moreover, the quantitative approach adopted here strengthens the empirical evidence on the subject.

3. Methods

The study proceeded in five stages. First, a detailed critical review of the literature was conducted using the SLR method to analyze existing empirical research (Dymitrowska, 2025, 2026). This enabled the definition of key concepts, identification of dependent and independent variables, control variables, and specification of the research period. Second, a group of RRC was identified. Third, individual NRF were examined and analyzed in detail. Fourth, a comprehensive database was compiled, incorporating a broad range of indicators from multiple international sources. Finally, panel regression analyses were performed in STATA⁴ using various combinations of variables and estimation techniques, followed by the presentation and interpretation of empirical findings.

3.1. Research sample

To ensure thorough preparation for the empirical analysis, a separate methodological and empirical groundwork was undertaken. Due to the extensive nature of the first three preparatory stages – namely, the literature review, the identification of the research group (RRC and the funds operating within them), and the development of methodological assumptions - the detailed findings from these stages will be presented in a separate publication.

Based on the results obtained, the following assumptions were adopted:

1. A RRC was defined as a country that meets at least one of the following criteria in at least half plus one of the years within the study period:
 - average annual revenues from the extractive sector exceeding 25% of GDP, or
 - natural resources accounting for at least 25% of average annual exports.
2. The study considers the following strategic commodities: fuel resources (oil, natural gas, and coal) and mineral resources (tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate).
3. The research period, spanning 2000–2023, aligns with the subsequent panel analysis. The year 2000 marks a turning point in NRF evolution, reflecting the growing global focus on IFs and SFGs, while 2023 was set as the endpoint based on data availability. This 24-year timeframe provides a robust foundation for empirical analysis.

Based on an analysis of selected indicators from the WB's World Development Indicators (WDI) database, the final research sample includes 49 RRC.

⁴ StataSE 18.

These countries were classified by level of economic development (per WB) and by type of extracted resources (Table 1).

In the next stage, a detailed analysis of NRF operating in the identified countries was conducted. A total of 43 funds were identified and classified by type – stabilization, investment, or savings (Table 2).

The next stage involved collecting data for the variables described in the following sections. After assessing data quality, significant gaps were identified for some countries. To ensure precision, the final sample comprised 28 RRC and 27 NRF, with funds operating in 19 of these countries.

The countries and funds included in the final analysis are highlighted in Table 2.

3.2. Variables and Data Collection

In line with the research framework (Figure 1), the identification of dependent variables was informed by both the literature review and a detailed analysis of the macroeconomic causes of the RC (Auty, 2004; Rosser, 2006; Stevens, 2003). Building on this foundation, the study assumes that an NRF fulfilling its stabilization function should operate as a buffer between volatile global commodity markets and the domestic economy.

To assess the effectiveness of these funds, the analysis addresses three key questions:

1. Do NRF stabilize public finances?
2. Do they stabilize the real economy, including GDP growth, investment, consumption, and inflation?
3. Do they contribute to stabilizing external indicators, such as the terms of trade (ToT)?

The first two research questions concern the spending effect, a consequence of the Dutch disease in RRC. Rising commodity prices typically increase government spending, domestic investment, and consumption, driving GDP growth and inflation. Conversely, falling prices reduce these indicators, exacerbating economic instability.

A country's dependence on the volatile global commodity market generates macroeconomic instability and can impede long-term economic development. NRF are designed to mitigate such volatility.

The third research question examines the ToT effect of the Dutch disease, which reinforces a country's overreliance on the resource sector and, ultimately, the RC. Rising commodity prices typically appreciate the domestic currency, improving ToT but reducing the competitiveness of non-resource sectors.

The presence of an NRF may ease exchange rate pressures and moderate currency appreciation by allocating surplus resource revenues to foreign investments. Moreover, such funds can help reduce extreme fluctuations in ToT.

This specific aspect has not been addressed in previous studies and therefore represents a novel contribution to the literature.

The study's main independent variable is the presence of an NRF within a country. Following the author's classification (Table 2), a general dummy variable was constructed, taking the value 1 if any NRF exists and 0 otherwise. This coding strategy allows for a consistent comparison across a broad panel of resource-rich countries over 2000–2023. Although it does not capture detailed differences in institutional design, such as governance structures, withdrawal rules, or rule enforcement, institutional quality is included through control variables, while these specific design features are left for future research.

Additionally, three distinct dummy variables were developed to differentiate SFs, IFs, and SFGs, each taking the value 1 if the respective fund type exists within the country.

Following Sugawara's (2014) approach, the study assumes that a fund becomes operational in the year after its establishment. Thus, if a fund was created in 2000, the corresponding dummy variable equals 0 for 2000 and 1 from 2001 onward.

In contrast to previous studies that lagged the main independent variables by five years (Sugawara, 2014; Taguchi & Ganbayar, 2022) or ten years (Oouba, 2016), this study adopts a different strategy. Multiple models were estimated by progressively lagging the fund presence variables from one to five years to determine when the effects of each fund type begin to materialize.

A maximum lag of five years was applied, as a ten-year lag would substantially reduce the reliability and explanatory power of the results within the 24-year research period.

In selecting control variables, the study considers country size (population), economic size (GDP), macroeconomic stability (inflation), resource dependence (resource rents and exports), global commodity prices, and institutional factors.

The first two variables – population and GDP – serve as standard controls in macroeconomic research, enabling the model to account for variations in country size and economic scale.

Inflation is a crucial indicator for RRC, as demand-driven inflation commonly arises from the spending effect associated with Dutch disease. Likewise, global commodity price trends are vital for explaining RRC macroeconomic conditions, serving as a key driver of the RC. Their inclusion in the model is therefore essential.

Many RRC exhibit strong dependence on the extractive sector, a fundamental source of the RC. Accordingly, two control variables were incorporated to capture the degree of resource dependence.

Finally, institutional quality – widely emphasized in recent literature on both the RC and NRF effectiveness – is a key determinant of economic

outcomes. Accordingly, the model includes three institutional indicators deemed most relevant to this research context.

To select appropriate indicators for the analysis, several databases were reviewed (accessed on 19 December 2024), including the IMF's World Economic Outlook (<https://www.imf.org/en/Publications/WEO>) and the WB's WDI (<https://databank.worldbank.org/source/world-development-indicators>), Worldwide Governance Indicators (WGI) (<https://www.worldbank.org/en/publication/worldwide-governance-indicators>), and Commodity Price Data (CPD) (<https://www.worldbank.org/en/research/commodity-markets>).

Following data quality assessment and preliminary empirical testing, indicators from the WB were used exclusively. This approach ensures consistency across variables and enhances the overall robustness of the empirical analysis.

Ultimately, the study includes: six dependent variables, four main independent variables of interest and nine control variables (Table 4). Additionally, each fund's performance was assessed according to its years of operation, ranging from 0 to 5 years.

To transform the dependent variables in a way that captures their volatility, two approaches were applied:

1. The method proposed by Sugawara (2014), which involves calculating the 5-year moving standard deviation of the annual growth rate of the dependent variables (as part of alternative dependent variable construction).
2. The approach used by Taguchi & Ganbayar (2022), which calculates the absolute value of the deviation from the period average of the dependent variables.

Applying both approaches – derived from two of the most recent and relevant studies on the topic – was intended to strengthen the robustness and depth of the empirical findings.

To address issues such as heteroskedasticity, non-linearity, and to enhance the clarity and stability of estimations, selected control variables – GDP, CPI, the Commodity Price Index, resource rents, and resource exports – were lagged. This approach is economically justified: GDP affects investment with delay, inflation has lagged effects, commodity prices influence the economy over time, and resource revenues are typically spent in subsequent years. To further improve data quality and model performance, the population variable was log-transformed (Table 4). Descriptive statistics for all variables are presented in Table 5.

3.3. Model Specification and Estimation Method

The empirical specification used in this study, following Sugawara (2014) and Taguchi & Ganbayar (2022), is formulated as follows:

$$effect_{i,t} = \alpha_0 + \alpha_1 fund_{i,t-k} + \alpha_2 X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

where i refers to the country and t to the year. $Effect_{it}$ represents the dependent variable capturing fund-related outcomes, while $fund_{i,t-k}$ denotes the independent variable of main interest measuring fund operation, lagged by $k=0$ to 5 years to examine delayed effects. X_{it} is a vector of control variables, some of which are lagged (e.g., GDP, CPI), and others contemporaneous (e.g., Control of Corruption, Government Effectiveness, Rule of Law). μ_i captures country-specific time-invariant effects. ε denotes the residual error term and $\alpha 0.2$ stand for the estimated coefficients (Table 6).

To prevent bias in the results, certain control variables were excluded due to their strong correlation with the dependent variables. Specifically, L1_GDP was omitted when analyzing gdp_vol and gdp_vol1 , and L1_CPI was excluded when analyzing cpi_vol and cpi_vol1 .

Given the broad scope of the study and to enhance the robustness of the results, the models were estimated using both Fixed Effects (FE) and Random Effects (RE) estimators, with robust standard errors applied to correct for heteroskedasticity.

The data analysis was conducted using StataSE 18.

4. Results

The econometric results are presented in Tables 7 and 8. Given the extensive number of models tested, the findings are summarized in a single comprehensive table to enable clear and concise comparison across specifications.

Cells marked with an “X” denote statistically insignificant results. Highlighted cells present statistically significant outcomes for each main independent variable, with the sign and magnitude of the estimated coefficient and the corresponding p-value.

For each dependent variable, the table reports results based on alternative methods of calculating volatility, along with estimates obtained under both FE and RE specifications.

One of the most striking findings is that the results neither confirm previous studies nor align with theoretical expectations regarding the stabilizing role of NR - particularly SFs - on public expenditure. Instead, the evidence indicates a statistically significant, albeit modest, destabilizing effect of these funds on government spending during their initial years of operation.

An especially noteworthy finding concerns SFGs. In several model specifications, these funds exhibited a statistically significant stabilizing effect on public spending during their first three years of operation. Although this effect becomes statistically insignificant thereafter, the negative coefficient signs persist, indicating a continued but weaker stabilizing tendency.

This underscores the need for continued monitoring of SFGs performance, particularly as many have only recently begun operating. The findings suggest that SFGs may evolve into a more effective mechanism for stabilizing public expenditure in RRC, potentially replacing traditional SFs in this role.

Regarding the impact of NRF on GDP growth volatility, the results reveal no significant effects. The only statistically significant outcome appears in the fifth year of operation for IFs, suggesting a stabilizing influence on economic growth; however, the effect is negligible and unsupported by other model specifications.

Comparable results were found for household consumption expenditure, where a slight short-term destabilizing effect – particularly for SFGs – was detected. Yet, its magnitude is minimal and unlikely to bear meaningful practical implications.

A particularly noteworthy finding concerns the stabilization of domestic investment levels. The effect is most pronounced for IFs, which exhibit a statistically significant and economically meaningful impact on the stability of real *per capita* gross fixed capital formation.

Although some tests revealed a slight short-term destabilizing effect of IFs, this pattern reversed after four years of operation, demonstrating a clear stabilizing influence. These findings suggest that IFs contribute to the long-term stabilization of domestic investment.

A statistically significant stabilizing effect was also identified for SFs in their fifth year of operation, although this effect emerges later than that observed for IFs.

Although IFs exhibit a stabilizing influence on domestic investment, they display a statistically significant destabilizing effect on inflation during their initial years of operation. This effect, however, is short-lived and dissipates by the fund's second year.

The analysis also indicates a slight short-term stabilizing effect on inflation for funds overall, though its magnitude is minimal and of limited practical relevance.

Notable insights arise from the analysis of ToT volatility and levels. Some results for NRF overall, as well as for SFs and IFs, suggest a slight destabilizing effect on ToT stability; however, the magnitude is minimal and diminishes over time for IFs.

Only IFs exhibit a statistically discernible influence on the ToT level. In the short term, they appear to improve ToT, but this effect reverses over time – after five years of operation, IFs are associated with a deterioration in ToT. Although this result approaches the threshold of statistical significance, the directional shift remains noteworthy.

In contrast, SFGs display a statistically significant and economically meaningful stabilizing effect on ToT from the outset of their operation –

a particularly important finding in assessing this fund type. The effect remains consistently negative over the entire five-year period, indicating a sustained and stable influence of SFGs on this indicator.

An overall analysis of the findings reveals a striking result: SFs – explicitly designed to serve a stabilization function – do not exhibit a consistent stabilizing effect on any of the dependent variables examined. The variable set employed in this study is broader than in most previous research and includes key indicators such as government expenditure, one of the most frequently analyzed measures in the literature.

This finding contradicts the conclusions of many earlier studies. One possible explanation is the more recent research period used in this study, which may better reflect current dynamics. Alternatively, it may signal a broader transformation in the global NRF landscape, where newer fund types – IFs and SFGs – are becoming increasingly prominent and may assume a greater role in mitigating the RC. One possible institutional interpretation is that the stabilizing role of IFs and SFGs may be linked to their longer time horizon and stronger intertemporal commitment. Compared with traditional SFs, these funds may be less exposed to short-term discretionary withdrawals, although this interpretation requires further institutional analysis.

Referring to the research framework in Figure 1, future studies should undertake a detailed assessment of NRF effectiveness across their other core functions, with particular emphasis on variations among fund types.

5. Conclusion

This study examined the effectiveness of NRFs in fulfilling their stabilization function in mitigating the RC. The analysis covered four fund categories – NRFs overall, SFs, IFs, and SFGs – and evaluated their stabilizing associations, both collectively and individually, with the macroeconomic conditions of RRCs.

Importantly, the analysis accounted for fund longevity, assessing the relationship between NRF presence and macroeconomic stability from the year of establishment through the fifth year. A broad set of dependent variables was examined, with volatility measured using two distinct methods. The study also introduced a variable not previously employed in this context – the stability of ToT – which represents an important dimension of Dutch disease and a key channel through which the RC may manifest.

Control variables were selected to capture the distinctive characteristics of RRCs, including the international commodity price index and measures of resource dependence – two major macroeconomic drivers of the RC alongside Dutch disease. The model also incorporated institutional quality indicators, whose importance is consistently underscored in the literature. This

comprehensive, multidimensional approach constitutes a novel contribution to the literature.

The findings indicate that SFs – though explicitly designed to stabilize economies exposed to resource volatility – do not exhibit a consistent stabilizing association with the variables analyzed, including public expenditure volatility. In contrast, IFs and SFGs are associated with selected stabilizing outcomes: IFs with greater stability of domestic investment, and SFGs with greater stability of public expenditure and ToT.

These results are consistent with a broader shift in the global NRF landscape. In recent years, traditional SFs have appeared to lose relative prominence, while many RRCs – developed, emerging, and developing alike – have established or transformed their funds into IFs or, increasingly, SFGs. This trend is reflected both in the structural characteristics and founding periods of existing funds (Table 2) and in the empirical evidence presented in this study.

The results also suggest that the formal objective of a fund may not be sufficient to determine its stabilization role. From an institutional perspective, the credibility of fund rules, the time horizon, and the extent to which they constrain discretionary fiscal behavior may be equally important. This may help explain why IFs and SFGs, although not primarily designed as stabilization funds, are associated with selected stabilizing outcomes in the empirical analysis.

Several limitations should be acknowledged. First, the final estimation sample is reduced due to data availability, which may affect the generalizability of the results. Second, although the analysis distinguishes between fund types, it does not directly model detailed institutional features such as governance arrangements, legal status, withdrawal rules, transparency, or political independence. These elements may significantly influence the de facto effectiveness of NRFs. Third, potential endogeneity and selection bias cannot be fully excluded, as countries with stronger institutions may be more likely both to establish NRFs and to experience lower macroeconomic volatility. Therefore, the findings should be interpreted as evidence of statistically significant associations rather than definitive causal effects. Finally, the classification of funds was based on a detailed review of their formal objectives and operational characteristics; nevertheless, the evolution of NRF mandates over time remains an important issue for future research.

Given the expanding role of IFs and SFGs, further research is needed to evaluate their effectiveness in performing other core functions – investment, long-term savings, and economic diversification, as outlined in Figure 1. Future studies should also examine whether and how specific institutional designs condition the stabilization outcomes identified in this study. In terms of policy implications, the findings suggest that policymakers in RRCs should not assume that stabilization funds automatically ensure macroeconomic

stability. The design of NRFs should account for the specific stabilization channels that a country aims to address, while the growing relevance of IFs and SFGs indicates that longer-term fund objectives may also contribute to selected stabilization outcomes. These implications should be interpreted together with the institutional context, since rule credibility, transparency, and enforcement may condition whether the expected stabilization role of a fund is achieved in practice. Understanding the broader impact of these newer fund types, as well as the institutional conditions under which they operate, will be crucial for future policymaking in RRCs.

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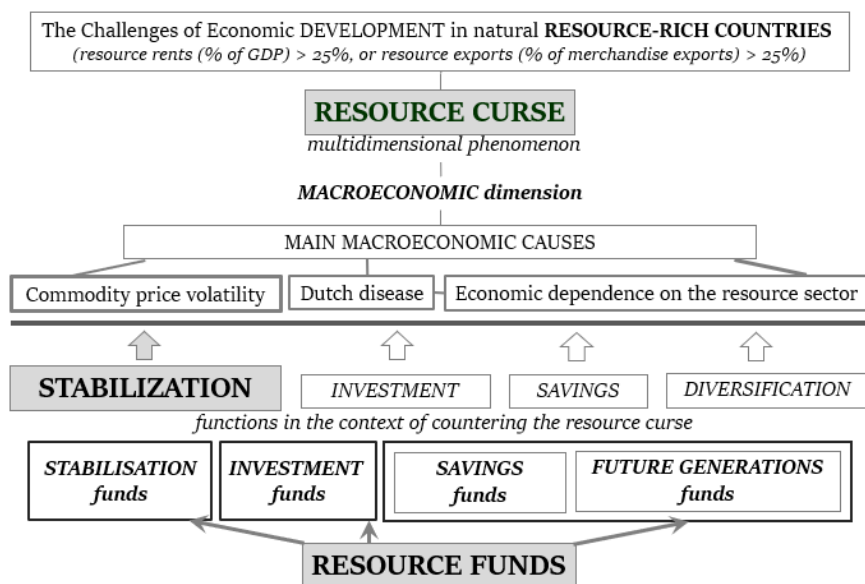
Acknowledgements

Author contributions: author has given an approval to the final version of the article. Author's total contribution to the manuscript: 100%.

Funding: Supported by funds granted by the Minister of Science of the Republic of Poland under the “Regional Initiative for Excellence” Programme for the implementation of the project “The Poznań University of Economics and Business for Economy 5.0: Regional Initiative - Global Effects (RIGE)”.

Appendix

Figure 1. Research concept



Source: Own preparation.

Table 1. Resource-rich countries

Classification according to development (WB): H - High income (\$14,006 or more), LM - Upper middle income (\$4,516 to \$14,005), LM - Lower middle income (\$1,146 to \$4,515), L - Low income (\$1,145 or less).	MINERALS (12)	
	H	Chile
	UM	Armenia, Georgia, Jamaica, Montenegro, Namibia
	LM	Guinea, Lao PDR, Mauritania, Zambia, Zimbabwe
	L	Rwanda
	FUELS (24)	
	H	Brunei Darussalam, Kuwait, Norway, Oman, Qatar, Russian Federation, Saudi Arabia, Trinidad and Tobago, United Arab Emirates
	UM	Algeria, Azerbaijan, Colombia, Ecuador, Equatorial Guinea, Gabon, Iran, Islamic Rep., Iraq, Libya, Turkmenistan, Venezuela, RB,
	LM	Angola, Congo, Rep., Nigeria,
	L	Yemen, Rep.
	MINERALS & FUELS (13)	
	H	Bahrain, Canada
	UM	Indonesia, Kazakhstan, Mongolia, South Africa
	LM	Bolivia, Cameroon, Egypt, Arab Rep., Myanmar, Peru
	L	Mozambique, Niger
	Total: 49	

Source: Own preparation.

Table 2. Natural resource funds

	COUNTRY	FUND NAME	ESTABLISHED SF	FUND TYPE		
				IF	SFG	
1	Algeria	Revenue Regulation Fund	2000	X		
2	Angola	Fundo Soberano de Angola	2012			X
3	Armenia	none				
4	Azerbaijan	State Oil Fund of the Republic of Azerbaijan	1999			X
5	Bahrain	Future Generations Reserve Fund	2006			X
6	Bolivia	none				
7	Brunei Darussalam	Brunei Investment Agency	1983	X	X	X
8	Cameroon	Caisse de Stabilisation des Prix des Hydrocarbures	1974	X		
9	Canada	Alberta Heritage Savings Trust Fund	1976			X
10	Chile	Social and Economic Stabilization Fund	1985 (2006)	X		
		Pension Reserve Fund	2006			X



	COUNTRY	FUND NAME		ESTABLISHED SF	FUND TYPE		
					IF	SFG	
11	Colombia	Colombia Savings and Stabilization Fund		2012	X		
12	Congo, Rep.	none					
13	Ecuador	none					
14	Egypt, Arab Rep.	none					
15	Equatorial Guinea	Fund for Future Generations		2002			X
16	Gabon	Sovereign Wealth Fund of the Gabonese Republic		1998 (2012)			X
17	Georgia	none					
18	Guinea	none					
19	Indonesia	none					
20	Iran, Islamic Rep.	Oil Stabilization Fund		2000–2010	X		
		National Development Fund of Iran		2011		X	
21	Iraq	none					
22	Jamaica	none					
23	Kazakhstan	National Fund of the Republic of Kazakhstan		2000	X		
		National Investment Corporation		2012			X
24	Kuwait	Kuwait Investment Authority		1953			X
25	Lao PDR	none					
26	Libya	Libyan Investment Authority		2006			X
27	Mauritania	National Fund for Hydrocarbon Reserve		2006	X		
28	Mongolia	Fiscal Stability Fund		2011	X		
29	Montenegro	none					
30	Mozambique	none					
31	Myanmar	none					
32	Namibia	none					
33	Niger	none					
34	Nigeria	Excess Crude Account		2004–2010	X		
		The Nigeria Sovereign In- vestment Authority	Stabilization Fund	2011	X		
			Future Generations Fund	2011			X
			Nigeria Infrastructure Fund	2011		X	
35	Norway	Government Pension Fund Global		1990			X



	COUNTRY	FUND NAME		ESTABLISHED SF	FUND TYPE		
					IF	SFG	
36	Oman	State General Reserve Fund		1980–2019	X		
		Oman Investment Fund		2006–2019		X	
		Oman Investment Authority	Future Generations Fund	2020			X
			National Development Fund	2020		X	
37	Peru	Fiscal Stabilization Fund		1999	X		
38	Qatar	Qatar Investment Authority		2005	X	X	X
39	Russian Federation	Russia's Stabilization Fund		2004–2007	X		
		Reserve Fund		2008–2018	X		
		The National Wealth Fund		2008	X	X	X
40	Rwanda	none					
41	Saudi Arabia	Public Investment Fund		1971		X	X
42	South Africa	none					
43	Trinidad and Tobago	Interim Revenue Stabilization Fund		2000–2006	X		
		Heritage and Stabilization Fund		2007	X		X
44	Turkmenistan	Stabilization Fund		2008	X		
45	United Arab Emirates	Abu Dhabi Investment Authority		1976		X	X
		Mubadala Investment Company		2002		X	X
46	Venezuela, RB	Macroeconomic Stabilization		1998–2003	X		
		Fondo de Desarrollo Nacional		2005		X	
47	Yemen, Rep.	none					
48	Zambia	none					
49	Zimbabwe	Mutapa Investment Fund		2014	X	X	

Additional information. **SF** – stabilization fund, **IF** – investment fund, **SFG** – savings fund (fund for future generations).

Source: Own preparation based on the data provided by the NRGI, IFSWF, SWFI and official websites of individual funds.



Table 3. Literature review

AUTHOR			Shabsigh & Ilahi (2007)	Ossowski et al. (2008)	Bagattini (2011)	Sugawara (2014)	Taguchi & Ganbayar (2022)
Sample			9 NRF, 15 OEC	21 OEC	12 countries with SF	32 NRF, 68 RRC	54 NRF, 41 RRC
Period			1973–2003	1992–2005	1992–2007	1988–2012	1996–2020
DEPENDENT VARIABLES			Money volatility; CPI; REER; CPI growth	Non-oil primary balance; Expenditure growth; Expenditure-to-oil revenue change ratio	SF success variable; Non-resource GDP, exports, revenues, balance; Government revenues, expenditures, balance; Public debt	Government expenditure volatility	Government expenditure, primary balance volatility
INDEPENDENT (Explanatory) VARIABLES	main	Existence of: oil fund	X	X			
		SF			X	X	X
	control	Population				X	X
		GDP		X	X	X	X
		GDP growth	X			X	
		HDI			X		
		Inflation		X		X	X
		Fiscal position		X	X	X	
		Trade			X		X
		Financial market	X			X	
		Resource dependence	X	X	X	X	X
		Oil price	X	X			
		Fund wealth /position		X	X		
		Institutional quality		X	X	X	X
		Form of government				X	
		Location				X	

Additional information. SF – stabilization funds, OEC – oil exporting countries, RRC – resource-rich countries, HDI – Human development index.

Source: Own preparation.

Table 4. A list of variables

Variable	Description	Sources
DEPENDENT VARIABLES		
spend_vol	5-year rolling standard deviation of the logarithmic annual growth rate of general government final consumption expenditure <i>per capita</i> , expressed in constant 2015 US\$	WDI
	general government final consumption expenditure <i>per capita</i> , expressed in constant 2015 US\$, absolute value of the deviation from the period average (spend_vol1)	
gdp_vol	5-year rolling standard deviation of the logarithmic annual growth rate of GDP <i>per capita</i> growth (annual %)	
	GDP <i>per capita</i> growth (annual %), absolute value of the deviation from the period average (gdp_vol1)	
inv_vol	5-year rolling standard deviation of the logarithmic annual growth rate of real <i>per capita</i> gross fixed capital formation, expressed in constant 2015 US\$	
	real <i>per capita</i> gross fixed capital formation, expressed in constant 2015 US dollars, absolute value of the deviation from the period average (inv_vol1)	
cons_vol	5-year rolling standard deviation of the logarithmic annual growth rate of real <i>per capita</i> household and NPISHs final consumption expenditure, expressed in constant 2015 US\$	
	real <i>per capita</i> household and NPISHs final consumption expenditure, expressed in constant 2015 US\$, absolute value of the deviation from the period average (cons_vol1)	
cpi_vol	5-year rolling standard deviation of the logarithmic annual growth rate of inflation, consumer prices (annual %)	
	inflation, consumer prices (annual %), absolute value of the deviation from the period average (cpi_vol1)	
tot_vol	5-year rolling standard deviation of the logarithmic annual growth rate of the net barter ToT index (base year = 2015)	
	net barter ToT index (base year = 2015), absolute value of the deviation from the period average (tot_vol1)	
INDEPENDENT – main interest variables		
Fund	NRF dummy: = 1 if resource fund exists	Own study
StabFund	SF dummy: = 1 if SF exists	
InvFund	IF dummy: = 1 if IF exists	
SavFund	SFG dummy: = 1 if SFG exists	
INDEPENDENT – control variables		
ln_Population	Population, total, log term, one lagged	WDI
L1_GDP	GDP <i>per capita</i> , PPP (constant 2021 international \$), one lagged	
L1_CPI	Inflation, consumer prices (annual %), one lagged	
L1_ResourceRents	Resource rents (% of GDP) (sum of oil rents, natural gas rents, coal rents, mineral rents (all in % of GDP), one lagged	
L1_ResourceEx	Resource exports (% of merchandise exports) (sum of fuel exports and ores and metals exports (all in % of merchandise exports), one lagged	



Variable	Description	Sources
DEPENDENT VARIABLES		
L1_CommodPI	Commodity Price Index (Real), one lagged	CPD
Corup	Control of Corruption	WGI
GovEffect	Government Effectiveness	
RuleLaw	Rule of Law	

Source: Own preparation.

Table 5. Descriptive statistics

Variables	mean	sd	min	max
spend_vol	.0479642	.0584984	.0001389	.677602
spend_vol1	216.8059	295.3857	.0578569	2383.884
gdp_vol	.0263506	.0181926	.000177	.1207942
gdp_vol1	2.501486	2.480742	.0039592	20.05583
inv_vol	.0939963	.0650135	.0016076	.3786816
inv_vol1	520.5809	756.9704	.1337957	5917.19
cons_vol	.038284	.0387752	.0016616	.3472749
cons_vol1	950.3432	1918.834	1.492428	14224.49
cpi_vol	.0267113	.0418703	.000029	.3998039
cpi_vol1	4.141219	13.49502	.0027276	281.3779
tot_vol	.1160446	.0809488	.00114	.4550724
tot_vol1	17.74346	14.08349	.0157974	65.41672
ln_Population	16.39181	1.50668	12.69595	19.44612
L1_GDP	25558.64	25224.22	1015.794	103226.9
L1_CPI	6.3832	16.61357	-2.489793	324.9969
L1_ResourceRents	13.94907	13.16961	0	57.70979
L1_ResourceEx	55.30006	26.27061	0	99.9613
L1_CommodPI	84.67231	22.65979	49.02574	121.3484
Corup	-.1720138	.8957926	-1.48399	2.286928
GovEffect	-.0796016	.8119283	-1.381049	2.058892
RuleLaw	-.2092441	.8412034	-1.633344	2.024315
Observations: 672				

Source: Own preparation.

Table 6. Description of the Equation Components

Components	Explanation		
i	sample country		
t	sample year		
effectit	the indicators of funds' evaluation and comprises volatility of:		
	spend_vol	government expenditure	expected sign of the coefficients: negative
	gdp_vol	economic growth	
	inv_vol	investment	
	cons_vol	household consumption expenditure	
	cpi_vol	inflation	
	tot_vol	trade	
	the indicators of funds' evaluation and comprises:		
	ToT	trade	
fundit,t-k	shows funds' operation and comprises the funds (lagged by k=0 to 5 years):		
	Fund	NRF, any kind	
	StabFund	SF	
	InvFund	IF	
	SavFund	SFG	
X	denotes the control variables and includes indicators (some are lagged, and others contemporaneous):		
	ln_Population	population	
	L1_GDP	economic growth	
	L1_CPI	inflation	
	L1_ResourceRents	resource dependence	
	L1_ResourceEx		
	L1_CommodPI	resource prices	
	Corup	quality of institutions	
	GovEffect		
	RuleLaw		
μ_i	captures country-specific time-invariant effects		
ϵ	residual error term		
$\alpha_0 \dots 2$	estimated coefficients		

Source: Own preparation.



Table 7. A summary of results – NRF overall, SF

fund age (years)		NRE, ANY KIND										SF				
		0	1	2	3	4	5	0	1	2	3	4	5			
the indicators of funds' evaluation and comprises volatility of:																
spend_vol	government	fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	expenditure	re	0.02; 0.019	0.02; 0.012	X	X	X	X	X	X	X	X	X	X	X	X
spend_vol1		fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
gdp_vol		fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
gdp_vol1	economic	fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	growth	re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
inv_vol		fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
inv_vol1	investment	fe	X	X	X	X	X	X	X	X	X	X	X	X	X	-142,53; 0,033
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
cons_vol	household	fe	0.02; 0.045	0.02; 0.015	0.02; 0.024	X	X	X	X	X	X	X	X	X	X	X
	consumption	re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
cons_vol1		fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
cpi_vol		fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	-0.02; 0.048	-0.01; 0.038	-0.008; 0.072	X	X	X	X	X	X	X	X	X	X	X
cpi_vol1	inflation	fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
tot_vol		fe	0.04; 0.030	0.04; 0.041	0.05; 0.013	0.05; 0.036	X	X	X	X	X	X	X	X	X	X
		re	0.06; 0.001	0.06; 0.001	0.06; 0.001	0.06; 0.001	0.05; 0.007	0.04; 0.022	X	0.04; 0.030	0.04; 0.024	0.04; 0.049	X	X	X	X
tot_vol1	trade	fe	-5.19; 0.005	-5.88; 0.023	-8.32; 0.015	-6.66; 0.049	-6.90; 0.012	-3.57; 0.088	-3.84; 0.016	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X
the indicators of funds' evaluation and comprises:																
ToT	trade	fe	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Additional information. **X** – no significant impact, **Colored field** – significant impact (sign and magnitude of the coefficients; p-value), **fe** – fixed effects, **re** – random effects. Source: Own preparation.

Table 8. A summary of results – IE, SFG

fund age (years)		0	1	2	IF			4	5	SFG				
the indicators of funds' evaluation and comprises volatility of:														
spend_vol	govern-	fe	X	X	X	X	X	X	X	X	X	X	X	X
	ment	re	0.02; 0.033	0.02; 0.028	0.02; 0.048	X	X	X	0.04; 0.020	0.03; 0.021	X	0.03; 0.032	X	X
spend_vol	expendi-	fe	X	X	X	X	X	X	X	X	X	X	X	X
	ture	re	X	X	X	X	X	X	X	-53.07; 0.044	-52.17; 0.027	-41.03; 0.089	X	X
gdp_vol	economic	fe	X	X	X	X	X	X	X	X	X	X	X	X
	growth	re	X	X	X	X	X	X	X	X	X	X	X	X
gdp_vol		fe	X	X	X	X	X	X	-0.70; 0.030	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X
inv_vol		fe	0.03; 0.025	X	X	X	X	-0.03; 0.021	-0.04; 0.006	X	X	X	X	X
		re	0.03; 0.003	0.02; 0.02	X	X	X	X	-0.02; 0.071	X	X	X	X	X
inv_vol	investment	fe	-38.34; 0.029	-75.28; 0.038	X	-29.33; 0.086	-311.80; 0.066	-287.63; 0.083	X	X	X	X	X	X
		re	X	X	X	X	X	X	X	X	X	X	X	X
cons_vol	household	fe	X	X	X	X	X	X	X	0.02; 0.047	X	X	X	X
	consump-	re	X	X	X	X	X	X	0.02; 0.029	0.02; 0.015	0.02; 0.040	X	X	X
cons_vol	tion expen-	fe	X	X	X	X	X	X	X	X	X	X	X	X
	diture	re	X	X	X	X	X	X	X	X	X	X	X	X
cpi_vol		fe	0.03; 0.053	0.03; 0.047	X	X	X	X	X	X	X	X	X	X
		re	0.03; 0.046	0.02; 0.043	X	X	X	X	X	X	X	X	X	X
cpi_vol	inflation	fe	3.38; 0.036	3.55; 0.049	X	X	X	X	X	X	X	X	X	X
		re	3.08; 0.033	3.24; 0.050	X	X	X	X	X	X	X	X	X	X
tot_vol		fe	0.06; 0.013	0.05; 0.005	0.05; 0.001	0.04; 0.001	X	X	X	X	X	X	X	X
		re	0.07; 0.000	0.07; 0.001	0.06; 0.001	0.05; 0.001	0.04; 0.008	0.03; 0.058	X	X	X	X	X	X
tot_vol	trade	fe	X	X	X	X	X	X	-5.15; 0.021	-5.95; 0.050	-4.43; 0.079	X	-6.92; 0.051	-6.19; 0.022
		re	X	X	X	X	X	X	-2.99; 0.083	-3.65; 0.052	-6.89; 0.098	X	-4.33; 0.066	-3.71; 0.058
the indicators of funds' evaluation and comprises:														
ToIT	trade	fe	X	5.76; 0.049	X	X	X	X	-10.01; 0.060	X	X	X	X	X
		re	X	4.74; 0.035	X	X	X	X	X	X	X	X	X	X

Additional information. **X** – no significant impact, **Colored field** – significant impact (sign and magnitude of the coefficients; p-value), **fe** – fixed effects, **re** – random effects. Source: Own preparation.